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Developing an interim technical definition for Coral Gardens specific for UK waters and its subsequent application to verify suspected records

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Summary

Coral Gardens are a habitat type listed on the OSPAR List of threatened and/or declining species and habitats (OSPAR, 2008). The OSPAR background document for Coral Gardens (OSPAR, 2010) provides a general characterisation of the habitat, which are comprised of mono- to multi- species assemblages of anthozoan and hydrozoan corals, exclusive of large areas of colonial Scleractinia. Although this definition provides initial guidance for general purposes, it is considered to be biased towards corals and their densities in Scandinavian waters and on temperate east Atlantic seamounts. Acknowledgement of species contributing to Coral Gardens in UK waters is thus incomplete within OSPAR documentation.

There is a wealth of new information from recent research initiatives that point to the need to better refine the definition, and map the occurrences of Coral Gardens in UK waters. This study set out to use information on key species components of Coral Gardens to refine the definition of the feature for UK waters and to verify suspected records of the habitat.

The refined habitat definition for Coral Gardens in UK waters was defined as follows:
A relatively dense seabed aggregation of at least one coral taxon (Alcyonacea, Pennatulacea, Antipatharia, Stylasteridae, Scleractinia) wherein the density of non-reef forming coral taxa exceeds that of reef-forming Scleractinia such as Lophelia pertusa*,* Solenosmilia variabilis *and* Madrepora oculata*. Coral Gardens taxa should characterise the assemblage and occur in densities that clearly exceed that found in adjacent habitats. These assemblages should confer a clear functional role for the Coral Garden e.g. enhanced associated biodiversity, support a distinct associated megafaunal assemblage, ecological symbioses, and/or create habitat for mobile fauna.*

As part of this process, Coral Gardens in UK waters were split into several sub-types:

- Soft-bottom bamboo coral gardens
- Cup coral gardens (including shallow and deep variations of the habitat)
- Lace coral gardens
- Black coral gardens
- Gorgonian coral gardens

A total of 260 suspected records were assessed from areas including Anton Dohrn Seamount, George Bligh Bank, Hatton Bank and the Hebrides continental slope. Using the refined technical definition of Coral Gardens for UK waters, three criteria were derived against which suspected records were assessed:

- *Density* – Are Coral Garden taxa relatively more abundant than other habitat-forming megafauna present?
- *Biotope* – Do suspected records conform most closely to what would be classed as a 'Coral Garden' or would it be better characterised as another habitat type based on the key species present?
- *Ecological function* – Do suspected records support a biological assemblage considered typical of a Coral Garden?

The data collation and verification exercises demonstrated numerous records of coral gardens in UK waters that conform to density, biotope and ecological function criteria. Verified high confidence records were recorded to varying degrees from across all geographic areas investigated.

The results from this study will be used to assist in the identification of Marine Protected Areas in UK waters for Coral Gardens, as well as in the development of further work areas concerning the conservation of habitats in UK waters.

Contents

1 The need for a technical definition for UK waters

The background document for Coral Gardens (OSPAR 2010) provides a general characterisation of Coral Gardens, which are comprised of mono- to multispecies assemblages of anthozoan and hydrozoan corals, exclusive of colonial Scleractinia although the latter may be present in relatively minor proportions.

Although this definition provides initial guidance for general purposes, it is too coarse a characterisation and thus falls short of being able to adequately capture the large variation between regions and depth, differences that manifest as changes in Coral Garden taxa and their densities.

These problems can be itemised with specific reference as to how the current OSPAR definition hinders classification when applied to UK waters. The OSPAR document provides generic evidence for Coral Gardens in OSPAR Region V including those in UK waters. This resulted in definitions heavily biased towards corals and their densities in Scandinavian waters and on temperate east Atlantic seamounts. Species contributing to Coral Gardens in UK waters are thus incomplete in the OSPAR document. There is a wealth of new information from recent research initiatives (Narayanaswamy *et al* 2006; Jacobs & Howell, 2007; Stewart & Davies, 2007; Neat *et al* 2008; Roberts *et al* 2008; Durán Muñoz *et al* 2009; Howell *et al* 2009; Stewart *et al* 2009; Howell *et al* 2010a; Long *et al* 2010; Durán Muñoz *et al* 2011; Sayago-Gil *et al* 2012) that point to the need to better refine the definition of Coral Gardens in UK waters, and these studies should be integrated along with emerging data on UK specific densities and characterising benthic assemblages.

1.1 Factors to consider in the development of a technical definition

1.1.1 Regional variation

Following the general definition, suspected Coral Gardens exist throughout deeper (>200m) UK waters and span different sub-regions of the UK northwestern continental shelf and slope including Hatton Bank, George Bligh Bank, Rockall Bank, Anton Dohrn Seamount, Rosemary Bank, and the Hebridean continental shelf and slope. Larger scale differences across OSPAR regions in Coral Garden taxa and densities likely reflect differences between oceanic and continental shelf settings, spatial and temporal intensity of anthropogenic disturbances and biogeography. This is particularly true at broad taxonomic levels for e.g. stylasterids and antipatharians that prefer oceanic settings, phenomena that have been confirmed by modelling studies that demonstrate the importance of hydrography and ocean chemistry in the global distribution of octocorals (Yesson *et al* 2012). Additionally, this is true at the species level: a clear example of regional variation is the rarity of the large habitat-forming gorgonian *Paragorgia arborea* in UK waters. This species occurs in high densities and comprises a major Coral Garden species in cooler northern OSPAR regions such as in Scandinavian waters, but appears otherwise localised on Hatton Bank (Frederiksen *et al* 1992; Roberts *et al* 2008). Likewise, more “southern” temperate Coral Garden species such as *Callogorgia verticillata* are not well represented in northern OSPAR regions. It is also important to note that UK waters are at a pivotal oceanographic point in the northeast Atlantic: water mass distributions are climatically controlled, creating oscillations between subpolar and subtropical gyre water masses into the Rockall Trough that facilitate the dispersal of southern and trans-Atlantic species. Thus, UK Coral Gardens have at any one time higher occurrences and perhaps densities of temperate or Mediterranean species, unlike northern OSPAR regions. A definition specific for the UK would help ensure that species forming Coral Gardens in UK waters would receive appropriate management that considers the vulnerability and sensitivity of these species to natural and human threats.

1.1.2 Depth

There is also considerable variation in Coral Garden taxa and densities across depth zones, a phenomenon evident within different UK sub-regions (Howell *et al* 2010a,b). This intraregional variability is driven by environmental heterogeneity within a seabed feature e.g. fine- and local-scale substratum (Roberts *et al* 2008) that varies with depth due to e.g. bathymetric shifts in hydrodynamic regimes across the wider northwestern UK region (Gage *et al* 2000). Taxonomic composition even varies on a single UK seamount e.g. Anton Dohrn Seamount, wherein the flanks and associated parasitic cones have higher densities of what appear to be Coral Gardens with mixed species of antipatharians, stylasterids and gorgonians versus the seamount summit and shallower slopes (Stewart *et al* 2009). An accurate definition of Coral Gardens for any OSPAR region, including for the UK, must therefore consider the entire geophysical diversity of environmental settings in a spatially explicit context to ensure that all relevant taxa and the range of species' densities are covered in this region.

Differences in depth tend to correlate with shifts in hydrodynamic regimes and substratum types, resulting in large shifts in the composition and abundances of Coral Garden taxa. This reiterates the need to perhaps subdivide, for example, hard- and soft-bottom Coral Gardens, but it also points to the need to develop a UK-specific definition that considers the wide bathymetric gradients and complex hydrography seen in UK waters. Optimal habitats for UK Coral Garden taxa are indicated by shifts in densities across such depth gradients, e.g. for *Acanella arbuscula* (Roberts *et al* 2000) which may or may not occur in other OSPAR regions depending on the regional-specific interplay between bathymetry and hydrography and species-specific ecological niches. Generally, the abundance of taxa are expected to decline exponentially with increasing depth (Rex et al 2006; Wei *et al* 2010) such that any density based categorisation scheme in the future must acknowledge this depth-related trend.

1.2 Benefits to developing an improved technical definition for UK waters

Development of an interim definition for Coral Gardens can benefit from recent research initiatives that provide species-specific information and congruent density and environmental data in a spatially explicit context. UK Coral Gardens have specific coral and associated taxa associated with them, the composition and density of which are determined by the interplay between the UK's unique oceanographic position at a boreal-temperate interface and the wide ranging environmental settings associated with this. Critically, a tighter definition for the UK will help address region-specific management issues such as move-on rules for vulnerable marine ecosystems. These rules currently suffer from being too generic and cannot adequately protect Coral Gardens in the UK. Current North East Atlantic Fisheries Commission guidelines would rarely trigger the move-on rule set whereby fishers would have to leave the area after catching more than 60kg of live coral bycatch (Auster *et al* 2011): large heavy gorgonians such as *Paragorgia arborea* are rare in UK waters, which are instead inhabited by smaller and lighter gorgonians, other soft corals, and black corals. Ideally, high-resolution georeferenced video survey data from UK waters could be integrated with fisheries bycatch data and improved benthic classification schemes (e.g. Howell *et al* 2010b) to define Coral Gardens and these could be used to better inform regional fishery management and work to identify Marine Protected Areas in UK waters.

2 Development of an interim definition

2.1 Identification of potential Coral Garden taxa for consideration

The OSPAR background document for Coral Gardens (OSPAR, 2010) and subsequent attempts to improve this definition (e.g. Rogers & Gianni, 2009; Oceana, 2011), include as the main characteristic a relatively dense aggregation of colonies or individuals of one or more coral species. Colonial scleractinians such as *Lophelia pertusa, Madrepora oculata* and *Solenosmilia variabilis* are associated with the OSPAR habitat *Lophelia pertusa* reefs. According to the background document, where these only occur as small, scattered colonies, they may be included within the Coral Gardens definition as they are not the dominant species. However dense aggregations of such solitary non-reef Scleractinia ("cup corals") such as *Desmophyllum dianthus* and *Caryophyllia* spp. can be included in the current definition.

Therefore the first step to form the interim technical definition was to identify a taxonomically robust definition of coral fauna that could potentially form key species components of Coral Gardens in UK waters. This comprised a checklist of species occurring in waters >200m depth. The checklist is restricted to taxa collected since 1990 because, for example, decadal shifts in oceanography, environmental settings and anthropogenic impacts may have detrimentally impacted the occurrences of some taxa since their original collection dates. All published records for Coral Garden taxa were checked until early 2013 and included: Frederiksen *et al* 1992; Roberts *et al* 2000; Hughes & Gage, 2004; Henry & Roberts, 2005; Narayanaswamy *et al* 2006; Jacobs & Howell, 2007; Stewart & Davies, 2007; Neat *et al* 2008; Roberts *et al* 2008; Durán Muñoz *et al* 2009; Howell *et al* 2009; Stewart *et al* 2009; Howell *et al* 2010a; Long *et al* 2010; Durán Muñoz *et al* 2011; Huvenne *et al* 2011; Sayago-Gil *et al* 2012; Bullimore *et al* 2013.

