Offshore Special Area of Conservation: Dogger Bank

SAC Selection Assessment Document

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Version 9.0 (26th August 2011)

* Cover photo shows whiting (*Merlangius merlangus*) and sand eels (*Ammodytes* spp.) on the Dogger Bank.

Introduction

This document provides detailed information about the Dogger Bank candidate Special Area of Conservation and evaluates its interest features according to the Habitats Directive selection criteria and guiding principles.

The advice contained within this document is produced to fulfil requirements of JNCC under Part 2 of the Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended) relating to the conservation of natural habitat types and habitats of species through identification of Special Areas of Conservation (SACs) in UK offshore waters. JNCC provides nature conservation 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 (as amended) to enable the Secretary of State to transmit to the European Commission the list of sites eligible for designation as Special Areas of Conservation (SACs). JNCC have been asked by 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 Commission[1].

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
DoggerBank_SelectionAssessment_v9_0.doc (26th August 2011)	- Site changed to candidate SAC throughout the document	European Commission, 26th August 2011
DoggerBank_SelectionAssessment_v8_0.doc (21st January 2011)	- Document updated following comments from Joint Committee MPA sub-group, UKMBPSG and UK MPA Policy Group Node 12 added to site boundary and site area re-calculated.	Defra, 21st January 2011
DoggerBank_SelectionAssessment_v7_0.doc (2nd December 2010)	- Document updated following comments from formal consultation.	Defra, MPA Sub-Group (13th December 2010)
DoggerBank_SelectionAssessment_v6_0.doc	- Site changed to possible SAC throughout the document	Public consultation (20 August 2010)
DoggerBank_SelectionAssessment_v5_0.doc	- Amended site boundary (v1.6) and regrading of harbour porpoise (Grade D) following reassessment of data in response to scientific questions on site justification	Defra, DAs 5 March 2010
DoggerBank_SelectionAssessment_4.0.doc	- Amended site boundary (v 1.5) based on new survey data from April 08 - Harbour porpoise graded as qualifying feature of the site (grade C) - Site centroid and boundary co-ordinates changed to degrees, minutes and seconds - Site map changed to incorporate 50m sand - Text description of 50m sand incorporated - Map of European SACs changed to GEBCO bathymetry - Text changed in all sections to incorporate April 2008 survey data	Defra, DAs & OGDs 28 October 2008
DoggerBank_SelectionAssessment_3.5.doc	- Text on Harbour Porpoise amended	Defra, DAs & OGDs 18 June 08
DoggerBank_SelectionAssessment_3.4.doc	- Revised site boundary (v 1.3) based on slope analysis and updated scientific data; - Text on marine mammals amended; - Draft Conservation Objectives and Advice on Operations presented in separate document	Defra 3 June 08
DoggerBankDossier_2.0_Draft.doc (26th August 2006)	- Draft Conservation Objectives and (revised) Advice on Operations added. - Map layout revised (v 1.1)	Defra, Devolved Administrations, and other Govt. departments (25 September 2006)
DoggerBank_ProformaForJNCC.doc (15 December 2004)		Defra (15 December 2004)

Further information

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

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Dogger Bank: SAC Selection Assessment

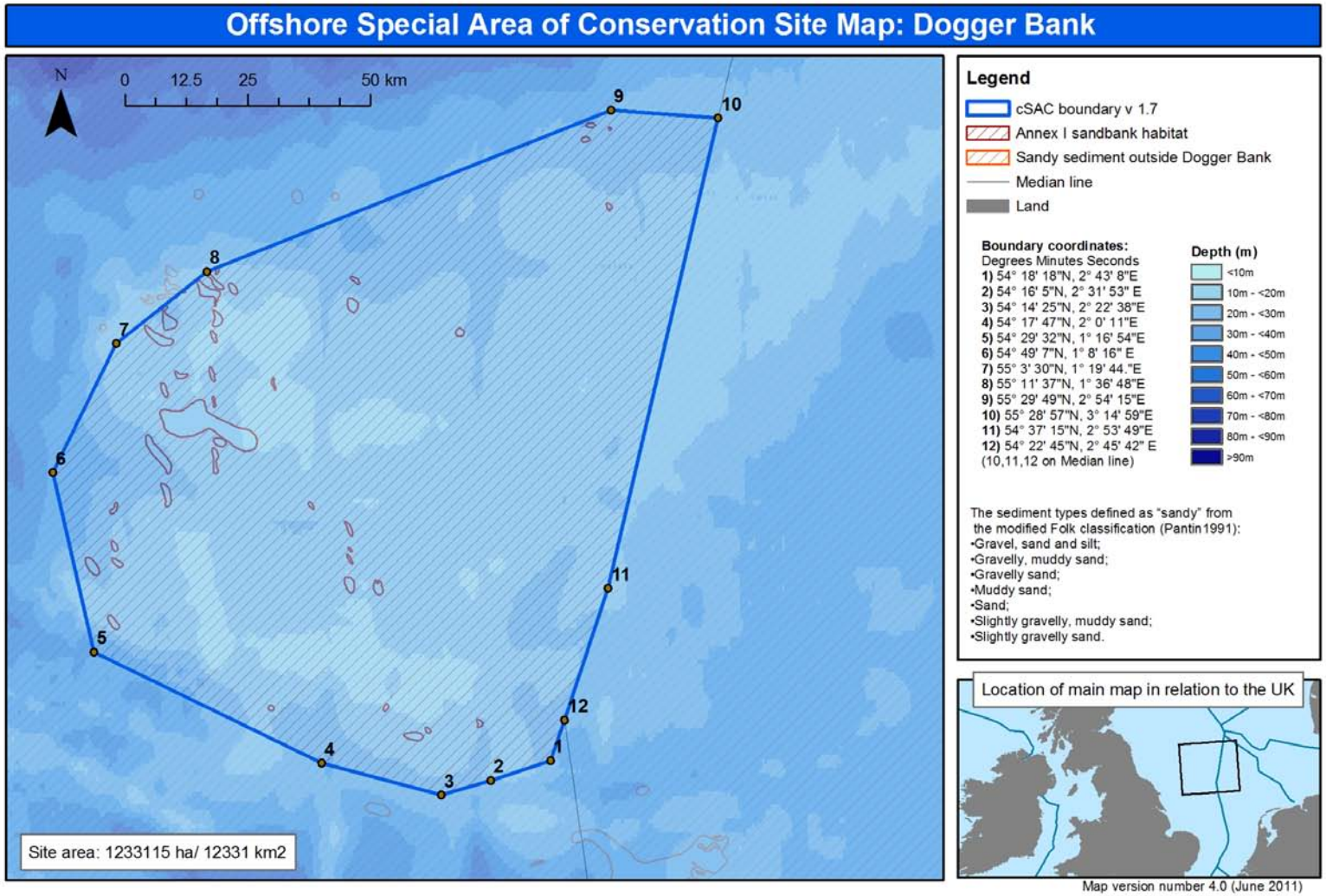
1. Site name	2. Site centre location
Dogger Bank	54º51'27", 02º13'08" (Datum: WGS 1984)
3. Site surface area	**4. Biogeographic region**
1,233,115 ha / 12,331 km^2 (Datum: WGS 1984 UTM Zone 31 North, calculated in ArcGIS)	Atlantic

5. Interest features under the EU Habitats Directive

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

1351 Harbour porpoise (*Phocoena phocoena*) (non-qualifying)
1364 Grey seal (*Halichoerus grypus*) (non-qualifying)
1365 Common seal (*Phoca vitulina*) (non-qualifying)

6. Map of site



Map version number 4.0 (June 2011)

Map projected in WGS84 (Zone 31N). World Vector Shoreline © US Defense Mapping Agency. Seabed habitat derived from BGS 1:250,000 seabed sediment maps © GEBCO bathymetry ,The GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of IOC and IHO, 2003. 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

7. Site summary

The Dogger Bank is the largest single continuous expanse of shallow sandbank in UK waters. It is located in the southern North Sea, approximately 150km north east of the Humber Estuary, and was formed by glacial processes before being submerged through sea level rise. The southern area of the bank is covered by water seldom deeper than 20m and extends within the cSAC in UK waters down to 35-40m deep. The bank structure slopes down further in UK and also in Dutch and German waters to greater than 50m deep. Its location in open sea exposes the bank to substantial wave energy and prevents the colonisation of the sand by vegetation on the shallower parts of the bank. Sediments range from fine sands containing many shell fragments on top of the bank to muddy sands at greater depths (Kröncke & Knust, 1995) supporting invertebrate communities typical of such sediments, characterised by polychaete worms, amphipods and small clams within the sediments, and hermit crabs, flatfish, starfish and brittlestars on the seabed (Wieking & Kröncke, 2001). Sand eels are an important prey resource found at the bank supporting a variety of species including fish, seabirds and cetacean (Cefas, 2007). Occasional, discrete areas of coarser sediments (including pebbles) were recorded on the bank, dominated by the soft coral *Alcyonium digitatum*, the bryozoan *Alcyonidium diaphanum* and Serpulid worms (Diesing *et al* 2009).

