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 :

H1140: Mudflats and sandflats not covered by seawater at low tide

Please note that this is a section of the report. For the complete report visit http://www.jncc.gov.uk/article17

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H1140 Mudflats and sandflats not covered by seawater at low tide

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 H1140 and its relations with UK classifications.

Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide. They form a major component of the Annex I features H1130 Estuaries and H1160 Large shallow inlets and bays in the UK, but they also occur extensively along the open coast and in lagoonal inlets. The physical structure of these intertidal flats ranges from mobile, coarse-sand beaches on wave-exposed coasts to stable, fine-sediment mudflats in estuaries and other marine inlets. This habitat type can be divided into three broad categories, or sub-types (clean sands, muddy sands and muds), although in practice there is a continuous gradation between them.

1. *Clean sands*. These occur particularly on open coast beaches and in bays around the UK where wave action or strong tidal currents prevent the deposition of finer silt.
2. *Muddy sands*. These occur particularly on more sheltered shores of the open coast and at the mouths of estuaries or behind barrier islands, where sediment conditions are relatively stable.
3. *Mudflats*. These form in the most sheltered areas of the coast, usually where large quantities of silt derived from rivers are deposited in estuaries.

Plant and animal communities present in these sub-types vary according to the sediment, its stability and the salinity of the water (Jackson and McLeod, 2000, 2002). Littoral sediments often form part of a very dynamic system and interact with other adjacent features such as subtidal sandbanks, saltmarshes and sand dunes. The shape and functioning of the littoral sediments is determined both by coastal processes acting upon it and the influence of these adjacent habitats (JNCC, 2004).

Table 1.1.1 Summary description of habitat H1140 and its relations with UK vegetation/habitat classifications

Classification	Correspondence with Annex I type	Comments
EU Interpretation Manual	= H1140	Sands and muds of the coasts of the oceans, their connected seas and associated lagoons, not covered by sea water at low tide, devoid of vascular plants, usually coated by blue algae and diatoms. They are of particular importance as feeding grounds for wildfowl and waders (European Commission, 2003).
Ramsar	Mudflat, Sandflat	These habitats may be found as part of or the whole of an occurrence of the Annex I type.
BAP priority habitat type	Mudflats, Seagrass Beds	These habitats may be found as part of or the whole of an occurrence of the Annex I type.
CSM reporting categories	Mudflat, Sandflat, Eel Grass Bed, Littoral Sediment	These habitats may be found as part of or the whole of an occurrence of the Annex I type.

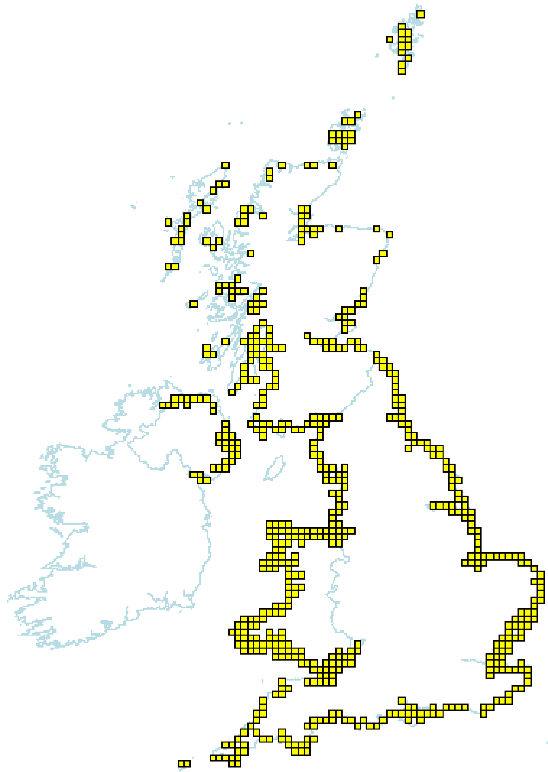
2. Range [2.3]

2.1 Current range

Range surface area [2.3.1]: **2, 900 km^2** (10-km square count: 549)
Date of calculation [2.3.2]: **May 2007**
Quality of data [2.3.3]: **Moderate**

There are no comprehensive data for the extent of this habitat type in the UK. The figure provided (Jackson and McLeod, 2000, 2002) was derived from a number of separate data sources but is likely to be a reasonable estimate. The total intertidal area only includes up to Mean High Water, rather than to the limit of extreme high water. It also includes areas of mixed stony shores as well as intertidal sand and mudflats. The following map (2.1.2) is derived from locations of the feature taken from the JNCC Marine Recorder data set. This data set includes point locations of the feature but no extent data.

