Data availability for the fisheries impact assessment of the FIMPAS project

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Content

1 Introduction

1.1 FIMPAS project

The project *Fisheries Measures in Protected Areas* (FIMPAS) aims to introduce fisheries measures in the marine Natura 2000 sites within the Exclusive Economic Zone of the Dutch part of the North Sea by the end of 2011. The FIMPAS project covers three such areas, the Dogger Bank and the Cleaver Bank (both to be designated for protection under the Habitats Directive) and the Frisian Front (to be designated for protection under the Birds Directive). These sites are beyond the Dutch 12 nm zone and several EU Member States fish within these areas. Therefore fisheries measures must be implemented through the Common Fisheries Policy. These marine protected areas, as well as the potential fisheries measures, are a consequence of the implementation of the European Birds and Habitats Directives and will be proposed to the European Commission by the Dutch government. The Dutch Ministry for Agriculture, Nature and Food Quality (LNV), together with Dutch environmental NGOs and the Dutch fishing industry, are cooperating within the FIMPAS project to develop the necessary fisheries measures to achieve the conservation objectives for the Dutch Natura 2000 sites of the North Sea. LNV has asked the International Council for the Exploration of the Sea (ICES) to organize the necessary scientific processes and give advice on the desired fisheries measures involving the relevant stakeholders in this process.

The FIMPAS project comprises an international process involving all relevant stakeholders (fishing industry, environmental organisations, scientists and policymakers, including site managers). The aim of this process is

i) to gather the maximum possible amount of relevant information necessary to assess the level and severity of interaction between different types of)fishing activities and conservation objectives of Marine Protected Areas (MPAs)

ii) to determine what fisheries measures are possible in order to achieve the conservation objectives.

The FIMPAS project consists of three phases, each culminating into a (stakeholder) workshop:

Workshop 1 aims to establish the data basis on which the following two workshops will be based.

Workshop 2 aims to assess the impact of fisheries on the designated sites.

Workshop 3 aims to generate management actions to meet the defined conservation objectives.

For the preparation of the first workshop ICES has requested IMARES (Institute for Marine Resources and Ecosystem Studies, part of Wageningen University Research, Wageningen UR) to draft a report that summarises the availability of data relating to fishery activities within the Dutch Natura 2000 sites on the North Sea and data relating to the conservation objectives of the specific sites. This report constitutes the basis for further discussions on data availability and data demand during the workshop.

1.2 Assignment

Workshop 1 was helt in February 2010 and during this workshop the data basis was established on which the following two FIMPAS workshops (outlined above) will be based. The preparatory phase for the first workshop is concerned with definition of the data requirements and compilation of data and information. The preparatory work carried out to facilitate Workshop 1 is presented in this report. The data include three main groups:

1) Documentation of the fisheries within the sites: temporal development and spatial distribution

2) Data on the conservation objectives for the designated sites

3) A review of the existing knowledge on ecological impacts of fisheries.

Based on this report, and any additional data brought to the workshop, the presence and sufficiency of the data for the project will be assessed at the workshop.

2 Areas concerned

The Minister of Agriculture, Nature and Food Quality of the Netherlands aims to protect more than 741,000 hectares of valuable nature in the North Sea under the European Habitats Directive. The European Habitats Directive provides for the designation and protection of sites containing certain habitat types, as well as sites that provide a habitat for specific protected species. In 2008, four Habitats Directive sites situated in the North Sea were proposed as Natura 2000 sites and notified to the European Commission in Brussels. The sites concerned are the coastal zone to the north of Bergen (expansion of the existing Habitats Directive site known as North Sea Coastal Zone 1), the Vlakte van de Raan (adjacent to the existing Habitats Directive sites known as the Voordelta and the Western Scheldt), the Dogger Bank and the Cleaver Bank (Figure 1).

In addition, under the European Birds Directive, the Frisian Front and the North Sea Coastal Zone 2 are to be designated for the protection of the habitat of a number of bird species. Sites under the Birds Directive are designated directly without any prior notification procedure.

The focus of the FIMPAS project is the three sites outside the 12nm zone, i.e. the Dogger Bank, the Cleaver Bank and the Frisian Front (Figure 1; Table 1). These sites have been notified to the EC based on the following habitat types and species that are to be protected under the Habitats Directive:

- H1110_C Sandbanks covered by sea water all the time (Dogger Bank)
- H1170 Open-sea reefs (Cleaver Bank)
- H1351 Harbour porpoise (*Phocoena phocoena*)
- H1364 Grey seal (*Halichoerus grypus*)
- H1365 Harbour seal (*Phoca vitulina*)

For the Birds Directive, which is applied to the Frisian Front and the Dutch Coastal Zone 2 site, the selected bird species are named below:

- A175 Great skua (*Stercorarius skua*)
- A183 Lesser black-backed gull (*Larus fuscus*)
- A187 Great black-backed gull (*Larus marinus*)
- A199 Common guillemot (*Uria aalge*)

Table 1 Description of the sites based on Bos et al. 2008

Sites	Directive	Longitude	Latitude	Surface (ha)	Max depth (m)	Min depth (m)
Cleaver bank	Habitat	3 05 07	54 01 21	±123,764	-71	-30
Dogger Bank	Habitat	3 29 02	55 08 17	±471,772	-40	-24
Frisian front	Birds	4 41 24	53 48 28	±288,057	-40	-30

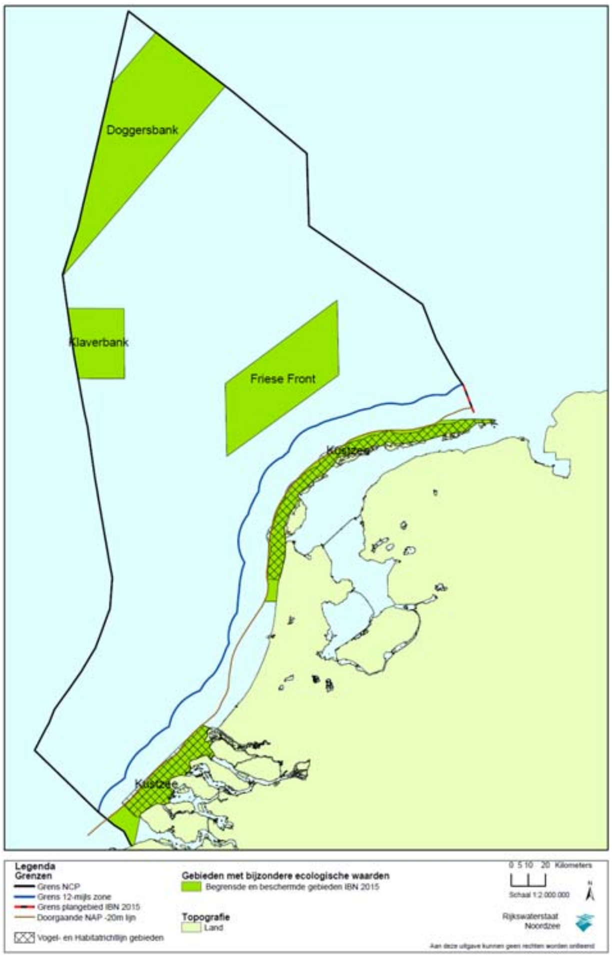

Figure 1 Overview of sites of special ecological value in the Exclusive Economic Zone taken from the Integrated Management Plan for the North Sea 2015 (Anonymous 2005). The FIMPAS project covers sites outside the 12nm limit that are to be designated as Habitats Directive sites (HD sites), i.e. the Dogger Bank and the Cleaver Bank, and as Birds Directive sites (BD sites), i.e. the Frisian Front. Other sites shown here (hatched parts) are the North Sea Coastal Zone 2 (HD and BD site expansion) Vlakte van de Raan (HD sites), both of which have already been designated. For more details on the sites see also Figures 2,3 and 4.

2.1 Dogger Bank

The Dogger Bank qualifies for habitat type H1110 (Sandbanks which are slightly covered by sea water all the time) and is also an area where harbour porpoises and grey and harbour seals are found, three species that are to be protected under the Habitats Directive (Bos et al., 2008). Habitat type H1110 has been expanded to include a new subtype, H1110_C. A detailed description of the site and the habitat type is presented below.

2.1.1 Site boundary and features

The notified site 'Dogger Bank' is part of a continuously covered sandbank in the northern part of the Exclusive Economic Zone (EEZ) (Figure 2). The entire Dogger Bank stretches across the UK, Dutch, German and Danish sectors of the North Sea. The Netherlands has decided to align the boundary of the nature values to be protected on the Dogger Bank with the boundary as proposed by the German government. Germany decided to use the inclination angle of the slopes of the sandbank in order to define the boundaries of their protected area and the boundary was set where the angle exceeded 1 in 10. Using the same criterion for establishing boundaries within the Dutch sector, the boundary along the southern edge of the Dogger Bank runs along the 40 m depth contour. Along the northern edge of the bank, however, the boundary extends beyond the EEZ. The northern boundary was therefore chosen such that it aligns with both the German sector in the East, and the northern boundary of the site expected to be notified by the United Kingdom in the West.[1]

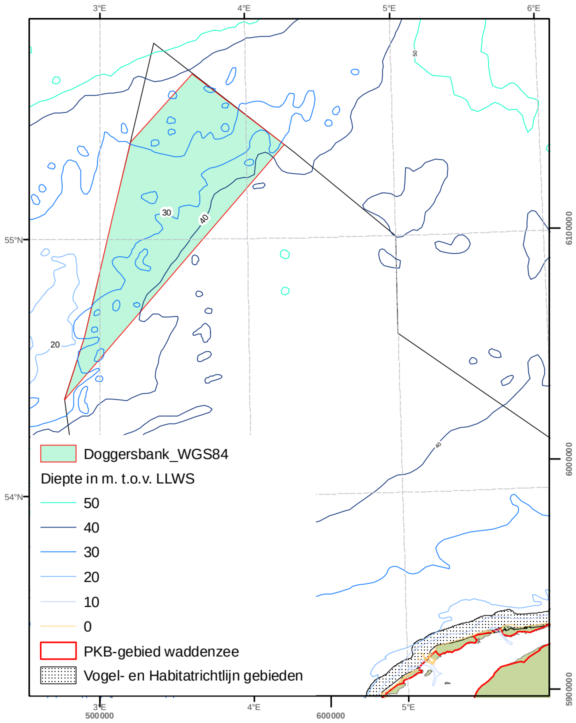

Figure 2 Dogger Bank with depth contours. In practice, the 40-metre depth contour is considered to be the edge of the sandbank and accordingly the boundary of habitat type H1110_C.

On the Dogger Bank the water depth ranges from 13 m to an arbitrary depth of 40 m; within the Dutch sector depths range from 24 m to 40 m. The depth limit applied by the EU for habitat type H1110 is 20 m, however, the notified site has other typical features of habitat type H1110. The topography is typical of a sandbank with a central shallow, but subtidal area graduating to deeper water on both sides. In addition, a transition in sediment type and associated fauna is observed. The shallowest parts of the bank are characterised by fine sands and a mosaic of high percentage of shell grit, which changes to areas richer in silt at the bank edges (Kröncke, 1992).

The Dogger Bank is a special ecological region (Kröncke & Knust 1995) characterized by shallow depths, sandy sediments, the occurrence of fronts (Pedersen 1994; Nielsen et al. 1993), subsurface phytoplankton blooms (Riegman et al. 1990; Nielsen et al. 1993; Richardson et al. 1998) and high primary production, which is continuous throughout the year (Brockmann & Wegner 1985; Richardson & Olsen 1987; Brockmann et al. 1990). Residual current direction in the Dogger Bank area is highly variable and strongly influenced by the prevailing wind directions (Lee, 1980). The different water masses of the Dogger Bank are characterized by different salinities, temperatures and seasonal variability in temperature. The water masses in the shallow areas on top of the bank are almost permanently mixed, whereas in the deeper areas around the Dogger Bank seasonal stratification occurs. The variability of the bottom water temperature in the shallow parts ranges between 5 – 16 °C.

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[1] Recently it has appeared that the United Kingdom is keen to establish a more northerly boundary, which would result in the boundaries of the UK and the Dutch sector no longer being aligned.

In the deeper areas south and especially north of the bank seasonal temperature differences are less pronounced (Otto et al. 1990). The shallow parts of the Dogger Bank are affected by surf waves, which can cause alternating resuspension and sedimentation events. The adjacent deeper parts are characterised by silt-rich fine sands. The tidal flow here is insufficient to support sediment resuspension (Kröncke, 1992), although storms and water motion can still lead to the resuspension of the finer sediments.

2.1.2 Biotic communities

The Dogger Bank forms a boundary between the occurrence of northern and southern species (Ursin, 1960, Kirkegaard, 1969 and Petersen, 1977). The site itself supports a relatively diverse benthic macrofaunal community compared to other areas in the EEZ (Daan & Mulder, 2006). Although the site is rich in terms of the number of individuals, the total biomass per square metre is considerably lower than is found in the Frisian Front or the North Sea Coastal Zone. On the shallow parts of the bank, species occur that are able to withstand great physical stress, such as strong water motion, resuspension, and sediment mobility. These are animals that are themselves mobile (*Bathyporeia*) or able to sustain themselves well in such conditions either by burrowing (e.g. the banded wedge shell, *Donax vittatus,* the razor shell, *Ensis ensis*) or by building and living in tubes for protection (e.g. bristleworms, Polychaeta) (Wieking & Kröncke, 2003).

The eastern part of the Dogger Bank, contains three faunal communities, referred to here as the typical 'sandbank' community, the 'northern' community, and the 'Amphiura' community typical of the south. The three distinct communities are separated mainly by depth and sediment type (Wieking & Kröncke, 2003).

The most characteristic 'sandbank' community is found in the central and shallowest part of the Dogger Bank and is dominated by species that feed in the sediment-water interface (suspension and deposit-feeding) and are adapted to a dynamic environment through increased mobility (including the ability to burrow rapidly) and/or protection by a robust shell. The amphipods *Bathyporeia elegans*, *B. guillliamsoniana* and *Tellina fibula* are characteristic of the community which is often referred to as the *Bathyporeia-Fabulina* community. The most important predator in the area is the Adler's necklace shell (*Polinices pulchellus*). Other typical species include *Urothoe poseidonis* (a species of sandhopper) and the Polychaetes *Ophelia limacina*, *Aricidea minuta* and *Sigalion mathildae.*

The 'northern' community situated along the northern edge of the Dogger Bank is a transitional community (i.e. low species richness, high abundance of opportunistic species) whose dominant species include *Spiophanes bombyx* and *Bathyporeia elegans*. In the deepest parts of the area, the brittle star (*Amphiura filiformis*) is also highly abundant. The species occurring within this 'northern' community are typical of the silt-rich sediments and greater water depths, both of which give rise to calmer conditions. The species occurring in this area are characteristic of the northern North Sea (Wieking & Kröncke, 2003).

The 'southern' benthic community is found in bank areas deeper than 30 m adjacent to the area of the central Oyster Grounds and accordingly hosts many of the same species. The species composition is largely determined by the sediment, which is rich in silt in this area. The faunal community is dominated by the brittle star *Amphiura filiformis* and a bivalve mollusc, *Mysella bidentata*. Other dominant species are the Polychaete *Pholoe baltica* and the shining nut shell, *Nucula nitidosa*.

The sandeel (*Ammodytes* spp.) are an important fish species on the Dogger Bank and occur in high densities, especially along the 20-30 m depth contours (summarised in JNCC, 2008). Their distribution is related to the distribution of plankton, on which they feed, which in turn is largely driven by the hydrographic conditions. Sandeel are an important food source for many species, including seabirds (Parsons et al., 2008), sea mammals (such as the harbour porpoise, MacLeod et al., 2007) and predatory fish species. As a staple food for birds and sea mammals, sandeel are thus important to the Dogger Bank site (Mackinson, 2007). Other fish species that occur in high densities include whiting (*Merlangius merlangus*), plaice (*Pleuronectes platessa*), Atlantic mackerel (*Scomber scombrus*), Atlantic cod (*Gadus morhua*), dab (*Limanda limanda*), lesser weever fish (*Echiichthys vipera*) and grey gurnard (*Eutrigla gurnardus*) (Callaway et al., 2002; Lindeboom et al., 2008). Some rarer species, that are vulnerable due to their longevity and slow reproduction strategies are also found at this site, one of which is the thornback ray (*Raja clavata*, Ter Hofstede et al., 2005). Furthermore, the site is an important area for numerous fish species that deposit their eggs within the site, including the Atlantic cod, which deposits eggs along the southern and eastern edges of the Bank in the period January-March (Fox et al., 2008), and plaice, which uses a large part of the EEZ as its spawning ground (Ter Hofstede et al., 2005).

Various sea mammals occur on the Dogger Bank, such as the harbour porpoise (*Phocoena phocoena*, Arts & Berrevoets 2005; Van der Meij & Camphuysen 2006) and the white-beaked dolphin (*Lagenorhynchus albirostris*) (Van der Meij & Camphuysen 2006). Minke whales (*Balaenoptera acutorostrata*) are also sighted during the summer months (Camphuysen & Peet 2006; Leopold pers. com.). Visual sightings at sea of the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*) are difficult, but the animals can be tracked with the help of satellite transmitters and it is evident form such data that both species occur on the Dogger Bank (Lindeboom et al. 2008).

2.1.3 Human activities

Fisheries

Several types of fisheries occur on the Dogger Bank (Lindeboom et al., 2005). Details on the intensity of different fisheries activities at the Dogger Bank are described in Chapter 6.

Other activities

There are no oil- or gas platforms present on the Dogger Bank and only a few pipelines and cables cross the area (Lindeboom et al. 2005, Figure 3). In addition, no shipping lanes are present, thus the only shipping that occurs is by fishing vessels and by ships that are allowed to sail beyond shipping lanes. A few ship wrecks are present and sightings of oil spills are relatively low. With respect to future developments, planning of oil- or gas rig installation may proceed in the near future. Furthermore, seismic research is planned and one new telecom cable is foreseen. No wind farms have been proposed in the area in the short term, however in the UK part of the Dogger Bank it is the intention to install large wind farm arrays. With respect to the more distant future there are some plans to designate wind farm areas in the North Western part of the Dutch Continental Shelf. Whether or not this designation will overlap with the Dogger Bank MPA is not sure at the moment.

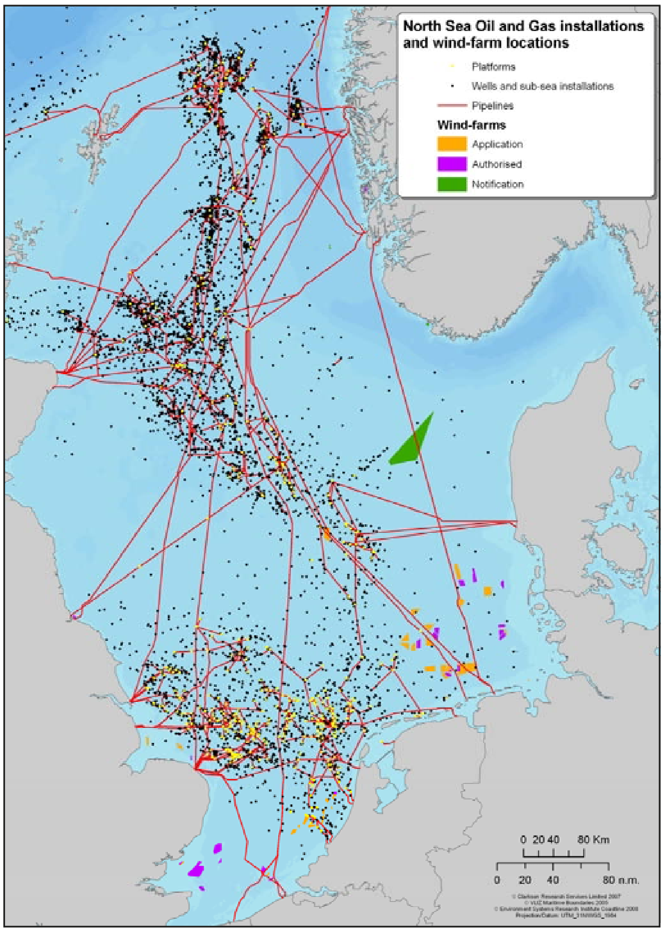

Figure 3 Location of oil and gas installations in the North Sea. Source: Clarkson Research Services Limited for data on the oil and gas installations, wind farm data is from OSPAR (adjusted from Paramor et al., 2009).

2.2 Cleaver Bank

The Cleaver Bank comes under habitat type H1170 (Open-sea reefs)[2] and is also an area where harbour porpoises and grey and harbour seals are found, three species that are to be protected under the Habitats Directive (Bos et al., 2008).

2.2.1 Site boundary and features

The Cleaver Bank lies in the north-western region of the Exclusive Economic Zone (EEZ, Figure 1) and the site's boundary was set by drawing a triangle around the gravel reserves shown on the map (Lindeboom et al., 2005, Figure 4 left and right). The Cleaver Bank is an example of habitat type H1170 'Open-sea reefs' and is characterised by geo-morphological features that are considered to be reef structures. Areas where large cobbles or coarse gravel occur are a characteristic feature. An additional characteristic is the presence of a mosaic of coarse sediment types that, in addition to cobbles and gravel, consists of various sands (Laban, 2004). Places with gravel (maximum 80%) and boulders alternate with coarse sand and places with old shell material. In some areas boulder clay rises to the

[2] To distinguish from reefs of biogenic origin, the habitat type H1170 (Reefs) as referred to here is further specified as 'Open-sea reefs'.

surface. Gravel with grain sizes larger than 30 mm is already covered with growth, which suggests that the mobility of these beds is minimal. Sessile organisms are important because they can cement loose bed elements, as was observed on the Georges Bank (Collie et al., 1997), and make the bed less sensitive to the effects of water motion. The area containing habitat type H1170 is cut in two by the deep and silt-rich Botney Cut, which does not contain habitat type H1170.

Owing to the variety of sediment types (Figure 5), such as the occurrence of coarse sediments and cobbles, the Cleaver Bank hosts a great diversity of species. Of all the macrobenthic species present in the Dutch EEZ, 44% occur exclusively on the Cleaver Bank (van Moorsel, 2003) and the diversity of the macrobenthos on the Cleaver Bank is among the highest in the EEZ (see Lindeboom et al., 2008). Over large areas a thin layer of marine sands has been deposited. Occasionally, under the influence of the dominant water current, these form what are known as ‘sand ribbons’ that run parallel to the current direction and can be kilometres long (Laban, 2004). Maximum measured current speeds vary between 0.25 and 0.40 m/s. Because of its depth (30-50 m), wave action only disturbs the seabed in heavy weather and as a consequence of this dynamics, the gravel is relatively poor in silt.

The mobility of sediments larger than 30mm in the area is minimal as is suggested from their cover of sessile organisms. The Cleaver Bank is also one of the clearest areas in the southern North Sea, allowing light to penetrate to deeper water and resulting in growth of red seaweeds at 34-39m (van Moorsel, 2003). The mosaic pattern and the low mobility of a large part of the sediment in combination with the clarity of the water make the Cleaver Bank unique in the Dutch EEZ, although this combination of features is less rare in other parts of the North Sea.

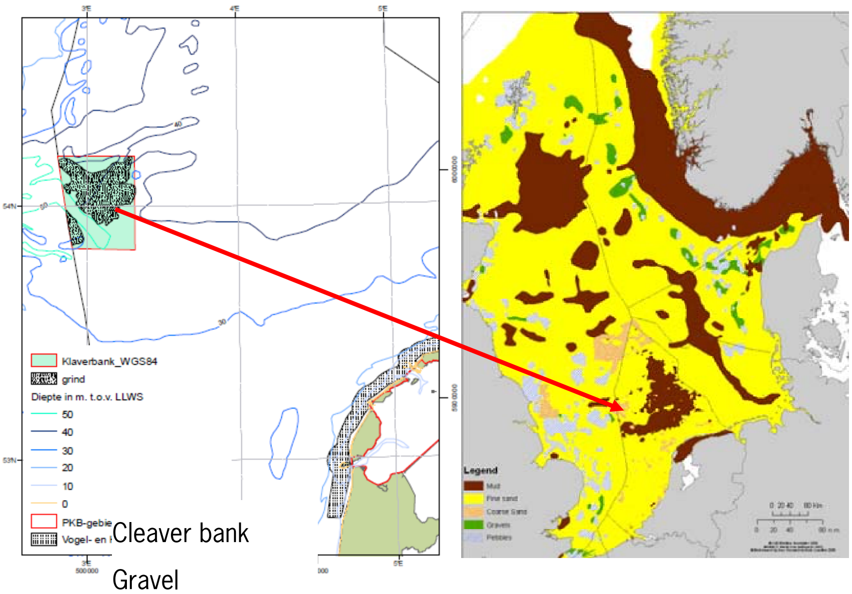

Figure 4 *Left – The Cleaver bank with depth contours and the position of the gravel banks (from Bos et al. 2008, Jak et al. 2009) and right – a sediment map of the English Channel and the North Sea, modified by Carpentier et al. (2008) after “Seafloor sediment of the North Sea” from the MARGIS project extended with a more detailed map of the Dutch Maritime area.*

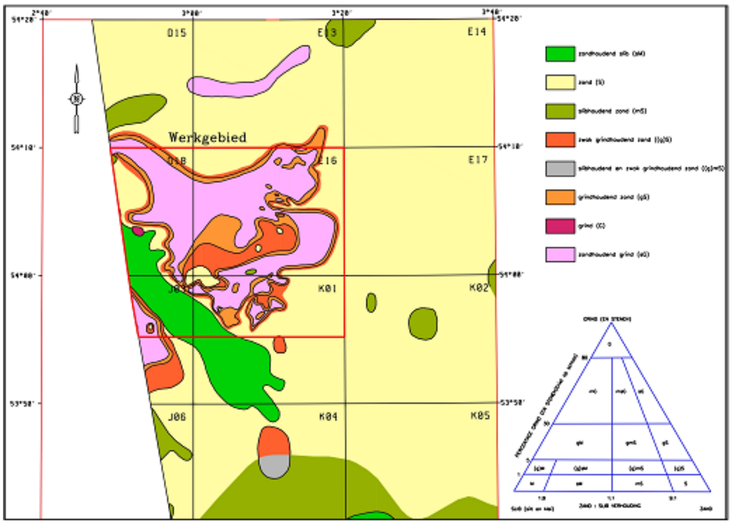

Figure 5 Map of the sediment types of the Cleaver Bank area (marked by the red line) and surroundings. The green area (sandy silt sM) in the south west part of the map is the Botney Cut (from Laban 2004).

2.2.2 Biotic Community

The coarse permeable sands within the site provide habitat for the European lancelet (*Branchiostoma lanceolatum*) and pea urchin (*Echinocyamus pusillus*). These species do not always occur in high abundances but are nevertheless characteristic due to their association with this specific course sediment. Other species named are the polychaeta *Aonides paucibranchiata, Typosyllis cornuta and Goniadella bobretzkii*. The amphipod *Urothoe marina* is named as a crustacean typical of coarse sand (Van Moorsel, 2003). Characteristic sessile organisms are the dead men's fingers (*Alcyonium digitatum*), encrusting coralline red algae (*Lithothamnion sonderi* and *Phymatolithon* sp.) and, for example, the keel worm (*Pomatoceros triqueter*), the ross worm (*Sabellaria spinulosa*) and the ribbed saddle oyster (*Pododesmus patelliformis*) (Van Moorsel, 2003). These last three species are of particular interest as they function as eco-engineers, by cementing the substrate and giving its structure and texture an extra dimension, stimulating the attachments of other species, such as the rock-boring mollusc (*Hiatella arctica*) and moss animalcules.

Species that occur specifically in coarse sediment are the rayed artemis (*Dosinia exoleta*) and the blunt tellin (*Arcopagia* (=*Tellina*) *crassa*). These species have a thick shell, which makes them well suited to the incidental movements of the gravel and it is precisely these species that occur in the well-sorted clean (silt-poor) finer gravel and coarse sand fractions. Ocean quahog (*Arctica islandica*) are also regularly encountered and considering the type of substrate, the site is potentially suitable for the occurrence of the horse mussel (*Modiolus modiolus*, Kenny & Rees, 1996), which is a long-lived species that can form mussel beds. The common whelk (*Buccinum undatum*) can sustain itself well here because there is sufficient fixed substrate for the deposit of egg cases. The site thus has the potential to host various long-lived shellfish species.

Furthermore, a variety of species are found that are otherwise only common in the deeper, more northern North Sea. Examples of these are the red whelk (*Neptunea antiqua*), the slender colus or common spindle (*Colus gracilis*), the hermit crab (*Anapagurus laevis*) and the purple heart urchin (*Spatangus purpureus*). A number of species new for the Netherlands have also been found at the site, such as the Norway bullhead (*Taurulus lilljeborgi*) and the spiny squat lobster (*Galathea strigosa*). Northern species that occur on gravel-rich locations are the worms *Glycera lapidum, Chone duneri* and *Laonice bahusiensis* (Van Moorsel, 2003).

Common fish species in the area are gobies (*Pomatoschistus* spp.) and small flatfishes, such as scaldfish (*Arnoglossus laterna*), solenette (*Buglossidium luteum*) and common dragonet (*Callionymus lyra*). These species are common throughout the North Sea and also often occur in other areas in the

EEZ in large numbers (Van Moorsel, 2003). Two species however, prefer to live on and between cobbles and are therefore considered characteristic of the area. These are the Norway bullhead (*Taurulus liljeborgi*) and the two-spotted clingfish (*Diplecogaster bimaculata*). Various fish species also spawn in the area (e.g. whiting) and the site is potentially suitable as a spawning ground for herring (summarised in Ter Hofstede et al., 2005). An expansion of the herring population could give rise to the need for new spawning grounds (Schmidt et al., 2009).

Five species of marine mammals have been sighted within the Cleaver bank area. During summer, the harbour porpoise (*Phocoena phocoena*, Arts & Berrevoets 2005; Van der Meij & Camphuysen 2006) can be found, particularly around the Botney Cut, as well as the white-beaked dolphin (*Lagenorhynchus albirostris*, Van der Meij & Camphuysen 2006;) and the minke whale (Camphuysen & Peet 2006; Brasseur et al., 2008). Although visual sightings of seals are difficult to make, the animals can be tracked with the help of satellite transmitters, which has shown that both the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*) can occur in the area (Lindeboom et al. 2008).

In terms of birds, the common guillemot and little auk are present in the area primarily in April/May (Arts & Berrevoets 2005).

2.2.3 Human activities

Fisheries

Several types of fisheries take place on the Cleaver Bank, both by Dutch vessels and by vessels from other European countries. The various fisheries activities in the years 2006-2008 on the Cleaver bank are shown in Chapter 6 using VMS and logbook data.

Other activities

Two pipelines and a telephone cable cross the Cleaver Bank and some wells or subsea installations occur within the Cleaver Bank area (Fig. 5). Furthermore, a shipping route, which is used as a route for dangerous substances, crosses the southern border, although its use is limited. Early in the 1990s a thorough inventory of the site was carried out in connection with the possible commercial extraction of coarse sand and gravel (see references in Van Moorsel, 2003). It was found that if the extraction of gravel and coarse sand were to be carried out on such a large scale that it led to a reduction of hard substrate on the surface of the seabed, this would lead to the loss of habitat for epibenthos. In this context, it is important to know that the thickness of the gravel layer is at most a few metres. However, mainly due to high transportation costs relating to the large distance to the Dutch coast no concrete plans for gravel extraction on the Cleaver Bank exist at this moment.

2.3 Frisian Front

The Frisian Front is a relevant area for birds under the Birds Directive (BD). Sites under the Birds Directive are designated directly without any prior notification procedure to the EC. It is thus not characterized based on the presence of specific habitats but due to the occurrence of specific bird species in relatively high numbers.

2.3.1 Site boundary and features

The Frisian Front lies in the eastern part of the Exclusive Economic Zone (EEZ, Fig. 1) and the site's boundary was set by drawing straight lines around the sampling stations with a higher biodiversity of benthos, locations at which the Ocean Quahog is present and with high bird values (Lindeboom et al., 2005). The Frisian Front is part of the long physical front in the central part of the North Sea that is stratified in summer. The unique characteristics of this front mean that silt and nutrients are imported from the English coast and the English part of the North Sea potentially resulting in higher primary production. In addition, the Dutch coastal river enters here in deeper, and consequently, slower flowing water into which silt and nutrients can settle. All these factors combined produce a zone with a high biomass of zoobenthos and a high diversity. The shellfish Ocean quahog *Arctica islandica* occurs in high numbers throughout the area and relatively high concentrations of fish and birds have been observed in this area as well. Guillemots in particular migrate to this area in large numbers in late summer and in autumn with their young to forage.

The entire proposed area has high bird values and qualifies under the Birds Directive for the Great skua and the Guillemot. In addition, the Frisian Front has a high biodiversity of benthos, which meets the OSPAR criteria.

2.3.2 Bird species

It has been stated by Lindeboom et al. (2005) that two bird species occur in the Frisian Front that qualify under the Birds Directive, namely the common guillemot and the great skua. These species qualify on the grounds of the Ramsar criteria for concentration areas. In the late summer and autumn the great skua (*Stercorarius* (= *Catharacta*) *skua*) satisfies the standard that 1% of the total European population of this bird species occurs at this site. The common guillemot (*Uria aalge*) satisfies the criterion that more than 20,000 individuals regularly reside at the site.

Other possible candidates are the Fulmar (*Fulmarus glacialis*), the Gannet (*Morus bassanus*), the Arctic Skua (*Stercorarius parasiticus*), the Lesser Black-backed Gull (*Larus fuscus*), the Great Black-backed Gull (*Larus marinus*), the Kittiwake (*Rissa tridactyla*) and the Razorbill (*Alca torda*), although for the latter insufficient data are available, because the species cannot be distinguished from the common guillemot in aerial counts. However, it is known that razorbill numbers are much lower than common guillemot numbers and during the summer period the site is host to few, if any, razorbills (Leopold, pers. comm). Based on criteria set by the Ministry of Agriculture, Nature and Food Quality (Memorandum of Reply Birds Directive, LNV 2000), migratory waterbirds are subject to the rule that at least 1% of the biogeographical population must be regularly present within the area. Two species meet this criterion: the Lesser Black-backed Gull and the Great Black-backed Gull.