The following taxa (found in >200m water depth) were confirmed as potentially contributing to Coral Gardens in UK waters:

Phylum Cnidaria
- Class Anthozoa
  - Subclass Octocorallia
    - Order Alcyonacea (**gorgonians and soft corals**)
      - *Acanella arbuscula*
      - *Acanella* sp.
      - *Acanthogorgia armata*
      - *Anthomastus grandiflorus*
      - *Anthomastus* sp.
      - *Callogorgia verticillata*
      - *Duva florida*
      - *Gersemia rubiformis*
      - *Gersemia* sp.
      - *Isidella* sp.
      - *Keratoisis* sp.
      - *Lepidisis* sp.
      - *Paragorgia arborea*
      - *Paramuricea biscaya*
      - *Paramuricea* sp.
      - *Primnoa resedaeformis*
      - *Swiftia pallida*

Order Pennatulacea (**sea pens**)
Anthoptilum murrayi
Anthoptilum sp.
Funiculina quadrangularis
cf *Funiculina* sp.
Halipteris sp.
Kophobelemnon stellifera
Pennatula phosphorea
Pennatula sp.
Umbellula huxleyi
Umbellula lindahli
Umbellula sp.
Virgularia mirabilis
Subclass Hexacorallia
Order Antipatharia (**black corals**)
Antipathella sp.
Bathypathes sp.
Leiopathes sp.
Parantipathes hirondelle
Parantipathes sp.
Stauropathes arctica
Stichopathes sp.
Stichopathes cf *gravieri*
Order Scleractinia (**a kind of stony coral**)
Caryophyllia (Caryophyllia) smithii
Caryophyllia spp.
Desmophyllum dianthus
Enallopsammia rostrata
Flabellum alabastrum
Flabellum sp.
Lophelia pertusa
Madrepora oculata
Solenosmilia variabilis
Stephanocyathus moseleyanus
Class Hydrozoa
Subclass Hydroidolina
Order Anthoathecata
Family Stylasteridae (**lace corals, also a kind of stony coral**)
Pliobothrus symmetricus
Stylaster sp.

2.2 Potential Coral Garden sub-types

After identifying all potential Coral Garden taxa in UK waters, literature on these assemblages was reviewed and passed through three step-wise ‘filters’ for density, biotope and ecological function to come up a definition for Coral Gardens and their sub-types (Figure 1). This filtering exercise produced a classification scheme for UK waters comprising six sub-types.

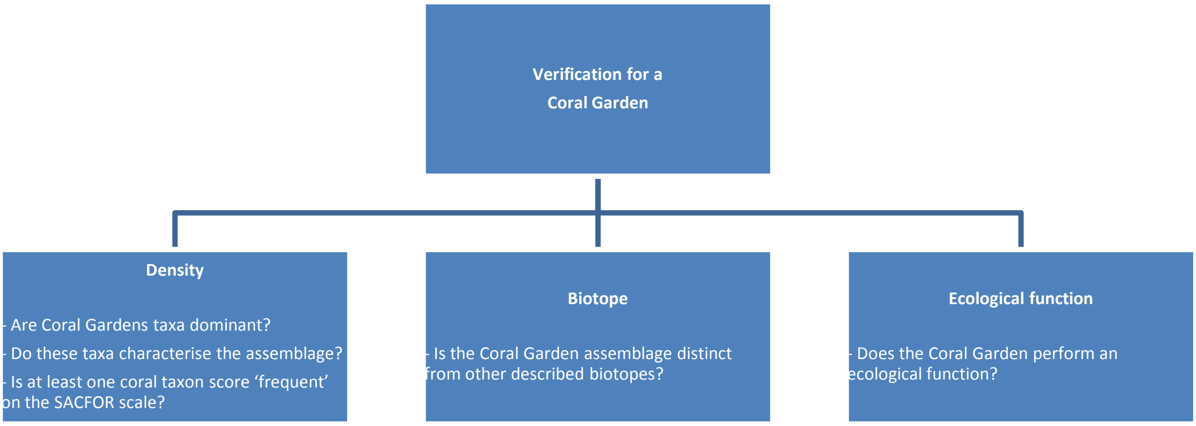

Figure 1. Step-wise filter classification scheme to derive Coral Gardens sub-types.

2.2.1 Density

As a first criterion, Coral Gardens taxa must be more dominant than other habitat-forming megafauna (ICES, 2007; OSPAR, 2008; Oceana, 2011). OSPAR recommendation 2010/9 (OSPAR 10/23/1-E, Annex 31) also refers to dense aggregations extending at least $25m^2$, however in most cases in UK waters such information on spatial extent cannot be accurately ascertained although Bullimore *et al* (2013) have attempted this from a subset of still images.

Thus, instead of spatial coverage which would have severely restricted the type of data and extent of coverage in UK waters, the first step of creating a new technical interim definition involved simply passing published coral density data for each of the above Coral Gardens taxa through a 'density' filter.

This first step was to compare the mean densities of Coral Gardens taxa, exclusive of *Solenosmilia variabilis*, *Lophelia pertusa* and *Madrepora oculata,* to the densities of other habitat-forming taxa (including those reef-building corals) in assemblages. Most studies have not estimated densities, and thus this filter could only be applied using the few available published and unpublished sources (Roberts *et al* 2000; Long *et al* 2010; Bullimore *et al* 2013; D. Hughes, unpublished data). This produced a set of assemblages wherein at least one, or the sum of all, Coral Gardens taxa were dominant.

Density alone cannot be used to distinguish Coral Gardens from other biotopes: coral species may occur in high densities in some locations, but may be entirely absent in others, in which case that assemblage cannot be described as being characterised by that species. Thus, the second step of applying the density filter was to test whether the remaining set of assemblages with high densities were also characterised by Coral Gardens taxa (exclusive of *Solenosmilia variabilis*, *Lophelia pertusa* and *Madrepora oculata*) and could thus constitute Coral Gardens and not another habitat type. This was tested by determining whether Coral Gardens taxa frequently occurred in these assemblages in an image/video/sample or contributed to at least 50% of the similarity between assemblages of this sort.

The third step of the density filter was to test whether Coral Gardens taxa occurred in sufficiently high enough densities to be categorised as at least ‘frequent’ in a standardised area. In each case where Coral Gardens taxa met steps one and two of the density filter, the mean densities of each coral taxon were then scored according to the Marine Nature Conservation Review’s SACFOR size-specific abundance scale into categories of Superabundant, Abundant, Common, Frequent, Occasional or Rare. This exercise allowed the SACFOR abundance of Coral Gardens taxa to be compared to that of other habitat-forming megafauna in a standardised area, to determine if the Coral Gardens taxa could be considered at least ‘Frequent’ in abundance within that assemblage type. This process eliminated assemblages with Coral Gardens taxa occurring in relatively high densities, but that visually appear only sparsely distributed in photos/samples.

2.2.2 Biotope

Once assemblages passed through the density filter, a ‘biotope’ filter was applied that determined whether the assemblage is best characterised as a Coral Garden or whether it strongly resembled biotopes described elsewhere. This was performed by qualitatively comparing characteristic species and environmental settings (depth, substrata) of previously described biotopes to the potential Coral Gardens that passed through the density filter.

In some cases, this filter eliminated otherwise relatively dense Coral Gardens. For example, although caryophylliids can be relatively dense in some cases, e.g. in Bullimore *et al* (2013), it was noted that these assemblages appeared to more closely correspond to a biotope already described by Howell *et al* (2010a), *Lanice*-dominated beds. Thus a confident assignment of these assemblages as ‘Coral Gardens’ could not be made as these cup coral-dominated assemblages may actually represent ecological variation within a *Lanice*-dominated biotope.

For the same reasons, this criterion eliminated assemblages dominated by the seapen *Kophobelemnon stelliferum* in the Southwest Approaches (Stewart & Davies, 2007; Howell *et al* 2010a) from being defined as Coral Gardens. This was due to overlap with proposed soft-bottomed biotopes characterised by burrowing sea anemones (Howell *et al* 2010a). However, future analyses of seapen density relative to the burrowing megafauna may help uncover yet another sub-type of Coral Gardens.

2.2.3 Ecological function

If the potential Coral Gardens did not demonstrate any strong overlap with other already described biotopes, a final ‘ecological’ filter was applied to test that the Coral Garden assemblage consistently supported an ecologically coherent group of associated species. This filter also reinforces the concept that a Coral Garden must be defined by its functioning as such. This can be measured as the extent to which the potential Coral Garden sub-type is able to support a characteristic biological assemblage. However, other potential ecological roles could include e.g. the occurrence of obligate biological associations between species, or evidence for Coral Gardens taxa being used as spawning substrata/grounds for oviparous fish such as sharks, skates, rays and chimaeras.

This was executed by examining whether any species tended to co-occur in high frequencies with the Coral Garden, or whether associated non-coral taxa characterised at least 50% of these assemblages alongside the coral taxa. Published sources were readily available (Roberts *et al* 2000; Hughes & Gage, 2004; Roberts *et al* 2008; Howell *et al* 2010a; Bullimore *et al* 2013). Evidence for being associated with a characteristic assemblage was also confirmed by identifying enhanced densities of species with known symbiotic associations to Coral Gardens taxa e.g. the ophiuroid *Ophiomusium lymani* with bamboo coral.

2.3 Environmental settings

Marine seabed biotopes vary with the interactions between depth, temperature, hydrography and substrata across the UK continental margin (e.g. Gage *et al* 2000; Roberts *et al* 2008; Howell *et al* 2010a,b). While not applied as a 'filter', the final step to prepare an interim technical definition was to determine the extent to which a Coral Garden sub-type could be uniquely defined by its environmental setting. Ecological variation across environmental gradients was examined by comparing these settings across Coral Gardens sub-types.

2.4 'Threshold' densities and records without density data

It was critical that objective criteria were used to improve the definition and make it specific for UK waters. There does not appear to be an ecological basis for adhering to "the rule of 10" (wherein Coral Gardens taxa must be at least 10 times more abundant than in adjacent areas; Rogers & Gianni, 2009). Instead, the interim technical definition uses the density at which the assemblage *functions* as a Coral Garden i.e. the threshold density in which the associated biological communities were distinct from other communities in different habitat types.

Incorporating an element of ecological relevance also helps overcome the challenge of overlapping with other OSPAR listed habitats such as deep-sea sponge aggregations and *Lophelia pertusa* reefs. Coral Gardens clearly function differently in many ways from these habitats. For example they do not baffle sediments or form reef accretions, nor do they exhibit cycles of framework growth and collapse like cold-water coral reefs. Critically, many Coral Gardens taxa also exhibit differences in ecological functioning. There are much higher incidences of obligate and parasitic symbioses associated with gorgonians than with reef-forming corals (Buhl-Mortensen & Mortensen, 2004; Carreiro Silva *et al* 2011). In addition, higher biodiversity is associated with living gorgonians, whereas in cold-water coral reefs, biodiversity 'grades' across the reef landscape from living framework to coral rubble aprons and surrounding sediments. This means that Coral Gardens are likely to host distinct assemblages compared with other OSPAR habitats and thus these assemblages may be key to distinguishing between them.

It should also be noted that many published accounts of Coral Gardens taxa in UK waters could not provide equivalent density data. This was because they were reported not as spatially explicit assemblages, but as coral bycatch in terms of biomass or frequency of capture in bottom fishing including long-lining, a limitation already noted (ICES 2007).

3 An interim technical definition for Coral Gardens in UK waters

Based on the approach and points considered in Section 2, the following interim technical definition has been proposed:

A relatively dense seabed aggregation of at least one coral taxon (Alcyonacea, Pennatulacea, Antipatharia, Stylasteridae, Scleractinia) wherein the density of non-reef forming coral taxa exceeds that of reef-forming Scleractinia such as Lophelia pertusa*,* Solenosmilia variabilis *and* Madrepora oculata*. Coral Gardens taxa should characterise the assemblage and occur in densities that clearly exceed that found in adjacent habitats. These assemblages should confer a clear functional role for the Coral Garden e.g. enhanced associated biodiversity, support a distinct associated megafaunal assemblage, ecological symbioses, and/or create habitat for mobile fauna. Coral Gardens in UK waters can be split into several habitat sub-types; these are differentiated based on their characterising coral taxa and their species-specific SACFOR abundances, their associated benthic assemblages and the distinct environmental settings in which they occur.*

Application of the step-wise filtering methodology produced a set of five unique Coral Gardens sub-habitats briefly overviewed here (more detail is provided for each sub-habitat in Appendix 1):

- **Soft-bottom bamboo coral garden:** characterised by *Acanella arbuscula* (1-9 corals/10m^2), sometimes with seapens and the solitary scleractinian cup coral *Flabellum* (*Ulocyathus*) *alabastrum* co-occurring.

