# Annex 6 - Background document Brown Ridge

Background document to the proposed Joint Recommendation for Conservation measures under the Common Fisheries Policy

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These institutes provided the scientific information on natural features, activities in the areas, economic value of the areas and the expected effects of the conservation measures. This information has been incorporated in chapters two and four of the area specific Background Documents and chapters three, six and seven of the General Background Document.

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# Summary

This document contains the area-specific background information to the proposed Joint Recommendation under Art. 11 and 18 of Regulation (EU) 1380/2013) on the Common Fisheries Policy to implement conservation measures on the Brown Ridge necessary to comply with Union Environmental legislation, such as the Habitat Directive, Birds Directive or Marine Strategy Framework Directive. The Brown Ridge is designated as a Special Protection Area under the Birds Directive (BD). The conservation objectives for six birds species on the Brown Ridge (little gull, northern gannet, great skua, great black-backed gull, common guillemot and razorbill) are to maintain extent and quality of the habitat to sustain maintenance of the population. The impact of fishing on protected birds for the Brown Ridge is assessed by Jongbloed et al. (2019) and described in this report. Although the true bycatch risk is unknown, probably the risk is considerably higher for common guillemots than for razorbills and northern gannets (Jongbloed et al., 2019). The other three species designated for the Brown Ridge (great skua, little gull, greater black-backed gull) are shallow divers and thus do not come into contact with the anchored gillnets (set) on the Brown Ridge (Jongbloed et al., 2019). Gillnet and entangling net fisheries on the Brown Ridge are a threat to birds who dive when foraging on fish, and for those who can easily reach the sea floor in the area. Species most at risk are the common guillemot and, to a lesser extent, razorbill (Jongbloed et al., 2019). Gillnets and entangling nets are potential causes of mortality of the two diving bird species razorbill and common guillemot because they can get entangled in the nets underwater while foraging. The conservation measures that are taken under Birds Directive focus on gillnets and entangling nets fisheries considering these pose the main threat to conservation of the aforementioned bird species. Other human activities that have (potential) impacts will be assessed and measures taken in the upcoming Brown Ridge management plan. The proposal is to close the entire Brown Ridge (circa 136.548 ha) for gillnets and entangling nets fishery from October until March. Fisheries measures aimed at limiting gillnets and entangling nets fisheries in the area will reduce the risk of bycatch for these species and are thus expected to be beneficial to their conservation objective. This may also apply for northern gannets since a considerable part of the Brown Ridge seafloor is also within reach for this species. The other species, which are shallow divers at best, are not expected to benefit from measures restricting gillnets and entangling nets fisheries.

# 1 Introduction

This document contains the area-specific background information to the proposed Joint Recommendation[1] under Art. 11 and 18 of Regulation (EU) 1380/2013) on the Common Fisheries Policy to implement conservation measures on the Brown Ridge necessary to comply with Union Environmental legislation, such as the Habitat Directive, Birds Directive or Marine Strategy Framework Directive. The Joint Recommendation contains a request and a proposal to the European Commission to implement conservation measures necessary in this area to ensure a key contribution to achieving the Natura 2000 conservation objectives for guillemots concerning their habitat in order to ensure their survival and reproduction in their area of distribution in accordance with Article 4 of the Birds Directive 2009/147 EEC. This document contains the background information for these conservation measures.

This chapter provides the introduction of this area-specific Background Document. Chapter two elaborates on the site description including its natural features, fishing activities, and other human activities. Chapter three describes the rationale for conservation. The conservation objectives are explained, the policy considerations are described and the translation into conservation measures is discussed.
Chapter four describes the expected effects of the conservation measures on natural features, fishing and other human activities. Finally chapter five elaborates on the discussions in the Scheveningen Group and NSAC regarding the proposed conservation measures for the Brown Ridge. In Chapter six the conclusion leading to the current Joint Recommendation is summarized.

The content of this area-specific Background Document is established in accordance with the requirements as requested by the European Commission (2018).

**This area specific Background Document needs to be read in conjunction with the Joint Recommendation and General Background Document.**

[1] This document refers to the (current) Joint Recommendation. With this reference the proposed Joint Recommendation for conservation measures is meant.

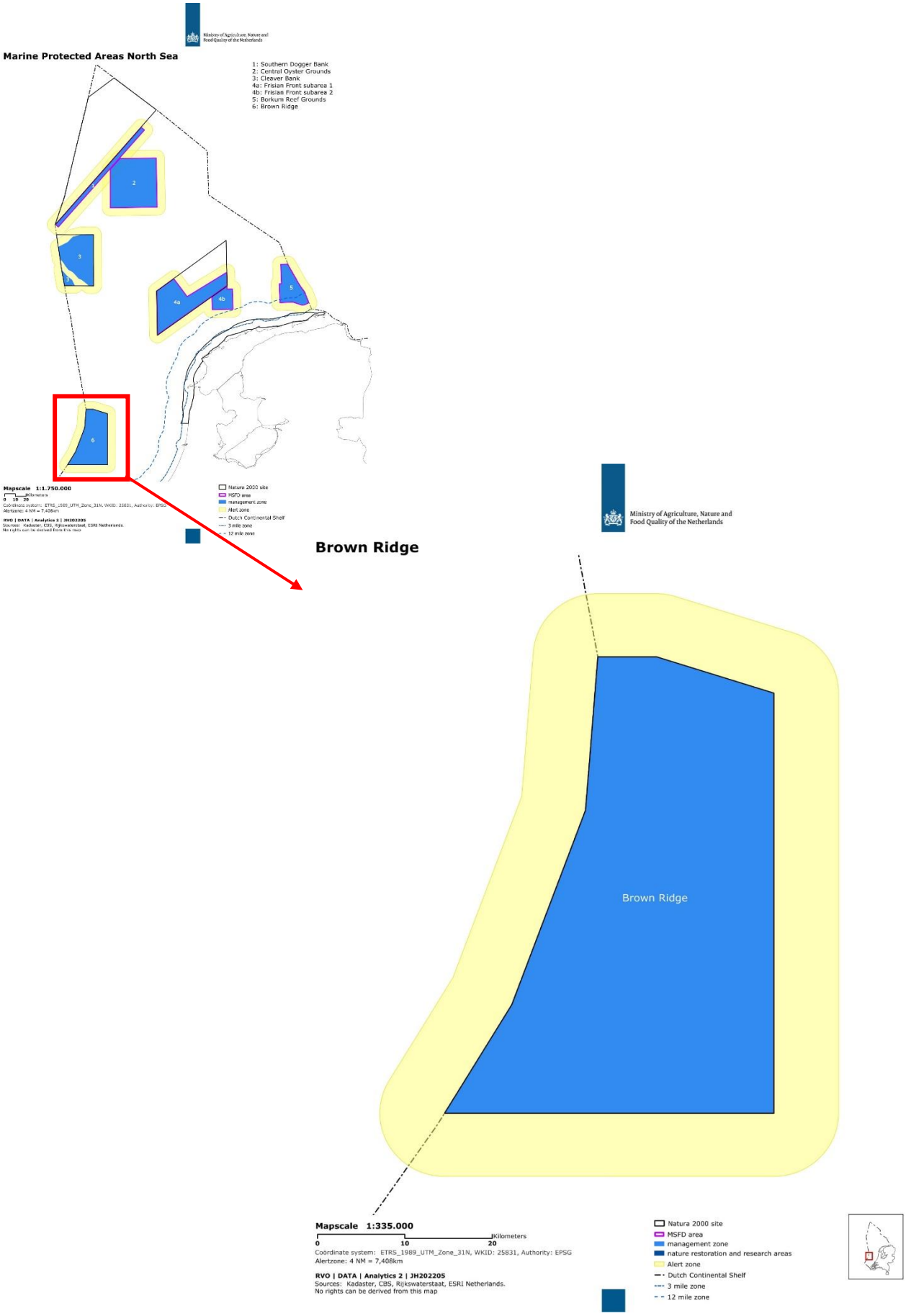


*Figure 1. North Sea protected areas with a detailed map of the area Brown Ridge.*

# 2 Area description

## 2.1 Legal status

The Brown Ridge is designated as a Special Protection Area under the Birds Directive (BD). In March 2021, a draft decision on designation has been published by the ministry of Agriculture, Nature and Food Quality (The Dutch Ministry of Agriculture, Nature and Food Quality (Min LNV), 2021). In November 2021, the Brown Ridge was officially designated as Special Protection Areas (SPA) on the Dutch EEZ and has become part of the Natura 2000 network.

The Standard Data Form (SDF) contains all relevant information, accompanying a submission of a candidate SPA to the European Commission. SDFs, including all underlying source information, are available at the website of the European Commission[2].
The designation of the Brown Ridge as SPA is described in the decision on designation as Natura 2000-area (Min LNV, 2021). Migratory seabirds for which the area complies with the 1% threshold are presented in Table 1. The occurrence of non-qualifying but significant numbers of other migratory bird species (at least 0.1% of the biogeographic population) (Leopold and van der Wal, 2015) is presented in Table 2.

The Brown Ridge meets the BD criterion that numbers of at least 20,000 waterfowl or at least 10,000 seabirds occur regularly (Min LNV, 2021). The Brown Ridge also meets the criterion that a number of individuals, representing at least 1% of the biogeographic population of a bird species, visit the area regularly for foraging, molting, resting or other functions. The area contains on average approx. 1% of the North Sea population of the razorbill (*Alca torda*) and the common guillemot (*Uria aalge*) in the years 2014 to 2017. This means that the area qualifies for the 1% criterion for these species. In addition, the Brown Ridge area has a special function within the range of the proposed designated species for the little gull (*Larus minutus*), northern gannet (*Morus bassanus*), great skua (*Stercorarius skua*) and great black-backed gull (*Larus marinus*) (Min LNV, 2021).

*Table 1: Migratory seabirds for which the area complies with the 1% threshold (BD, Article 4) (The Dutch Ministry of Agriculture, Nature and Food Quality, 2021)*

| Species | Species code | Breeding bird | Biogeographical population | 1% Biopop.* | % in area | Period |
|---|---|---|---|---|---|---|
| Common guillemot | A199 | No | North Sea | 15.620 | 1 | 2014-2015, 2015-2016, 2016-2017 |
| Razorbill | A200 | No | North Sea | 3.240 | 1 | 2014-2015, 2015-2016, 2016-2017 |

* Threshold, i.e. 1% of the relevant biogeographical population

[2] http://natura2000.eea.europa.eu/natura2000/

*Table 2: Species in Appendix 1 Birds Directive and migratory seabird species that occur in considerable numbers (The Dutch Ministry of Agriculture, Nature and Food Quality, 2021).*

| Species | Breeding bird | Biogeographical population | 1% Biopop.* | 2014-2015 | 2015-2016 | 2016-2017 | Average | % in area |
|---|---|---|---|---|---|---|---|---|
| Northern gannet | A016 | North Sea | 4.183 ** | 909 | 900 | 1.111 | 976 | 0.23 |
| Great skua | A175 | North Sea | 272 | 61 | 61 | 61 | 61 | 0.22 |
| Little gull | A177 | West-European | 1.100 | 266 | 133 | 441 | 280 | 0.25 |
| Great black-backed gull | A187 | West-European | 4.200 | 350 | 350 | 1.191 | 630 | 0.15 |

* Threshold, i.e. 1% of the relevant biogeographical population

** The numbers shown are seasonal maximum between August and February, expressed as the number of individuals. The lower limit is the average of the three seasons reaching 0.1% of the biogeographic population *(Leopold and van der Wal, 2015)*

## 2.2 Natural features

The Brown Ridge (also known as 'Brown Bank, and as 'Bruine Bank' in Dutch) is a ridge located in the centre of the southern North Sea, on the western edge of the Dutch Continental Shelf (DCS) adjacent to the EEZ of the United Kingdom. In the southern North Sea, between the Netherlands and the United Kingdom, a north-easterly flowing current sweeps water masses from the English Channel into the central North Sea (García et al., 2020 and references therein). Due to strong hydrodynamic changes induced by these water currents, this part of the North Sea is characterised by the presence of sandbanks, which are topographically different from the regular seabed. The transboundary area is characterised by sandy bottoms with a number of geologically, ecologically and archeologically interesting ridges on the seafloor surrounded by deeper waters. This results in a tidal upwelling, which concentrates zooplankton and therefore attracts associated pelagic fauna. The Brown Ridge is a known area of key habitat for harbour porpoise (*Phocoena phocoena*) (García et al., 2020; Lindeboom et al., 2005). For birds, the Brown Ridge is an important foraging area in winter and an important migration area in autumn (Min LNV, 2021).

### 2.2.1 Depth contours

The Brown Ridge is formed by a series of large-scale sand-banks that create an elevation in the otherwise relatively deep waters of the Southern Bight. The average depth of Brown Ridge is 32 m, with the deepest parts at around 60 m and the shallowest at 16 m. The ridge rises approximately 20 m above the surrounding seabed and runs from north to south, with the ledges parallel to the tidal ebb and flow streams. Sand ripples have been observed to form in the area, which are nearly perpendicular (i.e., running from east to west) to the larger sandbanks (García et al., 2020 and references therein) (**Fout! Verwijzingsbron niet gevonden.** and 4).

### 2.2.2 Sediment type

The sediment of the Brown Ridge consists of coarse sand with a median grain size varying between 250 and 300 µm. Occasional patches of coarse and mixed sediment are known to occur in the deeper parts of the area (García et al., 2020 and references therein).

There are areas of peat emerging to the surface of the seabed. The percentage of organic matter in the sediment is generally low and the oxidised sediment layer is roughly 20 cm thick (García et al., 2020 and references therein) (Figure 4).