Figure 6 shows distribution maps of the four birds species that have conservation objectives under the Bird Directive on the Frisian Front. The maps have been copied from the Ecological Atlas of the North Sea (*Ecologische Atlas Noordzee*) (Lindeboom et al. 2008). The seabird sightings by the RIKZ (1991-2002; aerial counts) and those from the ESAS database (1987-2002; ship counts) were grouped per 5 x 5 km block and actually counted seabird densities were converted into densities per 25 km^2. This calculation was carried out separately for each dataset, broken down by species and by season. The distribution maps ultimately became averages of the RIKZ and ESAS datasets. For the calculation of the average number of birds in the Frisian Front, GIS was used to determine how many birds are located within the boundary of the Frisian Front. This involved taking the numbers for each species in the two-month period in which the density of the species in the EEZ is at its highest.

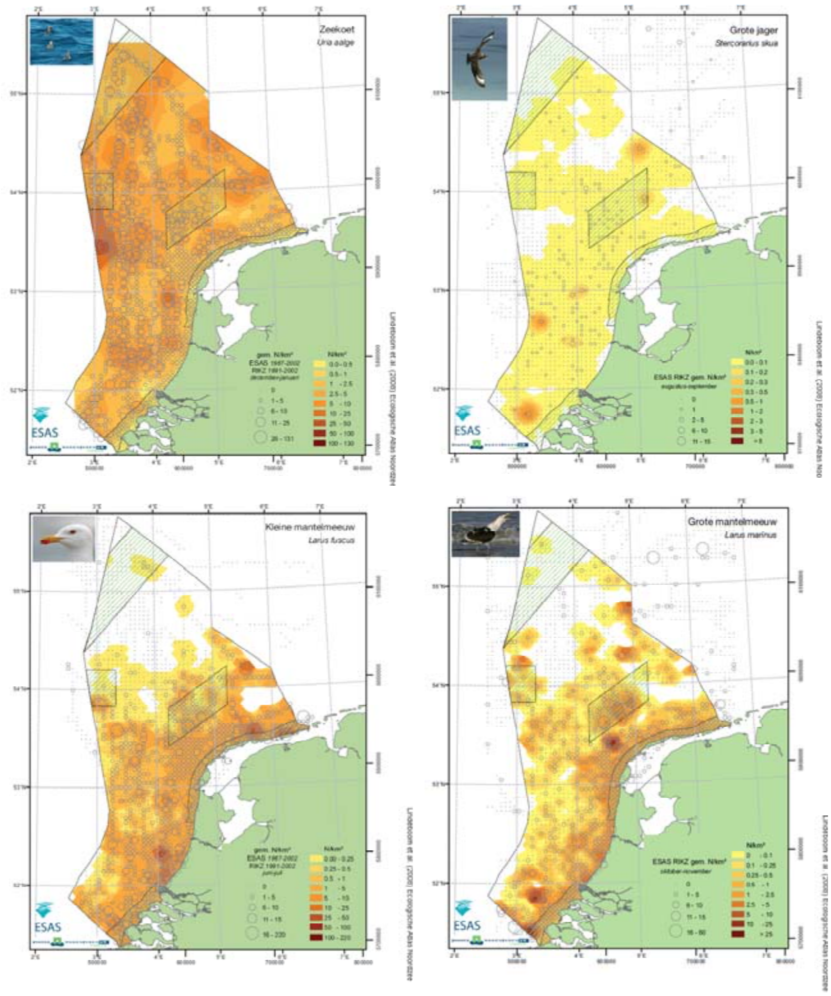

Figure 6 Distribution of the Guillemot in Dec-Jan (top left), Great skua in Aug-Sep (top right), Lesser black-backed gull in Jun-Jul (bottom left) and Great black-backed gull in Oct-Nov (bottom right) Combined RWS and ESAS data. From the Ecological Atlas of the North Sea method (Lindeboom et al. 2008).

2.3.3 Human activities

Fisheries

There are several types of human use occurring at the Frisian Front (Lindeboom et al, 2005). The fishery activities, especially beam trawl fisheries, are relatively intense within the area. Details on the intensity of different fisheries activities within the Frisian Front are described in Chapter 6.

Other activities

In addition to fishing activities, telecommunication cables are present in the area and a cluster of oil- and gas platforms with corresponding pipelines is distributed in the south-western part of the area (Fig 5). Several deepwater shipping lanes cross the area, which are used partly for the transport of dangerous substances, although the intensity of shipping traffic is relatively low. The number of detected oil spills in the area is relatively high compared to the shipping intensity. A few ship wrecks are present in the area.

A helicopter route for transport to and from the oil- and gas rigs crosses the airspace above the area. The Frisian Fronts also overlaps an area designated for military exercises of both the navy and the air force and flight- and shooting exercises occur almost on a daily basis.

With respect to future developments, one extra platform is expected to be constructed within the area, but there are no new plans for extra cables. The intensity of shipping activities is not expected to increase, however a shift toward bigger ships is expected. Military activities in the area are expected to remain the same. Due to its depth the area is not attractive for other human use and no offshore wind farms are planned in the area.

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3 Biological data availability and quality

3.1 Fish

The biological data collected within the Data collection framework contains data of regular surveys and of the observer program. Two benthic fish surveys are of possible interest related to the Natura 2000 sites, the International Bottom Trawl Survey and the Beam Trawl Survey. The number of hauls performed in each area by the surveys is given in table 2. The 2m beam trawl survey which takes place outside the Data collection framework is added in table 2 as well. .

Table 2 Number hauls done in each area by the different surveys.

Survey	Gear	Quarter	Cleaver bank	Dogger Bank	Frisian Front	total
IBTS	GOV-like	1	18	107	136	261
IBTS	GOV-like	2	2	11	15	28
IBTS	GOV-like	3	2	64	43	109
IBTS	GOV-like	4	1	20	16	37
BTS	8m beam	3	5	22	56	83
2m beam	2m beam	3	2	3	2	7
Total			30	227	268	525

3.1.1 International Bottom Trawl Survey (IBTS)

In the North Sea the IBTS started in the 1960's as a survey that was directed at juvenile herring and was at that time called the International Young Herring Survey (IYHS).

As it was gradually realised that the survey also yielded valuable information for other fish species, such as cod and haddock, the objectives were broadened and the survey was renamed into the International Young Fish Survey (IYFS). Besides the IYFS, which was carried out in the first quarter, a number of national surveys developed in the 1970's and 1980's that were mainly carried out in the third quarter.

In 1990 ICES decided to combine the international and the national surveys into the IBTS. The IBTS is carried out twice per year (1st and 3rd Quarters) since 1997 and on a quarterly basis in the period 1991-1996.

Prior to 1977 there was no standardisation of gear although all ships used bottom trawls with a small mesh cover. In 1977 ICES recommended that all ships should use a GOV trawl as specified by the Institut des Peches Maritimes, Boulogne. A detailed description of the net is to be found in the manual (Anon. 2004). The GOV trawl has been gradually phased in, e.g. in 1979 only three vessels were equipped with the GOV trawl, but by 1983 all eight nations were using this gear. It should be noted that although the gear is now standard, variations in the rigging exist between the various countries.

The fishing method is also standardized and described in the manual (Anon. 2004). Fishing speed is 4 knots measured as trawl speed over the ground. In 1977, ICES also recommended that the duration of a tow should be reduced from an hour to half an hour with the catch data to be expressed in numbers per hour. All nations accepted this recommendation although it was a number of years before 30 minutes became the standard.

Content

Information is available on haul basis. For each haul, basic information on ship, nation, date, location, speed, and duration is provided. Furthermore, for most hauls information on depth, temperature, salinity and weather conditions are provided. Information on the catch consists of measurements of all fish per species at the nearest cm, and in most cases the amount of benthic organisms per species. Often sub-sampling methods are used as the total catch is too large to measure or count.

For the target (commercial) species, also information on individual length and weight, sex, maturity and age are collected. Often this is done on a stratified grid, were samples are taken representative for a larger area.

Spatial and temporal scale

The survey started in late 1960s, and more or less standardized information is available since 1997. Most information (specifically on the Dutch EEZ) is available on the first quarter. In the period 1991-1996 data are available on all quarters in a year, and since 1997 data are available on the first and third Quarters.

The full spatial extend of the surveys is shown in Figure 7, the exact locations of the hauls differ per year and quarter.

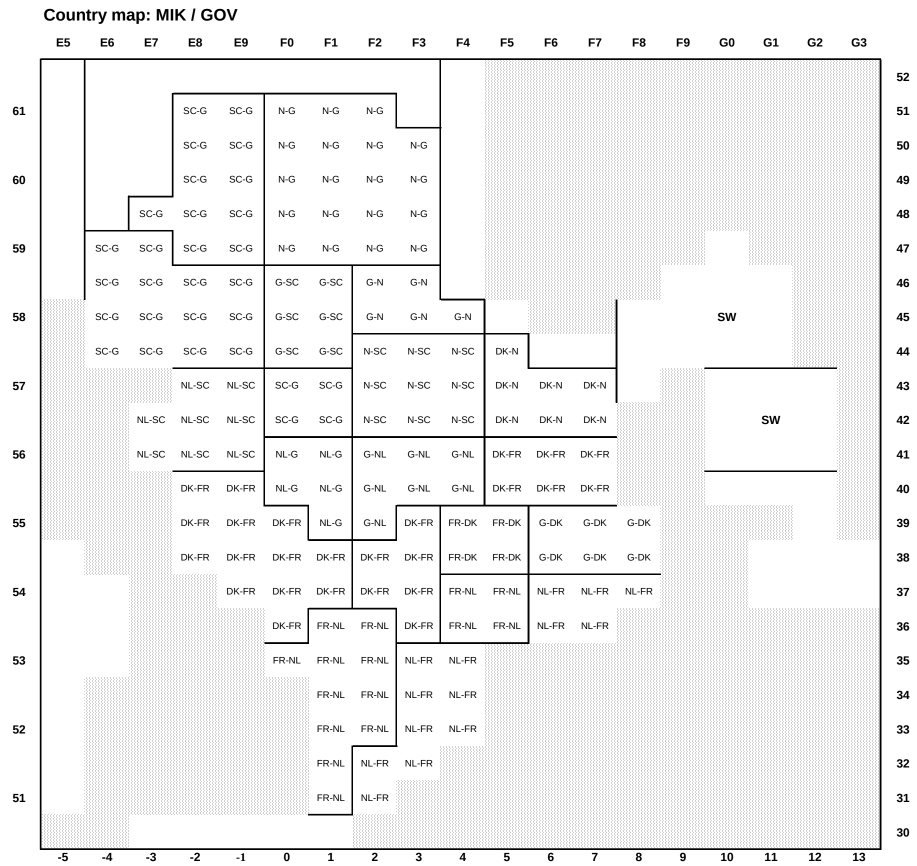


Figure 7 IBTS Quarter 1 Proposed Survey Grid All Participants. DK – Denmark, FR – France, G – Germany, N – Norway, NL – Netherlands, SC – Scotland, SW – Sweden.

Accessibility

All nations (institutes) taking part in the survey, supply their data on fish to ICES. The ICES datacenter combines all the data and gathers it in the Datras database. This database can be accessed online at http://datras.ices.dk. At this website, the manuals of the surveys are available and the data on Catch Per Unit of Effort (CPUE) per length and age and the indices of the commercial species can be downloaded.

Limitations

- The GOV-gear gives only information for a part of the system, mainly the demersal roundfish community.
- Due to limited catchability of the gear, only part of the target species is caught.
- Information on bycatch and discards is limited.

- Smallest spatial scale is a haul, which is on average (depending on the depth) about 30 ha.
- Information on benthos is limited.

3.1.2 Beam Trawl Survey (BTS)

The Dutch BTS was initiated in 1985 to estimate the abundance of the dominant age groups of plaice and sole including pre-recruits. Initially the survey was only carried out in the south-eastern North Sea (ICES area IV) using RV Isis equipped with a pair of 8 m beam trawls rigged with nets of 120 mm and 80 mm stretched mesh in the body and 40 mm stretched mesh cod-ends. A total of eight tickler chains are used, four mounted between the shoes and four from the ground-rope.

The survey was designed to take between one and three hauls per ICES rectangle. The stations are allocated over the fishable area of the rectangle on a "pseudo-random" basis to ensure that there is a reasonable spread within each rectangle. No attempt is made to return to the same tow positions each year. Towing speed is 4 knots for a tow duration of 30 minutes and fishing occurs during daylight only.

In 1995, the survey was expanded into the central and northern part of the North Sea using RV Tridens. This vessel uses the same gear but is equipped with a flip-up rope as it covers rougher grounds. Sampling strategy is also similar but only one haul per rectangle is taken, preferably close to the centre of the rectangle.

Content

Information is available on haul basis. For each haul, basic information on ship, nation, date, location, speed, and duration is provided. Furthermore, for most hauls information on depth, temperature, salinity and weather conditions are provided. Information on the catch consists of measurements of all fish per species at the nearest cm, and in most cases the amount of benthic organisms (mainly epibenthic species) per species. Often sub-sampling methods are used as the total catch is too large to measure or count.

For the target (commercial) species, also information on individual length and weight, sex and maturity and age are collected. Often this is done on a stratified grid, were samples are taken representative for a larger area.

Spatial and temporal scale

The survey is performed each year since 1985, the survey takes place in August /September. Up to 1995 the survey was done with the RV Isis covering the eastern part of the North Sea, since 1996 the area was extended using the RV Tridens II covering the North-north-western area of the North Sea (Fig. 8). In the Isis area, it is planned to do 2-4 hauls per rectangle, while in the Tridens area, apart from some exceptions, 1 haul per rectangle is done.

Each haul covers about 3 ha per beam.

Accessibility

All the information on the BTS is stored in the IMARES database, Frisbee and can be accessed via various available codes (SAS, R). A large part of the data has open access via the Datras database from ICES http://datras.ices.dk.

Limitations

- The beam trawl gives only information for a part of the system, mainly the demersal flatfish community.
- Due to limited catchability of the gear, only part of the benthis species is caught.
- The gear can not be used on all grounds, especially rocky substrates are avoided.
- Smallest spatial scale is a haul, which is on average (depending on the depth) about 3 ha.

The BTS collects more information on benthic species than the IBTS, mainly epibenthic, but this is still only a small part of the existing benthos.

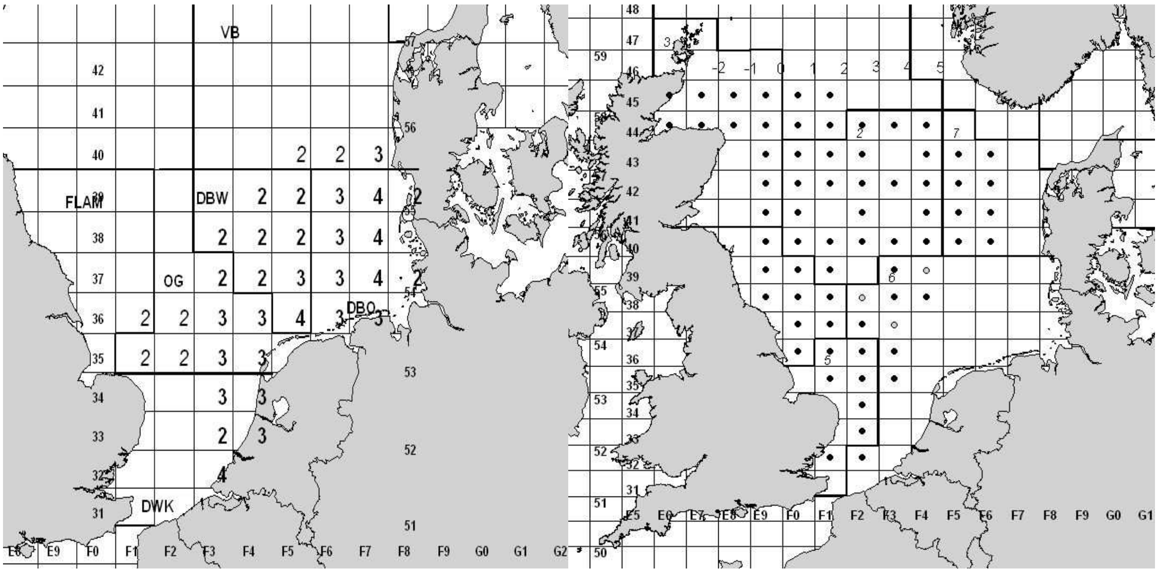


Figure 8 Spatial distribution of the Dutch BTS, left the area covered by the RV Isis with the planned number of hauls per rectangle; right the area covered by the RV Tridens II where 1 haul per rectangle is planned.

3.1.3 2m Beam Trawl Survey

During the BTS Tridens, but outside the Data Collection Framework, in a number of cases a 2m beam trawl with a mesh size of 4 mm is deployed. It was suggested that this survey would result in a better indication of epifauna compared to the 8m beam trawl. The 2m beam trawl survey is carried out since 1999 up to now. However, mapping the hauls and the Natura 2000 area results in only a very small number located within the areas (Table 7). Therefore no further results or discussion of this data will be done.

3.1.4 Observer program

Landings are one part of the catch of commercial vessels, less is known on the discards. These discards consist of undersized commercial fish, non-commercial fish and benthic species (starfish, sea-urchins, molluscs, etc.) and high-graded commercial fish[3]. Data on discards is available from observer data. The observers join a commercial vessel for a trip and measure (and weight) the discard part of the catch. Another source of discards estimates, are the estimations done by the assessment working

[3] However, the last is forbidden since the beginning of 2009

groups estimating the catches of undersized commercial fish (only on the level of the whole population) with the help of stock assessment models.

Content

Discards data have been collected under the EC Data Collection Regulations 1543/2000 and 1639/2001 (EC., 2000, 2001; Anon., 2002; ICES, 2003). Discard data is collected mainly from the larger commercial beam trawlers, however also some smaller beam trawlers, otter trawls and nephrops fisheries are sampled. The selection of the vessels to sample is quasi-random and based on co-operative sampling (ICES, 2000). This means that co-operation of a skipper within the project is on voluntarily basis. On forehand it is difficult to predict the sampling location, since this depends on the fishing strategy of the skipper. However, vessels from different regions are selected during a quarter to obtain widespread coverage.

For each sampled haul, day and night, a representative sub-sample of the discards was taken from the conveyer belt. All fish in the sub-sample were counted and measured. Benthic invertebrates were only counted. Total and sampled volume of discards was recorded. In addition, sub-samples of the landed fish were measured, and total and sampled landings weight were recorded. If possible, otoliths were collected from the major discarded fish species (plaice, sole, dab) for age readings. All data was entered into a computer program on haul-by-haul basis and later transferred into a central database. The haul by haul information is supplemented by information by trip from the auction (by market-category) and from the logbooks.

Spatial and temporal scale

From 1999 to 2001 discarding practices of the Dutch beam trawl fleet in the North Sea were monitored within an EC funded international research project (Anon., 2002). From 2002 onwards discard data have been collected under the EC Data Collection Regulations 1543/2000 and 1639/2001. An overview of the number of vessels sampled is presented in table 3. In 2009, a self sampling program on the larger beam trawls is started. In this program the fishers collect discard data from their own trips and report this to IMARES. These trips are also in table 3.

The sampling programs depend on the co-operation of a skipper and this depends on the fishing strategy of the skipper, IMARES can not decide on were the sampling takes place. However, due to this it represents the actual locations of the commercial fisheries. The spatial extend of the sampled hauls is presented in figure 8.

Table 3 An overview of the collected discard data by IMARES since 1999. The codes refer to the discard program, DISBT= Discards beam trawl; DISN= Discards Nephrops; DISOT= Discards Ottertrawl. N trip and N haul are the number of trips, or hauls performed per years for the specific métier.

Discard programme	Gear type	Mesh size (m)	Year	N trip	N haul
DISBT	Beam trawl04w	0.08	2000	2	75
DISBT	Beam trawl04w	0.08	2001	1	44
DISBT	Beam trawl04w	0.08	2003	1	36
DISBT	Beam trawl04w	0.08	2004	1	41
DISBT	Beam trawl04w	0.08	2006	1	9
DISBT	Beam trawl12w	0.08	2008	1	54
DISBT	Beam trawl12w	0.08	1999	3	130
DISBT	Beam trawl12w	0.08	2000	13	551
DISBT	Beam trawl12w	0.1	2000	2	54
DISBT	Beam trawl12w	0.08	2001	5	214
DISBT	Beam trawl12w	0.08	2002	6	172

Discard programme	Gear type	Mesh size (m)	Year	N trip	N haul
DISBT	Beam trawl12w	0.08	2003	9	306
DISBT	Beam trawl12w	0.08	2004	8	288
DISBT	Beam trawl12w	0.1	2004	1	35
DISBT	Beam trawl12w	0.08	2005	9	337
DISBT	Beam trawl12w	0.1	2005	1	38
DISBT	Beam trawl12w	0.08	2006	10	341
DISBT	Beam trawl12w	?	2006	6	10
DISBT	Beam trawl12w	0.08	2007	11	336
DISBT	Beam trawl12w	0.08	2008	11	388
DISBT	Beam trawl12w	0.08	2009	14	577
DISN	Ottertrawl	0.08	2007	3	27
DISN	Ottertrawl	0.08	2008	4	45
DISOT	Ottertrawl	0.1	2000	3	53
DISOT	Ottertrawl	0.08	2001	1	19
DISOT	Ottertrawl	0.095	2002	1	15
DISOT	Ottertrawl	0.1	2003	2	33
DISOT	Ottertrawl	?	2003	2	14
DISOT	Ottertrawl	0.08	2009	2	19
DISOT	Ottertrawl	0.12	2009	1	8
DISOT/DISBT	Outrigging	0.08	2006	1	21

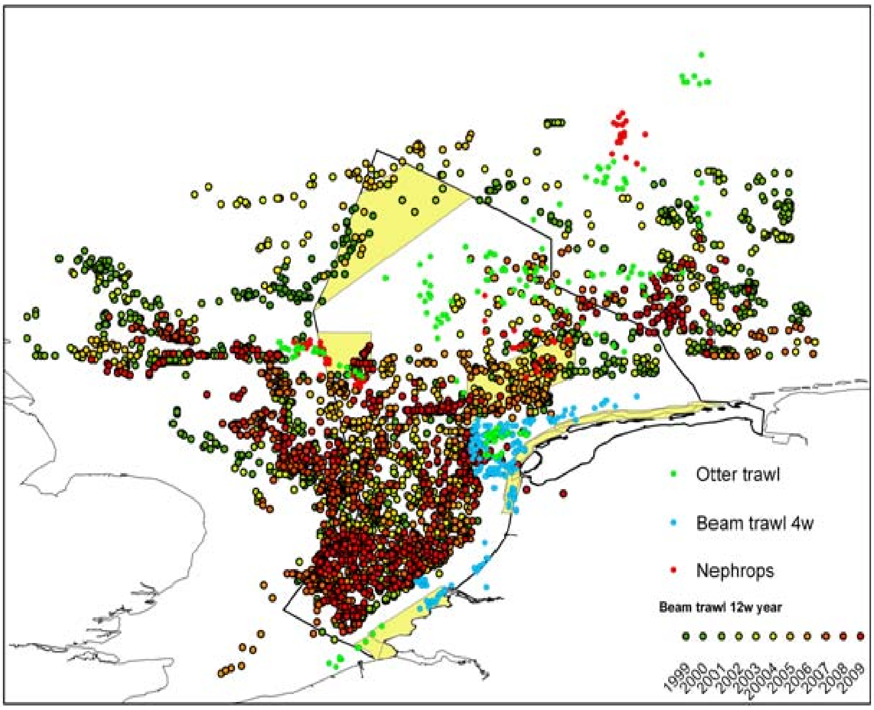


Figure 8 Spatial distribution of sampled discard hauls over the years. The larger beam trawl data is presented by year, 2009 dominates owing to the self sampling program.

Accessibility

The raw data are available in the IMARES databases and can be accessed by SAS-codes. Each year for each discard program, an overview report is written summarizing last years data (van Helmond and van Overzee, 2008; 2009).

Van Helmond and Van Overzee, 2008: http://www.cvo.wur.nl/default.asp?ZNT=S0T2O-1P275

Van Helmond and Van Overzee, 2009: http://www.cvo.wur.nl/default.asp?ZNT=S0T2O-1P301

Limitations

Small number of samples relative to the whole fleet

Data is meant to estimate discard proportions of specific fisheries, not for biological interpretations on abundance of species or biodiversity.

3.2 Birds

3.2.1 Bimonthly aerial RWS survey

Approximately every two months, aerial surveys are conducted in Dutch waters (EEZ and 12nm zone, Fig. 17) since late 1984. Although the survey is originally intended for birds, marine mammals were also consistently recorded from 1991 onwards. For a detailed description see Berrevoets & Arts (2001) and Arts & Berrevoets (2005).

The bimonthly sampling design ensures that the dataset covers all periods relevant for the selected species. The extent of the survey spans the entire NCP. Only a small part of the survey transect lies within the boundaries of the Frisian Front Natura 2000 area (Figure 9). There is one transect running west-east intersecting the north-eastern part of the area, whereas a north-south transects runs through the western part of the area. Per month, the surveyed area amounts to 9.6 km^2 (range: 1.8-20.5; SD=4.6) on average.

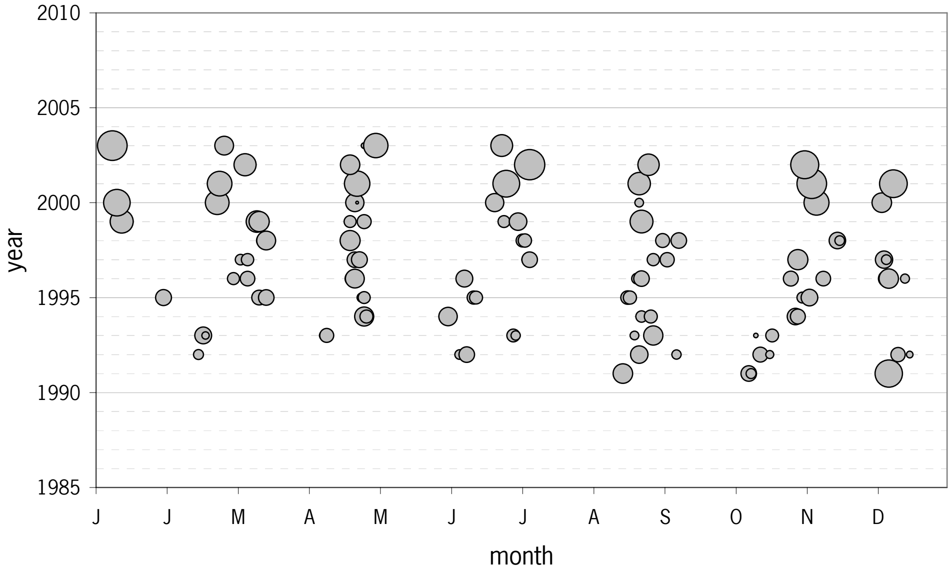


Figure 9 *Aerial survey effort (RIKZ) within the Frisian Front Natura 2000 area during August 1991- July 2003. Data from after July 2003 is not shown, but this program is still continuing. The size of the bubbles reflects the surveyed area; every bubble is one day. Effort is more or less evenly spread over months and years.*

3.2.2 Ship-based European Seabirds at Sea survey - ESAS

The ESAS database is composed of ship-based surveys which are added on a project basis. Over the last decades distribution patterns of seabirds and marine mammals have been studied using the “seabirds at sea” method. This is a standardized method described in detail by Tasker et al. (1984), Webb & Durnick (1992) and Garthe et al. (2002). The occurrence of birds is recorded within a 300m wide transect running parallel to the keel line of the observation vessel, either using continuous recording for swimming animals, or the “snapshot” method (Tasker et al. 1984) for flying birds. The survey vessels can be on dedicated surveys with pre-designed tracklines or they can be opportunistic platforms. As most surveys are done on opportunistic platforms (e.g. research fishery cruises) the spatial and temporal coverage is not predictable. Over the last two decades coverage in Dutch waters was too low to allow the use of the data for the interpretation of porpoise distribution in the offshore waters.

The seabirds at sea data from the Frisian Front spans a time period of 22 years, starting in 1987. In the entire study area, the effort exceeded 100km^2 during 14 of these years, but no effort was achieved in three of the years (1996, 2000 and 2001, Figure 10). Annual effort was greatest in 1987 with 2300km^2. The Frisian Front was surveyed for more than 50km^2 in eight years (1987, ‘88, ‘89, ‘90, ‘94, 2005, ’06 and ’09), with the largest effort in 1987. In total, 287 field days were made, spread over all months. Most effort was spent in July-August (Figures 10 and 11). In summary, effort is unevenly spread over both years and months. Overall, this dataset covers all periods relevant for the selected species, but due to many missing years is unable to trace interannual variation. Per month, the surveyed area amounts to on average 36.1 km^2 (range: 1.3-278.4; SD=50.2).

There is some considerable spatial variation, with much effort in the western and central part of the Frisian Front area, but limited effort in the (north-)eastern part (Figures 11, 12 and 13).

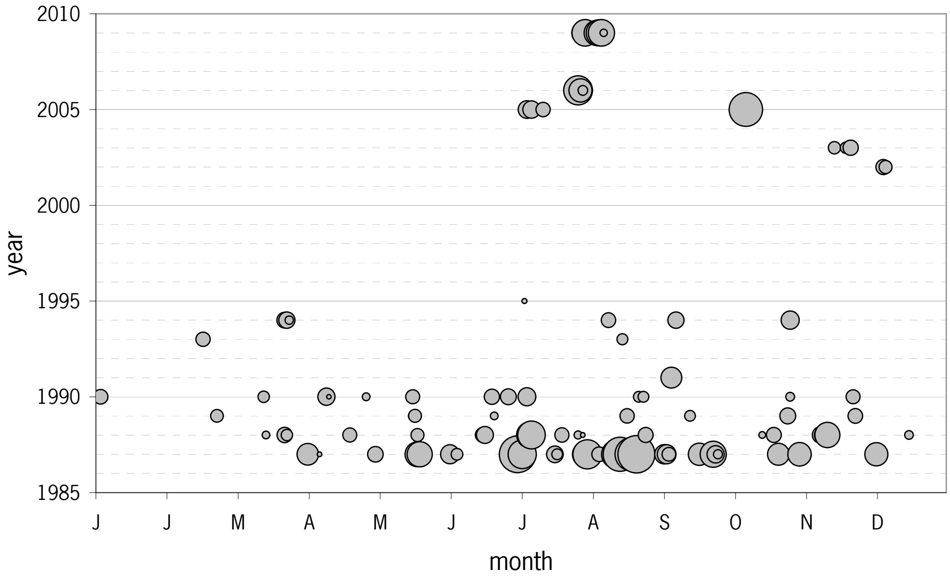


Figure 10 *Ship-based effort within the Frisian Front Natura 2000 area during 1987-2009 (ESAS database). The size of the bubbles represent the surveyed area; every bubble is one day. Effort is unevenly spread over months and years.*

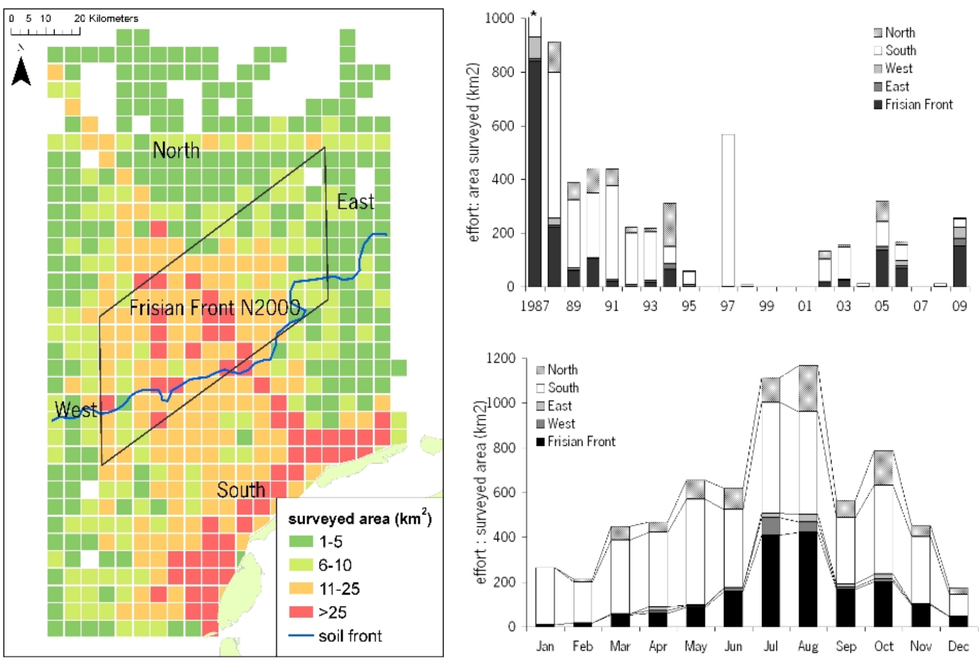


Figure 11 *ESAS Effort in the Frisian Front and adjacent areas, expressed in surveyed area (km^2) for the period 1987-2009. Spatial distribution of effort (left), summed per squares of 5x5km, effort per year (top right) and effort per month (bottom right). Total effort in 1987: 3300km^2. Effort spent in 'south' and 'north' (cut off at 1000km^2, marked by *) are 1113km^2 and 255km^2, respectively.*

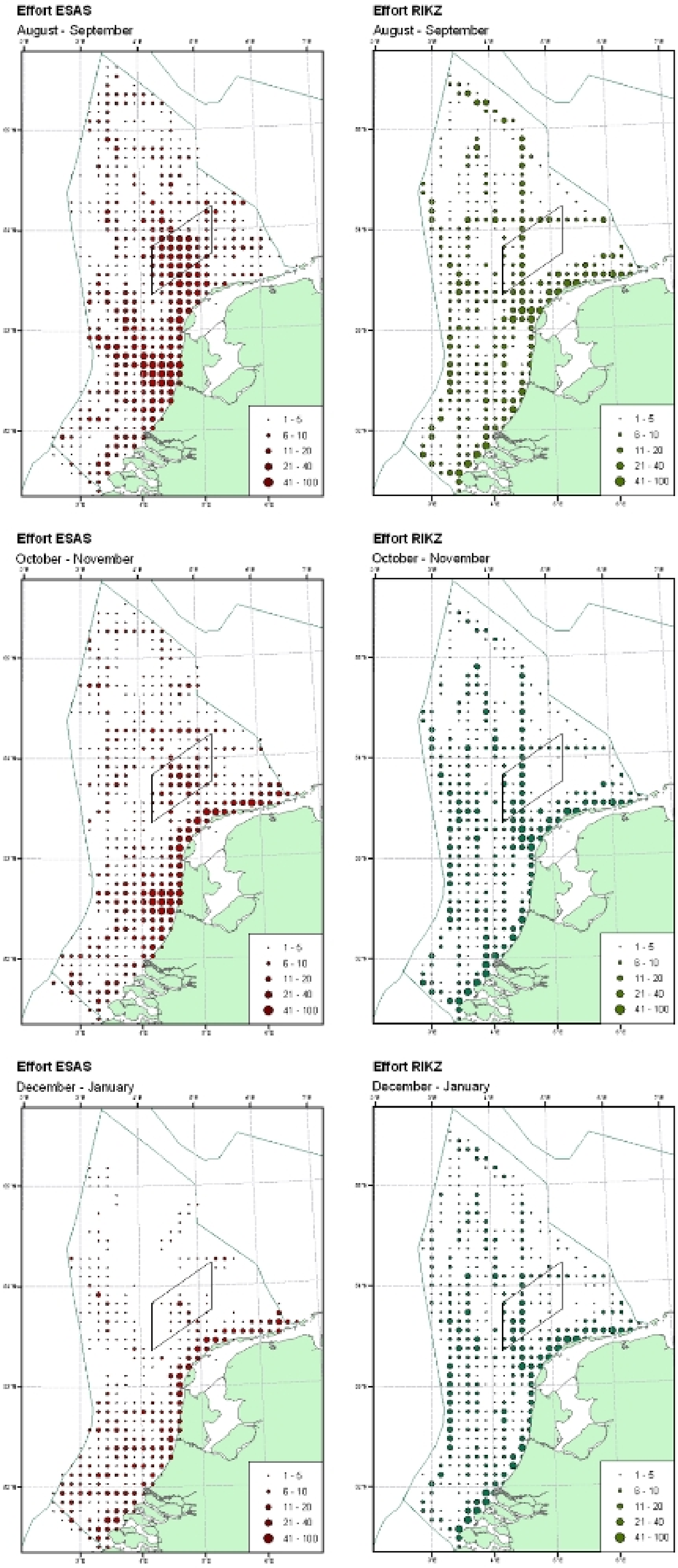


Figure 12 Effort of ship-based ESAS (left; 1987-2006) and aerial RIKZ (right; 1991-2007) survey data compared per two-month periods. Each dot represents the area surveyed per 10x10km square, expressed in km². From top to bottom, figures represent August-September, October-November, and December-January, respectively.