- **Cup coral garden:** with two categories – one ‘deep’ cup coral garden - characterised by *Caryophyllia* spp. cup corals (1-9 corals/10m^2), sometimes with seapens such as *Pennatula phosphorea* and *Halipteris* sp. co-occurring (1-9 corals/10m^2). Typically occurring at depths of 1069-1769m; and one ‘shallow’ cup coral garden characterised by *Caryophyllia smithii* (1-9 corals/m^2).Typically oc*curring at d*epths of 196-285m.

- **Lace coral garden:** characterised by *Pliobothrus or Stylaster spp. (*1-9 c*orals/10m^2* or 1-9 corals/m^2, respectively), sometimes with *Caryophyllia* sp. cup corals (1-9 corals/m^2), and *Callogorgia verticillata* and *Madrepora oculata* colonies (1-9 corals/100m^2).

- **Black coral garden:** characterised by the antipatharian black coral *Stichopathes* cf *gravieri* (1-9 corals/100m^2) with other antipatharians, gorgonians and the alcyoniid *Anthomastus grandiflorus* alongside living but relatively less dominant *Lophelia pertusa*.

- **Gorgonian coral garden:** characterised by large gorgonians (1-9 corals/10m^2), with co-occurrences of *Callogorgia verticillata (*1-9 corals/100m^2), the soft coral *Anthomastus grandiflorus* (1-9 corals/m^2) and bamboo corals such as *Keratoisis* spp. and *Lepidisis* sp. (1-9 corals/100m^2). *Solenosmilia variabilis*, *Lophelia pertusa* and *Madrepora oculata* also occur (1-9 corals/10m^2) but these do not strongly characterise the assemblages.

4 Verification of suspected coral garden records

Records of ‘suspected’ Coral Gardens in UK waters are currently held in the Geodatabase of Marine Features, Scotland (GeMS). These records were examined to test how well records from different geographic areas (George Bligh Bank, Hatton Bank, Rockall Bank) fit the interim technical definition. This was performed using a two-step 'Best Fit' assessment matrix (Table 1; detailed information is provided in Annex I) that produced a confidence level to verify how well each record (provided as a distinct Feature ID held in GeMS) fit the definition. Records currently held in GeMS were investigated in more detail from their original data source, and data obtained via personal communications were also used.

The first step involved assessing the 'fit' of each record in terms of its biological characteristics and environmental setting relative to the interim definition. Making this step the first one allows records without density estimates (e.g. those derived from fisheries bycatch surveys) to be included in this exercise. A tick-box strategy was used to complete the matrix: if a characteristic matched that provided by the interim definition, then a tick was provided for that box. Biological characteristics include the major Coral Gardens taxa and the characteristic associated megafauna. Assessment of environmental 'fit' was measured against the dominant substrata and depth (average or range) for that record.

The second step involved assessing the 'fit' of each record to the species-specific SACFOR abundance scale categories provided by the interim definition.

Confidence in the best-fit approach for each record was measured by enumerating the total number of ticks that matched the interim definition: 4-5 ticks = high confidence; 2-3 ticks = medium confidence; 0-1 ticks = low confidence.

As records of Coral Gardens in UK waters fit into different sub-types as produced by the interim definition, variation between verified records was also tabulated to demonstrate the range of Coral Gardens sub-types in each geographical area (Table 2).

Table 1. Two-step 'best fit' assessment matrix of 'verified' and 'suspected' Coral Gardens in different regions of UK waters. NK refers to data not known. A check (✓) indicates the record matches that described for a Coral Gardens sub-type, whereas a cross (X) indicates the record did not correspond to that described for the Coral Gardens.

Region (number of records)	**GeMS Feature ID or reference**	**Source of record**	**Biological and environmental correspondence**				**Density correspondence**	**Confidence**
			Coral Gardens taxa potentially dominant	Characteristic associated fauna	Depth	Substratum	SACFOR scale	
George Bligh Bank (5)								
	0, 1	bycatch	✓	NK	✓	✓	NK	**MEDIUM**
	11, 12	bycatch	✓	NK	X	X	NK	**LOW**
	Narayanaswamy *et al* 2006	video and photo	✓	✓	✓	✓	NK	**HIGH**
Anton Dohrn (75)								
	53-126, 130	video and photo	✓	✓	✓	✓	✓	**HIGH**
Hatton Bank (67)								
	16, 19, 21-24, 27, 28, 32, 33, 35-40	bycatch	✓	NK	X	✓	NK	**LOW**
	20, 25, 34	bycatch	✓	NK	✓	X	NK	**LOW**
	2-15, 17, 18, 26, 29-31, 41	bycatch	✓	NK	✓	X	NK	**MEDIUM**
	142-161, 171-178	video and photo	✓	✓	✓	✓	✓	**HIGH**
Rockall Bank (84)								
	13	bycatch	✓	NK	X	X	NK	**LOW**

	179-260	video and photo	✓	✓	✓	✓	✓	**HIGH**
	Long *et al* 2010	video and photo	✓	✓	✓	✓	✓	**HIGH**
Rockall Trough including Hebridean continental slope (5)								
	Roberts *et al* 2000	photo	✓	✓	✓	✓	✓	**HIGH**
	Hughes & Gage, 2004; D. Hughes, unpublished data	towed sled and photo	✓	✓	✓	✓	✓	**HIGH**
	Hughes & Gage, 2004; D. Hughes, unpublished data	photo	✓	x	✓	✓	✓	**HIGH**
	D. Hughes, unpublished data	photo	✓	x	✓	✓	✓	**HIGH**
	D. Hughes, unpublished data	photo	✓	x	✓	✓	✓	**HIGH**

Table 2. Coral Gardens geographical and ecological variation matrix of records. Those scored with 'low' or 'medium' confidence levels are indicated by a check in parentheses, while records scored with 'high' confidence are indicated with a check only.

Area/feature	Soft-bottom bamboo coral garden	Deep cup coral garden	Shallow cup coral garden	Lace coral garden	Black coral garden	Gorgonian coral garden
George Bligh Bank					(✓)	✓
Anton Dohrn/ flanks		✓		✓		
Anton Dohrn/ parasitic cones		✓				✓
Anton Dohrn/radial ridges						✓
Hatton Bank				✓	✓	(✓)
East Rockall Bank/shallow bank summit			✓			
East Rockall Bank/sloped flank margins		✓		✓		(✓)
Rockall Trough/deep margins	✓					

4.1 Commentary on verification exercise

Despite limitations of existing suspected records, the best-fit assessment exercise can provide the initial framework for critically evaluating new records from on-going surveys (Appendix 1). Limitations of such records were overcome using assumptions based on predicted and ground-truthed verification of seabed substratum and depth using UKSeaMap 2010 (McBreen *et al* 2011).

Notably, suspected fisheries bycatch records of Coral Gardens on Hatton Bank, George Bligh Bank and Rockall Bank were verified and in some cases assigned a ‘moderate’ confidence level. These records are valuable sources of information; future work must use novel ways of incorporating these data into methods for defining Coral Gardens e.g., by creating SACFOR abundance scales for trawl, long-line, *etc*. fisheries data.

5 Verified Coral Gardens in UK waters

Methods to develop the interim technical definition for Coral Gardens revealed five different sub-types of this habitat occurring in different geographical areas covering UK waters including George Bligh Bank, Anton Dohrn seamount, Hatton Bank, Rockall Bank, and the deep margins of the Rockall Trough including the Hebridean continental slope (Table 2). These are shown in Figure 1 symbolised by coral garden sub-type and level of confidence. Profiles of these coral garden sub-types are provided in Appendix 2.

5.1 George Bligh Bank

Five records of suspected Coral Gardens on George Bligh Bank were investigated, four of which were derived from fisheries bycatch data. Biological and environmental correspondence with only one record scored a ‘high’ level of confidence, based on a photographic station GB_A#7_0052 from the SEA 7 survey in 2005 (image published in Narayanaswamy *et al* 2006), which appeared to closely match at least one Coral Garden sub-type – the Gorgonian coral garden sub-habitat. The other records from bycatch data scored ‘low’ and ‘medium’, corresponding to what appear to be gorgonian and black coral gardens, respectively.

5.1.1 Gorgonian Coral Gardens

Non reef-forming Coral Gardens taxa (in this case, gorgonians, antipatharians and bamboo corals) appear to dominate the image from deeper depths on the bank, colonising dead *Lophelia* framework although some living reef-forming corals are apparent in the image too. Fisheries bycatch from George Bligh Bank (ICES 2007) supports this classification, with records of gorgonian bycatch held in GeMS that scored ‘low’ confidence, based on the fact they were obtained from depths assumed to be slightly more shallow (about 800-900m depth) than those described in the interim definition for this sub-type (1316-1770m depth). Further study of the gorgonian fauna of George Bligh could result in the discovery and characterisation of a ‘shallower’ sub-type, but species listed by Narayanaswamy *et al* (2006) and in ICES (2007) suggest the same taxa occur here that elsewhere in UK waters and thus the depth range of the gorgonian sub-type will likely expand.

5.1.2 Black Coral Gardens

GeMS held records of antipatharians from western George Bligh Bank based on fisheries bycatch data. The environmental settings from which these corals were obtained (about

900m depth on mixed sediment types) closely corresponded to what is described for the standard black coral garden sub-type and thus scored a ‘medium’ level of confidence. Antipatharian taxa on the bank include *Stichopathes* and *Leiopathes* spp. (Narayanaswamy *et al* 2006), which form major species components of the black coral gardens found elsewhere in UK waters. Targeted density analyses of the antipatharian fauna on George Bligh would help confirm these records.

5.2 Anton Dohrn

Anton Dohrn seamount has three Coral Gardens sub-types occurring on its parasitic cones and flank, all of which are listed as having high confidence.

5.2.1 Lace Coral Gardens

Coral Gardens characterised by stylasterid (or “lace”) corals occur at more shallow depths (around 810m water depth) of the seamount on pebble and cobble substrata (Stewart *et al* 2009). *Pliobothrus*-type stylasterids are the first Coral Gardens taxa to characterise the community. Raw density data are not published, but the mean density of ?*Pliobothrus* covering both Anton Dohrn and Hatton Bank is 0.5434 (Bullimore *et al* 2013), falling within the SACFOR abundance scale of ‘Frequent’. This Coral Garden also supports a megafaunal assemblage characterised by associated fauna including cerianthids, the bright orange anemone *Phelliactis* sp., the holothuroideans *Parastichopus tremulus* and *Psolus* sp., encrusting and lobed sponges, and pagurid hermit crabs (Bullimore *et al* 2013).

Equivalent stylasterid-dominant Coral Gardens have not been well characterised across the OSPAR region in the NE Atlantic.

5.2.2 Deep Cup Coral Gardens

Caryophyllia cup corals with seapens, associated with the xenophyophore *Syringammina fragilissima* along the flanks of the seamount (1367-1768m water depth) on pebble and cobble substrata and softer sediments. Raw density data are not published, but the mean density of *Caryophyllia* on both Anton Dohrn and East Rockall Bank is 0.7893 (Bullimore *et al* 2013), falling within the SACFOR abundance scale of ‘Occasional’. *Caryophyllia* sp. and the seapen *Pennatula phosphorea* occur at the base of a parasitic cone that graded into a low-lying debris flow field, typically on biogenic coral rubble, with a characteristic and biologically diverse megafaunal assemblage (Stewart *et al* 2009; Howell *et al* 2010a).

Equivalent deep cup coral-dominant Coral Gardens are not currently well represented in the wider NE Atlantic.

