BACKGROUND DOCUMENT
JOINT RECOMMENDATION SEABED PROTECTION
FRISIAN FRONT AND CENTRAL OYSTER GROUNDS

The Hague, 16 April 2019

Submission to the European Commission

Netherlands Ministry of Infrastructure and Water Management
Netherlands Ministry of Agriculture, Nature and Food Quality

Contents

Summary

This document provides the background information to the Joint Recommendation for offshore fisheries management on the Frisian Front and the Central Oyster Grounds as provided for in art. 11 of Regulation 1380/2013 on the Common Fisheries Policy. The Joint Recommendation contains a request to the European Commission to regulate fisheries in parts of these areas to protect the seabed ecosystem habitat.

The Frisian Front and the Central Oyster Grounds mark the transition from the relatively shallow southern North Sea to the deeper northern parts. Consequently, water current velocity decreases and sedimentation takes place, resulting in a silt-rich seabed. Two main seawater currents meet, creating a front; this Frisian Front is nutrient-rich. Benthos is characterised by high biodiversity and biomass. Several rare and/or long-lived species are found in the area (chapter 4).

The Frisian Front qualifies for the Birds Directive (guillemot), but the seabed of Frisian Front and Central Oyster Grounds does not qualify for the Habitats Directive. However, the proposal in this document aims at special protection measures under article 13.4 of the Marine Strategy Framework Directive, contributing to good environmental status regarding descriptors D1, D3, D4 and D6 (chapter 5).

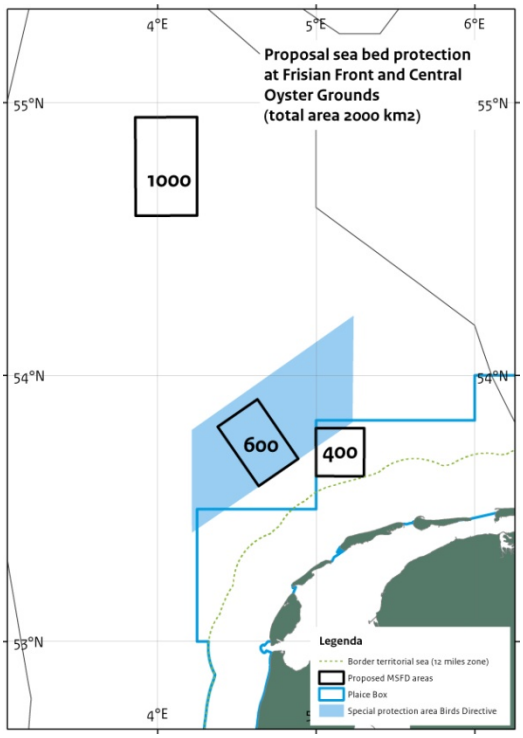
Since fishery with towed bottom contacting gear is considered to be the main human activity adversely affecting the seabed, measures aim at repulsing all mobile bottom contacting gears (beam trawl with tickler chains, otter trawl, pulse trawl, demersal seines) from designated areas within the Frisian Front and Central Oyster Grounds. The objective is the recovery of the seabed ecosystem from a disrupted state towards a natural condition.

Stakeholders have been consulted on the management areas designed. Preconditions: optimizing ecological value and at the same time minimizing the economic impact on the fisheries sector. To this end, proposed designs have been subject to a societal cost-benefit analysis.

Gear codes for the banned towed bottom contacting gear types, including pulse gears.

Gear groups that are banned in all closed zones	**Gear Code Annex XI in EU Regulation 404/2011**	**International Standard Classification of Fishing Gears (ISSCFG)**
Beam trawl	TBB	03.1.1
Bottom Otter Board Trawl	OTB, OTT, PTB, TBN, TBS, TB, BTM	03.1.2, 03.3.0, 03.1.3, 03.1.9
Dredges	DRB, HMD	04.1.0, 04.2.0, DRM, DRX
Demersal seines	SPR, SDN, SSC, SX, SV	SPR, SDN, SSC, SX, SV

The surface covered bij the proposed management areas totals 2000 km^2 (see below).


Proposal sea bed protection
at Frisian Front and Central
Oyster Grounds
(total area 2000 km2)
4°E
5°E
6°E
55°N
54°N
53°N
1000
600
400
Legenda
Border territorial sea (12 miles zone)
Proposed MSFD areas
Plaice Box
Special protection area Birds Directive

1. Introduction

1.1 Aim of the background document

This document provides the background information to the Joint Recommendation for offshore fisheries management on the Frisian Front and the Central Oyster Grounds as provided for in art. 11 of Regulation 1380/2013. The Joint Recommendation contains a request to the European Commission to regulate fisheries in parts of these areas to protect the seabed ecosystem habitat.

This document was submitted to the Scheveningen Group by the initiating Member State the Netherlands. Final approval of the Joint Recommendation was agreed by those Member States with a direct fisheries management interests in the "High Level Group" and submitted to the Commission by its Chair.

1.2 Background and problem setting

The proposed fisheries measures are part of the implementation of the Dutch Marine Strategy according to the European Marine Strategy Framework Directive. They contribute to the policy's aim to reverse the trend of degradation (due to damage to seabed habitat and biodiversity) to recovery by 2020. Article 13.4 of this Directive obliges Member States to include spatial protection measures contributing to coherent and representative networks of marine protected areas into their programmes of measures.

In Part 1 of the Dutch Marine Strategy (IenM, 2012, and actualisation 2018), the Frisian Front and Central Oyster Grounds were considered as search areas for seabed protection measures in addition to protection measures in designated Natura 2000 areas. Seabed protection measures in these areas contribute to the overall aim of the Dutch government for the Dutch part of the North Sea to protect 10-15% of the Dutch Continental Shelf against considerable disturbance by human activities, with a minimal impact for the fishermen.
In Part 3 of the Dutch Marine Strategy (Programme of measures; IenM, 2015), the principles for developing measures at Frisian Front and Central Oyster Grounds have been defined (see paragraph 5.1).

Frisian Front and Central Oyster Grounds are located outside the 12NM zone. Taking fisheries measures is the exclusive competence of the European Commission according to Article 46 of the Regulation 1380/2013 on the Common Fisheries Policy.

In drafting this Joint recommendation background document, the 2018 guidance published by the European Commission Services called *COMMISSION STAFF WORKING DOCUMENT on the establishment of conservation measures under the Common Fisheries Policy for Natura 2000 sites and for Marine Strategy Framework Directive purposes*[1] has been consulted. This document provides guidance on how Member States should prepare and submit a proposal for fisheries measures in the CFP framework for meeting Natura 2000 and MSFD conservation objectives.

[1] See http://ec.europa.eu/environment/nature/natura2000/marine/index_en.htm

1.3 General principles

The process was based on the following principles in accordance with article 11 of Regulation 1380/2013:

- *Sound scientific basis*

The process is centred around a scientific approach and the best scientific information available.

- *Stakeholder involvement*

Key stakeholders are involved in the process. From the start of the process, fishing industry and nature conservation organisations were invited to participate in an open and transparent manner on a national as well as European level (through the North Sea Advisory Council).

- *Transparency*

The process is transparent on the data being used, on the steps being taken and on the used methodology.

- *Proportionality*

The proposal delivers a key contribution to the achievement of the conservation objectives while minimizing the economic impact on the fishing industry.

- *Non-discrimination*

The proposal will need to ensure that measures are applied in a non-discriminatory manner. Presenting a proposal to the European Commission for regulation in the framework of the CFP will ensure a level playing field for the fishing sector.

2. Legal Framework

2.1 Common Fisheries Policy (CFP)

The European Common Fisheries Policy (CFP) is a key policy framework for the current proposal. Any regulation of fisheries in European marine waters must follow the principles, rules and procedures of the CFP. The basic rules are laid down in Regulation 1380/2013.

Recital 11 of the CFP states that 'The CFP should contribute to the protection of the marine environment, to the sustainable management of all commercially exploited species, and in particular to the achievement of good environmental status by 2020, as set out in Article 1(1) of Directive 2008/56/EC of the European Parliament and of the Council'.

The procedure to obtain appropriate fisheries measures is explained in article 11 of Regulation 1380/2013. In this article it is stated that 'where a Member State considers that conservation measures need to be adopted and other Member States have a direct management interest in the fisheries to be affected by such measures, the Commission shall be empowered to adopt such measures, upon request, by means of delegated acts'. To this end, the initiating Member State and the other Member States having a direct management interest submit a joint recommendation to the Commission.

2.2 Marine Strategy Framework Directive

The EU Marine Strategy Framework Directive requires Member States (article 1 and 5) to draw up a strategy for their marine waters to achieve a good environmental status (GES) by 2020 and to take

the necessary measures to actually achieve or maintain that good status. The directive covers the full environmental and ecosystem policy and the sustainable use. It comprises the themes (descriptors) of biodiversity (D1), non-indigenous species (D2), sea-floor integrity (D6), hydrography (D7), contaminants (D8, D9) and eutrophication (D5), litter (D10) and introduction of energy (D11, including underwater noise). The starting points are the ecosystem approach and the precautionary principle. Article 13 of the MSFD requires Member States to draw up a programme of measures by 2015, aimed at achieving or maintaining a GES. Article 13.4 states that programmes of measures shall include spatial protection measures, contributing to coherent and representative networks of marine protected areas. These are areas that fall under the Birds and Habitats Directive, but other areas can also contribute to the desired diversity of the constituent ecosystems.

2.3 Habitats Directive

The seabeds of Frisian Front and Central Oystergrounds do not qualify for the Habitats Directive. The Habitats Directive was adopted in 1992 and is aimed at conserving
(the natural habitats of) European wild flora and fauna. The main objective of the Habitats Directive is to bring habitats and species listed in Annex I and II of this directive into “favourable conservation status”. The offshore circalittoral mixed sediment of Frisian Front and the offshore circalittoral sand and offshore circalittoral mixed sediment of Central Oyster Grounds are not listed in Annex I and II of the Habitats Directive.

2.4 Birds Directive

Although this background document is on the protection of the seabed of the Frisian Front and the Central Oyster Grounds, the Frisian Front also qualifies for the Birds Directive. The Birds Directive was adopted in 2009. It relates to the conservation of all species of naturally occurring birds in the wild state in the European territory of the Member States. It covers the protection, management and control of birds and lays down rules for their exploitation. In order to do so, Member States shall classify special protection areas (SPAs) for the conservation of these species. The special protection areas are also part of the Natura 2000 Network. On 27 May 27 2016, the Minister of Economic Affairs designated the Frisian Front as an offshore special protection area. Management measures for the Frisian Front are in preparation and clarified in the background document with respect to the joint recommendation on the Birds Directive special protection area of the Frisian Front.

2.5 Application to seabed protection on Frisian Front and Central Oyster Grounds

The Frisian Front and Central Oyster Grounds do not qualify for the Habitats Directive, because their habitats are not included in the list of natural habitat types in Annex I of the Directive. Due to a unique combination of ecosystem elements it was decided in the Dutch Marine Strategy to offer additional protection to the seabed ecosystem in the areas of the Frisian Front and Central Oyster Grounds on the basis of article 13.4 of the MSFD. The proposed conservation measure areas are an addition to Natura 2000 areas on the Dutch part of the North Sea in order to contribute to a coherent and representative network of marine protected areas. For a complete overview of the protected areas in the Dutch part of the North Sea, see Annex I.

The MSFD is implemented in art. 4.6 and 4.16 of the Water Decree under the Dutch Water Act. Nature 2000 areas and MFSD area protection are part of the Dutch Policy Document on the North Sea 2016-2021 (2015) and Marine Strategy for the Dutch part of the North Sea 2012-2020, Part 3 Programme of Measures MSFD (2015). These documents are part of the Dutch Water Plan under article 4.1 paragraph 3b of the Dutch Water Act.

The Commison is empowered to adopt fisheries measures in order to protect the seabed. Fisheries measures are the exclusive competence of the European Commission on the basis of article 11 of Regulation 1380/2013 (Common Fisheries Policy). Fisheries measures are implemented in Dutch fishing legislation (*Uitvoeringsregeling zeevisserij*).

3. Process

3.1 National stakeholder process

In 2012, the Netherlands published the Marine Strategy for the Dutch part of the North Sea, part 1. Stakeholders were involved in the preparation process. In this document, the Central Oyster Grounds and Frisian Front were assigned as search areas for benthic protecting measures, in addition to the N2000 sites in the Dutch part of the North Sea.

From mid-2013 onwards, a stakeholder process was established with respect to preparing seabed protecting measures on Frisian Front and Central Oyster Grounds. Stakeholders most affected by the upcoming measures were included in this process, namely the fisheries organisations VisNed and the Nederlandse Vissersbond (NVB) and the NGOs the North Sea Foundation (Stichting De Noordzee) and WWF. In October 2014, Greenpeace also joined the table. The Dutch Ministry of Infrastructure and Water Management[2] coordinated this process due to its responsibility for the implementation of the MSFD. All work was carried out in close cooperation with the Ministry of Economic Affairs which at the time included the Fisheries and Nature Departments[3]. Several meetings with directors and board members of the different organisations were held from June 2014 until 2016.

In 2014, the main principles for the process were established with the stakeholders. These were, amongst others, maximum ecological gain, minimal costs for the fisheries, and robust larger areas instead of several smaller areas.There was also agreement from the start that the group of stakeholders would strive for consensus. However, if no consensus could be reached, the government would decide on the final outcome. This procedural agreement at the start of the process proved crucial for both the process as well as the outcome.

There were several knowledge gaps identified by the stakeholders and project group, and these were discussed in different workshops. The first knowledge workshop was held in September 2014, another one was held in March 2015, followed April 2015 by a design workshop (mapping tables), where fisheries organisation and NGOs attempted to design variants for closures. After this process, six variants were established, of which two were brought up by the fisheries sector, one

[2] Up to the end of October 2017: Ministry of Infrastructure and the Environment

[3] From end of October 2017 on: Ministry of Agriculture, Nature and Food Quality.

by the NGOs (namely the entire Central Oyster Grounds and Frisian Front areas) and three by the government.
A societal cost-benefit analysis (SCBA) was performed on all of those six variants, combining all the ecological and economic information available to get a sense of the ecological and economic values of the variants. All parties were involved in the drafting of the SCBA, by different workshops and possibilities for input along the process. The SCBA was finalised in December 2015 by LEI (Wageningen University). On the basis of this document and the Marine Strategy goals in mind, the government decided to strive towards a medium-size protection area of 2400 km^2. The arrangement of the protected areas can vary within the selected goal and therefore the Minister of Infrastructure and the Environment and the Minister of Economic Affairs proposed two alternative variants to Parliament (letter to the Dutch House of Representatives, 2015-2016 session, 33450, no. 49) and a definite variant (letter to the Dutch House of Representatives, 2016-2017 session, 33450, no. 50). The stakeholders were formally consulted regarding this choice. All variants were analysed with respect to their economical costs for fishing industries (Oostenbrugge, 2016a and 2016b).

In February 2017, the Dutch Parliament adopted a motion that adapted the proposal of the Minister of Infrastructure and the Environment and the Minister of Economic Affairs to a total area to be protected of 2000 km^2. The adapted proposal is presented in this background document.

3.2 Regional (stakeholder) process

Under the auspices of the High Level Scheveningen Group, a Technical FISH-ENVI Working Group has been established. This group has adopted the terms of reference for the procedure of submission of a joint recommendation to the Scheveningen Group. The procedure for the adoption of this Joint Recommendation follows the terms of reference for the High Level Scheveningen Group.