This site is located within the Southern North Sea Regional Sea and contains the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time'. Special Areas of Conservation in the Southern North Sea for which Annex I 'Sandbanks which are slightly covered by sea water all the time' is a qualifying feature are shown below along with their notable characteristics.

SAC	**Notable characteristics of Sandbank interest feature (JNCC, 2007)**
The Wash and North Norfolk Coast	Large expanse of coastal sublittoral sandbanks and a 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 gravelly sand to muddy sand, and some support eelgrass beds. 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, the polychaete *Lanice conchilega*, and the bivalve *Angulus tenuis* are present). The banks also provide nursery grounds for young 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.
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.

The Dogger Bank differs from the Wash and North Norfolk Coast in that the sediments of the Dogger Bank are finer and thus provide habitat for a different suite of species (English Nature, 2000). The Dogger Bank is also located further away from the coast, and therefore is less subject to coastal and freshwater influences. Three further areas have been put

forward to the European Commission for this feature in this region and are shown below with its characteristic features.

Candidate SAC (cSAC)	**Notable characteristics of Sandbank interest feature**
North Norfolk Sandbanks and Saturn Reef	A series of ten main sandbanks and associated fragmented smaller banks formed as a result of tidal processes: these are the most extensive example of the offshore linear ridge sandbank type in UK waters. The sandbanks are not vegetated, and support communities of invertebrates characteristic of southern North Sea sandbanks, ranging from those typical of highly-mobile fine sand sublittoral sediments, to communities on the outer banks which are more species rich, reflecting the lower sediment mobility. (Collins *et al* 1995)
Inner Dowsing, Race Bank and North Ridge	This site is located off the south Lincolnshire coast in the vicinity of Skegness. The area encompasses a wide range of sandbank types (banks bordering channels, linear relict banks, sinusoidal banks with distinctive subsidiary banks), associated channels and biogenic reef of *Sabellaria spinulosa*. The tops of the sandbanks are characterised by low diversity communities dominated by polychaete worms. The areas between these main sandbank features are composed of mixed sand and gravelly sands and are functionally linked to the sandbanks. Between the sandbanks, a diverse mosaic of biotopes occur dominated by the ascidian *Molgula* sp. along with a number of nemertean worms and polychaetes of the genera *Pomatoceros*, *Caulleriella*, *Polycirrus*, *Pholoe*, and *Lumbrineris*.
Haisborough, Hammond and Winterton	This site lies off the north east coast of Norfolk, and contains a series of sandbanks. The main sandbank ridge across the centre of the site is aligned with the curve of the coast and is composed of alternating ridge headland associated sandbanks in a characteristic S-formation (Dyer & Huntley 1999). This ridge is made up of Haisborough Sand, Haisborough Tail, Hammond Knoll, Winterton Ridge and Hearty Knoll. Hewett Ridge and Smiths Knoll form a ridge of sandbanks on the outer site boundary, and inshore there are additional banks including Winterton Shoal and the Newarp Banks. Infaunal communities on the tops of the sandbanks are impoverished, made up of small numbers of polychaetes and amphipods that are able to withstand dynamic sediment environments. On the flanks of the banks, and towards the troughs, where there is less water movement, sediments tend to be more stable and gravelly. In these regions of the site, infaunal and epifaunal communities are much more diverse.

The Dogger Bank represents a different sub-type of sandbank to the sandbanks within the North Norfolk Sandbanks cSAC, Inner Dowsing, Race Bank and North Ridge cSAC and Haisborough, Hammond and Winterton cSAC. The Dogger Bank is a sandy mound, formed by glacial processes and submergence through sea-level rise. It is also a cross-border sandbank, recognised by the German and Dutch designation of the Dogger Bank region within their waters.

8. Site boundary

The proposed site boundary for Dogger Bank has been defined using JNCC's marine SAC boundary definition guidelines (JNCC, 2008). The proposed boundary is a simple polygon enclosing the minimum area necessary to ensure protection of the Annex I habitat, following the extent of the habitat feature as closely as possible.

The interpretation manual for the Habitats Directive provides the definition for the Annex I habitat "sandbanks slightly covered by seawater all the time". This manual states that "Slightly covered by seawater all the time" means that above a sandbank the water depth is seldom more than 20m below chart datum. Sandbanks can, however, extend beneath 20m below chart datum. It can, therefore, be appropriate to include in designations such areas where they are part of the feature and host its biological assemblages" (CEC 2007)

In determining the extent of the Annex I sandbank habitat in waters deeper than 20m, JNCC have used information on the biological communities (infauna and epifauna), as well as physical information, to assess which areas are part of the feature and host its assemblages. The crest of the Dogger Bank lies in water less than 20m deep, and the bank gradually extends into deeper water with the greatest slope change around the 45-50m depth contour. Recent biological data (Diesing *et al* 2009) show gradual changes in infaunal communities across the bank, but predominantly, the delineation of the sandbank includes the main *Bank community* as well as a sub-group of the *Bank community* known as the *South-West Patch community* (Wieking & Kröncke, 2003). The deeper slope area north of the site boundary was characterised by communities more typically associated with muddier sediments (Diesing *et al* 2009)

The extent of the wider Dogger Bank has been shown using the slope analysis methodology described by Klein (2006), where a sandbank is defined by the change in slope from the bank to the surrounding plains. From this analysis, a clear edge to the morphological bank feature could be seen on the south and western edges although the northern edge of the bank was indistinct (Cefas, 2008). The extent of the wider bank is also corroborated by evidence from sub-surface geology maps. British Geological Survey 1:250000 quaternary geology maps identify the Dogger Bank Formation, which is a depositional unit up to 42m thick that was deposited at the end of the last ice-age. Sub-bottom profiles collected across the bank have been used to confirm the delineation of the formation and to improve accuracy by making minor adjustments (Diesing *et al* 2009).

The SAC boundary has been defined to include the shallow biological communities of the Dogger Bank itself (delineated as described above), whilst excluding adjacent linear banks to the north-west and south-west which were not considered to be part of the Dogger Bank Annex I sandbank feature (Figure 1). The UK-Netherlands median line defines the eastern boundary of the SAC.

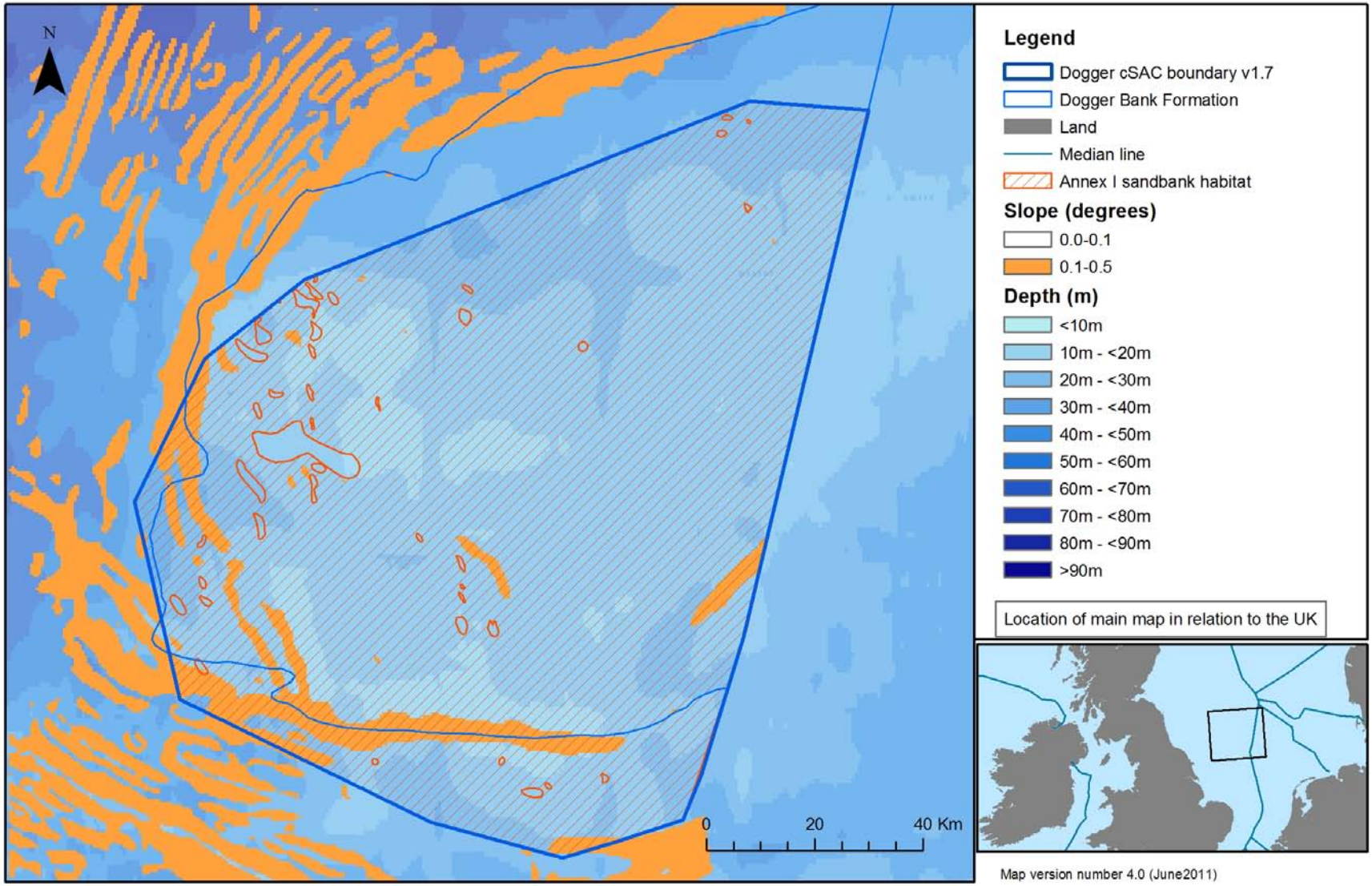


Figure 1. Dogger Bank SAC boundary in relation to slope analysis and Dogger Bank geological formation.