5.2.3 Gorgonian Coral Gardens

Gorgonian-dominated Coral Gardens found on bedrock and coral rubble on the parasitic cones and radial ridges on the seamount’s northwestern side. This assemblage occurs at 1316-1770m water depth, at temperatures 4.4-5.5°C (Stewart *et al* 2009; Long *et al* 2010; Bullimore *et al* 2013). SACFOR abundance category = Common; mean density 0.1425-0.7775 corals/m^2), with other less dominant *Callogorgia verticillata (*SACFOR abundance category = Frequent; mean density 0.044 corals/m^2), the soft coral *Anthomastus grandiflorus* (SACFOR abundance category = Common; mean density 0.548 corals/m^2) and bamboo corals such as *Keratoisis* spp. and *Lepidisis* sp. (SACFOR abundance category = Frequent; mean densities 0.026-0.059 and 0.033 corals/m^2, respectively). *Lophelia pertusa* and *Madrepora oculata* were also reported to occur at these sites (SACFOR abundance category

= Common; but with mean densities of 0.5314 and 0.205 corals/m^2, respectively). However review of stills images from these habitats on Anton Dohrn and the adjacent Hebrides Terrace Seamount by senior coral taxonomists revealed that at depths >1200m on these seamounts, the main reef-building coral is *Solenosmilia variabilis* and not *Lophelia pertusa* (Henry and Roberts submitted). The characterising gorgonians are typically distributed on coral rubble, with less dominant Coral Garden taxa found more on gravel, sand, coral rubble and bedrock. Associated fauna include a blue encrusting sponge (*Hymedesmia* spp.), and a rich echinoderm megafauna including the comatulid crinoid *Koehlermetra porrecta*, the urchin *Araeosoma fenestrum*, brisingids and *Ophiactis balli*.

This gorgonian-dominated Coral Gardens sub-type is highly similar to those described in other OSPAR regions, particularly with respect to the occurrence of the temperate gorgonian *Callogorgia verticillata* in this sub-type, a species that also characterises Coral Gardens on the Cantabrian margin, the Gorringe Bank, on Josephine Seamount, and the Azores (OSPAR 2010; Oceana, 2011).

5.3 Rockall Bank

Four Coral Garden sub-types occur on Rockall Bank, one of which (a shallow cup coral garden) is unique to East Rockall. Shallow cup coral gardens, deep cup coral gardens and lace coral gardens were scored with ‘high’ confidence. Gorgonian coral gardens could only be scored as low based on the lack of density data associated with bycatch records of what could be a possible gorgonian coral garden on Rockall Bank.

5.3.1 Shallow Cup Coral Gardens

Caryophyllia smithii Coral Gardens: the shallow bank summit (196-285m water depth, 9.3-9.6°C) is characterised by what appears to be a regionally unique assemblage of *Caryophyllia smithii* cup corals and the anemone *Actinauge richardi* found on gravelly sand substrata (Long *et al* 2010). *Caryophyllia* occurs in relatively high densities here (SACFOR abundance category = Frequent; mean density 4.2395 corals/m^2). There is reportedly a low biological diversity of associated megafauna (as seen in photos from Stewart *et al* 2009), with only the anemone *Actinauge richardi* distinctly evident from photos in densities averaging 3.3159 individuals/m^2. The verification exercise scored this record with ‘high’ confidence.

There does not appear to be a *Caryophyllia*-actinarian equivalent Coral Gardens representative in the wider NE Atlantic.

5.3.2 Deep Cup Coral Gardens

Caryophyllia cup corals with seapens, associated with the xenophyophore *Syringammina fragilissima* are found extensively along the southeast edges of Rockall Bank (Stewart *et al* 2009; Long *et al* 2010). Raw density data are not published, but the mean density of *Caryophyllia* on both Anton Dohrn and East Rockall Bank is 0.7893 (Bullimore *et al* 2013), falling within the SACFOR abundance scale of ‘Occasional’ along with occurrences of *Pennatula phosporea* with the SACFOR ‘Common’ abundance scale. Records of deep cup coral gardens scored with ‘high’ confidence.

Deep Cup Coral Gardens are not well known across the wider NE Atlantic, however these may grade into habitats dominated by the widespread *Syringammina fragilissima*.

5.3.3 Lace Coral Gardens

Stylasterid-dominated Coral Gardens (*Stylaster* sp.): these occur deeper than the *Caryophyllia smithii* Coral Gardens, colonising exposed bedrock and mixed substrata along a ledge feature spanning the eastern flank of the bank (Long *et al* 2010). *Stylaster* sp. occurs in relatively high densities (SACFOR abundance category = Common; mean density = 3.0604 corals/m^2). The assemblage is also closely associated with large lobose sponges, serpulid worms, brachiopods and the urchin *Cidaris cidaris* in waters 387-685m deep, at temperatures 9.2-9.7°C. The verification exercise scored this record with 'high' confidence.

Stylasterid-dominated Coral Gardens are not well known across the wider NE Atlantic.

5.3.4 Gorgonian Coral Gardens

The fisheries bycatch record from Rockall Bank was scored with only 'low' confidence, based on the lack of environmental correspondence between the GeMS record (about 800m depth in soft sand and muddy sand substrata) and that described for the gorgonian coral garden sub-type (1316-1770m depth, on hard gravel, sand, coral rubble and bedrock substrata). Furthermore the lack of gorgonian density data precluded assigning this record at a higher level of confidence.

5.4 Hatton Bank

Three Coral Gardens sub-types were verified for Hatton Bank. Many suspected records of Coral Gardens held in GeMS resulted in 'low'- to 'medium'-level confidence scores for the occurrence of Coral Gardens. Fisheries bycatch surveys yielded a diverse array of indicator taxa (antipatharians, gorgonians and other soft corals, stylasterids, scleractinians, and seapens) from the sedimentary habitats on the Hatton Drift and outcropping areas on the western region of this bank (Durán Muñoz *et al* 2011) and suggest there is a very high likelihood of encountering other Coral Garden types in this area, particularly as the verification exercise often revealed congruent environmental settings as those described for the interim definitions.

5.4.1 Lace Coral Gardens

Stylasterid-dominated (?*Pliobothrus* sp.) assemblages accompanied by *Madrepora oculata* are found at about 491-562m water depth on bedrock, boulders and cobbles. Raw density estimates are not available for just Hatton Bank, but SACFOR abundance category = Frequent; mean density = 0.5434/m^2. Substrata comprise sparsely distributed cobbles and boulders on sandy gravel substrata and exposed bedrock. Associated fauna include cerianthids, the holothuroians *Parastichopus tremulus* and *Psolus* sp., encrusting and lobed sponges, and pagurid hermit crabs (Narayanaswamy *et al* 2006; Jacobs & Howell, 2007; Roberts *et al* 2008; Bullimore *et al* 2013).

5.4.2 Black Coral Gardens

Stichopathes cf *gravieri* dominated Coral Gardens occur on Hatton Bank. These occur at 616-665m water depth on Hatton Bank, typically on coral rubble. This sub-type is dominated by the orange coiled antipatharian *Stichopathes* cf *gravieri* (SACFOR abundance category = Frequent; mean density 0.072 corals/m^2) but occurs alongside other less dominant antipatharians, as well as gorgonians and the alcyoniid *Anthomastus grandiflorus* and less frequently *Lophelia pertusa* (Bullimore *et al* 2013). Indicator taxa of black coral gardens such as *Parantipathes* sp. were also recorded in the Hatton Drift area and bedrock outcrops on the western slope of the bank based on fisheries bycatch data (Durán Muñoz *et al* 2009; Sayago-Gil *et al* 2012). Many of these also scored 'medium' confidence based on their environmental correspondence with those parameters outlined in the interim definition but caution must be taken as deeper coral assemblages inhabiting more mobile sediments on the drift appear to be sparser than those found on the outcrops (Sayago-Gil *et al* 2012). Notably, this habitat could grade into other OSPAR habitats such as *Lophelia pertusa* reefs, given its close association with *Lophelia* framework and these associated assemblages (Roberts *et al* 2008). There is also a rich associated biodiversity of megafauna associated with this sub-type of Coral Gardens, including the conspicuous orange anemone *Phelliactis* sp., *Cidaris cidaris*, brisingid echinoderms and globular sponges Narayanaswamy *et al* 2006; Jacobs & Howell, 2007; Roberts *et al* 2008; Bullimore *et al* 2013).

5.4.3 Gorgonian Coral Gardens

Several large habitat-forming gorgonian taxa are found on Hatton Bank, including *Paramuricea biscaya*, *Callorgorgia verticillata*, *Paragorgia arborea*, plexaurid seafans, and acanthogorgiid corals where they are particularly dense on outcropping areas of bedrock on the western slope of the bank (Frederiksen *et al* 1992; Roberts *et al* 2008; Durán Muñoz *et al* 2009; Sayago-Gil *et al* 2012). Fisheries bycatch records from GeMS scored 'low' to 'medium' confidence based on their occasional environmental correspondence to that described for the standard gorgonian sub-type. However as with potential black coral gardens on Hatton Bank, gorgonian coral gardens are perhaps more likely on the bedrock outcrop areas on the western slope of the bank (Durán Muñoz *et al* 2009; Sayago-Gil *et al* 2012) than on the drift.

Notably, the uniqueness of UK Coral Gardens across the wider OSPAR region is reflected in the biogeography of coral fauna inhabiting Hatton Bank: boreal cool water species such as *P. arborea* are at their southernmost range, while *P. biscayana* is typically found in more warm temperate regions and thus is at its northernmost distribution on Hatton Bank.

5.5 Deep Rockall Trough and the Hebrides Continental Slope

To date only one Coral Garden sub-type could be verified on the deep margins of the Rockall Trough including the Hebrides Continental slope. This sub-type appears restricted to the deeper bathyal zone and is not known elsewhere in UK waters.

5.5.1 Soft-Bottom Bamboo Coral Garden

The *Acanella arbuscula*-dominated Coral Garden is represented on deep, fine-grained silty to clay substrata along the edges of the Rockall Trough in waters 1295-2069m deep on the North Feni Ridge and on the Hebridean continental slope. Coral Gardens at both places are characterised by relatively dense stands of the bamboo coral *Acanella arbuscula* that occur in close association with seapens and solitary scleractinians such as *Flabellum (Ulocyathus) alabastrum* (Roberts *et al* 2000; Hughes & Gage 2004). *Acanella arbuscula* is dense relative to other megafauna (SACFOR abundance category = Common; mean density 0.2-0.447 corals/m^2), with occasional seapens and solitary corals such as *Flabellum* (*Ulocyathus*) *alabastrum* occurring. Temperatures range around 3°C, with current speeds 12 $cm{\cdot}s^{-1}$. Seabed is mostly fine silt/clay, with evidence for active bioturbation. Notably, bamboo corals are frequently accompanied by the brittlestar *Ophiomusium lymani*.

This habitat was reported from canyon ecosystems off France at comparable depths. Characteristic densities vary across the region however from mean densities of 0.2-0.447 corals/m^2 in UK waters, similar to its dominance at the Goban Spur, to about 27 colonies/m^2 in canyon ecosystems off France (Hughes and Gage, 2004; OSPAR 2010).