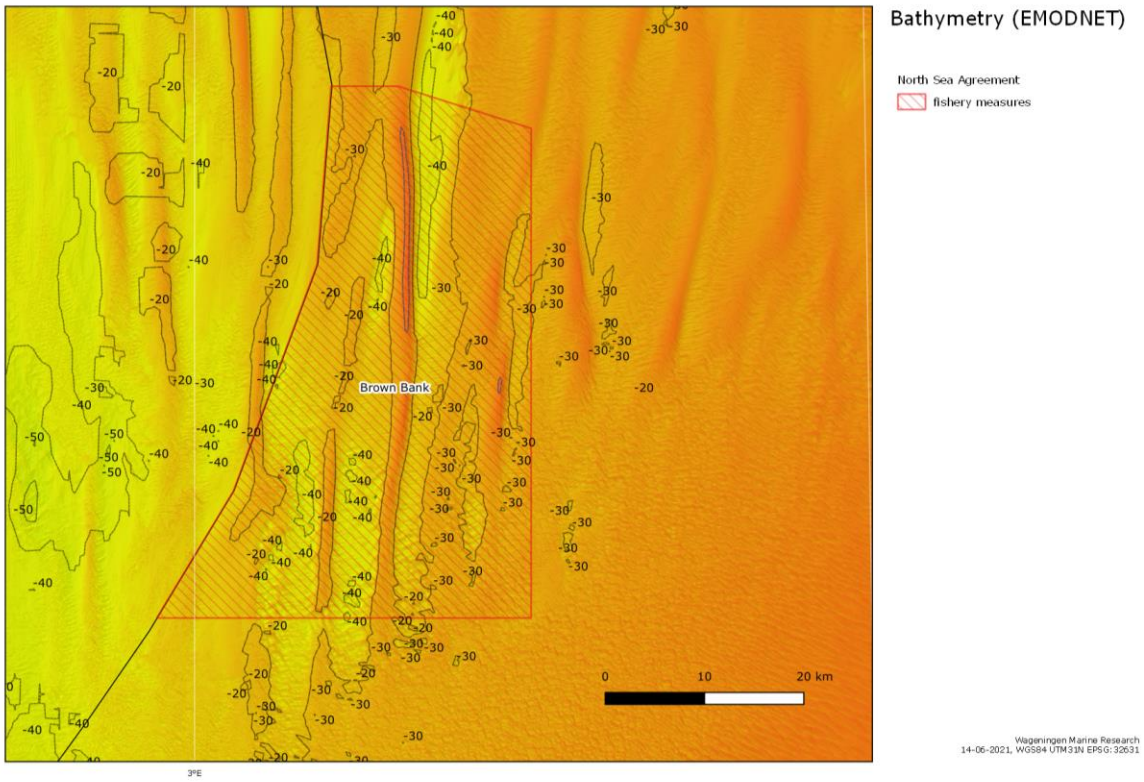


*Figure 3. Brown Ridge, proposed management zones and depth contours (source EMODNET).*

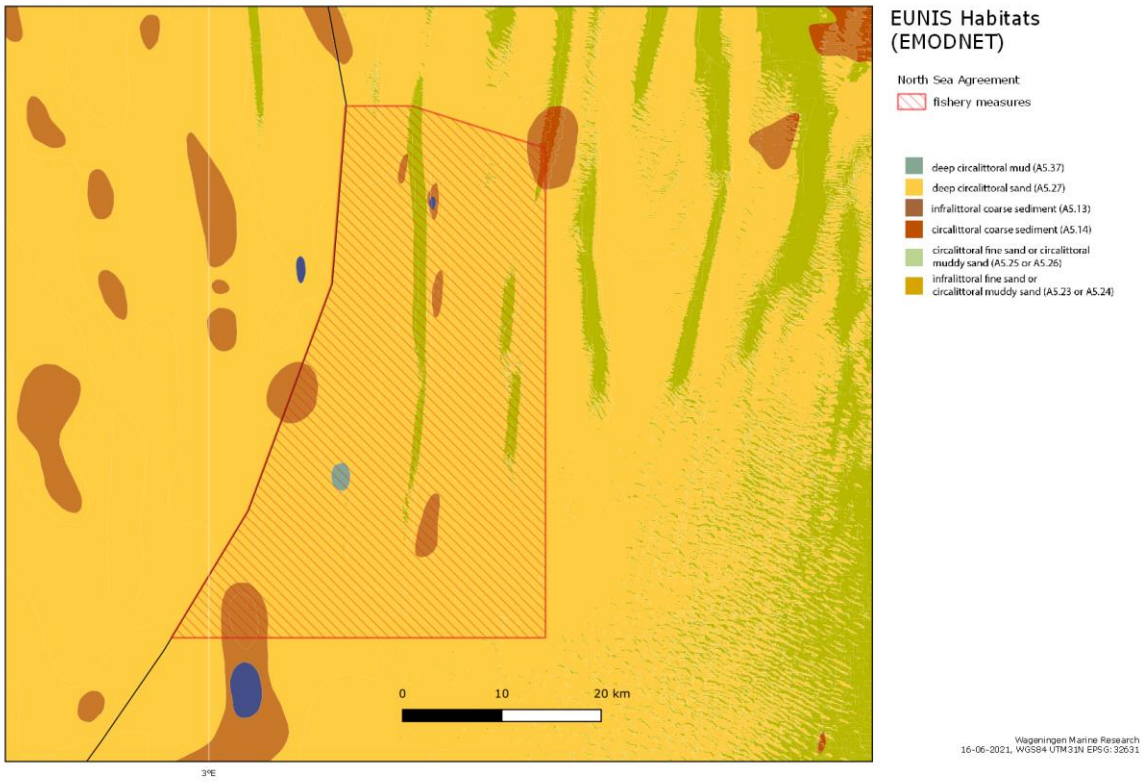


*Figure 2. Brown Ridge, proposed management zones and EUNIS habitats (source EMODNET).*

### 2.2.3 Benthic communities

Based on available data from box-corers and dredges, showed that the evenness of macrobenthos was moderately high in the area, but other benthic biodiversity metrics scored low (Bos et al., 2011). Based on surveys carried out in 2016 and 2017, three community types were found in Dutch waters of Brown

Ridge (in order of predominance): i) detritic sandy bottom with shell remains; ii) *Sabellaria spinulosa* aggregations and reefs on soft bottoms; and iii) artificial substrata (wrecks) covered by invertebrates on detritic sandy bottom with shell remains (García et al., 2020).

The Ross worm *Sabellaria spinulosa* (closely related to the honeycomb worm *Sabellaria alveolata*) can occur as an individual but can also form relatively large reef structures on both hard substrate and on somewhat consolidated (rather solid) sediment (Bos and Tamis, 2020). The tubes are about three cm long and the reefs around 50 cm high. Reefs of this species are common in other parts of the North Sea Ecoregion but rare in the Dutch part of the North Sea (van Duren et al., 2016). In 2017, *Sabellaria spinulosa* reefs were discovered at the Brown Ridge (van der Reijden et al., 2019). An overview of locations of biogenic reefs has been made by Bos et al. (2019). The reef structures have been identified as promoting biodiversity (van Duren et al., 2016). In total, >1000 $m^2$ of Sabellaria reefs were found (details in Van der Reijden et al., 2019). They are located in the middle and north of the current proposal for closures (Figure 5).

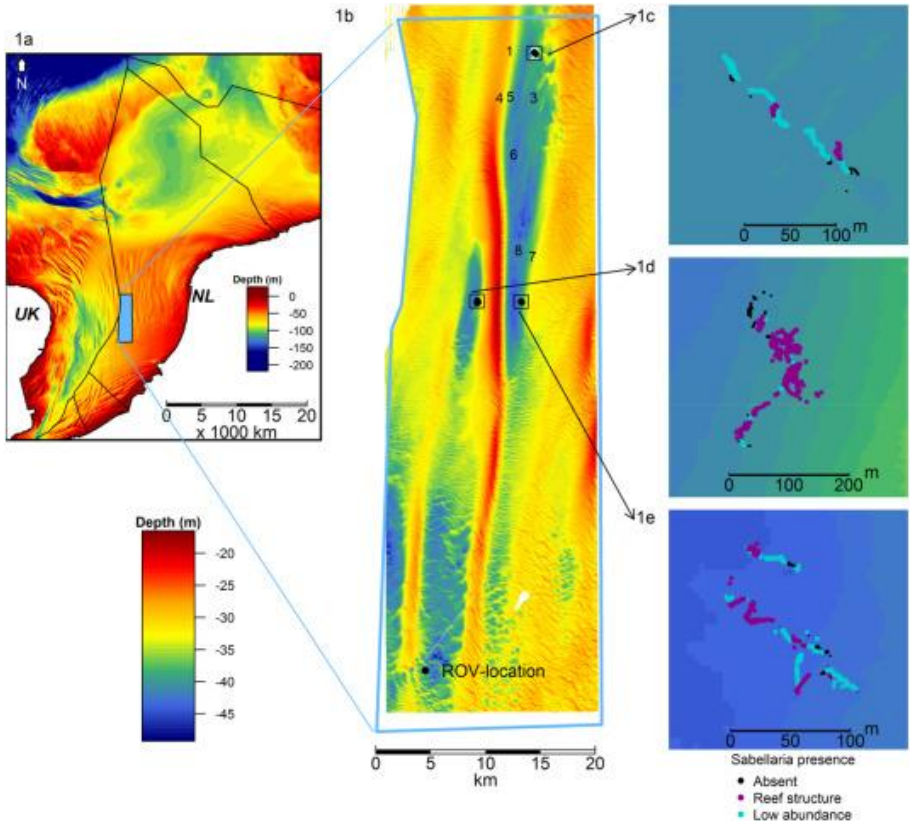


*Figure 4. A high-resolution bathymetry map of the Brown Ridge area depicting the locations of the sediment samples (1–8) and ROV- transects (dots) (b). S. spinulosa presence, including reef condition (reef structure versus low abundances), are shown for the separate ROV-locations (source: Van der Reijden et al., 2019).*

**Status of the habitat quality**

In the Netherlands, the benthic habitat quality status is evaluated by use of the Benthic Indicator Species Index (BISI) (Wijnhoven and Bos, 2017; Wijnhoven, 2018), which is specifically designed for areas of special ecological value and used for Marine Strategy Framework Directive (MSFD) status reporting (The Dutch Ministry of Infrastructure and Water Management (Min IenW) & Min LNV, 2018). Besides the MSFD areas and areas designated under the Habitats Directive (HD), potentially ecologically valuable areas are evaluated by use of the BISI, including the Brown Ridge. In addition, the Brown Ridge is

considered as representative of the Southern Bight and the deep sandy ecotope (offshore sand) within the evaluation of the Dutch benthic habitat quality status (Min I&W and Min LNV; Wijnhoven, 2018).

The general quality status of the Brown Ridge seabed habitats with a BISI score of 0.274 at T0 (situation 2015) can be described as low (Figure 6). Both natural disturbance and seabed-disturbing activities seem to play a role here (Wijnhoven, 2018). It is therefore expected that, for the time being, the quality will not improve (Min I&W and Min LNV; Wijnhoven, 2018). In the North Sea Agreement (Rijksoverheid, 2019) an agreement was reached on independent research on the presence of *Sabbellaria spinulosa*. If the research shows that these reefs need to be protected, they will be protected in the future according to the HD or MSFD.

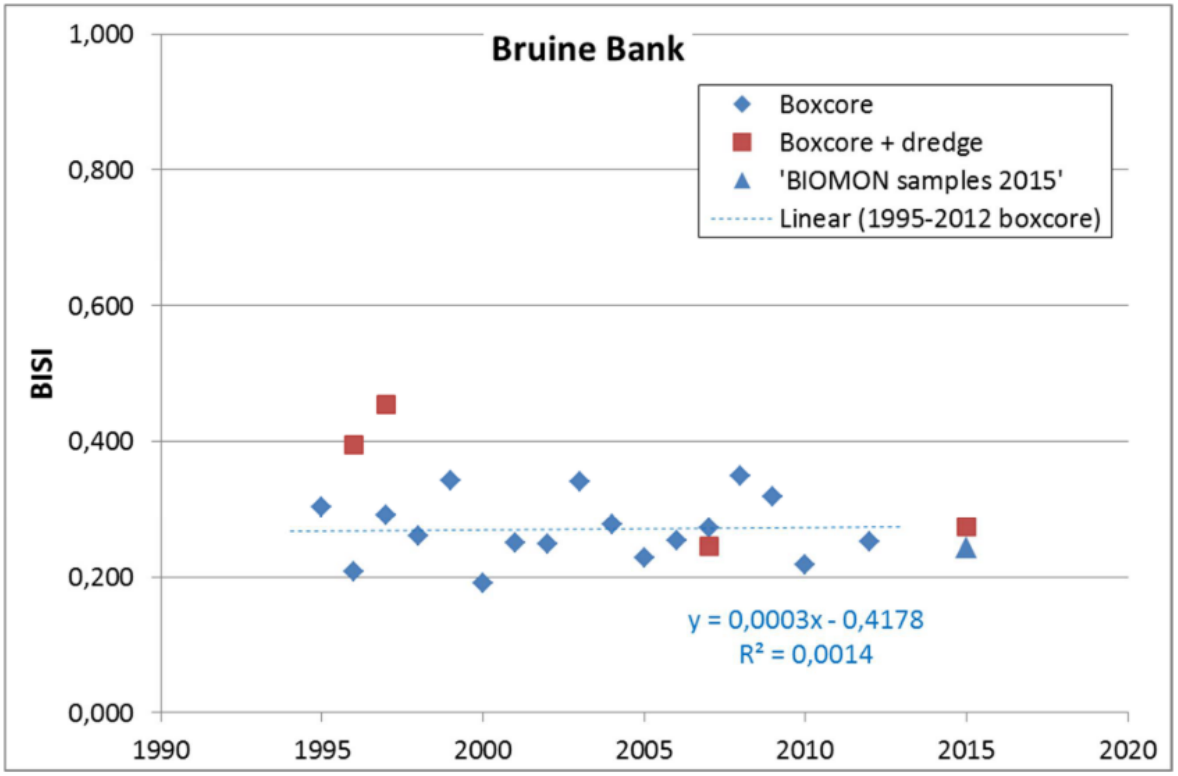


*Figure 5. Comparison of current (T0 = 2015) quality status with recent historical developments based on the Benthic Indicator Species Index (BISI) (Wijnhoven, 2018). The title Bruine Bank means Brown Ridge.*

### 2.2.4 Fish communities

Brown Ridge (and the Southern Bight more broadly) is known to be an area that provides essential fish habitat for a variety of commercial fish species (García et al., 2020 and references therein). Spawning grounds have been documented for species that include cod (*Gadus morhua*), herring (*Clupea harengus*), mackerel (Scomber scombrus), sandeels (Ammodytidae), sprat (*Sprattus sprattus*), plaice (*Pleuronectes platessa*), sole (*Solea solea*), and whiting (*Merlangius merlangus*). Nursery areas in the Brown Ridge area have been recorded for mackerel, sandeel, sprat, and whiting (García et al., 2020 and references therein).