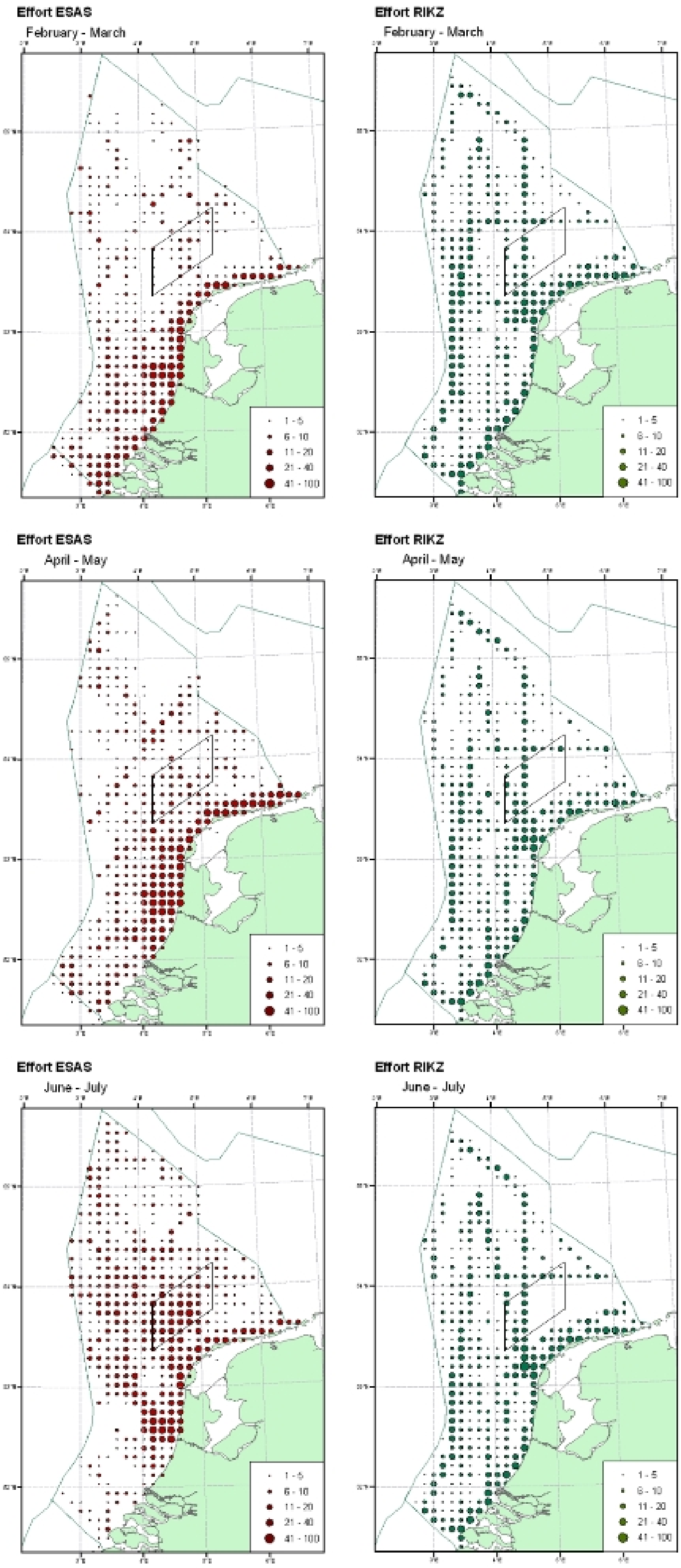


Figure 13 Effort of ship-based ESAS (left; 1987-2006) and aerial RIKZ (right; 1991-2007) survey data compared per two-month periods. Each dot represents the area surveyed per 10x10km square, expressed in km². From top to bottom, figures represent February-March, April-May, and June-July, respectively.

Suitability of seabird data

Both available datasets on density and distribution of marine birds, the bimonthly aerial RWS surveys and the ESAS database are unsuitable for the analyses of trends and micro distribution of seabirds in *relative small parts* of the NCP, such as the Frisian Front

Although the aerial surveys have been conducted regularly over a long time-span and may therefore be suitable for large-scale studies, this may not be the case for small parts of the NCP, such as Natura 2000 areas. Statistical power may be limited by the small amount of surveyed area per survey combined with a narrow transect width (resulting in a low absolute number of birds observed). Moreover, as seabirds tend to show a very patchy distribution, chances of missing local concentrations of birds may be considerable. Finally, for relatively small areas such as the Frisian Front, the wide spacing of transects requires interpolation of data to large proportions of the study area.

Also data from the ESAS database is unsuitable for trend analyses. This is due to considerable variation in effort across years and seasons.

When comparing aerial with ship-based surveys, several more drawbacks of the aerial survey methods emerge. A major disadvantage of aerial surveys in terms of data quality is that Common Guillemots can not be separated from Razorbills. In summer, Common Guillemots greatly outnumber Razorbills at the Frisian Front (Geelhoed et al. 2009), but this may be less so in autumn and winter. Moreover, juvenile Common Guillemots cannot be separated from older birds in aerial counts. During ship-based surveys, age, plumage (moult) and behaviour can be recorded for all species, providing important cues of how these animals use the areas.

The Frisian Front is a dynamic system, and our understanding of how these dynamics affect seabird numbers and distribution, is still in its infancy. This requires a more thorough study. Nevertheless, the available data clearly shows the importance of the Frisian Front for seabirds, in particular the two species that qualify under the Birds Directive. For Common Guillemots, the most important period is summer, when they use the area for raising chicks and moult. However, there is evidence (November-December 2002-2003; see also Berrevoets & Arts 2002) that the area supports high numbers of guillemots also in winter. Moreover, high concentrations of Common Guillemots have been found at the northern border of the Frisian Front area. It may well be that these concentrations reach further north, to within the Oystergrounds. Detailed surveys of this area are however lacking.

Tracking the changes of bird numbers within subsets of the NCP, such as the Frisian Front, across and within years is currently impossible and there is currently no monitoring program that could provide such data.

The need for high-quality data for trend analyses is probably best fulfilled by regular ship-based surveys, providing detailed data on density and distribution. These surveys should at least span the most important period for the selected species: Common Guillemot, Great Skua, Great and Lesser Black-backed Gull. This period is from June-December.

3.3 Mammals

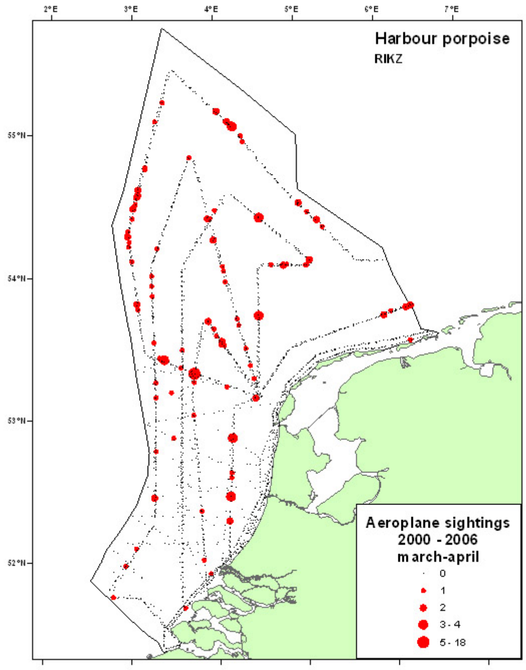
3.3.1 Bimonthly aerial RWS survey

Approximately every 2 months, aerial surveys are conducted in Dutch waters (EEZ and 12nm zone, Fig. 14). Although the survey is originally intended for birds, marine mammals were also consistently recorded from 1991 onwards. For a detailed description see Berrevoets & Arts (2001) and Arts & Berrevoets (2005).

This data source can not provide information on trends or relative abundance of porpoise. The data cannot be used to estimate abundance because the sighting probability (i.e. given the animal is present, what is the chance of detecting it) cannot be correctly quantified.

3.3.2 ESAS

Although the ESAS-method has been developed primarily for birds, marine mammals and in particular



cetaceans are also recorded (Figures 15 and 16).

Figure 14 Harbour porpoise sightings made from the RIKZ aircraft; combined data from 2002-2006 for the months March and April. The data presented have not been corrected for the varying likelihood of a sighting between the surveys. The observation effort and the sightings have been combined for a six-year period. The effort was not distributed evenly across the years and throughout the area studied. This map provides insight into the distribution of the harbour porpoise in the EEZ in the spring (March-April). It cannot be used to derive differences in the distribution of the density (e.g. to determine suitable sites for offshore structures) or to make density estimates of harbour porpoises (Brasseur et al. 2008).

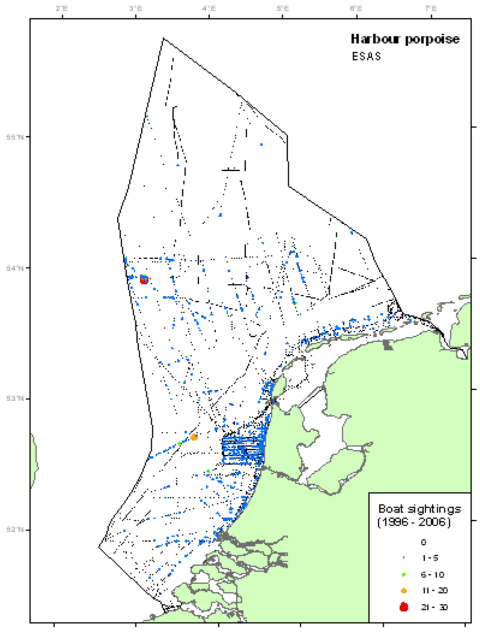
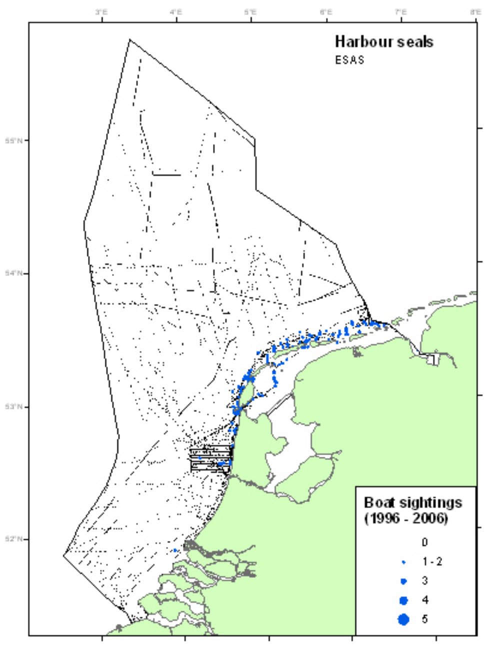


Figure 15 Harbour porpoise sightings made from ships from 1996 to 2006, based on the European Seabirds at Sea database. The data presented have not been corrected for any variance in the likelihood of a sighting between the surveys caused by, e.g. weather conditions. The effort and the sightings have been combined for a ten-year period. The effort varies between years and between areas. This map shows the information about the presence of harbour porposies throughout the year. It cannot be used to derive differences in the distribution of the density (e.g. to determine suitable sites for offshore structures) or to make density estimates of harbour



porpoises (Brasseur et al. 2008).

Figure 16 Harbour seal sightings made from ships (European Seabirds at Sea database). The data presented have not been corrected for any variance in the likelihood of a sighting between the surveys caused by, e.g. weather conditions. The effort and the sightings have been combined for a ten-year period. The effort varies between years and between areas. This map shows the information about the presence of harbour seals throughout the year. It cannot be used to derive *differences in the distribution of the density (e.g. to determine suitable sites for offshore structures) or to make density estimates of harbour porpoises (Brasseur et al. 2008).*

3.3.3 Aerial survey on harbour porpoise

Since 2008 a project financed by LNV and for part of the study by RWS used dedicated aerial surveys in combination with standard line transect distance sampling methodology to estimate the abundance of harbour porpoise. The study area covers the waters from the German to the Belgian coast to offshore distances of about 90 nautical miles. During the aerial surveys 10 - 20 tracklines are covered to count porpoises and use distance sampling methodology to obtain abundance estimates for this area, including confidence intervals and coefficients of variation. Surveys have so far been conducted in May 2008, November 2008, February – April 2009, August 2009 and November 2009. A final survey is planned to take place in March – April 2010. The project will finish in 2010. The data can provide more detailed information on the spatial distribution and density of harbour porpoises in Dutch waters then any of the before mentioned data sources. However, the spatial coverage only includes part of the Dutch EEZ, it does not include the Dogger Bank or Cleaver Bank sites. The temporal coverage is also limited with only a total of five surveys. In the future, the surveys could easily be extended to a larger area or be conducted at a higher frequency, e.g. to obtain more information on seasonal changes. An extension of the survey flights to the northern coastal area and the offshore waters, would allow an estimation of abundance for harbour porpoises for the time of the survey and would also then include the areas of the Dogger Bank and Cleaver Bank.

3.3.4 SCANS surveys

In the summers of 1994 and 2005 a European project (SCANS) covered the North Sea and adjacent waters to investigate the abundance of harbour porpoises. The survey was designed for sub-areas, of which two partly cover Dutch waters. Both the SCANS I and the SCANS II survey results have also been used to spatially model the distribution of porpoises in the summer. Again, the resulting maps are aimed to show distribution patterns at a larger scale (North Sea) and the spatial coverage in Dutch waters and in particular the Cleaver Bank can not be used to estimate abundance or obtain information on the distribution of harbour porpoises.

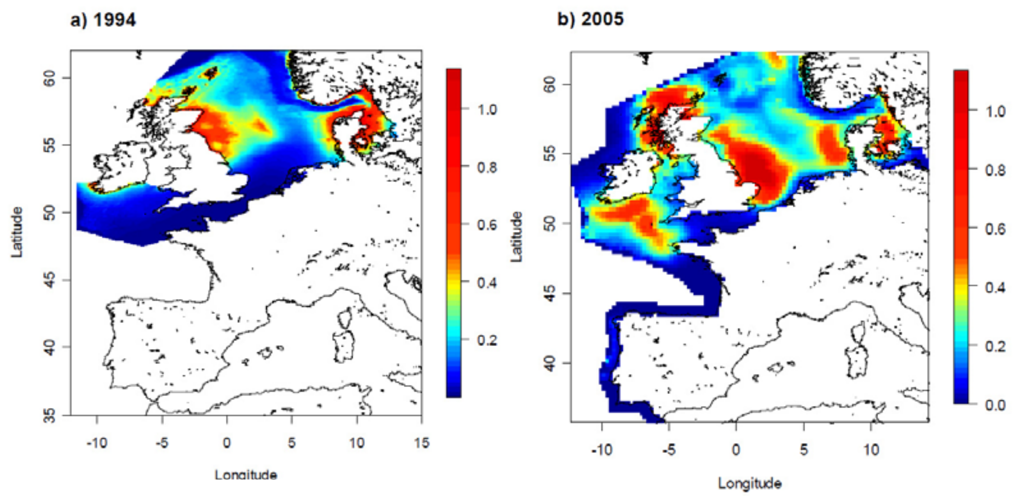


Figure 17 Estimated population density of the harbour porpoise (animals per km2) in (a) 1994 and (b) 2005. These maps are based on data collected as part of SCANS I and SCANS II research. The resolution of the predication shown is not high enough to differentiate between high and low densities at the Dutch subsectors (SCANS 2006; Brasseur et al. 2008).

The SCANS II study from 2005 shows that the distribution of the harbour porpoise has changed compared to the first SCANS survey. The population in the North Sea and adjacent waters (SCANS II survey area) is estimated at 335,000 animals. Densities in the northern North Sea, north of 56°N have roughly halved, while they have doubled in the southern North Sea (SCANS II, 2006). Sightings from the coast show a sharp increase between 1994 and 2005 (Fig. 17), after which a decline occurred. These counts were both performed in the summer months, a period in which probably the fewest harbour porpoises occur in the North Sea.

3.3.5 Cetacean atlas

The cetacean atlas (Reid et al. 2003) shows the distribution of harbour porpoises in the North Sea at the scale of 1/4 ICES rectangle. The atlas combines data from three different data sources (ESAS, SCANS I and Sea Watch data) over all seasons and over a time period from 1979 to 1998. The temporal resolution is not detailed enough as it summarizes almost two decades of data and does not include the last 12 years, in which a significant change in porpoise distribution has been observed.

3.3.6 Transmitter data on seals

It is commonly accepted that visual observation of seals at sea is not a usable method for studying seals. Therefore, other methods are used to define at sea distribution. There have been no dedicated studies undertaken to identify whether seals frequent the Dogger Bank, Cleaver Bank and the Frisian Front area, specifically. Consequently, no information exists as to the value or importance of these areas to seals. However, in the framework of other studies, more general insight has been gained in the habitat use of seals using telemetry. Not only have these studies shown that harbour and grey seals can travel hundreds of kilometres between haul-out sites and migrate over large distances, for example, harbour seals tagged in Zeeland (southern Netherlands) migrated to the German Wadden Sea and back and to the coast of northern France (Reijnders et al. 2000, Brasseur & Reijnders 2001). Whilst grey seals were tracked going from the Dutch Wadden Sea to Northern Scotland and back (Brasseur et al 2009). But more importantly, these studies have identified some of the factors that influence the seals' distribution. Consequently, it is possible to identify preferred habitat types and thus predict the distribution of seals. In several studies this has been done with a limited amount of data for harbour and grey seals in the Netherlands (Brasseur et al 2008, Brasseur et al 2009, Brasseur et al in review).

Thus, to summarise: there is data on seal distribution at sea (Fig. 18), however it is not currently known as to whether this data includes information on seal movements on the Dogger Bank, Cleaver Bank and in the Frisian Front area. Dedicated studies are needed to determine if seals use these areas and whether these areas are considered to be important to the seals. As most studies were completed under contract for private companies, not all of the data is publicly available. Having access to this data, thereby increasing the sample size, is essential to improving, and thus refining, the current models. In doing so the predictions of the model are greatly improved.

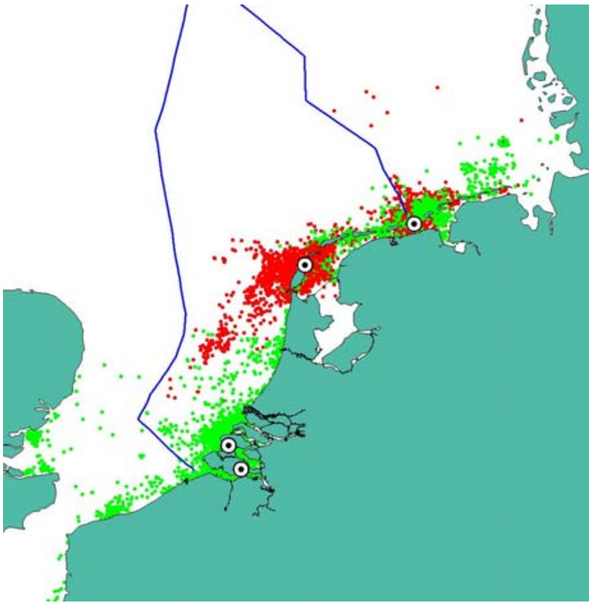


Figure 18 Unfiltered locations of telemetric data concerning the harbour seal in the EEZ collected between 1997 and 2006. It is evident that the sightings depend greatly on the location at which the animals were tagged, the number of tagged animals and the method used. Locations at which transmitters were attached are shown in white-with black dots, locations of sighted animals tagged in the Delta area in green, locations of animals tagged in the Wadden Sea in red. (Brasseur et al. 2008).

Currently, seal populations are monitored, both in the Netherlands and in neighbouring countries, by counting the number of hauled out seals. This data gives a good indication of the general status of the seals population. For example, both the grey and harbour seal populations in the Netherlands are increasing at an exponential rate, while in the United Kingdom, numbers are decreasing. At present there is no knowledge as to the driving force behind this and there is insufficient research into the movement of seals at sea to determine if these two trends are related.

3.4 Benthos

3.4.1 North Sea Benthos data

The ICES Benthos Ecology Working Group (BEWG) made a compilation of long-term studies on the benthic soft-bottom and hard-bottom infauna and epifauna in the OSPAR region (Annex 9 in BEWG 2008) (Table 4), based on a review by Kröncke & Bergfeld (2001).

A few cover the Central North Sea, including the Dogger Bank area and Cleaver Bank. These programs are described into more detail this section.

Table 4 Overview of different benthic surveys carried out in the North Sea over the past 60 years

Soft-bottom infauna			
Sea area	OSPAR region	Time scale	References
Van Mijenfjord (Svalbard)	I	1980, 2000–present	–
Svalbard fjords	I	1990s–present	–
western Barents Sea	I	1980, 1992, 2005	–
German Bight (Ziegelmeier)	II	1950s–1970	(Ziegelmeier, 1978)
Dogger Bank	II	1951–52, 1985–87, 1996–98	(Wieking and Kröncke, 2001)
German Bight (AWI)	II	1965–present	(Schroeder, 2003)
Skaggerak	II	1970–1998	–
NOR oil platform monitoring	II	1973–present	–
off Northumberland	II	1971–present	(e.g. Frid et al., 1996)
UK oil platform monitoring	II	1977–1998	–
off Norderney (Senckenberg)	II	1978–present	(Kröncke et al., 2001)
Norderney (Niedersachsen)	II	1976–1999	–
Northern North Sea	II	1981–1986	–
Dutch oil platform monitoring	II	1985–1993	(Daan and Mulder, 1995)
German inshore monitoring	II	1987–present	–
North Sea (NSBS, NSBP)	II	1986, 2000	(e.g. Rees et al., 2007)
Danish monitoring program	II	1989–1999	–
Dutch monitoring North Sea (BIOMON)	II	1991–present	(e.g. Daan and Mulder, 2001)
Dutch Continental Shelf (MILZON)	II	1988–1993	(Holtmann & Groenewold, 1994)
Shellfish monitoring North Sea	II	1995–present	(Craeymeersch and Perdon, 2004)
Shellfish monitoring Waddensea	II	1991–present	(Craeymeersch and van Stralen, 2004)
Gullmarsfjord	II	1983– ?	–
Dutch monitoring Waddensea	II	1980s–present	(e.g. Dekker and de Bruin, 2001)
Danish monitoring Skagerrak	II	? –2004	(Ærtebjerg et al., 1998)
German Bight Transect	II	1990–present	(Kröncke and Rachor, 1992)
Creutzberg Dutch North Sea sampling (NIOZ)	II	>1970	(Creutzberg et al., 1984)
German Bight (GB), surveys	II	1923, 1965, 1975, 2000	(Rachor and Nehmer, 2003)
GB Borkum Riffgrund	II	1967–72, 1996, 1999	(Rachor and Nehmer, 2003)
Belgian Continental Shelf	II	1979–present	–
Disposal Sites, Northumberland (UK)	II	1984–present	(Rees et al., 2003)
Disposal Sites, Thames (UK)	II	1985–present	–

Soft-bottom epifauna			
Sea area	OSPAR region	Time scale	References
UK National Marine Monitoring Programme	II	1995–present	(Anonymous, 2004)
La Coruna Bay, NW Spain	IV	1982–present	(López-Jamar et al., 1995)
Bay of Biscay (Basque coast, Nervion estuary)	IV	1989–present	(Borja et al., 2006)
Bay of Biscay (Basque coast and estuaries)	IV	1995–present	(Borja et al., 2004)
van Mijenfjord	I	1980, 2000–present	-
Svalbard fjords	I	1990s–present	-
western Barents Sea	I	1980, 1992, 2005	-
Shellfish monitoring North Sea	II	1995–present	(Craeymeersch and Perdon, 2004)
Shellfish montoring Waddensea	II	1991–present	(Craeymeersch and van Stralen, 2004)
MAFF	II	1980–1986	–
NSBS	II	1986	(Duineveld et al., 1991)
ZISCH	II	1987–1988	–
EU (Biodiversity, MAFCONS)	II	1986–present	(Zühlke et al., 2001)
Epibenthos (GSBTS)	II	1998–present	(Ehrich et al., 2007)
Creutzberg's trawl surveys North Sea	II	1970s–1980	(Creutzberg, 1979)
German Bight, Epi AWI, incl. Stones	II	1999–present	(Rachor and Nehmer, 2003)
Belgian Continental Shelf	II	1979–present	–
Hard-bottom epifauna			
Svalbard fjords	I	1980s–2006	–
South-West Netherlands	II	1985–2004	–
Helgoland	II	1987–1991, 2000 - 2004	–
Danish monitoring on stone reefs	II	1990–2004	–
Helgoland (BAH-AWI)	II	last 150 years	(Franke and Gutow, 2004)

In 1950-54 the echinoderm, polychaete and bivalve fauna of the Dogger Bank area were investigated intensively by Ursin (1960), Kirkegaard (1969) and Petersen (1977). At approximately the same time, Birkett (1953) sampled the western Dogger Bank. During April/May 1985-87 part of Ursin's stations were revisited by Kröncke (1990a, 1990b, 1992). In May 1996, 1997 and 1998 28 of these stations were revisited (Wieking & Kröncke 2001, 2003) to describe species composition, spatial distribution and trophic structure of the macrofaunal communities (Figures 19 and 20, Table 4). The water depth ranged from 18 m at the shallow stations on top of the bank to 68 m in the deeper southern part and 47 m in the northern part. Macrofauna samples were taken with RV "Senckenberg".

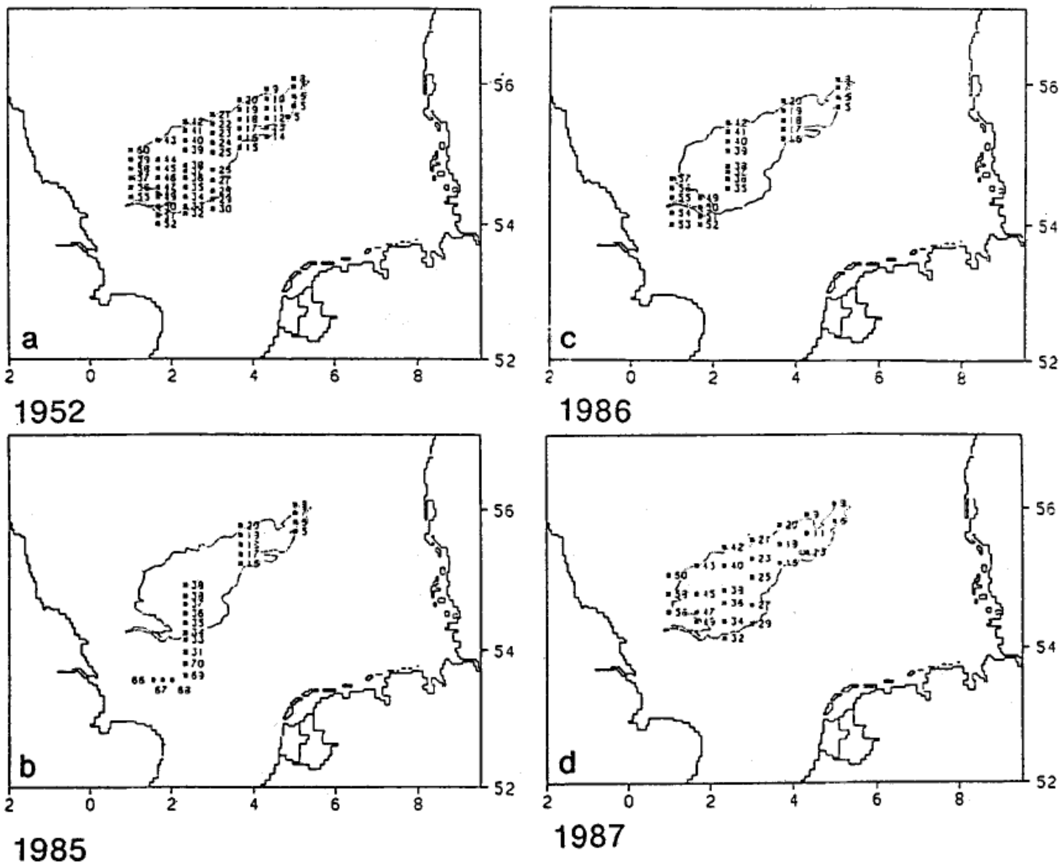


Figure 19 Station map of April/May 1952 (as exemplar of the years 1950-1954), 1985, 1986 and 1987 (Kröncke 1992)

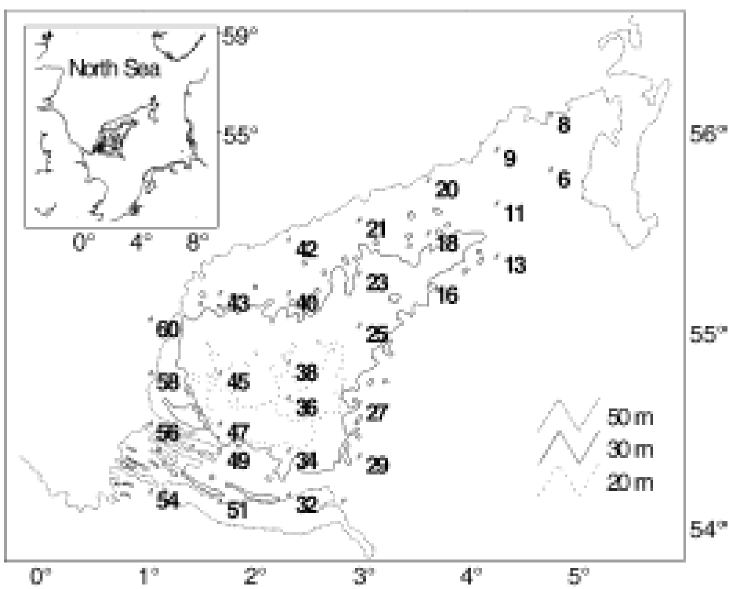


Figure 20 Station map of May 1996-98 (Wieking & Kröncke 2003)

3.4.2 North Sea Benthos Project (NSBP)

[Text extracted from Rees et al (2007, Chapter 3)]

Data for the macrobenthic fauna, i.e. animals retained on a 1 mm mesh sieve, together with associated data on sediment particle size and (where available) trace metal concentrations for the ICES North Sea Benthos Project 2000, were provided by the Netherlands Institute for Sea Research (NIOZ)/Rijkswaterstaat–RIKZ Haren, TNO/IMARES, the Alfred Wegener Institute for Polar and Marine Research (AWI), the Senckenberg Institute, Wilhelmshaven, the University of Kiel, the Bundesanstalt für Gewässerkunde, the Marine Station, Wimereux (University of Lille), the Centre for Environment, Fisheries and Aquaculture Science (Cefas), Marine Ecological Surveys Ltd (on behalf of a UK dredging consortium), Marine Biology section, University of Ghent, Institute for Agricultural and Fisheries Research, Oostende, FRS Marine Laboratory, Aberdeen, Akvaplan NIVA, Tromso, and the Norwegian Institute for Water Research (NIVA), Grimstad. Also, the data from the 1986 North Sea Benthos Survey were available for analysis and comparison with the NSBP 2000 data. A summary of those contributing benthic macrofaunal and associated sediment data is given in Table 5.

Table 5 Contribution institutions and contact person for datasets. Note the two-letter codes, which are used later in the account to distinguish between individual datasets.

DB	INSTITUTE	CONTACT PERSON	AREA
co	Akvaplan-NIVA	Sabine Cochrane	Norwegian waters
dg	Ghent University	Steven Degraer	Belgian waters
di	MES	Richard Newell	English Channel
do	TNO	Jan van Dalfsen	Dogger Bank
dr	Lille University	Nicolas Desroy (now at IFREMER)	French coastal waters
du	NIOZ/RIKZ	Gerard Duineveld	Dutch waters
dw	Lille University	Jean-Marie Dewarumez	English Channel
ee	MES	Richard Newell	English Channel
gl	MES	Richard Newell	English Channel
hi	ILVO	Hans Hillewaert	Belgian waters
md	MES	Richard Newell	English Channel
ne	BfG	Stefan Nehring	German estuaries
ns	ICES	1986 North Sea Benthos Survey	North Sea (NS)
ou	NIVA	Eivind Oug	South-Norwegian fjords
ra	AWI/Senckenberg	Eike Rachor; Ingrid Kroencke	Central and southeastern NS
re	Cefas	Hubert Rees	English waters
ro	FRS	Mike Robertson	North Sea
ru	Kiel University	Heye Rumohr	Eastern German Bight
wb	MES	Richard Newell	English Channel

Sampling occurred mainly in spring and early summer 2000 and covered almost the whole North Sea from the English Channel to about 60°N. The Norwegian dataset (*co*) contained information mainly from studies around offshore oil and gas platforms. Sampling locations are illustrated in Figure 21.

