European Community Directive
on the Conservation of Natural Habitats
and of Wild Fauna and Flora
(92/43/EEC)

Second Report by the United Kingdom under Article 17

on the implementation of the Directive from January 2001 to December 2006

Conservation status assessment for :

H1170: Reefs

H1170 Reefs

Audit trail compiled and edited by JNCC and the UK Inter-Agency Marine Monitoring Group

This paper and accompanying appendices contain background information and data used to complete the standard EC reporting form (Annex D), following the methodology outlined in the commission document "Assessment, monitoring and reporting under Article 17 of the Habitats Directive, Explanatory Notes and Guidelines, Final Draft 5; October 2006". The superscript numbers below cross-reference to the headings in the corresponding Annex D reporting form. This supporting information should be read in conjunction with the UK approach for habitats (see 'Assessing Conservation Status: UK Approach').

1. National-Biogeographic Level Information

1.1 General description and correspondence with NVC and other habitat types

Table 1.1.1 provides a summary description of H1170 and its relations with UK classifications.

'Reefs' are rocky marine habitats or biological concretions that rise from the seabed. They are generally subtidal but may extend as an unbroken transition into the intertidal zone, where they are exposed to the air at low tide. Intertidal areas are only included within this Annex I type where they are connected to subtidal reefs. Reefs are very variable in form and in the communities that they support. Two main sub-types of reef can be recognised: those where animal and plant communities develop on rock or stable boulders and cobbles (rocky reefs), and those where structure is created by the animals themselves (biogenic reefs) (Jackson and McLeod, 2000, 2002).

Table 1.1.1 Summary description of habitat H1170 and its relationship to UK vegetation/habitat classifications

Classification	Habitats in the classification that correspond with Annex I type	Comments
EU Interpretation Manual	= H1170 Reefs	Reefs can be either biogenic concretions or of geogenic origin. They are hard compact substrata (rocky reefs) on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions (European Commission, 2006)
CSM reporting categories	Reefs, Littoral rock	These habitats may encompass the whole or only part of the Annex I type depending on the composition of the reef at an individual site
BAP priority habitat type	Littoral and sublittoral chalk *Sabellaria alveolata* reefs *Modiolus modiolus* beds *Sabellaria spinulosa* reefs *Lophelia pertusa* reefs Tidal rapids	These habitats may encompass the whole or only part of the Annex I type depending on the composition of the reef at an individual site

Rocky reefs are extremely variable, both in structure and in the communities they support. A wide range of topographical reef forms meet the EU definition of this habitat type. These range from vertical rock walls to horizontal ledges, sloping or flat bed rock, broken rock, boulder fields, and aggregations of cobbles. Reefs are characterised by communities of attached algae (where there is sufficient light – on the shore and in the shallow subtidal) and invertebrates, usually associated with a range of mobile animals, including invertebrates and fish. The specific communities that occur vary according to a number of factors. For example, rock type is important, with particularly distinct communities associated with chalk and limestone. There may be further variety associated with topographical features such as vertical rock walls, gully and canyon systems, outcrops from sediment, and rockpools on the shore (Jackson and McLeod, 2000, 2002).

'Reefs' are often associated with other marine Annex I features, and may also grade into the Annex I feature H1230 'Vegetated sea cliffs of the Atlantic and Baltic coasts on the coast'.

2. Range [2.3]

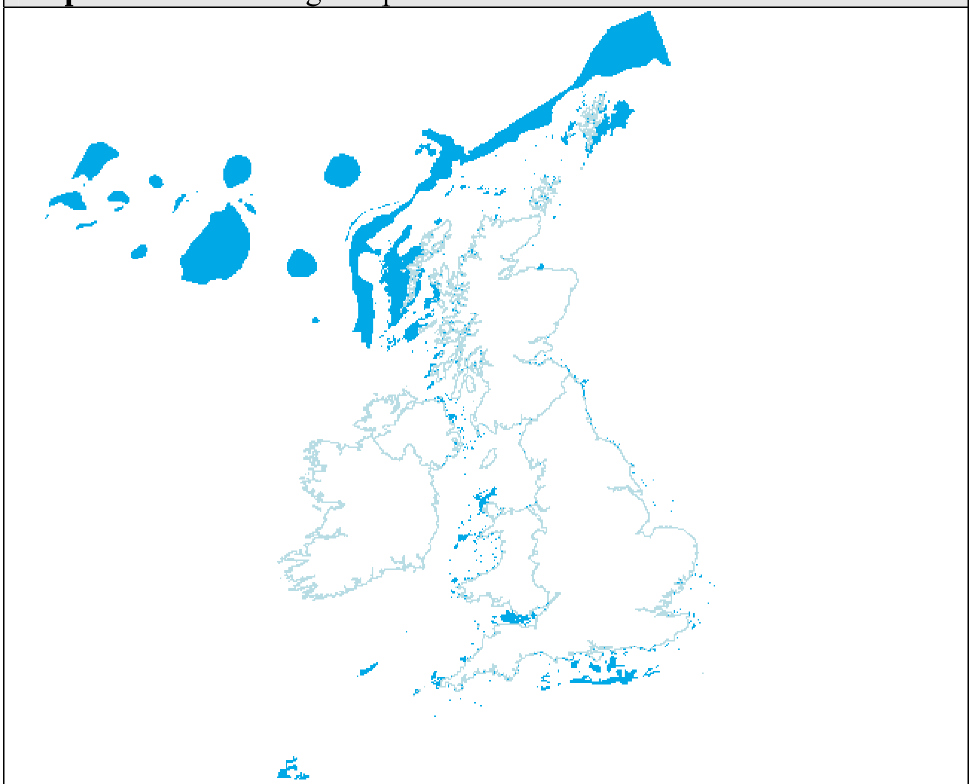
2.1 Current range

Range surface area[2.3.1]: **96,981 km²**
Date calculated[2.3.2]: **May 2007**
Quality of data [2.3.3]: **Poor**

Maps 2.1.1 and 2.1.2 show the range and distribution of H1170 in the UK.