Maps 2.1.1 and 2.1.2 show the range and distribution of H1140 in the UK

Map 2.1.1 Habitat range map [1.1] for H1140	**Map 2.1.2** Habitat distribution map [1.2] for H1140
No habitat range map available for this feature	
	Data source: JNCC database Marine Recorder, 2007. Each red square represents a 10x10km square of the National Grid and shows the known and/or predicted occurrence of this habitat.

2.2 Trend in range since c.1994

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**

As this feature is defined by its substrate type rather by a specific biological community, its range is determined by physical and geological processes. Mudflats and sandflats are widespread along the open coast, bays and estuaries and encompass all parts of the coast where the sedimentary regime allows. The nature of this sedimentary process means that the geographic range of this feature is likely to have remained the same in recent geological times. Although the physical area of some individual sand and mudflats may have changed due to erosion, land claim or other anthropogenic pressures there is no evidence that this has significantly affected the range of the feature.

The post-1994 trend is therefore reported as stable.

2.3 Favourable reference range

Favourable reference range[2.5.1]: 2,900 km^2

Mudflats and sandflats are widespread along the open coast, bays and estuaries and encompass all parts of the coast where the sedimentary regime allows and this situation has not changed radically in historic time (although the extent within the range may well have reduced due to local pressures, see 2.2).Furthermore, all significant ecological variations of the habitat type are represented in the UK resource as sandflats and mudflats support ubiquitous communities.

For these reasons, and because range is determined by physical, rather than biological processes (see 2.2), the current area has been set as the favourable reference value.

2.4 Conclusions on range

Conclusion[2.6.i]: Favourable

The current range is stable and not less than the favourable reference value. Therefore, in accordance with EC guidance, the conclusion is Favourable.

This feature is widespread throughout the UK and the communities incorporated are ubiquitous. The presence of the feature is determined by physical and geological processes and therefore the range is unlikely to be altered by anything other than significant natural change.

3. Area [2.4]

3.1 Current area

Total UK extent [2.4.1]: ~2,900 km^2
Date of estimation [2.4.2.]: May 2007
Method [2.4.3]: 3 = ground based survey
Quality of data [2.4.4.]: Poor

Table 3.1.1 provides information on the area of H1140 in the UK. There are no comprehensive data for the area of this feature type in the UK. The figure provided for the UK resource has been derived from a number of separate data sources (Davidson *et al*. (1991) (total intertidal area); JNCC unconfirmed Coastwatch data; Buck and Donaghy (1996)) but is likely to be a reasonable estimate (Jackson and McLeod, 2000, 2002) - the figures from the 2005 UKBAP reporting were 2,774 km^2 for mudflats alone (UKBAP, 2006a). The total intertidal area only includes up to Mean High Water, rather than to the limit of extreme high water. It also includes areas of mixed stony shores as well as intertidal sand and mudflats (Jackson and McLeod, 2000, 2002).

Table 3.1.1 Area of H1140 in the UK

	Area (ha)	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	> 11,000	3	Poor
Total UK extent [2.4.1]	290,000	3	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

Trend in area[2.4.5]: **Unknown**
Trend magnitude[2.4.6]: **Not applicable**
Trend period[2.4.7]: **1996-2006**
Reasons for reported trend[2.4.8]: **Not applicable**

Historically, intertidal areas were reclaimed to be used for industrial developments, particularly in large estuaries in urban areas (e.g. the Tees) and agricultural purposes. Since the introduction of national planning guidelines (see Section 5.1.2) there is now generally a presumption against coastal development, thus reducing the loss of this feature in recent times. Nevertheless, small scale, piecemeal removal of intertidal mudflats and sandflats has continued since 1994 through many smaller coastal developments (marinas and port expansion) provided for through Regional Development Plans keen to ensure local employment and to attract visitors (Paul Brazier, pers. comm.). Similarly, the need for coastal defence has increased in importance due to increasing sea levels and coastal erosion. The extent to which this affects mudflats and sandflats is unknown but planning permission is almost always given with ‘Overriding Public Interest’ being cited (Paul Brazier, pers. comm.).

There are no figures for the continuing small scale loss of this feature type on individual sites, so the extent of the problem at the national scale remains Unknown.