In July 2015, the North Sea Advisory Council (NSAC) was informally informed about the preparation process on proposals to protect the seabed of Frisian Front and Central Oyster Grounds and the analysis of costs and benefits of seabed protection in these areas.
From November 2015 to January 2016 UK, Germany, Denmark and Belgium have been informed on a regular basis on the development of the background document.

On 17 January 2017, the Ad hoc Scheveningen Group meeting in London was informed on the Dutch government's proposal to protect 2400 km^2 of the seabed of Frisian Front and Central Oyster Grounds with a reservation that the definite layout of the management zones might be subject to discussion in Parliament. This meeting was also attended by representatives from the NSAC.

On 23 February 2017, the NSAC meeting in Edinburgh was informed on the same proposal with the same reservation. On the same date, the Dutch Parliament adopted a motion to adapt the Dutch government's proposal.

The definite Dutch proposal to protect 2000 km^2 of the seabed of Frisian Front and Central Oyster Grounds was presented at the Ad hoc Scheveningen Group meeting in The Hague on 20 June 2017, also attended by NSAC representatives. A second meeting was held in The Hague on 26 September 2017.

A new version of the Joint recommendation, as well as a document which listed all comments received and how they were incorporated, was sent on 20 September 2017 and discussed at the Ad hoc informal Scheveningen Group meeting in The Hague on September 26, 2017, also attended by an NGO representative of the NSAC.

One last round of comments was collected and resulted in the conclusion early 2018 by the neighbouring countries that 'sufficient information' had been provided.

The Joint Recommendation and background document were agreed to by the High Level Scheveningen Group in its meeting on 27 February 2019.

The total body of information gathered in all of the processes described above has been incorporated in the current proposal to the European Commission.

3.3 Research and analysis

Part of the stakeholder process was the identification of knowledge gaps and the development of sound scientific information in order to provide for a solid base to decision making. The scientific institutes IMARES, NIOZ and LEI were asked to write reports on the knowledge gaps. Reports that have been used are[4]:

- biodiversity hot spots on the Dutch Continental Shelf, by Wageningen Marine Research (formerly: IMARES; Bos et al, 2012). In this report, Frisian Front and Central Oyster Grounds were identified as important and vulnerable benthic habitats;
- overview of available knowledge and data on Frisian Front and Central Oyster Grounds at the start of the process (Slijkerman et al, 2013; in Dutch);
- preliminary zoning measures with Marxan (Slijkerman et al, 2014; in Dutch);
- trends and developments in the fisheries sector (Kuhlman et al, 2014; in Dutch);
- expert workshop on the possible developments on Frisian Front and Central Oyster Grounds in case of absence of seabed disturbing fisheries (Jongbloed et al, 2013);
- comment on the issue how to interpret ecological information reported by fishermen (Kraan, 2015);
- the possible impact of flyshoot fisheries on Frisian Front and Central Oyster Grounds (Rijnsdorp, 2015a);
- the ecological importance of the Frisian Front (Lindeboom et al, 2015);

[4] All reports in this paragraph can be found on https://www.noordzeeloket.nl/Beleid/europese-kaderrichtlijn-mariene-strategie/stand_van_zaken/nationaal/econom_analyses_2010/Rapporten_Bodembescherming_Friese_Front_en_Centrale_Oestergronden.aspx

- analysis of environmental conditions and trawling on species richness and benthic ecosystem structure in the Frisian Front and Central Oyster Grounds (Van Kooten et al, 2015);
- literature review of fisheries displacement effects of closed areas (Slijkerman et al, 2015);
- case study of fisheries displacement effects in the Voordelta (De Vries; 2015);
- cost benefit analysis of the effects of seabed protection on the Frisian Front and Central Oyster Grounds (Van Oostenbrugge, 2015). This study integrates a lot of knowledge generated in the above mentioned reports and advises;
- addenda to the cost benefit analysis on the costs to fisheries as a consequence of proposed measures on seabed protection by government (Van Oostenbrugge, 2016a and 2016b);
- information on international fisheries activities at the areas to be protected (Buisman, 2017; Van Oostenbrugge, 2017).

4. Description of the Frisian Front and Central Oyster Grounds

4.1 General characteristics and ecological significance

The Frisian Front and the Central Oyster Grounds are naturally low dynamic areas with fine sediment (Rijnsdorp, 2015a and 2015b). They mark the transition from sandy seabed into the deeper, silt-rich part of the Dutch continental shelf (DCS), going from south to north. The area, especially the depth gradient at the Frisian Front, accommodates a variety of seabed habitats, resulting in a high benthos biodiversity (see figure 1).

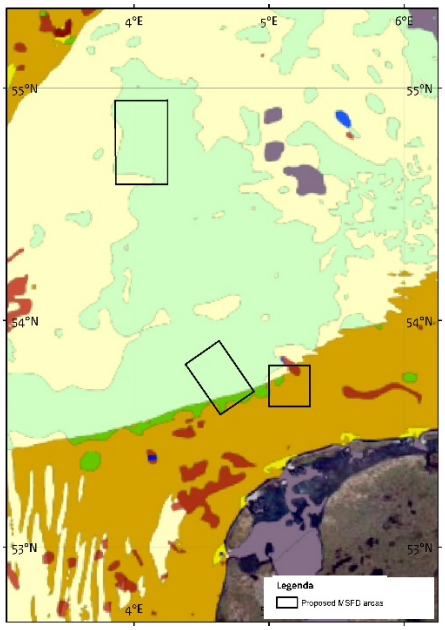


Figure 1 Habitat distribution at Frisian Front and Central Oyster Grounds. The proposed protected areas have been indicated. (Source: EMODnet). Light yellow: circalittoral fine sand (Class A5.25 op Emodnet); light green:circalittoral mixed sediments (A5.44); dark green: circalittoral sandy mud (A.5.35); light brown: infralittoral sandy mud (A5.33); dark brown: circalittoral coarse sediment (A5.14).

Together with the Central Oyster Grounds, the Frisian Front megabenthos shows the highest biodiversity values on the DCS (see figure 2).

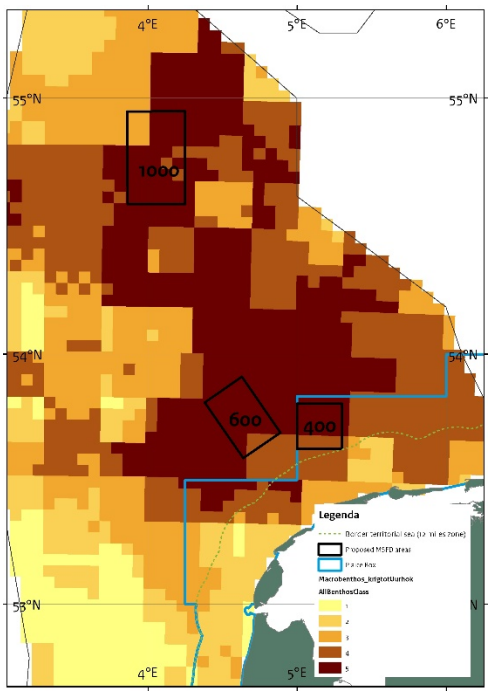


Figure 2 Total macro and megabenthos at Frisian Front and Central Oyster Grounds. The proposed protected areas have been indicated (Source: Bos, 2011).

The sea floor and the related benthos communities (for some examples see figure 3) are an essential link in the marine ecosystem and food webs. Species that live in the sea floor are important for the exchange of nutrients and oxygen. Species living in and on the sea floor form bottom structures. Burrowing animals locally rummage the soil (bioturbation). Natural sediment deposition processes and bioturbation determine structure and solidity of the bottom.
For example: parchment worms create fibrous channels protruding a couple of centimeters above the bottom. The channels dug by the burrowing mud shrimp result in deposition of manganese and iron, reinforcing the channels and thus stabilizing the open sea floor structure (Jongbloed, 2013).

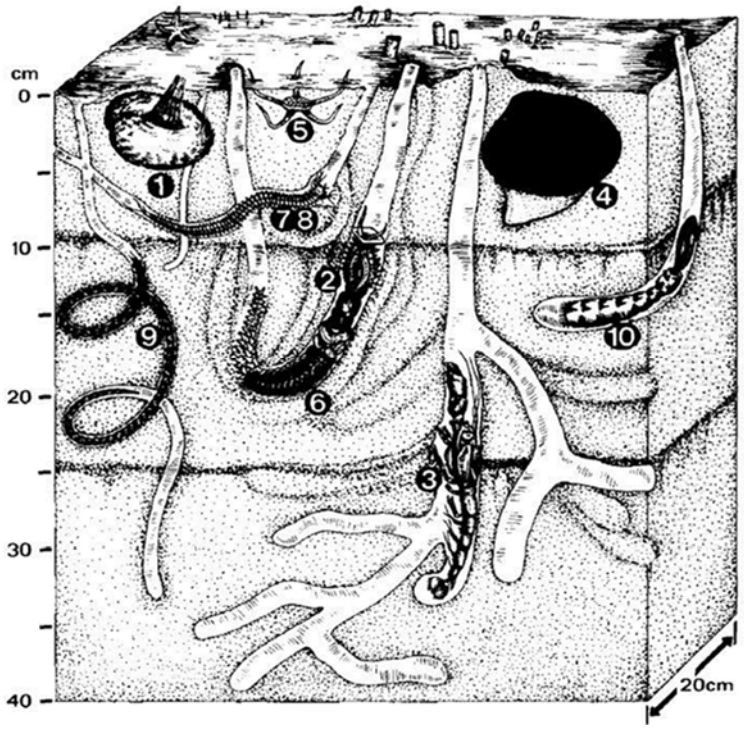


Figure 3 Artist impression of a cross section of the seabed and habitat species on Frisian Front and Central Oyster Grounds (Source: IenM, 2012, taken from De Wilde et al., 1984)). 1. Sea potato – *Echinocardium cordatum*; 2. Parchment worm – *Chaetopteris variopedatus*; 3. Burrowing mud shrimp – *Callianassa subterrana*; 4. Ocean quahog – *Arctica islandica*; 5. Brittle star – *Amphiura filiformis*; 6. Scale-worm - *Gattyana cirrosa*; 7. *Glycera unicornis*; 8. Ragworm spp. – *Nereis spp.*; 9. *Notomastus latericeus*; 10. Spoon worm - *Echiurus echiurus*

4.2 Frisian Front

The Frisian Front[5] is situated above the West Frisian Islands, 75 km from the city of Den Helder. It is a transition area between the shallow sandy grounds of the southern North Sea and the deeper muddy seabed of the Central Oyster Grounds. Over a relatively short distance, the sea floor drops 10 to 15 m, from approximately 25 until 40 m below sea level.

The following physical phenomena concur in the Frisian Front area:

- Two main seawater currents, one from the British coast and the second, nutrient-rich flow from the Channel and the southern North Sea, meet and mix, forming a hydrographic front.
- Increasing sea water depth causes a decreasing water flow rate, thereby causing silt and organic material to settle on the sea floor. In fact, the flow rates are the lowest on the Dutch Continental Shelf (DCS).
- Transport of nutrient-rich bottom water to the surface induces a high primary production (algae growth). Benthic fauna profits from dead algae sinking to the bottom.

These phenomena result in a large variety of sediment types, each with a specific fauna, parallel to the depth contour lines. The sediments range from sand in the south, via the hydrographic front to the silt-rich northern part. In the core area of the Frisian Front (100 x 15 km), the bottom consists of 15-20% silt.

[5] The content of this paragraph is taken from Lindeboom, 2015, unless otherwise mentioned.

Due to the concurrence of the physical phenomena, the Frisian Front is unique in the North Sea. Even globally there are only a couple of sites that are slightly similar: close to Newfoundland and in the Sea of Japan.
The wide variety of sediment types each with their specific fauna on a relatively limited surface with a steep gradient in environmental circumstances make the area special, even on a global scale. The area is characterized by high biodiversity and biomass and a high production of seabed fauna. The relatively short distance between the different fauna communities allows interaction between them. The front with its gradients forms a palette of valuable circumstances in which many species can find their potential niche.

On the Frisian Front, there are many large growing macrobenthic species. Together with the Central Oyster Grounds, the Frisian Front megabenthos shows the highest biodiversity values on the DCS. Also, richness of megabenthic species is high and the area contains high densities and biomasses of megabenthos, and many rare megabenthic species (Bos, 2011), such as the ocean quahog (*Arctica islandica*). The area contains relatively rare habitat types.

Due to the high primary production and production of plankton caused by the hydrographic front, the area attracts fish and birds. Appearance of sprat (*Sprattus sprattus)* and herring (*Clupea harengus)* attracts guillemots (*Uria aalge*), mainly in August-September.
In this respect, the Frisian Front has been assigned as a Natura 2000 SPA to protect the guillemot. Moreover, the Frisian Front meets three of the seven scientific criteria for a special ecological area as mentioned in the Convention on Biological Diversity (CBD): it is unique and has a high biological production as well as diversity.

4.3 Central Oyster Grounds

Going north from the Frisian Front, one enters the relatively low-dynamic sedimentation area of the Central Oyster Grounds and stratification in summer (Jongbloed, 2014). Water depth is 40-50m. The deep water habitats of offshore circalittoral sand and offshore circalittoral mixed sediment are not protected under the Habitats Directive.

The name originates from the fact that in the past a large part consisted of oyster banks, for example shown on a map by Olsen (1883). It is highly probable that these oyster banks with the attached fauna formed a habitat type of its own (Lindeboom, 2008). Between 1880 and 1926, the oyster banks have disappeared, probably due to fisheries, climate change and illnesses.
Between May and October, the phenomenon of stratification occurs: a layer of warm sea water (up to 20°C) floats on a colder one (12°C) without mixing. Only in autumn, strong winds cause the layers to mix again.

The most biodiverse element of this area is the benthos. The microbenthic community in the northern part of the DCS, north of the Frisian front, is characterized by a high species richness with a relatively high number of rare species (low frequency of occurrence), a relatively high number of old growing (>10 years) and larger growing species (>1 g AFDW, ash-free dry weight). Together with the Frisian Front, the megabenthos shows the highest biodiversity values on the DCS.

North of the -30 m bathymetric contour, the ocean quahog (*Arctica islandica*) is found on the Frisian Front and Central Oyster Grounds. Density is low: about 0,1 specimen per m^2. The oldest specimen of the long-lived quahog ever found in the Northsea was 167 years old (Lindeboom, 2008).

5. Rationale for conservation measures

5.1 Recovery objective

There is no seabed protection of Frisian Front and Central Oyster Grounds under the Habitats Directive. On the DCS, only two natural habitat types of community interest whose conservation requires the designation of special areas of conservation (Annex 1 of the Habitats Directive) can be found. These are H1110 Sandbanks which are slightly covered by sea water all the time and H1170 Reefs (of open sea). Thus, the ecologically valuable silty seabeds of the Frisian Front and Central Oyster Grounds do not qualify for protection under the Habitats Directive. As mentioned in paragraph 4.3, the Frisian Front has been designated as a Natura 2000 area under the Birds Directive.

However, article 13.4 of the MSFD stipulates that programmes of measures shall include spatial protection measures, contributing to coherent and representative networks of marine protected areas, adequately covering the diversity of the constituent ecosystems. These measures contribute to attain a good environmental status (GES; see paragraph 2.2) according to:

- descriptor 1: 'Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions'.
- descriptor 6: 'Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.'