Due to the large size and shallowness of the site, and the interpretive nature of defining the extent of the Annex I sandbank habitat, adding an additional margin in proportion to water depth to allow for mobile gear on the seabed being at some distance from the location of a vessel on the sea surface (see guidance in JNCC, 2008) would make no material difference. It has, therefore, not been added when delineating the site boundary.

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

9. Assessment of interest feature against selection criteria

9.1. Sandbanks which are slightly covered by sea water all the time

Annex III selection criteria (Stage 1A):

a) Representativity

The Dogger Bank is located within the Southern North Sea Regional Sea. This site represents an offshore sandy mound, composed of moderately mobile, clean sandy sediments (sands and gravelly sands) in full salinity. It is non-vegetated and is subject to intermediate coastal influence. In general the biological communities on the Dogger Bank are typical of fine sand and muddy sand sublittoral sediments. Species typical of these communities include the polychaetes *Nephtys cirrosa* and *Magelona* sp., mobile amphipods of the genus *Bathyporeia*, the brittlestar *Amphiura filiformis*, and bivalve molluscs such as *Tellina fabula (*formerly *Fabulina fabula)* and *Mysella bidentata* (Wieking & Kröncke, 2001). Epifaunal species include the hermit crab *Pagurus bernhardus,* sand eels *Ammodytes* spp*.,* plaice *Pleuronectes platessa* and the starfish *Asterias rubens*. The grade for the feature is A as it is a typical example of this type of Annex I sandbank habitat.

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 1,720,000 hectares 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 258,000 and 1,720,000 ha (15-100% of total resource)

B – extents between 34,400 and 258,000 ha (2-15% of total resource)

C – extents less than 34,400 ha (0-2% of total resource)

Dogger Bank sandbank habitat occupies a minimum area of 177,448 ha (based on the area within the 20m contour, Chart Datum) and a maximum area of 1,233,115 ha (based on the area of Annex I sandbank habitat enclosed by the Dogger Bank site boundary). The area of the interest feature shallower than 20m falls between the '2-15%' bracket on the Natura 2000 Data Form and is graded B. However, as the Annex I interest feature extends deeper than the 20m isobath, it should be noted that the above estimate of the contribution of

Dogger Bank to the total UK sandbank resource is an underestimate, and this is reflected in the Global assessment below.

c) Conservation of structure and functions

Degree of conservation of structure

The biological and physical structure of the Dogger Bank has been impacted locally by a small number of oil and gas installations. Recent pipeline laying on the western edge has experienced high levels of sediment mobilisation by tidal currents (Mark Tasker, pers. comm.). Although there is currently insufficient information to accurately assess the severity of impacts, it is likely that the fauna of the bank has been, and continues to be, affected by trawling over many years (Hiddink *et al*, 2006; Bergman & Van Santbrink, 2000; ICES, 2008). This may have reduced the number of long-lived or fragile organisms and resulted in a community dominated by robust short-lived organisms. The gross physical structure of the bank is however, intact, and the biology is likely to be representative of the habitat. Therefore, a suggested grading is II: structure well conserved.

Degree of conservation of functions

The prospect 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, aggregates, renewable energy and other commercial 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 laying of submarine cables and pipelines also requires regulatory consent. The bank is distant from terrestrial sources of pollution, however, enrichment of southern water masses, due to riverine inputs, and climatic variability are thought to be affecting ecological function at the Dogger Bank (Wieking & Kröncke, 2005). A suggested grading is II: good prospects.

Restoration possibilities

Restoration methods in the offshore area focus on the removal of impacts which should allow recovery where the habitat has not been removed. Active restoration of habitat on the Dogger Bank would be difficult since the structure and functions of the habitat and methods to restore it are not known (and are unlikely to be cost-effective). However, a cessation of anthropogenic disturbance could allow natural recovery of the biological communities associated with Dogger Bank. The suggested grading for this criterion is II: restoration possible with 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, irrespective of the grading assigned to the third sub-criterion.

d) Global assessment

The suggested grades for Stage 1A criteria a)-c) are A, B and B respectively. Due to the extent of habitat, its representative communities and sediment type and the acknowledgement that the contribution of Dogger Bank to the total UK sandbank resource is an underestimate, the Global Assessment grade is A ('excellent conservation value').

Summary of scores for Stage 1a criteria

Dogger Bank	Representativity (a)	Relative surface (b)	Structure and function (c)	Global assessment (d)
Sandbank	A	B	B	A

9.2. Annex II Species

Johnston et al. 2002 identified four of eight marine Annex II species which should be considered when identifying SACs in UK offshore waters (Bottlenose dolphin, harbour porpoise, grey seal, and common/harbour seal).

In assessing whether species listed on Annex II to the Habitats Directive should be a qualifying feature for an offshore SAC, JNCC considered the text from Article 4(1) of the Habitats Directive, as well as the Annex III selection criteria. This Article states that "sites will be proposed only where there is a clearly identifiable area representing the physical and biological factors essential to their life and reproduction". JNCC have applied the guidance to assist in identifying such sites for harbour porpoise developed by the European Commission in 2001, reported in CEC 2007, Although the guidance was developed for consideration of sites for harbour porpoise, it can be applied to other aquatic mobile Annex II species. The guidance states for areas representing crucial factors for the life cycle of such species, that "these areas would be identifiable on the basis of:

i. The continuous or regular presence of the species (although subject to seasonal variations);
ii. Good population density (in relation to neighbouring areas);
iii. High ratio of young to adults during certain periods of the year.

Additionally, other biological elements are characteristic of these areas, such as very developed social and sexual life."

In applying this guidance, JNCC consider that continuous or regular presence of an aquatic mobile species is not sufficient evidence on its own, for a clearly identifiable area which could be considered essential to the life and reproduction for that species, and that one or other of the above considerations also needs to be fulfilled.

Of the four Annex II species to be considered, three are known to occur within the Dogger Bank SAC boundary, and are considered against the Annex III selection criteria in the following sections. Bottlenose dolphin (*Tursiops truncatus*) has been recorded only once just inside the site boundary (Reid et al 2003, Joint Cetacean Database), and is therefore not considered further here.

9.3. Harbour porpoise (*Phocoena phocoena*)

The primary reason for proposing the Dogger Bank as an SAC is for its shallow sandbank habitat. In considering whether Dogger Bank represents a "clearly identifiable area essential to the life and reproduction" of harbour porpoise, JNCC have applied the EC guidance noted above.

For i) above, harbour porpoise occur within the boundary of the SAC according to SCANS surveys of populations in the North Sea in 1994 (Hammond *et al* 2002) and 2005

(Hammond, 2008) and other sightings data (Reid *et al* 2003); with evidence from both sightings and acoustic surveys indicating the presence of harbour porpoises for the majority of the year (Reid *et al* 2003; Todd *et al* 2009). We therefore conclude that there **is** 'continuous or regular presence of the species' within the candidate Dogger Bank SAC.

In considering ii) above, estimates based on the relevant SCANS strip data indicate that approximately 2.1% of the North Sea harbour porpoise population was present within the SAC area in June/July 1994 and 3.9% in July 2005. The variance (CVs) of these estimates however, indicates that the differences observed were not significant (Phil Hammond, pers. comm.). Similar estimates using a calculated 'UK population' (as required if applying the Annex III selection criteria) indicate that for some of the year approximately 4% of the UK population of harbour porpoises use the SAC. These proportions of the UK or North Sea population using the SAC are, within the confidence of the estimates, the proportion that would be expected to occur within the site purely as a result of the area of the North Sea that the SAC occupies. A coarse estimate of the proportion of the North Sea occupied by the Dogger Bank SAC is greater than 2% of the UK North Sea area. Over a longer time period (1973-1999), comparison of effort related sightings rate in the Joint Cetacean Database for the SAC at Dogger Bank and the North Sea, excluding the SAC, indicated no significant difference between the two. Similarly, more recent effort related sightings data collected between 2001 and 2008 did not indicate that the SAC was any more important for harbour porpoises than areas outside the SAC (WWT, 2009).