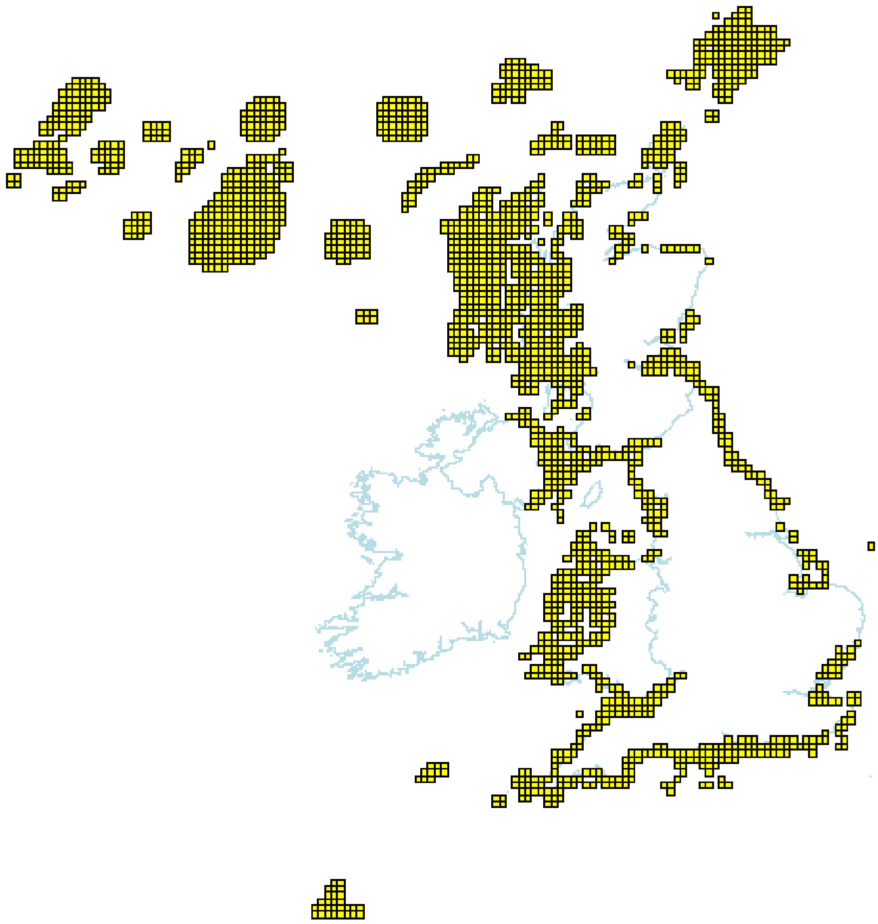
The range surface area figure is an estimate derived from mapping data in the JNCC Marine Recorder database. This database covers surveys conducted in inshore (within 12 nautical miles of the shore) waters and offshore surveys conducted by the British Geological Survey (BGS)). Inshore survey points were given a buffer of 500 m and added to the areas derived from the BGS categories of Rock, Cobble and Biogenic Reef (Graham, *et al*, 2001). Hence, the estimate is "based on partial data with some extrapolation". Map 2.1.1 includes the "Iceberg Ploughmarks" area which is known to incorporate cobble reefs, Map 2.1.2 does not include this area, as the cobble reefs within this have yet to be exactly located and mapped.

Map 2.1.1 Habitat range map [1.1] for H1170



This map is based on an extended OS 10-km square grid map. As the grid has been extended North and West it has been distorted due to the projection. The map should therefore be taken as indicative only.

Map 2.1.2 Habitat distribution map [1,2] for H1170



As above, this map is based on an extended OS 10-km square grid map. As the grid has been extended North and West it has been distorted due to the projection. The map should therefore be taken as indicative only.

Rocky Reef:
The true range of rocky reefs in the UK is unknown. The only indicator of the possible occurrence of inshore reefs is the length of intertidal rocky shores; subtidal reefs may or may not be contiguous with these. No comprehensive verified data are available for offshore reefs.

Biogenic reef:
Sabellaria alveolata reefs are a southern phenomenon reaching their northerly limit within Britain, the range is generally southern and western with reefs not found east of Lyme Regis in the English Channel (Holt *et al*, 1998).

Sabellaria spinulosa is naturally common around the British Isles although it is limited to areas with very high levels of suspended sediment (UKBAP, 2006b; Holt *et al*, 1998). In most parts of its geographical range *S. spinulosa* does not form reefs, but is solitary or in small groups encrusting pebbles, shell, kelp holdfasts and bedrock (UKBAP, 2006b). There are only five known areas of well developed *S. spinulosa* reef in UK waters (JNCC, 2004). Saturn Reef in the North Sea and the reefs partly within the Wash and North Norfolk SAC are the best developed examples. The scarcity of the habitat is believed to be in part attributable to its vulnerability to damage from bottom trawling (JNCC, 2004).

Mytilus edulis reefs appear to be widespread throughout Britain though the best examples are limited to large shallow inlets, bays and estuaries. *M. edulis* can be abundant in intertidal and sometimes subtidal habitats, ranging from fully saline to highly estuarine, and again over much of this range it is capable of forming dense beds, which could justifiably be called biogenic reefs (Holt *et al*, 1998). Areas which contain or may contain true reef include the Lindisfarne and Budle Bay estuary area, The Wash and the Burry Inlet. In many places such as the Lleyn Peninsula areas of sublittoral beds of *Mytilus* are unlikely to constitute true biogenic reefs (Holt *et al*, 1998).

Modiolus modiolus is a northern species and within Britain it is a widespread and common species, true beds forming a distinctive biotope are much more limited and are not known south of the Humber and Severn estuaries (Holt *et al*, 1998, UKBAP, 2006c). Beds are known from Shetland, Orkney, the Hebrides and other parts of western Scotland, the Ards Peninsula, Strangford Lough, off both ends of the Isle of Man, off north-west Anglesey and north of the Lleyn Peninsula. Dense beds of young *M. modiolus* also occur in the Bristol Channel but often seem not to survive to adulthood. Off North Sea coasts occasional beds occur between Berwickshire and the Humber, and probably elsewhere. Some beds may be self-maintaining relict features (UKBAP, 2006c).

Serpula vermicularis reefs are currently known from Loch Creran (Holt *et al*, 1998, UKBAP, 2006d), and new aggregations were discovered in 2006 in Loch Teacuis which will probably be extensive enough to be classed as reef (Laura Baxter, pers. comm.).

Estimating the current distribution of *Lophelia pertusa* is complicated by the difficulties encountered in detecting and sampling the discrete patches of *L. pertusa* that are scattered over wide areas of the seabed, on offshore banks and steep continental slopes (UKBAP, 2006e). *L. pertusa* has been found frequently in small colonies from north of the Shetlands to the far west of Rockall with the majority of the findings from Rockall westwards (Wilson 1979). However, in some areas, larger colonies of coral have been found, e.g. Hatton Bank, where sidescan sonar has identified features c. 30 m high as possibly being coral reefs, and on the Rockall Plateau (Long *et al*. 1999). The Darwin Mounds reefs were found using remote sensing techniques in May 1998 located at a depth of about 1000m in the north-east corner of the Rockall trough, immediately south of the Wyville-Thomson Ridge.