In order to determine the potential for such spatial measures, a study has been carried out to analyse and present hotspots of biodiversity for several taxonomical groups and habitats on the Dutch Continental Shelf, based on the spatial application of the GES descriptor 1 (Biodiversity) (Bos, 2011). In this study, data series and literature on benthos (macrobenthos and megabenthos), fish, seabirds, marine mammals and habitats have been assessed, thus providing biodiversity information on the three different levels (species, habitat and ecosystem) described in the 2010 Commission Decision on the criteria and methodological standards for GES descriptor 1. All in all, a set of 13 metrics of biodiversity covering the width of the Commission Decision criteria has been defined[6] and maps per biodiversity metric and per taxonomical group have been constructed.

[6] Distribution, density, biomass, resilience, dependence on the marine environment, breeding in the Netherlands, importance of the Dutch Continental Shelf for the species, trends, rarity, large specimens within populations, (potentially) large species, species richness, species evenness.

Conclusions from the maps:

- spatial patterns of benthic biodiversity were more consistent than for other taxonomic groups. Notably the Frisian Front and the Central Oyster Grounds score high for different biodiversity metrics;
- for fish and marine mammals, spatial biodiversity patterns are less clear;
- for birds, the coastal area and the Frisian Front stand out. It is not a coincidence that these areas have already been designated under the Birds Directive.
- a map of frequency of occurrence of different habitat types shows the level of rarity[7] of the various habitats in the Dutch North Sea. Unique habitats on the DCS, e.g. Cleaver Bank, have already been designated under the Habitats Directive. As stipulated before, this is not the case for the Frisian Front and the Central Oyster Grounds.

Area	Macrobenthos	Megabenthos	Habitat
Frisian Front	Many big growing species High species richness	High density High biomass Many rare species High species richness	Rare habitat
Central Oyster Grounds	Many old growing species Many big growing species High species richness	High density Many rare species High species richness	Rare Habitat

Based on the findings above regarding descriptor 1 (biodiversity) in 2012, the Frisian Front and Central Oyster Grounds have been considered as search areas for spatial measures aiming at the protection of benthos in addition to seabed protection in Natura 2000 areas on the Dutch part of the North Sea. The conservation objective for Frisian Front and Central Oyster Grounds is the recovery of substantial parts of the seabed ecosystem from a disrupted state towards a natural condition.

5.2 Human activities on Frisian Front and Central Oyster Gounds

This paragraph provides an overview of predominant human activities on the Frisian Front and Central Oyster Grounds. Information on the Frisian Front is based on Van der Burg (2012). Information on the Central Oyster Grounds is taken from databases of Rijkswaterstaat, the managing agency of the Dutch North Sea.

[7] Rarity is expressed as the relative abundance of a species or habitat compared to the other species or habitats (Bos et al., 2011).

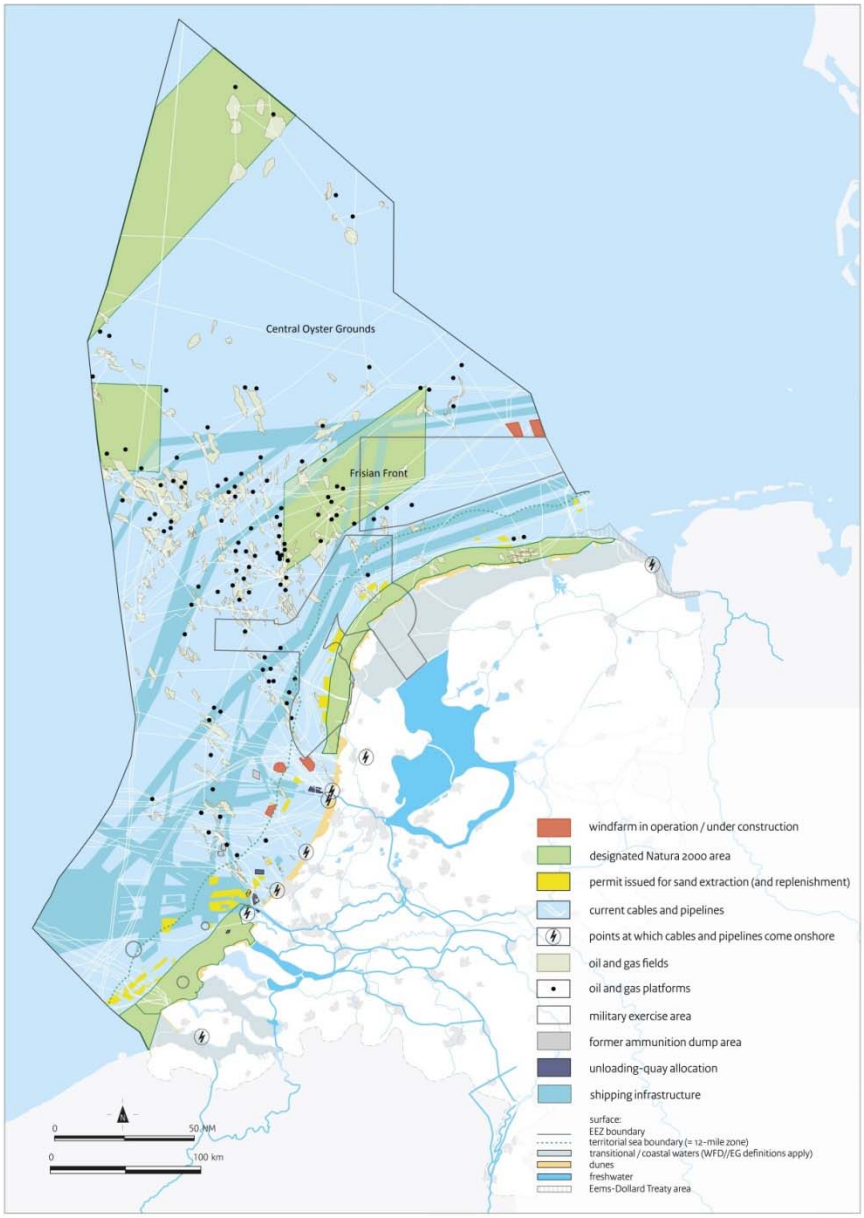


Figure 4 Human activities on Dutch part of the North Sea: shipping lanes, cables and pipelines, oil and gas platforms, sand and shell extraction and military use as well as designated Natura 2000 areas (Ministry of Infrastructure and the Environment, 2015).

1. Shipping

Several deep water shipping routes cut through the Frisian Front. When comparing these routes with the shipping routes south of the area, the routes transecting the Frisian Front are not used very intensively. The density of all ships using these routes is about 3 to 9 ships per 1000 km^2. In addition, shipping not bound to these routes occurs on both the Frisian Front and the Central Oyster Grounds, mainly recreational and fishing vessels. Disregarding eventual polluting incidents, shipping has no effect on the sea floor. In the past, the use of TBT (tributyltin) as biocide in anti-fouling paint on ship hulls had serious negative effects on marine organisms, including benthos (e.g. imposex in dog whelk populations). From the 1980s, regulations developed towards a complete ban of TBT. However, TBT may remain present in the ecosystem for 30 years or so, but is not linked to present shipping.

2. Cables and pipelines

On the DCS, cables stretch over about 4000 km (including 2100 km no longer in use). The length of pipelines is an estimated 2500 km.

In the Frisian Front area, several telecom cables are found, but only one is still in use. Three long distance gas pipelines cut through the area.

Plans exist for the construction of a new telecom cable between England and Denmark probably partly through the Central Oyster Grounds.

Construction, inspection and maintenance of cables and pipelines obviously affect the sea floor, but the scale is very limited in terms of surface and duration.

3. Oil and gas extraction

Within the boundaries of the Frisian Front, about twenty production installations are situated and another twenty in the direct vicinity (< 10 km, mainly SW of the area).

Above sea level, the lighting on oil and gas installations during nighttime may disturb birds within a radius of 5 km. Optical disturbance by the silhouette of the installations may occur to a lesser extent. For the Frisian Front (BD area), the effects have been investigated. Conclusion: no significant negative effects on the conservation objectives occur, mainly because the impacted surface is very limited (Tamis, 2011).

Regarding the impact on the sea floor and benthos: again the surface impacted by piles and drilling is very limited, in fact even much smaller than in the case of light disturbance mentioned above. Moreover, once an installation has been constructed the piles provide substrate for various organisms. In addition all shipping is prohibited within a distance of 500m from the installation, thus providing an area in which bottom disturbance is absent during the lifetime of the installation (Lindeboom et al, 2008).

4. Oil pollution

Van der Burg (2012) observed a decline in the number of incidents per year in the Frisian Front over the period 1992-2010, which is consistent with the global downward trend. Also, a strong decline of the volume of oil pollution in oil-related incidents was recorded.

5. Fisheries

Beam trawling on the DCS is intensive. Target species are plaice and sole. In addition, trawling for pelagic species such as herring and mackerel occurs. The Frisian Front is within reach of smaller fishing vessels.

The principle bottom contacting fisheries on the DCS are (figure 5):

- Beam trawl with tickler chains. The chains dig through the seabed to chase demersal fish (sole and plaice) into the net. Bycatch of benthos is imminent. Discards in the past amounted to 50-60% (Overzee and Quirijns, 2007);
- Otter trawl;
- Pulse trawl: beam trawl using electric pulses instead of tickler chains;
- Demersal seines: e.g. Danish seine, Scottish seine (flyshoot).

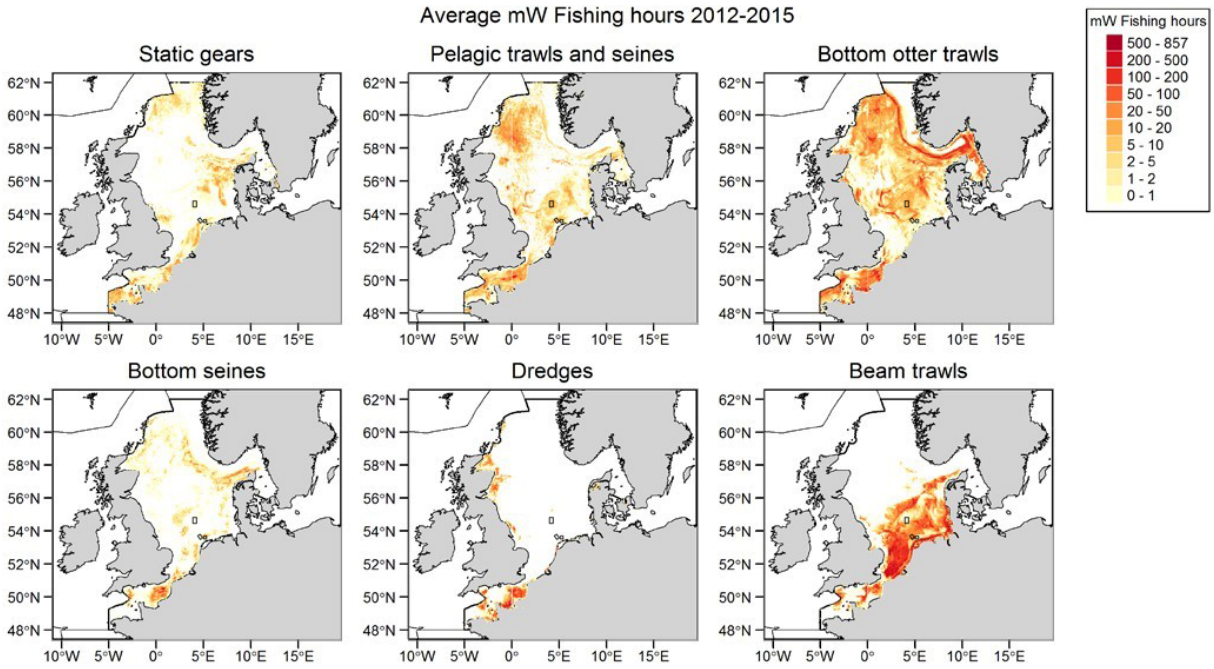


Figure 5 Spatial distribution of average annual fishing effort (mW fishing hours) in the Greater North Sea during 2012–2015, by gear type. Fishing effort data are only shown for vessels >12 m having vessel monitoring systems (VMS). (ICES, 2017) The proposed protected areas have been indicated.

The relative impact of towed bottom contacting fisheries on benthos is much more substantial than any other human activity at sea, even compared with extraction of surface minerals, e.g. sand (Lindeboom, 2005, referred to in Slijkerman, 2013). Besides, sand extraction has not been mentioned above under predominant human activities on the Frisian Front and Central Oyster Grounds, because it is non-existent in these areas.

5.3 Impact of fisheries on the seabed

The direct effects of trawl fishing are: fish death (sensitivity depending on species), change in food availability and changes in habitat conditions on the benthos which ultimately results in effects on abundance and diversity of the benthic community (Deerenberg et al, 2010, referred to in Slijkerman, 2013). Also, significant negative effects on total biomass, secondary production and species richness have been identified (Reiss et al, 2009 and Hinz, 2009, both referred to in Slijkerman, 2013).

Fisheries have a more severe impact on bigger species than on smaller species (Hiddink, 2006, referred to in Slijkerman, 2013).

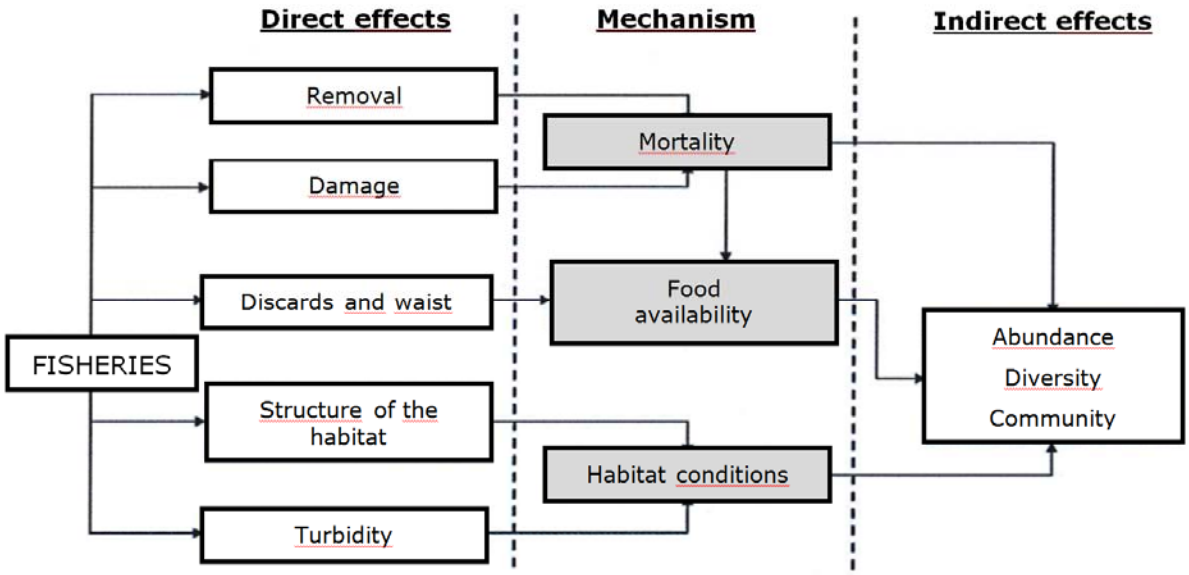


Figure 6 Direct and indirect effects of fisheries on benthos (Deerenberg et al, 2010, referred to in Slijkerman, 2013).