3.3 Favourable reference area [2.5.2]

Favourable reference area: **2,900 km^2**

The Nature Conservancy Council (NCC) estuary review (1989 – 1990) (Davidson *et al*, 1991) estimated that approximately 913 km^2 of intertidal habitat (in estuaries and large shallow inlets and bays) has been lost since Roman times (the majority occurring during the industrial revolution). Given the current area estimate of 2,900 km^2, this would imply that the historic area of the feature is 3813 km^2. Therefore at least 23 % of the total resource has been removed. However, the figures from Davidson *et al* (1991) do not contain the proportions of mudflats, sandflats and salt marsh lost, so it is not possible to say what proportion of H1140 has been affected. In addition, the species and communities the feature supports are ubiquitous and present throughout the UK.

Based on this, there is no reason to believe that the current area of the feature is below that required to maintain viability, so the feature is considered to be at its favourable reference area.

3.4 Conclusions on area covered by habitat

Conclusion[2.6.ii]: **Favourable**

The current area is equivalent to the favourable reference area. While there may well be developments that have significant impacts at a local level, there are no data for this and thus it is not possible to judge the cumulative significance of these.

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
220 Leisure fishing
221 Bait digging
720 Trampling, overuse
900 Erosion
870 Dykes, embankments, artificial beaches, general
400 Urbanised areas, human habitation

410 Industrial or commercial areas
504 Port areas
600 Sport and leisure structures
621 Nautical sports
623 Motorised vehicles
420 Discharges
700 Pollution
701 Water pollution
952 Eutrophication
974 Genetic pollution
960 Interspecific faunal relations
970 Interspecific floral relations
954 Invasion by a species

See 5.1 for full descriptions

- Fisheries (200, 210, 211, 220, 221, 720)
- Coastal erosion/sea level rise (900, 870)
- Coastal development (400, 410, 504, 600, 621, 623)
- Water quality (420, 700, 701, 952)
- 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 H1140 in the UK. The following attributes were examined for all CSM assessments relevant to the habitat (JNCC, 2004):

- Extent
- Biotope composition
- Distribution of biotopes
- Sediment character

In addition site-specific attributes were also measured such as (JNCC, 2004):

- Extent of sub-feature or representative/notable biotopes
- Species composition of sub-feature or representative/notable biotopes
- Species population measures

SAC condition assessments

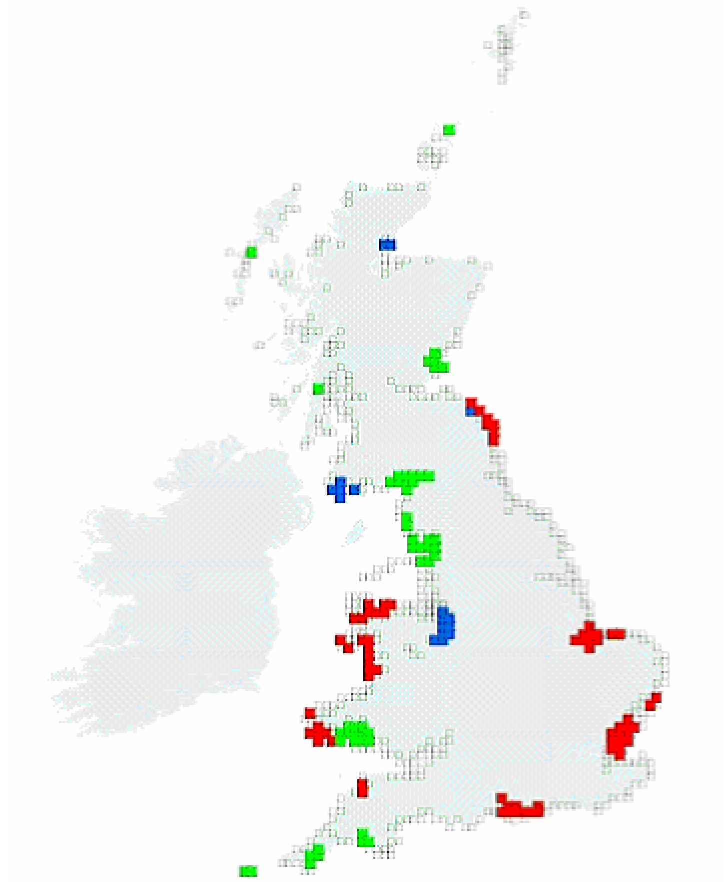
Table 4.2.1 and Map 4.2.1 summarise the Common Standards Monitoring condition assessments for UK SACs supporting habitat H1140. These data were collated in January 2007. The maps give an impression of the overall spread of where Unfavourable and Favourable sites exist (summary statistics for the map are given in Section 7.2). The combined assessments show that of the SACs assessed:

- 48 % of the area and 45 % of the number of assessments was Unfavourable;
- at least 22 % of the total UK habitat area was in Unfavourable condition.