2.2 Trend in range since c.1994

Reefs are composed of two main sub-types; Rocky Reef and Biogenic Reef. Rocky reef accounts for around 99% by area of the known resource. Trend information is separated into the two categories below, as there is real concern that the status of Biogenic reefs should be highlighted. However, as rocky reef is the most numerically dominant category, this information has been transferred to Annex D.

Rocky reef:

Trend in range[2.3.4]: **Stable**
Trend magnitude[2.3.5]: **Not applicable**
Trend period[2.3.6]: **1994-2006**
Reasons for reported trend[2.3.7]: **Not applicable**

Rocky reef is defined by its substratum rather than by a specific biological community; its range is therefore determined by physical and geological processes. While the physical area of some individual reefs may have declined due to localised pressures, the geographic spread and distribution of this feature type is unchanged as the range of rocky substratum has not been reduced.

Biogenic reef:

Trend in range: **Unknown**
Trend magnitude: **Not applicable**
Trend period: **1994-2006**
Reasons for reported trend: **Not applicable**

Due to the lack of data for biogenic reefs the trends are not known. While there is evidence of range reductions for some species (e.g. significant contraction in range of *Sabellaria alveolata* on the south coast of England and declines have also been reported in the western part of the north Cornish coast, the upper parts of the Bristol Channel and in North Wales and the Dee Estuary) it is difficult to assess the true significance of these changes given the natural variability of the species. For example, *S. alveolata* reefs have developed off Heysham (in Morecambe Bay), dominating two hectares of boulder scar from where it had been absent for 30 years (UKBAP, 2006a). In addition, while *Serpula vermicularis* reefs in Loch Sween died between 1982 and the mid 1990s and declined in Loch Creran (Holt *et al*, 1998, UKBAP, 2006d), new Serpulid aggregations were discovered in 2006 in Loch Teacuis which will probably be extensive enough to be classed as reef (Laura Baxter, pers. comm.).

2.3 Favourable reference range

Favourable reference range[2.5.1]: Unknown

The majority of the 'reef' feature is composed of rocky reefs which are widely distributed and composed of robust species. Thus the current range of the feature probably covers most of its potential range, with adequate provision for the full range of ecological variation. Although many individual biogenic reefs may have suffered declines due to anthropogenic impacts (see 2.2 and 3.2) we do not know how this has affected their overall distribution.. In conclusion, as we can only estimate the range of the feature, it is not possible to give a favourable reference range.

2.4 Conclusions on range

Conclusion[2.6.i]: Unknown

The range figures given here are estimates based on partial data with some extrapolation, and true range of reefs in the UK is therefore unknown. There are no trend data. While there are reports of range reductions for some biogenic reef types these only comprise a small proportion of the overall resource.

NOTE: Proportionally, rocky reef far outweighs biogenic reef in terms of area covered by range. But, if working on the numbers alone and taking into account the lack of definitive data for the location of reefs, it is likely that reef would be favourable overall. Biogenic reefs are known to have been impacted and are more sensitive to anthropogenic impacts than rocky reefs. Ideally these should be reported separately as they are of particular concern.

3. Area [2.4]

3.1 Current area

Total UK extent [2.4.1]: 57, 236 km^2
Date of estimation [2.4.2]: May 2007
Method [2.4.3]: 2 = based on remote sensing data
Quality of data [2.4.4]: Moderate

Table 3.1.1 provides information on the area of H1170 in the UK.

The true extent of reefs in the UK is unknown. The only indicator of the possible occurrence of inshore reefs is the length of intertidal rocky shores; subtidal reefs may or may not be contiguous with these. No verified extent data are available for offshore reefs. For the derivation of the figure given below see 2.1.

Table 3.1.1 Area of H1170 in the UK

	Area km^2	Method [2.4.3]	Quality of data [2.4.4.]
England	Present	Not applicable	Not applicable
Scotland	Present	Not applicable	Not applicable
Wales	Present	Not applicable	Not applicable

Northern Ireland	Present	Not applicable	Not applicable
Total UK extent [2.4.1.]	57, 236	2	Poor

Method used to estimate the habitat surface area: 1 = only or mostly based on expert opinion; 2 = based on remote sensing data; 3 = ground based survey. Only the most relevant class is given if more than one applies.
Quality of habitat surface area data: 'Good' e.g. based on extensive surveys; 'Moderate' e.g. based on partial data with some extrapolation; 'Poor' e.g. based on very incomplete data or on expert judgement

3.2 Trend in area since c.1994

Reefs are composed of two main sub-types; rocky reef and biogenic reef. Rocky reef accounts for around 99% by area of the known resource. Trend information is separated into the two categories below, as there is real concern that the status of biogenic reefs should be highlighted. However, as rocky reef is the most numerically dominant category, this information has been transferred to Annex D

Rocky Reef:
Trend in area: **Stable**
Trend magnitude: **Not applicable**
Trend period: **1994-2006**
Reasons for reported trend: **Not applicable**
There are no trend data for rocky reefs. However, as the area they cover is so large and their communities robust or naturally highly changeable, there is unlikely to be a significant downward trend in terms of area for rocky reef. This is not to say that the communities within that area have not been altered by direct or indirect pressures, but reef in some form will remain.

Biogenic reef:
Trend in area: **Unknown**
Trend magnitude: **Not applicable**
Trend period: **1994-2006**
Reasons for reported trend: **Not applicable**
There is evidence of declines in the area of several biogenic reef species, although in most cases it has not been possible to define the period of decline nor the extent of reef affected:

Lophelia pertusa – In 2001 sidescan sonar survey images and seabed photography both suggested that the Darwin Mounds area had been subject to considerable commercial trawling with resultant apparent damage to the deep-water coral ecosystems. There was abundant evidence of benthic trawling over mounds and in the intervening seabed. Some areas were 100 % trawled (Bett *et al*, 2001).

Modiolus modiolus – In Strangford Lough there was a 3.7 km^2 reduction in clumped Modiolus communities between 1993 and 2000 (Roberts, 2003). There is also the possibility that fisheries have damaged reefs in the Shetland Voes (Holt *et al*, 1998) and the *Modiolus* beds at the Skerries, Northern Ireland were reported as no longer present in 2006 (Joe Breen, pers. comm., cited in OSPAR, 2007).

Sabellaria spinulosa reefs are widely reported to have been lost in areas where shrimp fishing occurs (Holt *et al*, 1998). Saturn reef in the English Channel, has already been partly damaged, most probably by trawling (JNCC, 2004). Since the above assessment in 2003, new survey work conducted in the same area for JNCC in 2006 found no substantial reef structures (Foster-Smith and Limpenny, pers comm.). Further research is under way: it is not known whether the disappearance of the reef structures is due to damage through bottom trawling or dredging; or whether reef structures formed by *Sabellaria spinulosa* are naturally ephemeral structures, building up over several years and then dying down (perhaps due to natural predation by, for example, starfish) (Foster-Smith and Limpenny, pers comm.).

