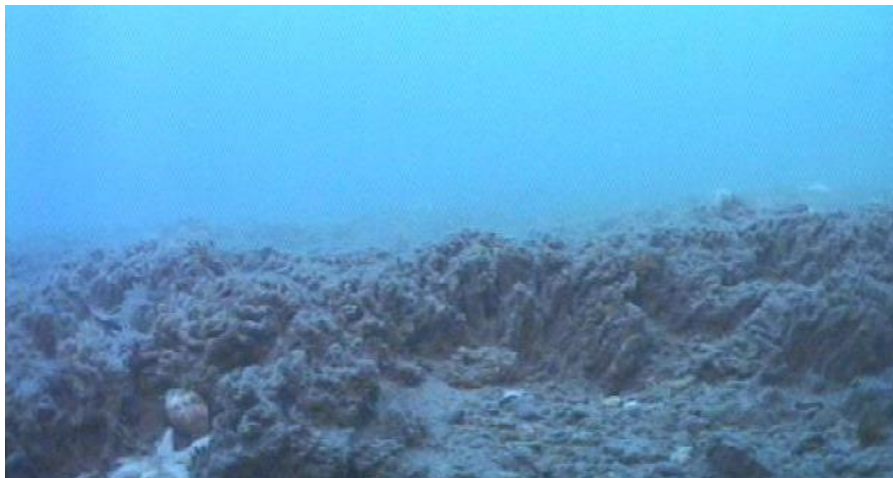




Offshore Special Area of Conservation: North Norfolk Sandbanks and Saturn Reef

SAC Selection Assessment



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Version 5.0 (20 August 2010)

* Cover photo illustrates the Saturn *Sabellaria spinulosa* reef in 2003 (BMT Cordah, 2003).

Introduction

This document provides detailed information about the North Norfolk Sandbanks and Saturn Reef site and evaluates its interest features according to the Habitats Directive selection criteria and guiding principles. Two separate SAC recommendations have been combined into one SAC in this paper: the North Norfolk sandbanks and Saturn *Sabellaria spinulosa* reef candidate SAC supersedes the previous draft SAC proposals for both Saturn *Sabellaria spinulosa* reef SAC and for the North Norfolk Sandbanks SAC.

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

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

Sites eligible for designation as offshore marine SACs are selected on the basis of the criteria set out in Annex III (Stage 1) to the Habitats Directive and relevant scientific information. Sites are considered only if they host a Habitats Directive Annex I habitat or Annex II species. Moreover, sites for Annex II species must contain a clearly identifiable area representing physical and biological factors essential to these species' life and reproduction to be eligible. Socio-economic factors are not taken into account in the identification of sites to be proposed to the European Commission¹.

In addition to information on the Annex I habitats and/or Annex II species hosted within the site, this document contains i) a chart of the site, ii) its name, location and extent, and iii) the data resulting from application of the criteria specified in Annex III (Stage 1) to the Habitats Directive. This is in line with legal requirements outlined under Regulation 7. JNCC has adhered to the format established by the Commission for providing site information. This format is set out in the 'Natura 2000 Standard data form' (CEC, 1995) (prepared by the European Topic Centre for Biodiversity and Nature Conservation on behalf of the European Commission to collect standardised information on SACs throughout Europe).

¹ Following European Court of Justice 'First Corporate Shipping' judgement [C-371/98](#) (7 November 2000)

Document version control

Version and issue date	Amendments made	Issued to and date
NNSandbanksandSaturnReef_SelectionAssessment_5.0.doc (20 th August 2010)	- Site changed to candidate SAC throughout the document	Submission to Europe (20 August 2010)
NNSandbanksandSaturnReef_SelectionAssessment_4.0.doc (3 rd July 2008)	- Post consultation modifications, including site boundary amendment	Secretary of State (July 2008)
NNSandbanksandSaturnReef_SelectionAssessment_3.1.doc (13 th November 2007)	- Draft SAC changed to possible SAC	Public consultation (December 2007)
NNSandbanksandSaturnReef_SelectionAssessment_3.0.doc (25 th May 2007)	- New introductory text, revised site summary and map layout, heading & text amendments - Additional guiding principles for site selection incorporated under Global Assessment - Conservation Objectives and Advice on Operations moved to separate document	JNCC Committee (June 07) and UK Marine Biodiversity Policy Steering Group (September 07)
NNSandbanksandSaturnReef Dossier_2.0_Draft.doc (26 th August 2006)	- Saturn reef feature added to North Norfolk sandbanks dSAC - Draft Conservation objectives and (revised) Advice on Operations added. - Map layout revised	Defra, Devolved Administrations, other Govt. departments (25 th September 2006)
North Norfolk Sandbanks Proforma and provisional management action statements: JNCC 05 P10 (September 2005)		JNCC Committee (September 2005) and Defra (Dec 2005)
Saturn Sabellaria Reef Proforma: JNCC 04 P09 (June 2004)		JNCC Committee (June 2004) and Defra (2004)

Further information

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

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North Norfolk Sandbanks and Saturn Reef : SAC Selection Assessment