Focussing on the sea floor: any gear that aims to catch demersal fish, crustaceans, or shellfish needs to be in contact with the seabed. On soft sediments, heavy components of the gear, such as the doors of an otter trawl or the shoes of a beam trawl, will penetrate in the seabed and create a furrow by pushing aside the sediment (Schwinghamer et al., 1996; Smith et al., 2007; Buhl-Mortensen et al., 2013; Depestele et al., 2016; O'Neill and Ivanovic´, 2016; all referred to in Rijnsdorp 2016). Sediment may be brought into suspension by the turbulence generated in the wake of the gear.

Rakes, or a series of tickler chains running in front of the groundrope, will penetrate and enhance the mixing in the impacted layer, thus damaging the tubes and burrows on infaunal species and homogenizing the texture of the sea bottom

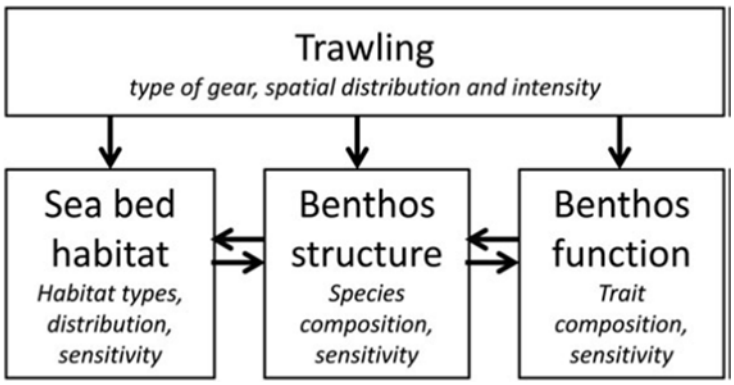


Figure 7 Impact of trawling on the seabed. Source: Rijnsdorp *et al.* (2016)

The physical impact can therefore be broadly classified into (Rijnsdorp, 2015a and 2015b):

- penetration into the seabed, thus damaging or taking away benthos;
- collision with (hard) structures; and

- re-suspension of sediments.

As a result the sea floor may be homogenized, having an negative impact on deep digging species such as shrimps. Those species are important for the structure, chemical conditions, mineralization of the sea floor, enhancing the distribution other species (Slijkerman, 2013).
Bottom structure is more important on the depth gradient to the deeper, silt-rich seabed than for shallower sandy parts (Jak et al, 2009, referred to in Slijkerman 2013).

Bottom fishing obviously causes death of fish but also may cause mortality of benthos and may result in a reduction of biomass and biodiversity. Long-lived species are more vulnerable because they need a longer time to recover. Robustly built animals are less susceptible than fragile species. Usually the share of long-lived species in fished areas is lower than in unfished areas (Rijnsdorp, 2015a and 2015b).
The density of ocean quahogs diminished since 1980. A probable cause is the increase of bottom trawling on the Frisian Front (Lindeboom, 2008b, referred to in Slijkerman, 2013).
The sensitivity of the seabed to disturbance of towed fishing gears depends primarily upon the natural disturbance (shear stress) and the structure of the seabed. The degree of natural disturbance decreases with water depth. The grain size of the sediment is usually a good indicator of the natural disturbance. High dynamic areas are characterized by coarse sediments, low dynamic areas by fine sediments. The Frisian Front and the Central Oyster Grounds are low dynamic areas with fine sediment and are characterized by a benthic community with a higher proportion of long-lived species (Rijnsdorp, 2015a and 2015b).

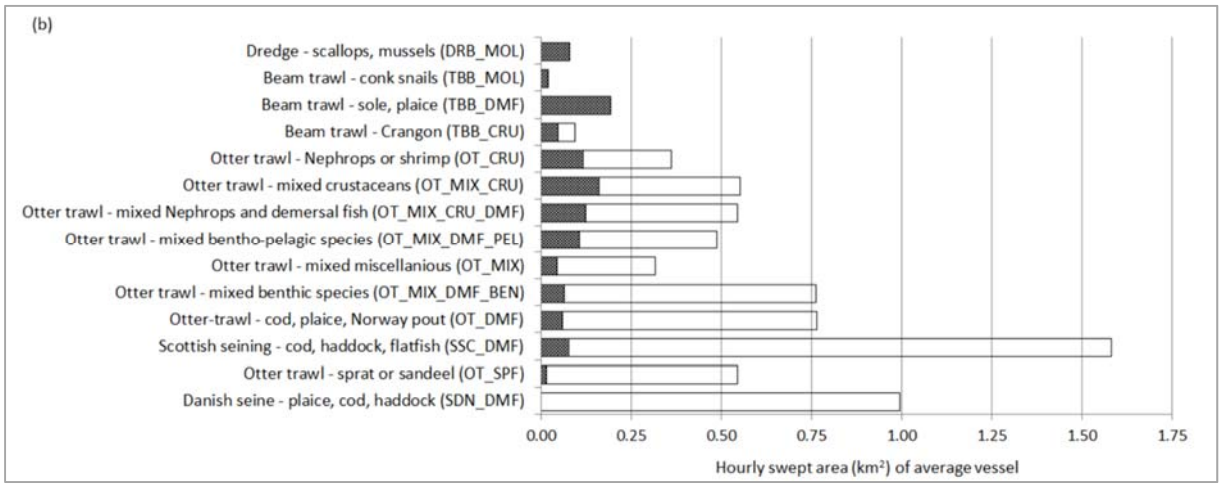


Figure 8 Area of seabed swept in 1 h of fishing with an average-sized vessel with impact at the surface level (sediment penetration up to 2 cm) and at both the surface and the subsurface (> 2 cm) level for 14 BENTHIS métiers. Eigaard et al. (2016).

Eigaard (2016) quantified the surface and the subsurface impact to the seabed area of all towed fishing gears (figure 8). All towed gears cause abraision up to a depth of 2 cm. Gears that impact surface over a large swept area include Scottish seines (flyshoot) and Danish seines. In addition most gears disturb the subsurface (depth over 2 cm) to a certain extent. The annual subsurface and surface disturbance is given in figure 9 (ICES 2017).

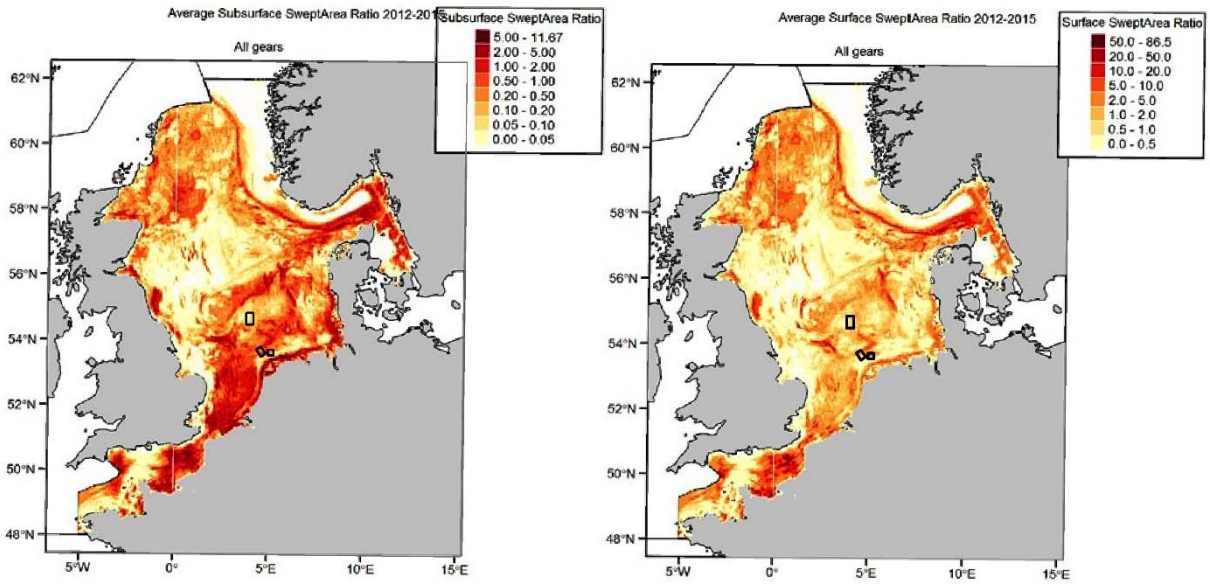


Figure 9 Average annual subsurface (left) and surface (right) disturbance by mobile bottom contacting fishing gear (otter trawls, beam trawls, dredges, and demersal seines) in the Greater North Sea during 2012–2015, expressed as average swept area ratios (SAR) (ICES, 2017). The proposed protected areas have been indicated.

5.4 Development of species and habitats in areas closed for towed bottom contacting fisheries

Measures aiming at avoiding disruption of the seabed by towed bottom contacting fisheries will not only contribute to GES for biodiversity (descriptor 1, see 5.1) and sea floor integrity (descriptor 6), but also to:

- descriptor 4: 'All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.' Food webs normally occurring in the Frisian Front and Central Oyster Grouds (i.e. in a undisturbed situation, matching the function and structure of the low-dynamic silty habitat) can develop.
- to a limited extent descriptor 3: 'Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.' Although fish are highly mobile and displacement of fisheries may occur, obviously fish mortality due to fisheries will decrease in the protected areas.

The Dutch Marine Strategy combined descriptors 1, 3, 4 and 6 into one integrated descriptor: 'marine ecosystem'.

An indication of the effects of long term closure of an area to fisheries is provided by research in and nearby a exclusion zone for all shipping, and thus for fisheries, around a gas production platform (Duineveld et al., 2007). See box below.

Case study

Long term closure of an area to fisheries at the Frisian Front (Duineveld et al., 2007).

The effects of fishery exclusion on the composition of the macrofauna were determined by comparing the 500m circular fishery-exclusion zone around a gas production platform in the southern North Sea, just 3NM West of the Frisian Front, with nearby regularly fished areas. A gas production platform has been chosen because of the absence of oil-based mud (OBM). Platform L07A has been selected because of the silty seabed close to the Frisian Front and the fact that the presence of the platform (and thus the closure for fisheries) covers a period of over twenty years.
A Triple-D dredge was used, in addition to a standard box corer, to collect the relatively rare and larger species.
Multivariate analysis showed:

- Greater species richness, evenness, and abundance of mud shrimps (*Callianassa subterranea, Upogebia deltaura*) and fragile bivalves, long-lived (*Arctica islandica, Thracia convexa)* as well as short-lived *(Abra nitida, Cultellus pellucidus*) in the exclusion area.
- Greater densities of the brittlestar *Amphiura filiformis.*

The observation that fisheries affect deep-living mud shrimps may point to consequences for the functioning of the benthic ecosystem other than simple loss of biodiversity.

The development of habitat and species characteristics as a result of closing Frisian Front and Central Oyster Grounds for seabed disrupting fishing techniques have been assessed in a qualitative way by expert judgement (Jongbloed, 2013). In general it is expected that seabed structure will change towards natural intrinsic conditions and an increase in natural bioturbation. A benthic community in which epifauna has a larger role can develop. It is assumed that benthos biodiversity increases, biogenic structures develop, scavengers and worms decrease, crustaceans and bivalves increase, as well as sensitive fish species, predatory fish and large specimens of certain species. On the basis of various studies, it is expected that the period over which a benthic community recovers may be in the order of 5 to 25 years.

Furthermore, it is assumed that the Frisian Front ecosystem will show a faster recovery of benthic fauna than Central Oyster Grounds because of an initial situation which is a result of a greater impact of fisheries and dynamism, heterogeneity and dynamics of the landscape on the Frisian Front than is the case for the Central Oyster Grounds. Frisian Front is also assumed to have a higher potential for growth of long-lived benthos (individuals and species), higher

potential for growth of biomass, higher potential for increasing biodiversity, higher potential for several types of big fish.

The experts do not expect the return of the historical ecosystem of the Central Oyster Grounds (where oyster beds were key elements) in the foreseeable future due to the absence of hard structures. Natural oyster beds may develop again, provided there is hard substrate present on which oyster larvae can settle. Also, the quahog can spread in the northern part of the Central Oyster Grounds, potentially making a major contribution to the status of local biomass and long lived species.

6. Designing seabed protecting measures on Frisian Front and Central Oyster Grounds

6.1 Accordance with policy

The conservation objective for Frisian Front and Central Oyster Grounds is the recovery of substantial parts of the seabed ecosystem from a disrupted state towards a natural condition. Since the main pressure on benthos in the areas is fisheries with bottom contacting gear, the projected measures focus on reducing bottom trawling in the area.

The Marine Strategy for the Dutch part of the North Sea 2012-2020, Part 1 (2012) therefore states: *In addition to the existing Natura 2000 areas, the Friese Front (Frisian Front) and Centrale Oestergronden (Central Oyster Grounds) are considered search areas for protective measures aimed at reducing bottom trawling to be taken within the CFP framework.*
This is in accordance with the position of the Dutch government regarding the 2013 revision of the CFP: focus on the sustainable use and preservation of natural marine resources and ecosystems (Dutch Senate, 2011-2012, 32 848, A). The Frisian Front and the Central Oyster Grounds are considered search areas for protective measures aimed at reducing bottom trawling (see map Annex 1).

This ambition is in accordance with Sustainable Development Goal 14, part 5: *By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information*.

Moreover, the aforementioned ambitions support the objective as expressed by the contracting parties in the Convention on Biological Diversity (CBD), namely that 10% of coastal and marine areas, especially areas that are important for biodiversity and ecosystem services, are to be protected by 2020. This ambition was confirmed by the General Assembly of the United Nations in Rio de Janeiro in 2012.[8]

[8] CBD Strategic Plan 2011-2020, Aichi Biodiversity Targets, Goal C Target 11

6.2 Design principles for protected areas on Frisian Front and Central Oyster Grounds

In the designing process towards seabed protection, the following prerequisites were applied (Marine Strategy for the Dutch part of the North Sea 2012-2020, Part 3; IenM,2015):

- the ambition to protect 10 to 15% of the Dutch part of the North Sea against considerable seabed disruption; and
- minimization of economic impact on the fisheries sector.

On the Dutch part of the North Sea, six special areas of conservation (SACs), both on shore as well as off shore, have been designated under the Habitats Directive. These areas are part of the Natura 2000 Network.
Management plans have been developed for three onshore Natura 2000 areas (North Sea Coastal Zone, Voordelta, Raan Flats). On 27 May 2016, the Minister of Economic Affairs designated two offshore special areas of conservation: Dogger Bank and Cleaver Bank. For both areas management measures are in preparation.

On the basis of the measures in the onshore management plans and the proposed measures for Dogger Bank and Cleaver Bank, about 8% of the Dutch part of the North Sea will not be significantly be disrupted. These areas contribute to the ambition to protect 10 to 15% of the Dutch part of the North Sea against significant seabed disruption. From this it is concluded that additional 2 to 7% of the seabed has to be protected.

On the basis of these preconditions and after consultation with fisheries organisations and nature conservation organisations (prior to the draft programme of measures and while the draft was published for public consultation), the central government formulated the following principles for developing measures:

a) The areas in the Frisian Front and the Central Oyster Grounds where seabed protection measures will apply comprise a *minimum of 1200 km²* (at least 2% of the Dutch part of the North Sea) and a *maximum of 4200 km² (7%)*.[9] In this area or in these areas, fishing that significantly disturbs the seabed will no longer be permitted.
b) The measures are geared towards protecting the ecologically most valuable areas and, wherever possible, ensuring the recovery of the seabed ecosystem.
c) Areas should be established within the search area and be large enough to be ecologically valuable and be able to contain (as many) different habitats and gradients (as possible), such as in depth or silt richness; they must be effective and cost-effective in terms of monitoring; they must be effective and cost-effective in terms of maintenance.
d) Within the area or areas where seabed protection measures apply, areas can be designated in which another management regime applies, enabling comparison of two protection procedures.
e) The spatial implementation of the measures allows for the principle of minimal burdening of fisheries.