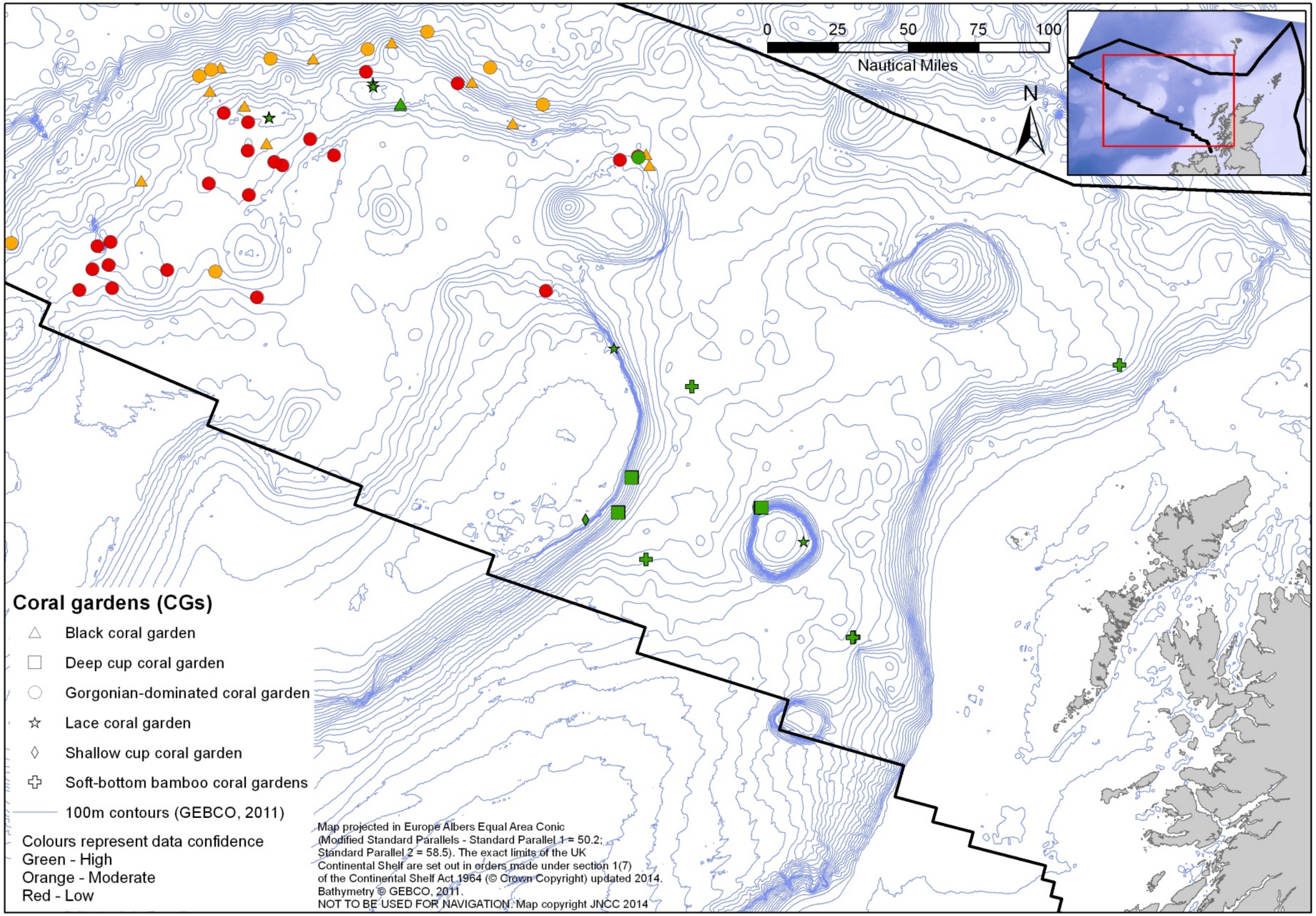

Figure 2. Coral garden sub-types in UK waters symbolised by confidence

6 Further recommendations

Fisheries bycatch data represents a severely underexploited database from which the scientific community can greatly benefit to improve habitat mapping and characterising benthic assemblages (Durán Muñoz & Román 2002). Subsequent attempts to define Coral Gardens across the OSPAR jurisdiction should ensure that such vital information is not lost, but instead be encapsulated into and wholly aligned with, for example, threshold values to better define Vulnerable Marine Ecosystems. For example, the SACFOR abundance scale could be modified by estimating densities of organisms based on trawl surveys, which requires knowledge of trawl efficiency, duration of trawl tows, and standardised to area, effort and/or time, at the minimum. Alternatively, these data can be evaluated using qualitative measures, in the absence of accompanying quantitative density estimates (OSPAR 2008).

Applying the stepwise filtering process to identify habitats in UK waters may help distinguish between Coral Gardens and other biotopes that overlap in space due to similar environmental requirements e.g. deep-sea sponge aggregations and cold-water coral reefs.

Specifically, confirmation of a ‘seapen’-dominated Coral Gardens sub-type in UK waters could be made by additional density and associated faunal analyses to help distinguish these from other soft-bottom biotopes such as those structured by burrowing megafauna other than corals. Confirmation could lead to the designation of biotopes characterised by aggregations of the seapen *Kophobelemnon stelliferum* found in canyon ecosystems of the Southwest Approaches as a seventh sub-type of Coral Gardens.

The verification of Coral Gardens in UK waters through this exercise now permits future targeted exploration and mapping exercises to determine the spatial extent of these habitat sub-types against OSPAR’s criterion of $25m^2$. Expert opinion asserts that many areas in UK waters will meet such criteria, including those north of Shetland where historic and industry-lead exploration using remotely operated vehicles have allowed expert verification of high concentrations of *Umbellula* seapens and alcyonarians (Jones & Gates, 2010).

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Appendix 1

Details of ‘suspected’ and ‘verified’ Coral Garden records analysed

GeMS Feature ID or reference	Confidence	Latitude	Longitude	Characteristic Coral Gardens taxon/taxa	Possible membership to a Coral Garden sub-type	Depth (m)	Substratum
George Bligh Bank							
0	**MEDIUM**	59.302961	-13.804989	Antipatharia	black coral gardens	900*	mixed sediment*
1	**MEDIUM**	59.357867	-13.881858	Antipatharia	black coral gardens	900*	mixed sediment*
11	**LOW**	59.327691	-13.96318	gorgonian	gorgonian coral gardens	900*	mixed sediment*
12	**LOW**	59.272838	-14.148308	gorgonian	gorgonian coral gardens	800*	mixed sediment*
Narayanaswamy *et al* 2006; transect GB_A#7	**HIGH**	59.320886	-13.953997	*Stichopathes*, *Callogorgia verticillata*, *Capnella*, *Isidella*, *Keratoisis*, *Leiopathes*	gorgonian coral gardens	861	dead coral framework
Anton Dohrn							
53	**HIGH**	57.575848	-11.409413	gorgonians, *Madrepora oculata* with some *Lepidisis* and *Keratoisis*	gorgonian coral gardens	1451	coral rubble
54	**HIGH**	57.575864	-11.40921	gorgonians, *Madrepora oculata* with some *Lepidisis* and *Keratoisis*	gorgonian coral gardens	1452	coral rubble
55	**HIGH**	57.575881	-11.408056	gorgonians, *Madrepora oculata* with	gorgonian coral gardens	1471	coral rubble

56	**HIGH**	57.575889	-11.407836	some *Lepidisis* and *Keratoisis* gorgonians, *Madrepora oculata* with	gorgonian coral gardens	1473	coral rubble
57	**HIGH**	57.575888	-11.4076	some *Lepidisis* and *Keratoisis* gorgonians, *Madrepora oculata* with	gorgonian coral gardens	1476	coral rubble
58	**HIGH**	57.575898	-11.407429	some *Lepidisis* and *Keratoisis* Gorgonians, *Madrepora oculata* with some *Lepidisis* and *Keratoisis*	gorgonian coral gardens	1478	coral rubble
59	**HIGH**	57.579369	-11.394232	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
60	**HIGH**	57.57944	-11.394154	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
61	**HIGH**	57.579533	-11.394008	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
62	**HIGH**	57.579526	-11.393691	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
63	**HIGH**	57.579667	-11.393764	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
64	**HIGH**	57.579705	-11.393562	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
65	**HIGH**	57.579774	-11.393682	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
66	**HIGH**	57.579877	-11.393234	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
67	**HIGH**	57.579817	-11.393276	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
68	**HIGH**	57.579897	-11.393266	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
69	**HIGH**	57.579966	-11.393212	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
70	**HIGH**	57.580033	-11.393043	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
71	**HIGH**	57.580093	-11.392879	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
72	**HIGH**	57.580163	-11.39275	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
73	**HIGH**	57.5802	-11.392659	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
74	**HIGH**	57.5802	-11.392579	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
75	**HIGH**	57.580276	-11.392404	*Caryophyllia* sp.	deep cup coral gardens	1769	pebbles and cobbles
76	**HIGH**	57.580376	-11.392231	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles

77	**HIGH**	57.580414	-11.392288	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
78	**HIGH**	57.580415	-11.392155	*Caryophyllia* sp.	deep cup coral gardens	1768	pebbles and cobbles
79	**HIGH**	57.580576	-11.392063	*Caryophyllia* sp.	deep cup coral gardens	1767	pebbles and cobbles
80	**HIGH**	57.580589	-11.391992	*Caryophyllia* sp.	deep cup coral gardens	1767	pebbles and cobbles
81	**HIGH**	57.580673	-11.391756	*Caryophyllia* sp.	deep cup coral gardens	1767	pebbles and cobbles
82	**HIGH**	57.580719	-11.391672	*Caryophyllia* sp.	deep cup coral gardens	1766	pebbles and cobbles
83	**HIGH**	57.580804	-11.391629	*Caryophyllia* sp.	deep cup coral gardens	1766	pebbles and cobbles
84	**HIGH**	57.580881	-11.391451	*Caryophyllia* sp.	deep cup coral gardens	1766	pebbles and cobbles
85	**HIGH**	57.580918	-11.391429	*Caryophyllia* sp.	deep cup coral gardens	1766	pebbles and cobbles
86	**HIGH**	57.580972	-11.391251	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
87	**HIGH**	57.581076	-11.39133	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
88	**HIGH**	57.581132	-11.391126	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
89	**HIGH**	57.581186	-11.39105	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
90	**HIGH**	57.581271	-11.390826	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
91	**HIGH**	57.581263	-11.390575	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
92	**HIGH**	57.58132	-11.390606	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
93	**HIGH**	57.581434	-11.390507	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
94	**HIGH**	57.581477	-11.390464	*Caryophyllia* sp.	deep cup coral gardens	1764	pebbles and cobbles
95	**HIGH**	57.581535	-11.390321	*Caryophyllia* sp.	deep cup coral gardens	1764	pebbles and cobbles
96	**HIGH**	57.581598	-11.390314	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
97	**HIGH**	57.581715	-11.390122	*Caryophyllia* sp.	deep cup coral gardens	1764	pebbles and cobbles
98	**HIGH**	57.581759	-11.389935	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
99	**HIGH**	57.58182	-11.389841	*Caryophyllia* sp.	deep cup coral gardens	1765	pebbles and cobbles
100	**HIGH**	57.581878	-11.3898	*Caryophyllia* sp.	deep cup coral gardens	1764	pebbles and cobbles
101	**HIGH**	57.581931	-11.389724	*Caryophyllia* sp.	deep cup coral gardens	1764	pebbles and cobbles
102	**HIGH**	57.58198	-11.38955	*Caryophyllia* sp.	deep cup coral gardens	1764	pebbles and cobbles
103	**HIGH**	57.582053	-11.389465	*Caryophyllia* sp.	deep cup coral gardens	1763	pebbles and cobbles
104	**HIGH**	57.582153	-11.389325	*Caryophyllia* sp.	deep cup coral gardens	1763	pebbles and cobbles
105	**HIGH**	57.582209	-11.389203	*Caryophyllia* sp.	deep cup coral gardens	1763	pebbles and cobbles
106	**HIGH**	57.58228	-11.389099	*Caryophyllia* sp.	deep cup coral gardens	1762	pebbles and cobbles
107	**HIGH**	57.582339	-11.388924	*Caryophyllia* sp.	deep cup coral gardens	1762	pebbles and cobbles
108	**HIGH**	57.58243	-11.388921	*Caryophyllia* sp.	deep cup coral gardens	1762	pebbles and cobbles
109	**HIGH**	57.582493	-11.388775	*Caryophyllia* sp.	deep cup coral gardens	1761	pebbles and cobbles
110	**HIGH**	57.582528	-11.388674	*Caryophyllia* sp.	deep cup coral gardens	1761	pebbles and cobbles
111	**HIGH**	57.582586	-11.388539	*Caryophyllia* sp.	deep cup coral gardens	1761	pebbles and cobbles