All the above data indicate that there is no difference in occurrence of harbour porpoise within the Dogger Bank SAC (identified for its sandbank habitat) compared to outside the SAC. Therefore we conclude that there is **not** "good population density (in relation to neighbouring areas)".

For iii) above, there is no evidence to indicate that there is a high ratio of young to adults for the Dogger Bank area, We therefore cannot conclude that the proposed site is important for harbour porpoise in this respect. There is also no evidence of very developed social and sexual life for the species at Dogger Bank.

JNCC's conclusion, therefore, is that the Dogger Bank SAC cannot be considered a "clearly identifiable area essential to the life and reproduction" of harbour porpoise, and that therefore the species should not be a qualifying feature for the site. Efforts concentrating on threat/impact reduction, particularly bycatch, coupled with wider surveillance as a mechanism to assess progress and effectiveness are the mechanisms through which the favourable conservation status of this highly mobile species can be maintained.

Given the presence of the species within the site boundary throughout the year, it should be recorded as Grade D.

9.4. Grey seal (*Halichoerus grypus*) and common seal (*Phoca vitulina*)

The primary reason for proposing the Dogger Bank as an SAC is for its shallow sandbank habitat. However, both grey and common seals are known to occur within the boundary of the SAC area proposed for its Annex I sandbank habitat. Therefore it is appropriate to consider whether the SAC can be considered "a clearly identifiable area essential to the life and reproduction" for either species, and if so, whether they should be added as features for this SAC according to the selection criteria in Annex III to the Habitats Directive.

From satellite telemetry work, both grey and common seals are also known to be occasionally present in the area (Matthiopoulos *et al* 2004; Matthiopoulos, 2007). At this time, however, it is not possible to estimate what proportion of the population of either species uses the area, or how important the area is with respect to the physical and biological factors essential to their life and reproduction. Research is about to be commissioned by JNCC that will enable a more detailed assessment of the importance of this area for seals in the near future. It is therefore recommended that both species are listed as grade D, a non-significant presence, for the Dogger Bank cSAC. This grading may be revised at a later date depending on the outcome of the aforementioned commissioned research.

10. Sites to which this site is related

The Dutch Dogger Bank proposed SCI (Site of Community Importance) and German Dogger Bank SAC (Figure 2). JNCC have followed the EC Guidance on the establishment of the Natura 2000 network in the marine environment (EC 2007) in recommending a boundary for the Dogger Bank SAC based on scientific data for the UK sector of the bank, including new detailed data collected in April 2008. Use of the new scientific data to revise the boundary for the UK section of the Dogger Bank has resulted in the boundary extending further north than earlier versions of the UK boundary, with which the Netherlands pSCI (based on older data) aligned. A process has been initiated with the Dutch government to discuss how best to align the UK and Dutch SAC boundaries at the median line (coordinate 10 in Figure 1) between the two countries.

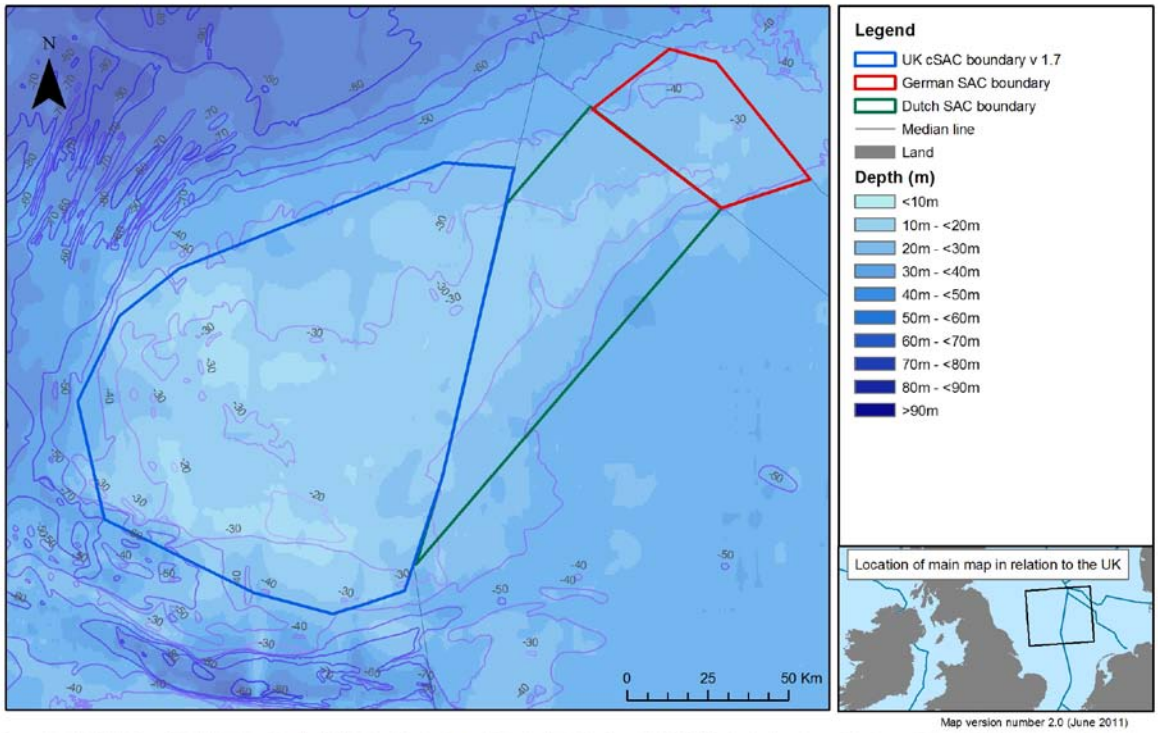


Figure 2. The location of the UK Dogger Bank candidate SAC alongside the Dutch and German Dogger Bank SCI boundaries.

11. Supporting scientific documentation

Various environmental studies for academic research and for industry investigations have been conducted in the Dogger Bank area in the last 20 years, and these have been used to support the selection of this site. More recently, an extensive survey was conducted in April 2008 by Cefas under contract to JNCC, during which multibeam and sidescan data were collected over a broadscale grid. These remote sensed data were ground-truthed using biological sampling by grabs (61 stations), video/stills (56 stations), and beam trawls (10 stations) (Diesing *et al* 2009)

Data Source	**Data Type**	**Purpose of study**
Aberdeen University Marine Studies Ltd, (1989a; 1989b)	Scientific reports of benthic monitoring surveys using 0.1m^2 Day grabs.	Monitoring data of benthic conditions pre and immediately post drilling with a further survey conducted one year after the cessation of activities to assess benthic recovery.
Callaway *et al* 2002	Scientific paper analysing samples collected by 2m beam trawl and otter trawl	Investigation of epibenthic and fish diversity and community structure within the North Sea
Cefas (2007)	Scientific report on fisheries monitoring using multibeam bathymetry, echosounder and biological samples collected by dredging and Granton and beam trawl.	Collection of information on the sand eel fishery along the English East Coast that was used to create a model to assess the impacts of different management options for the sand eel population and that of its predators.
Diesing *et al* (2009)	Seabed habitat mapping of the Dogger Bank offshore draft SAC.	Collection and interpretation of acoustic (multibeam swathe bathymetry and sidescan sonar) and groundtruthing (video tows, Hamon grab sampling and beam trawling) data acquired during Cefas cruise CEND 07/08.
Daan & Mulder (2001; 2006)	Scientific reports of benthic monitoring surveys using 0.078m^2 box cores.	Monitoring to assess trends in macrobenthos on the Dutch Continental Shelf. One monitoring station falls just within the UK side of the Dogger Bank with a further 6 stations corresponding to the Dutch sector of the Dogger Bank for which quantitative infaunal data are obtained.

Data Source	Data Type	Purpose of study
DTi, (2005)	Environmental Statement for which sediment and biological grab samples were collected and analysed.	Environmental Statement incorporating benthic data in support of the Hunter Field Development (south Dogger Bank).
Emu Ltd., (2003)	Environmental Statement and supporting studies including 2m beam trawl and 0.1m^2 Hamon grab sampling and subsea video surveys.	Site specific benthic surveys to inform an Environmental Statement (ES) supporting an application for a Government View for aggregate extraction at North West Roughs (known as Area 466) (north west Dogger Bank).
Emu Ltd., (2007)	Environmental Statement and supporting studies including 2m beam trawl and 0.1m^2 Hamon grab sampling and subsea video surveys.	Site specific benthic surveys to inform an Environmental Statement (ES) supporting an application for a Government View for aggregate extraction at Southernmost Roughs (known as Area 485) (south west Dogger Bank).
Hammond *et al* (1995, 2002); Hammond & MacLeod, (2006); Hammond, (2008)	Papers/reports of visual surveys for cetaceans were carried out from ships and aircraft using line transect methods. SCANS covered the whole North Sea, plus an area north of Scotland, the English Channel and Celtic shelf, the Skagerrak, Kattegat and part of the Baltic in July 1994. SCANS II, undertaken in July 2005, covered a larger area. As well as the North Sea, continental shelf waters west of Britain and Ireland and south to the Straits of Gibraltar were included (36° - 62° N). All the ships involved towed hydrophones, as well as visual surveys.	SCANS and SCANS II were both international projects mapping the distribution and estimating the abundance of harbour porpoise and other small cetaceans in the North Sea and adjacent waters in 1994, extending the area of coverage to European continental shelf in 2005.