[9] Seabed protection measures in Natura2000 areas on shore and off shore add up to about 8% of the Dutch part of the North Sea. In orther to fulfill the Government ambition to protect 10-15% an additional 2 – 7% of the Dutch North Seabed has to be protected.

f) When ascertaining the economic impact of measures, consideration will be given to various fishing technologies and the interests of Dutch and foreign fishermen. Current fishing data will be used in this process. Current and future interests of local fishermen and the development towards more sustainable fishing will also be taken into account.
g) A societal cost-benefit analysis will be prepared for the potential measure(s). Any effects (socio-economic, ecological) ensuing from the possible relocation of fishing activities will be also included, as will the local effects on fishing communities.

7. Economic interest of Frisian Front and Central Oyster Grounds for fisheries[10]

Dutch and foreign fisheries on the Frisian Front and Central Oyster Grounds have been analysed using a methodology described in a societal cost-benefit analysis of fisheries measures in these areas (Oostenbrugge, 2015). The analysis of fisheries on the Frisian Front is applied on the area that matches with the area assigned for as Natura 2000 on grounds of the Birds Directive. The analysed area on the Central Oyster Grounds is not formally assigned but is often refered to in scientific reports (e.g. IMARES 2013); actually the habitat extends over a larger area than used in scientific reports.

7.1 Dutch fleet

Main target species of Dutch demersal fisheries are plaice, shrimp and sole and to a lesser extend turbot, brill, codfish, whiting and langoustine (Kuhlman, 2014). Average annual landing values of the Dutch demersal fleet amount around €250 million. The number of trawlers has been reduced from about 370 in 2003 to 270 in 2012.

Landing values of the Dutch fishing sector on Frisian Front and Central Oyster Grounds amount to about € 4,9 million on annual average in the period 2008-2014; this is 2% of the total value of the Dutch demersal fleet. Average annual gross value added (GVA) is about € 1,7 million in this period. Fishing efforts (fishing days) decreased substantially over this period by 50-60%, landing values decreased by about 30% due to increasing fishing opportunities elsewhere as well as decreasing prices.

From 2013, beam trawls including traditional beam trawl, puls trawl, pulswing and sumwing, are no longer the dominant gear used in the areas; other bottom trawls such as otter trawl and twin trawl and seines, became more important. Within the beam trawls, a partial shift has taken place from the traditional beam trawl to the pulse wing gear. Nets, dredges or shrimp trawl are hardly used in the areas.

Landing values of fisheries on the Frisian Front and on the Central Oyster Grounds on average are 3 to 1, although this proportion might differ considerably from year to year. Quarterly about 45 vessels are fishing in the areas. Three quarters of them take 10% or less of their revenues from these areas.

[10] The information in this chapter is mainly taken from Oostenbrugge et.al. (2015), unless otherwise indicated.

7.2 Foreign fleet

Information on the foreign fleet is based on data sets provided by institutes in Denmark, Germany, Belgium and the UK (Oostenbrugge, 2015).

Landing values of the foreign fleet on Frisian Front and Central Oyster Grounds are on average 1,5 times larger than landing values of the Dutch fleet. Average gross value added by the foreign fleet amounts on average 2 times gross value added by the Dutch fleet (table 1).
The majority of the fishing activities is carried out by the UK fleet which contributes to more than 50% of the effort. The landings volume (tonnes) of the Danish fleet is more or less comparable with the UK, but these are predominantly low price species, caught in large quantities. As a result, the contribution of the Danish fleet to the total landings value and GVA is relatively low. The effort levels of the German fleet and Belgian fleet are generally comparable to the Danish ones, but differences exist for specific years. The time series of the foreign fleets do not show a clear trend. Fishing activities seem to be stable over time.

Table 1 Gross value added (GVA) by the Netherlands and foreign fleets on Frisian Front and Central Oyster Grounds. Average of foreign fleet over period 2010-2014; average of Dutch fleet over period 2008-2014.

Member state	GVA range	Average GVA	Percentage of foreign fleet	Percentage of NL and foreign fleet
	€ million	€ million	%	%
UK	1,5-2	1,8	55	36
Denmark	0,5-1	0,8	25	16
Germany	0,3-0,5	0,4	13	8
Belgium	0-0,3	0,2	7	5
Total foreign	**3-3,5**	**3,3**	**100**	**65**
Netherlands	**1,2-2,3**	**1,7**		**35**
Total	**4,2-5,8**	**5,0**		**100**

7.3 Flag vessels

Part of the foreign fishing fleet on the Frisian Front and the Central Oyster Grounds consists of flag vessels, Dutch-owned vessels under a foreign flag. 80% of the effort from German vessels and 60% of the effort of Belgian vessels is made by flag vessels. Flag vessels under Belgian and German flags contribute at least 20% to the total effort and 4% to the GVA of foreign fleets over the period 2010-2014. Based on the current data, the German flag fleet in the area is more important than the Belgian flag fleet. Fishing activities of Belgian and German flag vessels have been increasing over the period 2010-2014. Efforts nearly doubled in the areas and value of landings and GVA more than doubled. This might be due to the fact that in the last years it has become easier for owners of flag vessels to use their Dutch quota on foreign vessels.

Data for UK flag vessels is missing due to the fact that for the UK the information on fishing activity could only partly be matched with the vessel information from the Dutch sector. The significant

number of UK flag vessels (33) suggests that the proportion of the UK fishing activities carried out by Dutch owned vessels is substantial.
No Danish flag vessel (Dutch-owned Danish vessel) is operating in the areas.

7.4 Social aspects

In the demersal fisheries sector in the Netherlands, about 3.000 people are employed. In auctions, trade, supply and use about 20.000 people were working in 2012. Most vessels fishing on Frisian Front and Central Oyster Grounds are from two fishing communities: Urk and Wieringen.

7.5 Future developments

In the societal cost-benefit analysis, developments in the fisheries sector are described and incorporated in four Policy, Economy and Innovation scenarios. The most important developments are price changes of fish and fuel; changes in fish abundance (MSY targets of management); implementation of the landing obligation; technical innovations; and restriction of the fishing area by nature conservation, wind parks etc.

8. Description of the proposed conservation measure to be implemented

8.1 Geographical description, management zones

In order to allow the seabed ecosystem of Frisian Front and Central Oyster Grounds to recover from the present disturbed state, measures aim at reducing the adverse effects of fisheries with bottom contacting fishing gear in designated areas (See figure 8).

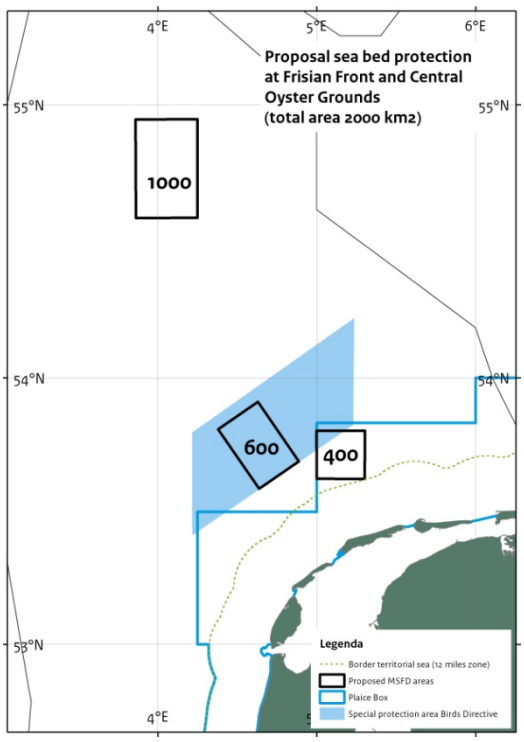


Figure 10 Proposed management zones

The designated areas amount up to 2000 km^2. On the Central Oystergrounds protection will be given to the seabed of 1000 km^2 in one area with a size of 25 by 40 km. On the Frisian Front, protection will be given to the seabed in two areas with a size of 600 km^2 (20 by 30 km) and 400 km^2 (20 by 20 km), 1000 km^2 in total at the Frisian Front. The coordinates of the closed zones are attached in Annex III.

8.2 Fisheries measures

All management zones will be closed to fisheries using existing, new and/or modified bottom contacting gears and travelling under six knots. Because of the low dynamic character of the closed areas and the possible impact on habitat structure and included epibenthos and endobenthos, the use of the following towed bottom contacting gear types is prohibited:

- beam trawl (including pulse trawl and pulse wing);
- bottom trawl/otter trawl;
- dredges;
- demersal seines.

Table 2 Gear codes for the banned towed bottom contacting gear types, including pulse gears.

Gear groups that are banned in all closed zones	**Gear Code Annex XI in EU Regulation 404/2011**	**International Standard Classification of Fishing Gears (ISSCFG)**
Beam trawl	TBB	03.1.1
Bottom Otter Board Trawl	OTB, OTT, PTB, TBN, TBS, TB, BTM	03.1.2, 03.3.0, 03.1.3, 03.1.9
Dredges	DRB, HMD	04.1.0, 04.2.0, DRM, DRX
Demersal seines	SPR, SDN, SSC, SX, SV	SPR, SDN, SSC, SX, SV

8.3 Coherence with design principles

The proposal to close three areas at the Frisian Front and Central Oyster Grounds with a total area of 2000 km^2 is coherent to the design principles presented in paragraph 6.2. The total area of 2000 km^2 is within the range of 1200-4200 km^2 of the Dutch ambition (principle a). The three areas represent areas with high biodiversity and ecological values (b). The minimum size per area of 400 km^2 (20 by 20 km) is expected to have a positive influence to the ecological development within the areas and to efficient monitoring and control (c). Especially the area of 600 km^2 at the Frisian Front covers the depth gradient and its related habitats and species (c). The burden to fisheries has been assessed for the Dutch fleet and is expected to be within the range of 0 to € 6 million over a 30-year period; the value of the areas to be closed has been analysed for the Dutch and foreign fleets (e; see paragraph 9.2). In the proposal, consideration is given to current fishing data and fishing interests (f). The proposal is based on a societal cost-benefit analysis and specific addenda (g; see chapter 9). All towed bottom contacting fishing gear considerably disrupt the seabed (see paragraph 5.3). Therefore all areas will be closed to all these fishing techniques (a). There are no designated areas to which different management regimes apply (d).

9. Methodology to assess the ecological and economical value

The conservation objective for Frisian Front and Central Oyster Grounds is the recovery of substantial parts of the seabed ecosystem from a disrupted state towards a natural condition. In order to assess the possible impacts of the conservation measure, a societal cost-benefit analysis was performed in 2015 (Oostenbrugge, 2015). In this analysis, ecological benefits and economic costs to industry were assessed to facilitate decision making. Initially, the analysis was performed on six variant of closures of areas to seabed disturbing fisheries. Three variants have been proposed by the Dutch government (1200, 1600, 4200 km^2), two variants were proposed by the fishing industry (1265 and 1685 km^2) and one by nature conservation organisations (6340 km^2).

9.1 Ecological value

In the societal cost-benefit analysis, the ecological benefits were assessed using the ecopoint method, focusing on the current status of the benthic ecosystem and possible focus areas in the management zones. The ecopoint method makes it possible to compare options with different ecological qualities on the basis of a numerical score attributed to an area or subarea. The final ecopoint score is the product of the size of each specific area (i.e. in km^2), the numerical value of that area on the basis of biodiversity characteristics (preferably the future biodiversity recovery potential) and a weighing factor. The ecopoint method does not provide for an absolute value of the biodiversity situation of an area, but is always relative to other areas.

The areas on the Frisian Front and the Central Oyster Grounds to be closed can – with respect to their ecological merits – be compared with areas in the variants that have been analysed in the societal cost-benefit analysis. Information on the ecological quality of the subareas in these variants is presented in table A4.2 of Appendix 4 of Oostenbrugge (2015). The area on the northern part of the Central Oyster Grounds (1200 km^2) on fine sand contains relatively high numbers of long lived macrobenthos species and species richness. The area on the Frisian Front covers the central part of the gradient including the core area with the highest amount of silt, about 20%, and contains relatively high macro- and megabenthos biomass, species richness and species density. The area south-east of the Frisian Front of coarse and medium fine sand runs into the Frisian Front itself and contains relatively high amounts of megabenthos biomass, species richness and species density.

Due to a lack of adequate information on the recovery potential of the protected areas, the future situation of the areas could not be taken into account in terms of ecopoints. Therefore in the societal cost-benefit analysis, the ecopoints attributed to the six variants are based on the current status of the benthic ecosystem. Thus, assessment of the proposed measures with respect of the conservation objective is not possible because of this lack of information on the recovery potential. In paragraph 5.4, an indication is given of the development of habitats and species in general as a result of closing Frisian Front and Central Oyster Grounds for seabed disrupting fishing techniques.

In order to be able to assess the ecological development of closed areas and to evaluate the measure, monitoring of the areas is of utmost importance. Monitoring of Frisian Front and Central Oyster Grounds is part of the Monitoring Programme (Dutch Marine Strategy, part 2; IenM, 2014 (see also paragraph 10)).

9.2 Economic value

A prerequisite to seabed protecting measures is the minimization of economic impact on the fisheries sector. This paragraph provides an analysis of the value of the areas to be closed to the Dutch and foreign fleets (9.2.1) as well as an assessments of the impacts on the Dutch fleet taking into account political, economic and innovation scenarios as well as displacement of fisheries to other fishing areas (9.2.2).

9.2.1 Economic value Dutch and foreign fleets in areas to be closed

Wageningen Economic Research analysed the value of the fishing activities of the Dutch, British, Danish, German, Belgian, Swedish and French fishing fleets at the proposed closed areas on the Central Oyster Grounds and Frisian Front (Buisman, 2017; Oostenbrugge 2017). Oostenbrugge (2017) also shows maps of fishing activities (in kg, euro and days at sea) per country, per gear and per year over the period 2010-2016.

The fishing effort, value and landings by these fleets are presented for a six year period (2010-2015 in Buisman, 2017; 2016 added in Oostenbrugge, 2017) and show variations over the last years without a clear trend (see Annex IV, Table IV.1 and Figure IV.1). Value of landings and Gross Value Added (GVA) of the Dutch, British and Belgian fleets have been fluctuating over the past years but there was a clear upward trend for Danish and German fleets. Sweden and France have not been active in the area in the period 2010-2016.

During the period 2010-2016, the Dutch effort was on average 206 days, while British, German, Danish and Belgian activities amounted to 16, 54, 29 and 18 days at sea respectively, about 4 to 11 times less. The landings remained relatively stable over the period at an average of 347 tonnes for the Netherlands, 67 tonnes for the UK, 26 tonnes for Belgium, 131 tonnes for Germany, and 1869 tonnes for Denmark. These landings represented a value of 900 k€ (The Netherlands), 110k€ (UK), 70 k€ (Belgium), 253 k€ (Germany) and 629 k€ (Denmark) and a GVA of 418 k€ (The Netherlands), 40k€ (UK), 28 k€ (Belgium), 123 k€ (Germany) and 409 k€ (Denmark). The values for the various subareas can be found in Annex IV, Table IV.2.