### 2.2.5 Birds

In 2005 the area of Brown Ridge was identified as an important marine area for (among others) birds (Lindeboom et al., 2005). Subsequently, the specific value of the area was further studied. A total of 80 birds species were observed in the area (Bemmelen et al., 2012). Since 2014, seabird species have been monitored by airplane within the MWTL monitoring programme (Monitoring Waterstaatkundige Toestand des Lands)) over the Brown Ridge and its surroundings in four months of the year (January, February, August, November) (Fijn and de Jong, 2019). Maps of the density of the seabirds in the area can be found in Fijn & de Jong (2019). In autumn and winter the number of birds peak due to

simultaneously presence of auks, kittiwakes, little gulls, great black-backed gulls, great skuas, sandwich terns, northern gannets, lesser black-backed gulls, fulmars, puffins, storm gulls, guillemots and herring gulls. Therefore, the area has been designated as SPA under the BD (Min LNV, 2021), see also section 3.1.

The Brown Ridge meets the BD criterion that regularly numbers of at least 20,000 waterfowl or at least 10,000 seabirds occur (Min LNV, 2021). The Brown Ridge also meets the criterion that a number of individuals, representing at least 1% of the biogeographic population of a bird species, visit the area regularly for foraging, moulting, resting or other functions. The area contains on average approx. 1% of the North Sea population of the razorbill (*Alca torda*) and the common guillemot (*Uria aalge*) in the years 2014 to 2017. This means that the area qualifies for the 1% criterion for these species. Other designated species are little gull (*Larus minutus*), northern gannet (*Morus bassanus*), great skua (*Stercorarius skua*) and great black-backed gull (*Larus marinus*) because they are regularly occurring migratory species.

The Brown Ridge area has a special function within the range of the designated species (Min LNV, 2021):

- Northern gannet (*Morus bassanus*)
  the area is used by the gannets for foraging during the autumn migration and winter. The largest numbers are present during the months of August and November-January.
- Great skua (*Stercorarius skua*)
  the area is used by the great skua for foraging and molting during the autumn migration. The largest numbers are present in August.
- Little gull (*Larus minutus*)
  the area is used by the little gull for foraging during the autumn migration. The largest numbers are present during the months of October-November.
- Great black-backed gull (Larus marinus)
  the area is used by the great black-backed gull for foraging during the autumn migration and during the winter months. The largest numbers are present during the months of November-January.
- Common guillemot *(Uria aalge*)
  the area is used by the guillemot for foraging. The largest numbers are present during the winter months of November-February.
- Razorbill (*Alca torda*)
  the area is used by the razorbill for foraging. The greatest numbers are present during the winter months of January-March.

Common guillemot and razorbill dive when foraging on fish and can easily reach the sea floor in the study area (Jongbloed et al., 2019 and references therein). A considerable part of the Brown Ridge seafloor is also within reach for gannets, but not to any of the other species, which are shallow divers at best.

For common guillemot and razorbill distribution maps were constructed by Jongbloed et al. (2019) for the derived mean season distribution across the three winter seasons 2014-2015, 2015-2016, 2016-2017 (Figure 7 and Figure 8).

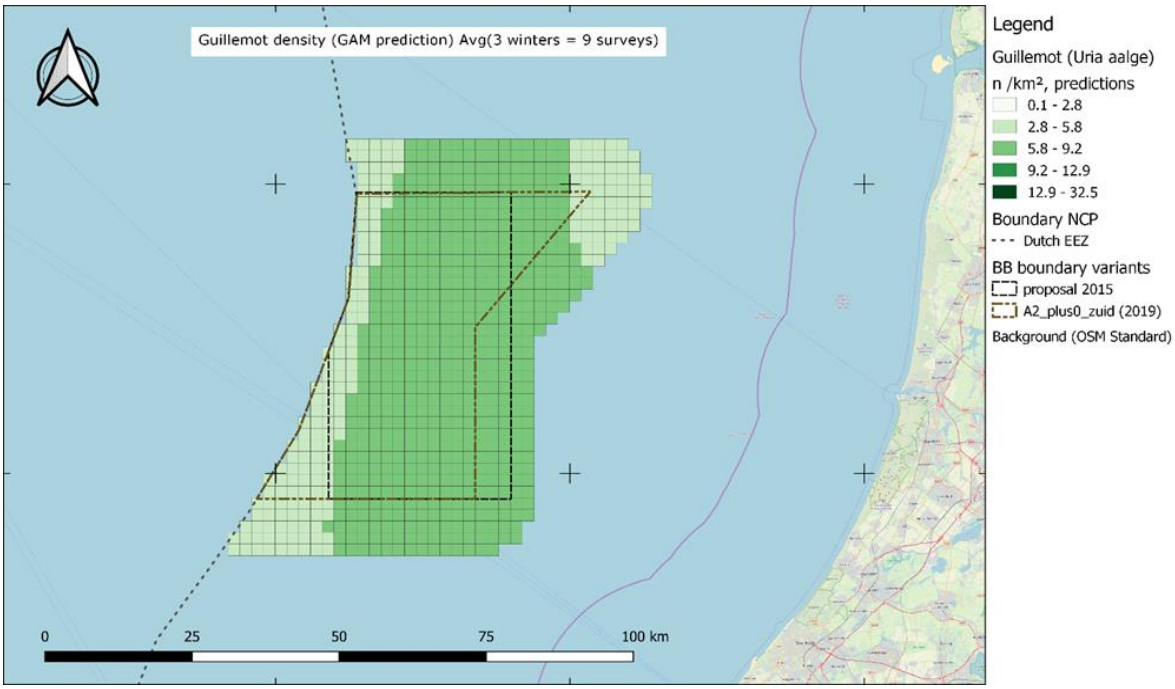


*Figure 6. Common guillemot (Uria aalge) mean season maxima distribution across the Brown Ridge area across 3 winter seasons (2014-2015, 2015-2016 and 2016-2017, includes 9 surveys).*

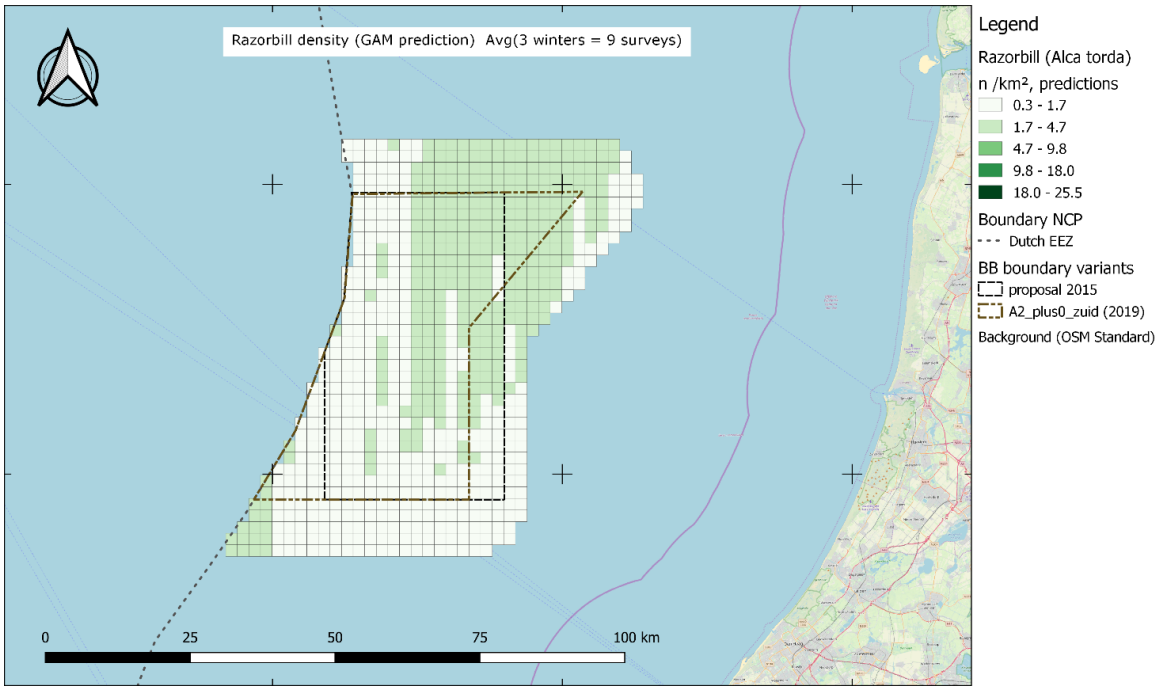


*Figure 7. Razorbill (Alca torda) mean of season maxima distribution across the Brown Ridge area across 3 winter seasons (2014-2015, 2015-2016 and 2016-2017, includes 9 surveys).*

A relative high presence is found for six months (October to March) for the common guillemot and for four months (December-March) for the razorbill (Figure 9, Jongbloed et al. (2015)). During spring and summer (April-September) the presence of the razorbill is much lower to not present, while the common guillemot remains present in the months April and May and throughout the summer months in low numbers.

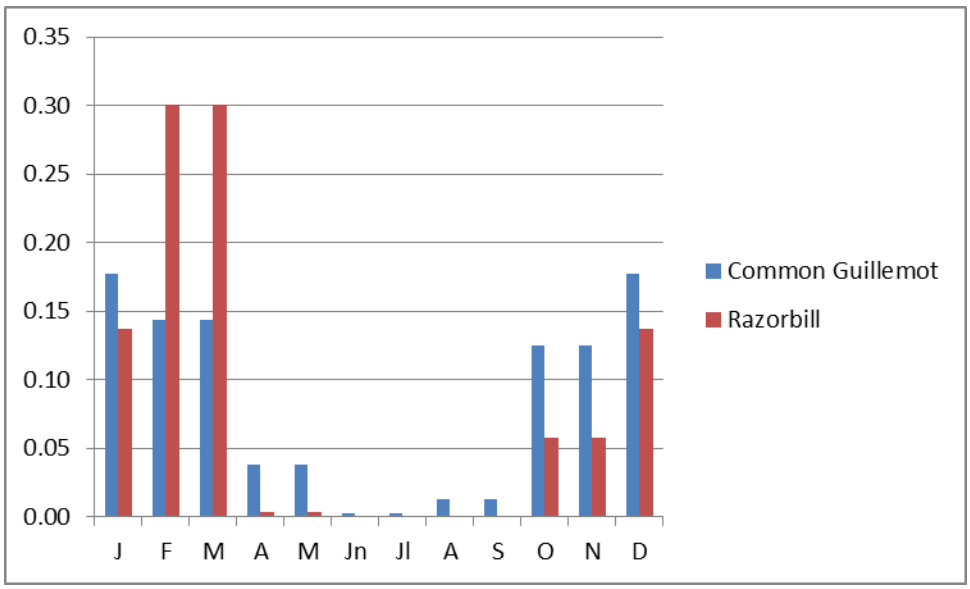


*Figure 8. Relative presence during the year of common guillemots and razorbills in the Brown Ridge. For each bird species, the presence per month was divided by the sum of presence over the year. The bars add up to 1 for each bird species represented by colours. Data are based on monitoring with ESAS and MWTL for the period 2004-2013. Figure is taken from Jongbloed et al. (2015).*

### 2.2.6 Marine mammals

Resident or annual present species of the DCS are harbour seal, grey seal, harbour porpoise, white-beaked dolphin and minke whale. The UK waters of Brown Ridge are protected for harbour porpoise under the Habitats Directive (Natura 2000 area code UK0030395). The Dutch side of Brown Ridge has been identified as a general biodiversity hotspot for marine mammals on the DCS, not only with regard to harbour porpoises (*Phocoena phocoena*), but also because of the presence of white-beaked dolphins (*Lagenorhynchus albirostris*), grey seals (*Halichoerus grypus*) and harbour seals (*Phoca vitulina*) (Bos et al., 2011). Highest densities of white-beaked dolphins, which are scarce on the DCS, are found along the western border of the DCS, in particular areas like Brown Ridge.

## 2.3 Fishing activities

The Brown Ridge is designated as Special Protection Area under the BD because of its importance for the razorbill (*Alca torda*) and the common guillemot (*Uria aalge*), and other bird species. The area is also an important area for fisheries. However, gillnets and entanglingnets fisheries can cause bird mortality. In this chapter we describe the economic importance of the area for all fishing activities and in detail the gillnet fisheries. The impact of gillnets and entangling nets fisheries on seabirds in the Brown Ridge area has been described by Jongbloed et al. (2019). The texts below are taken from their publication and from the recent publications of Hamon, K. G. & Klok, A, (2023) and Jongbloed et al., (2023).

Other types of fisheries are not expected to have a significant negative effect on the survival and reproduction in their area of distribution mentioned in Annex I of the BD. However, at the request of relevant countries around the North Sea we have done additional research which includes other types of fisheries as well. The first two paragraphs (2.3.1 and 2.3.2.) will focus on gillnet and entangling nets fisheries and the following paragraphs (2.3.3 up to and including 2.3.10) will focus on all types of fisheries. The information for data sources and processing of the overall fishing activities on the Dutch EEZ is included in chapter 3.2 of the General Background Document.

### 2.3.1 Impacts of fishing activities

In this section the impact assessment of gillnets and entangling netsfishery for common guillemot, razorbill and norther gannet is presented. At first, the method is described. Subsequently the different aspects playing a role in the assessment are dealt with. Finally, the impact is assessed by integration of the aspects.

#### 2.3.1.1 Method for impact assessment

The conflict analysis consists of the evaluation of the fishing impact on a selection of seabirds. Species were selected as follows: common guillemot and razorbill are relevant seabird species to consider because of the high numbers in the Brown Ridge, meeting the requirements of the Bird Directive (Fijn & De Jong, 2019) in combination with a potential risk for entanglement in gillnets and entangling nets (i.e. both species dive when foraging on fish and can easily reach the sea floor in the study area (Jongbloed et al., 2019 and references therein)). In addition to common guillemot and razorbill, four other species are proposed for designation under the BD (northern gannet, great skua, little gull, greater black-backed gull). Only the northern gannet is a deep diver and a considerable part of the Brown Ridge seafloor is within reach for northern gannets (Jongbloed et al., 2019 and references therein). This is not the case for any of the other species, which are shallow divers at best. Therefore, the northern gannet is also selected for the impact assessment, together with common guillemot and razorbill.

The bycatch of seabirds in gillnets and entangling nets set in the Natura 2000-area Brown Ridge is not recorded and no exhaustive data exist on the interaction between fishers and seabirds. To evaluate the fishing impact on the bird populations several aspects must be accounted:

- Do the fishery and birds overlap spatially?
    - In the Natura 2000-area Brown Ridge (geographically)
    - In the water column (vertically)
- Do the fishery and birds overlap temporally?
- What is the risk for a diving bird to be caught in a gillnets and entangling nets?
- Do all gillnets and entangling nets types share the same risks?