Data Source	Data Type	Purpose of study
Kröncke, (1992); Kröncke & Knust, (1995); Wieking & Kröncke, (2001; 2003; 2005)	Scientific papers for which Van Veen grab samples were collected for sediment and biological analysis.	Description of the ecology of the Dogger Bank region and examination of temporal changes in the macrofaunal community of the Dogger Bank between 1950-54, 1985-87 and 1996-98.
Metoc, (2004)	Environmental Statement including the results of grab sampling.	Environmental Statement incorporating benthic data in support of the Cavendish Development (south Dogger Bank).
North Sea Benthos Project (NSBP)	Benthic grab sampling to derive biological, physical and chemistry data.	Collation and comparison of recent and historic North Sea benthic data for assessment of temporal changes. Several benthic grab samples were collected at the Dogger Bank.
Oil & Gas UK (formerly UKOOA)	Benthic sample physical and biological database collating multiple grab sample datasets	Collation of environmental survey data to assist detection of potential impacts due to oil and gas activities. Data are available for developments to the south of the Dogger Bank.

12. Site overview and conservation interest

Hydrography and geology

The Dogger Bank is a highly productive area due to its shallowness, topography, hydrography and sediment types (Wieking & Kröncke, 2001). It is influenced by cool Atlantic water masses coming from the north and warmer inflow from the Channel to the south resulting in the creation of a front in the northerly region where these two masses meet. The warmer waters from the Channel, located on the top of the bank and in more southerly regions, are enriched by riverine input (Kröncke, 1992) and remain mixed throughout the year whilst the cool Atlantic waters to the north of the bank exhibit seasonal stratification during spring and summer (Wieking & Kröncke, 2005; Weston *et al* 2005). Phytoplankton production on the bank occurs throughout the year supporting a high biomass of species at higher trophic levels year-round and creating a region that is biologically unique in the North Sea (Kröncke & Knust, 1995). Tidal current velocities across the Dogger Bank are considered insufficient for initiating sediment transport (von Haugwitz & Wong, 1988; as cited in Wieking & Kröncke, 2005). Large parts of the Dogger Bank are however situated above the storm-wave base (provided by Proudman Oceanographic Laboratory for Connor *et al* 2006). Klein *et al* (1999) estimated that during a storm event, sediment up to medium sand was mobilised in 60m water depth at the northern slope of the Dogger Bank.

The morphology of the Dogger Bank is largely controlled by the extent of the Dogger Bank Formation, a geological formation up to 42m thick that was deposited at a glacial margin during the last glacial maximum (Cameron *et al* 1992). Holocene sands of variable thickness overlie the Dogger Bank Formation. Maximum values of locally more than 20m are attained in the southeast, while the Holocene sand cover is thin (typically 0.1 – 0.2m) in the west and north (British Geological Survey, 1990a; 1990b; British Geological Survey & Rijks Geologische Dienst, 1988). The sediments on the surface of the Dogger Bank mainly consist of fine sands with mud content below 5%. In terms of Folk's (1954) classification, they can be described as sand, slightly gravelly sand, gravelly sand, slightly gravelly muddy sand and muddy sand. Mud content slightly increases towards deeper water (Diesing *et al* 2009). Coarser gravelly sand and sandy gravel substrates together with isolated patches of larger pebble and cobble-sized particles have been recorded in southern and western sections of the bank (Emu Ltd., 2003 & 2007; Diesing *et al* 2009) (Figure 3).

Infaunal community

Spatial patterns in infaunal community characteristics on the Dogger Bank, and its surrounding area, were investigated by Cefas (Diesing *et al* 2009). Grab samples were collected and processed, for both infauna and Particle Size Analysis (PSA), to investigate the infaunal communities, and their habitat associations, both on the Dogger Bank and in adjacent, deeper water habitats. Multivariate analyses of the infaunal dataset identified 12 distinct faunal communities, which are plotted in relation to the candidate SAC boundary in Figure 4a. The infaunal communities, identified by this study as being characteristic of the Dogger Bank, largely support the findings of other studies in that they are largely representative of fine sand and muddy sand sublittoral sediments (Kröncke, 1992; Kröncke & Knust, 1995; AUMS, 1989a; 1989b; NSBP, 2000; Daan & Mulder 2001; 2006; Wieking & Kröncke, 2001; 2003; 2005; Emu Ltd. 2003; 2007 & DTI, 2005) (See Figure 4b for distribution of sampling effort).

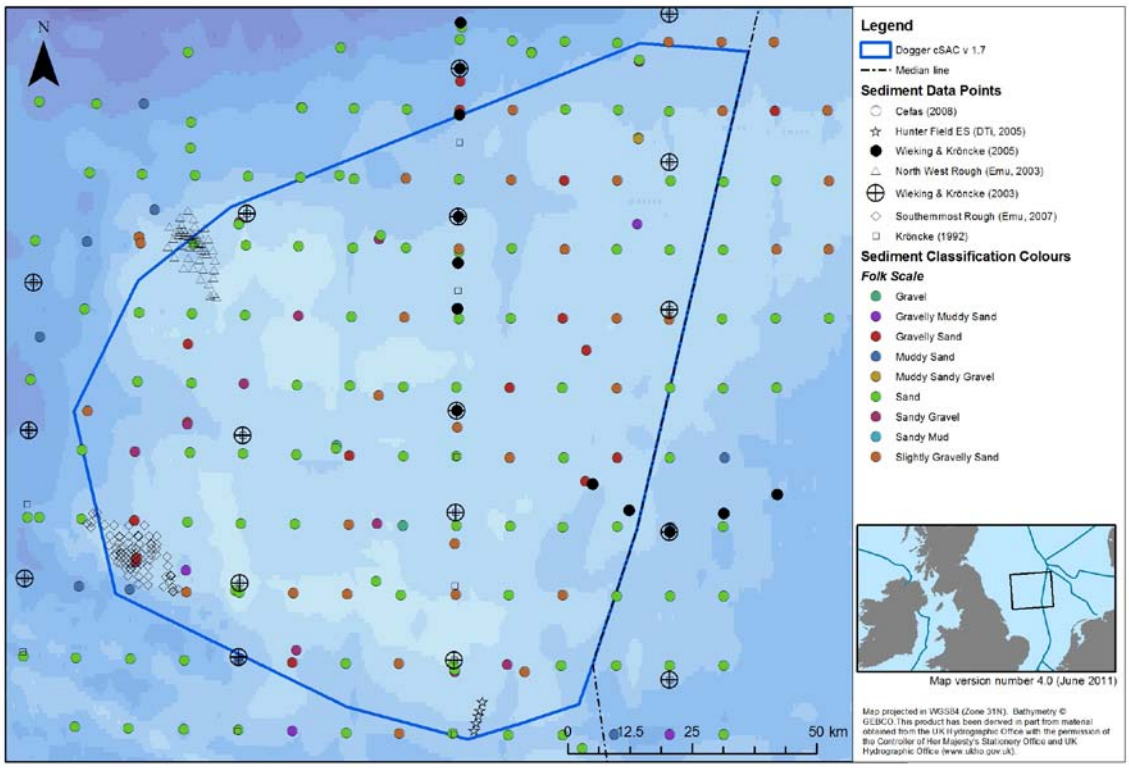


Figure 3. Distribution of physical seabed sediment sample locations.

Consideration was given to combining the Cefas (Diesing *et al* 2009) data with other datasets due to the variety of scientific data available for the infaunal communities in the Dogger Bank area. However, this was considered inappropriate for statistical analysis as the data was gathered using a variety of sampling methodologies and techniques, and as a consequence showed a clustering tendency according to dataset rather than 'true' biological assemblage.

The spatial patterns identified by Diesing *et al* (2009) are supported by UKOOA site-specific survey datasets and other surveys (AUMS, 1989a; 1989b; Daan & Mulder, 2001 & 2006; Wieking & Kröncke, 2001 & 2003; Emu Ltd. 2003; 2007; Metoc 2004; DTi, 2005), which identify a transition of species assemblages across the bank with depth. The transition in biological communities grades from a low diversity community in the shallowest areas, down to a more diverse community distributed across the main extent of the bank. Finally the communities in the deepest locations on the edge of the wider bank (and outside the site boundary) were characterised by species typical of sediments with higher silt content.

In shallower regions in the south-west of the site (Group H in Figure 4a) the community was characterised by the presence of the polychaete *Nephtys cirrosa* and amphipods of the genus *Bathyporeia* sp. This can be likened to the *South-West Patch community* described by Wieking & Kröncke (2003) which is similarly impoverished.

The majority of stations within the site boundary are of a similar community (assigned to group K), with characterising species including two amphipod species *Bathyporeia elegans* and Bathyporeia guilliamsoniana, the polychaete Magelona mirabilis and the burrowing bivalve *Tellina fabula* (Figure 4a). Such findings support those reported by Wieking and Krönke (2001 & 2003) who identified a similar sub-set of species as being characteristic of their Bank community (Figure 4a).