The majority of the fishing activities on the Central Oyster Grounds and Frisian Front is carried out by Dutch vessels followed by Danish, German, British and Belgian fleets. The fishing occurs mainly with beam trawls and otter-board trawls (Annex IV, Figure IV.2). The Dutch fleet also operates seines in the area.

The main species targeted by the beam-trawl fleet on the Central Oyster Grounds and Frisian Front is plaice with low catches of sole. The other demersal gears catch a combination of species such as sprat, plaice and herring. Some sole and nephrops are caught as well. All other species have much

lower landings with the notable anomaly of the Danish fleet in 2014 that caught sprat (Annex IV, Figure IV.3).

9.2.2 Assessment of economic effects to the Dutch fleet

The economic effects of closures on both the Dutch fishing sector have been assessed by an analysis of the historic fishing activities in the areas combined with scenario analysis.[11] The scenarios used are described in a societal cost-benefit analysis (Van Oostenbrugge, 2015). They consist of four Policy, Economy and Innovation scenarios (PEI scenarios) and three displacement scenarios. The PEI scenarios include combined effects of external developments such as fish prices, stock developments and other area closures. The displacement scenarios are based on scientific insights into displacement effects, the fishing sectors' point of view, and the assumption that due to alternative fishing opportunities the long-term costs of displacement will be negligible.
The results are presented as net present values (future discounted costs over a 30-year period). The displacement scenario based on the fishing sectors view results in significantly higher costs than the two other displacement scenarios. The closures will have an effect on social aspects in fisheries and their communities. These social effects have been assessed through interviews with fishermen. Most of these aspects cannot be attributed to one of the variants but have been described in Oostenbrugge (2015). Costs for monitoring and control have been estimated but are non-distinctive for most of the variants as the uncertainty in the costs is high.

The proposals sent to the Dutch Parliament, both amounting to 2400 km^2 to be protected, as well as the present final proposal agreed upon in the Dutch Parliament amounting to 2000 km^2, were not described in Van Oostenbrugge (2015). In order to assess the economic effects of the proposals of 2400 km^2 to the Dutch Parliament, two addenda to the societal cost-benefit analysis have been produced, applying the PEI scenarios and displacement scenarios (Van Oostenbrugge, 2016a and 2016b).

Key findings in the adjusted 2400 km^2 proposal (Van Oostenbrugge, 2016b) are that costs in terms of gross value added of the proposed variant for the Dutch fisheries range between € 0 and € 6 million (net product value GVA over a 30-year period).
After the Dutch Parliament decided on reducing the 2400 km^2 proposal to 2000 km^2 by leaving out one area of 400 km^2, no additional assessment of the economic effects has been carried out. Therefore, in the adapted proposal of 2000 km^2 of this background document, the range is expected to be between € 0 and less than € 6 million.

10. Monitoring and assessment

10.1 Dutch monitoring programme

In the Netherlands, all marine monitoring is programmed in the Marine Strategy for the Dutch part of the North Sea, part 2, the MSFD monitoring programme (IenM, 2014). This programme follows the structure of the MSFD on the basis of the 11 descriptors. Per descriptor, a description is given

[11] The information in this paragraph is taken from Van Oostenbrugge (2015) unless otherwise indicated.

of the environmental targets, the associated indicators, the research needs per indicator, the research strategy, the functional measurement needs, the monitoring strategy and the measurement plan.
Based on the measurement data, the monitoring programme provides insight into:

1. the status of the indicators, thereby indicating the extent to which an environmental target is achieved (MSFD, Art. 10), in order to facilitate the ongoing assessment and periodic updating of the environmental targets (MSFD, Art. 5)
2. the effectiveness of the programme of measures to be implemented under the MSFD.

'Informatiehuis Marien' is the supporting body which plays a central role in implementing the MSFD monitoring cycle, particularly in monitoring quality, transparency, availability and cost efficiency.[12]

To reduce costs and improve consistency, the MSFD monitoring programme is aligned as much as possible with the existing monitoring programmes for the Birds and Habitats Directives and the Water Framework Directive. International cooperation is pursued in all steps of implementing the monitoring cycle. OSPAR plays an important role in achieving regional cooperation, be it on common indicators, or joint monitoring.

In 2015, a baseline measurement campaign was executed for benthos, focusing on the marine protected areas in the Netherlands. The baseline campaign and subsequent monitoring focuses on the typical species (in accordance with the Birds and Habitats Directives) and on a set of species indicative for the structure and function of the habitats, species that are sensitive to disturbance by human activities and species indicative for recovery. The data will be used for the update of the Initial Assessment in 2018, and also the reporting for the Birds and Habitats Directives in 2019, and the evaluation of management plans for the different marine protected areas. The measurement campaigns will be repeated every three years in order to be able to evaluate the status and effectiveness of measures.

Once the measures to prevent seabed disruption in the proposed closed areas at Frisian Front and Central Oystergounds are determined, the monitoring programme will be modified and the baseline measurement will be performed.

The monitoring plan that has currently been designed is able to detect a change of 50% in population distribution based on hit rate of the species within the samples, with a power of 80%. Here, hit rate is considered to be a good proxy for species distribution and/or abundance.
Once every three years, samples are taken with a grab sampler and video tracks.
All species found in the samples (grab and video) are recorded. The analysis needed for the detection of an increase in hit rate will be performed only for the indicator species as mentioned in table 3. A 50% change in hit rate for an indicator species triggers further analysis of the monitoring plan, both at the level of (indicator) species and that of the basic principles (spatial and temporal distribution).

[12] http://www.informatiehuismarien.nl/uk/

In a recent update of the monitoring campaign, an additional statistical analysis has been done with regard to all proposed closures in the Dutch EEZ (Wijnhoven, 2017) to determine the necessary number of sampling stations. An additional 86 sampling stations were added to the original monitoring campaign to be able to make statistical significant assessments on the status and effectivity of measures in all protected areas. See figure 11 for an overview of all sampling stations.

The measure will be evaluated every six years. Fishery industries and nature conservation organisations will be involved in the monitoring and assessment process.

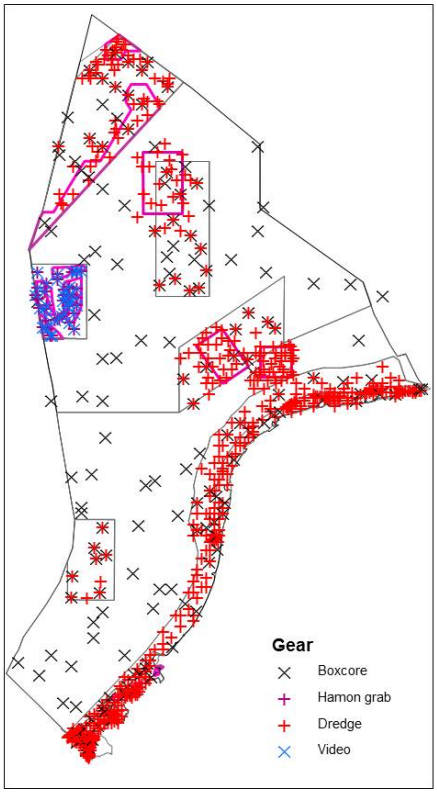


Figure 11 Overview sampling stations of the monitoring campaign at the Dutch part of the North Sea

Table 3 Species to be used to assess the measures in the protected areas at Frisian Front and Central Oystergrounds (source IenM, 2014).

Central Oyster Grounds	**Dutch name**	**English name**
Callianassa subterranea	Moddergarnaal	Burrowing mud shrimp
Upogebia stellata	n.a.	n.a.
Brissopsis lyrifera	n.a.	Spiny mudlark
Corbula gibba	Korfschelp	Basket shell
Acanthocardia echinata	Gedoornde hartschelp	Prickly cockle
Turritella communis	Penhoren	Common tower shell / Auger shell
Amphiura filiformis	Draadarmige slangster	Brittle star
Frisian Front	**Dutch name**	**English name**

Amphiura filiformis	Draadarmige slangster	Brittle star
Callianassa subterranea	Moddergarnaal	Burrowing mud shrimp
Upogebia deltaura	Harige molkreeft	n.a.
Thracia convexa	Bolle papierschelp	Convex thracia
Goneplax rhomboides	Trapezium krab	Angular crab
Corystus cassivelaunus	Helmkrab	Masked crab / Helmet crab
Nephtys incisa	n.a.	n.a.

10.2 Suitable biological and pressure indicators

The basic principle of a suitable *biological indicator* is that it indicates the quality of the habitat type. This can be either a 'positive indication' (indicates quality improvement) or a 'negative indication' (indicates quality deterioration). The Marine Strategy Framework Directive published a new Commission Decision (2017/848), which provides a set of indicators or criteria to assess the condition and change of the benthic environment. The Netherlands have taken up the following criteria accordingly:

- Spatial extent and distribution of physical loss (permanent change) of the natural seabed (D6C1) and of the natural extent of the habitat type in the assessment area (D6C4).
- Spatial extent and distribution of physical disturbance pressures on the seabed (D6C2).
- Spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance (D6C3).
- The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), does not exceed a specified proportion of the natural extent of the habitat type in the assessment area (D6C5).

Quality of the habitat is defined by the following quality aspects:

- physical structure
- diversity
- community structure
- typical species

Considering the conservation objective for Frisian Front and Central Oyster Grounds, biological indicators aim to indicate the improvement of these quality aspects. And, considering the quality aspects, suitable indicator species are selected based on the typical species from the Habitats Directive and species selected specifically for MSFD purposes. A national benthos indicator, the Benthic Indicator Species Index (Wijnhoven, 2017), was developed to assess the quality and account for changes in quality on the Dutch part of the North Sea and the different protected

areas, among which Frisian Front and Central Oyster Grounds. This indicator is suitable for assessment following the monitoring campaign as described in paragraph 10.1.

Besides the biological indicators, fisheries data are an important indicator to analyse the temporal and spatial fine-scale distribution of fishing efforts through the Physical Disturbance Indicator, which is developed by ICES and the Benthis project (Rijnsdorp, 2017).[13]
This indicator is a *pressure indicator* (impact of fisheries on the areas not closed for fishing effort) by combining VMS data and information on footprint.

10.3 Principal properties of indicator species

The following principle properties of indicators species are hereby defined:

- Species should indicate improvement in the quality aspects of the habitat type.
- Species should be sensitive to the impact of mobile bottom contacting gear.
- The time of reaction of a species on the measure (being reduction or removal of bottom contacting activities) should be considered (preferably after 6 or, at the latest, 12 years).
- Species should be abundant enough to give quantitative information about the effect/ effectiveness of the measure.

To assess quality status and detect effectiveness of measures, a list of indicator species is drawn up. These are all benthic species (epi- and infauna) (table 3) and are considered to cover the relevant quality aspects of the habitat as mentioned above. Mobile species, such as fish, and rare species are excluded, since there is a low hit rate for these species. These species will however be reported whenever found in video samples.

11. Control and enforcement of the proposed fisheries management measures

The proposed control, enforcement and compliance regime for the Frisian Front and the Central Oyster Grounds consist of a combination of surface and aerial surveillance, establishment of an alert zone outside of these management areas, and remote monitoring of vessel position.

Key provisions in accordance with Council Regulation 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of common fisheries policy to be included in the delegated act to facilitate control enforcement and compliance are as follows:

- Fishing activities of all fishing vessels in the management zones and a 4 NM-wide alert zone around the management zones shall be controlled by the fisheries monitoring authorities of the coastal Member State by using their system to detect and to record the vessels' entry into, transit through and exit from the fishing restricted areas.

[13] www.benthis.eu

- Fishing vessels carrying on board any prohibited gear types and travelling with a speed under 6 knots within the alert zone and management zone must use their vessel monitoring system for reporting fishing vessel identification (geographical position, date, time, course and speed). These data shall be transmitted every 30 minutes.[14] Such ping frequency shall not set a precedent for any other MPAs and must be considered as provisional as long as:
    - regional groups (accordingly to conclusions of control expert groups) have not yet adopted a relevant uniform compliance policy for MPAs within EU waters; and/or
    - the fisheries control framework has not yet been revised at EU level.

- The relevant fisheries monitoring authority shall be informed about entry and exit of alert and management zone.

- Fishing vessels may transit alert zone and management zone with prohibited gears on board provided that:
    - any prohibited gear on board be lashed and stowed during the transit; and
    - the speed during transit is no less than six knots except in case of force majeure or adverse conditions. In such cases, the master shall without delay inform the fisheries monitoring centre of the flag Member State which shall then inform the competent authorities of the coastal Member State.

- The high frequency data can also be transmitted via GPRS/GSM. When GPRS/GSM signal is not available, data shall be safely stored and forwarded as soon as the signal is available.

- A fishing vessel travelling at six knots or less that carries a prohibited gear entering an alert zone area without such a system or not transmitting or storing the data is in breach of the regulations, except in the case of force majeure or adverse conditions.

- On the level of the Scheveningen Group, guidelines for a common approach are in development. This common approach, when ready, will be taken into account in the implementation of the proposal.

An increase in ping frequency could lead to additional costs, however not in all cases. Costs depend on different factors, such as the type of system and equipment, the type of contract or having a system already installed on board or not.

For fishing vessels with a length of less than 12 meters, no VMS-obligation applies. However, analysis of the Dutch fleet below 12 meter showed there are almost no bottom trawling ships active in the Frisian Front and Central Oystergrounds (less than 0.1 days at sea per year for the years 2012-2016). The reason being that small ships do not sail out that far. For that reason, it is also unlikely that foreign vessels below 12 meters will visit these areas. Therefore, these types of

[14] These are the minimum requirements in the Council Regulation 1224/2009.

small ships are not considered to be a risk for the conservation objectives. Subsequently, it will not be necessary to take any additional measures for these ships.

12. Implementation

EU Regulations do not need to be implemented into national law. In order to enforce the regulation, a provision will be made in the *Uitvoeringsregeling Zeevisserij* (implementing regulation for marine fisheries) under the *Visserijwet 1963* (Fisheries Act 1963).

After a period of six years since the publication of the Regulation, the initiating Member State will assess the impact of the measure on the benthic ecosystem.

Fishing industry and nature conservation organisations are invited to jointly give guidance to the implementation process, the communication of it, the monitoring of the ecological effects, the evaluation of the measure and to the improvement of compliance and enforcement.

13. Reflection on the general principles

The proposal presented in chapter 8 of this background document meets the general principles outlined in paragraph 1.3.

- Sound scientific basis

The proposal is based on recent and actual information with regard to both ecological and economic aspects of the areas to be closed. During the process of preparing the proposal, all scientific questions have been dealt with and if necessary analysed by scientific institutes. The reports resulting from this process are mentioned in paragraph 3.2.

- Stakeholder involvement

Key stakeholders from fishing industry and nature conservation organizations were involved in the preparation process from the very start in 2013 (paragraph 3.1). They participated in the joint fact-finding process and presented proposals to be taken into account in the societal cost-benefit analyses. Also, they commented on the proposals sent to the Dutch Parliament.

- Transparency

Stakeholders were informed on the formal and informal steps to be taken and on the available information (paragraph 3.1).

- Proportionality

The proposal is expected to deliver a key contribution to the conservation objective: allow the seabed ecosystem of Frisian Front and Central Oyster Grounds to recover from the present disturbed state. Economic analysis shows that the economic impact on fishing industry is expected to be limited (paragraph 9.2).