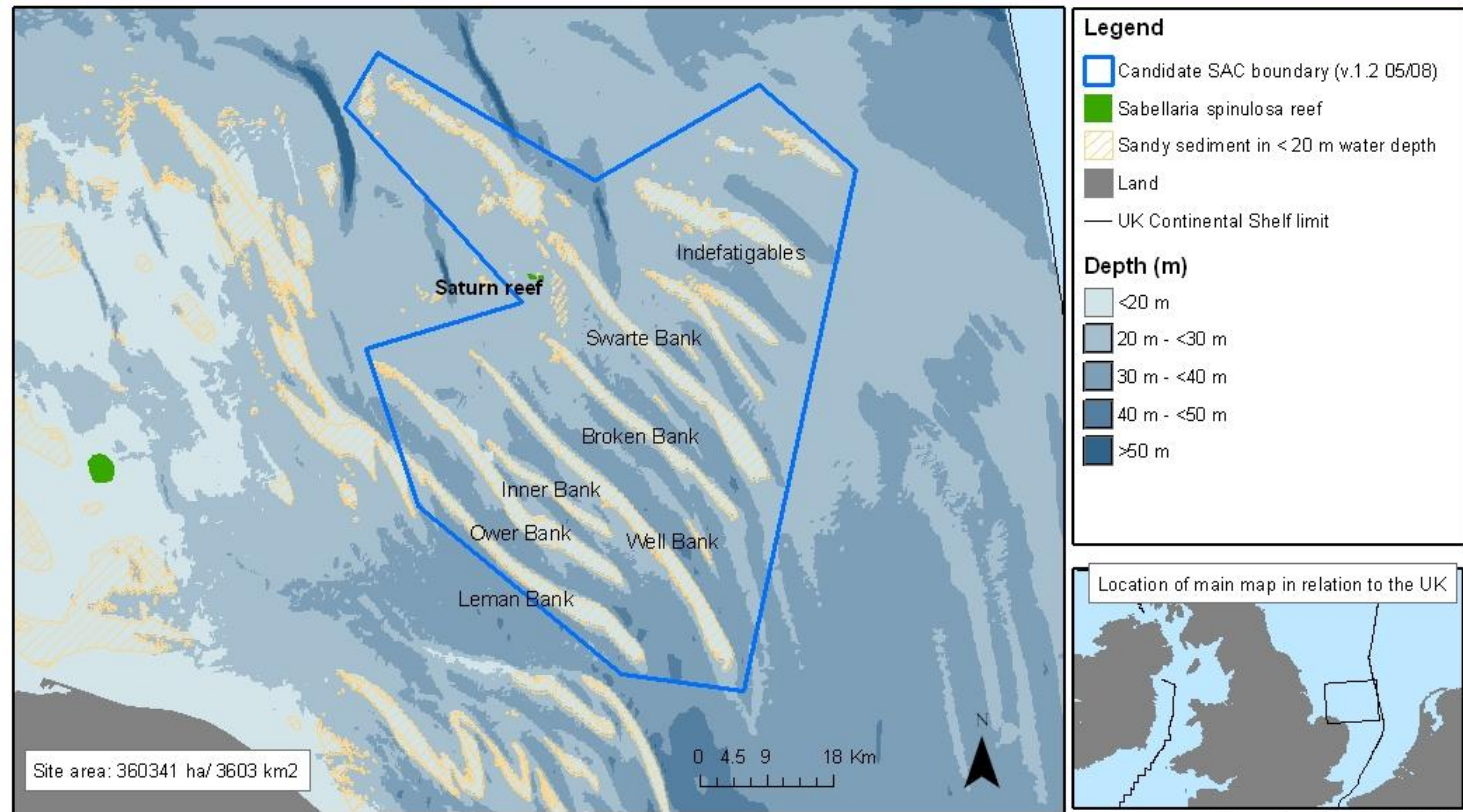
<p>1. Site name</p> <p>North Norfolk Sandbanks and Saturn Reef</p>	<p>2. Site centre location</p> <p>53°22'29", 2°7'15" (Datum: WGS 1984)</p>
<p>3. Site surface area</p> <p>360,341 ha/ 3,603 km² (Datum: WGS 1984 UTM Zone 31 North, calculated in ArcGIS)</p>	<p>4. Biogeographic region</p> <p>Atlantic</p>

5. Interest features under the EU Habitats Directive

1110 Sandbanks which are slightly covered by sea water all the time
1170 Reefs

6. Map of site

Offshore Special Area of Conservation Site Map: North Norfolk Sandbanks & Saturn Reef



Boundary coordinates:
 1) 53°37'0", 2°36'0" 2) 52°58'52", 2°22'42" 3) 53°0'0", 2°07'60" 4) 53°12'3", 1°43'1" 5) 53°23'24", 1°36'27" 6) 53°26'58", 1°55'13" 7) 53°40'57", 1°33'18"
 8) 53°45'0", 1°37'0" 9) 53°36'0", 2°4'0" 10) 53°43'0", 2°24'0"

Site map projected in UTM (Zone 31N, WGS84 datum). Seabed habitat derived from BGS 1:250,000 seabed sediment maps © NERC and SeaZone bathymetry. Bathymetry © British Crown and SeaZone Solutions Limited. All rights reserved. Products Licence No. PGA042006.003. This product has been derived in part from material obtained from the UK Hydrographic Office with the permission of the Controller of Her Majesty's Stationery Office and UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION. The exact limits of the UK Continental Shelf are set out in orders made under section 1(7) of the Continental Shelf Act 1964 (© Crown Copyright). Map copyright JNCC 2008.

7. Site summary

The North Norfolk Sandbanks and Saturn Reef site comprises i) a series of ten main sandbanks and associated fragmented smaller banks formed as a result of tidal processes; and ii) areas of *Sabellaria spinulosa* biogenic reef.