When considering the area losses of biogenic reefs, the contribution of these to the area of feature H1170 overall has to be taken into account. Current estimates of area are that *S. alveolata* covers 400 ha (4 km^2) and *S. vermicularis* covers 108 ha (1.08 km^2) in total for the UK (UKBAP, 2006).

3.3 Favourable reference area

Favourable reference area[2.5.2]: Unknown

The area figure given in 3.1 is an estimate based on data derived from a combination of field methods (acoustic with ground truthing, diver/video survey etc) that was then interpolated and buffered in GIS.

Map 2.1.1 includes the "Iceberg Ploughmarks" area which is known to incorporate cobble reefs; these have yet to be exactly located and mapped. This area is responsible for most of the difference between the Range and the Area estimates (c. 39 000 km^2). Given such a large area it is therefore highly likely that this contains a substantial area of reef and that the 57 236 km^2 (5 723 600 ha) area estimate is substantially below the true area.

A favourable reference area cannot therefore be derived from this figure and it should be only thought of as indicative.

3.4 Conclusions on area covered by habitat

Conclusion[2.6.ii]: Unknown

The area figures given here are estimates based on partial data with some extrapolation, and true area of reefs in the UK is therefore unknown. There has been a loss of area for some of the biogenic reef species; however, this is a small fraction of the total reef area.

NOTE: Proportionally, rocky reef far outweighs biogenic reef in terms of area. But, if working on the numbers alone and taking into account the lack of definitive data for the location of reefs, it is likely that reef would be Favourable (due to inherent robustness of rocky reef). Biogenic reefs are known to have been impacted and are more sensitive to anthropogenic impacts than rocky reefs. Ideally these should be reported separately as they are of particular concern.

4. Specific Structures and Functions (including typical species)

4.1 Main pressures [2.4.10]

200 Fish and Shellfish Aquaculture
210 Professional fishing
211 Fixed location fishing
212 Trawling
220 Leisure fishing
240 Taking / Removal of fauna, general
250 Taking / Removal of flora, general
400 Urbanised areas, human habitation
410 Industrial or commercial areas
420 Discharges
621 Nautical sports
690 Other leisure and tourism impacts not referred to above
720 Trampling, overuse
800 Landfill, land reclamation and drying out, general
851 Modification of marine currents
860 Dumping, depositing of dredged deposits
871 Sea defense or coast protection works
952 Eutrophication

940 Natural catastrophes
700 Pollution
701 Water pollution
954 Invasion by a species
960 Interspecific faunal relations
970 Interspecific floral relations
974 Genetic pollution

See 5.1 for full descriptions
- Fisheries (200, 210, 211, 212, 220, 240, 250)
- Coastal development and other disturbances (400, 410, 420, 621, 690,720, 800, 851, 860, 871)
- Offshore development and aggregate extraction (300, 510, 512)
- Pollution (952, 420, 700, 701)
- Non-Indigenous Species (954, 960, 970, 974)

4.2 Current condition

4.2.1 Common Standards Monitoring condition assessments

Condition assessments based on Common Standards Monitoring (see http://www.jncc.gov.uk/page-2199) provide a means to assess the structure and functioning of H1170 in the UK. The following attributes were examined for all CSM assessments relevant to the habitat:
- Extent (area)
- Biotope Composition
- Distribution and spatial pattern of biotopes

In addition site specific attributes were examined including:
- Presence of representative/notable biotopes
- Presence of representative/notable species

SAC condition assessments

Table 4.2.1 and Map 4.2.1 summarise the Common Standards Monitoring condition assessments for UK Special Areas of Conservation (SACs) supporting habitat H1170. These data were collated in January 2007 and are based on data collected in the period 2000-2006. The maps give an impression of the overall spread of where Unfavourable and Favourable sites exist (summary statistics for the map are given in Section 7.2.).

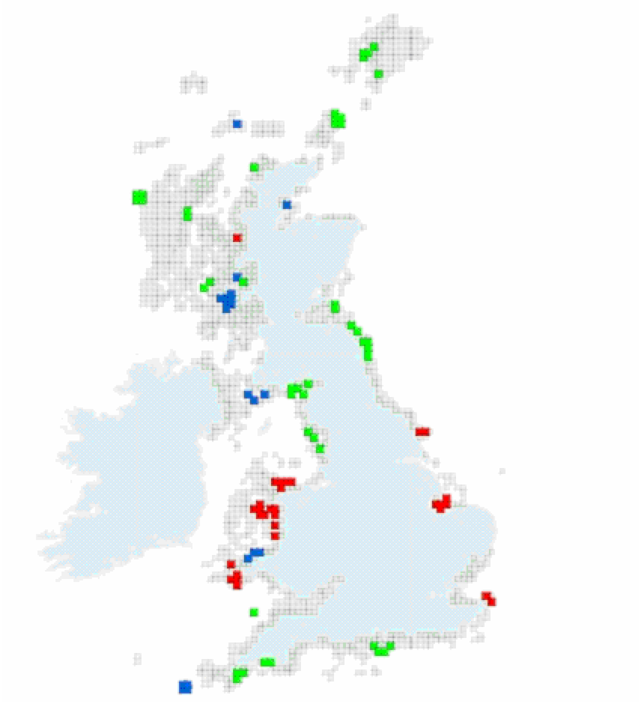
The combined assessments show that of the SACs assessed:
- 55% of the area and 29% of the number of assessments were Unfavourable;
- at least 1 % of the total UK 'reef' area was in Unfavourable condition.

Only a small fraction (2.3 %) of the total reef resource is encompassed in the SAC series and there are few widespread monitoring programmes, outside this series, that have data for 'reefs'. Even if all SACs had reported CSM results there would not be any justifiable case for scaling up these figures to a national scale.