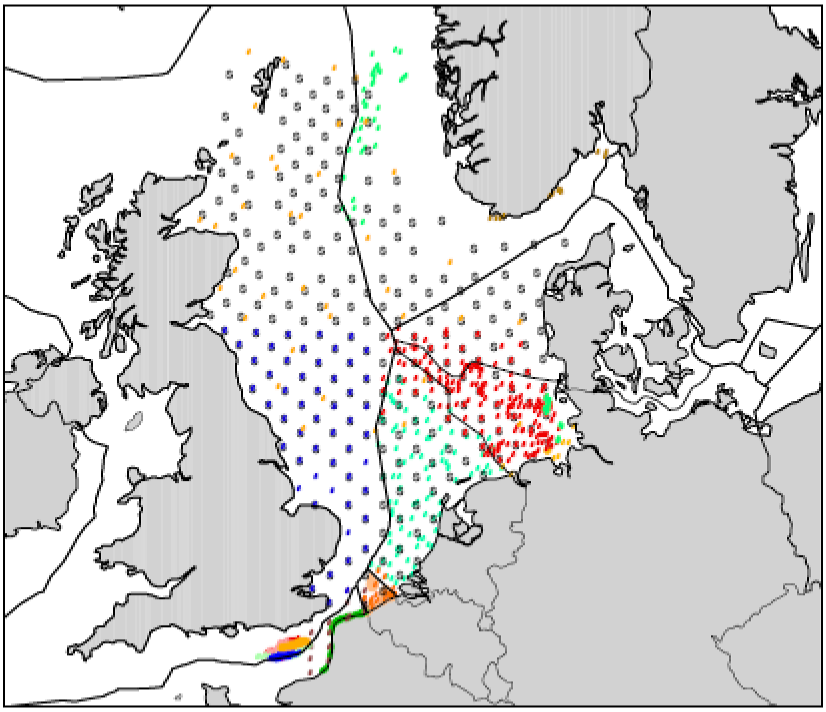


Figure 21 Location of sampling stations (1986 and 2000 surveys). The different datasets contributing to NSBP 2000 are colour-coded (e.g. red=ra). The NSBS 1986 stations are indicated by S.

Sampling in UK waters was spread evenly over the area for the southern half of the North Sea (dataset *re*), with stations corresponding with those of NSBS 1986. Northern UK waters were sampled less intensively, but again locations were relatively evenly spaced (*ro*); additional stations in this dataset extend into other national waters. One of the Norwegian datasets (*co*) was collected as part of an extensive monitoring programme around offshore oil platforms. A separate smaller dataset (*ou*) was obtained for inshore southern and western Norwegian waters. Therefore, except for occasional stations from dataset *ro*, no data were available for the area between the Norwegian west coast and the offshore monitoring stations. Only a limited amount of data (*ra*/AWI) could be obtained for Danish waters. Several datasets were available for German estuarine and marine waters (*ne, ra, ru*). A single dataset from the Netherlands (*du*) covered the entire Dutch continental shelf. However, because of the relatively small surface area covered by the corer (see Table 6), samples collected in 2000 were supplemented with those from 2001 at comparable locations, and employed as "pseudo-replicates". A separate small dataset was available from the Dogger Bank (*do*). Two datasets were available from Belgian waters (*dg, hi*), one of which consisted of large numbers of stations in a relatively confined area, sampled within a proposed marine protected area in the southern part of the Belgian Economic Exclusion Zone (EEZ). Of two French contributions (*dr, dw*), the first was coastal and the second comprised a regular grid extending into the English Channel, including UK waters. Finally, a series of five UK datasets (*di, ee, gl, md, wb*) comprised several stations in the central part of the eastern English Channel, which were sampled by a consortium of dredging companies to generate baseline data in the vicinity of proposed aggregate extraction sites.

Most of the sampling for NSBP 2000 was conducted with a 0.1 m^3 van Veen grab; Dutch (*du*) and Scottish (*ro*) samples were obtained with boxcorers, English ones (*re*) mostly with a 0.1 m2 Day or Hamon grab, depending on the sediment type (Table 6). Samples were sieved over a 1 mm mesh. Sieving was done before fixing, except for the samples from ILVO (*hi*) and a proportion of the samples from Ghent University (*dg*), where they were fixed before sieving. Generally, two to three replicates per station were taken; only one sample per station was taken by, e.g. Ghent University and NIOZ–RIKZ. Dutch samples were collected as part of an annual monitoring programme. Further details of sampling and subsequent treatment of the samples are given in Table 6.

Table 6 Sampling equipment used for the different datasets and availability of biomass data.

DB	EQUIPMENT	REPLICATES	BIOMASS
co	0.1 m^2 van Veen grab	5 or 10	Not available.
dg	0.1 m^2 van Veen grab	1	Not available.
di	0.2 m^2 Hamon grab	1–3	Biomass per grab–Polychaeta, Mollusca, Crustacea, Echinodermata, misc.
do	0.1 m^2 van Veen grab	5	Not available.
dr	0.2 m^2 Hamon grab	2	Replicates pooled–Polychaeta, Nemertea, Mollusca, Crustacea, Echinodermata, misc.
du	0.068 m^2 boxcore	2	To species.
dw	0.1 m^2 van Veen grab	2	To species. Data for the one pooled station was estimated per replicate from the densities recorded in each. Data reported in mg per 0.1 m^2.
ee	0.1 m^2 Hamon grab	1–3	Biomass per grab–Polychaeta, Mollusca, Crustacea, Echinodermata, misc.
gl	0.1 m^2 Hamon grab	1–3	Biomass per grab–Polychaeta, Mollusca, Crustacea, Echinodermata, misc.
hi	0.1 m^2 van Veen grab	3	Complete, to species.
md	0.1 m^2 Hamon grab	1	Biomass per grab–Polychaeta, Mollusca, Crustacea, Echinodermata, misc.
ne	0.1 m^2 van Veen grab	6	Not available.
ns	Cores; van Veen/Smith-McIntyre grabs	2–12	Replicates separate. Polychaeta, Mollusca, Crustacea, Echinodermata, misc.
ou	0.1 m^2 Day or van Veen grab	4	Not available.
ra	0.1 m^2 van Veen grab	1–4	Replicates separate. Polychaeta, Mollusca, Crustacea, Echinodermata, Chordata, Bryozoa, Cnidaria, misc.
re	0.1 m^2 Hamon, Day or van Veen grab	2–3	Replicates separate, to species.
ro	0.25 m^2 NIOZ core	1–3	Replicates separate, to species.
ru	0.1 m^2 van Veen grab	1	Not available.
wb	0.2 m^2 Hamon grab	1	Biomass per grab–Polychaeta, Mollusca, Crustacea, Echinodermata, misc.

Sampling in the southern North Sea for NSBS 1986 was conducted in April/May, 1986, employing a 1 mm mesh sieve to extract the macrofauna. However, sampling in the northern North Sea was conducted between 1980 and 1985, using a 0.5 mm mesh sieve, as part of an earlier synoptic survey of this area by FRS (Scotland). Further details are given in Eleftheriou and Basford (1989), Heip *et al.* (1992), and Künitzer *et al.* (1992). The samples for NSBP 2000 were mostly collected in 2000 but, as is apparent from Table 7, some data for 1999, 2001, and 2002 were also included in the combined dataset to improve the evenness of the coverage. Three samples from 2002 were included in the *ra* dataset because these locations were not visited in 2000. Likewise, 20 samples from 2002 were included in the *re* dataset, to complete a synoptic survey of English waters, employing the same stations as in 1986 NSBS. To compensate for the under-representation of samples in Dutch waters, samples collected in 2001 were included as pseudo-replicates.

In comparisons with earlier sampling in April/May 1986 for the southern North Sea, there is the potential for confounding influences associated with the wider (spring/early summer) sampling window for NSBP 2000. However, the use of a 1 mm mesh sieve might be expected to limit any effects on density and diversity estimates arising from new recruitment in this period, compared with the use of a smaller (0.5 mm) mesh sieve.

Biomass was estimated by most of the laboratories, ranging from wet weight to ash-free dry weight (AFDW). Conversion factors can be used to standardize biomass for all datasets. AFDW and wet weight data are available from NIOZ–RIKZ and Wimereux to calculate conversion factors; conversions by Rumohr *et al.* (1987) are also commonly used. Some laboratories determined biomass for individual species, others for phyla only (or other high rank taxon). The availability of biomass data, along with an indication of the taxonomic levels at which they were determined, is illustrated in Table 6.

Samples for analysis of the meiofauna were taken only by Cefas and FRS.

Table 6 Number of samples, per year and per dataset

nn	1980–1985	1986	1999	2000	2001	2002
co				192	105	
dg				183	73	
di					138	
do				12		
dr				179		
du				100	100	
dw				31		
ee					165	
gl					83	
hi				56		
md			89			
ne				60		
ns	62	219				
ou				48		
ra				339		3
re				78	50	20
ro					75	
ru				30	25	
wb			94			

3.4.3 BIOMON

[Text is adapted from van Dalfsen et al (2007)]

Within the framework of a series of national monitoring programs, a yearly monitoring program of macrobenthos in the Dutch part of the North Sea, the Wadden Sea and the Delta Estuary is carried out. The monitoring of these Dutch marine waters started in 1989 with the goal to study the temporal variation of the marine ecosystems on the Dutch Continental Shelf (DCS). The biological monitoring program comprises besides the macrobenthos also plankton, fish, seagrass, hard substrate populations, seabirds and mammals. From the start until 2005 the benthic analyses were carried out by Royal Netherlands Institute for Sea Research (NIOZ), for the period 2006-2008 the contract for this work was awarded to another consortium.

The aim of the MWTL program (also known as BIOMON) is to obtain insight in the spatial and temporal variation in the composition of the macrobenthos and to detect possible trend-like changes on the NCP as a whole or in parts of it. During the first years (1991-1994) there were 25 stations located along five transects perpendicular to the Dutch coast. At these stations five replicate boxcore samples were collected each year. Although in this way a rather detailed picture was obtained of the fauna composition at each of these stations, it was argued that (changes in) the macrobenthos composition of the DCS as a whole could better be studied by spreading the sampling effort over a larger number of stations (see e.g. van der Meer 1997). Therefore, from 1995 onwards the sampling strategy changed and each year 100 stations were visited, that were selected according to a stratified random sampling design in each of the four subareas of the NCP, i.e. Dogger Bank (DOG), Oyster Grounds (OYS), Offshore area (OFF) and Coastal area (COA) (Figure 22). The number of stations within each subarea was proportional to its surface area. At each station only one benthos sample was taken. The 100 stations that were selected include the 25 original BIOMON stations. The selection procedure is described in more detail by Essink (1995) and Holtmann et al. (1996).

At each station, two boxcore samples (0.078 m^2, minimal depth 15 cm) are taken. One of the samples is used for sediment analysis and the other sample is washed through a sieve with round holes (1 mm) to collect the macrobenthic fauna. For sediment analysis 2 subsamples (3.4 cm Ø, depth 10 cm) are pooled and immediately stored at -20°C. The residue of the macrobenthos samples is preserved in a borax-buffered solution of 4-6 % formaldehyde in seawater and stored at room temperature.

In the laboratory the macrobenthos samples are washed over a set of nested sieves with 0.7 mm as the smallest mesh size, to facilitate sorting. The macrofauna is identified to species level, except for some notoriously difficult taxa such as anthozoans, phoronids, priapulids and nemerteans, and subsequently counted. Juvenile macrobenthic animals which, because of their size, cannot be identified to species level are recorded on higher taxonomic levels, usually the genus level. Sizes (to the nearest 0.5 mm) are recorded for most molluscs and echinoderms.

The ash-free dry weight (AFDW) of the different taxa is determined in one of the following ways:

- By means of length-AFDW relationships of the form $W = a*L^b$ (W = AFDW in g and L = length in mm);
- Indirectly, by converting the (blotted) wet weight into AFDW by means of conversion factors provided by Rumohr et al. (1987) and Ricciardi & Bourget (1998);
- Small amphipods and cumaceans are assigned an average individual AFDW of 0.2-0.5 mg;

Figure 22 Locations of the MWTL sampling stations on the Dutch Continental Shelf.

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4 Fisheries data availability and quality

4.1 Data Collection Framework

Commission Regulation (EC) No. 665/2008 establishes the Data Collection Framework (DCF), a Community Framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy (CFP). Under this regulation the European Commission requires Member States to collect data on Biological and Economic aspects of many European fisheries and related fisheries sectors, these data can be accessed by the Commission. The data can be divided into four categories:

- Fisheries data for catch and effort
- Economic data for fisheries
- Surveys at sea data
- Biological data

The Fisheries data for catch and effort are relevant to describe the fisheries in the Dutch EEZ and the designated Natura 2000 areas. They comprise information from logbooks and the Vessel Monitoring by Satellite (VMS) data. For each of these two data sources we describe:

- Content
- Spatial and temporal scale
- Accessibility
- Limitations

The economic data will be described and analysed by the Dutch Agricultural Economic Institute (LEI). The biological data, including those obtained during surveys, is described in chapters 3 and 5.

4.1.1 Logbooks

Landings of commercial vessels can be based on auction statistics, which contain information on total landings (in biomass) of commercial species. These statistics give no information on the spatial extent of the landings and only partial information on the catch of the vessels is available due to the by-catch not being registered. Landings including spatial information can be obtained from logbook data, whireas by-catch data are only available from some observer programs.

Content

Logbook data are based on recordings by individual fishers. Fishers report the start and end date of the trip, vessel code, gear type and engine power. For each trip, landings (kg) per species per ICES rectangle[4] are also reported. For species that are fished under quotas, landings have to be reported by trip day and by ICES rectangle, while for non quota species landings have to be reported by trip only.

Based on logbook data, total effort is calculated as the number of days at sea (end date minus start date). If the start and end date are the same, total effort is 1. To get an estimate of effort per rectangle, total effort is averaged out over the ICES-rectangles for which landings are reported. If the landings (based on the price*weight of target species) in rectangle A are five times as high as the landings in rectangle B, then effort is said to be five times higher in A. As a consequence, the patterns of calculated effort may not reflect the true spread of effort, i.e. if multiple hauls of small catches are recorded in

[4] An ICES rectangle is, at the latitude of the Netherlands, about 30x30 Nautical miles (0.5 degree latitude x 1 degree longitude)

rectangle A, but only one haul with an exceptionally high catch is recorded in rectangle B, in proportion more effort will be placed in B, while actually a higher proportion should have been in A.

For the Netherlands, the logbook data are gathered by the General Inspection Service (AID) for monitoring and control purposes. Information that is less relevant for control, e.g. landings per ICES rectangle, are registered less carefully. The logbook data are gathered for the whole Dutch fleet and for foreign vessels landing in Dutch ports. Logbook data from other (EU) countries are gathered by national research institutes, e.g. CEFAS for the UK and DTU-Aqua for Denmark.

Spatial and temporal scale

In the Netherlands, a first version of a database for logbook data was implemented by the AID in 1990 and was given the name VIRIS. This version only contained information on landings of the most important target species. A more versatile and complete version of the database was introduced in 1995, when other commercially interesting species were also registered and landings in the Netherlands by foreign vessels were included. Shrimp landings have also been registered since then. Since 2000 landings of almost all species are registered. Since 2009 a successor of VIRIS is running, this database is called VISSTAT.

The spatial range of VIRIS data covers the entire area where Dutch vessels, as well as foreign vessels landing catches in the Netherlands, are fishing, which includes the Dutch EEZ, the North Sea and other areas. However, the highest spatial resolution available in VIRIS is an ICES rectangle. As data is collated by trip, the highest temporal resolution depends on the length of the individual trips and can range from daily to weekly or longer.

Accessibility

To use the VIRIS or VISSTAT data permission of the Dutch ministry is needed.

IMARES and LEI have routines (software: SAS and R) to extract landings, link these to relevant other information and make specific selections on timing, space and vessel types. Making the whole database available for the assessments within FIMPAS is impossible and unfeasible. LEI will produce a report on landings and economical value in the different Natura 2000 areas (Van Oostenbrugge et al. in prep.). In the case additional data are needed, specific requests can be handled directly by IMARES.

Other countries have their own databases, but the availability and the resolution of the raw data are similar. The differences between data sets stem from amongst other things coding of the métiers and aggregation level.

German, British and Danish (aggregated) logbook data have been obtained through collaboration with sisterinstitutes of IMARES in the respective countries: CEFAS in the UK, Johann Heinrich von Thünen Institute in Germany and DTU-Aqua in Denmark.

Limitations

- Highest spatial resolution ICES-rectangle
- Highest temporal resolution is the duration of a trip, however target species are reported by day.
- Effort is reported spatially based on landings, not actual recordings.
- Landings from foreign vessels, caught in Dutch waters but landed in foreign ports, comprise only those landed in Germany, Denmark and Great Britain.
- No data available on discards.
- The database is set up for inspection purposes; data that are less relevant for inspection – such as landings per ICES rectangle – are registered less carefully and are thus less reliable.
- In the shrimp fishery, ICES rectangle are usually not recorded, thus the fishing area for the shrimp trawl fleet can not be derived from VIRIS.

4.1.2 Vessel Monitoring by Satellite (VMS)

The Vessel Monitoring by Satellite (VMS) system is currently the only available method of tracking the commercial fleet at high spatial and temporal resolution. Each vessel which has a VMS system on board records its geographical position, speed and course direction on average every two hours. Using data on speed, the activity of a vessel, i.e. floating, fishing, or steaming, can be derived. The registration of vessel speed is not obligatory, so it is not possible to estimate the activity of all vessels. However, since 2002 over 95% of the VMS data points contain information on both speed and direction.

Content

IMARES has access to VMS data of all Dutch vessels of the period 2006-2008. For the earlier period, since 2000, only part of the data from the Dutch fleet is available for now. Similar to the Netherlands, all EU member states and Norway collect landings data for the North Sea with the help of logbooks. However, the accessibility of these international data is limited and permission is needed from the individual member states.

Unlike the logbook data, IMARES has access to VMS registrations of all foreign vessels (under VMS legislation, thus vessels >15m, for Norway most likely >24m) fishing within the Dutch EEZ during 2005-2007. These data provide a rough estimate of the distribution of foreign fishing vessels active in the area and can be assessed by individual country (Appendix A). These maps represent registrations of all types of activity, not just fishing registrations. To derive fishing activity, information on the vessel and gear type is needed (available from logbooks) and knowledge on fishing speed. From this overview it appears that Germany, Denmark and Great Britain have the highest number of VMS registrations in the three designated Natura 2000 areas. VMS data (combined with logbook data) of all German, Danish and British vessels of the period 2006-2008 have been provided by (fisheries-) institutes in these countries (see 4.4.1).

Assessing the activity of vessels is based on the average fishing speed obtained from a whole fleet using a specific gear. The allocation of gear type used at the time of the VMS regiostration is obtained from logbook data. Differences in behaviour between individual vessels or changes in behaviour over time can thus not be taken into account in assessing the activity. Furthermore, average fishing speeds have not yet been established for all types of fisheries and it is possible that in some cases the speed is not specific to an activity. Speed is currently only used as an indicator for activity for the gears presented in Table 8.

Table 8 The fishing gears for which speed is used to derive activity

Gear	Engine power (hp)	Fishing speed (mile/h)
Beam trawl (TBB)	260-300	3-6
	> 300	5-8
Otter trawl (OTB) +(OTT) +(PTB)	260-300	3-5
	> 300	3-4
Beam trawl shrimp (TBS)		3-4

VMS registrations do not contain information on the gear used. Therefore, where possible, VMS registrations are merged with logbook data on the basis of one trip defined between the day out of the harbour and the day entering the harbour. In the same way information of engine power is linked to each VMS point.

Spatial and temporal scale

Since 2000, the Dutch General Inspection Service (AID) uses satellite data to follow Dutch vessels. The position of each vessel is recorded on average every two hours. The frequency of registration depends on the area a vessel is located and the accuracy of a position registration is 100 meters.

Since 1st of January 2000 all vessels larger than 24m are followed by means of VMS. Equally, since the 1st of September 2003, vessels between 21-24m; since the 20th of April 2004 vessels between 18-21 meter and since the 1st of January 2005 vessels between 15-18 meter are also being followed.

Accessibility

Currently, VMS data are linked to logbook data, allowing vessel attributes and gears to be identified. A prototype database has recently been put into place to link these data, including the automatic update of VMS data provided by the ministry. Different SAS and R- routines are available to extract, merge, handle and map these data.

Different methods have been developed to estimate the total area being fished. All of these methods require fishing activity to be derived from vessel speed. The most basic method presents the amount of VMS registration considered as fishing (in time) by the surface of the area (Piet et al., 2007). This is the method adopted here to present the data.

A second method uses VMS registrations (in time) multiplied by the distance trawled and the width of the fishing gear, to estimate the frequency of trawling. This method also averages a single VMS point over a larger area, because the hours spent fishing recorded from a single point do not take place only at this point. Various assumptions are made for the averaging process (Rijnsdorp et al., 2006; Bierman et al., 2009).

The third, and most advanced, method uses a cubic Hermite spline to interpolate a trawl track between individual points of an individual ship. Overlying the trawl tracks of all vessels multiplied with the width of the gear gives the best estimate of the trawl frequency in an area (Hintzen et al., in press).

These data can be used for research and advisory purposes under specific conditions, the main restriction being that they are not published in a way that allows individual vessels to be identified. The privacy limits the detail in which some of the fishing types can be presented.

Limitations

- In most areas information is only available on a 2 hourly basis
- The spatial accuracy of the positioning system (<100m)
- Fishing activity is interpreted from derived estimates using average speed
- Speed estimates are only available for a few métiers
- No information on vessels <15m

4.2 ICES Fisheries statistics

Fisheries data held by ICES can be found among other catch statistics in the so called STATLANT database, which contains yearly nominal catches of fish and shellfish officially submitted by 20 ICES member countries in the Northeast Atlantic and includes over 200 species. ICES has published these data in the Bulletin Statistique des Pêches Maritimes from 1903 to 1987 and for 1988 in ICES Fisheries Statistics. As of the year 2000 the data are published on a CDROM containing data for the period 1973-2003.

The Coordinating Working Party on Fishery Statistics (CWP) coordinates collection of these statistics under the STATLANT programme. The organizations involved are the United Nations Food and Agriculture Organization (FAO), Commission for the Conservation of the Antarctic Marine Living Resources (CCAMLR), Northwest Atlantic Fisheries Organization (NAFO), International Commission for the Conservation of Atlantic Tunas (ICCAT), Statistical Office of the European Communities, and ICES. The CDROM holds data from all these organizations, thereby covering the entire Atlantic.

STATLANT data are updated each year and the catch statistics by species, area and year (1973- 2008) can be downloaded from the ICES homepage: http://www.ices.dk/fish/statlant.asp

4.3 References

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5 Conservation objectives

This chapter starts with a description of the Natura2000 conservation objectives relevant to the Cleaver Bank, the Dogger Bank and the Frisian Front. This is followed by a description and analysis per site of the availability of data that are related to the conservation objectives, i.e. data on the relevant habitat types (H1170 and H1110_C), harbour porpoise, harbour seal, grey seal, great skua, common guillemot, great black-backed gull and lesser black-backed gull.

5.1 General objectives

A set of general conservation objectives applies to all Natura 2000 sites within the Netherlands (from Jak et al. 2009) and comprise the maintenance and, if applicable, restoration of:

1) the contribution of the Natura 2000 site to the ecological coherence of Natura 2000 within both the Netherlands and the European Union;
2) the contribution of the Natura 2000 site to the biological diversity and to the favourable conservation status of natural habitat types and species within the European Union and as included in Annex I or Annex II of the Habitats Directive. This includes the site's necessary contribution to the pursuit of a favourable conservation status at the national level for the habitat types and the species for which the site has been designated;
3) the natural features of the Natura 2000 site, including the coherence of the structure and functions of the habitat types and of the species for which the site has been designated;
4) the ecological requirements of the habitat types and species for which the site has been designated as they apply to the site.

5.1.1 H1170 Open-sea reefs

Short description

Habitat type H1170 'Open-sea reefs' is characterised by geomorphological features and occurs in the Dutch Exclusive Economic Zone (EEZ) within the Cleaver Bank site in the north-west and possibly also at the site of the Borkum Reef Ground (Dutch part) in the south-east of the EEZ. Essential to habitat type H1170 is the occurrence of a hard substratum (large cobble-shell banks) that arise from the sediment surface. It may be that a mosaic of (coarse) sediment types occurs in which various sediment types occur alternately. Characteristic of the habitat type is the very high biodiversity. This is the consequence of the presence of stable hard substrata and the variety in sediment types, namely sand and gravel of various grain size distributions. The high biodiversity is caused by the presence of sessile epifauna and the occurrence of species typical of coarse sediments, in addition to the occurrence of less specific, general species. The water should be clear to enable the growth of calcareous red algae on the sea bottom. These calcareous algae form a crust on the (gravel) bottom and form a biogenic reef structure. With the cementing of the surface, the possibility arises that sessile epibenthic species may become established, while the scope for specific infauna (which are able to withstand the movement of the gravel) to become established disappears.

Owing to the three-dimensional structure and the stable subsurface, the reef can offer space to a well-developed sessile hard-substrate community. For such a community to develop well, seabed stability is required (Watling and Norse, 1998). This structure can also offer space to the larval or juvenile stadia of, for example, fish. The natural development and succession of a complex sessile biotic community is only possible if the position and orientation of the cobbles on which it grows do not change (Watling & Norse, 1998). Owing to the development of a sessile community, a habitat is created on which other species can find a habitat and/or food source.

Conservation objective

The conservation objective for H1170 at the Cleaver Bank is to:

"Maintain the surface area and improve quality of reefs"

(see Jak et al. 2009, Table 9)

Good quality is characterised by the presence of sessile biotic communities of long-lived species. These communities are attached to the hard substrate. An improvement of the quality can be achieved if the disturbance of hard compact substrates and their biotic communities is prevented, i.e. firmly touched or their position changed.

Table 9 Assessment of national Conservation Status (CS)

Aspect	2009	Explanation
Distribution	Favourable	
Surface area	Favourable	
Quality	Unfavourable-inadequate	The assessment is made with reference to structure and function the abiotic preconditions and other features of good structure and function including the typical species (See Jak et al., 2009)
Future prospects	Unfavourable-inadequate	Based on generic text that accounts for other marine habitat types as well [1]
Total assessment CS	Unfavourable-inadequate	

[1] The decrease in fisheries intensity that has occurred throughout the North Sea in the last decade is likely to continue, but this is uncertain. In view of this and all sorts of other uncertainties in this system or developments not yet taken into account in policy, a favourable conservation status in the short term (2020) would not be logical. For this reason, the future prospects for H1170 are considered to be 'unfavourable–inadequate'.

5.1.2 H1110_C Sandbank covered all the time, tidal area

Short description

Subtype H1110_C concerns the Dogger Bank situated in the most northerly region of the Dutch North Sea. The Dogger Bank is a sandbank in the central North Sea that extends across the Danish, German, Dutch and UK sectors. The area came into being when it was pushed up in the last Ice Age and was submerged by water with the subsequent rise in sea level. The shallowest part of the sandbank is located in the UK sector. Here the water is less than 15 metres deep. Although the Dutch sector is deeper than 20 metres, the site nevertheless falls within the international agreements on the definitions of the habitat type since these definitions take into account the angle of inclination of the sea bottom. The Dogger Bank has the topography typical of a sandbank due to the transition to deeper water on both sides of the shallow area. In practice, the boundary aligns with the 40-metre depth line (see Lindeboom et al., 2008).

Owing to the diversity of water depths and sediment types, consisting of mixed sands (of clean, silt-poor sediment to silt-rich in the deepest parts), the biodiversity of bottom-dwellers of subtype H1110_C is higher than in the surrounding areas (Lindeboom et al., 2008). In the Dutch sector of the Dogger Bank three biotic communities of bottom-dwellers can be distinguished (Wieking & Kröncke, 2003). The most typical sandbank community is found on the crest of the bank and is dominated by species that live at the sediment surface and are adapted to a relatively dynamic environment, owing to the fact that in this shallow part the influence of wave action is greater than in the deeper parts. The fauna consists of species that are relatively short-lived. The southern community includes species that occur in the Oyster

Grounds and are characteristic of the greater depths and high silt levels. Along the north-east edge of the Dogger Bank live species which are rare in the Netherlands but also occur in the northern North Sea.

Owing to the water's high level of translucency, within the depth boundary of the subtype light can penetrate to the bottom. As a result epiphytobenthos occurs in the form of diatoms (Reiss et al., 2007). These form an important food source for some of the fauna, mainly small crustaceans (such as *Bathyporeia guillamsoniana, B. elegans* and *Iphinoe trispinosa*) that scrape them off the sand grains.

The fine-sand substrate on the shallowest parts of the subtype is an essential habitat for sandeel (*Ammodytes* spp.) and accordingly, in certain periods of the year, for the occurrence of seabirds and marine mammals.

Conservation objective

The conservation objective for H1110_C at the Dogger Bank is to:

"Maintain the surface area and improve the quality of sandbanks covered all the time, tidal area (subtype C)"

(see Jak et al. 2009, Table 10).

The conservation status of this habitat subtype has been assessed as 'unfavourable–inadequate'. Good quality can be said to be present if long-lived species of bottom-dwellers are present, which can be achieved by restoring the natural dynamic of the bottom and preventing seabed disturbance.

Table 10 Assessment of national Conservation Status (CS)

Aspect	2009	Explanation
Distribution	Favourable	
Surface area	Favourable	
Quality	Unfavourable-inadequate	The assessment is made with reference to structure and function the abiotic preconditions and other features of good structure and function including the typical species (see Jak et al., 2009)
Future prospects	Unfavourable-inadequate	Based on generic text that accounts for other marine habitat types as well[1]
Total assessment CS	Unfavourable-inadequate	
The decrease in fisheries intensity that has occurred throughout the North Sea in the last decade is likely to continue, but this is uncertain. In view of this and all sorts of other uncertainties in this system or developments not yet taken into account in policy, a favourable conservation status in the short term (2020) would not be logical. For this reason, the future prospects for H1110_C are considered to be 'unfavourable–inadequate'.		

5.1.3 Harbour porpoise

Short description

The harbour porpoise is the most abundant marine mammal in the Dutch EEZ. It is present in all Dutch coastal and offshore waters, including the Natura 2000 sites Cleaver Bank and Dogger Bank.

Little is known about the habitat requirements of the harbour porpoise. Sufficient food should be available. Suitable food species are whiting, cod, herring and flatfish species. Almost all their prey fish are smaller then 25 cm.

In addition, disturbance by high underwater noise levels should be prevented. Disturbing underwater noise levels can arise as a consequence of shipping, beam trawl fishing, seismic research, the construction of offshore structures (windmills, gas platforms), industrial activity and the use of sonar and acoustic equipment intended to chase away marine mammals (such as the instruments known as 'pingers' used in the fishery).

Conservation objective

The conservation objective for the harbour porpoise at both the Cleaver Bank and the at the Dogger Bank is to:

"Maintain the extent and quality of habitat in order to maintain the population"

(see Jak et al. 2009, Table 11).

Based on recent data on the numbers in the Dutch sector of the North Sea, the conservation status of the harbour porpoise can be revised from 'unfavourable–bad' to 'unfavourable–inadequate'.

In so far as is known, the Cleaver Bank and dogger Bank have no special significance as a reproduction site, foraging site or otherwise compared to other parts of the Dutch sector of the North Sea.

Specific data about the animal's occurrence on the Dogger Bank are limited and insufficient for estimating densities, or stating the site's ecological importance for the harbour porpoise. Dogger Bank and the other Natura 2000 sites are part of the area of distribution of the harbour porpoise in the North Sea. Relatively many harbour porpoises are sighted on the Dogger Bank compared to the surrounding area, which may be related to the presence of suitable prey fish on which they forage. In so far as is known, the Dutch sector of the Dogger Bank has no special significance as a reproduction site compared to other parts of the Dutch sector of the North Sea.

Owing to the animals' wide range North Sea-wide protective measures are maybe more effective than area specific measures.

Table 11 Assessment of national Conservation Status (CS) : a revised schedule is presented, as proposed by Jak et al (2009), which deviates from the 2007 assessment by the Ministry of LNV.

Aspect	2009	Explanation
Distribution	Favourable	
Population	Unfavourable-inadequate	Although population size is higher than the favourable reference, reproduction is not at a desired level.
Quality	Unfavourable-inadequate	Recently, many dead harbour porpoise are washed ashore, of which many seem to be drowned in fishing nets. The impact on the population level is unknown.
Future prospects	Unfavourable-inadequate	It is unclear whether the recent increase in numbers will sustain. Furthermore, it is unclear that measures to reduce fishing mortality will be effective.
Total assessment CS	Unfavourable-inadequate	

5.1.4 Grey seal

Short description

The grey seal recolonized the Dutch North Sea, including the Wadden sea from the 1980's onwards. The species has rapidly increased population size, originally by migration from the UK east coast, and currently also by reproduction in the Dutch coastal zone. Reproduction and moulting takes place on sandbanks and beaches.

Little is known about the aquatic habitat requirements of the grey seal. The diet consists of many different species of fish. The possibly harmful effects of noise on the grey seal and its habitat is currently the topic of much discussion. The various suspected causes include the pile-driving of windmill poles. Disturbing underwater noise levels can further arise as a consequence of shipping, beam trawl fishing, seismic research, the construction of offshore structures (windmills, gas platforms), industrial activity and the use of sonar and acoustic equipment intended to chase away marine mammals (such as the instruments known as 'pingers' used in the fishery).

Conservation objective

The conservation objective for the grey seal at both the Cleaver Bank and the at the Dogger Bank is to:

"Maintain the extent and quality of habitat in order to maintain the population"

(see Jak et al. 2009, Table 12).

The national conservation status of the grey seal is 'unfavourable–inadequate' due to the disturbance of tidal flats. This aspect is not of importance on the Cleaver Bank or the Dogger Bank. However, the drowning of grey seals must be prevented, similarly as their disturbance by underwater noise produced by human activities. The entire North Sea is part of the habitat of the grey seal and, like other parts of the EEZ, the Dutch offshore Natura 2000 sites Cleaver Bank and Dogger Bank are of significance as a foraging site. The areas as such have no special significance compared to other parts of the EEZ. It has been established that animals migrate between the Dutch and UK colonies; during these trips grey seals pass by and through the Cleaver Bank and Dogger Bank areas.