- Non-discrimination

The proposal is applied to all towed bottom contacting fishing gear types of all EU Member States, ensuring a level playing field for the fishing sector affected (chapter 8).

Abbreviations

AFDW	Ash-free dry weight
BD	Birds Directive
CBD	Convention on Biological Diversity
CFP	Common Fisheries Policiy
CO	Central Oyster Grounds
DCS	Dutch Continental Shelf
EC	European Commission
EEZ	Exclusive Economic Zone
EU	European Union
FF	Frisian Front
GES	Good Environmental Status
GVA	Gross Value Added
GPRS/GSM	General Packet Radio Service/Global System for Mobile Communications
HD	Habitats Directive
IenM	Ministry of Infrastructure and the Environment (as of Ocober 2017: Ministry of Infrastructure and Water Management)
IMARES	Institute for Marine Resources & Ecosystem Studies, as per September 1st 2016: Wageningen Marine Research
LEI	Landbouw Economisch Instituut (Agriculture Economic Institute), as per September 1st 2016: Wageningen Economic Research
MSFD	Marine Strategy Framework Directive
MSY	Maximum Sustainable Yield
NGO	Non-Governmental Organisation
NIOZ	Koninklijk Nederlands Instituut voor Onderzoek der Zee (Royal Netherlands Institute for Sea Research)
NM or Nmi	Nautical mile (1852 m)
NSAC	North Sea Advisory Council
OBM	Oil based mud
PEI	Policy, Economy and Innovation
RWS	Rijkswaterstaat (managing agency of the Ministry of Infrastructure and Water Management)
SAC	Special Area of Conservation (Habitats Directive)
SCBA	societal cost-benefit analysis
SPA	Special Protection Area (Birds Directive)
UK	United Kingdom
VMS	Vessel monitoring systems
WER	Wageningen Economic Research (formerly: LEI)

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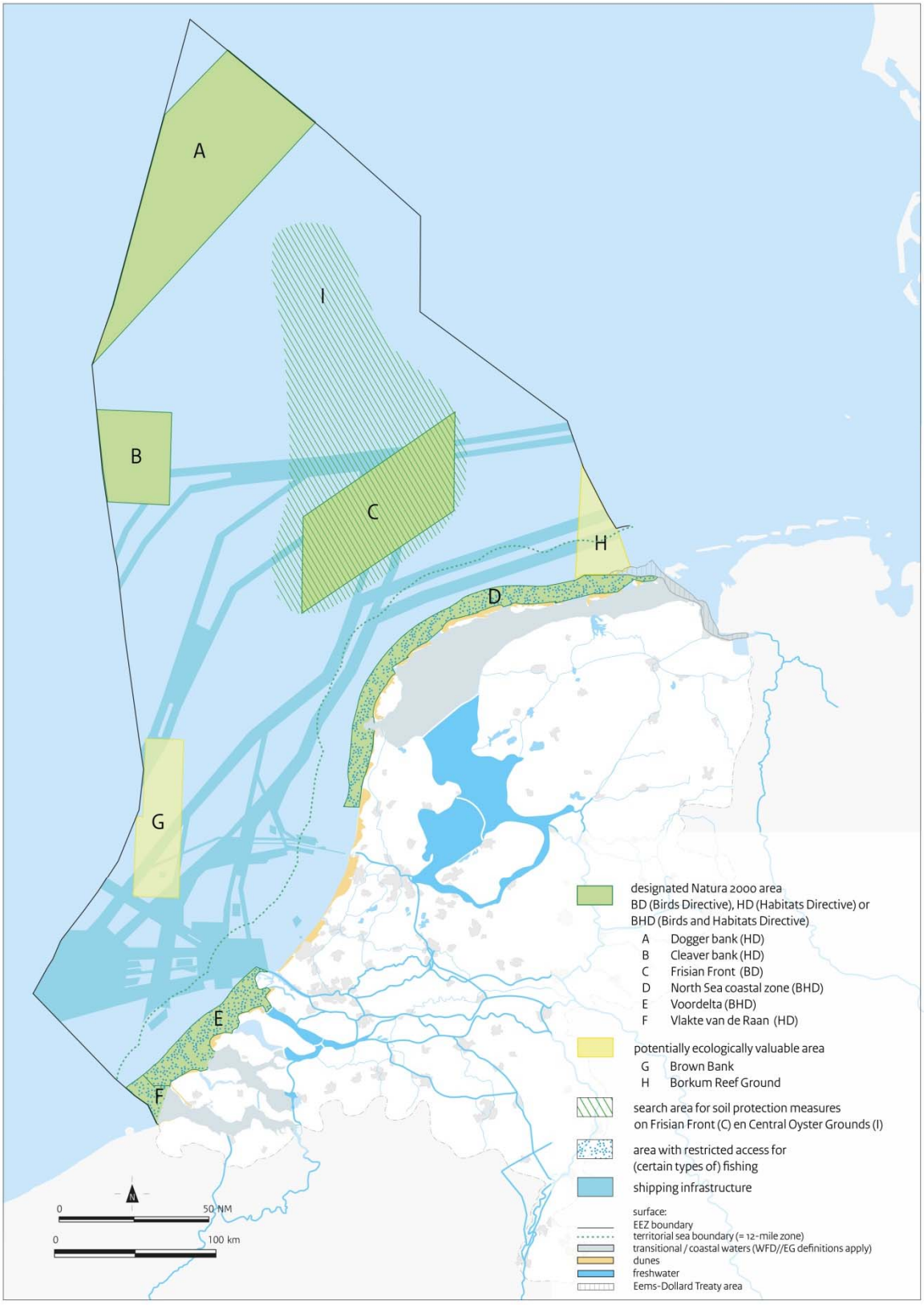
Annex I Marine protected areas (Natura 2000) in the Dutch part of the North Sea

(IenM, 2015)



Annex II Coordinates of the management zones (based on WGS84)

Latitude	Longitude
590345	7098542
590234	7064825
556587	7064865
556556	7098582
516381	7057934
487616	7099509
515436	7118761
544127	7076987
473080	7316907
473080	7247754
430048	7247639
429672	7316788

Annex III Coordinates of the alert zones (based on WGS84)

Latitude	Longitude
518651,2427	7136231,372
544040,695	7099247,989
544011,6242	7111083,786
602921,1425	7111015,966
602635,8477	7052321,136
544155,0218	7052390,592
544131,962	7061882,044
513201,8472	7040636,221
470188,3199	7102629,957
485963,2451	7329767,923
485810,7021	7235002,450
417386,3906	7234820,001
416718,3101	7329579,813

Annex IV Economic figures with respect to the proposed closed areas at Frisian Front and Central Oyster Grounds

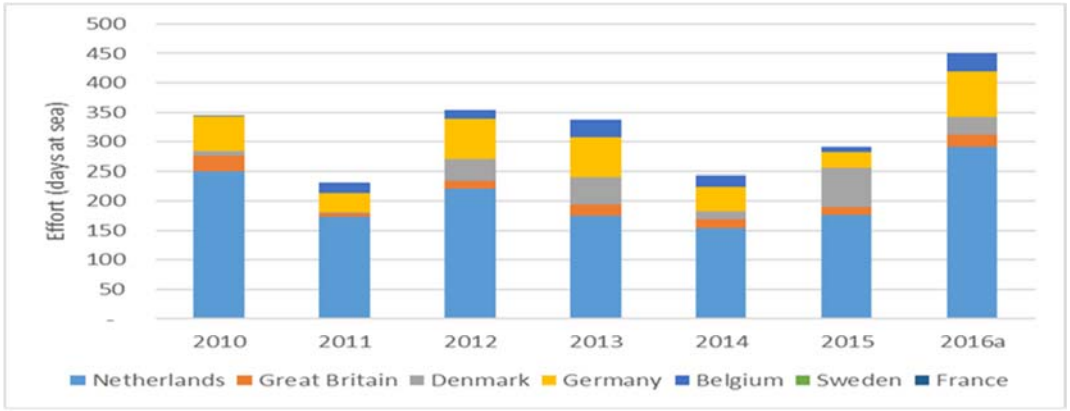
The figures in this Annex are taken from the analysis of the Dutch, British, German, Belgian, Danish, French and Swedish fleets at the proposed closed areas at Frisian Front and Central Oystergrounds (Buisman, 2017; Van Oostenbrugge, 2017)

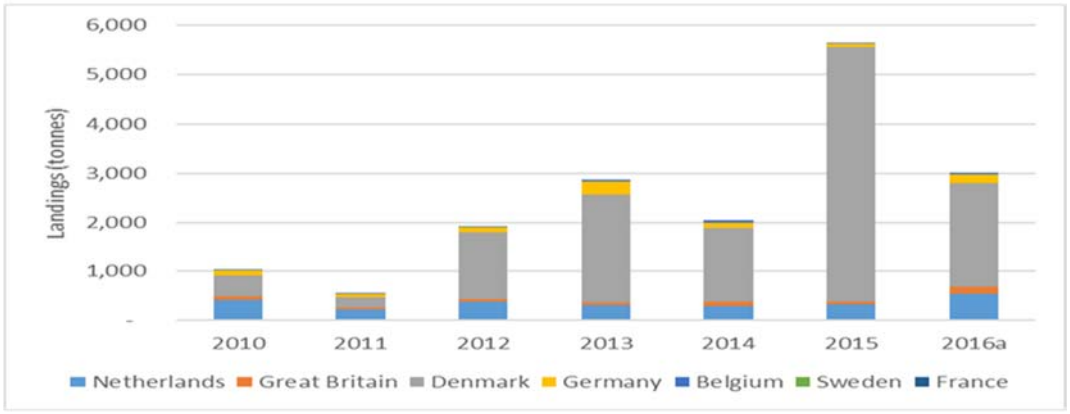
Table IV.1 Overview of effort, landings and values and gross value added of the fishing sector in the proposed closed areas of the Central Oyster Grounds and Frisian Front of the different fleets (VMS and logbook merged data only) (Van Oostenbrugge, 2017)

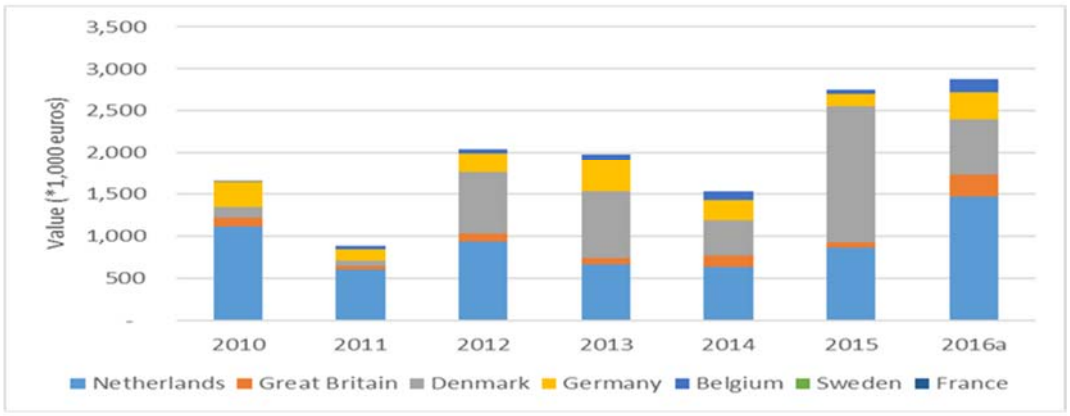
Country	2010	2011	2012	2013	2014	2015	2016a	Average
Effort (days at sea)								
Netherlands	250	173	221	175	154	177	291	206
Great Britain	26	6	13	20	15	13	22	16
Denmark	8	2	36	45	13	66	30	29
Germany	60	33	69	68	42	27	77	54
Belgium	1	17	15	30	20	9	32	18
Sweden	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-
Total	**345**	**230**	**354**	**337**	**244**	**292**	**451**	**322**
Landings (tonnes)								
Netherlands	409	216	370	305	281	325	523	347
Great Britain	68	25	51	53	83	42	148	67
Denmark	431	218	1,372	2,216	1,523	5,186	2,137	1,869
Germany	113	64	108	272	112	74	171	131
Belgium	1	13	18	34	47	19	47	26
Sweden	-	-	-	-	-	-	-	-
France	-	-	-	-	-			-
Total	**1,023**	**536**	**1,919**	**2,880**	**2,047**	**5,646**	**3,026**	**2,440**
Value (*1,000 euros)								
Netherlands	1,115	608	939	668	632	865	1,472	900
Great Britain	102	38	96	73	134	68	260	110
Denmark	123	60	724	788	422	1,618	667	629
Germany	311	135	231	377	242	149	325	253
Belgium	3	40	50	80	105	59	154	70
Sweden	-	-	-	-	-	-	-	-
France	-	-	-	-	-			-
Total	**1,654**	**881**	**2,040**	**1,986**	**1,536**	**2,758**	**2,877**	**1,962**
Gross Value Added (*1,000 euros)								
Netherlands	413	230	344	283	317	496	843	418
Great Britain	34	9	27	24	43	28	116	40
Denmark	85	42	454	586	243	1,027	423	409
Germany	119	52	88	217	130	81	176	123
Belgium	2	16	18	33	32	30	63	28
Sweden	-	-	-	-	-	-	-	-
France	-	-	-	-	-			-
Total	**652**	**350**	**931**	**1,143**	**765**	**1,662**	**1,621**	**1,018**

a) Provisional economic data

Figure IV.1 Historical trends of the fishing activities by the different fleets in the proposed closed areas at FF/CO. Effort, landings, value of landings and GVA are given by country. (Van Oostenbrugge, 2017)







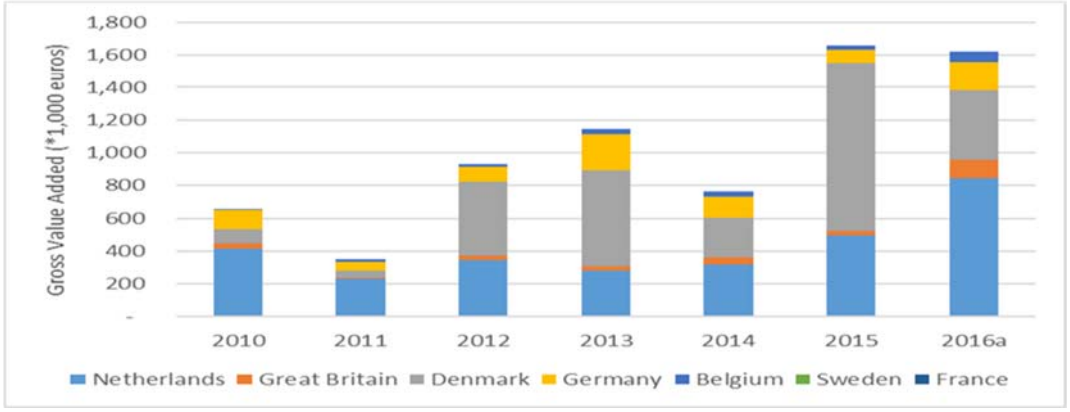


Figure IV.2 Historical trend of the fishing activities with different gears in the proposed closure of the Central Oyster Grounds and Frisian Front for the different countries. Effort, landings, value of landings and GVA are given by country. Source: Logbook data and VMS data and data from the Annual Economic report (STECF 2016), processed by WUR, CEFAS, TI, DTU, ILVO, SLU and IFREMER. (Buisman, 2017)