Table 4.2.1 Common Standards Monitoring condition assessment results for UK SACs supporting H1140. 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	58,075	8
	No change		
	Unclassified		
	Recovering	6,204	2
	Total	64,278	10
	% of all assessments	***48%***	***45%***
	% of total UK resource	***22%***	***unknown***
Favourable	Maintained	16,297	6
	Recovered		
	Unclassified	52,843	6
	Total	69,140	12
	% of all assessments	***52%***	***55%***
	% of total UK resource	***24%***	***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 March 2005, as used for the JNCC Common Standards Monitoring Report 2006

Current Condition of H1140 on Common Standard Monitoring condition assessments (See Sections 4.2 and 7.2 for further information)
Map 4.2.1 SAC assessments

Key: Red = Unfavourable, i.e. the square contains at least one SAC where this habitat feature is present and has been judged to be Unfavourable Green = Favourable, 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 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

4.3 Typical species[2.5.3 and 2.5.4]

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. Mudflats and sandflats are habitat complexes made up of an interdependent mosaic of 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.

The main factor influencing the structure and composition of intertidal communities is exposure to wave action. This exposure determines the particle size of the shore and thus the species that inhabit it (Eliot *et al*, 1998). The types of community present will therefore range from robust mobile species in wave exposed areas to sensitive sedentary species in the more sheltered areas (Elliot *et al*, 1998).

Sandflats:

i. Exposed shores

Exposed shores are usually made up of coarse mobile sands that are low in diversity, generally have no sedentary species, especially bivalve molluscs, and are dominated by agile swimming species. These species have a short lifespan, tend to be robust and are characterised by their ecological adaptability (Elliot *et al*, 1998). In north-west Europe, this community consists of small, burrowing amphipods and polychaetes in which diversity increases towards the low shore area (Elliot *et al*, 1998, Jackson and McLeod, 2000, 2002).

ii. Moderately exposed shores
Moderately exposed shores are dominated by fine sands which favour the establishment of a sessile community of polychaetes and long-lived bivalves (Elliot *et al*, 1998). Often these shores are colonised in their intertidal zones by subtidal species as well as their usual intertidal species that follow a clear zonation pattern down the shoreline (Elliot *et al*, 1998).

iii. Sheltered shores
In areas of low energy, or sheltered shores, sediments are poorly sorted with high levels of organic matter and silt content. Extreme shelter favours the establishment of a predominantly sessile tube-dwelling community of polychaetes with often high numbers of bivalves also well represented. As in moderately exposed shores, some species characteristic of subtidal areas may also be present (Elliot *et al*, 1998). In addition, beds of the seagrass *Zostera marina* may occur at the lower margins (UKBAP, 2006b). A wide range of species, such as lugworm *Arenicola marina*, and other polychaete worms and bivalve molluscs, can colonise these sediments. Substantial beds of mussels *Mytilus edulis* may develop on the lower shore (Jackson and McLeod, 2000, 2002).

Mudflats:
The species composition of mudflats is heavily influenced by the amount of silt present, but typically they have a large number of a few species that reflect the prevailing physical conditions (Elliot *et al*, 1998). In areas of low salinity, the characteristic species are: common cockle *Cerastoderma edule,* mud shrimp *Corophium volutator,* laver spire shell *Hydrobia ulvae*, and ragworm *Hediste diversicolor*. With a slight increase in the proportion of sand, the polychaetes catworm *Nephtys hombergi* and lugworm *Arenicola marina* occur (UKBAP, 2006). Firm muds may support piddocks such as *Barnea candida* and the boring spionid worm *Polydora ciliata,* while less well-consolidated muds are characterised by other nereid, spionid and capitellid worms (Eliot *et al*, 1998). Where stones and shells provide an initial attachment for bivalve byssus threads, beds of the common mussel *Mytilus edulis* occur and accrete material through faecal deposition. Occasional stones or shells may also provide suitable attachment for stands of fucoid macroalgae such as *Fucus vesiculosus* or *F. spiralis* (UKBAP, 2006).

The surface of the sediment is often apparently devoid of vegetation, although mats of benthic microalgae (diatoms and euglenoids) are common. These produce mucilage (mucopolysaccharides) that binds the sediment. Under nutrient-rich conditions, there may be mats of the macroalgae *Enteromorpha* spp or *Ulva* spp. (UKBAP, 2006b). The high biomass of invertebrates in such mudflats often provides an important food source for waders and wildfowl, such as common shelduck *Tadorna tadorna*, knot *Calidris canuta* and dunlin *Calidris alpina* (Jackson and McLeod 2000, 2002).