Table 12 Assessment of national Conservation Status (CS)

Aspect	2009	Explanation
Distribution	Favourable	
Population	Favourable	
Quality	Unfavourable-inadequate	Because many resting places on the islands and the mainland that are in principle suitable for grey seals are not currently in use by the seals possibly due because they are being subject to disturbance.
Future prospects	Favourable	
Total assessment CS	Unfavourable-inadequate	

5.1.5 Harbour seal

Short description

The harbour seal is the most common seal in the Netherlands. The main population is present in the Dutch Wadden Sea where it makes use of the tidal flats for reproduction, moulting and resting.

The offshore areas are significant to harbour seals as a foraging site. In their search for food (fish), the water depth throughout the EEZ is not a limiting factor since harbour seals can dive to depths deeper than 150 m. It is unknown whether the notified offshore areas are of special significance for foraging compared to the rest of the EEZ.

Conservation objective

The conservation objective for the harbour seal at both the Cleaver Bank and the at the Dogger Bank is to:

"Maintain the extent and quality of habitat in order to maintain the population"

(see Jak et al. 2009, Table 13).

The national conservation status of the harbour seal is 'favourable'. The species occurs primarily along the coast, but can cover distances of hundreds of kilometres. The entire EEZ forms a habitat for the harbour seal and, like the rest of the EEZ, the Cleaver Bank and Dogger Bank are used as a foraging site. Both sites as such have no special significance compared to other parts of the EEZ.

Table 13 Assessment of national Conservation Status (CS)

Aspect	2009
Distribution	Favourable
Population	Favourable
Quality	Favourable
Future prospects	Favourable
Total assessment CS	Favourable

5.1.6 Great skua

Short description

The great skua is a fast, powerful seabird with a short tail and broad wings. In the EEZ peak numbers of 1500 (RIKZ) to 2900 (ESAS; Camphuysen & Leopold 1994) birds are counted in August/September, which means that a significant proportion of the world population occurs in the EEZ. In August/September 5.5% of the biogeographical population occurs in the EEZ. In the Frisian Front it appears that a concentration of 350 birds can occur in August/September, which means that this area is of international importance to this reasonably rare species.

The great skua is a bird of the open sea. It forages in open sea and in coastal waters (Leopold et al. in prep). Its breeding grounds are outside the Netherlands in northern Europe (BirdLife International 2009). The great skua eats mainly fish that it robs from gulls, terns and even northern gannets. In addition, it catches fish, eats eggs, amphibians, other birds and rodents (Jonsson 1993, Votier 2004, Jones et al. 2008). It benefits indirectly from fishery, by robbing gulls and other birds of discards and waste and by eating other birds. When discards become less available, the great skua's predation on other seabirds increases. A reduction in the sandeel stock due to fishery has the same effect (Votier 2004).

Conservation objective

The conservation objective for the Great skua at Frisian Front is to:

"Maintain the extent and quality of habitat with the capacity to carry a population averaging 180 birds (August-September)"

(see Jak et al. 2009, Table 14).

In the period August-September approx. 5.5% of the biographical population occurs in the EEZ and more than 1% in the Frisian Front. The national conservation status has been assessed as 'favourable'.

Table 14 Assessment of national Conservation Status (CS)

Aspect	2009
Distribution	Favourable
Population	Favourable
Quality	Favourable
Future prospects	Favourable
Total assessment CS	Favourable

5.1.7 Great black-backed gull

Short description

The great black-backed gull is the largest gull in northern Europe. The Dutch Continental Shelf (or EEZ) in winter hosts 7.7% of the biogeographical population (refs in Leopold et al. In prep). The great black-backed gull is an opportunistic feeder and has a varied diet. It is able to forage at the water's surface, dive from a metre high, rob other birds, eat fish waste and discards in the wake of fishing vessels and drop shellfish on the ground to break them open. It also eats rubbish (refs in Arts & Berrevoets 2005; refs in Mendel et al. 2008). Most human activities and threats at sea are of no consequence to great black-backed gulls. However, although they can fly well, in conditions of poor visibility they can fly into structures such as windmills. They may also become entangled in floating nets because they are attracted to the caught fish. These birds are also vulnerable to oil discharges because they often swim at sea. Great black-backed gulls may suffer a food shortage due to the reduction in fishery activities and the amount of discard (Mendel et al. 2008).

Conservation objective

The conservation objective for the Great black-backed gull at Frisian Front is to:

"Maintain the extent and quality of habitat with the capacity to carry a population averaging 80 birds (October-November)"

(see Jak et al. 2009, Table 15).

The great black-backed gull occurs primarily in autumn and winter in the Dutch EEZ (October-November), but since the early 1990s there has also been a small but growing breeding population in the Netherlands. The numbers in the EEZ fluctuate. The national conservation status has been assessed as 'favourable'.

Table 15 Assessment of national Conservation Status (CS)

Aspect	2009
Distribution	Favourable

Population	Favourable
Quality	Favourable
Future prospects	Favourable
Total assessment CS	Favourable

5.1.8 Common guillemot

Short description

The common guillemot is the most abundant overwintering bird on the Dutch Continental Shelf (or EEZ). They occur throughout the North Sea, but the densities in a narrow strip along the Dutch coast are lower. The Netherlands is not within the breeding area, which is located mainly in the north of the North Sea. After the breeding season, common guillemot males swim with their young, mostly from the Scottish breeding colonies, to remote places such as the Frisian Front to forage. The young cannot yet fly at this stage and the adults use this time to moult.

The common guillemot eats mainly fish, which are caught by diving. Important prey fish species are sandeel and Clupeidae in summer and the gobies, pipefish and Gadidae in winter. Prey for the chicks consists mainly of sandeel and Clupeidae (refs. in Mendel et al. 2008). As common guillemots swim a great deal and often gather in large groups, they are highly vulnerable to oil pollution. They may also be indirectly affected when their prey animals ingest oil. In addition, common guillemots are disturbed by shipping movements. They often react to approaching ships by diving or on occasion by flying away. They also show other signs of stress. In all, this indicates that ships disturb the natural behaviour of common guillemots. The consequence of this disturbance is that the time the birds need to eat and rest is reduced, which can cause the birds' condition to deteriorate. (refs in Mendel et al. 2008).

Conservation objective

The conservation objective for the Common guillemot at Frisian Front is to:

"Maintain the extent and quality of habitat with the capacity to carry a population averaging 20,000 individuals in July-August"

(see Jak et al. 2009, Table 16).

The common guillemot is the most abundant overwintering bird in the EEZ. Highest densities are reached in summer once the birds from the breeding colonies in Scotland have spread out over the North Sea to forage. The national conservation status has been assessed as 'favourable'. However, the species is vulnerable to oil pollution and shipping. Incidents can have a major effect on the population.

Table 16 Assessment of national Conservation Status (CS)

Aspect	2009
Distribution	Favourable
Population	Favourable
Quality	Favourable
Future prospects	Favourable
Total assessment CS	Favourable

5.1.9 Lesser black-backed gull

Short description

The Lesser black-backed gull breeds along the Dutch coastal area, in dunes, salt marshes and artificial biotopes. Furthermore, it is a regularly occurring migratory bird not listed in Annex I but within the meaning of Article 4.2 of the Birds Directive. Also relevant to Natura 2000 as a non-breeding bird.

The main food of the Lesser black-backed gull consists of fish., mainly discards from fishing boats.

Conservation objective

The conservation objective for the Lesser black-backed gull at Frisian Front is to:

"Maintain the extent and quality of habitat in order to maintain the population"

(see Jak et al. 2009, Table 17).

The Frisian Front is important for breeding lesser black-backed gulls that come here to forage. Maintaining the function as a foraging site contributes to the national conservation objective.

Table 17 Assessment of national Conservation Status (CS)

Aspect	2009
Distribution	Favourable
Population	Favourable
Quality	Favourable
Future prospects	Favourable
Total assessment CS	Favourable

5.2 Area-specific objectives and data coverage

The objectives proposed by Jak et al. (2009) for the Cleaver Bank and the Dogger Bank are derived from the Habitats Directive. Those for the Frisian Front are derived from the Birds Directive. The conservation objectives for the various sites are listed in Table 18.

Table 18 Overview of the various site-specific objectives

Natura 2000 objective	Cleaver Bank	Dogger Bank	Frisian Front
H1170 Open-sea reefs	Maintain surface area, improve quality		
H1110_C Inundated sandbanks		Maintain surface area, improve quality	
Harbour porpoise	Maintain extent and quality of habitat to maintain population	Maintain extent and quality of habitat to maintain population	
Grey seal	Maintain extent and quality of habitat to maintain population	Maintain extent and quality of habitat to maintain population	
Harbour seal[4]	Maintain extent and quality of habitat to maintain population	Maintain extent and quality of habitat to maintain population	
Great skua			Maintain extent and quality of habitat to carry 180 birds (Aug-Sep)[1]
Great black-backed gull			Maintain extent and quality of habitat to carry 80 birds (Oct-Nov)[2]
Common guillemot			Maintain extent and quality of habitat to carry 20,000 birds (Jul-Aug)[3]
Lesser black-backed gull			Maintain extent and quality of habitat to maintain population

[1] on average in August-September, [2] on average in October-November, [3] on average in July-August

5.2.1 Dogger Bank

Habitat Type 1110 C

Conservation objective:

"Maintain the surface area and improve the quality of sandbanks covered all the time, tidal area (subtype C)"

Benthic community

The most extensive time series covers infauna data from the 1950s (1951-52), the 1980s (1985-97) and the 1990s (1996-1998) (Kröncke & Bergfeld 2001, 2003; Wieking & Kröncke 2003; see section 3.4). Since 1995, the monitoring program of the macrobenthic infauna in the Dutch sector of the North Sea includes seven stations on the southern part of the Dogger Bank, providing data on an annual basis. To our knowledge, however, there is no regular monitoring of the whole area.

The available data up to 1998 provide good coverage of the Dogger Bank, enabling a good description of the spatial variation in the benthic communities. Significant differences in the trophic structure of the communities suggest that the main factors causing the differences among the communities were the availability, quantity and quality of food in the benthic boundary layer which, in turn, are partly dependent of the frontal systems such as the Flamborough/Frisian frontal system (Wieking & Kröncke 2003).

The data also allow a time series analysis. The changes found show that the numbers of opportunistic species have increased from the 1950s to the 1980s (Kröncke 1992). There are significant differences in the macrofaunal community structure between the 1980s and the 1990s too (Wieking & Kröncke 2001). Abundances of southern and interface-feeding species increased in the 1990s on top and in the southern parts of the bank, whereas abundances of northern species decreased. Along the northern slope of the Dogger Bank abundances and total number of species, which prefer coarser sediment, increased in the 1990s as well as diversity of feeding types and total number of northern species, whereas abundances of species preferring fine sand and interface-feeding species decreased. Fisheries impact seems to be of minor importance for the observed changes between the 1950s and the 1990s, in contrast to the decrease of the extensive *Spisula* patches since the 1920s. There are possible synergetic effects of climate, eutrophication and pollution. Due to the great distance to the influx of nutrients from the rivers eutrophication caused by anthropogenic activity does not greatly affect the central North Sea (Baretta et al 2008). A possible connection of the observed changes with changes in temperature or changing hydrography would therefore seem more probable. Indeed, Wieking & Kröncke (2001) described the NAO influenced changes in hydrography (low NAO in the 1950s, high NAO in the 1990s) and the increased temperature, especially in the southern and eastern part of the Dogger Bank.

The currently available data are not sufficient to establish trends in some of the typical species (Table 19), as part of them are not adequately sampled by the sampling equipment (van Veen grab) used in the studies mentioned above. Only juvenile specimen of ocean quahogs are found in grab samples, for example, and epibenthic species, such as whelks, are hardly found at all. Other sampling equipments (such as quantitative dredges) should be used to give insight into the population structure of particular typical species.

Table 19 Proposal for a list of typical invertebrate species for habitat type habitat type H1110_C (Dogger Bank). (from Jak et al 2009)

English name	Scientific name	Species group	Cat.[5]	Description of occurrence
Sand mason worm	Lanice conchilega	Bristleworms	K, Ca	Occurs on sand substratum
	Sigalion mathildae	Bristleworms	K, Ca	Primarily occurs in clean sandy substrata, Dogger Bank one of the sites where the species commonly occurs

[5] Included among the typical species are: Ca = constant species indicative of good abiotic conditions; Cb = constant species indicative of good biotic structure; Cab = constant species indicative of good abiotic conditions and good biotic structure; K = characteristic species; E = exclusive species.

English name	Scientific name	Species group	Cat.[5]	Description of occurrence
	Bathyporeia guillamsoniana	Crustaceans	K, Cab	Benefits from epiphyton on sand grains, in clean sand in Southern Bight and Dogger Bank
	Bathyporeia elegans	Crustaceans	K, Cab	Occurs in coarse, clean silt-poor sediments. Benefits from epiphyton that live on sand grains
	Iphinoe trispinosa	Crustaceans	K, Cab	Specific to sand of Southern Bight and Dogger Bank
Sand-burrowing brittle star	Acrocnida brachiata	Echinoderms	E	Occurs in high densities in clean sand tot depth of 40 m
Sea urchin	Echinocyamus pusillus	Echinoderms	Ca	Occurs in coarse sand and fine gravel enriched with detritus
Ocean quahog	Arctica islandica	Molluscs	Ca	Occurs on the edges of the Dogger Bank, long-lived species
Common whelk	Buccinum undatum	Molluscs	Cab	Occurs on various substrata, long-lived species
Rayed trough shell	Mactra corralina	Molluscs	Ca	Long-lived species that feeds on particles in the water column. Occurs in fine to moderately fine coarse sand

Fish

Important fishes on the Dogger Bank are the sandeel (*Ammodytes* spp.). This species occurs in high densities, especially along the edges of a depth of 20-30 metre (summarised in JNCC, 2008). This is related to the hydrographic conditions and the related high densities of plankton; sandeel feed on plankton. During the day , they live buried in the sand and at night they forage above the deeper parts of the bank (Van der Kooij et al., 2008). Sandeel are key prey fish in the ecosystem and are preyed upon by many marine birds and mammals. They are also caught by industrial fisheries and reduced to extract meal and oil that are principally used to feed animals in agriculture and aquaculture. The sandeel spawn demersal eggs within the aggregations of the adults and the pelagic larvae settle often in similar areas. Larvae are at least found at the southeastern boundary of the Dogger Bank. Figure 23 (left side) presents the most likely spawning areas and figure 23 (right side) shows the distribution of larvae.

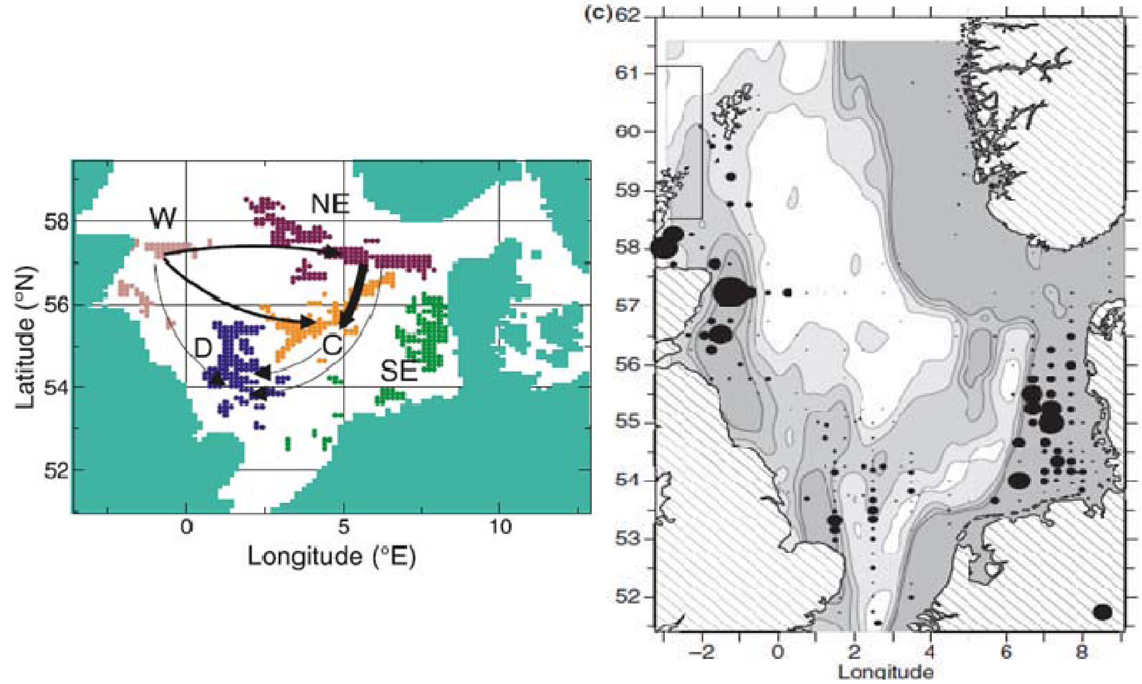

Figure 23 Left – Suitable sandeel banks in the central and southern North Sea (W, D, C, NE, SE), and the most important interbank exchanges in the North Sea of sandeel larvae (Christensen et al. 2008). Right – Ammodytidae larvae abundance is illustrated by area of symbol; circles in bottom corners illustrate area for an abundance of 500 larvae m^{2} during the International Ichthyoplankton surveys from 18 February and 23 March 2004 (Taylor et al. 2007; from Munk et al. 2009).

The fish species that are mentioned as occurring in high densities on the Dogger Bank include whiting (*Merlangius merlangus*), plaice (*Pleuronectes platessa*), Atlantic mackerel (*Scomber scombrus*) and Atlantic cod (*Gadus morhua*). Also found at the site are high densities of dab (*Limanda limanda*) and grey gurnard (*Eutrigla gurnardus*) (Callaway et al., 2002). Other species mentioned in the conservation target document (Jak et al. 2009) are the lesser weever (*Echiichthys avipera*) and thornback ray (*Raja clavata*). Distribution of these species is presented in figures 24 and 25 and is based on the IBTS and BTS surveys. The IBTS can be analysed over a long time period and even on a quarterly basis. The BTS covers a shorter time period and this survey has only limited information on the Dogger Bank (Table 2).

Data on spawning fish based on the distribution of eggs and larvae is presented in a report of Taylor et al. 2007. The data of this ichthyoplankton survey is available for further analysis on specific locations. And could be used to determine spawning in the specific areas. A review on egg and larvae distribution of a large number of species in on the Dutch EEZ is written end of 2009 (Teal et al. 2009) and this gives the most up to date overview on spawning locations.

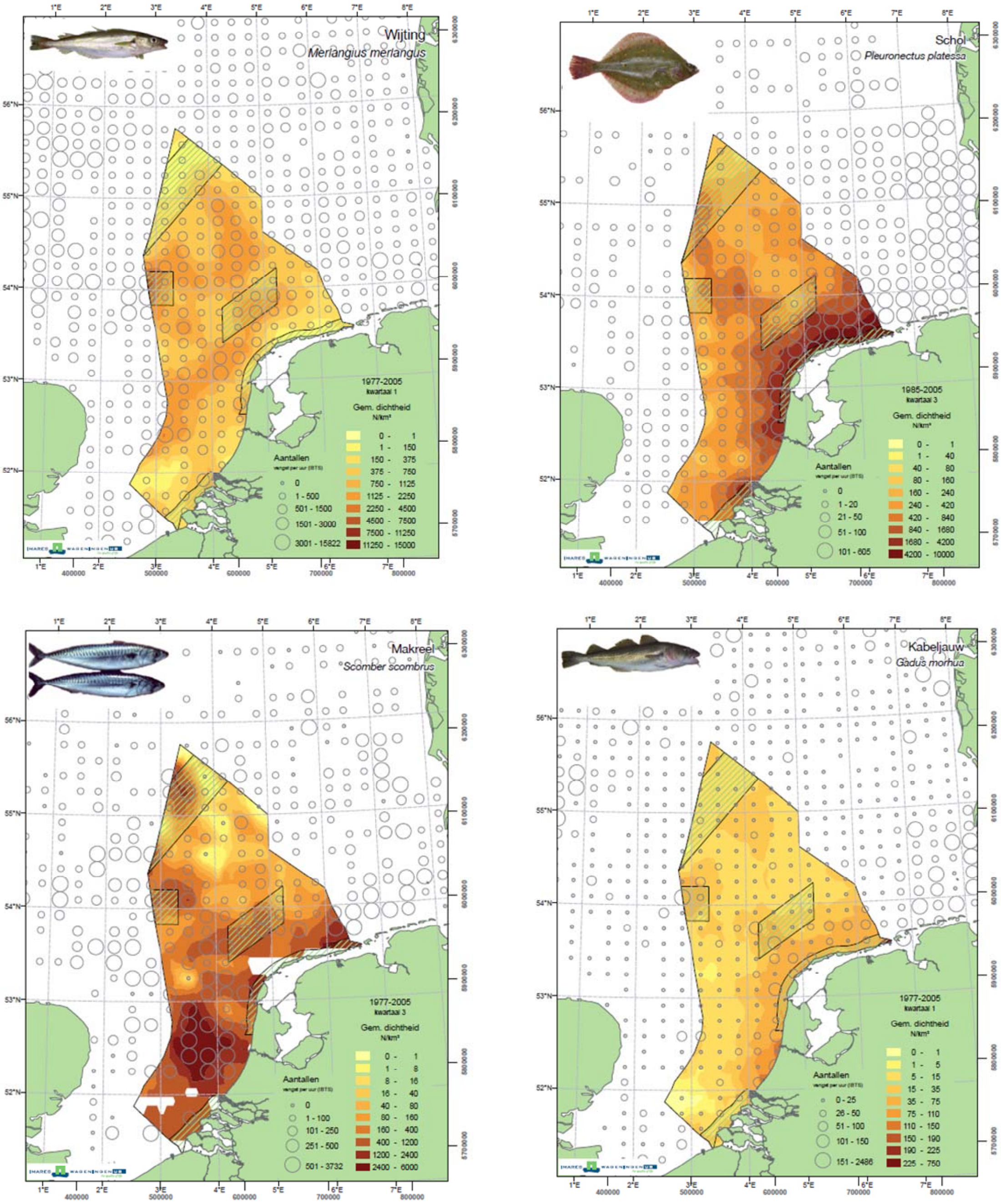

Figure 24 Distribution of Whiting, plaice, mackerel and cod in the North Sea. Whiting and cod are presented in catches per hour from the IBTS in quarter 1. Mackerel is presented as catches per hour in the IBTS in quarter 3 and Plaice is presented as catches per hour in the BTS quarter 3 (Lindeboom et al. 2008).

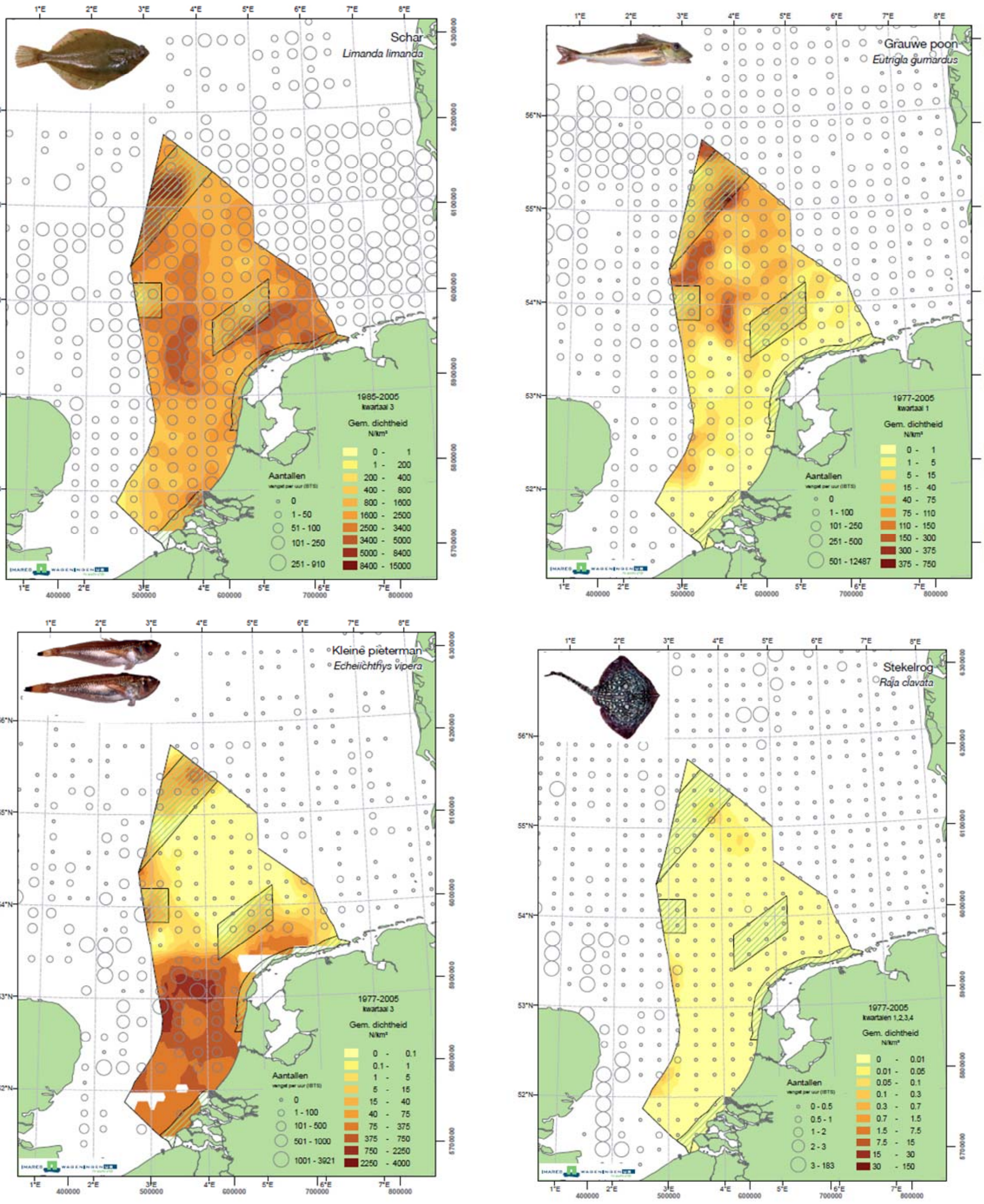

Figure 25 Distribution of dab, grey gurnard, lesser weever and thornback ray in the North Sea. Grey gurnard is presented in catches per hour from the IBTS in quarter 1. Thornback ray is presented as catches per hour in the IBTS in quarter 1,2,3 and 4, lesser weever is presented in catches per hour in the IBTS quarter 3 and DAB is presented as catches per hour in the BTS quarter 3 (Lindeboom et al. 2008).

Harbour Seal en Grey Seal

Conservation objective

"Maintain the extent and quality of habitat in order to maintain the population"

Visual sightings at sea of the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*) are difficult to make, and given that there is no available sandbank for the seals to haul out on, the presence of seals and the potential importance of the area remain largely unknown. Based on the seals' habitat preference, there is a high likelihood of the seals using the Dogger Bank. Anecdotal evidence suggests that the seals do use the Dogger bank (unpublished data Brasseur et al.). Satellite transmitter studies have identified where seals occur, both in the Wadden and North Sea (Brasseur et al 2008, Brasseur et 2009, Brasseur et al in review). This information has been used to model seal density in the North Sea.

Harbour porpoise

Conservation objective

"Maintain the extent and quality of habitat in order to maintain the population"

Similar to the Cleaver Bank, no specific monitoring programmes for harbour porpoises on the Dogger Bank have taken place. The data sources listed and described in the next chapter apply here as well, none of them have the temporal or spatial resolution to allow an interpretation of harbour porpoise abundance or distribution.

Based on limited data, it has been ascertained that relatively many harbour porpoises are sighted on the Dogger Bank compared to the surrounding area, which may be related to the presence of suitable prey fish on which they forage.

5.2.2 Cleaver Bank

Habitat Type H1170

Conservation objective

"Maintain the surface area and improve quality of reefs"

Data on benthic fauna of the Cleaver Bank mainly result from studies on gravel extraction in the north-eastern part of the area. An overview of all available data is presented in Van Moorsel (2003). First data are available from the years 1983 and 1985. In 1988 and 1989 the baseline status of the benthic fauna was studied before extraction began. Short-term effects on the fauna were investigated in 1990 and 1991, but the latter study was restricted to large shellfish. In 2002 long-term effects were assessed and the fauna was studied on other parts of the Cleaver Bank, resulting in a more general knowledge on the spatial variation of the benthic fauna of the whole area and a comparison with the infauna and epifauna of other parts of the North Sea.

No information about the current situation of the biotic communities is available, as only one station of the MWTL-monitoring program (see section 3.4) is located within the Cleaver Bank site. The station is situated in the silt-rich Botney Cut, which is not representative of the habitat type "Open-sea reefs" (Jak et al 2009). Thus, it is impossible to detect trends of community attributes and typical species (Table 20), except for the recovering period in the north-eastern part of the year before 2002.

The report of van Moorsel (2003), however, provides a good summary of the spatial distribution of the fauna of the Cleaver Bank. The broad variety in sediment types and the clarity of the water results in a high diversity of organisms. It is evident that the characteristic species are precisely those restricted to the coarse, highly permeable sands and/or species that cling to stable hard subsurface (Jak et al 2009).

Table 20 Proposal for a list of typical species for habitat type H1170 Open-sea reefs (Jak et al 2009).

English name	Scientific name	Species group	Cat.	Description of occurrence
	Lithothamnion sonderi	calcareous red alga	K	Occurs on hard substratum where light reaches the bottom
Dead men's fingers	Alcyonium digitatum	Anemones	Cab	Sessile long-lived species, present where there is strong water movement
Keel worm	Pomatoceros triqueter	Bristleworms	Ca	Sessile species that contributes to a complex biogenic structure
	Sabellaria spinulosa	Bristleworms	K, Ca	Occurs in sandy substratum, contributes to complex biogenic structure as it is itself a reef-building organism
	Chone duneri	Bristleworms	K	Characteristic species for gravel communities
Squat lobster	Galathea intermedia	Crustaceans	E	Exclusive species of rocks and cobbles
Blunt tellin	Arcopagia (=Tellina) crassa	Molluscs	Cab	Long-lived species of coarse sandy and gravel bottoms
Common whelk	Buccinum undatum	Molluscs	Cab	Long-lived species, cobbles form a deposit substratum for eggs
Rayed artemis	Dosinia exoleta	Molluscs	Cab	Long-lived species of coarse sandy and gravel bottoms
Ribbed saddle oyster	Pododesmus patelliformis	Molluscs	K, Ca	Sessile species that contributes to a complex biogenic structure
Norway bullhead	Taurulus lilljeborgi	Fishes	E	Exclusive species of rocks and cobbles
Two-spotted clingfish	Diplecogaster bimaculata	Fishes	E	Exclusive species of rocks and cobbles

Fish

The two species, Norway bullhead and Two-spotted clingfish, on the proposed list of typical species have been caught on the Cleaver Bank during the surveys described in van Moorsel (2003). However, both species have never been caught in any of the surveys performed by IMARES. Thus besides the single observations by van Moorsel no information is available on these two species.

Harbour Seal en Grey Seal

Conservation objective

“Maintain the extent and quality of habitat in order to maintain the population”

Visual sightings at sea of the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*) are difficult to make, and given that there is no available sandbank for the seals to haul out on, the presence of seals and the potential importance of the area remain largely unknown. Satellite transmitter studies have identified where seals occur, both in the Wadden and North Sea (Brasseur et al 2008, Brasseur et 2009, Brasseur et al in review). This information has been used to model seal density in the North Sea. Based on the seals’ habitat preference, there is a high likelihood of the seals using the Clever Bank.

Harbour porpoise

Conservation objective

“Maintain the extent and quality of habitat in order to maintain the population”

No dedicated surveys for harbour porpoises have taken place on the Cleaver Bank. However, some surveys have covered part of the Cleaver Bank on different spatial and temporal scales. Further description of these datasets is in the next chapter.

From the bimonthly aerial survey of RIKZ, currently, the data cannot be used to estimate absolute abundance because the sighting probability (i.e. given the animal is present, what is the chance of detecting it) cannot be correctly quantified. The spatial coverage of the Cleaver Bank is small and can not be used to interpret the habitat use of harbour porpoises in this area. A similar issue plays a role in the SCANS, and ESAS data, these can not be used to estimate abundance or obtain information on the distribution in the Cleaver Bank site. Thus in conclusion there is no good information source for harbour porpoise on the Cleaver bank. It can only be said that the harbour porpoise is observed on the Cleaver Bank (Arts & Berrevoets 2005; Van der Meij & Camphuysen 2006). With a concentration in summer especially around the Botney Cut.

5.2.3 Frisian Front

The Frisian Front qualifies for protection under the Birds Directive (BD). Sites under the Birds Directive are designated directly without any prior notification procedure to the EC. It is not characterized based on habitat but on the occurrence and abundance of birds species.

In this section, we will describe which bird species are selected, which conservations objectives have been formulated, and what data is currently available for these species. In section 3.2, the current monitoring schemes for seabirds are discussed.

Selected bird species

Jak et al (2009) state the conservation objectives for the four species selected for the Frisian Front. These are: **Great Skua** ‘maintain the extent and quality of habitat with the capacity to carry a population averaging 180 birds (August-September)’; **Lesser Black-backed Gull** ‘maintain the extent and quality of habitat in order to maintain the population’; **Great Lesser Black-backed Gull** ‘maintain the extent and quality of habitat with the capacity to carry a population averaging 80 birds (October-November)’; and **Common Guillemot** ‘maintain the extent and quality of habitat with the capacity to carry a population averaging 20,000 individuals in July-August’.

Hence, the most important periods are July-August (Common Guillemot), August-September (Great Skua), October-November (Great Black-backed Gull. For the Lesser Black-backed Gull, no period has been given in the conservation objectives, but Jak et al (2009) mention June-July.

5.3 References

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6 Fisheries

In this chapter a description of the fisheries is given. The description is given only for the Dutch fisheries activities according to logbook and VMS data in the years 2006-2008. Older VMS data are available. The activities are described by metier. Gear type is the first criteria to distinguish between metiers. Within each gear type, the activities are where possible further distinguished based on engine power and target fish species.

The VMS data used are supposed to contain all the recordings gathered by the General Inspection Service (AID). Before the data obtained from the ministry could be used for mapping fisheries, some adjustments were required in the data:

The data contained a number of duplicate registrations: registrations sent at almost the same time (some seconds a part) however having different speeds and course. Only one of these registrations was kept and the information on speed and course were deleted. In some cases the date and time of multiple registrations were the same but the position was different: in that case the complete records were deleted, because without reconstructing the course on trip level it is impossible to make a decision on which position to keep.