The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters (Graham *et al.*, 2001). They are subject to a range of current strengths which are strongest on the banks closest to shore and which reduce offshore (Collins *et al.*, 1995). The outer banks are the best example of open sea, tidal sandbanks in a moderate current strength in UK waters. Sandwaves are present, being best developed on the inner banks; the outer banks having small or no sandwaves associated with them (Collins *et al.*, 1995). The banks support communities of invertebrates which are typical of sandy sediments in the southern North Sea such as polychaete worms, isopods, crabs and starfish. The sandbanks have a north-west to south-east orientation and are thought to be progressively, though very slowly, elongating in a north-easterly direction (perpendicular to their long axes) (Cooper *et al.*, 2008). They extend from about 40km (22 nautical miles) off the north-east coast of Norfolk out to approximately 110km (60n miles) (Collins *et al.*, 1995). The banks included are: Leman, Ower, Inner, Well, Broken, Swarte and four banks called, collectively, the Indefatigables. The summits of the banks are in water shallower than 20m below Chart Datum, and the flanks of the banks extend into waters up to 40 m deep.

The Saturn *Sabellaria spinulosa* biogenic reef, first discovered in 2002, consists of thousands of fragile sand-tubes made by ross worms (polychaetes) which have consolidated together to create a solid structure rising above the seabed (BMT Cordah, 2003). This structure qualifies as Annex I Reef according to European Commission interpretation (CEC, 2007). Reefs formed by *Sabellaria* allow the settlement of other species not found in adjacent habitats leading to a diverse community of epifaunal and infaunal species (MarLIN, 2006a). In 2003, the Saturn reef covered an area approximately 750m by 500m just to the south of Swarte Bank, varying in density over this area (BMT Cordah, 2003). More recent survey in the Saturn area did not find the extensive reef found in 2003, but whether this absence is as a result of damage to the reef structures (e.g. by bottom trawling) or whether such reefs are naturally ephemeral is not yet known. However, formation of such a substantial reef of *Sabellaria spinulosa* in this area in 2003 indicates favourable conditions for reef formation.

This site is located within the Southern North Sea Regional Sea (JNCC, 2004a; Defra, 2004). Special Areas of Conservation in the southern North Sea for which 'Sandbanks which are slightly covered by sea water all the time' are qualifying features are shown below along with their notable characteristics:

SAC	Notable characteristics of sandbank/reef/submarine structure made by leaking gases(delete as appropriate) interest feature
The Wash and North Norfolk Coast	One of the largest expanses of inshore sublittoral sandbanks in the UK, and representative example of this habitat type on the more sheltered east coast of England. Headland associated, estuary mouth sandbanks and sandy mounds are all found at this site. The sandbanks vary in composition from coarse gravely sand to muddy sand, and some support eelgrass beds (Natural England,

	pers. comm. 2007). Salinity is variable/reduced and coastal influence is strong. Benthic communities on sandflats in the deeper, central part of the Wash are particularly diverse (brittlestar beds, polychaete <i>Lanice conchilega</i> , and the bivalve <i>Angulus tenuis</i> are present). The banks also provide nursery grounds for commercial fish species.
Essex Estuaries	Estuary mouth sandbanks in variable/reduced salinity and subject to strong coastal influence. These subtidal sandbanks are unvegetated and composed of gravelly and muddy sand (Natural England, pers. comm. 2007).
Humber Estuary	Estuary mouth sandbanks in variable/reduced salinity and subject to strong coastal influence. These subtidal sandbanks are unvegetated and composed of muddy sand (Natural England, pers. comm. 2007).

The sediments of the Wash and North Norfolk Coast are coarser and more subject to coastal influences (such as estuarine outflows) than those of the North Norfolk sandbanks further offshore; as a result, they support a different range of biological communities.

Special Areas of Conservation in the southern North Sea for which Reef is a qualifying Annex I habitat are shown below along with their notable characteristics:

SAC	Notable characteristics of Reef interest feature (JNCC, 2007b)
Flamborough Head	Bedrock and boulder chalk reefs which extend from the infralittoral to the circalittoral zone. The presence of many overhangs and vertical faces adds to the topographic complexity of the interest feature. These full salinity reefs are subject to strong coastal influence and high to moderate energy levels. Some typically northern species reach the edge of their range at this site (e.g. the northern alga <i>Ptilota plumosa</i>).
Thanet coast	Chalk bedrock reefs with associated chalk-boring fauna and flora. This inter-tidal and infralittoral feature has relatively high topographic complexity and is strongly influenced by coastal processes. It is in full salinity and exposed to moderate energy levels. The reefs are comparatively impoverished, owing to the harsh environmental conditions. Species present include an unusually rich littoral algal flora, essentially of chalk-boring algae.
The Wash and North Norfolk coast	<i>Sabellaria spinulosa</i> biogenic reefs and associated epibenthic and crevice fauna. These subtidal reefs stand up to 30 cm proud of the seabed and extend for hundreds of metres. The reefs are diverse and productive habitats which support many species that would not otherwise be found in predominantly sedimentary areas. Associated motile species include large numbers of polychaetes, mysid shrimps, the pink shrimp <i>Pandalus montagui</i> , and crabs. The site is strongly influenced by coastal processes.

The biogenic reef within the North Norfolk Sandbanks and Saturn Reef site is of the same type as the reef in The Wash and North Norfolk coast SAC. However, as with the sandbanks, the Saturn Reef is in slightly deeper waters, and not subject to coastal influences, and is therefore likely to support different epifaunal communities to those found inshore. *Sabellaria spinulosa* biogenic reef is limited in geographical range in UK waters to the southern North Sea, English Channel and Bristol Channel.