There are no trend data associated with these species so an assessment of typical species can not be made.

4.4 Conclusions on specific structures and functions (including typical species)

Conclusion[2.6.iii]: **Unfavourable – Bad and deteriorating**

The EC Guidance states that where "more than 25% of the area of the habitat is Unfavourable as regards its specific structures and functions", the conclusion should be Unfavourable – Bad. In the UK this was generally taken to mean that more than 25% of the habitat area in Unfavourable condition.

Based on the CSM data for this feature, at least 22 % of the UK resource is in Unfavourable condition and declining. With such a large proportion of the assessed feature in Unfavourable condition, it is highly likely that at least another 3 % of the remaining feature area would also be Unfavourable; if the features within the SAC series are taken as representative of the wider feature, then approximately half of H1140 would be in Unfavourable condition at the UK level.

Based on this, the conclusion is Unfavourable – Bad and deteriorating

5. Future prospects

5.1 Main factors affecting the habitat

5.1.1 Conservation measures
Elements of this habitat are covered by several national action plans under the UK BAP (see http://www.ukbap.org.uk), with targets to maintain, improve, restore and expand the resource.

In addition, 50 % of the estimated extent of the feature is covered in the SAC series with conservation objectives to maintain the resource or restore sites to Favourable condition. 12 SACs have H140 as the primary qualifying feature; while for a further 15 SACs, H1140 is a qualifying feature but not the primary reason for site selection.

5.1.2 Main future threats[2.4.11]
The most obvious major future threats to H1140 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
220 Leisure fishing
221 Bait digging
720 Trampling, overuse
900 Erosion
954 Invasion by a species
952 Eutrophication
970 Interspecific floral relations
974 Genetic pollution
870 Dykes, embankments, artificial beaches, general
400 Urbanised areas, human habitation
410 Industrial or commercial areas
504 Port areas
600 Sport and leisure structures
621 Nautical sports
623 Motorised vehicles
420 Discharges
700 Pollution
701 Water pollution
960 Interspecific faunal relations

- Fisheries (200, 210, 211, 220, 221, 720)

Fishing activities are the most widespread source of anthropogenic physical disturbance of benthic communities of Northern Europe and represent the most significant human activity causing change in the UK's marine environment (de Groot and Lindeboom, 1994, LaFolley 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 top threats to marine biodiversity (Boyes *et al.*, 2006) However, the effect of this is currently unquantified due to the lack of data on unlicensed activities of vessels under 11m.

Marine invertebrate species are commercially and subsistence harvested from intertidal areas. Although most are harvested for human consumption (e.g. Hall and Harding, 1997; Ferns *et al.*, 2000), some are also collected for use as bait (Olive, 1993). It has been shown that intertidal soft-sediment communities composed mainly of large bodied sessile organisms and biogenic habitat such as seagrass, serpulid worms and mussel beds have a low tolerance to disturbance and can take years to recover, even if harvesting techniques are non-mechanical (Kaiser *et al.*, 1999).

Cockle collecting occurs on some sand and mudflats, and whilst the effects of hand gathering may be negligible or have impacts on shorter time scales, undersized cockles may be damaged (Kaiser *et al.*, 1999). Mechanical harvesting may have a significant impact on abundance and diversity of intertidal organisms, leading to longer term effects (Sewell and Hiscock, 2005). A study in the Wadden Sea indicated that it took three years for the density of lugworms and five years for the density of *Mya arenaria* to return to pre-exploitation levels following mechanical lugworm harvesting on a tidal mudflat (Beukema, 1995). Bait digging occurs at different scales from personal use to commercial collection, most of which is unlicensed and thus not quantifiable (Boyes *et al.*, 2006) but all types can cause significant impacts. Digging brings coarser sediments, including pebbles and cobbles, to the surface layers changing the substratum type with significant effects on the infaunal community (Boyes *et al.*, 2006).

Dredging and trawling gear can cause death or severe damage to benthos and physical disturbance to sediment structure. The degree of the impact depends on towing speed, gear size and weight, substrate type and local hydrodynamic factors. Trawling impacts are naturally less severe in areas naturally impacted by storms and wave disturbance. Otter trawl boards may penetrate into soft sediments by 6 – 20 cm. The tickler chains from beam trawls plough sediments to a depth of 4 – 8 cm (Royal Commission on Environmental Pollution, 2004). By-catch from suction dredging (for shellfish) or of juvenile flatfish (from the shrimp fisheries) may have a significant effect on non-target populations (UKBAP, 2006).