Based on a list with coordinates of harbours around the North Sea, registrations within 2.5nm of a harbour were deleted. Most of these were registrations of vessels resting in the harbour or steaming in or out of the harbour. By this action, a large part of the recordings on land (or rivers) is deleted. However, the list of harbours was not complete and other registrations on land are not removed.

Multiple sources of logbook data were used for merging with VMS in order to get information on the gear used. Logbook data from earlier extractions of the ministry in the VIRIS database were used and also logbook data from more recent extractions in the VISSTAT database. These data from the earlier extraction and more recent extraction do not completely match: some information is missing in VIRIS (only part of the information is available) while in VISSTAT information on shrimp fisheries was lacking. We used both sources to link the VMS records based on trip level.

In logbooks, all beam trawls are reported as TBB. No distinction is made between beam trawl with tickler chains and shrimp trawls. Based on mesh size (16-31 mm) and landings (shrimps), shrimp fishery could be recognized and the gear code was converted from TBB to TBS.

Beam trawl (TBB), otter trawl (OTB), twin trawl (OTT), pair trawls (PTB) and shrimp trawl (TBS) activity characterisation is based on speed (table 5). Duplicate records of which the speed was removed were excluded from the maps and tables presented below.

The number of VMS registrations and the hours corresponding to these registrations are presented in table 21. In this table the information is presented for all gear codes in the VIRIS+VISSTAT database. For each gear code the information is split up in total number of registrations and the number of registrations in each MPA.

Table 21 Summary of the VMS dataset (2006-2008): gear types with registrations are presented by year. For the TBB a split is made based on engine power. For OTB, OTT, PTB, TBB and TBS a selection is made based on speed: only records considered as fishing records are presented (similar in the maps). "Vessels" represents the number of vessels that used the specific gear: vessels can use multiple gears in a year, which can result in a vessel to be included in the information for multiple gear types (thus the total number of vessels exceeds the actual number of vessel). "Records" represents the number of VMS records (excluded are positions within 2.5nm of a harbour and duplicate records). "Hours" is the total sum of hours between records. "Percentage" is the percentage of records found in the specific Natura 2000 site in relation to the total number of records of the gear type: 0.0 means that it is less then 0.05% of the records.

Year 2006					Total		Dogger Bank			Frisian Front			Cleaver Bank		
gear		Engine type (kW)	action	vessels	records	hours	records	hours	%	records	hours	%	records	hours	%
TBB	Beam trawl	<221kW	fishing	94	60323	106322.7				418	791.3	0.7	20	37.0	0.0
TBB	Beam trawl	>221kW	fishing	113	206848	358350.8	763	1164.4	0.4	5782	10534.6	2.8	451	848.8	0.2
TBS	Shrimp trawl	all	fishing	189	90478	144746.4				2	0.3	0.0			
Bottom Trawls	Otter Trawls, Twin Trawls, Paired Trawls	all	fishing	67	30260	51556.5	92	179.9	0.3	3012	5138.1	10.0	1653	2899.1	5.5
Seines	Danish and Scottish Seines	all	all	5	9559	18147.1	1	1.9		19	39.9	0.2	6	11.5	0.1
Static	Pots & Traps, Gill nets	all	all	19	5332	10005.8				1	1.0	0.0			
DRB	Dredge	all	all	6	6100	11519.9									
OTM	Otter midwater trawl	all	all	21	46504	76508.5	13	25.1	0.0	2	3.8	0.0	47	60.8	0.1
PS	Purse seine	all	all	4	1698	2006.2									
PTM	Pelagic paired trawl	all	all	2	6329	12537.2	14	28.9	0.2				6	11.5	0.1
Unknown		all	all	12	589	1108.2									

Year 2007					Totaal		Dogger Bank			Frisian Front			Cleaver Bank		
gear		Engine type (kW)	action	vessels	records	hours	records	hours	%	records	hours	%	records	hours	%
TBB	Beam trawl	<221kW	fishing	77	46241	84134.2				285	549.8	0.6	1	1.9	0.0
TBB	Beam trawl	>221kW	fishing	112	211002	363747.4	287	521.0	0.1	7861	12420.6	3.7	681	1276.4	0.3
TBS	Shrimp trawl	all	fishing	189	88213	160481.1									
Bottom Trawls	Otter Trawls, Twin Trawls, Paired Trawls	all	all	66	28821	46750.1	72	127.4	0.2	1325	2248.7	4.6	2006	3720.6	7.0
Seines	Danish and Scottish Seines	all	all	8	13441	25197.5	4	7.6	0.0	35	65.4	0.3	83	157.3	0.6
Static	Pots & Traps, Gill nets	all	all	16	6604	12352.7	3	5.8	0.0	15	28.6	0.2			
DRB	Dredge	all	all	7	7497	14446.4									
OTM	Otter midwater trawl	all	all	19	46089	73327.2	17	29.0	0.0	5	9.6	0.0	25	48.3	0.1
PS	Purse seine	all	all	2	1229	1552.4									
PTM	Pelagic paired trawl	all	all	2	5433	10709.4	14	32.6	0.3				5	9.5	0.1
Unknown		all	all	13	696	1222.2				15	25.0	2.2	1	1.9	0.1

Year 2008					Totaal		Dogger Bank			Frisian Front			Cleaver Bank		
gear		Engine type (kW)	action	vessels	records	hours	records	hours	%	records	hours	%	records	hours	%
TBB	Beam trawl	<221kW	fishing	101	39125	69764.0	0	0.0	0.0	285	523.1	0.7	4	7.7	0.0
TBB	Beam trawl	>221kW	fishing	100	162142	272947.1	637	1076.9	0.4	4477	8213.0	2.8	363	694.5	0.2
TBS	Shrimp trawl	all	fishing	195	92393	158082.4									
Bottom Trawls	Otter Trawls, Twin Trawls, Paired Trawls	all	all	69	29554	54088.3	642	1223.9	2.2	1356	2445.0	4.6	1438	2601.2	4.9
Seines	Danish and Scottish Seines	all	all	12	18893	34019.6	29	53.7	0.2	19	38.4	0.1	123	239.1	0.7
Static	Pots & Traps, Gill nets	all	all	24	5658	10595.3				55	106.5	1.0	2	3.9	0.0
DRB	Dredge	all	all	5	7520	14557.0									
OTM	Otter midwater trawl	all	all	17	44569	68816.0	10	19.1	0.0	3	5.7	0.0	10	19.1	0.0
PS	Purse seine	all	all	3	1655	1903.7									
PTM	Pelagic paired trawl	all	all	2	5387	10549.0	18	34.5	0.3				5	9.6	0.1
Unknown		all	all	9	196	339.7									

6.1 Beam trawl

The beam trawl derives its name from the beam supported by the two shoes at either end. The net is attached to the beam, shoes and ground rope, thus the mouth of the net is held open regardless of the speed at which it is towed. Shoes of the beam glide across the surface of the seabed and prevent the beam from sinking into soft substrata. In some cases, the shoes of the beam are enhanced with wheels to reduce the drag. The beam trawls are deployed with tickler chains to disturb or dig out the target species (Figure 26). The larger beam trawls can be fitted with over 20 tickler chains and penetrate soft sands to a depth of over 6 cm. Beam trawls with standard tickler chains are usually fished over clean ground as on rougher ground the net would soon fill with rocks. To be able to fish on rougher ground chain mats are added, along with a flip up gear fitted to the ground rope. The beam trawl produces amongst the most severe impacts by fishing activities on benthos and habitats, both because it captures epifaunal and infaunal components but also because of the high mortality associated with contact with this heavy gear (de Groot and Lindeboom, 1994).

Beam trawling is an efficient method for catching demersal flatfish species (mainly sole *Solea vulgaris* and plaice *Pleuronectes platessa*) and brown shrimp *Crangon crangon*. The fishing vessel operates two steel spars or beams from two derricks simultaneously (Figure 26). A beam trawl gear consists of the beam with two trawl shoes on each side to which a net is attached and an array of chains, called 'tickler chains'. Often at the footrope inside the net additional chains are placed, called 'net ticklers'. The number of these chains varies. Values of 8-10 ticklers and 8-10 net ticklers are commonly used. By EU Regulation No 850/98 the width of the gear or beam length is limited to 12 m, and the power of the installed main engine is limited to 2000 hp for flatfish beamtrawling.

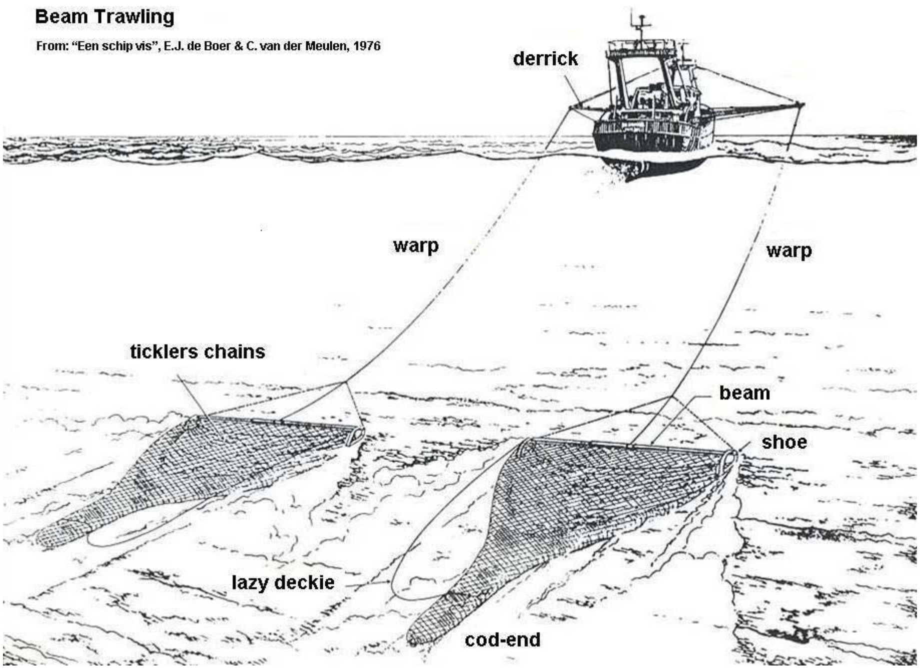

Figure 26 Beam trawling (From: E.J. de Boer en C. Vermeulen, 1976)

In the flatfish fishery two types of beam trawl are in use, one with tickler chains for flat sandy fishing grounds, called the 'V'-net (Figure 27 left), and one with a chain mat for rough grounds, called the 'R'-net. A 'flip-up' rope system can be used to enable passage over stones and boulders (Figure 27 right). The mesh size used in the codends for flatfish is usually 80 mm for sole fishery and 100 mm for plaice fishery. Codends are restricted in circumference to 100 meshes round, and the twine thickness to 6 mm double braided.

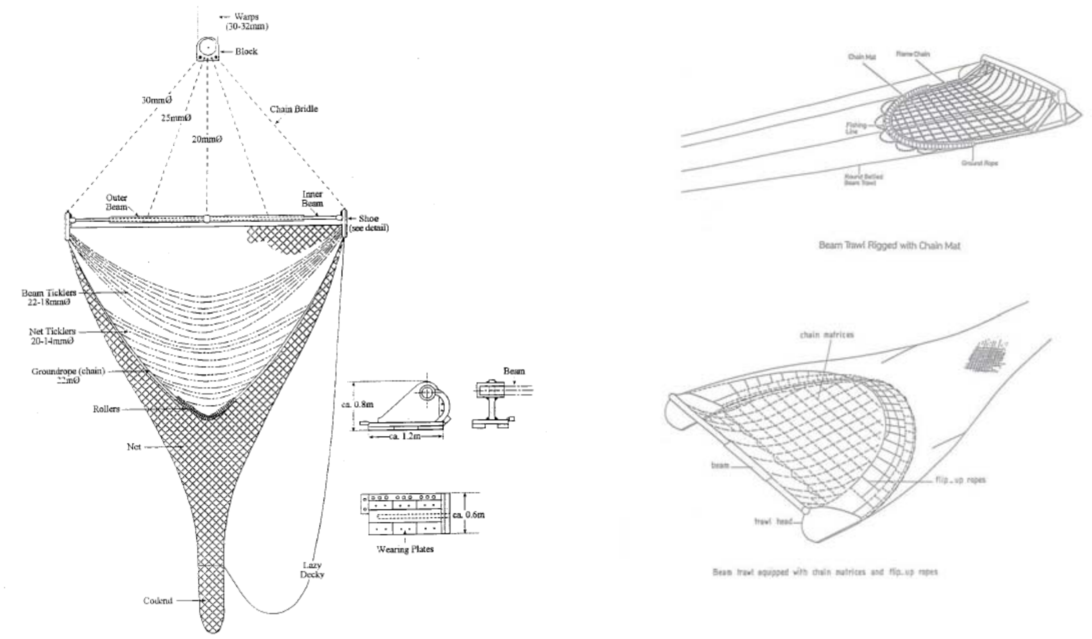

Figure 27 Beam trawl with tickler chains (V-net) (left) and beam trawl chain mat without (upper right) and with 'flip-up' rope (lower right)

In the North Sea, two principal métiers are usually distinguished: "large vessels" with an engine power of 221 kW or more (on average 1471 kW), and "eurocutters", with an engine power <221 kW and a maximum length of 24 metres. The large vessels deploy two 12-m beam trawls and are not allowed to fish inside the 12 nm coastal zone or the "plaice box", whereas the eurocutters deploy two 4.5-m beam trawls and are allowed to fish inside those areas (Piet et al., 2007; Rijnsdorp et al., 2008).

Mesh size regulations applying to beam trawls prohibit the use of any mesh size between 32 to 119 mm in the greater North Sea, north of 56° N. However, it is permitted to use a mesh size between 100 to 119 mm within a limited area, provided that the catches taken within this area with such a fishing gear and retained on board consist of no more than 5% cod. In the southern North Sea, it is permitted to fish for sole south of 56° N with 80-99 mm meshes in the cod end, provided that at least 40% of the catch is sole, and no more than 5% of the catch is composed of cod, haddock and saithe (*Pollachius virens*) (ICES, 2008).

Except for distinguishing "large vessels" and "eurocutters" a further aggregation can be made based on target species. A part of the "eurocutters" fishes on shrimps mainly in coastal areas, using a small mesh (16 and 31 mm) and lighter gear without tickler chains.

The development of alternative gear for beam trawls has a long history. It started in the 1950s with electric fishing or 'pulse' trawling that uses an electric pulse instead of tickler chains. Although electric fishing is prohibited (EC Regulation 850/09), the developments have been promising and the effects of pulse trawling, both on the economics (marketable catch, fuel consumption) and on the biology (by-catch of non-target species, mortality on the two path, bottom disturbance, e.g. Van Marlen et al. 2006, 2009). More recently (about 2006) the sharp rise in fuel prices have driven the a series of practical trials with a whole range of adjustments to the beam trawl (e.g. outrigger system, hydro-rig, sumwing). The aim of these developments was initially to reduce drag and thus fuel consumption. Reduced bottom disturbance is a positive by-effect. These gear types have only been applied in experimental fishing in latest years (Steenbergen and Van Marlen 2009; Van Marlen et al. 2009).

6.1.1 Large Beam trawl (TBB >221 kW)

The fisheries with large beam trawlers is mainly carried out by Dutch vessels targeting plaice and sole. There are also Belgium, German and UK beam trawlers. However, a large part of the UK beam trawlers are Dutch vessels fishing on the UK register, the so called flagvessels. The target species are plaice and sole, when the vessels are targeting plaice they fish further north then when they target sole. Due to changes in quota of these two species the fishery has been fishing further north in years when the plaice quota was high and the other way around (Rijnsdorp et al. 2008).

An historic overview since the 1950s on developments in this métier are presented in Rijnsdorp et al. (2008). In latest years, a reduction in number of vessels in this métier occured, especially in the largest ones with engine power >1490 kW. Of the beam trawl vessels around 35% fall within the métier Large beam trawlers (Taal et al., 2009).

The large beam trawlers are not allowed to fish within the 12nm zone and plaice box, but outside these areas they fish almost everywhere in the southern North Sea. From the maps of the distribution based on VMS (Figures 28 and 29) it is clear that the highest concentration of the Dutch beam trawlers is immediately outside the 12nm zone and the plaice box, whereas other countries concentrate in other areas (UK – Dogger Bank, Germany – in and around Frisian Front). The maps show fishing intensity expressed in hours fishing, where on average about 31 ha are fished per hour (2*12m*7nm/h*1852). Around 2.8 to 3.7% of the total fishing activity of the larger beam trawls in the Dutch EEZ takes place in the Frisian Front, while in the Dogger Bank and Cleaver Bank areas only 0.1 to 0.4% respectively occurs. It should be noticed that this represents only three years for which the fishermen say that the TAC of plaice and the high oil price prevents them from fishing on the Dogger Bank. We don’t have access to a the full set of VMS data from earlier years that could support these statements.

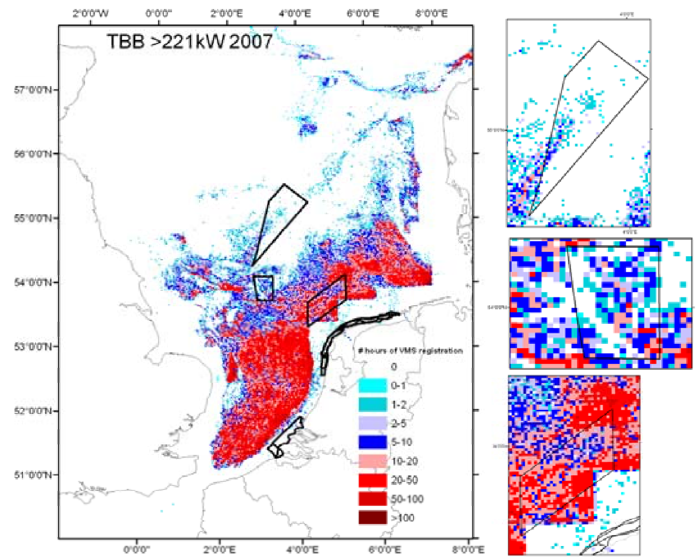

Figure 28 VMS registrations of the Dutch large beam trawlers in 2007. These are the registrations considered as fishing activity based on speed. Represented are the number of hours between two VMS points.

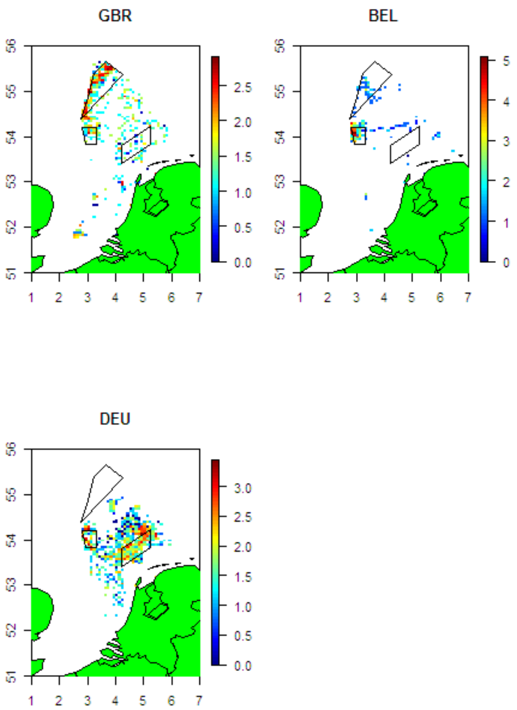

Figure 29 VMS registrations of foreign large beam trawlers in the Dutch EEZ 2007. GBR=UK, BEL=Belgium, DEU=Germany.

6.1.2 Eurocutters (TBB <221 kW)

This fleet comprises beam trawlers operating with mesh sizes over 80 mm and engine power <221 kW, main target species are sole, plaice and dab. Of the Dutch beam trawl vessels about 65% of the number of vessels falls in this métier. However, this number does include vessels fishing on shrimp (16-31 mm mesh size) that are discussed in the next section.

The eurocutters are allowed to fish within the 12nm zones and the plaice box and most of the effort of the Dutch and Belgian fleet takes place in these areas. Especially the effort of the German fleet extends out of the 12nm zones and into and beyond the Frisian Front areas (Figures 30 and 31). Within an hour of fishing an eurocutter covers on average an area of 8 ha. This is a much smaller area than that of the large beam trawlers. The gear used by eurocutters is less heavy than that of the larger beam trawls and digs less deep in the substrate compared to the larger beam trawls. Overall the impact of a single haul from an eurocutter has a lower impact than the impact a larger beam trawl.

The total number of cutters (all engine powers) in the Netherlands was 308 in 2008, however also the cutters participating in twin rigging and flyshooting are included in this number.

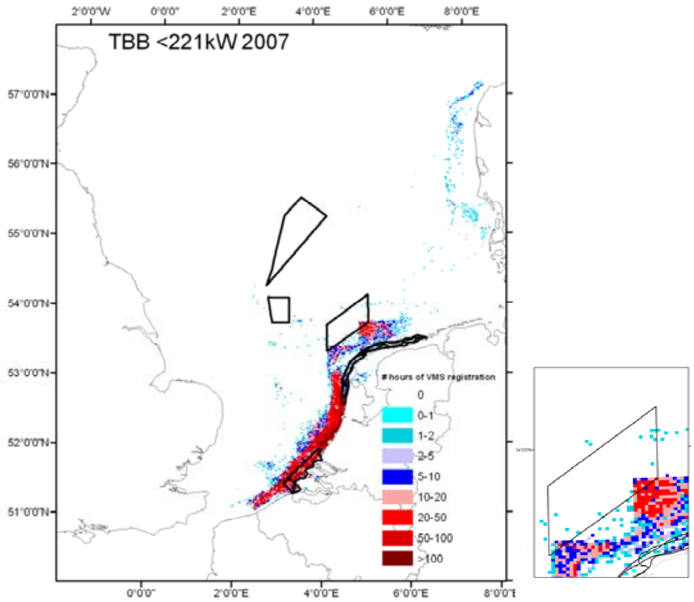

Figure 30 VMS registrations of the Dutch eurocutters in 2007. These are the registrations considered as fishing activity based on speed. Represented are the number of hours between two VMS points.

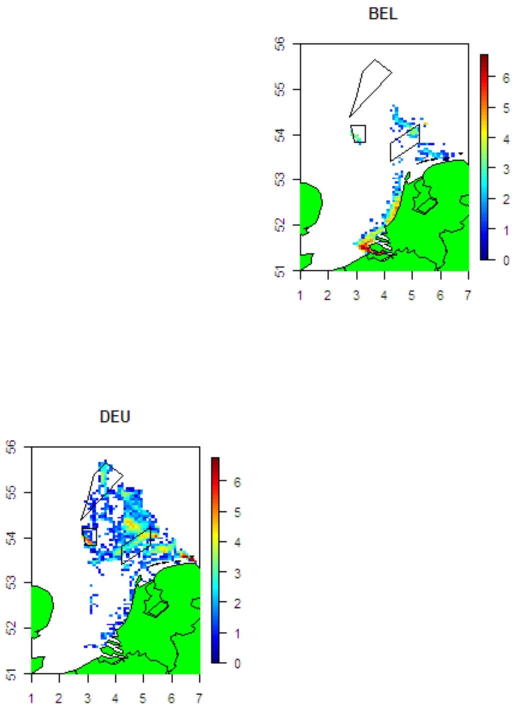

Figure 31 VMS registrations of foreign large beam trawlers in the Dutch EEZ 2007. BEL=Belgium, DEU=Germany.

6.1.3 Shrimp beam trawl (TBS)

The shrimp vessels fall within the métier of the eurocutters, but fish with smaller mesh sizes and without tickler chains. In the logbook data the gear type of these vessels is TBB, but based on their mesh size (16-31 mm) and landings of shrimp they are classified as TBS. Only a limited amount of the VMS registrations classified as this métier are found outside the 12nm zone and plaice box (Figure 32). This type of fishery is not relevant to the fisheries executed in three MPAs.

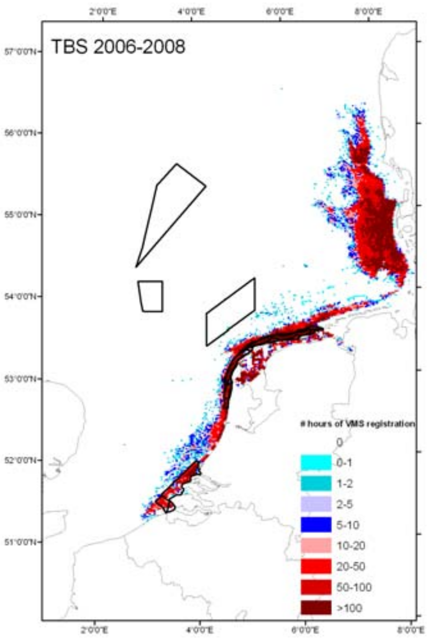

Figure 32 VMS registrations of the Dutch shrimp beam trawls summed over 2006-2008. These are the registrations considered as fishing activity based on speed. Represented are the number of hours between two VMS points.

Shrimp fisheries are coastal targeting shrimp with small meshed beam trawls. The shrimp beam trawls are less heavy compared to those used by the eurocutters or large beam trawls. Due to their design, the net will usually not touch the seafloor whilst fishing, except when the catch accumulates in the cod end. By-catch of undersized commercial species is a problem in the shrimp fisheries. By-catch species are amongst others dab, sole, plaice, and whiting (ICES, 2007). To reduce the amount of by-catch the shrimpers use a veil or sieve net or sorting grid.

6.2 Otter trawl

Otter trawls are demersal trawls that use a large, usually cone-shaped net that is towed across the seabed. Rectangular boards (otter boards) are used to keep the mouth of the net open during trawling. The hydrodynamic forces on the boards push the net outwards (Figure 33). The otter boards have to be towed at a certain speed (depending on their size) for this effect to be achieved. The distance between otter boards during a tow is between 60 and 120 metres and the whole under-surface may come into contact with the substrate. However, only a proportion of the entire width of the gear penetrates the sea bed (EFEP, 2001). The long-term damage of such penetrations in benthic habitats depends partly on the substrate type.

Floats and/or kites on the headline and weighted bobbins attached to the foot rope maintain the vertical opening of the net. The design of the bobbins is adjusted to on the roughness of the sea bed which is fished. Otter trawls adapted for fishing over rocky grounds are known as rockhopper trawls. Tickler chains are used within this fishery, but their numbers are usually limited (EFEP, 2001). Otter trawls can be equipped with nets having different mesh sizes, which differ in target fish and in rules applying to them. The otter trawls with ≥120mm mesh, correspond to the directed whitefish fishery, with landings consisting mostly of haddock, saithe, cod, whiting, monkfish and plaice. This fishery has the highest impact in terms of both weight and numbers of cod removed in the North Sea (STECF, 2008). The otter trawl is also used in a directed saithe fishery by vessels fishing under the special condition that the percentage of cod, sole and plaice in the landings should be less than 5%. This fishery also takes some haddock, but has relatively little by-catch of other roundfish species. Significant landings of saithe are also made by otter trawls with 100-119mm mesh size fishing under the same special condition.

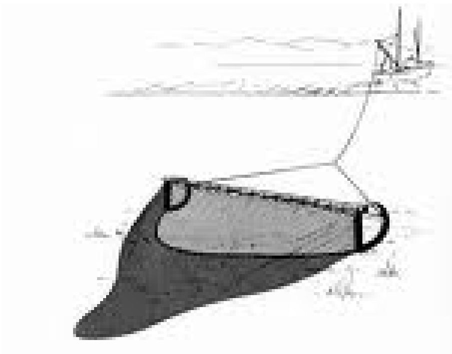

Figure 33 Otter trawl

The use of otter trawls with mesh sizes of 90–99 mm is mostly associated with Danish and Swedish vessels fishing in the Skagerrak, and, to a lesser extent, the eastern North Sea. This fishery takes account for most cod landings in the Skagerrak. The same gear is used by the UK *Nephrops* fisheries. The *Nephrops* fishery in the central and northern North Sea also uses otter trawls with a mesh size of 70-89 mm, mesh sizes that are also used by the whiting fishery in the southern North Sea (STECF, 2008).

The gear codes reported for otter trawl are OTB and OTT. The first is a single trawl, while the second is twin trawling. The second code was only implemented in the last years and a large number of recordings of the logbook still report OTB while actually they use OTT. Therefore the distributions presented here are a combination of both gear codes. Also included are the records of the PTB, which are two vessels using one net, a pair (Figures 34 and 35). According to the logbooks, only two pairs have been fishing in this métier. Thus presenting data for only PTB would make it possible to track individual vessels, which is not allowed according to the privacy legislation. The descriptions of the individual gear codes are still separated.

6.2.1 Otter trawl (OTB)

This is the main métier using otter trawls and it can apply a single net or two on each side of the vessel (twinrigging or outrigging). It is the main fishery in the North Sea and conducted by most countries. It uses the larger mesh sizes are adjusted to target species and area where it is used. Otter trawling targeting whitefish takes place across the entire North Sea with highest levels in the northern part (MAFCONS, 2007). Otter trawling by the Dutch fleet is limited to the Dutch EEZ area and the Channel. The otter trawls with engine power less than 221 kW are allowed to fish in the 12nm zone, but apart from that have a distribution similar to the larger otter trawlers. Therefore, they are grouped together in the distribution maps. Most of the effort in the otter trawl fishery in the Dutch EEZ is carried out by Danish and German vessels. The Dutch fishery takes place in the Frisian Front area and in the Cleaver Bank area, although in the Cleaver Bank the main activity is located along the Botney Cut (in the Dutch as well as in the English part). The Danish otter trawl fishery takes place over almost the whole Dutch EEZ, and the German and to a lesser extent British fishery seems to be limited to the more central Dutch EEZ areas (Figures 34 and 35).

6.2.2 Otter twin trawls (OTT)

Twin rig trawlers use a gear that is rigged in a similar way as a single otter trawl. The trawl doors are used to provide the spread on the outer wings of the pair of nets. The main difference is that a twin trawler has two nets, and uses a central wire from the vessel to a large weight (the clump) located on shorter bridles between the two nets. This weight is often fitted with rollers or wheels to prevent unnecessary digging in on the seabed, and to help reduce drag. The twin trawler often has a lower headline height, so is best suited for species which stay close to or on the seabed.

6.2.3 Pair trawls (PTB)

A bottom pair trawl consists of a large funnel shaped net with two, four or more panels, closed by a cod end with side wings that extend forward from the opening to guide fish into the funnel. It is operated by two vessels – one of the vessels only tows the trawl whilst the other handles the trawl and collects the catch. Bottom pair trawls do not require trawl doors to keep the net open horizontally, and with the combined towing pull of the two vessels, a larger net can be used than would be possible with a single vessel. Similar to the bottom otter trawl, the selectivity of the bottom pair trawl can be improved by the use of Square Mesh Panels and Sorting grids. The Dutch effort in this métier is low.

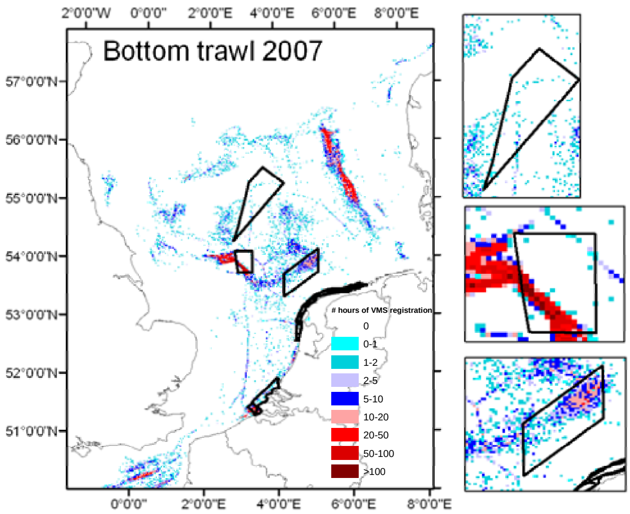

Figure 34 VMS registrations of the Dutch bottom trawls (OTB OTT PTB) in 2007. These are the registrations considered as fishing activity based on speed. Represented are the number of hours between two VMS

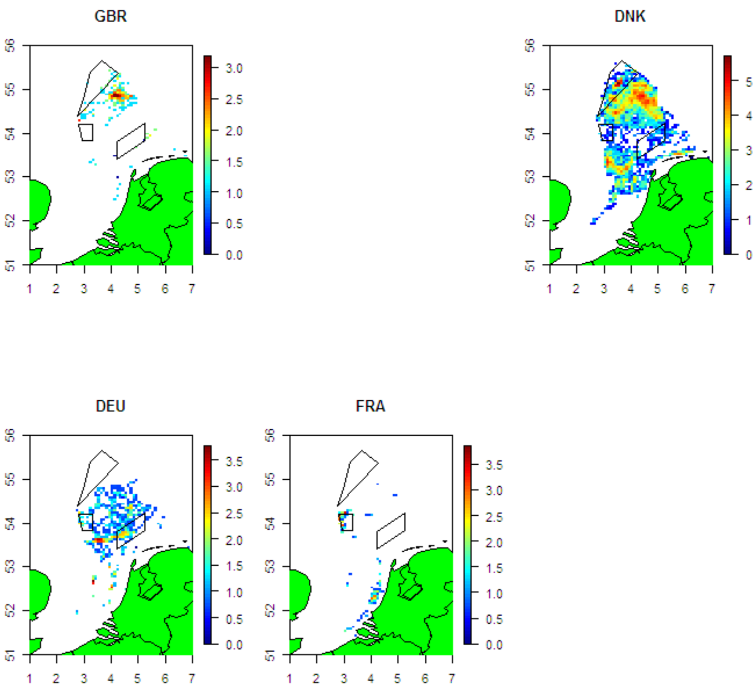

Figure 35 VMS registrations of foreign otter trawls in the Dutch EEZ 2007. GBR=UK, DNK=Denmark, DEU=Germany, FRA=France.

6.3 Dredges

This type of gear is used to target shellfish species such as oysters, mussels, ensis and scallops and it includes boat dredges and hand dredges.

6.3.1 Boat dredges (DRB)

Boat dredges are heavier than hand dredges, and are towed across the seafloor. They consist of a mouth frame, attached to a holding bag that is made of metal rings or meshes called a 'chain belly'. There are two variants of boat dredges; one type scrapes the surface of the seabed, using rakes or teeth to penetrate the top substrate layer, and captures animals that have retracted into the seabed, passing them back into the holding bag. The other type of boat dredges penetrate the seabed up to 10 cm, collecting macro-infauna (animals that live within the sediment and are large enough to be seen with the naked human eye). These infaunal dredges include hydraulic dredges that use water jets to fluidize the sediment, and mechanical dredges, which penetrate the substrate using the mechanical force of long teeth.