#### 2.3.1.2 Spatial overlap

The spatial overlap is studied for two dimensions: surface area and water column. Both are relevant for the assessment of the potential exposure.

Surface area

There is a potential spatial overlap between gillnets and entangling nets fishery (**Fout! Verwijzingsbron niet gevonden.**9, **Fout! Verwijzingsbron niet gevonden.**0, **Fout! Verwijzingsbron niet gevonden.**) and sea bird distribution (Figure 6 and Figure 7) in the Brown Ridge. Precise predictions about differences among sub areas within the Brown Ridge concerning the extent of overlap cannot be made. There is also due to the considerable difference between fishery intensity and seabird density in the spatial scale. The grid size of the fishery intensity maps is large, namely either 1/16 ICES rectangle or an entire ICES rectangle. The grid size of seabird density maps is small with a resolution of 2 x 2 km and seabirds numbers per $km^2$ per species. General predictions can be made, and this is carried out for the five geographical options for the Brown Ridge based on the spatial density maps derived in the present study. There is a high uncertainty because locations of fishing and birds presence can vary.

Water column and diving depth

The gillnets and entangling nets stand on the sea floor. The sea floor depth of the Brown Ridge varies between 16 and 50 m (average 32 m), see section 2.2.1. The diving depth of common guillemots and razorbills has not been investigated in the Brown Ridge or adjacent areas of comparable depth. Based on an evaluation of literature, Jongbloed et al. (2019) expected that razorbills and northern gannets mostly forage well away from the bottom in the Brown Ridge area whereas common guillemots probably often dive to the seafloor of the Brown Ridge area in case of foraging on sandeels and other demersal fish where they are exposed to gillnets and entangling nets. Both razorbills and guillemots have been caught in set gillnets (anchored), over a large range of water depths, for both species exceeding 100 m (Jongbloed et al., 2019 and references therein). Although entanglements of northern gannets in fishing gear on the Dutch coast have been reported, the risk of entanglement in gillnets and entangling nets

standing on the seafloor of the Brown Ridge is assessed to be very low for northern gannets and much lower than for common guillemots and razorbills when foraging in the same marine area (Jongbloed et al., 2019 and references therein).

#### 2.3.1.3 Temporal overlap

Spatial data of common guillemot and razorbill densities are available for November (years 2014 until 2016) and January and February (2015 until 2017). For both the Dutch- and German gillnets and entangling nets fleet, information on the spatial and temporal distribution of the fishing effort is available that can be used to calculate the overlap between fishing activities and bird presence.

The available data on fishing effort show that only sole- and cod fishery is relevant as fishery targeting seabass does not take place in November, January and February (Jongbloed et al., 2019). In the months that birds are recorded, fishing effort is relative low (Figure 10, Figure 12). Finally, there is only fishing effort recorded in the southern part of the Brown Ridge area that is located in ICES rectangle 33F3 in those months.

For the German fleet only sole fishery takes place (Jongbloed et al., 2019). When looking at this fishery activity in more detail it can be seen that there is only some limited activity in February and in the Brown Ridge area located inside 33F3 ICES rectangle (Figure 11).

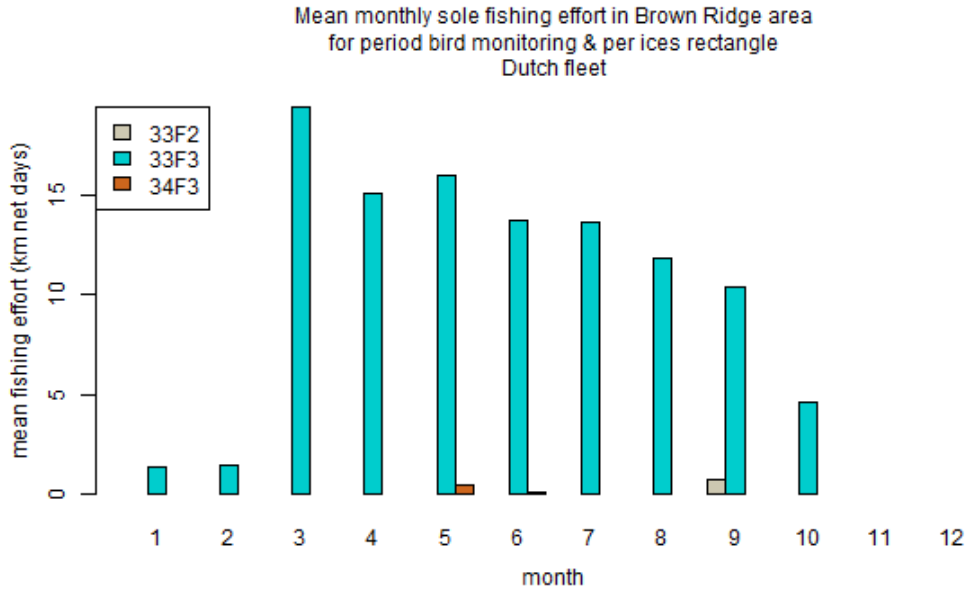


*Figure 9. Mean monthly sole gillnet fishery effort by the Dutch fleet in the Brown Ridge in ICES rectangles (Jongbloed et al., 2019).*

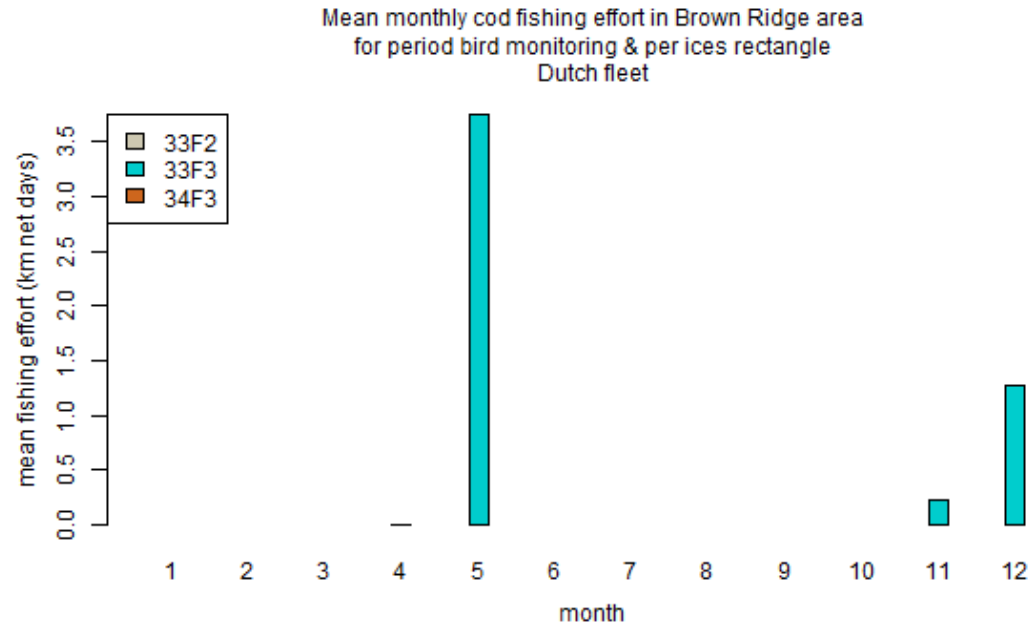


*Figure 11. Mean monthly cod gillnet fishery effort by the Dutch fleet in the Brown Ridge in ICES rectangles (Jongbloed et al., 2019).*

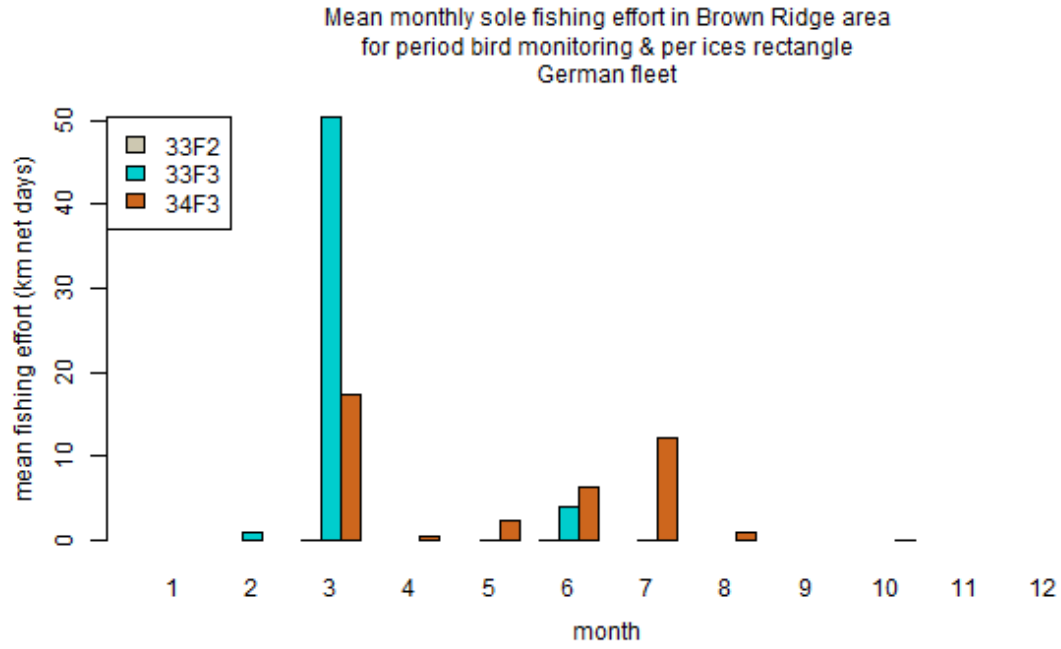


*Figure 10. Mean monthly sole gillnet fishery effort by the German fleet in the Brown Ridge in ICES rectangles (Jongbloed et al., 2019).*

There is little temporal overlap between gillnets and entangling nets fishery intensity (Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14) and sea bird distribution (see section 2.2.5) in the Brown Ridge in the months August, November, January and February. In general, the intensity of seabass and sole fishery is much higher in the summer half year than in the winter half year, whereas the abundance of common guillemot and razorbill is opposite with high numbers in the winter half year and low number is the summer half year (Jongbloed et al., 2019). Cod fishery is carried out in only three months in the year (May, November, December) with a potential high overlap in November and December, however, the presence of the birds was only recorded in four months, with November as the only month with a temporal overlap. This produces a fragmentary picture. For all three gillnets and entangling nets fishery types the temporal overlap analysis is hampered by the limited availability of bird abundance data.

Inclusion of bird counts all months of the period October to May is of importance for improvement (Jongbloed et al., 2019).

In ICES rectangles 34F3 and 33F2 there is no (proof for) exposure as there is no fishery activity in the months with bird monitoring data. When overlaying the relevant Dutch and German fishery activities in ICES rectangle 33F3 over bird presence in the same ICES rectangle the Brown Ridge variants can be compared to each other. In Figure 13 – Figure 17, it can be seen that for both the Dutch and German fleet the Brown Ridge variant A1-3 (with the largest surface area located in ICES rectangle 33F3) leads to the highest overlap in use while variant B1 (with the lowest surface area in ICES rectangle 33F3) leads to the lowest overlap in use. The overlap between seabirds and gillnets and entangling nets fishery in the five Brown Ridge variants decreases in the order: A1-3, A1-1 and A1-2, A2, B1. It can be concluded that less spatial overlap of the birds with the gillnets and entangling nets fishery can be expected in case the Brown Ridge optional areas are less situated in the southern part (33F3). In the previous years (2012 and 2013) the gillnets and entangling nets fishery intensity in ICES rectangle 33F3 was also higher than the one in 34F3. Although it should be noted that these data are based on a relatively short period.

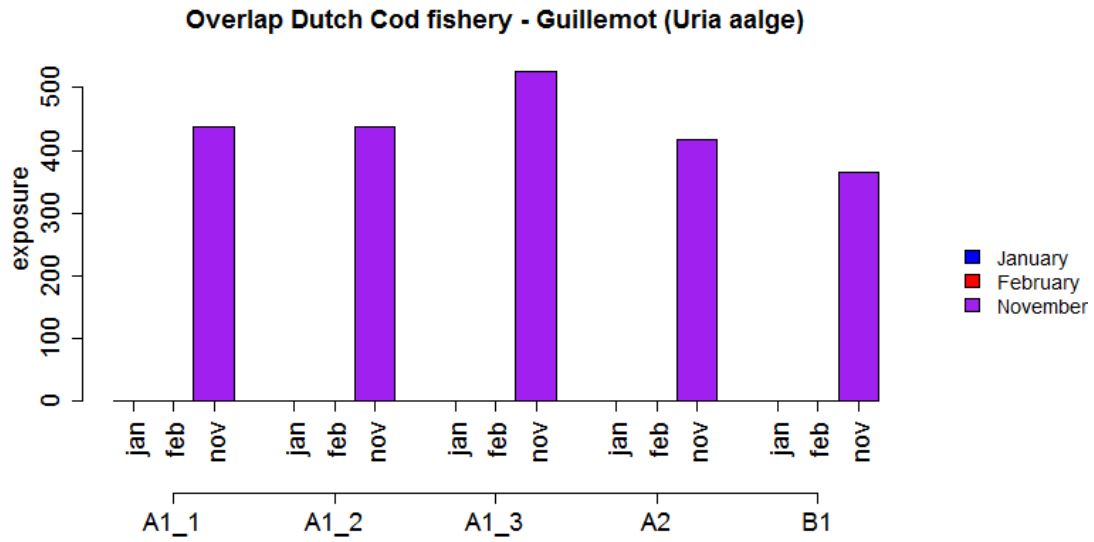


*Figure 12. Overlap of Dutch gillnet fishery on cod and common guillemots on the Brown Ridge in the months January, February and November as average of the seasons 2014/2015, 2015/2016, 2016/2017. Overlap is expressed as exposure in km net days * number of birds (Jongbloed et al., 2019).*