Intertidal eel grass beds (*Zostera* sp) on mudflats and areas of intertidal sand are potentially vulnerable to trampling by bait collectors, clam and cockle digging or raking. Studies have shown that while raking is less damaging than digging, both can potentially lead to loss of plant biomass and can take a long time to recover due to damage to their root system (Sewell and Hiscock, 2005).

- Climate change (900, 954, 960, 970, 974)

There is at present no general agreement about the degree of physical change that might be acceptable in the marine environment. It is therefore not currently possible to define what is acceptable coastal erosion and coastal flooding risk. Shoreline areas will be affected by increased storminess and windiness: the distribution of some shoreline habitats may be altered or reduced by these effects. In addition sea level rise will significantly impact on the distribution and extent of sand and mudflat habitats (Brooker and Young, 2005).

There has already been a major change in the plankton species and abundance since the early 1980s (Hays *et al*, 2005). This affects a large area of the North Atlantic and appears to be linked to changes in the North Atlantic Oscillation and climate (Defra, 2005a).

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). All of these effects may affect the structure and function of estuaries; however, uncertainties exist with respect to predictions including: species specific responses to climate change; 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.

- Coastal erosion/sea level rise (900, 870)

Coastal erosion as a result of waves, storm action and the generally soft nature of the coastline is a major concern in some areas. Transport of the resultant suspended material tends to be inshore into many estuaries and results in siltation of harbour and port areas necessitating continuous dredging (Defra, 2005a). Many beach areas around Scotland are currently also suffering loss of sand, largely, it is thought, due to lack of supply of new material from offshore (Defra, 2005a).
Sedimentary areas protected by hard defences will suffer the greatest impact of sea level rise (Boorman *et al*, 1989). Erosive forces are predicted to become more dominant (due to increased wave action) and losses of fine sediment will therefore produce narrower intertidal areas, with coarser sediment. The subsequent change to sediment characteristics will include a reduction in the amount of organic matter in the sediments and a change to community structure. Taken to its conclusion, a greater proportion of estuaries on open-coasts are likely to become marine and sandy, and brackish waters will ingress inland and up-river. In more sheltered areas, there will be more deposition, extending areas of fine sediment and marsh. However, this process will cease once the sediment supply is reduced and ultimately erosion would become the dominant process (Boorman *et al*, 1989).

The combined effects of coastal erosion, sea level rise and the high cost of maintaining sea defences in areas such as the south-east are matters of concern. There has been a decision in principle to work with natural sedimentary processes in managing these problems. If relative sea level rise continues to occur at present rates, it will necessitate a number of difficult decisions and call for novel engineering solutions - both hard and soft. It will also necessitate the establishment of an appropriate balance between managed retreat and construction of higher and stronger sea defences (Defra, 2005a). There are no UK-wide projections for how this would affect intertidal sediments as a whole, however it has been estimated that sea level rise will result in a loss of 8000 to 10,000 ha of intertidal flats in England by 2013 (Pye and French, 1993). Much of this loss is expected in southern and south-east England although research suggests that the major firths in Scotland will also be affected (UKBAP, 2006b).

- Coastal development (400, 410, 504, 600, 621, 623)

There is a presumption against coastal development in GB which is described by the following planning policy documents; NPPG 13 (Scotland) (Scottish Executive, 2006) TAN 14 (Wales) (Welsh Assembly Government, 1998) PPG 20 (England) (Department of Environment, 1992) – the following is taken 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 brownfield 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.

With a few notable exceptions few major coastal construction projects are currently planned or in progress and those that are, are required to provide mitigation for areas of habitat loss (Defra, 2005). Barrage schemes for water storage, amenity, tidal power and flood defence continue to pose a threat to the integrity and ecological value of mudflats in estuaries and enclosed bays (UKBAP, 2006b and 2006c). The proposed Severn Barrage could cause up to 50% loss of intertidal area of the estuary (8000 ha) which would be approximately 2.7 % of the UK sand and mudflat resource (Mitchell *et al*, 1981).

Intertidal eel grass beds on mudflats and sandflats are highly vulnerable to boat anchorages and local boating activities, particularly launching across the eel grass beds. Use of vehicles on the sediment flats changes the drainage and cuts channels along which increased erosion of the eel grass rhizomes occurs (Paul Brazier, pers comm.).

- Water Quality (420, 700, 701, 952)

Diffuse and point source discharges from agriculture, industry and urban areas, including polluted storm-water run-off, can create abiotic areas or produce algal mats which may affect invertebrate communities. They can also remove embedded fauna and destabilising sediments thus making them liable to erode (UKBAP, 2006b).