For fishing on Ensis a method is used that forces water into the bottom under pressure, such that it liquefies the silt, as a result of which the Ensis shells come loose. By additionally forcing air to the silt the shells are exposed to a lifting effect and eventually float. The shells are harvested through a tube that is connected to the ship.

There are two Dutch vessels in the VMS recordings that fish for scallops outside the 12nm zone, but this activity mainly takes place in the Channel and around the Moray Firth. There are vitually no registrations of dredges (Dutch or other countries) in the three MPAs (Figure 36).

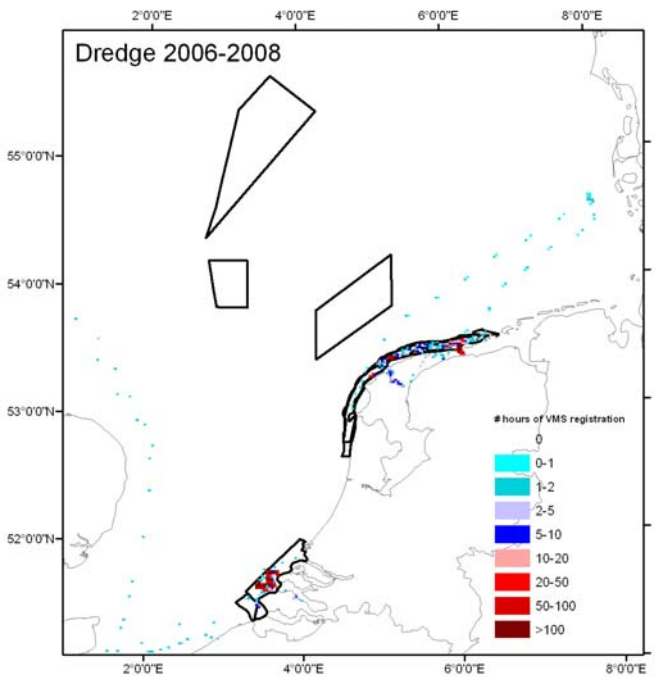

Figure 36: VMS registrations of the Dutch dredge summed over 2006-2008. Due to lack of information to distinguish between activities, no selection on activity has been made, thus also drifting and steaming are included. Represented are the number of hours between two VMS points.

6.4 Seine fisheries

Two Seine types are distinguished, the Scottish and the Danish Seine. The difference is in how hauling takes place, with the vessel anchored or moving at a slow speed. The seine fishery has certain disadvantages compared to trawls. It cannot work on such rough grounds as otter trawls and it demands relatively calm weather and low currents. It is difficult to use during the night or in fog. The workload of the fishers is higher. Finally, it demands better navigational skills, as it can not be moved to another ground when it is set, except after hauling. The advantages of the seine are, however, that it does not need much power to operate (low fuel consumption per catch), that it is much cheaper and less bulky than a trawl and can, therefore, be used on much smaller vessels.

6.4.1 Scottish seines/flyshooting (SSC)

Scottish and Danish seines are based on similar techniques. The main difference is that using the Scottish seine, the vessel applies propeller thrust to move forward and heave in the gear, whereas using the Danish seine fishing method the vessel is anchored during hauling.

The Scottish Seine or flyshooting fishery uses long lengths of seine rope to herd fish into the path of the net as the gear is hauled. Up to 3 kilometers of rope may be put out in a triangular configuration with a marker buoy, marking the start position. The vessel returns to this to complete the shoot. Both ropes are then led to the winch and the vessel steams slowly ahead at around 1 knot, gradually increasing winch speed as the gear closes to keep the net moving steadily forward. Floats keep the net open vertically and this is attached to the footrope using a combination sweep of rope and wire. The footrope is generally rigged much lighter than that of a trawl, but is sufficiently weighted to keep the lower edge of the net mouth in contact with the sea bed. Floats rigged to the headline keep the seine net open. A seine net may reach a forward speed of 2 knots during the later stages of the haul, before it leaves the bottom. Most whitefish species is caught by this method. The Dutch beam trawling sector is fitting vessels with this technique at increasing scale. The method is not suitable for catching sole.

6.4.2 Danish seines (SDN)

Danish seining or ‘snørrevåd’ is a semi-static fishing method based on the herding effect of cables running over the sea bed. Its origin is operated from a beach. Later the application with fishing vessels anchored off-shore was developed. A rope called ‘seining rope’ is paid out first from the shore, then the net laid on the sea bed, and the other cable attached to the net paid out. Its end brought back and connected to the first cable. Both are heaved in by hand or using a winch enclosing fish on the sea floor and sweeping them together in the surface between the cables. The net is then pulled in through the accumulated fish and heaved in (Figure 37). The catch is only briefly inside the net during the last phase of the operation, ensuring high quality. The method depends on detection of the cables by fish, thus needing light and visibility. In the off-shore variant the vessel pays out a buoy with floatation on anchor, shoots the seining rope from the buoy, places the net on the sea bed, returns to the buoy to pick up the end of the first seining rope, and then heaves in both ends and the net. The number of Dutch vessels reporting that they use SDN are low and therefore, because of privacy legislation, can not be mapped separately (Figure 38). Of the other coutries, mainly the Danish fishery applies this method in the Dutch EEZ (Figure 39).

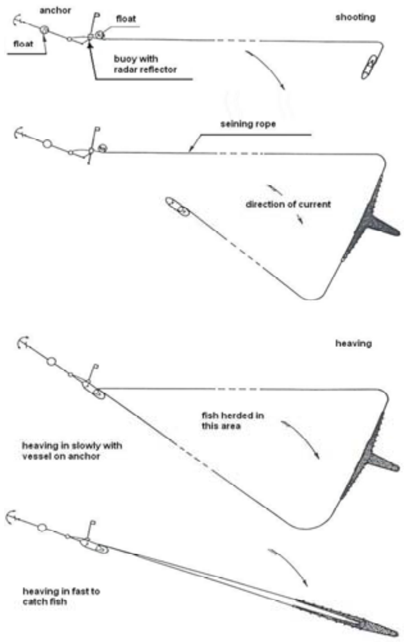

Figure 37 Danish seining shooting and heaving operation

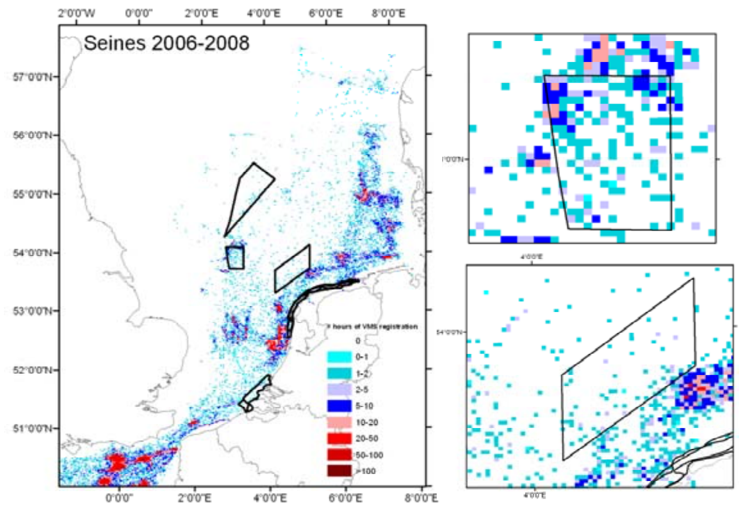

Figure 38 VMS registrations of the Dutch seine fisheries (SSC and SDN) summed over 2006-2008. Due to lack of information to distinguish between activities, no selection on activity has been made, thus also drifting and steaming are included. Represented are the number of hours between two VMS points.

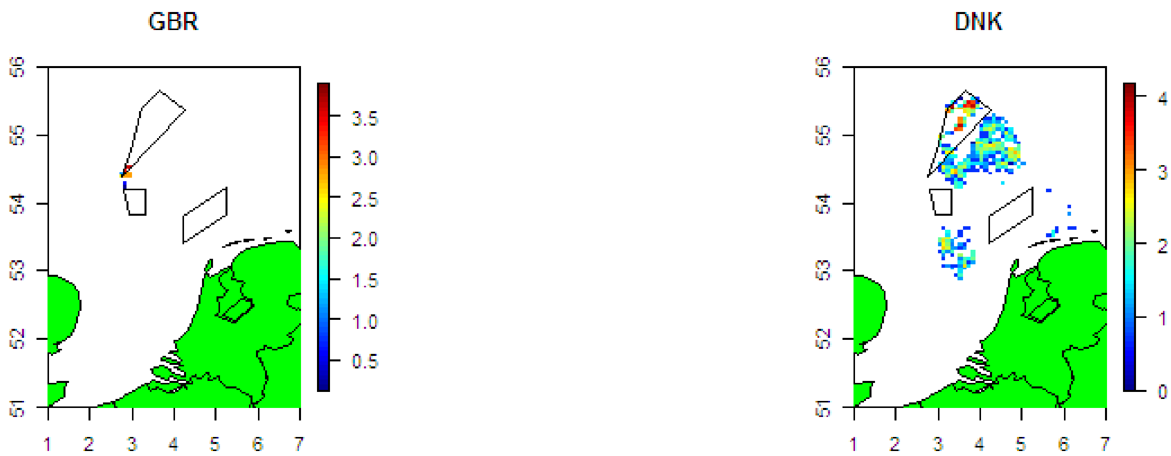

Figure 39 VMS registrations of foreign seine fisheries (operated from vessels <221kW) in the Dutch EEZ in 2007. GBR=UK, DNK=Denmark, BEL=Belgium, DEU=Germany, FRA=France, IRL=Ireland.

6.5 Static gears

Static gears are various types of nets, pots and traps. The vessels fishing with these gears often set multiple gears overboard into the water and these remain in place for a certain period at the end of which they are picked up again. The VMS records of these vessels thus do not indicate the time of fishing. These records may give an impression of the locations where the gears are set and the time of setting. The return time may be estimated separately from other sources, e.g. information from the fishermen.

6.5.1 Fixed nets: set gillnets, tangle nets and trammel nets (GN, GNS)

Set gillnets consist of a single netting wall kept vertical by a floatline (upper line/headrope) and a weighted groundline (lower line/footrope) (Figure 40). They are mainly used to catch cod. Small floats are evenly distributed along the floatline, while lead weights are evenly distributed along the groundline. The lower line can also be made of lead cored rope which does not need additional weight. The net is set on the bottom, or at a distance above it and held in place with anchors or weights on both ends. By adjusting the design these nets can fish in surface layers, in mid water or at the bottom, targeting pelagic, demersal or benthic species. The fish are being caught when they get stuck in the mesh of the net. The practice of surrounding wrecks – 'wreck-netting' – is also increasingly prevalent.

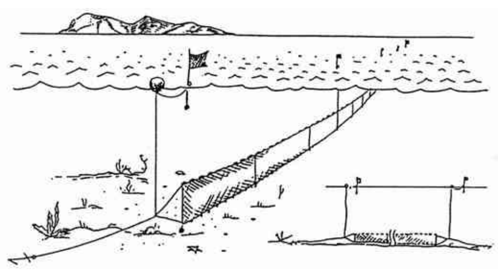

Figure 40 Set gill net

Tangle nets are similar to gillnets in that they are a single wall of netting suspended from a floated headline. They are used to catch e.g. sole and turbot. While they resemble gill nets in their design they have a greater amount of slack netting and less flotation at the headline and a smaller vertical height of netting. The result is a much more loosely hung net, which effectively entangles species with protruding spines.

Trammel nets comprise three walls of monofilament netting. They can be used to catch a wide variety of species ranging from cod and monkfish to plaice and sole. The net consists of three walls of netting in which a small fine meshed inner net is sandwiched between two outer walls of larger mesh netting. The three sheets of netting are attached to the floated headline and weighted footrope so that all three hang vertically in the water. Slack netting is ensured by setting the net loosely on the headline and footrope and by having the inner net depth measuring approximately twice the outer net wall depth (Figure 41). The nets catch target species as they swim through the large mesh outer panels and become trapped in a pocket of finer mesh created by their own forward swimming motion. The mesh size of the outer panels can be adjusted to different target species by adjusting the head and footrope settings.

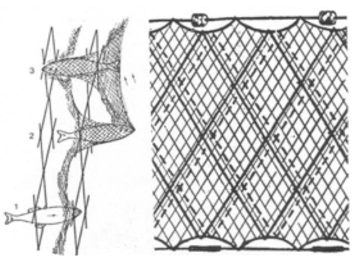

Figure 41 Trammel net

There have been some Dutch VMS records of vessels using nets in 2006 and 2007 in the Dogger Bank and Frisian Front area (Figure 42). However, this amount is very low and could refer to steaming only without setting of the nets. The Danish, German and British fishery is far more active with gillnetting in the Dutch EEZ (Figure 43).

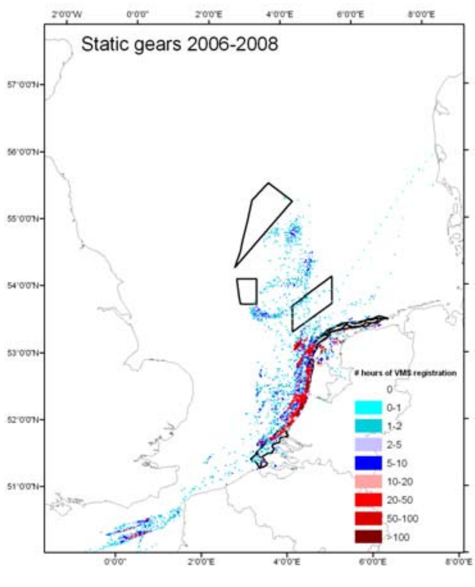

Figure 42 VMS registrations of the Dutch fixed net fishery summed over 2006-2008. No selection on activity is made, these are only the locations of the vessels active in this fishery thus not the nets that are in the water. Represented are the number of hours between two VMS points.

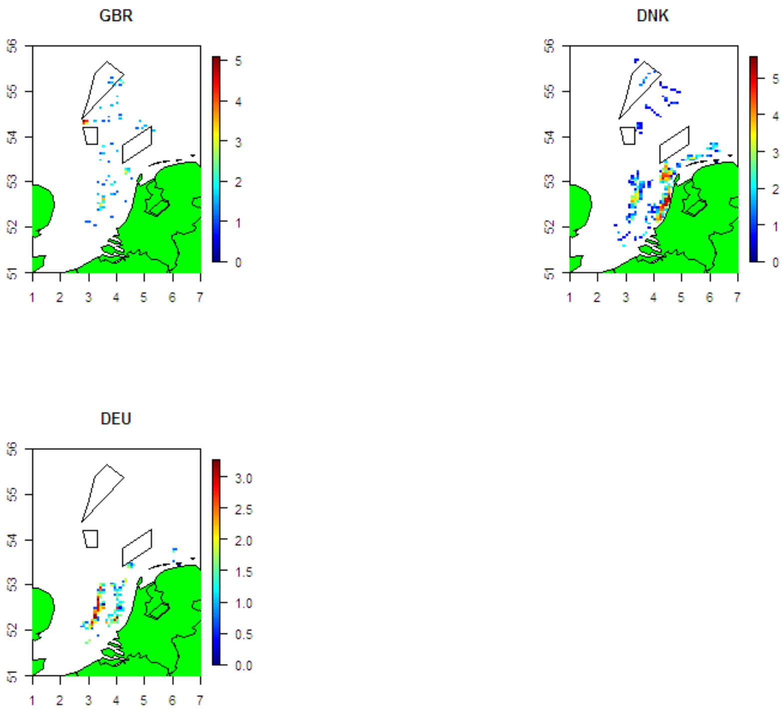

Figure 43 Foreign VMS registrations of gillnet fishery operated from vessels <221kW in the Dutch EEZ in 2007. GBR=UK, DNK=Denmark, BEL=Belgium, FRA=France.

6.5.2 Pots and Traps (FPO)

Traps are a form of semi-permanent staked net designed to intercept and hold fish during their annual or daily migrations. They are simple, passive fishing gear that allow fish to enter and then make it hard for them to escape. This is often achieved by putting chambers in the trap or pot that can be closed once the fish enters or having a funnel that makes it difficult for the fish to escape. Pots are constructed either of wooden slats or, more commonly, coated wire mesh. They are set on the bottom individually or in strings and harvest various species of shellfish and finfish. Pot fishing can be done in shallow estuaries, in inshore ocean waters and in deeper water offshore. The traps range in size from the two or three foot long crab pots to the very large, deep water traps, which can be ten feet square. The smaller pots are hauled from the bottom by hand while the larger traps require hydraulic haulers. The pots are usually baited but often, particularly on flat, sandy bottoms, it is thought that the quarry enters traps as much for the shelter they offer as for food.

There is some effort in the Frisian Front area allocated to vessels reporting the code FPO (pots or traps), most likely for langoustines and edible crab. Furthermore, there is a grouping of effort just below the Cleaver Bank and the Dogger Bank. The effort of this is in the maps combined with the gillnets, because else individual vessels can be tracked. Among the Dutch vessels, FPO refers to one vessel only, which can not be reported separately and is therefore group with the other two métiers.

6.6 Midwater trawls

Midwater trawling is also known as pelagic trawling in contrast to bottom or benthic trawling. A midwater trawl consists of a cone shaped body, normally made of four panels, ending in a codend with lateral wings extending forward from the opening (Figure 44). It is usually much larger than a bottom trawl and designed and rigged to fish in midwater, including in the surface water. The front parts are sometimes made with very large meshes or ropes, which herd the targeted fish inwards so that they can be overtaken by smaller meshes in the aftertrawl sections. The horizontal opening is maintained either by otter boards or by towing the net by two boats (pair trawling). Floats on the headline and weights on the groundline often maintain the vertical opening. Modern large midwater trawls, however, are rigged in such a way that floats are not required, relying on downward forces from weights to keep the vertical opening during fishing.

Two gear codes for midwater trawls are used, OTM and PTM. From figure 45 is seems that most of the registration of these gear types on Dutch vessels represent steaming to the actual fishing grounds outside the North Sea, where they fish on horse mackerel, mackerel, pilchard, sardinella and other species. However, these vessels also fish on herring. There is some activity of midwater trawl fishery by German and French vessels in the Channel, and the Danes appear to fish (for sandeel) on the Dogger Bank (Figure 46).

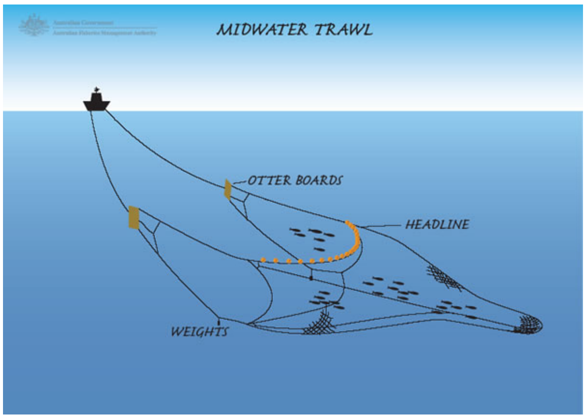

Figure 44   Midwater trawl

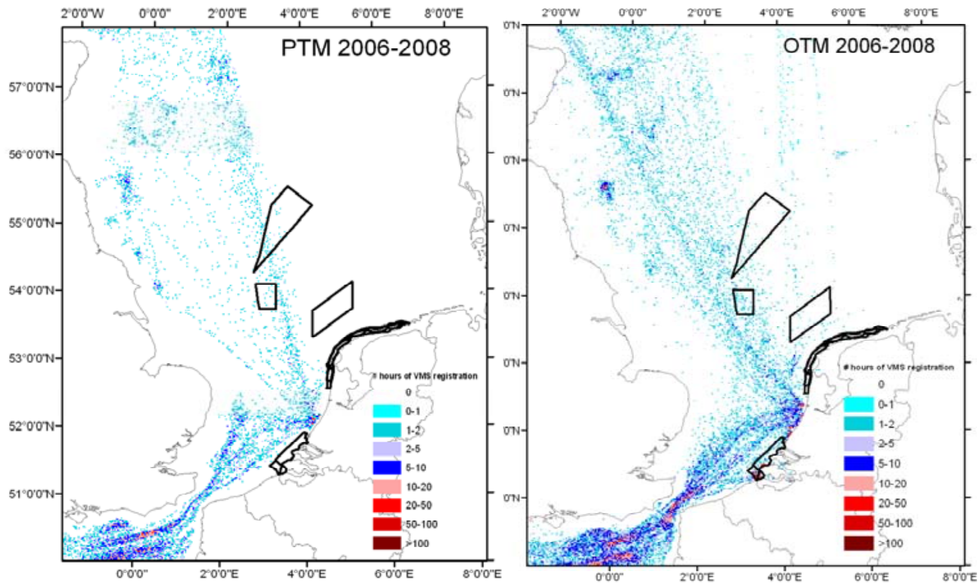

Figure 45   VMS registrations of the Dutch PTM and OTM gears summed over 2006-2008. No selection on activity is made. Represented are the number of hours between two VMS points.

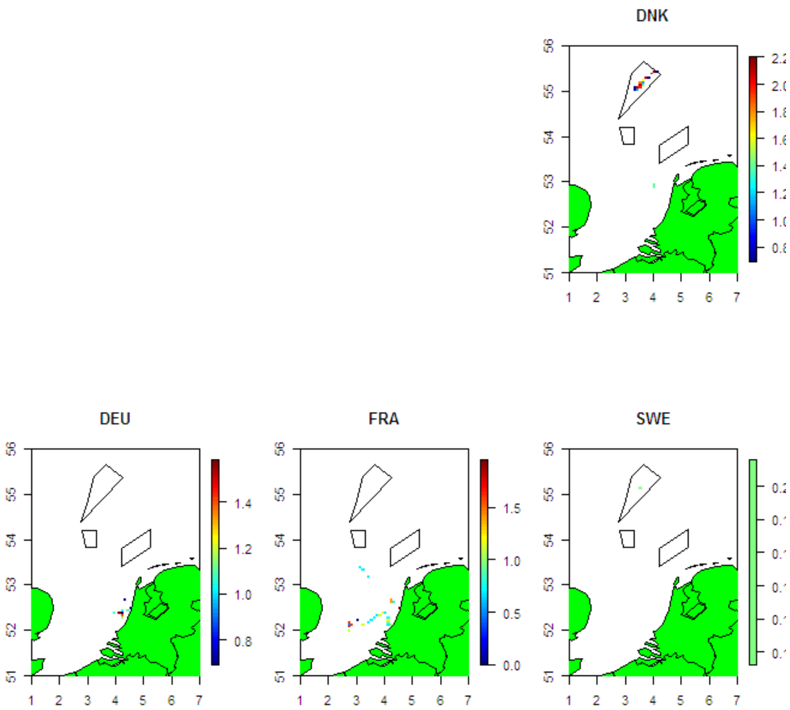

Figure 46   VMS registrations of foreign midwater otter trawls operated from vessels >221kW in the Dutch EEZ in 2007. GBR=UK, DNK=Denmark, BEL=Belgium, DEU=Germany, FRA=France, IRL=Ireland.

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7 Impact of fisheries

This section describes in general the information that is available and published on the impacts of fisheries activities on the ecosystem. A vast number of studies describes these effects and they have been reviewed several times before (Jennings & Kaiser 1998, Auster & Langton 1999, Kaiser et al. 2002, 2006, Sewell & Hiscock 2005, Hiddink et al. 2006, 2007, ICES 2006, 2007a, b, c, MAFCONS 2006, Pedersen et al. 2009). The various types of fisheries exert various types of effect, both directly and indirectly. Some of these effects are shared among more types of fisheries, other types are restricted to fewer types of fisheries (see Table 15), e.g. bottom disturbance is no issue of concern in pelagic trawling. The distinction according to type of effect is important in a later stage of the FIMPAS process, when effects of different origins have to be weighed and combined. We distinguish the following types of effects (adapted from Jongbloed et al in review, ICES 2007)

Immediate or direct effects:

Disturbance of the structure of the sea floor

Increased turbidity of the water column

(By)catch of target and non-target fish, benthos, marine mammals and seabirds

Reduction of food availability

Visual disturbance and noise

Delayed or derived effects:

Population effects (direct and through the foodweb)

Reduced biodiversity and/or changes in community structure

Genetic effects and effects on the phenotype

We here briefly review the current knowledge on impact of fisheries according to the two types of conservation objectives: habitats and species (mammals and birds).

7.1 Impact on benthic habitats

7.1.1 Disturbance of sea floor

Fisheries operating on the sea floor will affect benthic processes as designed to cause disturbance to the top layers of benthic habitats. This includes removal of large physical features, reduction in structural biota and a reduction in complexity of habitat structure (leading to increased homogeneity) (ICES 2002, 2003, 2006, 2007a, b).

Seafloors in areas in which for example beam trawls are used regularly have been observed to have been homogenised as any large protuberances are removed or flattened (Auster and Langton, 1999; Johnson, 2002). The importance of the physical features of habitats in determining the community structure of benthos is well documented (Duineveld et al., 1991; Hall et al., 1994; Hall, 1994). Some protected habitats, such as maerl beds, *Lophelia* reefs, *Sabellaria spinulosa* reefs and *Modiolus modiolus* beds, which support high levels of biological diversity will be seriously affected by any gear which is dragged along the sea floor. The impact would affect both the biogenic habitat itself and the communities they support.

It is generally recognized that the first fishing event has proportionally more impact than subsequent ones (Collie et al. 2000, Schroeder et al. 2008). However, the effects of multiple events are cumulative such that multiple fishing events by a low impact gear may in fact exceed the changes induced by a single pass of a more impacting gear. This relationship is further complicated by the fact that in most biological systems mechanisms for recovery exist. For example otter trawl tracks were visible for up to one year after trawling the sandy sea floor of the Grand Banks of Newfoundland (Schwinghamer et al., 1998), and up to 18 months on muddy substrates in the Irish Sea (Ball et al., 2000). Recovery rates appear most rapid in less physically stable habitats, which are generally inhabited by more opportunistic species. However, areas that are fished more than three times a years are likely to stay in a permanently changed state. The key issue in assessing the impact of fishing gears is therefore not the absolute frequency of an impacting activity but the frequency relative to the recovery time for that system. Thus, the impacts of fishing need to be considered in terms of intensity of impact, frequency of impact, and nature of the impacted system, in particular its ability to, and rate of recovery.

Benthic invertebrates suffer mortality both in the gears and in the towpath of the gear. There is an inherent difficulty in interpreting the actual mortality (fishing disturbance) resulting from the fishing event because there is often a time lag between the disturbance by fishing event and the subsequent assessment of the community. This allows for the incorporation of other community structuring factors such as predation, changing resource availability and immigration of animals into the disturbed area. Thus, the longer the time period between the fishing event and the post-fishing sampling event, the greater the likelihood that the community level response to fishing, rather than the absolute fishing mortality is actually measured. A number of studies have tried to reduce the effect of this by focusing on the actual fishing disturbance. For example, an attempt was made to estimate the annual fishing mortality of megafaunal invertebrate populations in the Dutch sector of the North Sea (Bergman and Van Santbrink, 2000a, b). To minimise the influence of dispersal on the interpretation of the change in populations following a fishing event, only species that lead a predominantly sedentary lifestyle were included. Also, all sampling of the densities of animals following trawling was undertaken between 24-48 hours after trawling, in order to reduce the interference of other biotic and abiotic factors on the estimation of fishing mortality. There was, however, no attempt to try to exclude the effect of predation on damaged animals on the estimation of fishing mortality. It is likely that it will be difficult to quantify invertebrate mortality in the towpath of the gear that completely excludes any subsequent predation mortality. Another factor that will make it difficult to gain an accurate estimation of mortality in the towpath of the gear for disturbance indices is the influence of disturbance history on the level of mortality sustained by populations. It is widely believed that the highest levels of mortality will be sustained in an area that has not been trawled recently. If an area has been recently trawled however, residual fishing-induced mortality decreases with every subsequent pass of the gear.

Benthic species that live deep in the sediment, are more mobile, smaller, or hard bodied, are less likely to be affected by fishing. Within communities, selective mortality is likely to lead to reduced abundance of large species with low intrinsic rates of population increase, and dominance of smaller species with higher intrinsic rates of population increase. There is, however, some disparity between individual studies in the definition of which taxa are particularly vulnerable. This may be because a taxon will be vulnerable in one respect, for example having soft body parts with little armour, but will have this offset by another characteristic such as its' location within the sediment. For example, it is widely believed that thin-shelled molluscs and some echinoderms, such as delicate sea urchins and heart urchins, are at greater risk to serious physical damage than thick-shelled molluscs or robust crustaceans (Rumohr and Krost, 1991; Collie et al., 2000). However, where these species have high intrinsic population growth rates due to high fecundity and/or low age at maturity, high levels of mortality experienced could be offset by high levels of juvenile recruitment (e.g. for brittle stars see (Bergman, 2000) meaning that population size is not noticeably affected. There is certainly evidence that benthic invertebrate communities respond to fishing disturbance (e.g. Robinson and Frid, 2008) but predicting the vulnerability of individual species is far from simple (Alexander et al., in prep.).

Changes in size distribution have been described for a number of areas in the North Sea (Jennings et al., 2001; Duplisea et al., 2002) and the implications of this on secondary productivity have been discussed (Hiddink et al., 2006). It is essential that we recognize that the most important ecological changes will be shifts in dominance of particular functional units. For the North Sea demersal system, we still do not have the evidence to describe where this has occurred and whether it is as a result of fishing (Robinson and Frid, 2008). A described change is the beneficial effect on scavenging populations (Rumohr and Kujawski, 2000). The interaction between these and the increases in moribund material in the towpath of the gear has been described in a number of studies in the Southern North Sea and Irish Sea but the implications of this at the population level and the scale of the North Sea are unknown.

7.1.2 Bycatch of undersized and non-target fish and benthos

Most if not all fisheries catch benthic species or fish that can not be landed, and are discarded again. These discards consist of undersized (juvenile) fish of the commercially interesting species, because for most target species a minimum landing size (MLS) is decided. In addition, also species, benthic and fish, that are not commercially interesting are discarded. Also some target species above the MLS are discarded because of their low value, this is called high-grading. However, since the beginning of 2009 in all European waters a high grading ban is enforced.

These discards should be avoided, because most discarded species do not survive. Therefore, various methods are developed or under development to decrease the number of discards in the fisheries, e.g. the use of a veil or sieve net in the shrimp fisheries.

The amount of discards depends on various aspects. The area in which the fishery takes place. For example in the coastal nursery areas, with high numbers of undersized fish, the discards are higher than in offshore areas, i.e. the three MPAs. This was the reason for banning large vessels from the 12nm zone and the main reason that the plaice box was installed.

Another aspect is the selectivity of the fishing method and the gear. Mid water trawls that use echo-sounding equipment to locate the shoals of their target species generally have low discards. The echogram provides information on the location, size and position of a shoal in the water column, which makes this fishery very efficient in targeting fish. Theoretically, the use of echo-sounding equipment should result in low by-catch, making the fishery selective. However, shoals may consist of mixed species, which could result in non-target species being discarded (ICES, 2008a). In contrast, beam and other trawls are not selective and catch everything on the bottom hoping for enough target species in their net.

The next aspect is the selectivity of the net used. Differences in meshsize result in a different length range that is maintained by the net. The small meshsize used in the shrimp fishery catches even the smallest fish in the codend. While the use of 100 or >120 mm meshsizes in the otter trawl and gillnet fisheries limits the amount of small fish collected in the codend. However, these large meshsizes also increase the chance that target species can escape from the net.

The Scientific, Technical and Economic Committee for Fisheries (STECF), combines and discusses the discard data collected by each EU member state (section 3.4.1). In their summary of the fisheries in the North Sea, the discard ratios obtained show that the demersal trawl and seine (OTB+OTT+PTB+SDN+SSC) discard around 20%. Trammel nets (FTN) and static gears, discard around 40% of the catch of herring, horse mackerel, mackerel, mullets and whiting with year-to-year variability; while pelagic trawl (PTM+OTM) have low discard rates of only pelagic species. Beam trawl (TBB) discards between 40 to 60% of targeted and non-targeted species (STECF, 2006).

7.1.3 Impact by type of fishery

The magnitude of both the initial and long-term impacts of different fishing gear types varies significantly among habitats (Kaiser et al. 2006). Therefore, the different types of fishing based on their contact with the substrate and in most cases thus the attributes considered in the Habitats Directive can be ranked (Collie et al. 2000, Kaiser et al. 2006). Both authors carried out a meta-analysis and concluded that inter-tidal dredging had more effects than scallop dredging and otter trawling. It should however be noticed that not all the aspects of the gear have a similar impact. For example, the type of impact from the shoes of the beam trawls or the otter boards differ from the type of impact due to the tickler chains or the ground rope.

Dredges are amongst the most impacting gears on benthos, as they are designed to penetrate the seafloor to capture molluscs. They are heavy and so have a high mechanical impact and associated mortality and they cause high post-capture damage and mortality in the net (Kaiser et al., 1996). Penetration of the dredge teeth varies with the nature and compaction of the deposits. Three principal components of a mechanical dredge may cause benthic effects: the beam from which dredges may be towed, the toothed bar or cutting blade, and the bellies of the dredge bags (Rose *et al.*, 2000). Dredges either rake through, or cut into, the sediment to a depth determined by the length and structure of the toothed bar or cutting blade and the downward force of the dredge. Underwater observations have shown trenches formed by the passage of dredges over the substratum, with distinct ridges of sediment being deposited on each side (Bradshaw *et al.*, 2000).

Beam trawls especially those with chainmats follow the dredge. The larger beam trawls can be fitted with over 20 tickler chains and penetrate soft sands to a depth of over 6 cm. The distinction between the larger beam trawls and eurocutters is made because the eurocutters use lighter gears and have a lower fishing speed. However, there was no difference found between the mortality of the lighter beams compared to the larger beams (Bergman and Van Santbrink, 2000a, b)

Traditional **otter trawls** are not particularly damaging to benthic habitats and processes in sedimentary environments, where the main impact occurs from the otter boards on the seafloor. Krost et al. (1990, cited in Jennings and Kaiser, 1998) estimated that otter boards could penetrate up to 15cm in the soft mud of the Baltic Sea, and sometimes the doors may be fitted with metal shoes to prevent them penetrating too far into the sediment. Laboratory experiments established that a single door could create a 2cm deep furrow in a sandy substrate and form an adjacent berm of displaced frontal spoil along the trailing edge of the trawl door (Gilkinson et al., 1998). The width of the tracks created by the otter boards may range between 0.5m – 6m. Tickler chains are used to disturb fauna and disrupt the surface of the sea bed, but their numbers are usually limited on otter trawls as they reduce the size of the opening (Rijnsdorp and Leeuwen, 1996). Some disturbance may be generated by the underside of the trawl also. Generally the impact from otter trawling is considered to be less than that from beam trawling (e.g. Collie et al., 2000; Kaiser et al., 2006; De Groot & Lindeboom, 1994). Rock hopper gear and any trawl used in a structural complex environment will have more negative impacts and may result in major changes in habitat structure and ecological functioning. Other configurations of the trawl (rollers on the ground gear, tickler chains etc) will all increase the degree of impact on habitat features and benthic processes and may mean that an otter trawl can exert the same degree of impact as a beam trawl. As Twin trawls are constructed in a similar way the impact is considered similar as a single otter trawl.