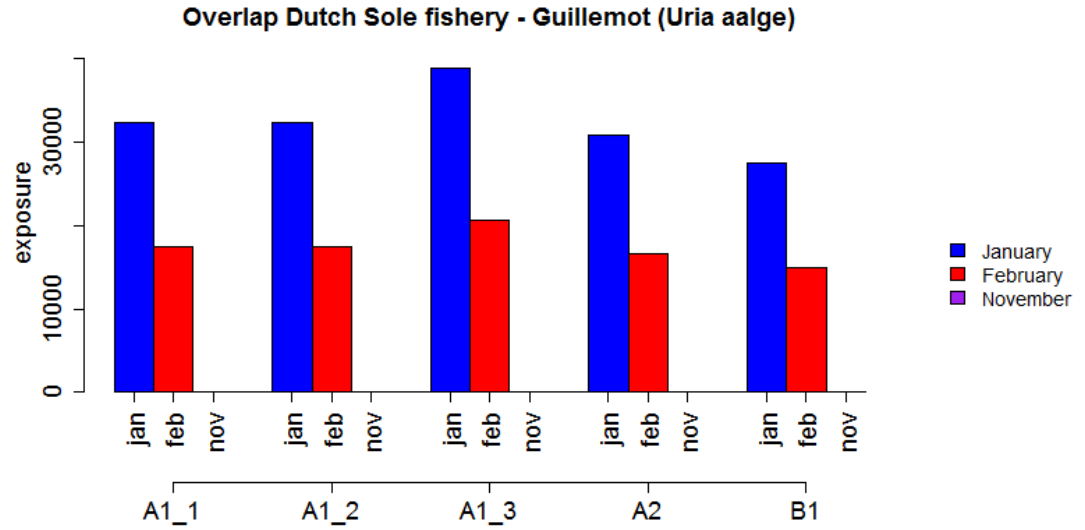


*Figure 13. Overlap of Dutch gillnet fishery on sole and common guillemots on the Brown Ridge in the months January, February and November as average of the seasons 2014/2015, 2015/2016, 2016/2017. Overlap is expressed as exposure in km net days * number of birds (Jongbloed et al., 2019).*

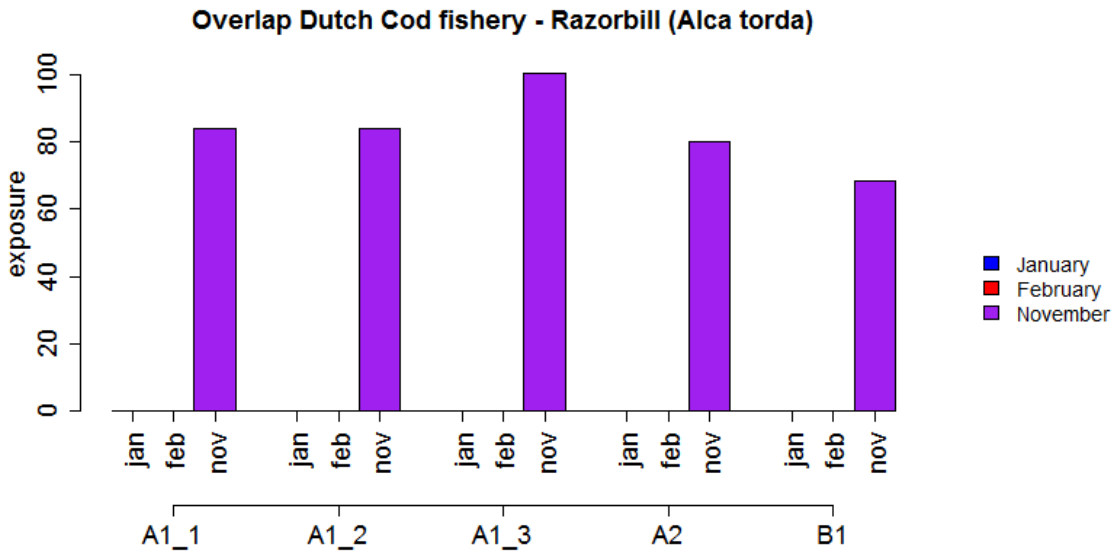


*Figure 14. Overlap of Dutch gillnet fishery on sole and razorbills on the Brown Ridge in the months January, February and November as average of the seasons 2014/2015, 2015/2016, 2016/2017. Overlap is expressed as exposure in km net days * number of birds (Jongbloed et al., 2019).*

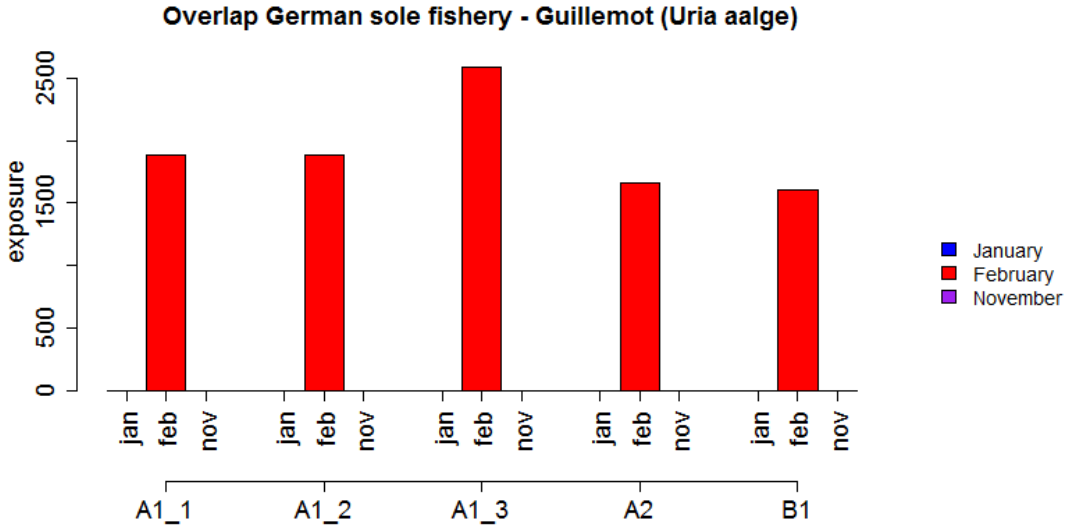


*Figure 15. Overlap of German gillnet fishery on sole and common guillemots on the Brown Ridge in the months January, February and November as average of the seasons 2014/2015, 2015/2016, 2016/2017. Overlap is expressed as exposure in km net days * number of birds (Jongbloed et al., 2019*

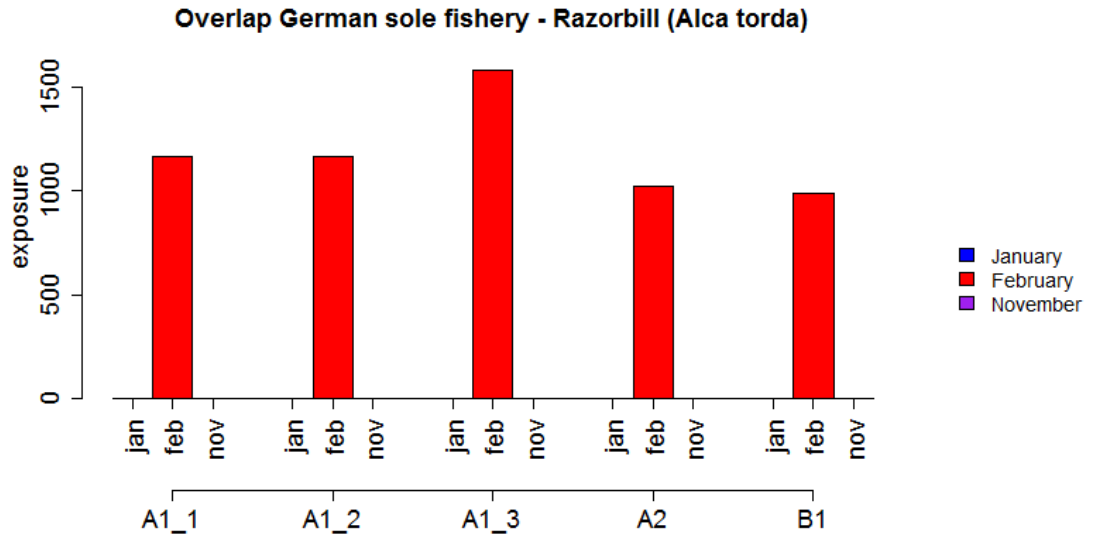


*Figure 16. Overlap of German gillnet fishery on sole and razorbills on the Brown Ridge in the months January, February and November as average of the seasons 2014/2015, 2015/2016, 2016/2017. Overlap is expressed as exposure in km net days * number of birds (Jongbloed et al., 2019)*

It is clear that the risk assessment is seriously hampered by the absence of data for seabird abundance in 8 of the 12 months (Jongbloed et al., 2019). In fact, the average fishery effort in the four months when bird were counted (January, February, August, November) covered a small part of the effort during a complete year, amounting to 0% for seabass fishery, 21% for sole fishery and 13% for cod fishery. The previous study by Jongbloed et al. (2015) used seabird density data that were developed by Leopold *et al.* (2014). The underlying data has been taken from the ESAS and MWTL databases for the years 1991 up to 2013 and have been processed to show a seasonal average distribution. Seasons are six two-monthly periods starting with 1= Aug-Sep, 2= Oct-Nov, 3= Dec-Jan, 4= Feb-Mar, 5= Apr-May and 6= Jun-Jul. In case it is chosen to apply the extrapolation in the present study than the density values of August could be applied to September, the ones of November to October, the ones for January to December and the one for February to March. In that way eight months of the year (August up to March) could be covered, representing the most important period for the selected seabird species in the Brown Ridge. In that case it can be expected that the highest bycatch risk would occur in some months (March, October, December) for which no MWTL-airplane monitoring data for seabirds are available for the period 2014 to 2017 (Jongbloed et al., 2019). In more detail (Jongbloed et al., 2019):

- In seabass fishery the highest risks for all three seabird species occurred in October, March and September due to a relatively high fishery intensity in combination with seabird numbers extrapolated from adjacent months (respectively November, February, August).
- In sole fishery the highest risks for common guillemot and razorbill occurred especially in March due to a relatively high fishery intensity in combination with high seabird numbers extrapolated from adjacent month (February).
- In cod fishery the highest risks for all three seabird species occurred especially in December due to a relatively high fishery intensity in combination with high seabird numbers extrapolated from adjacent month (November).

#### 2.3.1.4 Difference between gillnets and entangling nets types

A basis for differences among gillnets and entangling nets types with respect to the risk of seabird bycatch was not found. However, there is a lack of knowledge on this subject (Jongbloed et al., 2019 and references therein). Any type of gillnets and entangling nets is likely to catch diving seabirds, if these are present at the time of fishing, and forage near the sea floor. It is obvious that there is a difference in bycatch risk between the three gillnets and entangling nets categories studied in this report, although this risk cannot be quantified. The gear design of gillnets and entangling nets for seabass, sole and cod differs with respect to mesh size, net height, depth set, twine type and lead line. These gear design factors are demonstrated to be correlated with bycatch rate (Jongbloed et al., 2019 and references therein).

#### 2.3.1.5 Integration

The impact of gillnets and entangling nets fishery on seabirds results from integration of the factors described above. The Brown Ridge is deeper than coastal waters which reduces the risk significantly of sea birds being caught by gillnets and entangling nets set or anchored on the sea floor (as compared to Dutch coastal waters). From the scarce information on diet and diving behaviour (during daylight only), razorbills and northern gannets would seem to be mainly shallow divers in the Brown Ridge area, which would reduce their risk of being by-caught significantly. Common guillemots however dive deeper. Although the true bycatch risk is unknown, probably the risk is considerably higher for common guillemots than for razorbills and northern gannets (Jongbloed et al., 2019). Data on bird abundance during the year are only available for four months, whereas data on gillnets and entangling nets fishery effort are available for all year. This hampers the analysis of the temporal overlap and thereby the possible bycatch risk. Based on the four months August, November, January and February, the month August provides the greatest risk of encounter for common guillemot and northern gannet due to the relatively high fishery effort. Seabass gillnets and entangling nets fishery did not occur in these four months and cod gillnets and entangling nets fishery only occurred in November and was low. Therefore, bycatch risk of seabirds in seabass and cod gillnets and entangling nets fishery on the Brown Ridge was absent or negligible in the period 2014 to 2017 (Jongbloed et al., 2019). In addition, gillnets and entangling nets fishery carried out by the Dutch fleet is not expected at distances greater than 20 miles from the coast and at the very low cod stock level in the southern North Sea. In contrast the intensity of the Dutch sole gillnets and entangling nets fishery may still be substantial, although this could not be elucidated from the available fishery activity information. Therefore, the actual magnitude of the problem is unknown, monitoring the bycatch of diving seabirds in gillnets and entangling nets should be a first step in the process and an alternative to temporal closure of the Brown Ridge (Jongbloed et al., 2019).

The conclusion for the impact on common guillemots in the study by Jongbloed et al. (2019) is in line with the ones from the FIMPAS project (ICES, 2011, 2010). In the FIMPAS project an impact assessment was carried out for gillnets and entangling nets fisheries in the Frisian Front. In the workshops, a fishing gear impact matrix for the conservation objectives was composed. A high impact level was indicated for the impact of gillnets and entangling nets on common guillemots. High impact levels was defined as "direct disturbance, the continuity of the species is in danger". The judgement is based on majority opinions of the stakeholders (industry, scientists, NGO's) (ICES, 2011).

### 2.3.2 Data for fishing effort calculations

From 2014 to 2017 there were 21 unique Dutch VMS-fishing vessels using gillnets and entangling nets in an area around the Brown Ridge, namely our study area with ICES-rectangles 34F2, 33F2, 34F3, 33F3, 34F4, 33F4, 32F3 & 35F. Information from these vessels is used to quantify the spatial distribution of the fishing effort at a high resolution. Logbook information extracted from the VISSTAT database reveals that 115 unique Dutch vessels were using gillnets and entangling nets as fishing gear during the period, including the 21 VMS vessels and 94 vessels smaller than 15 meters and without VMS. Records of vessels with a cumulative effort of less than 1 day at sea per year on average are omitted.
By selecting fishing trips with gear codes GNS, anchored gillnets (set), and GTR, trammel nets, a total of 8238 unique trips of vessels fishing in ICES rectangles 34F2, 33F2, 34F3, 33F3, 34F4, 33F4, 32F3 & 35F4 were selected from the VISSTAT database.

**Net length:** "Kenniskring Staandwantvisserij" provided information on the gillnets and entangling nets lengths used by vessels targeting seabass (category a), sole (category b), or cod (category c), supplemented with vessel specific information of 27 vessels (Jongbloed *et al.*, 2013). The average minimal number of used nets of 50 m each is 240, ranging from 50 to 400. The maximal amount is on average 330, ranging from 150 to 500. The net lengths of the remaining vessels was assumed to be minimal 50, 10,000 and 50 meters for categories a (seabass), b (sole)and c (cod) respectively. The maximal net lengths are 2500, 25,000 and 500 meters of the three categories respectively.