Oil and gas extraction and related activities, and dredging for navigation, have an important effect on sediment biota and on sediment supply and transport. Many coastal areas, including estuaries, are now either licensed or available for exploration and development (UKBAP, 2006c).

- 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 (e.g. Ruiz *et al*. 1997; Cohen and Carlton 1998). The deleterious impacts of NISs have been shown across global regions, habitat types, and taxonomic groups worldwide, including marine systems (Ruiz *et al*., 1997; Cohen and Carlton, 1998; Ruiz *et al*., 2000). Within marine systems, ships' ballast water, used to improve ship stability and trim, is one of the primary mechanisms for the transport and introduction of non-indigenous marine species to ports worldwide (Carlton, 1996). Given the continued growth of global trade and the complexity of shipping patterns globally, with numerous different source regions, ship types and routes operating worldwide, 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 place to reduce the introduction of NIS via Ballast Water through the International Maritime Organisation (International Maritime Organisation, 2004). This legislation aims to limit the number of viable organisms within ballast tanks in the future, but NIS remain a grave concern, and could potentially lead to habitat alteration and biodiversity loss within marine Annex I habitat features. Our ability to predict invasions is severely limited by the complexity of the invasion process itself, and therefore it is difficult to identify those marine Annex I features that are at greatest risk. Nonetheless, certain areas are known to be at a particularly high risk:

(i) Areas within the vicinity of ports. Because the marine environment is essentially an open system, there is also potential for rapid and widespread secondary transfer of NIS within the UK once species establish reproducing populations.

(ii) Areas with a high diversity of habitat types (including diversity of substrate, salinity and temperature regimes and exposure). These habitats are most likely to be successfully invaded because, as the number of habitat types increases, so does the chance that a particular species will locate a suitable habitat for its establishment.

(iii) Areas already altered or damaged by anthropogenic effects.
(iv) Areas that have already been invaded by high numbers of NIS.
(v) Areas of low indigenous species richness. Brackish water conditions, for example, such as those found in estuaries generally support low diversity

For mudflats and sandflats it is unlikely that we will be able to accurately predict which species will arrive, establish or what their impacts might be on native communities in the future. Estuaries in particular are susceptible to NIS (e.g. Ruiz *et al*. 1997; Cohen and Carlton 1998). For example the spread of cord-grass *Spartina anglica* which has vegetated some upper-shore mudflat areas with important ecological consequences in some areas (UKBAP, 2006b).

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 H1140 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 in the table below.

SAC condition assessments

Table 5.2.1 and Map 5.2.1 summarise the predicted potential future condition of H1140 on UK SACs. This is based on the approach described above. The map gives 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:

- 56 % of the area and 64 % of the number of assessments fall within the Future-Favourable category;
- at least 26 % of the total UK habitat area falls within the Future-Favourable category.

Table 5.2.1 Predicted future condition of UK SACs supporting H1140 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

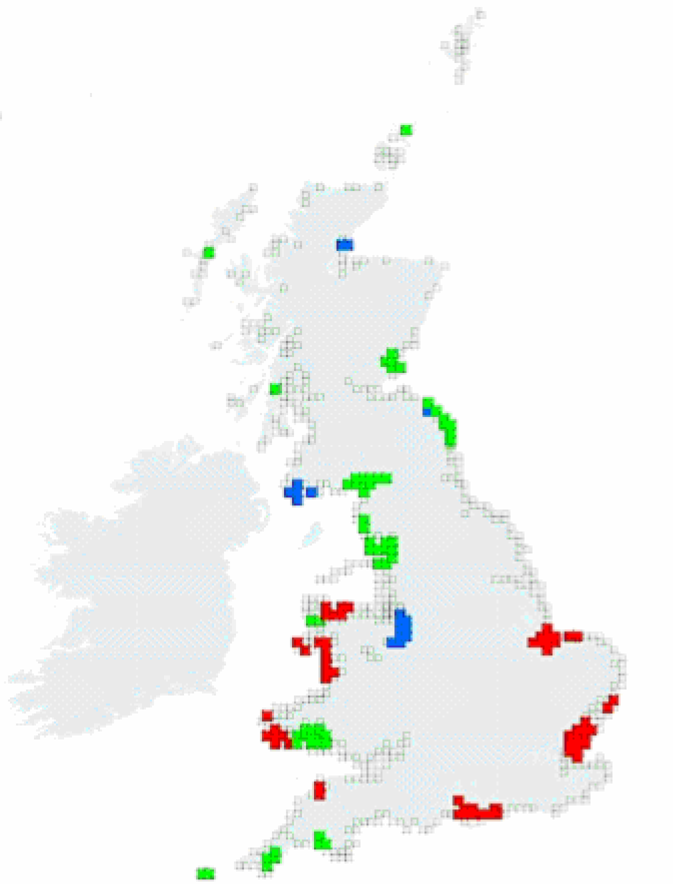
Future condition	Present condition	Area (ha)	Number of site features
Future-Unfavourable	Declining	58,075	8
	No change		
	Unclassified		
	Total	***58,075***	***8***
	% of assessments	***44%***	***36%***
	% of total UK extent	***20%***	***Unknown***
Future-Favourable	Favourable maintained	16,297	6
	Favourable recovered		
	Unfavourable recovering	6,204	2
	Favourable unclassified	52,843	6
	Total	75,344	14
	% of assessments	***56%***	***64%***
	% of total extent	***26%***	***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 H1140 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]: Unfavourable – Bad and deteriorating