Shrimp beam trawls do not use tickler chains, therefore they are considered to have lower impact compared to the other beam trawls.

The **demersal pair trawl** is considered to have lower impact as the otter trawls because two vessel are used to keep the net open, this eliminates the need of otter boards. The nets used are however even larger than the otter trawl nets and thus sweep an even larger distance of the seafloor. Also here, rock hoppers and rubber reinforced footropes are used to protect the net from bottom damage.

Scottish and Danish seine are not actual trawling fisheries. They use long lengths of seine rope to herd fish into the path of the net as the gear is hauled. The seine rope and the footrope of the net make contact with the sediment. The footrope is generally rigged lighter as that of previous described gears. Overall impacts are much less than trawl operations, as there is no use of trawl doors and the gear is not towed for long distances. The Danish seine has a lower impact as the gear is not towed at all, because it is hauled as the ship is on its anchor.

Gill nets, pots and traps rest on the sediment and disturb the sediment when they are set and hauled. Depending on the weight this will alter small areas of sediment. Also gillnets are set on the sediment and fish for a longer period on the same location. An average length of the gillnets is 20km, and they will impact the sediment over this distance specifically during setting and hauling. An other issue relating the pots, traps and gillnets is the effect of ghost fishing as nets get lost.

Midwater trawls do not physically contact the sediment. However, slippage of a catch occurs (i.e. discarding fish before the catch is brought on board for sorting) when too many invaluable fish are caught (Borges et al., 2008). This may cause concentrations of discarded fish on the sediment, which can attract and be beneficial for scavengers, and the decaying process may cause an anoxic environment.

Table 22 Ranking of the different gears based on their impact on the benthic ecosystem.

Rank	Type of fishery	Gear
1	Dredge	DRB
2	Beam trawl	TBB >221kW Chainmats
		TBB >221 kW
		TBB < 221kW
3	Otter board trawl	OTT+OTB
4	Shrimp trawl	TBS
5	Pair trawl	PTB
6	Seine	SSC
		SDN
7	Pot or trap	FPO
	Gill net	GNS
8	Mid water trawl	PTM

7.2 Impact on marine mammals and birds

7.2.1 Bycatch of marine mammals and seabirds

The (unintentional) bycatch of marine mammals, in particular porpoises and seabirds, by gillnet fisheries is another direct impact from fisheries on the conservation objectives within the three MPAs considered in this report. As presented earlier in Chapter 6, the Dutch gillnet fishery has a negligible presence within the Dogger Bank and Cleaver Bank, but there may be some activity of Dutch gill net fisheries on the Frisian Front (Figure 42). Both Danish and British gill net fisheries appear to take place on the Dogger Bank (Figure 43). Because of the nature of the gill net fishery (static) it is not possible to extract exact location and intensity of this type of fishery from the combined VMS and logbook data. Nevertheless gillnet fisheries within the marine MPAs in the Dutch EEZ is likely to occur.

An overview of the bycatch of porpoises by fisheries in Dutch waters is presented by Couperus (2009). Based on pathological research, he concluded that a part of the porpoises stranded on the Dutch coast in recent years are a result of bycatch in fisheries. The type of fisheries responsible for the bycatch is unknown, however set gillnet fishery are thought to the most likely candidate. Nevertheless, it should also be mentioned, that there are several different types of gillnet fishery and therefore most likely a large difference in the amount of bycatch between these types may occur. Observer programme's have also been carried out but were on a relative small scale and didn't cover all types of fisheries. No general conclusions on size and distribution of the impact can be drawn from this observer programme. Furthermore, information on the distribution and population level of porpoises within Dutch waters is to scarce to derive any conclusions with respect to the impact of bycatch on the population level or on the scale of areas like the Dogger Bank and the Cleaver Bank.

Seabirds can also get entangled in gillnets (ICES, 2008). Entanglement of seabirds in gillnets has not yet been studied or otherwise recorded in offshore areas in the Netherlands. On the other hand, in other areas e.g. coastal areas in the Baltic Sea bycatch of sometimes large amounts of seabirds have been recorded (ICES 2008).

7.2.2 Discards as food for seabirds

Beneficial effects of fishing on species have been shown for the discards produced by the fisheries and the use of these as food by birds. It has been estimated that discards (including offal) can account for up to 30% of the total food consumed by scavenging seabirds in the North Sea (ICES, 1996). Further estimates suggest that this discarding could support between two and six million scavenging seabirds in the North Sea depending on the assumptions (Furness et al., 1992; Camphuysen and Garthe, 2000).

Several seabird species feed on discards produced by fishery activities at sea. As stated before conservation objectives set for the Frisian Front are related to the Great Skua, Great Black-backed Gull and Lesser Black Backed Gull (Jak et al, 2009). All three species are known to follow fishing vessels and feed on discards. They do this directly or in case of the Great Skua by stealing food from other fish-eating birds. For example one of the birds from the Birds Directive, the great skua, benefits indirectly from fishery, by robbing gulls and other birds of discards and waste. When discards become less available, the great skua's predation on other seabirds increases. Thus not only the great skua benefits, but also the other bird species due to reduced predation pressure. If discards from fishery become less available either by generic measures taken in order to reduce discarding of fisheries on a North Sea level or by future measures taken especially within the Frisian Front area, populations of these species might be affected.

7.2.3 Visual disturbance by fishing vessels

Visual disturbance by the presence of the fishing vessels in the area is another direct impact of fisheries in relation to the conservation objectives for the three areas concerned. This disturbance affects mainly seals, porpoises and seabirds. For seals, porpoises and diving birds disturbance by underwater noise can be relevant. However, knowledge in relation to this type of impact is very scarce. With respect to seabirds also visual disturbance by vessels can be relevant. As said before Great Skua, Great Black-backed Gull and Lesser Black Backed Gull probably will be attracted to fishing vessels because of discarding taking place. Thie overall effect on these bird species is that they benefit from the presence of vessels. On the other hand the Common Guillemot can be affected in an negative sense. They often react to approaching ships by diving or on occasion by flying away. They also show other signs of stress. In all, this indicates that ships disturb the natural behaviour of common guillemots. The consequence of this disturbance is that the time the birds need to eat and rest is reduced, which can cause the birds' condition to deteriorate (Jak et al. 2009). However, dose-effect relationships for the effect of visual disturbance on the condition of birds are scarcely available.

7.3 Pre-assessment by expert judgement

During the first FIMPAS workshop held 22-24 February 2010 in Scheveningen, The Netherlands, the workshop participants together constructed a first, expert-judgement matrix classifying the expected interactions of fisheries and conservation objectives (Table 23).

Table 23 Matrix of expected (by expert judgement) interaction between fisheries and conservation objectives

	Beam Trawl	Shrimp trawl	Otter board trawl	Seine nets	Gillnet
Habitat	*** Direct disturbance	** Direct disturbance	** Direct disturbance	* Direct disturbance	* Direct disturbance
Marine mammals	* Potential by-catch	* Potential by-catch	* Potential by-catch	* Potential by-catch	*** By-catch
Sea birds	* Discards and offal		* Discards and offal Food availability		*** By-catch inshore areas

We adapted the interaction matrix to include the various types of effects that may be expected (or can not be excluded in advance, see beginning if this chapter) (Table 24). It becomes apparent that the impact assessment of fisheries on conservation objectives (FIMPAS workshop 2) needs to consider multiple lines of potential effects.

Table 24 Application of the potential effects of fisheries to the matrix of interaction between fisheries and conservation objectives

Habitats	Beam trawl	Otter trawl	Seine nets	Fixed nets
(By)catch of target and non-target species	***	**	*	?
Disturbance of the structure of the sea floor	***	**	*	*
Increased turbidity of the water mass	***	**	*	
Reduction of food availability	?	?	?	
Visual disturbance				
Population effects (direct and through the foodweb)	***	**	*	
Reduced biodiversity and/or changes in community structure	***	**	*	
Marine mammals	**Beam trawl**	**Otter trawl**	**Seine nets**	**Fixed nets**
(By)catch of target and non-target species	*	*	*	***
Disturbance of the structure of the sea floor				
Increased turbidity of the water mass	?	?	?	
Reduction of food availability	*	*	*	
Visual disturbance	*	*	*	*
Population effects (direct and through the foodweb)	?	?	?	*
Reduced biodiversity and/or changes in community structure				
Seabirds	**Beam trawl**	**Otter trawl**	**Seine nets**	**Fixed nets**
(By)catch of target and non-target species				***
Disturbance of the structure of the sea floor				
Increased turbidity of the water mass	?	?	?	
Reduction of food availability	?	?	?	?
Visual disturbance	*	*	*	*
Population effects (direct and through the foodweb)				
Reduced biodiversity and/or changes in community structure				*

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8 Closing remarks

This report was drafter prior to and as input to FIMPAS workshop 1, held on 22-24 Febbruary 2010. During the workshop, its content was discussed together with the completeness and quality of the data assessed in view of the assessment of the impact of the fisheries on the conservation objectives of the three marine Natura 2000 areas in the Dutch EEZ. The workshop concluded that the available information seems adequate for most impact drivers in relation to the Terms of Reference of FIMPAS.

Upon request from the workshop, the report has been updated with:

a more detailed description of the fishing geasr, including gear variation and new developments

combined VMS and logbook data from other EU coutries, especially from Denmark, Great Britain, Germany and Belguim

an extension of the brief overview of the literature on the impact of fisheries

expert judgement interaction matrices between the fisheries and conservation objectives, based on the one constructed tentatively at the end of the workshop

Especially the latter two items will have to be further detailed and extended during the preparation for FIMPAS workshop 2 – mainly because they were beyond the scope of this (data availability report).

Quality Assurance

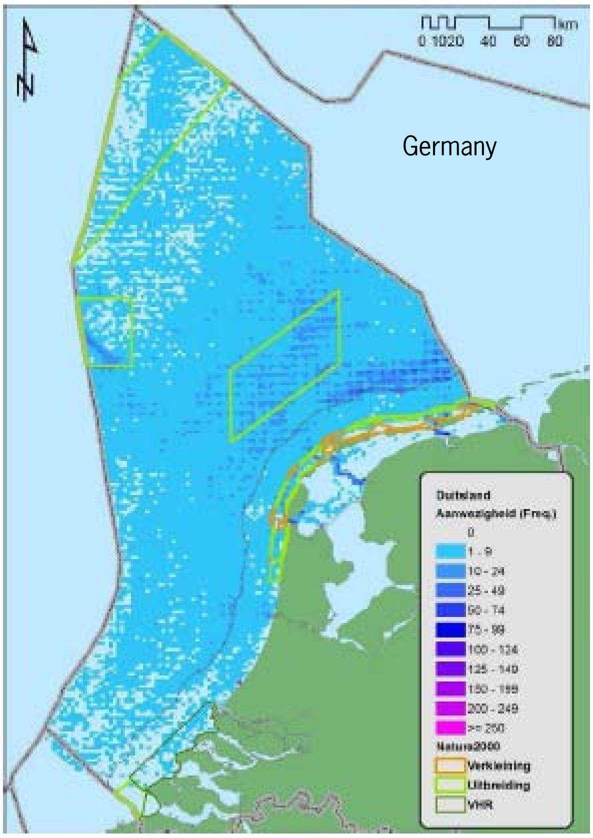
IMARES utilises an ISO 9001:2000 certified quality management system (certificate number: 08602-2004-AQ-ROT-RvA). This certificate is valid until 15 December 2009. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

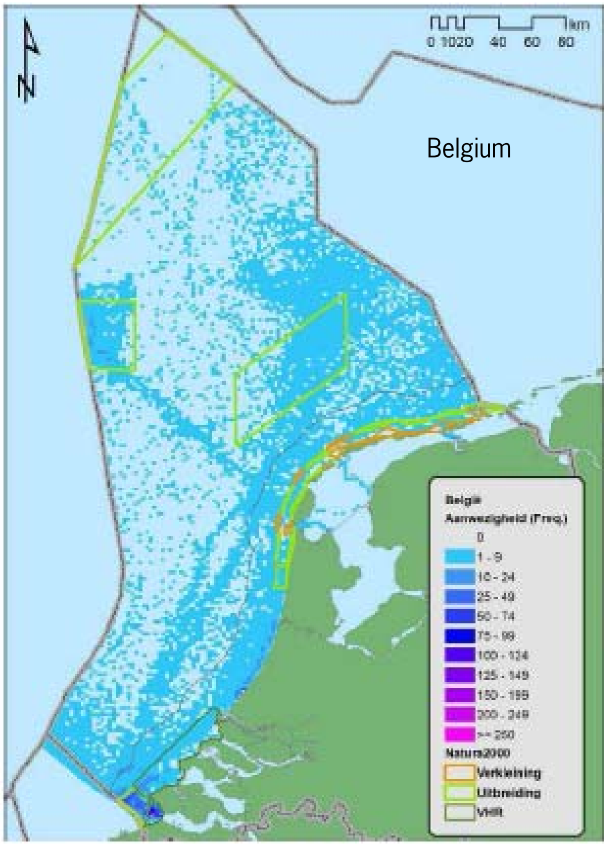
Appendix A. Distribution of foreign vessels

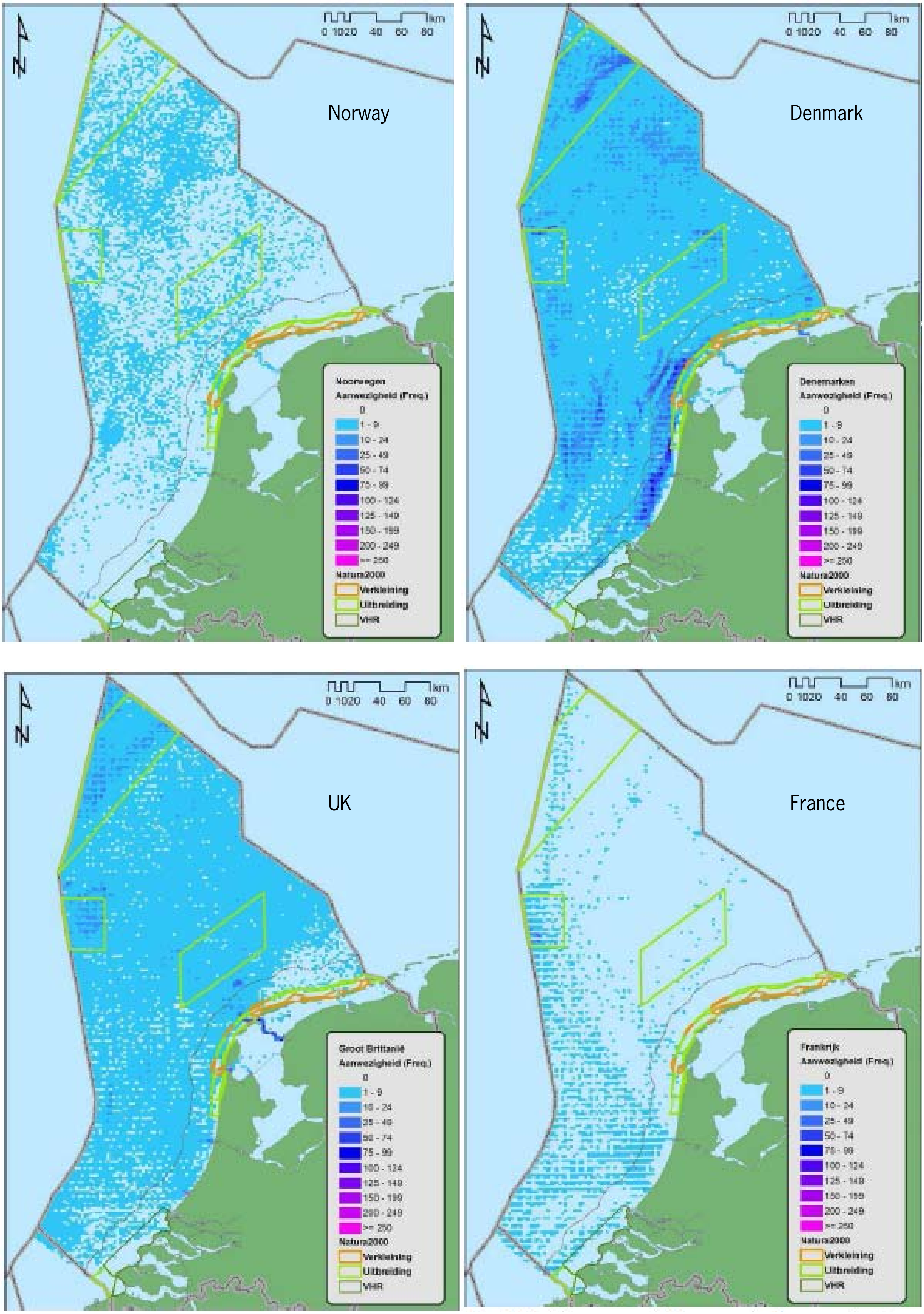
In the figures the distribution of the foreign vessels in on the Dutch EEZ for the years 2005-2007 is presented. The data are for the following countries:

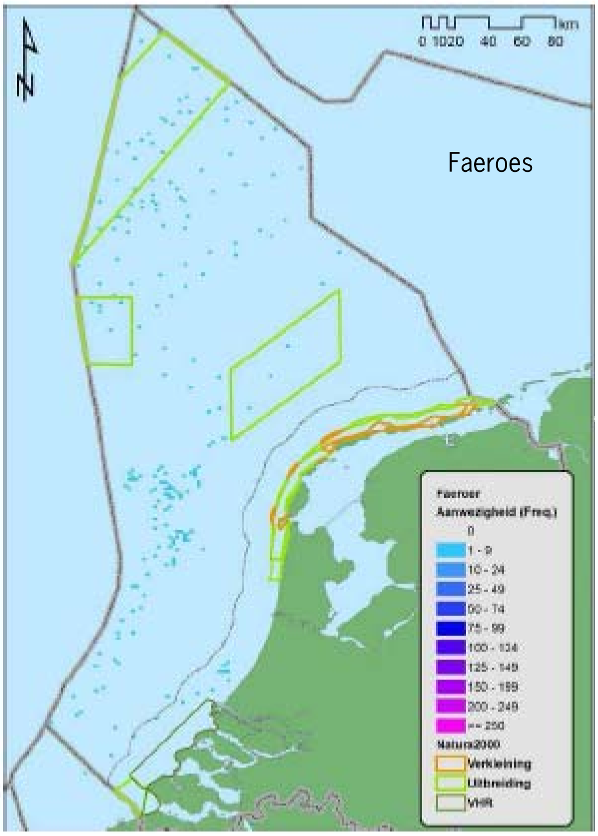
Germany	Belgium	Norway	Denmark	U.K.	France
Faeroe	Ireland	Lithuania	Poland	Sweden	Unknown

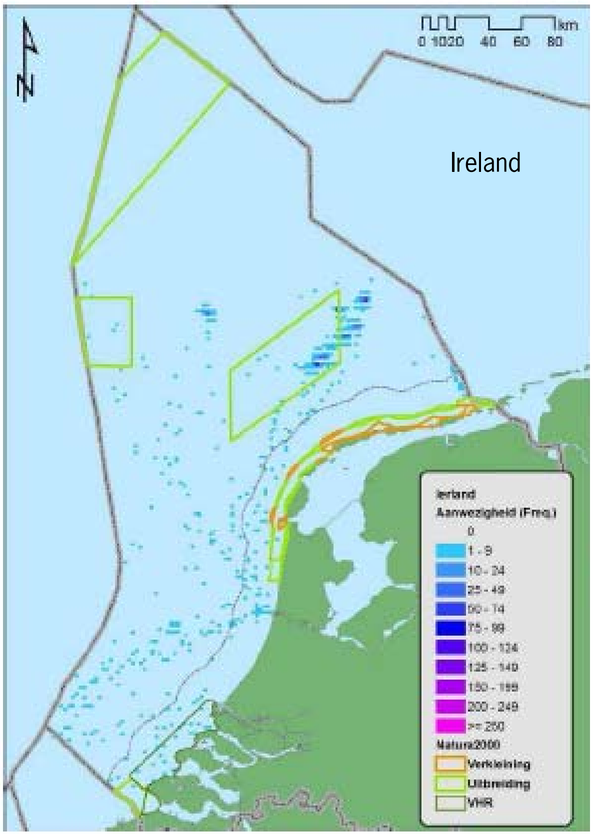
The data are the distribution of all VMS registrations, activity (e.g. fishing, floating, steaming) is not derived. Neither is there a separation on gear type, e.g. pelagic, demersal and static gears all presented the same. The points are presented as the total of points in a1 by 1 minutes (approx 1 sea mile) square averaged over the years.

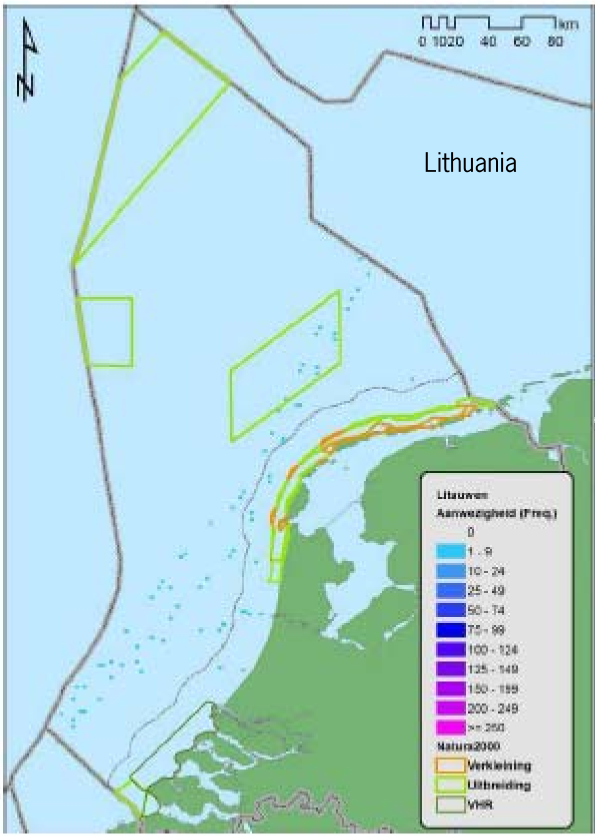


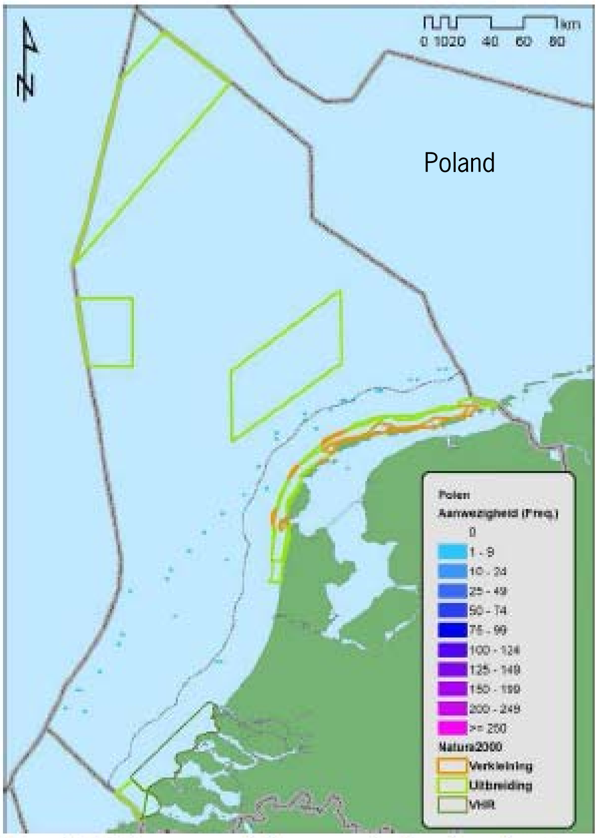


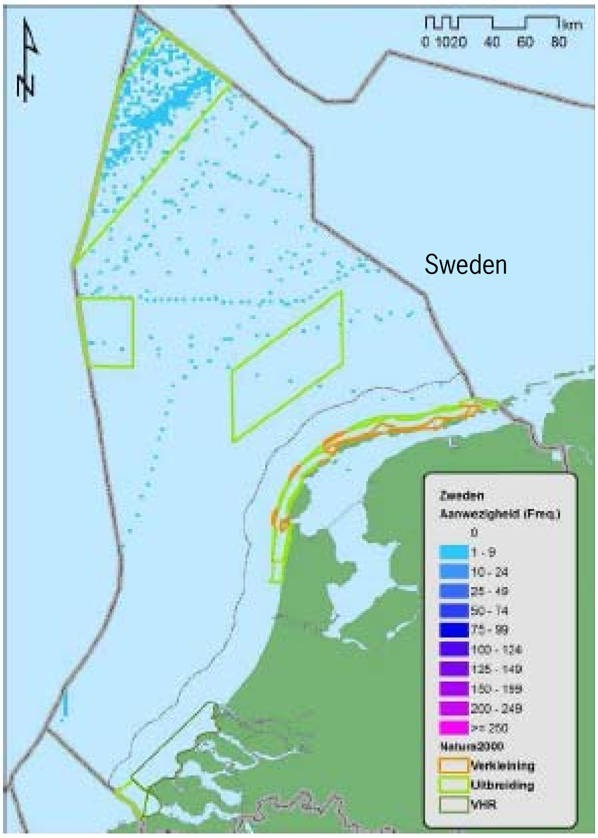

Norway
Noorwegen
Aanwezigheid (Freq.)
0
1 - 9
10 - 24
25 - 49
50 - 74
75 - 99
100 - 124
125 - 149
150 - 199
200 - 249
>= 250
Natura2000
Verkleining
Uitbreiding
VHR
Denmark
Denemarken
Aanwezigheid (Freq.)
UK
Groot Brittanië
Aanwezigheid (Freq.)
France
Frankrijk
Aanwezigheid (Freq.)
0 10 20 40 60 80 km

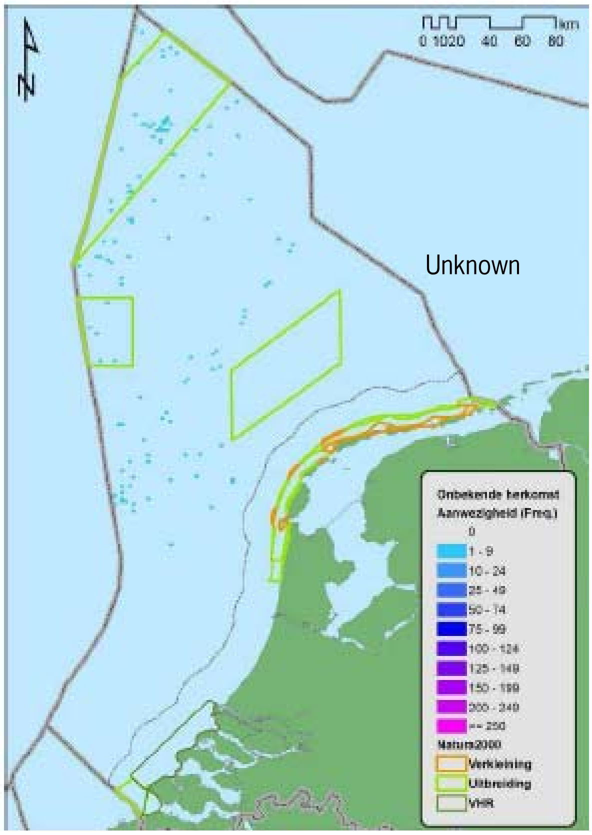

0 1020 40 60 80 km
Faeroes
Faeroer
Aanwezigheid (Freq.)
0
1 - 9
10 - 24
25 - 49
50 - 74
75 - 99
100 - 124
125 - 149
150 - 199
200 - 249
>= 250
Natura2000
Verkleining
Uitbreiding
VHR


0 1020 40 60 80 km
Ireland
Ierland
Aanwezigheid (Freq.)
0
1 - 9
10 - 24
25 - 49
50 - 74
75 - 99
100 - 124
125 - 149
150 - 199
200 - 249
>= 250
Natura2000
Verkleining
Uitbreiding
VHR

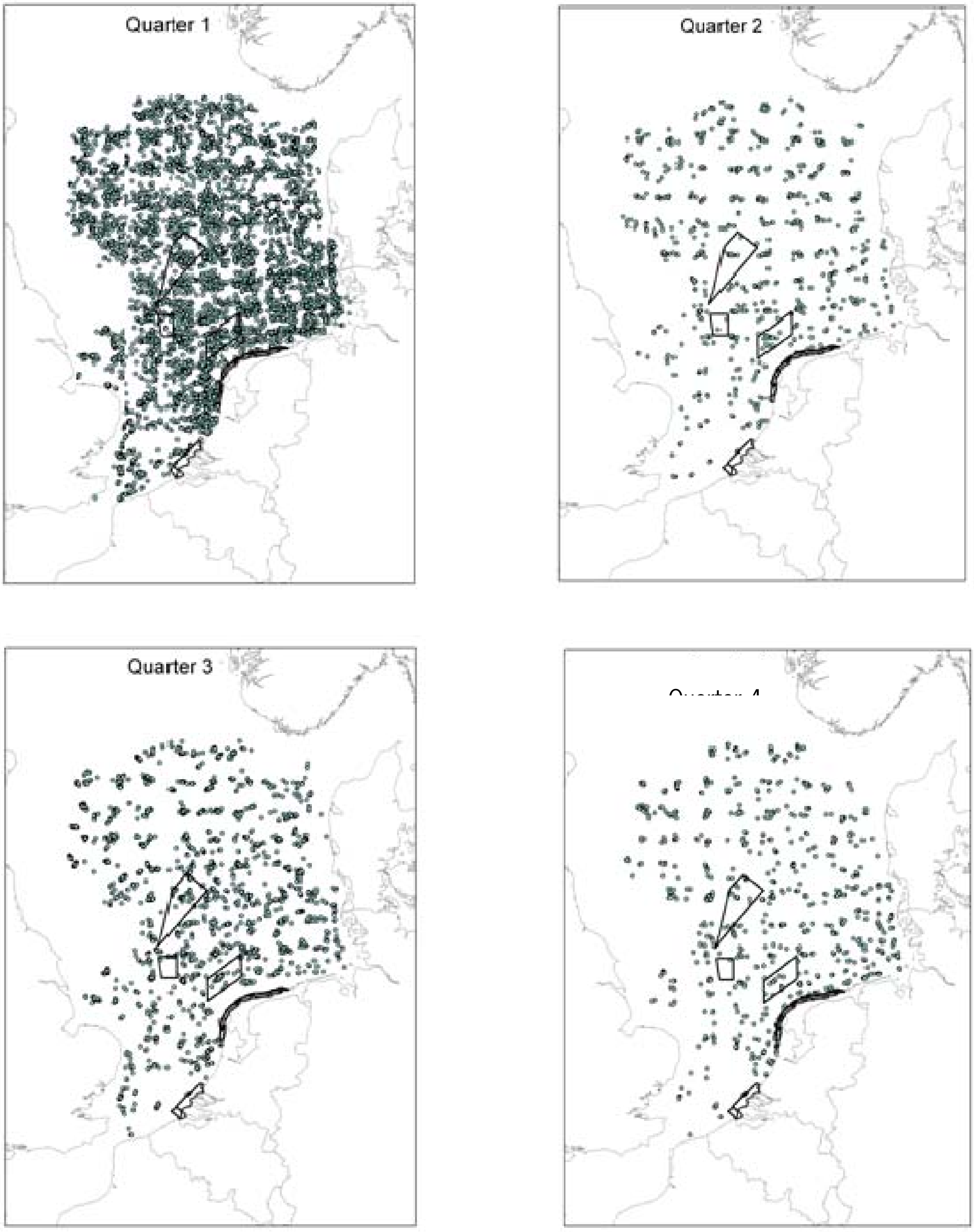

0 1020 40 60 80 km
Lithuania
Litauwen
Aanwezigheid (Freq.)
0
1 - 9
10 - 24
25 - 49
50 - 74
75 - 99
100 - 124
125 - 149
150 - 199
200 - 249
>= 250
Natura2000
Verkleining
Uitbreiding
VHR


0 1020 40 60 80 km
Poland
Polen
Aanwezigheid (Freq.)
0
1 - 9
10 - 24
25 - 49
50 - 74
75 - 99
100 - 124
125 - 149
150 - 199
200 - 249
>= 250
Natura2000
Verkleining
Uitbreiding
VHR


0 10 20 40 60 80 km
Sweden
Zweden
Aanwezigheid (Freq.)
0
1 - 9
10 - 24
25 - 49
50 - 74
75 - 99
100 - 124
125 - 149
150 - 199
200 - 249
>= 250
Natura2000
Verkleining
Uitbreiding
VHR


0 10 20 40 60 80 km
Unknown
Onbekende herkomst
Aanwezigheid (Freq.)
0
1 - 9
10 - 24
25 - 49
50 - 74
75 - 99
100 - 124
125 - 149
150 - 199
200 - 249
>= 250
Natura2000
Verkleining
Uitbreiding
VHR

Appendix B. Distribution of IBTS haul locations



Spatial distribution of the IBTS hauls by Quarter in IBTS areas 2,5,6,7 included are all the international hauls over all years that are available in the Datras database.

Justification

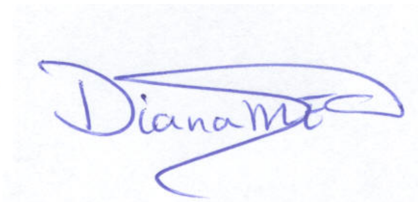
Rapport C052/10

Project Number: 4302501001

The scientific quality of this report has been peer reviewed by the a colleague scientist and the head of the department of IMARES.

Approved: Ruud H. Jongbloed and Diana M.E. Slijkerman

Researchers



Signatures:

Date: 7 July 2010

Approved: Jakob Asjes

Head of Department Fish

Signature:

Date: 7 July 2010