Across the bank, more gravelly patches frequently occurred, reflecting the heterogenous nature of the seabed sediments in some areas of the bank; this different sediment type was reflected by the presence of certain fauna, such as *Glycera lapidum* (group E) a species which has previously being described as characteristic of gravelly regions of the Dogger Bank (Emu Ltd., 2003; 2007).

The stations assigned to groups G, J and L were largely situated in the deeper waters along the northern edge of the bank and were excluded from the site boundary as these areas were not considered to host the biological assemblages of the main sandbank feature. In particular, Groups G and L have infaunal communities that are particularly distinct from those more representative of the main Dogger Bank, largely due to the presence of species more commonly associated with sediments containing a higher proportion of silt (i.e. the polychaetes *Scoloplos armiger, Galathowenia oculata* and *Goniada maculata* and the burrowing bivalves *Thyasira flexuosa* and *Lucinoma borealis*) (Figure 4a).

Epifaunal community

Epifaunal communities on the Dogger Bank were investigated by Diesing *et al* (2009), through the combined use of towed underwater imaging equipment and beam trawls. Analysis of the video footage showed that the epifaunal communities within the site boundary were largely typified by communities dominated by a subset of burrowing species, including primarily the burrowing urchin *Echinocardium* sp., along with the razor shell *Ensis* sp., the sandmason worm *Lanice conchilega*, the masked crab *Corystes cassivelaunus* and sandeels. Communities associated with more gravelly sediments were distinguished from the more typical bank communities by the presence of the brittlestar *Ophiothrix fragilis* and the hermit crab *Pagurus bernhardus*. These areas of coarser sediment, along with occasional pebbles and cobbles provided a substrate for the soft coral *Alcyonium digitatum*, the bryozoan *Alcyonidium diaphanum* and Serpulid worms to colonise (Diesing *et al* 2009). Stations situated along the deeper contours of the northern edge of the bank (and subsequently excluded from the candidate SAC boundary) were distinct from the main bank communities by the presence of certain fauna found in muddier seabed sediments including the seapen *Pennatula phosphorea*.

Overall, spatial patterns in epifaunal community characteristics largely support the findings of the previously reported trawl surveys (Callaway *et al* 2002; Cefas, 2007; Emu Ltd., 2003; 2007 & Jennings *et al* 1999). Callaway *et al* (2002) identified three variant and geographically distinct epibenthic communities characterised by the common starfish *Asterias rubens*, the sand star *Astropecten irregularis*, hermit crab *Pagurus bernhardus*, infaunal brittlestar *Ophuira* spp. and the green sea urchin *Psammechinus miliaris*. All three community types broadly corresponded with a discrete southern North Sea assemblage of free living epibenthos identified by Jennings *et al* (1999) in terms of characterising taxa (Figure 5). Site specific 2m trawl sampling and seabed video surveying at North West Rough and Southernmost Rough (Emu Ltd, 2003; 2007) identified commonly occurring epibenthic species within the boundaries of the candidate SAC (Figure 5).

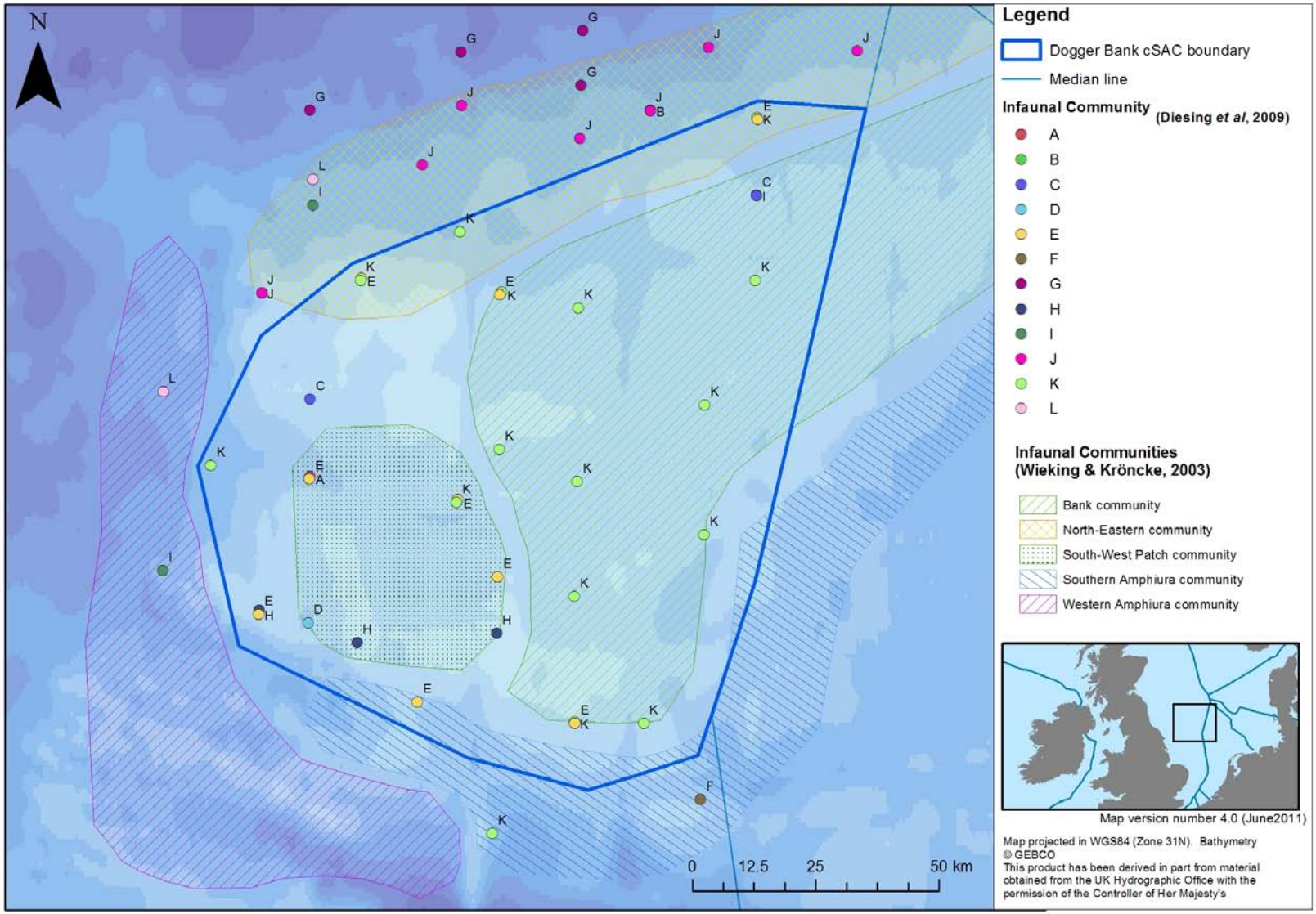


Figure 4a. Distribution of infaunal communities identified by Diesing *et al* (2009) and Wieking & Kröncke (2003).

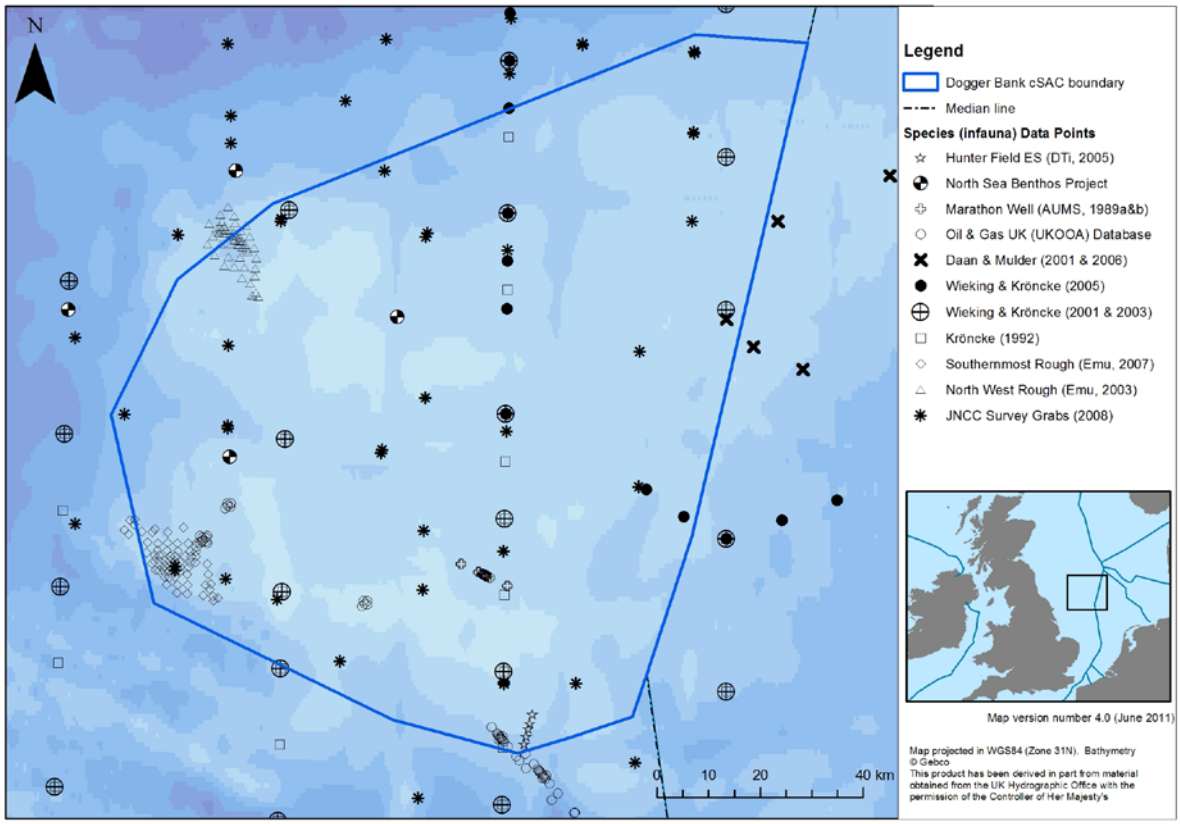


Figure 4b. Infaunal sampling locations on Dogger Bank.