8. Site boundary

The proposed site boundary for the North Norfolk Sandbanks and Saturn Reef site has been defined using JNCC's marine SAC boundary definition guidelines (JNCC, 2004b) and information provided during public consultation on this site in 2007-2008. The proposed boundary is a simple polygon enclosing the minimum area necessary to ensure protection of the Annex I habitats, taking into account potential movement of the sandbanks. The boundary presented includes both 'sandy sediments in less than 20m water depth' and the flanks and troughs of these banks which are also part of the sandbank feature but extend into deeper waters. Coordinate points have been positioned as close to the edge of these interest features as possible, rather than being located at the nearest whole degree or minute point. No margin to allow for mobile gear was applied given the shallow water depth at this site and the lack of a precise feature edge from which to add a margin.

The boundary of the site has been defined to enable conservation of the structure and functions of the sandbanks and to include representation of both more disturbed (inshore) and more stable (offshore) sandbank biological communities. The sandbank structures are maintained through offshore sediment transport, with each bank acting as a stepping stone, and the development of new sandbanks between existing banks. Therefore, the proposed boundary encompasses the whole linear sandbank system rather than attempting to separate out individual banks. The proposed boundary allows for the potential elongation of banks in a north-easterly direction, and the coarse scale at which the underlying geological and bathymetric data are mapped.

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

9. Assessment of interest feature against selection criteria

9.1. Sandbanks

Annex III selection criteria (Stage 1A)

a) Representativity

The North Norfolk sandbanks site is located in the southern North Sea, and represents non-vegetated, sublittoral, open shelf ridge tidal current sandbanks consisting of sandy sediment. The interest feature is located in full salinity waters, away from coastal influences. The North Norfolk sandbanks as a group are the best example of tidal linear sandbanks in UK waters. Sandwaves are present on the banks indicating that the surface sediment is regularly mobilised by tidal currents. This observation is reflected in the biological communities present: they are typical of the biotope 'infralittoral mobile clean sand with sparse fauna'

(Connor *et al.*, 2004). This biotope is characterised by common epifaunal species such as hermit crabs *Pagurus bernhardus*, swimming crab *Liocarcinus depurator*, common shore crab *Carcinus maenas* and starfish *Asterias rubens*. Where the substratum is highly mobile, there are fewer infauna. The grade for the feature as a whole (including all banks within the site) is A (excellent representativity).

b) Area of habitat

The evaluation of relative surface area is approximate as it is not possible to calculate an accurate total extent figure for Annex I shallow sandbank habitat for UK waters. A best minimum estimate, based on the mapped area of sandy sediments in less than 20m water depth, of 733,100 hectares (UK Favourable Conservation Status Reporting 2007) has been used to assess area of habitat. This figure gives the following thresholds for the grades of this criterion (CEC, 1995):

A – extents between 733,100 and 109,965 ha (15-100% of total resource)

B – extents between 109,965 and 14,662 ha (2-15% of total resource)

C – extents less than 14,662 ha (0-2% of total resource)

The North Norfolk sandbank habitat occupies a minimum area of 54,488ha (based on the 20 m contour, LAT datum). The area of the interest feature falls between the '2 and 15%' bracket on the Natura 2000 Data Form and is therefore graded as B. As noted above, the actual area of sandbank within the North Norfolk sandbanks SAC is larger than this minimum extent figure based on the 20m contour, as the banks themselves extend into deeper waters. The parts of the banks in deeper waters are considered integral to the structure and functions of the banks and an integral part of the sandbank feature of conservation interest, although their precise extent is not defined. Minimum figures for the area of each individual bank are presented in Table 1 below. These figures are minimum areas as they are based on the area of sandy sediment in less than 20m water depth, and do not include the flanks of the banks and channels between them in water deeper than 20m.

Table 1. Minimum areas (hectares) of sandbank within the North Norfolk sandbank series

Bank	Minimum Area (ha) ²
Indefatigable 1	1,651
Indefatigable 2	6,502
Indefatigable 3	1,852
Indefatigable 4	2,319
Swarte	13,469
Broken	4,108
Well	8,432
Inner	2,000
Ower	7,541
Leman	6,614

² Minimum extent calculated from sandy sediment in less than 20m water depth derived from BGS Surface Seabed Sediments and UKHO bathymetry (offshore scale, LAT datum).

c) Conservation of structure and functions

Degree of conservation of structure

The biological and physical structure of the North Norfolk Sandbanks may have been impacted locally by some gas extraction infrastructure (mainly pipelines across banks) (UK DEAL, 2006) on the two inner banks of the Indefatigables, the north-west tip of Broken bank, the south-east portions of Well, Ower and Leman banks and the north-west tip of Ower bank. Aggregate extraction occurs near to the NW boundary though it is unlikely that this has had a significant impact on the sandbanks. It is highly probable that the fauna of the banks have been impacted by bottom trawling which is known to occur at this site (MFA, 2008). This may have reduced the number of long-lived or fragile organisms associated with the interest feature. The physical structure of the banks is intact, if not pristine, and the biology is representative of the habitat. The grading is III: average or partially degraded structure.

Degree of conservation of functions

The prospects of this feature to maintain its structure in the future, taking into account unfavourable influences and reasonable conservation effort, are good. Regulations are in place to control oil and gas activity in and around SACs in the UK Continental Shelf Designated Area and developments are subject to appropriate assessment if they are likely to affect the features of a SAC. A mechanism is available through the European Commission's Common Fisheries Policy regulations to modify fishing activity in the area if this is deemed to be necessary. The aggregates industries' operations are currently subject to Environmental Assessment, and would be subject to appropriate assessment if likely to affect SAC interest features. The laying of submarine cables and pipelines also requires regulatory consent. The banks are distant from terrestrial sources of pollution. The grading is II: good prospects.