112	**HIGH**	57.582683	-11.388496	*Caryophyllia* sp.	deep cup coral gardens	1761	pebbles and cobbles
113	**HIGH**	57.582726	-11.388276	*Caryophyllia* sp.	deep cup coral gardens	1761	pebbles and cobbles
114	**HIGH**	57.582791	-11.388215	*Caryophyllia* sp.	deep cup coral gardens	1760	pebbles and cobbles
115	**HIGH**	57.582886	-11.388045	*Caryophyllia* sp.	deep cup coral gardens	1760	pebbles and cobbles
116	**HIGH**	57.582957	-11.387889	*Caryophyllia* sp.	deep cup coral gardens	1759	pebbles and cobbles
117	**HIGH**	57.583056	-11.387887	*Caryophyllia* sp.	deep cup coral gardens	1758	pebbles and cobbles
118	**HIGH**	57.583106	-11.387764	*Caryophyllia* sp.	deep cup coral gardens	1758	pebbles and cobbles
119	**HIGH**	57.583167	-11.387621	*Caryophyllia* sp.	deep cup coral gardens	1757	pebbles and cobbles
120	**HIGH**	57.583249	-11.387412	*Caryophyllia* sp.	deep cup coral gardens	1757	pebbles and cobbles
121	**HIGH**	57.583337	-11.38733	*Caryophyllia* sp.	deep cup coral gardens	1757	pebbles and cobbles
122	**HIGH**	57.583473	-11.387042	*Caryophyllia* sp.	deep cup coral gardens	1756	pebbles and cobbles
123	**HIGH**	57.583622	-11.386916	*Caryophyllia* sp.	deep cup coral gardens	1756	pebbles and cobbles
124	**HIGH**	57.583715	-11.386829	*Caryophyllia* sp.	deep cup coral gardens	1756	pebbles and cobbles
125	**HIGH**	57.583702	-11.386734	*Caryophyllia* sp.	deep cup coral gardens	1756	pebbles and cobbles
126	**HIGH**	57.583743	-11.386633	*Caryophyllia* sp.	deep cup coral gardens	1755	pebbles and cobbles
130	**HIGH**	57.465935	-10.834137	?*Pliobothrus*	lace coral gardens	810	pebbles and cobbles
Hatton Bank							
2	**MEDIUM**	59.259036	-15.452171	Antipatharia	black coral gardens	500*	mixed sediment*
3	**MEDIUM**	59.401792	-16.067119	Antipatharia	black coral gardens	1100*	rock*
4	**MEDIUM**	59.445717	-17.099353	Antipatharia	black coral gardens	1000*	coarse sediment*
5	**MEDIUM**	59.182168	-17.868037	Antipatharia	black coral gardens	1400*	rock*
6	**MEDIUM**	58.611145	-17.988831	Antipatharia	black coral gardens	700*	mixed sediment*
7	**MEDIUM**	58.764882	-18.384154	Antipatharia	black coral gardens	800*	rock*
8	**MEDIUM**	58.764882	-18.812422	Antipatharia	black coral gardens	1000*	rock*
9	**MEDIUM**	58.918619	-18.812422	Antipatharia	black coral gardens	1300*	coarse sediment*
10	**MEDIUM**	58.11699	-19.119895	Antipatharia	black coral gardens	1100*	mixed sediment*
14	**MEDIUM**	59.423683	-15.204225	gorgonian	gorgonian coral gardens	1100*	mixed sediment*
15	**MEDIUM**	59.519676	-15.931025	gorgonian	gorgonian coral gardens	1500*	mixed sediment*
16	**LOW**	59.361974	-16.212146	gorgonian	gorgonian coral gardens	700*	rock*
17	**MEDIUM**	59.581385	-16.760674	gorgonian	gorgonian coral gardens	1500*	coarse sediment*
18	**MEDIUM**	59.355117	-17.329772	gorgonian	gorgonian coral gardens	1100*	coarse sediment*
19	**LOW**	59.224842	-17.247493	gorgonian	gorgonian coral gardens	800*	mixed sediment*
20	**LOW**	58.696883	-17.226923	gorgonian	gorgonian coral gardens	1100*	mud and sandy mud*
21	**LOW**	58.731166	-17.549184	gorgonian	gorgonian coral gardens	1000*	mixed sediment*

22	**LOW**	58.525468	-17.727455	gorgonian	gorgonian coral gardens	900*	mixed sediment*
23	**LOW**	58.525468	-17.823448	gorgonian	gorgonian coral gardens	800*	mixed sediment*
24	**LOW**	58.285487	-17.946867	gorgonian	gorgonian coral gardens	800*	mixed sediment*
25	**LOW**	57.743815	-17.425765	gorgonian	gorgonian coral gardens	1200*	mud and sandy mud*
26	**MEDIUM**	57.791812	-17.96058	gorgonian	gorgonian coral gardens	1100*	mixed sediment*
27	**LOW**	58.525468	-18.150096	gorgonian	gorgonian coral gardens	600*	mixed sediment*
28	**LOW**	58.68317	-18.273515	gorgonian	gorgonian coral gardens	600*	rock*
29	**MEDIUM**	59.080853	-18.321512	gorgonian	gorgonian coral gardens	1400*	coarse sediment*
30	**MEDIUM**	58.882012	-18.897466	gorgonian	gorgonian coral gardens	1300*	coarse sediment*
31	**MEDIUM**	58.820302	-18.993459	gorgonian	gorgonian coral gardens	1300*	coarse sediment*
32	**LOW**	58.258061	-18.410647	gorgonian	gorgonian coral gardens	800*	mixed sediment*
33	**LOW**	58.676314	-18.568349	gorgonian	gorgonian coral gardens	700*	rock*
34	**LOW**	57.462695	-18.938606	gorgonian	gorgonian coral gardens	1100*	mud and sandy mud*
35	**LOW**	57.688963	-18.458644	gorgonian	gorgonian coral gardens	800*	mixed sediment*
36	**LOW**	57.579257	-19.075738	gorgonian	gorgonian coral gardens	800*	mixed sediment*
37	**LOW**	57.709532	-19.158017	gorgonian	gorgonian coral gardens	900*	mixed sediment*
38	**LOW**	57.65468	-19.27458	gorgonian	gorgonian coral gardens	1000*	mixed sediment*
39	**LOW**	57.517547	-19.219727	gorgonian	gorgonian coral gardens	900*	mixed sediment*
40	**LOW**	57.373559	-19.260866	gorgonian	gorgonian coral gardens	1000*	mixed sediment*
41	**MEDIUM**	57.462695	-20.15715	gorgonian	gorgonian coral gardens	1200*	mixed sediment*
142	**HIGH**	59.180150	-17.125992	?*Pliobothrus*	lace coral gardens	491	bedrock
143	**HIGH**	59.161977	-17.104869	?*Pliobothrus*	lace coral gardens	491	bedrock
144	**HIGH**	59.161804	-17.104586	?*Pliobothrus*	lace coral gardens	491	bedrock
145	**HIGH**	59.161638	-17.104419	?*Pliobothrus*	lace coral gardens	491	bedrock
146	**HIGH**	59.161559	-17.104299	?*Pliobothrus*	lace coral gardens	491	bedrock
147	**HIGH**	59.162739	-17.105831	?*Pliobothrus*	lace coral gardens	491	bedrock
148	**HIGH**	59.162653	-17.105712	?*Pliobothrus*	lace coral gardens	491	bedrock
149	**HIGH**	59.16263	-17.105666	?*Pliobothrus*	lace coral gardens	491	bedrock
150	**HIGH**	59.162681	-17.105607	?*Pliobothrus*	lace coral gardens	491	bedrock
151	**HIGH**	59.162619	-17.105626	?*Pliobothrus*	lace coral gardens	491	bedrock
152	**HIGH**	59.162545	-17.105554	?*Pliobothrus*	lace coral gardens	491	bedrock
153	**HIGH**	59.162422	-17.105489	?*Pliobothrus*	lace coral gardens	491	bedrock
154	**HIGH**	59.162243	-17.105234	?*Pliobothrus*	lace coral gardens	491	bedrock

155	**HIGH**	58.758172	-18.07623	?*Pliobothrus*	lace coral gardens	538	cobbles and boulders
156	**HIGH**	58.758147	-18.076053	?*Pliobothrus*	lace coral gardens	538	cobbles and boulders
157	**HIGH**	58.758095	-18.076016	?*Pliobothrus*	lace coral gardens	538	
158	**HIGH**	58.756826	-18.073259	?*Pliobothrus*	lace coral gardens	562	bedrock
159	**HIGH**	58.756577	-18.073104	?*Pliobothrus*	lace coral gardens	562	bedrock
160	**HIGH**	58.756418	-18.072852	?*Pliobothrus*	lace coral gardens	562	bedrock
161	**HIGH**	58.75635	-18.072632	?*Pliobothrus*	lace coral gardens	562	bedrock
171	**HIGH**	59.118661	-16.737917	*Stichopathes* cf *gravieri*	black coral gardens	616	coral rubble
172	**HIGH**	59.130479	-16.741525	*Stichopathes* cf *gravieri*	black coral gardens	618	coral rubble
173	**HIGH**	59.130389	-16.741482	*Stichopathes* cf *gravieri*	black coral gardens	618	coral rubble
174	**HIGH**	59.130299	-16.741431	*Stichopathes* cf *gravieri*	black coral gardens	618	coral rubble
175	**HIGH**	59.130199	-16.741377	*Stichopathes* cf *gravieri*	black coral gardens	619	coral rubble
176	**HIGH**	59.130113	-16.741326	*Stichopathes* cf *gravieri*	black coral gardens	620	coral rubble
177	**HIGH**	59.12857	-16.740564	*Stichopathes* cf *gravieri*	black coral gardens	665	boulders and cobbles
178	**HIGH**	59.128482	-16.740502	*Stichopathes* cf *gravieri*	black coral gardens	665	boulders and cobbles
Rockall Bank							
13	**LOW**	58.395193	-14.436285	gorgonian	gorgonian coral gardens	800*	sand and muddy sand*
179	**HIGH**	57.297287	-12.865354	*Caryophyllia* sp.	deep cup coral gardens	1365	sand
180	**HIGH**	57.297521	-12.864957	*Caryophyllia* sp.	deep cup coral gardens	1364	sand
181	**HIGH**	57.29768	-12.86466	*Caryophyllia* sp.	deep cup coral gardens	1364	sand
182	**HIGH**	57.297801	-12.864406	*Caryophyllia* sp.	deep cup coral gardens	1364	sand
183	**HIGH**	57.297842	-12.864262	*Caryophyllia* sp.	deep cup coral gardens	1363	sand
184	**HIGH**	57.297021	-12.864262	*Caryophyllia* sp.	deep cup coral gardens	1365	boulders and cobbles