Table 4.2.1 Common Standards Monitoring condition assessment results for UK SACs supporting H1170. See notes below table for details. Information on the coverage of these results is given in Section 7.2

Condition	**Condition sub-categories**	**Area (ha)**	**Number of site features**
Unfavourable	Declining	2,024	2
	No change	74,446	2
	Unclassified		
	Recovering	4,684	3
	Total	81,155	7
	% of all assessments	***55%***	***29%***
	% of total UK resource	***1%***	***unknown***
Favourable	Maintained	12,585	10
	Recovered		
	Unclassified	54,642	7
	Total	67,227	17
	% of all assessments	***45%***	***71%***
	% of total UK resource	***1%***	***unknown***

Notes
1. Data on features that have been partly-destroyed have been excluded from this table because they are not relevant to the consideration of present condition.
2. The data included are from CSM assessments carried out between April 1998 and December 2006. NB: these include additional and some up-date data form those used in the six year report produced by JNCC. (Williams, J.M., ed. 2006. *Common Standards Monitoring for Designated Sites: First Six Year Report*. Peterborough, JNCC)
3. Only assessments made for qualifying interest features on SAC have been included in this analysis.
4. Area figures for CSM assessments have been calculated using the data presented on the standard Natura 2000 data forms submitted to the EU.

Current Condition of H1170 based on Common Standard Monitoring condition assessments (See Sections 4.2 and 7.2 for further information)
Map 4.2.1 SAC assessments

Key: <u>Red = Unfavourable</u>, i.e. the square contains at least one SAC where this habitat feature is present and has been judged to be Unfavourable <u>Green = Favourable</u>, i.e. the square contains at least one SAC where this habitat feature is present and has been assessed as Favourable but there are no Unfavourable SAC features <u>Blue = SAC not assessed</u>, i.e. the square contains at least one SAC supporting this habitat feature but no assessment has been reported <u>Transparent = SAC feature not present</u>, i.e. the square does not contain any SAC features of this habitat type

4.3 Typical species

Typical species[2.5.3]: **None used**

Typical species assessment[2.5.4]: **Not applicable**

This feature is not defined by the presence of particular species, nor is it structurally dependent upon particular species. 'Reefs' are habitat complexes which comprise an interdependent mosaic of subtidal (and intertidal) habitats and span the full geographic range of the UK. The following information is provided for context only and has not been transferred to Annex D.

Rocky Reef:

Rocky shore communities are often unstable due to a combination of physical disturbance, competition, grazing, predation and recruitment variation (Hill *et al*, 1998). Long-term monitoring has shown that some rocky shore communities can be highly variable in time. Natural variations are poorly understood but are thought to be due to variations in the supply of planktonic propagules and survival subsequent to settlement. This is largely influenced by biological interactions and direct climatic effects. For example, cover of macroalgae can vary naturally within a decade from very low to complete cover (Hill *et al*, 1998).

Subtidal rocky reefs are also poorly understood. For example, the ecological interactions of most of the several thousand different species that may be found in kelp biotopes are largely unknown. One of the characteristics of rocky reefs is the patchwork of different species and groups of species that occur. These patches are not stable, but are constantly changing and the factors influencing this dynamic pattern are unknown (Birkett *et al*, 1998).

Biogenic Reef:
Many of these species form extremely variable community types, with obvious gradation between non-reef and reef biotopes. Furthermore, the concept of biogenic reefs has not been an important consideration in past survey work, and community/habitat descriptions are often inadequate to decide whether a habitat/biotope constitutes a biogenic reef. This is a major problem for many biogenic communities. There is little consistency in the biology, ecology and sensitivity within the grouping 'biogenic reefs', which is to some degree an artificial conglomerate of communities with differing characteristics (Holt, *et al* 1998).

4.4 Conclusions on specific structures and functions (including typical species)
Conclusion[2.6.iii]: **Unknown**
The data coverage is not sufficient to make a judgement at a national level.

This feature is not defined by the presence of particular, or, 'typical' species, nor is it structurally dependent upon particular species. There are no surveillance data relating to trends in any reef species. It is therefore not possible to assess the status of 'Typical Species' for this feature.

5. Future Prospects

5.1 Main factors affecting the habitat

5.1.1 Conservation measures
Many of the component habitats (see table 1.1.1) are covered by a national action plans under the UK BAP (see http://www.ukbap.org.uk), with targets to maintain, improve, restore and expand the resource.

Approximately 2 % of the total estimated resource is included within the current SAC suite. 19 SACs have 'reef' as a primary reason for designation with 14 SACs where this H1170 is a qualifying feature, but not a primary reason for site selection (JNCC, 2000, 2002). In addition there are three draft SACs and one possible SAC in the offshore area (JNCC, 2007a).

In response to a request by the UK, the European Commission introduced 'emergency measures' in August 2003, under the recently reformed Common Fisheries Policy (CFP), to ban bottom trawling within the Darwin Mounds area which contain reefs of *Lophelia pertusa* (JNCC, 2007b). The Commission then started negotiations for a permanent measure under the CFP to ban trawling. After detailed negotiations this regulation was agreed by the European Council in April 2004. Agreement of this ban, and the method by which it was achieved, sets an important precedent for the control of damaging fishing activity in areas of nature conservation importance at a European level. The Darwin Mounds is the first area to have Europe-wide fishing restrictions imposed, but there are likely to be other sites requiring restriction of certain fishing activities, both in UK waters and in other Member States (JNCC, 2007b).

The Fisheries Division of the Northern Ireland Department of Agriculture and Rural Development (DARD) responded to the destruction of *Modiolus modiolus* reef in Strangford Lough (see 5.1.2) by temporarily closing the lough to fishing using mobile gear in 2003 (EHS, 2006). To date the closure is still in place and an independently managed restoration programme, in co-operation with DARD, has recently been agreed (J. Breen, pers comm.)

5.1.2 Main future threats[2.4.11]

The most obvious major future threats to H1170 are listed below, several of which are referred to in Section 4.1.

200 Fish and Shellfish Aquaculture
210 Professional fishing
211 Fixed location fishing
212 Trawling
220 Leisure fishing
240 Taking / Removal of fauna, general
250 Taking / Removal of flora, general
900 Erosion
910 Silting up
930 Submersion
400 Urbanised areas, human habitation
410 Industrial or commercial areas
420 Discharges
621 Nautical sports
690 Other leisure and tourism impacts not referred to above
720 Trampling, overuse
800 Landfill, land reclamation and drying out, general
851 Modification of marine currents
860 Dumping, depositing of dredged deposits
871 Sea defense or coast protection works
300 Sand and gravel extraction
510 Energy transport
512 Pipe lines
952 Eutrophication
700 Pollution
701 Water pollution
954 Invasion by a species
974 Genetic pollution
970 Interspecific floral relations
960 Interspecific faunal relations

- Fisheries (200, 210, 211, 212, 220, 240, 250)

Fishing activities are the most widespread source of anthropogenic physical disturbance of benthic communities in Northern Europe and represent the most significant human activity causing change in the UK marine environment (de Groot and Lindeboom, 1994, Laffoley and Tasker 2004). Of the six "Class A - Priority Human Pressures" identified by OSPAR, fisheries account for three (OSPAR, 2000). The effects of fisheries include (Laffoley and Tasker 2004):

- Removal of target species (including genetic effects) – given the size of most fish stocks the fishing pressure exerted upon them is outside safe biological limits
- Mortality of non-target species.
- Physical disturbance of the seabed.
- Shifts in community structure.
- Indirect effects on the food web.