Restoration possibilities

Restoration of habitat on the North Norfolk sandbanks would be possible accepting that restoration methods in the offshore area focus on the removal of impacts which should allow recovery where the habitat has not been removed. The grading is II: restoration possible with average effort.

Overall grade

When grade III for the first sub-criterion, grade II for the second sub-criterion and grade II for the third sub-criterion are combined, the overall grade for the criterion is C: average or reduced conservation.

d) Global assessment

The suggested grades for Stage 1A criteria a)-c) are A, B and C respectively. Taking all the above factors into consideration, the Global Assessment grade is B ('good conservation value').

Summary of scores for Stage 1a criteria

Area of habitat	Representativity (a)	Relative surface (b)	Structure and function (c)	Global assessment (d)
North Norfolk Sandbanks	A	B	C	B

9.2. Reefs

Annex III selection criteria (Stage 1A):

a) Representativity

The 'Saturn' *Sabellaria spinulosa* reef is located in the Southern North Sea Regional Sea. This site represents *Sabellaria spinulosa* biogenic reef in an open, tide-swept situation on sand and gravelly sand habitat. The interest feature is located in full salinity waters, away from coastal influences. Images of the reef (BMT Cordah, 2003) showed the structure to rise well above the seabed (around 10 cm) and densely cover the substratum. Some patches of the reef had an elevation of around 25cm (Vicki Hendrick, pers. comm., 2007). Despite the widespread occurrence of the species *Sabellaria spinulosa*, there are few known areas of well developed biogenic reef formed by *Sabellaria spinulosa* in UK waters (and very few in other European waters). The grade for the feature is A: excellent representativity.

Note: Since the above assessment was made based on 2003 data, new survey work (Bob Foster-Smith, Dave Limpenny, pers. comm., 2006) conducted in the same area found no substantial reef structures. Further research is under way: we do not yet know whether the disappearance of the reef structures is complete, nor if it 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). In any case, we know that this particular area is suitable for the development of the substantial and extensive reef structures observed in 2003, and that *Sabellaria spinulosa* preferentially settle on suitable habitat where the species has been present before (Hendrick and Foster-Smith, 2006). Therefore the area should be protected from operations which may damage or prevent such reef structures from re-forming naturally to allow restoration of the feature. Monitoring should be carried out to identify reef structures as they recover, and any activities likely to damage them.

b) Area of habitat

An evaluation of relative surface area is approximate as no accurate total extent figure is available for Annex I reef habitat for UK waters. The closest approximation available for the entire resource (bedrock, cobble and biogenic reef) in UK waters is 5,723,600 hectares (UK Favourable Conservation Status Reporting 2007). This total extent figure gives the following thresholds for the grades of this criterion (CEC, 1995):

- A – extents between 5,723,600 and 858,540 ha (15-100% of total resource);
- B – extents between 858,540 and 114,472 ha (2-15% of total resource);
- C – extents less than 114,472 ha (0-2% of total resource).

In 2003, the Saturn reef feature had an area of approximately 115 hectares (based on interpreted sidescan with ground validation) and this included areas of both dense and less

dense clumps (BMT Cordah, 2003). This site's feature therefore falls within the '0-2%' bracket for Area of Habitat and is graded C.

c) Conservation of structure and functions

Degree of conservation of structure

In 2003 the biological and physical structure of the biogenic reef in this area was mainly intact, although there was an area in the south which had been fragmented, presumably by bottom trawling (BMT Cordah, 2003). This type of demersal fishing is known to take place within the site boundary (MFA, 2008). The underlying sandbank structure is likely to be significant in providing conditions suitable for the formation of the reef, as well as maintaining its structure and function. The grading for this feature, based on the 2003 survey, was II: structure well conserved.

Degree of conservation of functions

The prospects of this feature to maintain its structure in the future, taking into account unfavourable influences and reasonable conservation effort are moderate. A mechanism is available through the European Commission to modify fishing activity in the area. The oil and gas and aggregates industries' operations are currently subject to Environmental Assessment, and are subject to appropriate assessment if likely to affect SAC interest features. The laying of submarine cables and pipelines also requires regulatory consent. The area is quite distant from terrestrial sources of pollution, and potential local sources of pollution (from oil & gas industry activities) are also subject to regulation. However, *Sabellaria spinulosa* is vulnerable to mechanical damage from storms and this feature could be degraded in spite of reasonable conservation effort. The grading is II: good prospects.

Although recent surveys have not detected the substantial reef structures identified in 2003, until all operations likely to damage the reef structure (eg. bottom trawling) are excluded from the reef area (with subsequent monitoring of the site), it will not be possible to ascertain whether the absence of the substantial reef structures since 2003 is part of a natural cycle of growth and degeneration, or is caused by human activity. Therefore the assessment of conservation structure and functions is based on the 2003 data, but may need to be modified if new information becomes available.

Restoration possibilities

Restoration methods in the offshore area focus on the removal of impacts which should allow recovery where the habitat has not been removed. Restoration of the biogenic reef habitat should be possible if suitable underlying substratum and conditions for reef re-growth remain. A recent report by Pearce *et al.* (2007) indicates that *Sabellaria* aggregations can recover within 5 years of a damaging event, suggesting the Saturn reef could be re-established if this area were afforded protection from physical disturbance. The grading is II: restoration possible with an average effort.