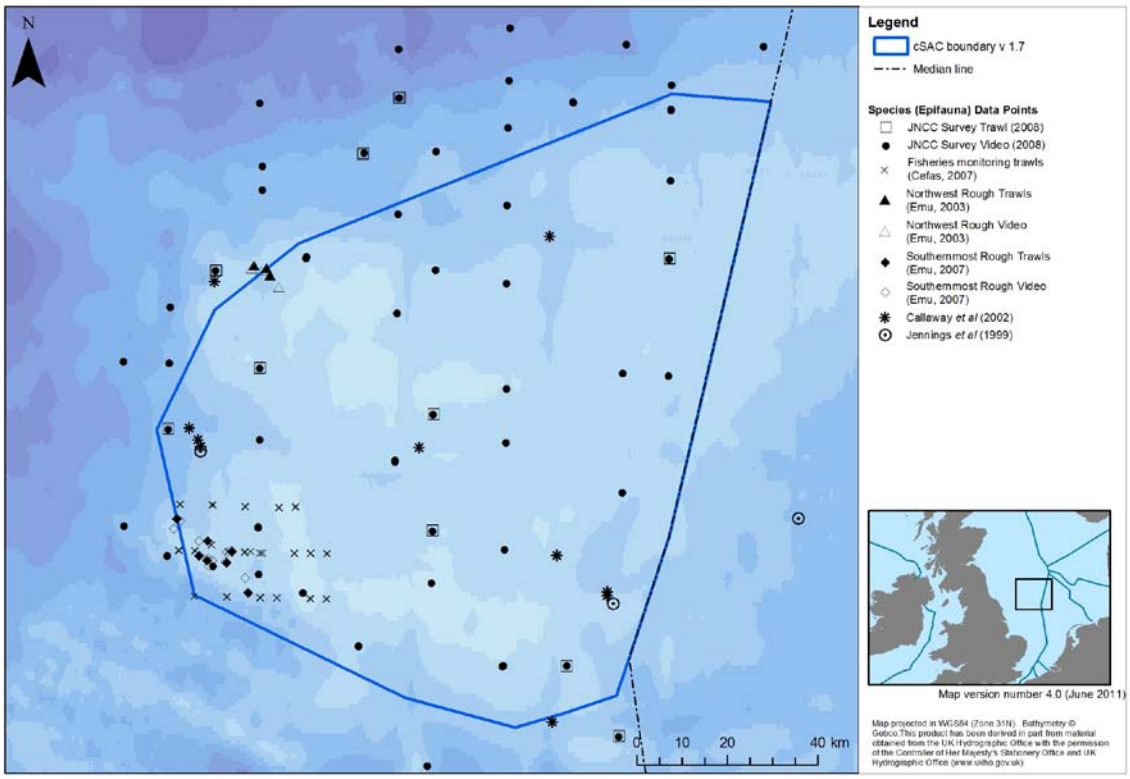


Figure 5. Location of beam trawl and seabed video surveys informing the description of epifaunal communities on Dogger Bank.

These included *Alcyonium digitatum* (dead men's fingers), the crabs *Pagurus bernhardus* and *Liocarcinus holsatus,* the starfish *Astropecten irregularis, Asterias rubens* and the flatfish *Limanda limanda*, consistent with the wider array sampling completed by Callaway *et al* (2002) and Jennings *et al* (1999). Isolated patches of mixed coarse sandy gravel and cobble substrata at the north west of the Dogger Bank supported the epifaunal brittlestar, *Ophiothrix fragilis*, which occurred in densities of up to 1,300 individuals/m^2 (Emu Ltd, 2003) (Figure 5).

Whilst the video techniques employed by Diesing *et al* (2009) differ from the trawling techniques utilised in the reported literature (Callaway *et al* 2002; Cefas, 2007; Emu Ltd., 2003; 2007, Jennings *et al* 1999) a similar subset of species, including the burrowing urchin *Echinocardium* sp., the razor shell *Ensis* sp., the crabs *Pagurus bernhardus* and *Corystes cassevalaunus* and fish species including sandeels *Ammodytes* sp., the dab *Limanda limanda*, gobies and the dragonet *Callionymus lyra*, were found to be largely typical of epifaunal communities present within the Dogger Bank candidate SAC.

Fish community

The distribution of sand eels (*Ammodytes* spp.) within the North Sea is highly localised and they are abundant in the Dogger Bank region. The sand eel population on the Dogger Bank is concentrated along the edges in water depths of around 20-30 m. Their distribution is linked to local hydrography and higher levels of food resource at these locations with increased plankton abundance where fronts meet (Cefas, 2007). Sand eels are most active during the spring when they are thought to undertake diurnal migrations of up to 5-10 km moving from the seabed where they are buried at night to the water column over deeper areas of the seabed during the day to feed (Cefas, 2004). Sand eel nursery areas are even more geographically localised than general sand eel distributions, being restricted to apparently 'higher quality' nursery habitat, such as the North West Riff area to the west of the Dogger Bank (Figure 6) which is regarded as crucial as a sand eel nursery to the wider area (Cefas, 2007). Importantly, this high degree of site attachment exhibited by sand eels indicates low re-colonisation potential of areas denuded by fishing.

Sand eels are a significant prey resource for various predators including other commercial fish species, seabirds (such as fulmar and kittiwake) and cetaceans, in particular the harbour porpoise (Cefas, 2007). Predatory fish species present on the Dogger Bank include whiting *Merlangius merlangus*, plaice *Pleuronectes platessa*, mackerel *Scomber scombrus* and cod *Gadus morhua* (Emu, 2003; 2007; Cefas, 2007; Fox *et al* 2008) with dab *Limanda limanda* and grey gurnard *Eutrigla gurnardus* being particularly abundant (Cefas, 2007). In a survey of cod distribution and the distribution of cod spawning grounds throughout the North Sea, Fox *et al* (2008) found a high abundance of both mature cod and stage I cod eggs in the southern Dogger Bank region. These fish species consume a wide variety of prey types and therefore are not as dependent upon a constant sand eel population as seabird and cetacean species, however, a link between higher sand eel abundance and improved condition of these commercial fish species has been recorded indicating the importance of maintaining a healthy sand eel stock to the wider fish community on the Dogger Bank (Cefas, 2007).