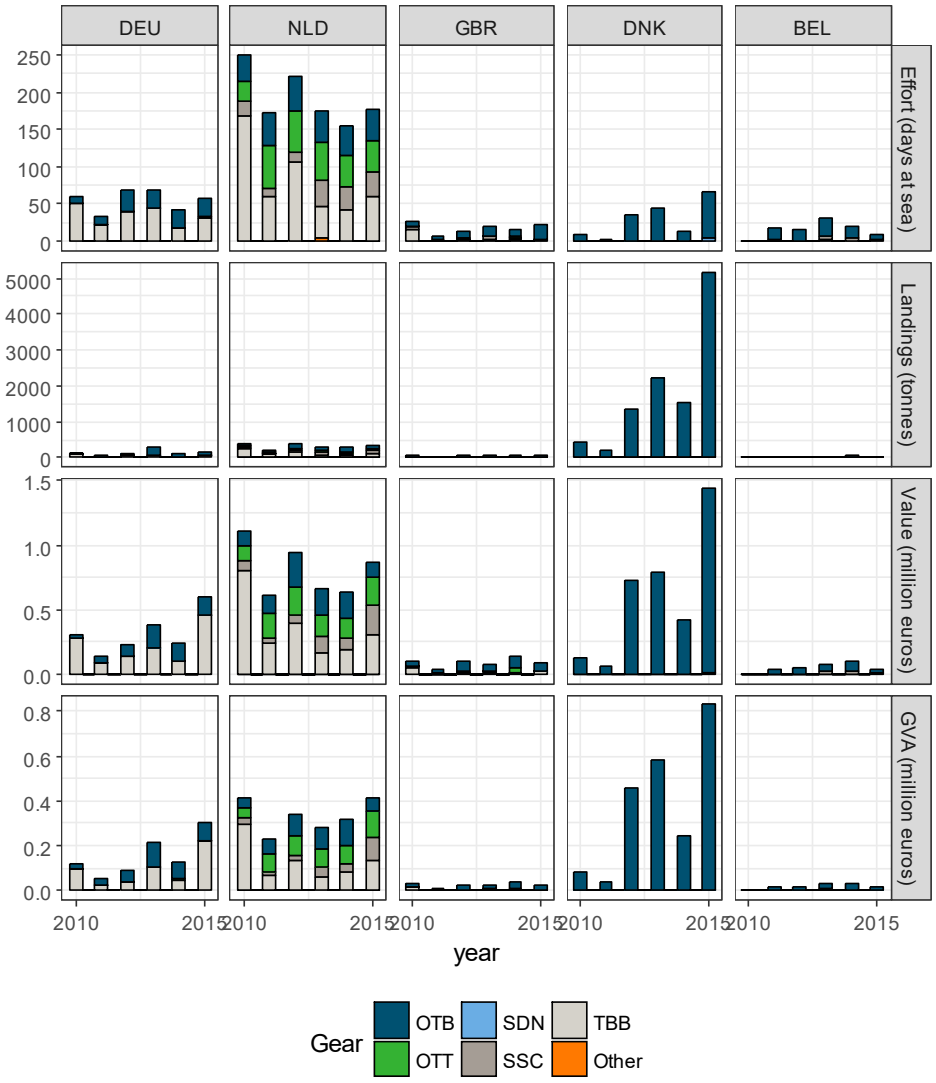


Figure IV.3 Landings in tonnes for the top 5 species per country on the proposed closed areas of the Central Oyster Grounds and Frisian Front for bottom contact gears. Source: Logbook data processed by WUR, CEFAS, TI,DTU, ILVO, SLU and IFREMER., CSH= brown shrimp, HER=herring, NEP=nephrops, PLE=plaice, SAN=sandeel, SOL=sole, SPR=sprat. (Buisman, 2017)

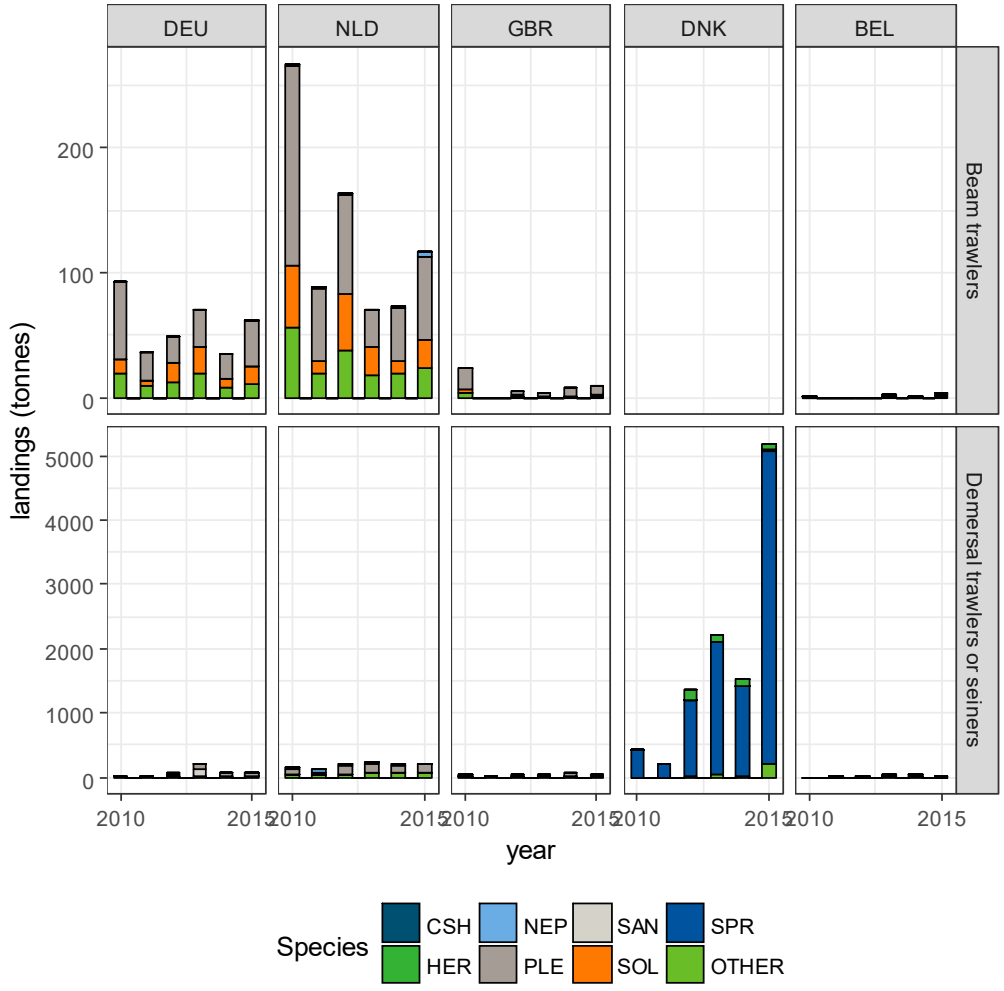


Table IV.2 Overview of effort and landings of the different fleets in the different sub-areas. (Buisman, 2017*)*

Country	Year	Gear	Sub-area	Effort (days at sea)	Landings (kg)	Type of data
BEL	2010	TBB	CO	0	777	FFCO_2017.Rdata-tacsatEflalo
BEL	2010	OTB	FF_Central	0	261	FFCO_2017.Rdata-tacsatEflalo
BEL	2010	TBB	FF_Central	0	353	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	OTB	CO	1	1499	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	TBB	CO	0	49	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	OTB	FF_Central	14	10760	FFCO_2017.Rdata-tacsatEflalo
BEL	2011	SSC	FF_East	2	828	FFCO_2017.Rdata-tacsatEflalo
BEL	2012	OTB	CO	7	11817	FFCO_2017.Rdata-tacsatEflalo
BEL	2012	OTB	FF_Central	8	5939	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	OTB	CO	0	238	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	OTB	FF_Central	23	20598	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	SSC	FF_Central	2	4101	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	TBB	FF_Central	0	629	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	SSC	FF_East	4	7686	FFCO_2017.Rdata-tacsatEflalo
BEL	2013	TBB	FF_East	1	1149	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	OTB	CO	6	25922	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	OTB	FF_Central	9	6765	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	SSC	FF_Central	1	6469	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	TBB	FF_Central	1	664	FFCO_2017.Rdata-tacsatEflalo
BEL	2014	SSC	FF_East	3	6935	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	OTB	CO	1	2558	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	OTB	FF_Central	5	7358	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	TBB	FF_Central	2	3000	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	OTB	FF_East	0	188	FFCO_2017.Rdata-tacsatEflalo
BEL	2015	TBB	FF_East	0	181	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	OTB	CO	7	16354	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	OTB	FF_Central	3	3265	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	TBB	FF_Central	50	93078	FFCO_2017.Rdata-tacsatEflalo
DEU	2010	TBB	FF_East	1	340	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	OTB	CO	8	23400	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	TBB	CO	0	149	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	OTB	FF_Central	4	4156	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	TBB	FF_Central	19	35088	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	OTB	FF_East	0	55	FFCO_2017.Rdata-tacsatEflalo
DEU	2011	TBB	FF_East	2	1184	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	OTB	CO	19	47835	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	OTB	FF_Central	9	10472	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	TBB	FF_Central	29	40594	FFCO_2017.Rdata-tacsatEflalo
DEU	2012	TBB	FF_East	12	8636	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	OTB	CO	14	56928	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	OTB	FF_Central	10	144979	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	TBB	FF_Central	43	69258	FFCO_2017.Rdata-tacsatEflalo
DEU	2013	TBB	FF_East	1	848	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	OTB	CO	17	68161	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	OTB	FF_Central	6	8267	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	OTT	FF_Central	2	849	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	TBB	FF_Central	16	34738	FFCO_2017.Rdata-tacsatEflalo
DEU	2014	TBB	FF_East	0	467	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	OTB	CO	23	68533	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	OTT	CO	0	604	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	OTB	FF_Central	3	4559	FFCO_2017.Rdata-tacsatEflalo
DEU	2015	TBB	FF_Central	32	61629	FFCO_2017.Rdata-tacsatEflalo

DEU	2015	OTB	FF_East	0	41	FFCO_2017.Rdata-tacsatEflalo
DNK	2010	OTB	CO	8	431165	FFCO_2017.Rdata-tacsatEflalo
DNK	2010	OTB	FF_Central	0	126	FFCO_2017.Rdata-tacsatEflalo
DNK	2011	OTB	CO	2	218318	FFCO_2017.Rdata-tacsatEflalo
DNK	2012	OTB	CO	31	1180499	FFCO_2017.Rdata-tacsatEflalo
DNK	2012	OTB	FF_Central	1	8172	FFCO_2017.Rdata-tacsatEflalo
DNK	2012	OTB	FF_East	4	183816	FFCO_2017.Rdata-tacsatEflalo
DNK	2013	OTB	CO	7	757481	FFCO_2017.Rdata-tacsatEflalo
DNK	2013	OTB	FF_Central	14	426588	FFCO_2017.Rdata-tacsatEflalo
DNK	2013	OTB	FF_East	23	1032017	FFCO_2017.Rdata-tacsatEflalo
DNK	2014	OTB	CO	9	1517436	FFCO_2017.Rdata-tacsatEflalo
DNK	2014	OTB	FF_Central	4	5677	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	OTB	CO	50	3853290	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	SDN	CO	5	12054	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	OTB	FF_Central	4	526964	FFCO_2017.Rdata-tacsatEflalo
DNK	2015	OTB	FF_East	7	794162	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	OTB	CO	7	34249	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	SSC	CO	1	2002	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	TBB	CO	0	40	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	TBB	FF_Central	15	23685	FFCO_2017.Rdata-tacsatEflalo
GBR	2010	SSC	FF_East	3	7671	FFCO_2017.Rdata-tacsatEflalo
GBR	2011	OTB	CO	4	17471	FFCO_2017.Rdata-tacsatEflalo
GBR	2011	OTT	CO	1	7316	FFCO_2017.Rdata-tacsatEflalo
GBR	2011	TBB	FF_Central	0	93	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	OTB	CO	9	39491	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	OTT	CO	3	5650	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	TBB	FF_Central	1	3730	FFCO_2017.Rdata-tacsatEflalo
GBR	2012	TBB	FF_East	1	1672	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	OTB	CO	13	33470	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	SSC	CO	3	13940	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	TBB	CO	1	1703	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	TBB	FF_Central	1	1100	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	SSC	FF_East	2	2363	FFCO_2017.Rdata-tacsatEflalo
GBR	2013	TBB	FF_East	1	542	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	OTB	CO	8	55188	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	OTT	CO	3	19354	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	TBB	CO	1	5642	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	TBB	FF_Central	1	1697	FFCO_2017.Rdata-tacsatEflalo
GBR	2014	SSC	FF_East	2	1084	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	OTB	CO	18	42743	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	SDN	CO	0	4	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	OTB	FF_Central	2	364	FFCO_2017.Rdata-tacsatEflalo
GBR	2015	TBB	FF_Central	2	9817	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTB	CO	13	35992	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTT	CO	13	31013	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	TBB	CO	1	6164	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTB	FF_Central	23	20870	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	OTT	FF_Central	14	13835	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	TBB	FF_Central	151	243085	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	SSC	FF_East	18	40238	FFCO_2017.Rdata-tacsatEflalo
NLD	2010	TBB	FF_East	17	18047	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTB	CO	6	13114	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	TBB	CO	2	6124	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTB	FF_Central	38	42835	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTT	FF_Central	53	41525	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	TBB	FF_Central	56	80784	FFCO_2017.Rdata-tacsatEflalo

NLD	2011	OTB	FF_East	1	166	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	OTT	FF_East	4	6941	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	SSC	FF_East	12	22404	FFCO_2017.Rdata-tacsatEflalo
NLD	2011	TBB	FF_East	2	1672	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTB	CO	34	104523	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTT	CO	3	4707	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	TBB	CO	1	2306	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTB	FF_Central	11	12325	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	OTT	FF_Central	53	48491	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	TBB	FF_Central	93	147466	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	SSC	FF_East	14	36464	FFCO_2017.Rdata-tacsatEflalo
NLD	2012	TBB	FF_East	12	13984	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	DRB	CO	1	312	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTB	CO	32	93747	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTT	CO	4	7362	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	TBB	CO	0	160	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTB	FF_Central	10	11814	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	OTT	FF_Central	47	44457	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	SSC	FF_Central	1	2651	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	TBB	FF_Central	41	65462	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	DRB	FF_East	3	95	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	SSC	FF_East	33	73748	FFCO_2017.Rdata-tacsatEflalo
NLD	2013	TBB	FF_East	3	5065	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTB	CO	20	74270	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTT	CO	2	5037	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTB	FF_Central	18	27694	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTT	FF_Central	40	45842	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	SSC	FF_Central	2	7591	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	TBB	FF_Central	40	70845	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	OTT	FF_East	1	2	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	SSC	FF_East	29	48228	FFCO_2017.Rdata-tacsatEflalo
NLD	2014	TBB	FF_East	2	1682	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTB	CO	10	23262	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTT	CO	10	24748	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	TBB	CO	0	186	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTB	FF_Central	31	32633	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTT	FF_Central	32	45094	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	SSC	FF_Central	9	40493	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	TBB	FF_Central	60	116414	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTB	FF_East	1	775	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	OTT	FF_East	0	225	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	SSC	FF_East	23	40680	FFCO_2017.Rdata-tacsatEflalo
NLD	2015	TBB	FF_East	1	426	FFCO_2017.Rdata-tacsatEflalo