The EC Guidance states that where “habitat prospects are bad, with severe impacts from threats expected and long-term viability not assured”, the judgement should be Unfavourable – Bad. In the UK, this was generally taken to mean that habitat range and/or area are in decline, and/or less than 75% of the habitat area is likely to be in favourable condition in 12-15 years.

Future threats are unlikely to cause a decline in range due to the inherent stability of this parameter for H1140. However, coastal development and erosion could have significant effects on the total area of the feature. At least 20% of the total area of the resource will remain Unfavourable even after current sympathetic management has improved the situation. In addition there are a number of serious but unquantified threats from other sources.

6. Overall conclusion and judgement on conservation status

Conclusion[2.6]: **Unfavourable – Bad and deteriorating**

Although Range and Area are Favourable, Structure and Function and Future Prospects have been identified as Unfavourable – Bad and deteriorating. Therefore in accordance with EU Commission guidance, the overall conclusion must also be Unfavourable – Bad and deteriorating.

Table 6.1 Summary of overall conclusions and judgements

Parameter	Judgement	Grounds for Judgement	Confidence in Judgement*
Range	Favourable	The current range is stable and not less than the favourable reference value.	2
Area covered by habitat type within range	Favourable	The current area is equal to the favourable reference area. While there are developments that have significant impacts at a local level, there are no data for this and thus it is not possible to judge the cumulative significance of these.	2
Specific structures and functions (including typical species)	Unfavourable - Bad and deteriorating	More than 25% of the habitat area is considered to be Unfavourable as regards its specific structures and functions. EU Commission guidance advises that where "more than 25% of the area of the habitat is Unfavourable as regards its specific structures and functions", the conclusion should be Unfavourable – Bad. Based on the CSM data for this feature, at least 22 % of the UK resource is in Unfavourable condition and declining. With such a large proportion of the assessed feature in Unfavourable condition, it is highly likely that at least another 3 % of the remaining feature area would also be Unfavourable; if the features within the SAC series are taken as representative of the wider feature, then approximately half of H1140 would be in Unfavourable condition at the UK level.	2
Future prospects (as regards range, area covered and specific structures and functions)	Unfavourable - Bad and deteriorating	Habitat prospects over next 12-15 years considered to be bad, with severe impact from threats expected and long term viability not assured. Future threats are unlikely to cause a decline in range due to the inherent stability of this parameter for H1140. However, coastal development and erosion could have significant effects on the total area of the feature. At least 20% of the total area of the resource will remain Unfavourable even after current sympathetic management has improved the situation. In addition there are a number of serious but unquantified threats from other sources.	2
Overall assessment of conservation status	Unfavourable - Bad and deteriorating	One or more Unfavourable – Bad and deteriorating	2

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

7. Annexed material (including information sources used 2.2)

7.1 References

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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)	70	13%
Current – Favourable (green)	50	9%
On SAC but not assessed (blue)	17	3%
Not on SAC (transparent)	412	75%
Total Number of 10km squares (any colour)	549	
Future – Unfavourable (red)	61	11%
Future – Favourable (green)	59	11%

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

Data	Value
Number of SACs supporting feature (a)	27
Number of SACs with CSM assessments (b)	22
% of SACs assessed (b/a)	81
Extent of feature in the UK – hectares (c)	290,000
Extent of feature on SACs – hectares (d)	144,827
Extent of features assessed – hectares (e)	133,419
% of total UK hectarage on SACs (d/c)	50
% of SAC total hectarage that has been assessed (e/d)	92
% of total UK hectarage that has been assessed (e/c)	46