There is also evidence indicating that over-fishing is often a precondition for eutrophication, disease outbreaks, or species introductions (Jackson *et al*. 2001). The combined effect of all these impacts is to reduce the overall stability of marine ecosystems (Royal Commission on Environmental Pollution, 2004). It is often difficult to establish direct relationships between specific fisheries activities and ecological effects as many ecosystem properties and components that are affected directly or indirectly by fishing also show substantial natural variability. In addition, there are many gaps in our knowledge of marine ecological processes and so it is not always possible to establish clear links between ecological change and environmental or anthropogenic factors.

Unlicensed commercial fishing is considered to be one of the most important to marine biodiversity (Boyes *et al.*, 2006) However, the effect of this is currently unquantified due to the lack of data on the activities of vessels under 11m.

Rocky Reef:

Intertidal reefs are subject to bait collection and collection of large crustaceans. Where collection involves boulder-turning, substantial damage may be done as boulders are often not returned to their original positions (Sewell and Hiscock, 2005).

Sublittoral rock reefs are mainly fished using static gear for crustaceans. The main damage associated with these is displacement or crushing of sessile organisms when the gear is placed or retrieved (Sewell and Hiscock, 2005). Diver collection of crustaceans is minimal but may significantly reduce stocks of large crustaceans. Tangle nets are used to catch crawfish and sessile invertebrate species may also be tangled and removed (Sewell and Hiscock, 2005).

Mobile fishing gear may not directly cross reefs but the activities of dredging and trawling on surrounding soft sediments can affect the surrounding reefs. Dredging results in the suspension of fine sediment and studies have shown that it can double the suspended matter content of the water, an effect that is likely to persist for several days. Whilst the increase in suspended particulates may benefit filter feeders, many species are adversely affected by smothering (Hartnoll, 1998). In some cases where reef structures are low-lying and will not damage the gear, reefs are dredged directly. This can have a substantial impact on the communities as seen in Lyme Bay, Devon (Sewell and Hiscock, 2005). Such impacts are worsened if the substratum is soft rock, in which case the reef is vulnerable to irreversible structural damage as well as removal of epifauna.

Offshore fisheries employing demersal trawls are known to break off pieces of *Lophelia pertusa* reef, removing reef clumps and causing physical damage to the associated reef species and seabed. There is good evidence that the repeated use of heavy rock-hopper gear and otter trawls will flatten and destroy even very substantial reefs and should be regarded as a significant threat to such structures (UKBAP, 2006e, Sewell and Hiscock, 2005). Trawled areas of deep-water coral are often sparse and characterised by coral rubble, leaving broken up fragments of coral, with much lower habitat complexity and species diversity than unimpacted reef areas. Again re-suspension of sediments may smother reefs. In addition to the physical impacts on the reef itself, many of the species targeted by fisheries in deep water areas are especially vulnerable to the effects of over fishing due to their long life histories (Sewell and Hiscock, 2005).

Biogenic reef:

The encrusting epifaunal species typical of biogenic reefs create complex microhabitats that are able to support species assemblages with relatively high diversity. Often this creates a habitat for species that are not otherwise found on the surrounding seabed (Royal Commission on Environmental Pollution, 2004). These complex habitats increase the survival of juvenile commercial fish species by reducing predation pressure. Thus, the removal of biogenic structures affects not only the benthos but also the associated species that feed and shelter around them (Kaiser *et al*, 1999). Many reef building species are slow growing and recovery of reefs impacted by trawling is expected to take many decades or centuries. In most cases, the first pass of trawl gear is sufficient to damage or destroy some areas permanently (Royal Commission on Environmental Pollution, 2004).

Sabellaria alveolata reefs are easily damaged by physical impact associated with trampling and are also sometimes gathered by anglers for use as bait. However, there is evidence that following physical damage, the worms themselves are often unaffected. (Sewell and Hiscock, 2005). It has been suggested that *Sabellaria* reefs may also be able to withstand the impact of a lightweight beam trawl, though this may not be true for repeated trawling (Sewell and Hiscock, 2005).

Large areas of *Modiolus modiolus* reef have been lost through scallop dredging in the Irish Sea (Sewell and Hiscock, 2005). The *M. modiolus* reefs in Strangford Lough in Northern Ireland have also been virtually destroyed. Evidence began to emerge in 2001 that there had been a serious decline in the extent and nature of Strangford reefs and the biotic communities associated with these habitats. Surveys in 2001 confirmed that there had been a collapse in the populations at several sites within the Lough.

- Climate change (900, 910, 930)

There is at present no general agreement about the degree of physical change that might be acceptable in the marine environment. Shoreline areas will be affected by increased storminess and windiness and sea level rise; the distribution of some shoreline habitats may be altered or reduced by these effects (Brooker and Young, 2005).
There has already been a major change in the plankton, both in species and abundance terms since the early 1980s. This affects a large area of the North Atlantic and appears to be linked to changes in the North Atlantic Oscillation and climate (Defra, 2005). We have changed the diversity, dynamics and composition of marine life by the introduction of non-native species and by changes in the relative abundance of species from fisheries (Brooker and Young, 2005).

Changes in the length of growing and breeding seasons, community composition and species ranges are likely to continue. Increasing temperatures can alter the timing of ecological processes and there is therefore potential for temporal mismatch between trophic levels. Generally, warm water species are likely to replace cold water species, with cold water species moving to more northerly latitudes or greater depths (Brooker and Young, 2005). Populations of some rocky shore species are particularly responsive to temperature changes, particularly those at the edges of their latitudinal ranges, and have been used as indicators of climatic change (Hill *et al*, 1998). Depletion of the northern ozone layer may result in depth distribution changes and reduced productivity of the kelp species, with uncertain consequences for the kelp biotopes (Birkett *et al*, 1998).

Patterns of species response to climate change are not straightforward, due to factors such as current flow and barriers to species movement. The positive effects of increased temperatures, for example increased primary productivity may be offset by the negative impacts of increased disturbance from wave and storm surge action (Brooker and Young, 2005).

Uncertainties exist with respect to any predictions including: species specific responses to climate change; the capacity of species from different habitats to migrate in response to a changing climate; the possible influx of new invasive species; the impact of increasing ocean acidity due to absorption of atmospheric CO_2. In addition, sectoral activities – for example, managed retreat to enable persistence of some coastal habitats might be inhibited by coastal development and construction of sea defences, whilst changes in fishing policy will substantially alter the pressure on the marine biodiversity resource (Defra, 2005).