**Duration of fishing trips:** The duration of fishing trips, the time period the gillnets and entangling nets were actually set in the water, is difficult to assess from logbook information. Often fishers leave the harbour to set the nets and collect these nets the day after. The days at sea estimated from logbook

information does not reflect the actual fishing effort in these cases. The patterns of times leaving and returning to the harbours and the time period out at sea are depicted in Annex 1. The estimation of the net set times can also be found in Annex 1.

### 2.3.3 Fleet activity in effort

The data sources and processing, data for fishing effort calculations and fishing gear types and groups are described in the General Background Document and Jongbloed et al. (2022). A data call to relevant EU member states was sent out in autumn 2022 by Wageningen Marine Research. Wageningen Research provided the R-script to collect data from the Dutch, Danish, German, Belgian, Swedish and French fleets. No UK fleet data were used, since the UK is not part of the EU anymore. The pre-processing of the data follows the approach developed in Hintzen et al. (2013).
Data on the annual fishing activity of fleets, gear types and gear groups on the Brown Ridge in the period 2014 to 2021 is shown in Table 3, Table 4,

Table 5 and Figure 17. The tables plus figures show the fishery effort of EU member states only. This is because the article 11 procedure only applies to member states and does not apply to third countries. For instance, UK interests are being evaluated after consensus has been reached between member states. The extent and trends in the fishing activity are described in the next sections.

*Table 3: Overview of fishery effort (fishing days) per year of fleet nationality in the proposed management zone of the Brown Ridge.*

| Country | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Average |
|---|---|---|---|---|---|---|---|---|---|
| Belgium | 1 | 0 | 4 | 4 | 0 | | 0 | 1 | 1 |
| Denmark | 31 | 16 | 4 | | 9 | 6 | 2 | | 8 |
| France | 0 | | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| Germany | 16 | 18 | 8 | 22 | 44 | 58 | 46 | 49 | 33 |
| Netherlands | 230 | 261 | 293 | 382 | 376 | 416 | 381 | 376 | 339 |
| *Total* | *277* | *295* | *313* | *410* | *432* | *481* | *432* | *427* | *383* |

*Table 4**:** Overview of fishery effort (fishing days) per year of gear types in the proposed management zone of the Brown Ridge.*

| Gear type | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Average |
|---|---|---|---|---|---|---|---|---|---|
| **TBB+ | 219.6 | 243.4 | 273.5 | 380.2 | 384.4 | 437.7 | 371.6 | 398.6 | 338.6 |
| **TBS* | | | | | | 0.5 | | | 0.1 |
| **OTB | 0.5 | 1.8 | 2.1 | 1.1 | 1.5 | 2.7 | 4.0 | 3.0 | 2.1 |
| **SSC | 10.6 | 18.4 | 26.2 | 25.7 | 19.6 | 19.2 | 44.6 | 22.9 | 23.4 |
| **SDN | | | 3.0 | 1.6 | 3.1 | 1.6 | 2.9 | 1.6 | 1.7 |
| GNS | 42.6 | 29.1 | 6.7 | 1.7 | 23.5 | 16.0 | 6.2 | 0.4 | 15.8 |
| GN | 3.3 | 1.2 | 0.8 | | | 3.5 | 2.0 | | 1.3 |
| **FPO | | | | | | | 0.9 | 0.2 | 0.1 |
| **OTM | | 1.6 | 0.4 | | 0.1 | 0.1 | | 0.0 | 0.3 |
| *Total* | *276.7* | *295.5* | *312.7* | *410.2* | *432.2* | *481.2* | *432.3* | *426.8* | *383.5* |

**not part of the proposed fishery measures

*Table 5: Overview of fishery effort (fishing days) per year of gear groups in the proposed management zone of the Brown Ridge.*

| Gear group | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Average |
|---|---|---|---|---|---|---|---|---|---|
| **Beam trawl | 219.6 | 243.4 | 273.5 | 380.2 | 384.4 | 438.2 | 371.6 | 398.6 | 338.7 |
| **Bottom trawl | 0.5 | 1.8 | 2.1 | 1.1 | 1.5 | 2.7 | 4.0 | 3.0 | 2.1 |
| **Flyshooting seine | 10.6 | 18.4 | 26.2 | 25.7 | 19.6 | 19.2 | 44.6 | 22.9 | 23.4 |
| **Anchored seine | | | 3.0 | 1.6 | 3.1 | 1.6 | 2.9 | 1.6 | 1.7 |
| Nets | 45.9 | 30.4 | 7.4 | 1.7 | 23.5 | 19.5 | 8.2 | 0.4 | 17.1 |
| **Traps | | | | | | | 0.9 | 0.2 | 0.1 |
| **Pelagic trawl | | 1.6 | 0.4 | | 0.1 | 0.1 | | 0.0 | 0.3 |
| *Total* | *276.7* | *295.5* | *312.7* | *410.2* | *432.2* | *481.2* | *432.3* | *426.8* | *383.5* |

**not part of the proposed fishery measures

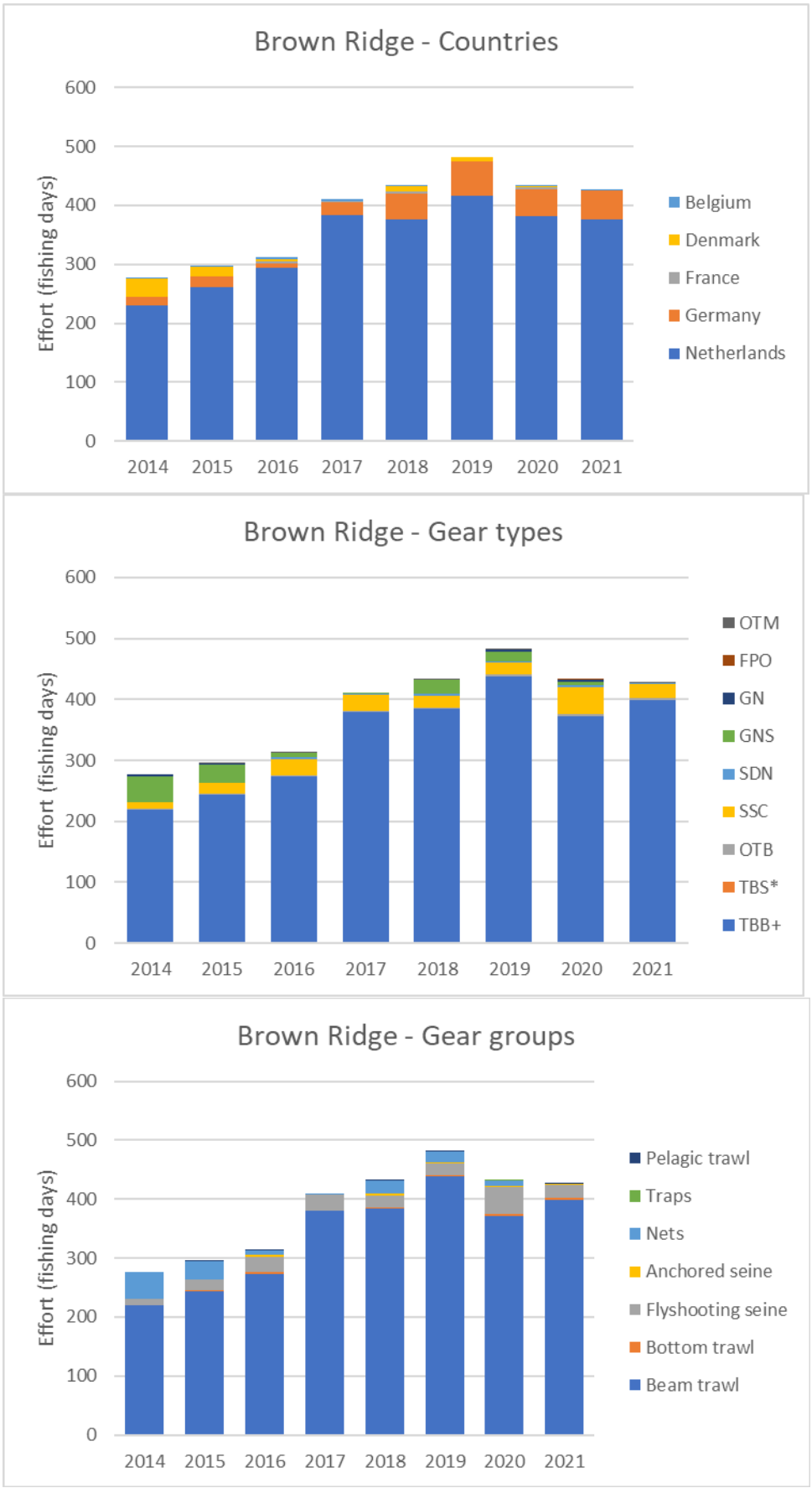


*Figure 17. Fishery effort (fishing days) per year in the proposed management zone Brown Ridge for fleets (countries), gear types and gear groups. Gear types 'GN' ad 'GNS' and gear group 'Nets' are part of the proposed fisheries measures, the rest is shown for comparison.*

### 2.3.4 Fleet activity by member state

WMR requested fishery data from Danish, German and British fishery institutes in order to assess the fishing effort in the Brown Ridge area for the years 2014-2021. The main fishing effort in the Brown Ridge is carried out by the Dutch fleet and the German fleet with on average 89% and 9% of the total effort of 383 fishing days per year for the five countries considered. There was a small share of the Danish fleet (2.2%), and very small share of the French fleet (0.4%) and Belgian fleet (0.3%).

**Trend over years**
Over the period 2014-2021 there was a trend of increase (average: 9.3% per year) in total fishering activity in the Brown Ridge. However, the pattern for the effort over the 8-year period was irregular for some national fleets.

### 2.3.5 Gears and gear groups

In the period 2014-2021 fishing took place with nine different gear types in the Brown Ridge. The fishing effort was heavily dominated by beam trawling (TBB+) with a percentage of 88.3%. A small percentage was taken by SSC (6.1%), GNS (4.1%) and GN (2.8%). The share of other individual gear types was below 0.6% (
Table 7). This means that 95.4% of all fishery effort was caused by fishing gear contacting the seafloor.

**Trend over years**
Over the 2014-2021 period there was a trend of increase in the effort for the gear types TBB+ and SSC.

### 2.3.6 Seasonal variation in fishing activity

Data on the fishing activity per month of fleets, gear types and gear groups in the Brown Ridge in the period 2014-2021 is shown in Table 6,
Table 7, Table 8 and Figure 18.

*Table 6: Overview of fishery effort (fishing days) per month of fleets nationality in the proposed management zone of Brown Ridge. Months are numbered as follows: 1 January; 2 February; 3 March; 4 April; 5 May; 6 June; 7 July; 8 August; 9 September; 10 October; 11 November; 12 December.*

| Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.1 | 0.3 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 |
| Denmark | | 0.1 | 5.4 | 1.8 | 0.3 | 0.2 | 0.2 | | 0.3 | | | 0.2 | 0.7 |
| France | | | 0.0 | 0.0 | 0.2 | 0.8 | 0.5 | 0.1 | 0.0 | | 0.0 | 0.0 | 0.1 |
| Germany | 3.0 | 1.1 | 8.0 | 5.8 | 4.3 | 4.6 | 2.0 | 0.7 | 0.8 | 0.5 | 1.2 | 0.7 | 2.7 |
| Netherlands | 48.4 | 31.2 | 29.6 | 20.7 | 37.4 | 23.3 | 21.0 | 26.9 | 21.3 | 23.1 | 29.1 | 27.5 | 28.3 |
| *Total* | *51.4* | *32.5* | *43.3* | *28.3* | *42.2* | *28.9* | *24.1* | *27.8* | *22.5* | *23.6* | *30.4* | *28.4* | *32.0* |

*Table 7: Overview of fishery effort (fishing days) per month of gear types in the proposed management zone of Brown Ridge.*

| Gear | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TBB+ | 51.3 | 30.8 | 31.3 | 21.9 | 38.0 | 24.7 | 18.3 | 22.6 | 19.3 | 22.7 | 29.4 | 28.2 | 28.2 |
| **TBS* | | | | | | | | | | | 0.1 | | 0.0 |
| **OTB | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.4 | 0.6 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.2 |
| **SSC | | 1.3 | 0.6 | 2.0 | 3.4 | 2.5 | 4.2 | 5.0 | 2.8 | 0.8 | 0.8 | | 2.0 |
| **SDN | | 0.1 | 0.0 | 0.0 | 0.2 | 0.7 | 0.5 | 0.1 | 0.0 | | | | 0.1 |
| GNS | | 0.1 | 9.9 | 4.2 | 0.3 | 0.7 | 0.4 | | 0.3 | 0.0 | | | 1.3 |
| GN | | | 10.6 | 0.1 | | | | | | | | | 0.1 |
| **FPO | 0.0 | 0.1 | | 0.0 | 0.0 | | | | | | 0.0 | | 0.0 |
| **OTM | | | | | | | | | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 |
| *Total* | *51.4* | *32.5* | *43.3* | *28.3* | *42.2* | *28.9* | *24.1* | *27.8* | *22.5* | *23.6* | *30.4* | *28.4* | *32.0* |

**not part of the proposed fishery measures

*Table 8: Overview of fishery effort (fishing days) per month of gear groups in the proposed management zone of Brown Ridge.*

| Gear group | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Beam trawl | 51.3 | 30.8 | 31.3 | 21.9 | 38.0 | 24.7 | 18.3 | 22.6 | 19.3 | 22.7 | 29.5 | 28.2 | 28.2 |
| **Bottom trawl | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.4 | 0.6 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.2 |
| **Flyshooting seine | | 1.3 | 0.6 | 2.0 | 3.4 | 2.5 | 4.2 | 5.0 | 2.8 | 0.8 | 0.8 | | 2.0 |
| **Anchored seine | | 0.1 | 0.0 | 0.0 | 0.2 | 0.7 | 0.5 | 0.1 | 0.0 | | | | 0.1 |
| Nets | | 0.1 | 11.2 | 4.2 | 0.3 | 0.7 | 0.4 | | 0.3 | 0.0 | | | 1.4 |
| Traps | 0.0 | 0.1 | | 0.0 | 0.0 | | | | | | 0.0 | | 0.0 |
| **Pelagic trawl | | | | | | | | | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 |
| *Total* | *51.4* | *32.5* | *43.3* | *28.3* | *42.2* | *28.9* | *24.1* | *27.8* | *22.5* | *23.6* | *30.4* | *28.4* | *32.0* |