Overall grade

When grade II for the first sub-criterion and grade II for the second sub-criterion are combined, the overall grade for the criterion is B: good conservation.

d) Global assessment

The suggested grades for Stage 1A criteria a)-c) are A, C and B respectively.

The assessment of Area of Habitat (criterion b) is made with reference to the area of *all* sub-types of reef habitat combined (bedrock, cobble and biogenic). Because the *Sabellaria* reef at this site occupies a relatively small area in relation to the total UK reef resource, its grade for this criterion is C as reefs overall are widely distributed and extensive in UK waters. The species *Sabellaria spinulosa* itself is widely distributed and common in UK waters, occurring as individuals and also forming ‘crusts’ of many individuals on sandy and mixed coarser sediments as well as rock. However, substantial reef structures formed by *Sabellaria spinulosa* could be considered rare as they are relatively small (less than 1000ha) and only occur in four known locations in UK waters. The Saturn reef in 2003 was one of the two best developed examples, the other being partly within the Wash and North Norfolk SAC. Due to the scarcity of this sub-type of reef habitat in UK and European waters, a high proportion of the habitat should be protected. The scarcity of the habitat is believed to be in part attributable to its vulnerability to damage from bottom trawling.

Given these gradings, the rarity of *Sabellaria spinulosa* biogenic reef in UK waters, and the large extent and good development in 2003 of this reef subtype, the Global Assessment grade is A (‘excellent conservation value’).

Summary of scores for Stage 1a criteria

Area of habitat	Representativity (a)	Relative surface (b)	Structure and function (c)	Global assessment (d)
'Saturn' <i>Sabellaria spinulosa</i> reef	A	C	B	A

10. Sites to which this site is related

This site subsumes the former Saturn *Sabellaria spinulosa* Reef dSAC advised to Defra in 2004, as the Saturn reef is wholly within the area of the North Norfolk Sandbanks cSAC.

11. Supporting scientific documentation

Scientific information on the Sandbanks comes from the DTI (SEA 2), and EC Biodiversity Survey (Zuhlke, 2000), as well as the UKOOA dataset of environmental surveys (UKBenthos, 2001). A detailed statistical analysis of data obtained through the DTI Strategic Environmental Assessment process (SEA 2) (Survey documented in Hartley Anderson Ltd., 2001) was undertaken by JNCC. Part of the site area was also surveyed by Entec/Envision on behalf of Natural England, as part of their Outer Wash Sandbank survey (Natural England, 2008). See Figure 1 for the location of datapoints.

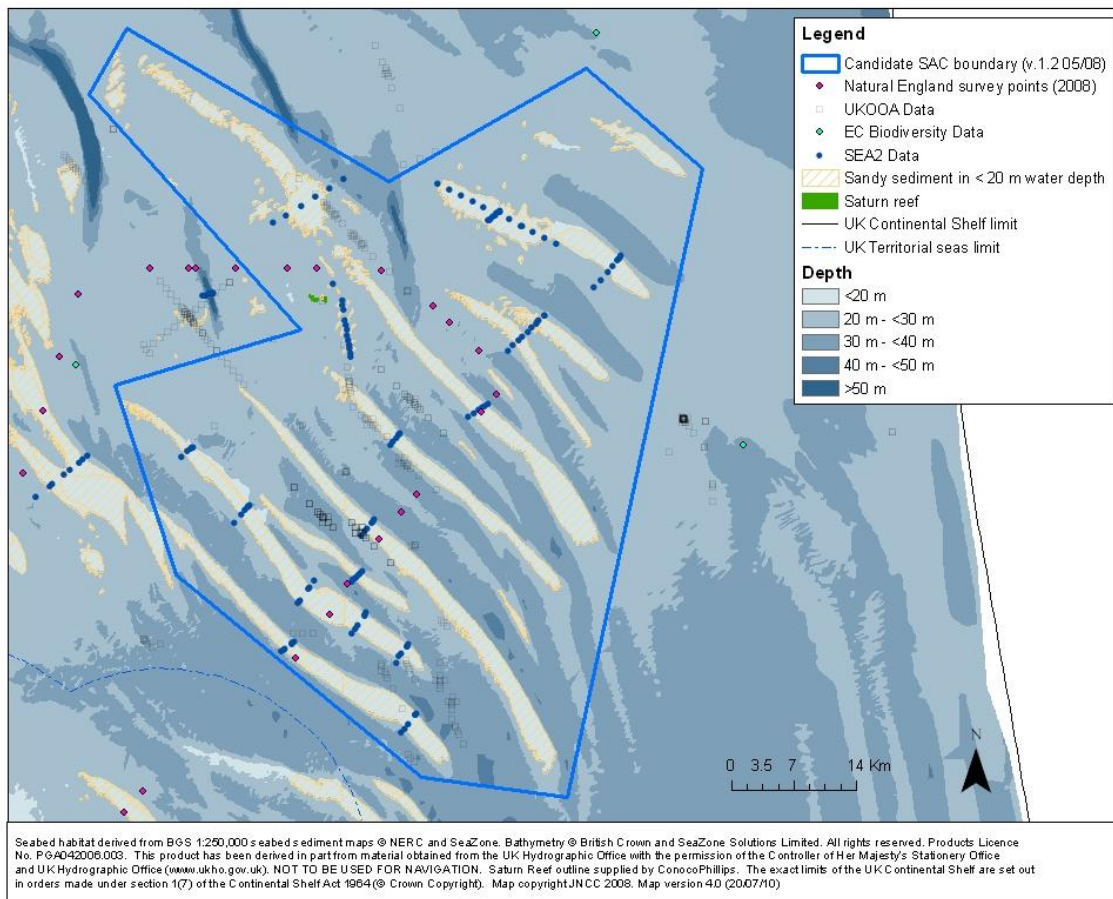


Figure 1. Data used for habitat characterisation (sediment type and biological community) within the North Norfolk Sandbanks and Saturn Reef site boundary