So far, there are no studies on the sensitivity of cold-water corals to CO_2-related changes in seawater chemistry. However, because of the comparatively uniform response of all calcifying organisms tested so far, it is reasonable to expect that calcification of cold-water corals will also be reduced as carbonate supersaturation declines. Because the carbonate saturation state generally decreases with latitude and water depth, the conditions in waters typically inhabited by cold-water corals are less Favourable for calcification to start with. This may cause cold-water corals to be affected earlier and more strongly by CO_2-related ocean acidification than warm-water species (The Royal Society, 2005). This process will also affect other reef building species, calcareous algae and associated reef organisms with calcareous parts (e.g. crustacean exoskeletons) (Haughan *et al*, 2006).

- Coastal development and other disturbances (400, 410, 420, 621, 690,720, 800, 851, 860, 871)

In most regions construction has taken place to a greater or lesser extent to create ports, harbours and urban areas. These various constructions have altered both the shape of the coastline and the variety and type of habitats available for wildlife (Defra, 2005). In the past little attention was paid to the consequences of coastal and offshore construction but the agreement of other marine interests must now be sought whenever any form of construction is contemplated. This requirement applies whatever the construction proposal. Few major coastal construction projects are currently planned or in progress (Defra, 2005). There is a presumption against coastal development in the UK which is described by the following documents; NPPG 13 (Scotland) TAN 14 (Wales) PPG 20 (England). This does not apply to Northern Ireland.

The following is adapted from NPPG 13:
The presumption against development includes projects for which a coastal location is not required; projects that are approved should be accommodated on the developed coast, reuse available and suitable brown-field land, incorporate conservation interests and work within natural processes at work on the coast. In addition where potential damage to the environment is both uncertain and significant, a precautionary approach is required and the criteria required by the various bodies responsible for environmental protection should be met.
Coastal constructions may provide suitable habitats for rocky reef organisms in sedimentary areas or represent a threat due to the reduction in structural complexity of rocky shores. Other artificial substrata and some introduced species may have positive effects (Hill *et al*, 1998).

- Offshore development and aggregate extraction (300, 510, 512)

Government departments are responsible for the assessment of the potential impacts of oil and gas exploration and production aggregate extraction, marine construction work, land reclamation and dumping of dredged material prior to licensing. The conditions attached to these licences can stipulate that measures are adopted to minimise environmental impacts. Licenses may be refused on environmental grounds. The EIA Directive requires oil companies to conduct an environmental impact assessment before any operations take place. The assessments are then scrutinised by DTI and statutory consultees (JNCC, FRS and Defra). The Directive is implemented through the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999.

There are currently over 70 production licences producing approximately 22 million tonnes of material per annum (Crown Estate, 2004). These only cover about 0.12% of the UK continental shelf. Of this about 12% is actively dredged each year, which equated to 144 square kilometres in 2003, a reduction of some 114 square kilometres since 1998. The physical impacts of marine aggregate extraction arise from removing the substrata and altering the seabed topography; creation of a turbidity plume within the water column in the area of activity, and sediment re-deposition. Dredging disturbs the benthic community and can reduce the number and diversity of benthic species (Jones *et al*, 2004).

The development of the North East Atlantic oil fields is being undertaken in areas where *Lophelia pertusa* is found. This development is in an 'unfamiliar' environment and due to data limitations, oil companies suggest that the model predictions provided in their environmental assessments can only be considered to be indicative of the expected pattern of deposition on the seabed and hence possible impact on reefs (UKBAP, 2006e).

- Pollution (952, 420, 700, 701)

The effects of pollution on reefs are largely known from the rocky intertidal. Some species are particularly sensitive to contaminants, notably dog whelks driven locally to extinction by tributyl tin leached from anti-fouling paints. Rocky shore communities are sensitive to a range of environmental impacts from chronic low impacts such as sewage pollution, through to acute factors including red tides and oil spills. Generally, the effects of chronic impacts on rocky shores are reversible provided the disturbance is stopped. Recovery (defined as a return to the normal community structure and dynamics) from acute impacts is also possible but may take much longer depending on the scale of the impact (Hill *et al*, 1998).

- Non-Indigenous Species (954, 960, 970, 974)

Non-indigenous species (NIS) present a significant threat to the marine environment and their effects can have both economic and ecological ramifications, including biodiversity loss. The deleterious impacts of NIS have been shown across global regions, habitat types, and taxonomic groups worldwide. In marine ecosystems, ships' ballast water and fouled hulls are the primary mechanisms for the transport and introduction of non-indigenous marine species to ports worldwide (Cohen and Carlton, 1998). Given the continued growth of global trade and the complexity of shipping patterns globally, it is clear that non-indigenous species will continue to be transferred to UK waters for the foreseeable future.

There is some legislation currently in process to reduce the introduction of NIS via Ballast Water through the International Maritime Organization (International Maritime Organization, 2004). This legislation aims to limit the number of viable organisms within ballast tanks upon arrival in port. Though this will in theory reduce the risk of introduction via shipping, the techniques to reduce density are still in the Research and Development phase and therefore the effectiveness of this legislation in the long term remains to be seen. Due to this uncertainty, NIS remain a grave concern for Annex 1 features.

Our capacity to predict invasions is severely limited by the complexity of the process, which is influenced by numerous factors associated with introduction, establishment and subsequent growth and range expansion of introduced species. Because of our limited predictive capacity in relation to NIS, it is difficult to identify those Annex 1 features that are at greatest risk, and thus we must consider all of them to be threatened to some degree by NIS. Nonetheless, certain areas are known to be at a particular high risk (Ruiz *et al*. 1997):

5.2 Future condition (as regards range, area covered and specific structures and functions)

5.2.1 Common Standards Monitoring condition assessments

The Common Standards Monitoring condition assessments reported in Sections 4.2.1-2 provide a basis to predict the potential future condition of H1170 in the UK. This involved treating all assessments currently identified as either Favourable or Unfavourable recovering as future-Favourable: remaining categories were treated as future-Unfavourable – see Table 5.2.1.1 There are a number of caveats to this approach, which are set out beneath this table.

SAC condition assessments

Table 5.2.1 and Map 5.2.1 summarise the predicted potential future condition of H1170 on UK SACs. This is based on the approach described above. The maps give an impression of the overall spread of where future-Unfavourable and future-Favourable sites are predicted to occur (summary statistics for the map are given in Section 7.2.). The combined assessments show that of the SACs assessed:

- 1 % of the area and 83 % of the number of assessments fall within the future-Favourable category;
- at least 1 % of the total UK habitat area falls within the future-Favourable category.