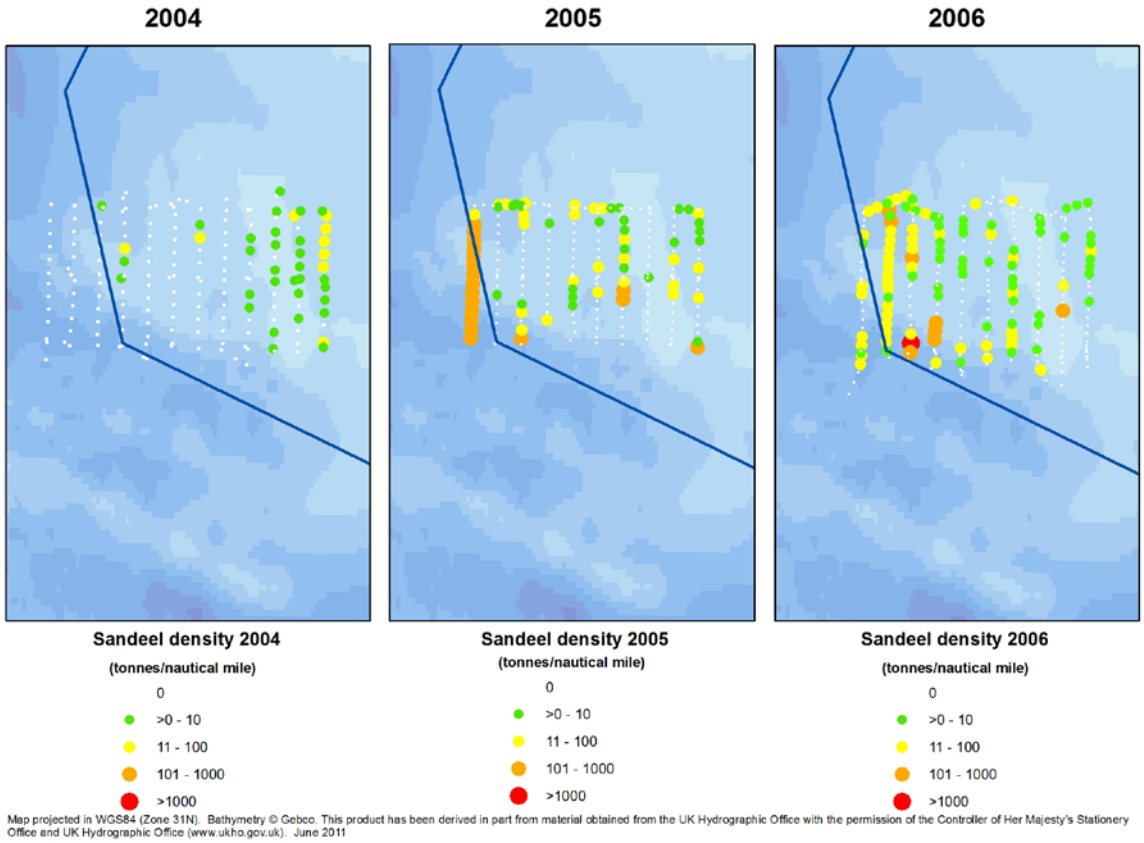


Figure 6. Sand eel density in the south-western section of the Dogger Bank from 2004-2006 (Cefas, 2007)

Marine mammals

Harbour porpoise are the most abundant cetacean in the North Sea, are highly mobile and widely distributed, and occur within the Dogger Bank candidate SAC boundary. The SCANS II (2005) survey indicated that harbour porpoise occur within the Dogger Bank region, although this is likely to vary over time due to the mobile nature of the species. Sightings from the Joint Cetaceans Database for the cSAC at Dogger Bank and the North Sea, excluding the cSAC, indicated no significant difference and therefore indicate that the cSAC is no more important for harbour porpoises than other parts of the North Sea.

Satellite telemetry work has identified that common and grey seals are present in the area (Matthiopoulos *et al* 2004; Matthiopoulos, 2007). There are known to be large haul-out populations of common seals along the Lincolnshire and North Norfolk coastline with the species travelling long distances on foraging trips and regularly visiting offshore sites (SCOS, 2007). At present, we do not have detailed information regarding the specific usage of the Dogger Bank by these two species, but it is likely to be a foraging area. Both species prey on a wide variety of fish species including white fish, flatfish, gadoids (e.g. saithe, cod), clupieds (e.g. herring, whiting, sprat), cephalopods (e.g. octopus and squid) and sand eel populations (Hammond *et al* 1994a, 1994b; Hall *et al* 1998; Hall & Walton, 1999; SCOS, 2007). The contribution of each prey species is known to vary by area and season, however, for grey seals, sand eels can comprise up to 50% of the diet (Hammond & Prime, 1990; Hammond *et al* 1994a, 1994b).

Plate 1. Hermit crabs (Paguridae) and sandeels (*Ammodytes* spp.) (Image © Cefas/JNCC).

Plate 2. Dense *Ophiothrix fragilis* bed (Image © Cefas/JNCC).

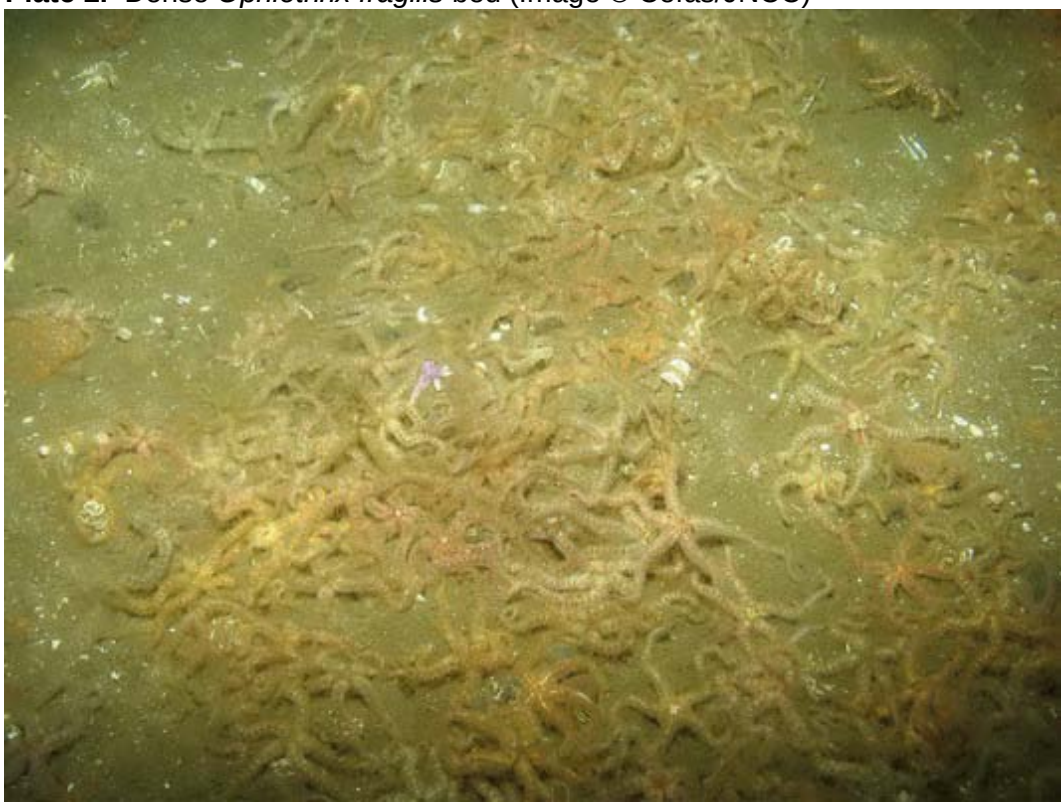
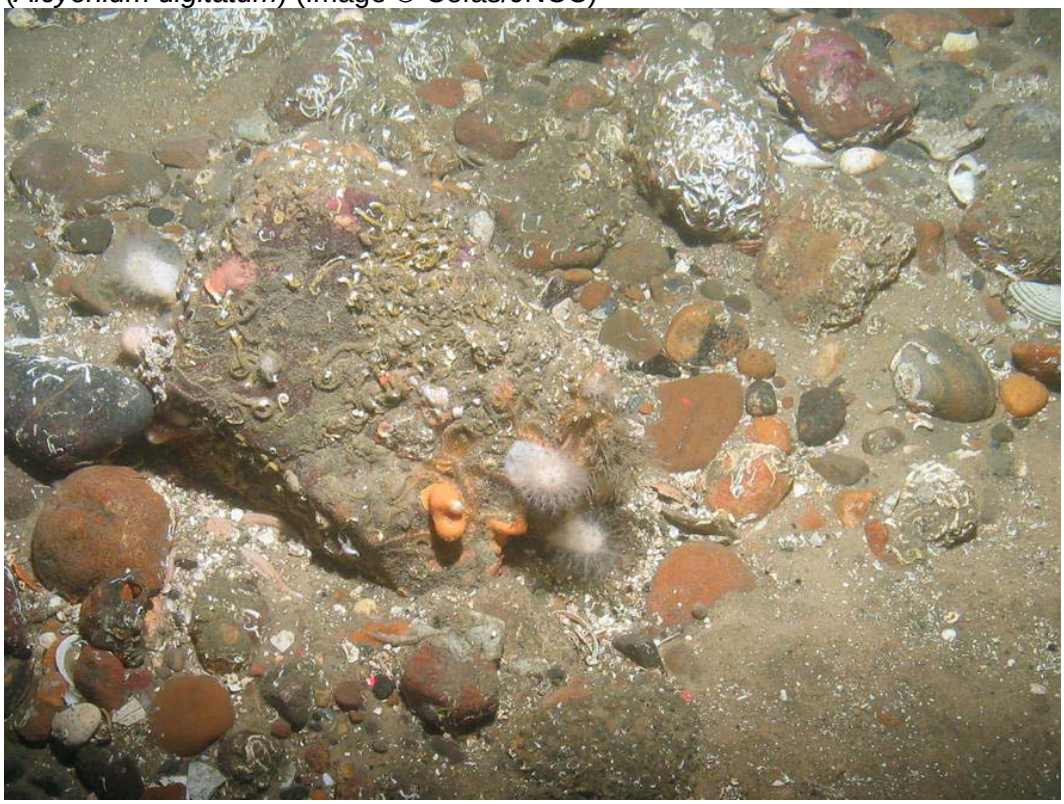


Plate 3. One of many gravel patches on Dogger Bank, with the soft coral dead men's fingers (*Alcyonium digitatum*) (Image © Cefas/JNCC)



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