The area of biogenic reef was first discovered during a proposed North Sea pipeline route survey in 2002. Sonarographic scans of the seabed identified a shadow that was subsequently investigated by means of a sediment grab. The sample was described as consisting of “tubeworms” and this was reported to ConocoPhillips. In 2003, ConocoPhillips commissioned Subsea 7 to undertake a visual survey of the area using an ROV to determine the identity and extent of these tubeworms (BMT Cordah, 2003). Video and photographic images taken during this survey clearly demonstrated the presence of *Sabellaria spinulosa* reef (and its associated fauna). This survey provides most of the scientific information on the *Sabellaria spinulosa* reef at the site (BMT Cordah, 2003) on which this assessment is based. Subsequent to the recommendation of this site to Defra in 2005, additional surveys have been undertaken in the Saturn area to further study the reef structures (Bob Foster-Smith and Dave Limpenny, pers. comm., 2006).

12. Site overview and conservation interest

Sandbanks

The North Norfolk sandbanks as a group are the best example of tidal linear sandbanks in UK waters. The outer Indefatigable banks are the best example of open sea, tidal sandbanks in a moderate current strength in UK waters. The inner banks of the group (Leman and Ower) are likely to be similar in nature to the banks of the Haisborough grouping. The North Norfolk Sandbanks are active systems that are thought to be progressively, although very slowly, elongating in a north-easterly direction (Cooper *et al.*, 2008). It is difficult to

demonstrate whether or not such migration occurs at the present time and at what rate (Cooper *et al.*, 2008). However, recent observations of water movement, sand wave asymmetry and sand tracers support an offshore sand transport component (Collins, *et al.* 1995). The sandbanks act as stepping stones transporting sand from the coastline seaward, with the material transported offshore partly contributing to the development and maintenance of the sandbank system, and eventually dissipated into deeper waters (Collins *et al.*, 1995). It has been suggested that new embryonic sandbanks are present in the swales between the banks. The sandbanks are generally asymmetric with a steeper face of about 6° to the northeast and a flatter face of less than 1° on the opposite flank (Houbolt, 1968; Caston, 1972; and Stride, 1988 all cited in Cooper *et al.* 2008).

In general the biological communities on the sandbanks, as re-analysed by JNCC are typical of highly mobile fine sand sublittoral sediments, with the communities present all representative of the infralittoral mobile sand biotope (UK Marine Habitat Classification Code SS.SSa.IFiSa.IMoSa, Connor *et al.*, 2004). Species typical of this habitat include the polychaete *Nephtys cirrosa* and the isopod *Eurydice pulchra*. Opportunistic populations of infaunal amphipods and low numbers of mysids such as *Gastrosaccus spinifer* are also typical in more stable examples of this biotope. Sand eels *Ammodytes* sp. may occasionally be observed in association with this biotope (and others) as well as other common epifaunal species such as hermit crabs (*Pagurus bernhardus*), swimming crab (*Liocarcinus depurator*), common shore crab *Carcinus maenas* and the common starfish *Asterias rubens*.

The series of sandbanks within this site are very similar in terms of the biological communities present. However, the communities present represent a gradient within the infralittoral mobile sand biotope from those with few species present on the inner and eastern most end of the outer banks, to those with increasing species numbers on the outer most banks, particularly in the Indefatigables and the western-most end of Swarte bank. This change in biological community, albeit within a single biotope, is likely to be related to the change in hydrodynamic regime with increasing distance from the coast. Currents on the inner most banks are stronger than on the outer most banks and, therefore, the communities are more disturbed on the inner compared to the outer banks. Therefore, the site encompasses representative areas of both more disturbed and more stable sandbank communities.

There are no data currently available on fish and mobile epifaunal species at a suitable scale specifically within the proposed site boundary. However, general information on the interest of the area in relation to fish, with a bias towards commercially exploited species as it is for these that data have been collected, can be gleaned from sources such as Fisheries Sensitivity Maps in British Waters' (Coull *et al.*, 1998) and Fisheries research scientists in both England and Scotland. Spawning and nursery areas for the species mentioned below are not unique to the proposed site, and are not rigidly fixed. The North Norfolk Sandbanks and Saturn Reef site is within recognised spawning areas for lemon sole and the eastern part for plaice and sprat. The whole site is within recognised nursery grounds for lemon sole and whiting and the northern half for sprat. At the north eastern edge of the site *Nephrops* (scampi, or Norway lobster) are also present.

***Sabellaria spinulosa* reef**

The biogenic *Sabellaria spinulosa* reef was surveyed by Subsea 7 under contract to ConocoPhillips in 2003. Formed by dense aggregations of the ross worm *Sabellaria spinulosa* (see Plate 1), it is located between Swarte and Broken banks on the edge of a small sandbank in the Southern North Sea (BMT Cordah, 2003). The density of Saturn *Sabellaria spinulosa* reef varied across the area (see Plates 2 and 3). A core section of near continuous and high profile reef (10cm high) with very dense coverage (90%) was identified.