As the network covers only ~ 2 % of the extent of the 'reef' feature nationally it is not reasonable to extrapolate anything from these figures.

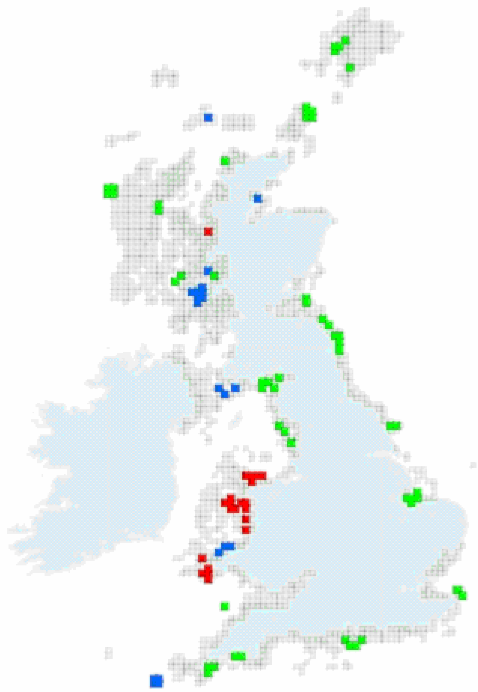
Table 5.2.1 Predicted future condition of UK SACs supporting H1170 based on current Common Standards Monitoring condition assessments. See notes below table for details. Information on the coverage of these results is given in Section 7.2

Future condition	Present condition	Area (ha)	Number of site features
Future-Unfavourable	Unfavourable declining	2,024	2
	Unfavourable no change	74,446	2
	Unfavourable unclassified		
	Total	76,470	4
	% of assessments	***52%***	***17%***
	% of total UK extent	***1%***	***Unknown***
Future-Favourable	Favourable maintained	12,585	10
	Favourable recovered		
	Unfavourable recovering	4,684	3
	Favourable unclassified	54,642	7
	Total	71,912	20
	% of assessments	***48%***	***83%***
	% of total extent	***1%***	***Unknown***

Note that the scenario presented above is based on the same information as used to construct the Table in section 4.1. It is based on the following premises:
(i) the Unfavourable-recovering condition assessments will at some point in the future become Favourable.
(ii) all Unfavourable-unclassified sites will remain unfavourable, which is probably overly pessimistic;
(iii) sympathetic management will be sustained on sites already classified as Favourable and these will not be seriously damaged by any unforeseen events.
IMPORTANT NOTE: we do not have information on the timescale of the predicted recovery, which may be influenced by many past, natural and human related factors. A sustained, sympathetic management regime is more likely to result in 'Favourable' condition being attained.

Predicted Future Condition of H1170 based on Common Standard Monitoring condition assessments (See Sections 5.2 and 7.2 for further information on these maps)

Map 5.2.1 SAC assessments



Key:
Red = future-Unfavourable, i.e. the square contains one or more SACs where this habitat feature is present and has been predicted to be future-Unfavourable
Green = future-Favourable, i.e. the square contains at least one SAC where this habitat feature is present and has been predicted to be future-Favourable
Blue = SAC not assessed, i.e. the square contains at least one SAC supporting this habitat feature but no assessment has been reported
Transparent = SAC feature not present, i.e. the square does not contain any SAC features of this habitat type

5.3 Conclusions on future prospects (as regards range, area covered and specific structures and functions)

Conclusion[2.6.iv]: Unknown

While much of the known area of reef (i.e. the rocky inshore) is robust and covers a wide area that should allow absorption of localised pressures, not enough is known about the current functioning and state of the offshore part of the feature to be able to make a judgement. In addition, the effects of climate change and NIS cannot be quantified reliably at this stage.

6. Overall Conclusions and Judgements on Conservation Status

Conclusion[2.6]: Unknown

All four parameter conclusions are Unknown; the overall conclusion reflects this.

Table 6.1 Summary of overall conclusions and judgements

Parameter	Judgement	Grounds for Judgement	Confidence in judgement*
Range	Unknown	The data coverage is not sufficient to make a judgement at a national level. The range figures given here are estimates based on parital data with some extrapolation, and true range of reefs in the UK is therefore Unknown. There are no trend data. While there are reports of range reductions for some biogenic reef types these only comprise a small proportion of the overall resource.	
Area covered by habitat type within range	Unknown	The data coverage is not sufficient to make a judgement at a national level. The area figures given here are estimates based on parital data with some extrapolation, and true area of reefs in the UK is therefore unknown. There has been a loss of area for some of the biogenic reef species; however, this is a small fraction of the total reef area.	3
Specific structures and functions (including typical species)	Unknown	The data coverage is not sufficient to make a judgement at a national level. This feature is not defined by the presence of particular, or, 'typical' species, nor is it structurally dependent upon particular species. There are no surveillance data relating to trends in any reef species. It is therefore not possible to assess the status of 'Typical Species' for this feature.	3
Future prospects (as regards range, area covered and specific structures and functions)	Unknown	The data coverage is not sufficient to make a judgement at a national level. While much of the known area of reef (i.e. the rocky inshore) is robust and covers a wide area that should allow absorption of localised pressures, not enough is known about the current functioning and state of the offshore part of the feature to be able to make a judgement. In addition, the effects of climate change and NIS cannot be quantified reliably at this stage.	3
Overall assessment of conservation status	Unknown	All parameter conclusions are Unknown.	3

Key to confidence in judgement: 1 = High; 2 = Medium; 3 = Low

7. Annexed Material (including information sources used 2.2)

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7.2 Further information on Common Standards Monitoring data as presented in Sections 4.2 and 5.2

Table 7.2.1 Summary of the coverage of the data shown in Tables 4.2.1 and 5.2.1

Status	Number of squares	Proportion of all squares
Current – Unfavourable (red)	32	6%
Current – Favourable (green)	45	8%
On SAC but not assessed (blue)	24	4%
Not on SAC (transparent)	440	81%
Total Number of 10km squares (any colour)	541	
Future – Unfavourable (red)	21	4%
Future – Favourable (green)	56	10%

Table 7.2.2 Summary of grid square map data shown in Maps 4.2.1-3 and 5.2.1-3

Status	Number of squares	Proportion of all squares
Current – Unfavourable (red)	32	6%
Current – Favourable (green)	45	8%
On SAC but not assessed (blue)	24	4%
Not on SAC (transparent)	440	81%
Total Number of 10km squares (any colour)	541	
Future – Unfavourable (red)	21	4%
Future – Favourable (green)	56	10%