**not part of the proposed fishery measures

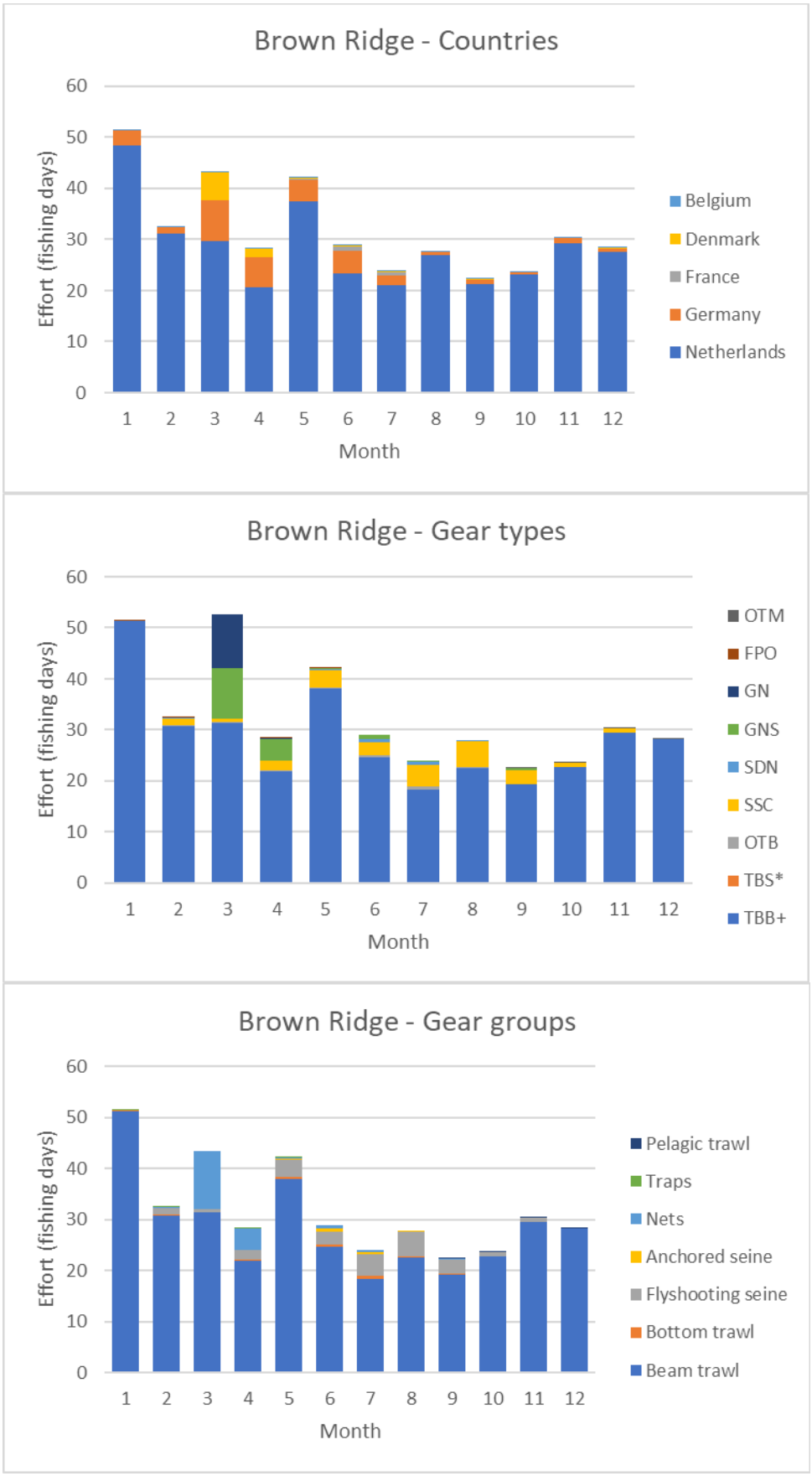


*Figure 18. Fishery effort (fishing days) per month in the proposed management zone Brown Ridge for fleets (countries), gear types and gear groups. Months are numbered as follows: 1: January; 2: February; 3: March; 4: April; 5: May; 6: June; 7: July; 8: August; 9: September; 10: October; 11: November; 12: December. Gear types 'GN' ad 'GNS' and gear group 'Nets' are part of the proposed fisheries measures, the rest is shown for comparison.*

There was a seasonal pattern for the fishing activity in the Brown Ridge (Figure 18). The relative fishing activity over an average year is the highest in the period January-May. This seasonal pattern for overall effort also applies to the relative high effort of the Dutch, German and fleets, as well as the gear types TBB+, GN and GNS.

### 2.3.7 Spatial distribution of fishing activity

Maps for the spatial distribution of the fishing activity of all gear groups combined and of the fishing activity of the various gear groups in the Brown Ridge and their surroundings are shown in Figure 8 and Figure 9. The area is mainly used by the beam trawl gear group.

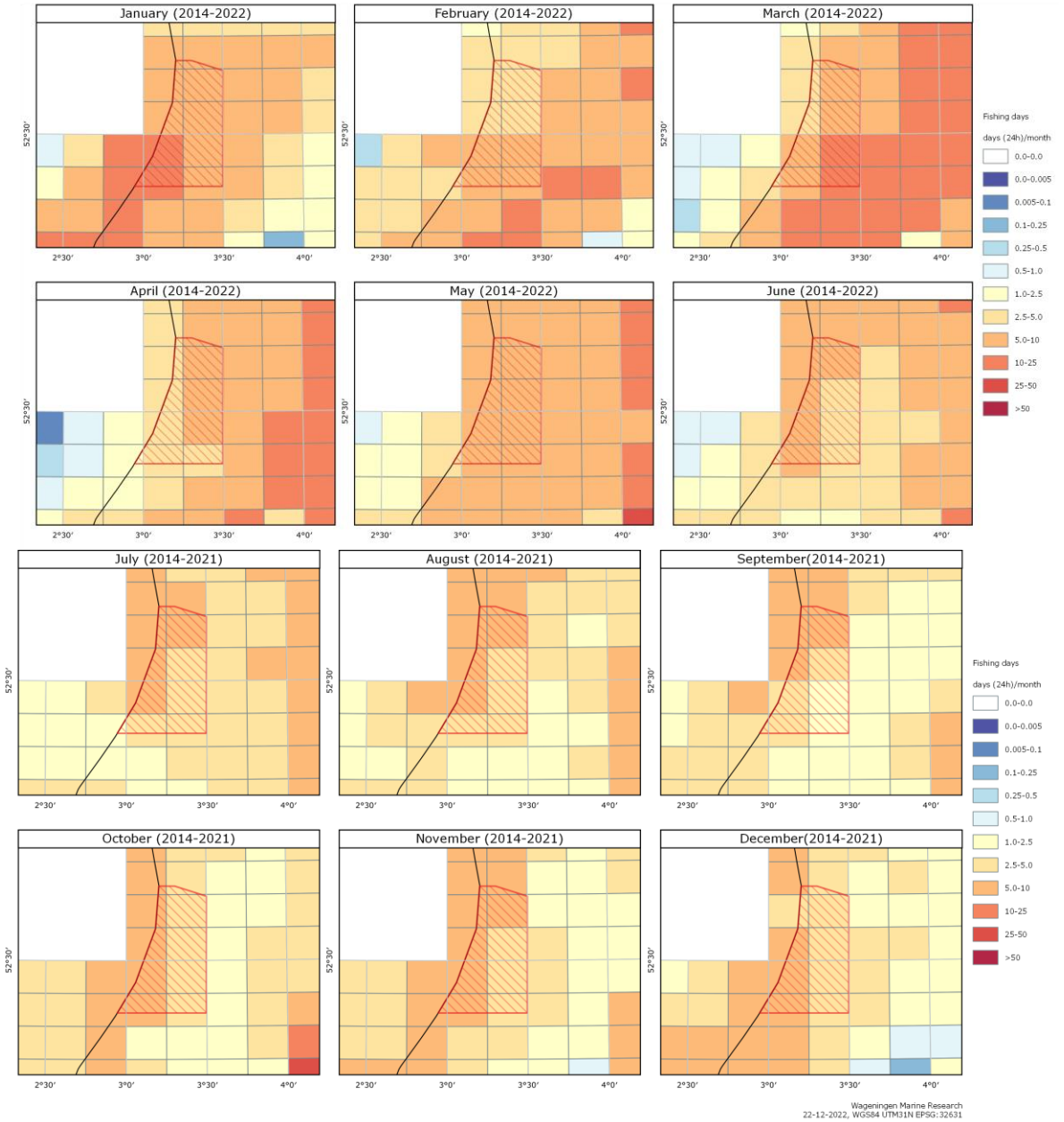


*Figure 19. Brown Ridge: Fishing effort per month, of all gears groups combined (fishing days/month).*

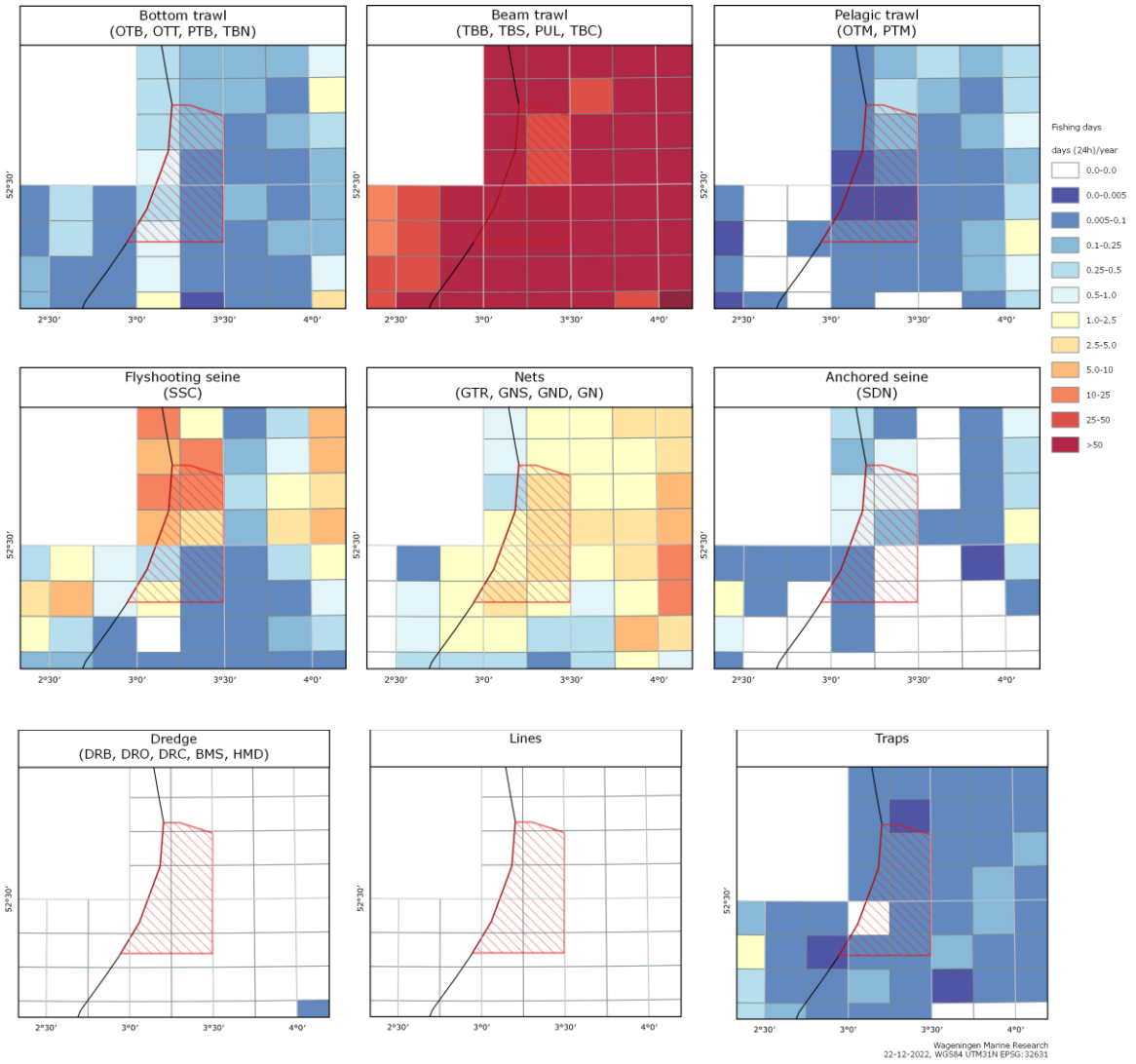


*Figure 20. Brown Ridge: Fishing effort (fishing days/year) per gear group. Gear group 'Nets' is part of the proposed fisheries measures, the rest is shown for comparison.*

### 2.3.8 Main target species

The main species caught in the Brown Ridge with bottom contacting gears are European plaice (PLE: *Pleuronectes platessa*) and common sole (SOL: *Solea solea*) caught by beam trawls and tub gurnard (GUU: *Chelidonichtys lucerna*) caught by Scottish seines (Figure 21). In addition, the Danish trawlers (pelagic and demersal) also incidentally caught European sprat (SPR: *Sprattus sprattus*). The German and Danish Netters also catch mainly sole.