Some parts of this core reef section rose to 25cm above the seabed (Vicki Hendrick, pers. comm., 2007). Also observed were more patchy areas with 10-50% coverage and even sparser reef patches with less than 10% coverage (BMT Cordah, 2003). Overall, the extent of the ross worm reef was estimated to be approximately 750m x 500m, with nearly 50% (500m x 250m) consisting of the higher profile reef (BMT Cordah, 2003). Reef patches were either broken by various shaped 'holes' or were elongated strips, raised above surrounding seabed. Surrounding sediment included both tube debris and non-tube sediment (silty sand/stones). Damage to the reef structure, believed to be the result of trawling, was also observed, particularly in the south western part of the area (see Plate 4).

Though *Sabellaria spinulosa* reefs are of interest because of their biodiversity, it is recognised that the fauna found in and on the reef are not exclusive to this habitat (Foster-Smith and Hendrick, 2003; George and Warwick, 1985). Samples of the reef were taken and 103 species were identified with a breakdown into major faunal groups as indicated in Table 2.

Table 2. Percentage distribution of species recorded

Faunal group	Percentage of total species
Polychaetes	58
Crustaceans	16
Molluscs	8
Echinoderms	6
Others	13

Notable species which were more abundant within the biogenic reef were:

- i) Worms: *Pholoe synophthalmica*, *Mediomastus fragilis*, *Notomastus* sp. A, and *Scalibregma inflatum* ii) Decapods: *Galathea intermedia*, *Pisidia longicornis*, *Upogebia deltuara*, *Ebalia cranchii*, and *Pilumnus hirtellus* iii) Bivalve molluscs: *Abra alba*, *Mysella bidentata*, *Tapes rhomboides* and *Mya truncate* iv) Gastropod molluscs: *Noemiamea dolioliformis*. These worms and bivalve molluscs are typical of soft sediments. The reef structure allows for the accumulation of fine sediments and hence facilitates colonisation and proliferation of these species. In adjacent, reef-free, sediments they are unlikely to be present in such high numbers (BMT Cordah, 2003).
- ii) The reef also supports epifaunal species, especially small crabs such as *Pisidia longicornis*, *Ebalia cranchii*, and *Pilumnus hirtellus*. Also present were squat lobsters (*Galathea intermedia*) which are otherwise abundant only where stones, cobbles and rocks offer hideaways. The gastropod mollusc *Noemiamea dolioliformis*, believed to be an ectoparasite of *Sabellaria* (Killeen and Light, 2000), was also recorded (BMT Cordah, 2003).



Plate 1. Close up of ross worm (*Sabellaria spinulosa*) aggregations, showing tubes built from sand (BMT Cordah, 2003)



Plate 2. Patches of *Sabellaria spinulosa* reef (up to 25cm high) and associated fauna at the Saturn survey site (BMT Cordah, 2003)

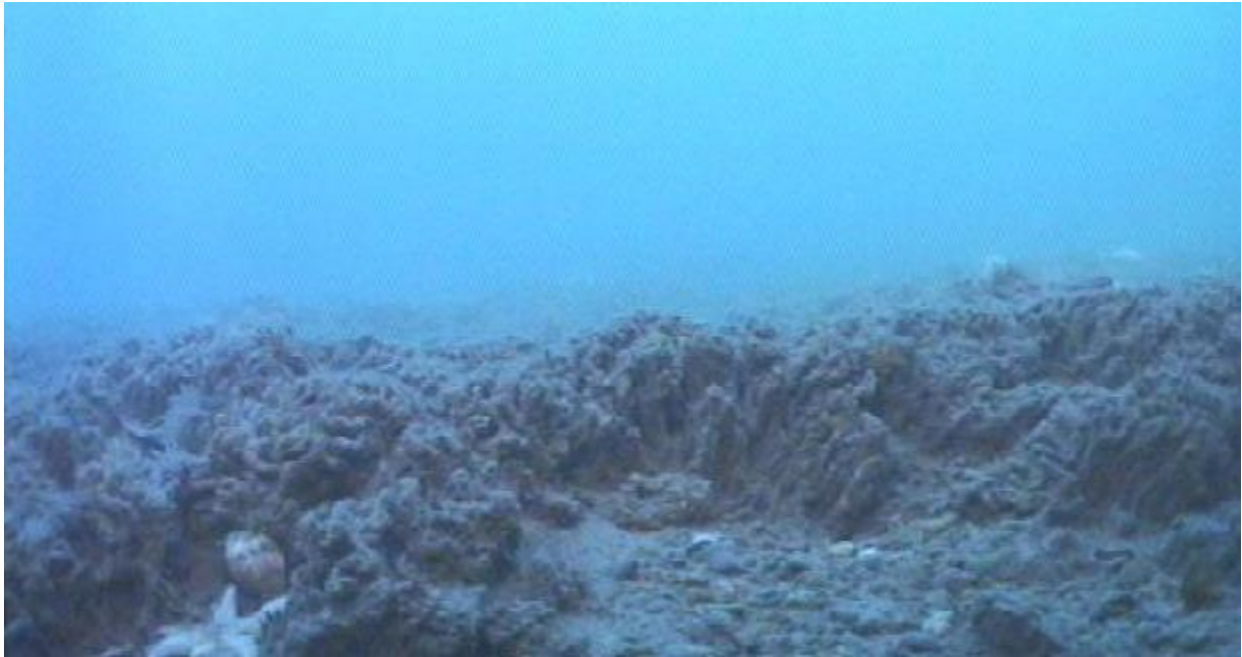


Plate 3. General *Sabellaria spinulosa* reef view showing profile and extent (BMT Cordah, 2003)



Plate 4. Suspected trawl damage of the *Sabellaria spinulosa* reef (BMT Cordah, 2003)

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