185	**HIGH**	57.296945	-12.864333	*Caryophyllia* sp.	deep cup coral gardens	1366	boulders and cobbles
186	**HIGH**	57.296892	-12.864355	*Caryophyllia* sp.	deep cup coral gardens	1366	boulders and cobbles
187	**HIGH**	57.296043	-12.865533	*Caryophyllia* sp.	deep cup coral gardens	1396	sand
188	**HIGH**	57.295949	-12.865693	*Caryophyllia* sp.	deep cup coral gardens	1401	sand
189	**HIGH**	57.295896	-12.865786	*Caryophyllia* sp.	deep cup coral gardens	1404	sand
190	**HIGH**	57.295799	-12.86587	*Caryophyllia* sp.	deep cup coral gardens	1407	sand
191	**HIGH**	57.295715	-12.865973	*Caryophyllia* sp.	deep cup coral gardens	1409	sand
192	**HIGH**	57.295634	-12.866127	*Caryophyllia* sp.	deep cup coral gardens	1411	sand
193	**HIGH**	57.295568	-12.866216	*Caryophyllia* sp.	deep cup coral gardens	1413	sand
194	**HIGH**	57.295419	-12.866362	*Caryophyllia* sp.	deep cup coral gardens	1414	boulders and cobbles
195	**HIGH**	57.295344	-12.866498	*Caryophyllia* sp.	deep cup coral gardens	1415	boulders and cobbles
196	**HIGH**	57.295272	-12.866552	*Caryophyllia* sp.	deep cup coral gardens	1417	boulders and cobbles
197	**HIGH**	57.29523	-12.866585	*Caryophyllia* sp.	deep cup coral gardens	1418	boulders and cobbles
198	**HIGH**	57.295165	-12.866731	*Caryophyllia* sp.	deep cup coral gardens	1419	boulders and cobbles
199	**HIGH**	57.295054	-12.866772	*Caryophyllia* sp.	deep cup coral gardens	1420	boulders and cobbles
200	**HIGH**	57.294996	-12.866887	*Caryophyllia* sp.	deep cup coral gardens	1420	boulders and cobbles
201	**HIGH**	57.294922	-12.866985	*Caryophyllia* sp.	deep cup coral gardens	1421	boulders and cobbles
202	**HIGH**	57.29483	-12.867063	*Caryophyllia* sp.	deep cup coral gardens	1422	pebbles
203	**HIGH**	57.294732	-12.867194	*Caryophyllia* sp.	deep cup coral gardens	1423	pebbles
204	**HIGH**	57.294666	-12.867273	*Caryophyllia* sp.	deep cup coral gardens	1423	pebbles
205	**HIGH**	57.294214	-12.867741	*Caryophyllia* sp.	deep cup coral gardens	1427	sand
206	**HIGH**	57.294124	-12.867881	*Caryophyllia* sp.	deep cup coral gardens	1428	sand
207	**HIGH**	57.294075	-12.867922	*Caryophyllia* sp.	deep cup coral gardens	1428	sand
208	**HIGH**	57.294005	-12.86803	*Caryophyllia* sp.	deep cup coral gardens	1428	sand
209	**HIGH**	57.293943	-12.86804	*Caryophyllia* sp.	deep cup coral gardens	1428	sand

210	**HIGH**	57.293592	-12.868508	*Caryophyllia* sp.	deep cup coral gardens	1431	sand
211	**HIGH**	57.293476	-12.86856	*Caryophyllia* sp.	deep cup coral gardens	1432	sand
212	**HIGH**	57.293434	-12.868704	*Caryophyllia* sp.	deep cup coral gardens	1434	sand
213	**HIGH**	57.293079	-12.868997	*Caryophyllia* sp.	deep cup coral gardens	1436	sand
214	**HIGH**	57.293013	-12.8691	*Caryophyllia* sp.	deep cup coral gardens	1435	sand
215	**HIGH**	57.292952	-12.869162	*Caryophyllia* sp.	deep cup coral gardens	1435	sand
216	**HIGH**	57.29286	-12.869258	*Caryophyllia* sp.	deep cup coral gardens	1434	sand
217	**HIGH**	57.291239	-12.871038	*Caryophyllia* sp.	deep cup coral gardens	1440	sand
218	**HIGH**	57.291171	-12.871077	*Caryophyllia* sp.	deep cup coral gardens	1440	sand
219	**HIGH**	57.291091	-12.871198	*Caryophyllia* sp.	deep cup coral gardens	1440	sand
220	**HIGH**	57.520564	-12.845132	*Caryophyllia* sp.	deep cup coral gardens	1197	boulders and cobbles
221	**HIGH**	57.520491	-12.845189	*Caryophyllia* sp.	deep cup coral gardens	1200	sand
222	**HIGH**	57.520402	-12.845239	*Caryophyllia* sp.	deep cup coral gardens	1202	sand
223	**HIGH**	57.518235	-12.846869	*Caryophyllia* sp.	deep cup coral gardens	1237	sand
224	**HIGH**	57.518187	-12.84694	*Caryophyllia* sp.	deep cup coral gardens	1240	sand
225	**HIGH**	57.518109	-12.847016	*Caryophyllia* sp.	deep cup coral gardens	1241	sand
226	**HIGH**	57.518009	-12.847087	*Caryophyllia* sp.	deep cup coral gardens	1243	sand
227	**HIGH**	57.517854	-12.847243	*Caryophyllia* sp.	deep cup coral gardens	1246	sand
228	**HIGH**	57.517763	-12.847316	*Caryophyllia* sp.	deep cup coral gardens	1248	sand
229	**HIGH**	57.517669	-12.84739	*Caryophyllia* sp.	deep cup coral gardens	1249	sand
230	**HIGH**	57.517575	-12.847453	*Caryophyllia* sp.	deep cup coral gardens	1251	sand
231	**HIGH**	57.517493	-12.847516	*Caryophyllia* sp.	deep cup coral gardens	1253	sand
232	**HIGH**	57.517466	-12.847526	*Caryophyllia* sp.	deep cup coral gardens	1255	sand
233	**HIGH**	57.517377	-12.847601	*Caryophyllia* sp.	deep cup coral gardens	1256	sand
234	**HIGH**	57.51729	-12.847682	*Caryophyllia* sp.	deep cup coral gardens	1258	sand
235	**HIGH**	57.517194	-12.847756	*Caryophyllia* sp.	deep cup coral gardens	1259	sand
236	**HIGH**	57.517094	-12.847829	*Caryophyllia* sp.	deep cup coral gardens	1261	sand
237	**HIGH**	57.517008	-12.847898	*Caryophyllia* sp.	deep cup coral gardens	1262	sand
238	**HIGH**	57.51692	-12.847974	*Caryophyllia* sp.	deep cup coral gardens	1264	sand
239	**HIGH**	57.516822	-12.848038	*Caryophyllia* sp.	deep cup coral gardens	1265	sand
240	**HIGH**	57.516722	-12.848114	*Caryophyllia* sp.	deep cup coral gardens	1266	sand
241	**HIGH**	57.516691	-12.848151	*Caryophyllia* sp.	deep cup coral gardens	1267	sand
242	**HIGH**	57.516624	-12.848214	*Caryophyllia* sp.	deep cup coral gardens	1267	sand
243	**HIGH**	57.516526	-12.848288	*Caryophyllia* sp.	deep cup coral gardens	1266	sand

244	**HIGH**	57.516436	-12.848363	*Caryophyllia* sp.	deep cup coral gardens	1267	sand
245	**HIGH**	57.516284	-12.848489	*Caryophyllia* sp.	deep cup coral gardens	1267	boulders and cobbles
246	**HIGH**	57.516196	-12.848563	*Caryophyllia* sp.	deep cup coral gardens	1266	sand
247	**HIGH**	57.515998	-12.848705	*Caryophyllia* sp.	deep cup coral gardens	1266	sand
248	**HIGH**	57.515913	-12.848756	*Caryophyllia* sp.	deep cup coral gardens	1266	sand
249	**HIGH**	57.51585	-12.848803	*Caryophyllia* sp.	deep cup coral gardens	1265	sand
250	**HIGH**	57.515802	-12.848863	*Caryophyllia* sp.	deep cup coral gardens	1265	sand
251	**HIGH**	57.515716	-12.848969	*Caryophyllia* sp.	deep cup coral gardens	1262	sand
252	**HIGH**	57.515636	-12.849038	*Caryophyllia* sp.	deep cup coral gardens	1261	sand
253	**HIGH**	57.515581	-12.849092	*Caryophyllia* sp.	deep cup coral gardens	1259	sand
254	**HIGH**	57.515499	-12.849166	*Caryophyllia* sp.	deep cup coral gardens	1257	sand
255	**HIGH**	57.515412	-12.849243	*Caryophyllia* sp.	deep cup coral gardens	1255	sand
256	**HIGH**	57.515337	-12.849291	*Caryophyllia* sp.	deep cup coral gardens	1254	sand
257	**HIGH**	57.514209	-12.850138	*Caryophyllia* sp.	deep cup coral gardens	1225	sand
258	**HIGH**	57.514134	-12.850154	*Caryophyllia* sp.	deep cup coral gardens	1223	sand
259	**HIGH**	57.51376	-12.850457	*Caryophyllia* sp.	deep cup coral gardens	1209	sand
260	**HIGH**	57.513665	-12.850538	*Caryophyllia* sp.	deep cup coral gardens	1207	sand
Long *et al* 2010	**HIGH**	57.19195	-13.18147	*Caryophyllia smithii*	shallow cup coral gardens	285	gravelly sand
Long *et al* 2010	**HIGH**	58.20690	-13.49833	*Stylaster* sp.	lace coral gardens	459	bedrock
Rockall Trough and Hebrides Continental Slope							
Roberts *et al* 2000	**HIGH**	58.9777	-7.9567	*Acanella arbuscula*, seapens	soft-bottom bamboo coral gardens	1295	fine silt
Hughes & Gage, 2004; D. Hughes, unpublished data	**HIGH**	58.1403	-12.5347	*Acanella arbuscula*	soft-bottom bamboo coral gardens	1900	fine silt and clay
Hughes & Gage, 2004; D. Hughes, unpublished data	**HIGH**	57.0833	-12.4167	*Acanella arbuscula*	soft-bottom bamboo coral gardens	1988	fine silt and clay

D. Hughes, unpublished data	**HIGH**	57.0067	-10.0089	*Acanella arbuscula*	soft-bottom bamboo coral gardens	2056	fine silt and clay
D. Hughes, unpublished data	**HIGH**	57.0019	-10.0183	*Acanella arbuscula*	soft-bottom bamboo coral gardens	2069	fine silt and clay

* Depth and substratum inferred from GEBCO bathymetry and UKSeaMap (McBreen *et al* 2011)

Appendix 2

Profiles of Coral Garden sub-types in UK waters

SOFT-BOTTOM BAMBOO CORAL-DOMINATED

SOFT-BOTTOM BAMBOO CORAL (*ACANELLA ARBUSCULA*) DOMINATED, WITH SEAPENS AND THE SOLITARY CORAL *FLABELLUM (ULOCYATHUS) ALABASTRUM*

Image	Characterising coral species
	Bamboo corals (*Acanella arbuscula*) Seapens Solitary scleractinians (*Flabellum (Ulocyathus) alabastrum*)

Sub-habitat characteristics

Technical description: *Acanella arbuscula* (SACFOR abundance category = Common; mean density 0.2-0.447 corals/m^2) with occasional seapens and *Flabellum* (*Ulocyathus*) *alabastrum*.

Environmental preferences: Occurs at depths of 1295-2069m, in water temperatures of around 3°C, and current speeds of 12 cm·s^{-1}. Found on fine silt/clays with active bioturbation.

Associated megafauna: *Acanella arbuscula* in very close association with the brittlestar *Ophiomusium lymani*. Other fauna include the agglutinated xenophyophore *Syringammina fragilissima*, occasional cerianthids and the burrowing anemone *Phelliactis robusta*.

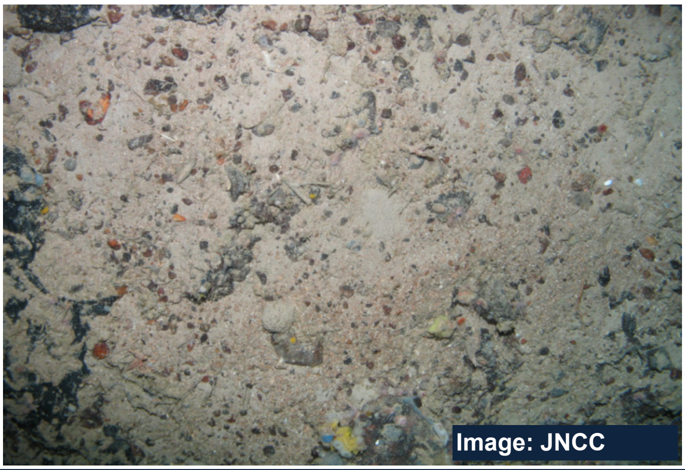
Scottish distribution: Hebridean continental slope across to the deep margins of the Rockall Trough

Information sources

Roberts *et al* 2000; Hughes & Gage, 2004; D. Hughes (Scottish Association for Marine Science, personal communication and unpublished data)

DEEP CUP CORAL-DOMINATED

CUP CORAL (*CARYOPHYLLIA* SPP.) DOMINATED, OCCASIONALLY WITH SEAPENS (*PENNATULA PHOSPHOREA*, *HALIPTERIS* SP.)

Image	Characterising coral species
 Image: JNCC	Cup corals (*Caryophyllia* spp.) Seapens (*Pennatula phosphorea*, *Halipteris* sp.)

Sub-habitat characteristics

Technical description: *Caryophyllia* spp. (SACFOR abundance category = Occasional; mean density 0.7893 corals/m^2) occasionally with seapens including *Pennatula phosphorea* and *Halipteris* sp. (SACFOR abundance category for both = Common; mean density 0.058 and 0.01 corals/m^2, respectively).

Environmental preferences: Occurs at depths of 1069-1769m. Found on substrata such as sand, pebbles, cobbles, and boulders. Can be distinguished from the *Acanella arbuscula*-dominated assemblage by the lack of *Acanella* and the different substrate type.

Associated megafauna: Associated fauna include the large xenophyophore *Syringammina fragilissima* (mean density 0.7717 individuals/m^2), cerianthids, and the large bird's nest sponge *Pheronema carpenteri*.

Scottish distribution: Anton Dohrn seamount, East Rockall Bank

Information sources

Stewart *et al* 2009; Long *et al* 2010; Bullimore *et al* (2013)

Shallow Cup coral-dominated	
Cup coral (*Caryophyllia smithii*) dominated coral garden	
Image	**Characterising coral species**
	Cup corals (*Caryophyllia smithii*)

Sub-habitat characteristics

Technical description: *Caryophyllia smithii* (SACFOR abundance category = Frequent; mean density 4.2395 corals/m^2).

Environmental preferences: Occurs at depths of 196-285m and in water temperatures of around 9.3-9.6°C. Substratum is composed of sands and gravelly sands.

Associated megafauna: Low diversity of associated megafauna: only the anemone *Actinauge richardi* is evident in photos (mean density 3.3159 individuals/m^2).

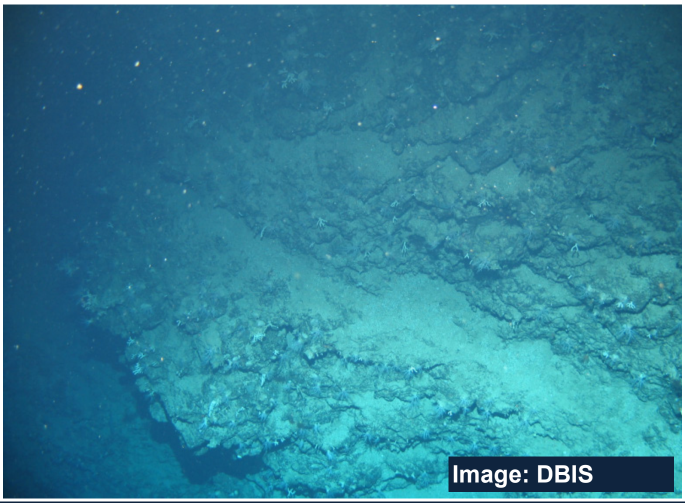
Scottish distribution: East Rockall Bank

Information sources

Long *et al* 2010

LACE CORAL-DOMINATED

STYLASTERID-DOMINATED (?*PLIOBOTHRUS* SP. OR *STYLASTER* SPP.) CORAL GARDEN

Image	**Characterising coral species**
	Stylasterid hydrocorals (*Pliobothrus* sp. or *Stylaster* spp.)

Sub-habitat characteristics

Technical description: Stylasterid-dominated, including what appear to be *Pliobothrus* or *Stylaster* sp. (SACFOR abundance category = Frequent or Common, respectively; mean density = 0.5434 and 3.0604 corals/m^2, respectively) with occasional *Caryophyllia* sp. cup corals (SACFOR abundance category = frequent; mean density = 6.5566), and *Callogorgia verticillata* and *Madrepora oculata* colonies (SACFOR abundance category for both = Frequent; mean density 0.0943 corals/m^2).

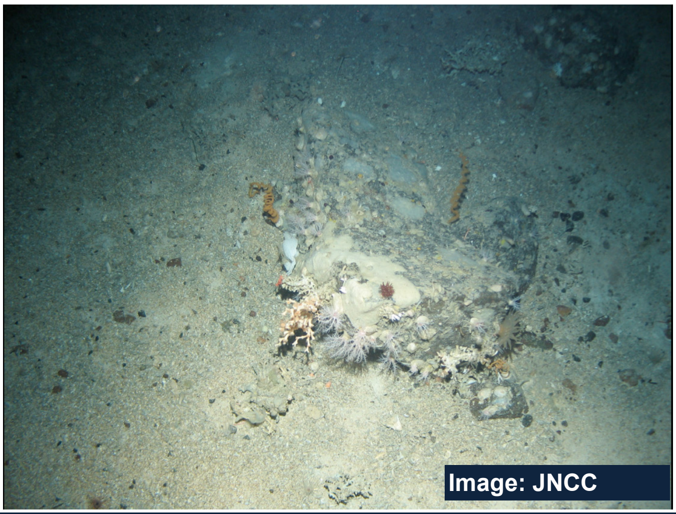
Environmental preferences: Occurs at depths of 471-811m. Substrata comprise sparsely distributed cobbles and boulders on sandy gravel substrata and exposed bedrock.

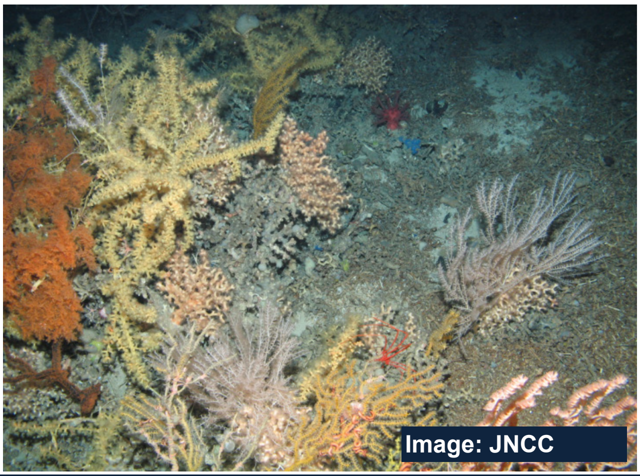
Associated megafauna: Associated fauna include cerianthids, the holothuroideans *Parastichopus tremulus* and *Psolus* sp., encrusting and lobed sponges, and pagurid hermit crabs.

Scottish distribution: Anton Dohrn, Hatton Bank, East Rockall Bank. This hard bottom Coral Garden sub-type and its associated fauna resemble the stylasterid assemblage described in Howell *et al* (2010a) on mixed substrata: this assemblage was found across a wide range of environmental conditions in waters 180-1054m deep and between -1 to 12°C. Thus the two assemblages may represent a broader habitat type associated with mixed hard bottoms wherein fauna such as *C. verticillata* and *M. oculata* associated with temperate Atlantic waters represent a form of ecological variation. However more quantitative analysis of the relative proportion of stylasterids in the latter assemblage must be analysed.

Information sources

Roberts *et al* 2008; Stewart & Davies, 2009; Howell *et al* 2010a; Long *et al* 2010; Bullimore *et al* 2013

BLACK CORAL-DOMINATED	
STICHOPATHES*-DOMINATED WITH SOFT CORALS INCLUDING *ANTHOMASTUS GRANDIFLORUS	
Image	**Characterising coral species**
 Image: JNCC	Antipatharian *Stichopathes* cf *gravieri* Soft coral *Anthomastus grandiflorus* *Lophelia pertusa*
Sub-habitat characteristics	
Technical description: *Stichopathes* cf *gravieri* dominated (SACFOR abundance category = Frequent; mean density 0.072 corals/m^2) with other less dominant antipatharians, as well as gorgonians and the alcyoniid *Anthomastus grandiflorus* alongside living but less frequent *Lophelia pertusa*. **Environmental preferences:** Occurs at depths of 211-1247m. Found on substrata such as gravelly sand, sandy gravel, cobble, boulder, coral rubble and bedrock. Could potentially grade into other OSPAR habitats such as *Lophelia pertusa* reefs. **Associated megafauna:** Rich associated biodiversity including the conspicuous orange anemone *Phelliactis* sp., *Cidaris cidaris*, brisingid echinoderms and globular sponges. **Scottish distribution**: George Bligh Bank; Hatton Bank, East Rockall Bank	
Information sources	
Narayanaswamy *et al* 2006; Roberts *et al* 2008; Howell *et al* 2010a; Long *et al* 2010	

GORGONIAN-DOMINATED	
GORGONIAN-DOMINATED, WITH SOFT CORALS, BAMBOO CORALS AND COLONIAL SCLERACTINIA	
Image	**Characterising coral species**
	Gorgonians (e.g. *Callogorgia verticillata*) Bamboo corals (*Keratoisis, Lepidisis*) Soft corals *Anthomastus grandiflorus* *Solenosmilia variabilis*, possibly some *Lophelia pertusa* and *Madreopora oculata*

Sub-habitat characteristics

Technical description: Gorgonian-dominated (SACFOR abundance category = Common; mean density 0.1425-0.7775 corals/m^2), with less dominant *Callogorgia verticillata* (SACFOR abundance category = Frequent; mean density 0.044 corals/m^2), the soft coral *Anthomastus grandiflorus* (SACFOR abundance category = Common; mean density 0.548 corals/m^2) and bamboo corals such as *Keratoisis* spp. and *Lepidisis* sp. (SACFOR abundance category = Frequent; mean densities 0.026-0.059 and 0.033 corals/m^2, respectively). *Lophelia pertusa* and *Madrepora oculata* were reported to occur by Bullimore *et al* 2013 (SACFOR abundance category = Common; with mean densities of 0.5314 and 0.205 corals/m^2, respectively), but taxonomic review uncovered the main reef-building coral on Anton Dohrn to be *Solenosmilia variabilis* (the presence of *Lophelia* could not be confirmed; Henry and Roberts submitted).

Environmental preferences: Occurs at depths of 1316-1770m. Characterising gorgonians typically distributed on coral rubble, with less dominant Coral Garden taxa found more on gravel, sand, coral rubble and bedrock.

Associated megafauna: Rich associated fauna including blue encrusting sponges (likely *Hymedesmia* spp.), and rich echinoderm megafauna including the comatulid crinoid *Koehlermetra porrecta*, the urchin *Araeosoma fenestrum*, brisingids and *Ophiactis balli*.

Scottish distribution: Anton Dohrn, Hatton Bank, George Bligh Bank, East Rockall Bank

Information sources

Narayanaswamy *et al* 2006; Roberts *et al* 2008; Stewart *et al* 2009; Long *et al* 2010; Durán Muñoz *et al* 2011; Bullimore *et al* (2013), Henry & Roberts (submitted).