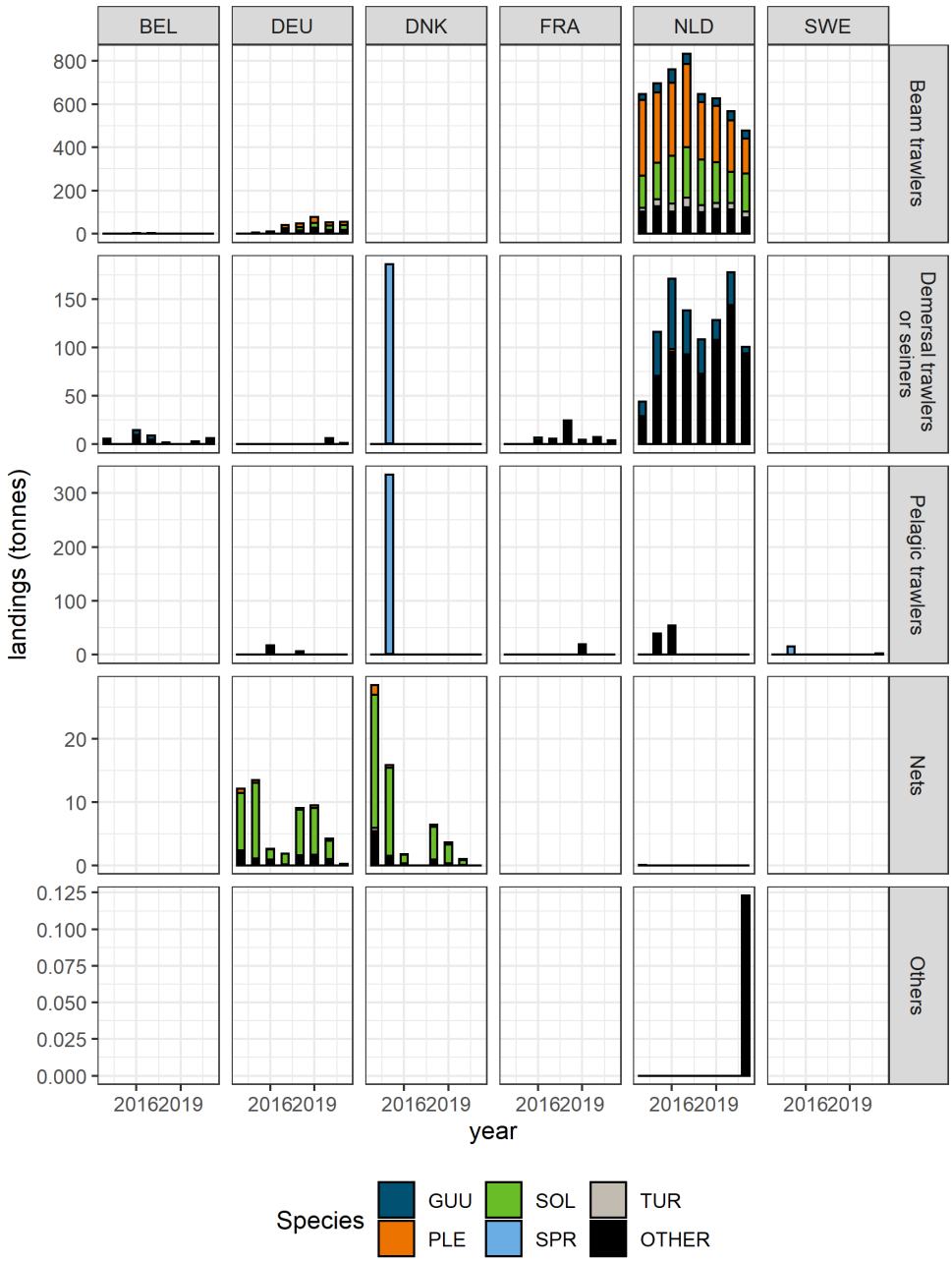


*Figure 21. Historical trend by gear type of the species caught in the Brown Ridge by the Belgian, German, Danish, French, Dutch and Swedish fleets (GUU: tub gurnard; PLE: European plaice; SOL: common sole; SPR: European sprat; TUR: turbot; Other: other species). Note the scale difference for the landings by gear type*
*Source: Logbook data and VMS data, processed by WUR, DTUAQUA, TI, ILVO, SLU and IFREMER.*

### 2.3.9 Economic value of historic landings

Over the 2014-2021 period, the Brown Ridge is mainly fished by the Dutch fleet and to a lesser extend the German and Danish fleets (Table 9). Belgian, French and Swedish fleets were virtually absent from the area. Between 2014 and 2017, the amount of fishing effort increased from about 280 up to 410 fishing days. Since 2017 and until the end of the study period, the effort remained stable between 410 and 480 fishing days per year. The gross added value shows a different trend. At the beginning of the time series, GVA increased with effort from 1.3m euros in 2014 up to 2.4m euros in 2016 and 2017, then it decreased again down to 1.6m euros in 2021.

*Table 9: Effort, landings and values and gross value added of the fishing sector in the Brown Ridge by country*

| | Country | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| Effort (fishing days) | BEL | 1 | 0 | 4 | 4 | 0 | 0 | 0 | 1 | 1 |
| | DEU | 16 | 18 | 8 | 22 | 44 | 58 | 46 | 49 | 33 |
| | DNK | 31 | 16 | 4 | | 9 | 6 | 2 | | 9 |
| | FRA | 0 | | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| | NLD | 230 | 261 | 293 | 383 | 376 | 416 | 381 | 376 | 339 |
| | SWE | | 0 | | | | | | 0 | 0 |
| | **Total** | 277 | 296 | 313 | 410 | 432 | 481 | 432 | 427 | 384 |
| Landings (tonnes) | BEL | 7 | 1 | 20 | 13 | 3 | 0 | 3 | 7 | 7 |
| | DEU | 13 | 18 | 31 | 44 | 63 | 86 | 64 | 57 | 47 |
| | DNK | 29 | 536 | 2 | | 6 | 4 | 1 | | 72 |
| | FRA | 0 | | 7 | 6 | 25 | 24 | 8 | 4 | 9 |
| | NLD | 721 | 880 | 1,006 | 1,011 | 762 | 754 | 744 | 583 | 808 |
| | SWE | | 16 | | | | | | 2 | 2 |
| | **Total** | 770 | 1,452 | 1,066 | 1,074 | 858 | 869 | 819 | 653 | 945 |
| Value (1,000 euros) | BEL | 13 | 3 | 48 | 33 | 5 | 0 | 6 | 16 | 15 |
| | DEU | 74 | 127 | 80 | 201 | 357 | 469 | 338 | 323 | 246 |
| | DNK | 169 | 254 | 16 | | 63 | 37 | 8 | | 68 |
| | FRA | 0 | | 45 | 22 | 141 | 31 | 14 | 6 | 33 |
| | NLD | 2,467 | 3,223 | 4,071 | 4,335 | 3,580 | 3,521 | 3,112 | 3,057 | 3,421 |
| | SWE | | 4 | | | | | | 1 | 1 |
| | **Total** | 2,722 | 3,610 | 4,261 | 4,591 | 4,146 | 4,058 | 3,478 | 3,402 | 3,784 |
| Gross Value Added (1,000 euros) | BEL | 6 | 2 | 28 | 19 | 2 | 0 | 3 | 9 | 9 |
| | DEU | 44 | 78 | 49 | 105 | 215 | 242 | 185 | 175 | 137 |
| | DNK | 104 | 200 | 11 | | 41 | 22 | 5 | | 48 |
| | FRA | 0 | | 23 | 11 | 62 | 10 | 5 | 2 | 14 |
| | NLD | 1,142 | 1,514 | 2,284 | 2,260 | 1,732 | 1,515 | 1,401 | 1,374 | 1,653 |
| | SWE | | 2 | | | | | | 0 | 0 |
| | **Total** | 1,296 | 1,796 | 2,394 | 2,394 | 2,052 | 1,789 | 1,599 | 1,560 | 1,860 |

Source: Logbook data and VMS data and data from the Annual Economic report (STECF 2022), processed by WUR, DTUAQUA, TI, ILVO, SLU and IFREMER.

The main activity of the Dutch fleet is done with beam trawls (TBB) and Scottish seines (SSC) (Figure 22) with a bit of gillnet fishery at the beginning of the time series. The German and Danish fleets also fish with gillnets at the beginning of the study period and the German fleet increasingly used beam trawls from 2017 onward.

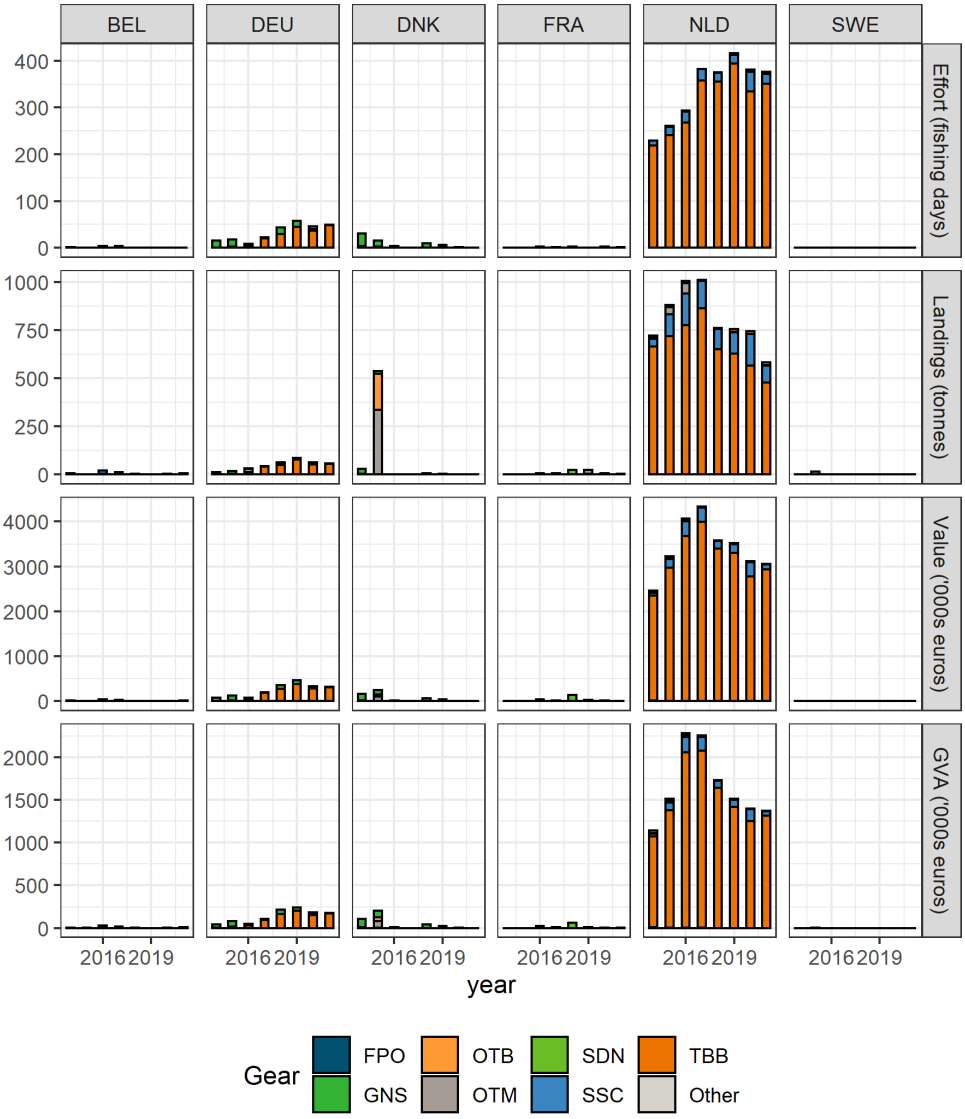


*Figure 22. Historical trend of the fishing activities in the Brown Ridge with different gears (GNS: set gillnets (anchored); OTB: bottom otter trawls; OTM: otter trawls midwater; OTT: otter twin trawls; SDN: Danish seines; SSC: Scottish seines; TBB: beam trawls; Other: other gears) in the proposed closure of the Brown Ridge 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 2022), processed by WUR, DTUAQUA, TI, ILVO, SLU and IFREMER.*

### 2.3.10 Individual dependency of Dutch fishermen

Figure 23 shows that the number of Dutch vessels actively fishing on the Brown Ridge increased over the study period, going from about 50 vessels during 2014-2016 up to 70 vessels in 2020. While the revenue dependency on the Brown Ridge of most vessels was lower than 10%, every year between five and seven vessels had higher dependency on the area. In 2017, 2019, 2020 and 2021, a couple of vessels had a dependency between 20 and 30%, and in 2020, one vessel even had between 30 and 40% of its revenue from the Brown Ridge.

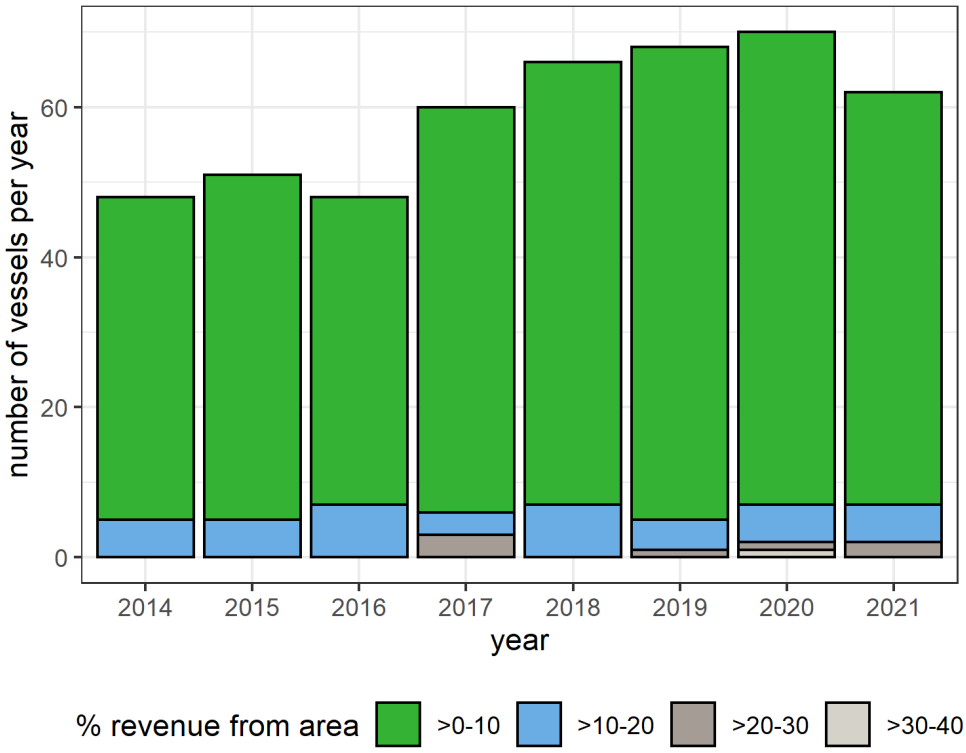


*Figure 23. Number of Dutch vessels per year and revenue dependency*

Over the 2014-2021 period, the majority of the vessels with fishing activities on the Brown Ridge had a moderate dependency on the area (less than 10% of their revenue) and they came mainly from Holland (about 30 vessels) followed by Urk (20 vessels) and the North of the Netherlands (8 vessels) (Figure 24). Only a few vessels came from Zeeland. Most of the vessels that had a higher revenue dependency came from the Holland region.

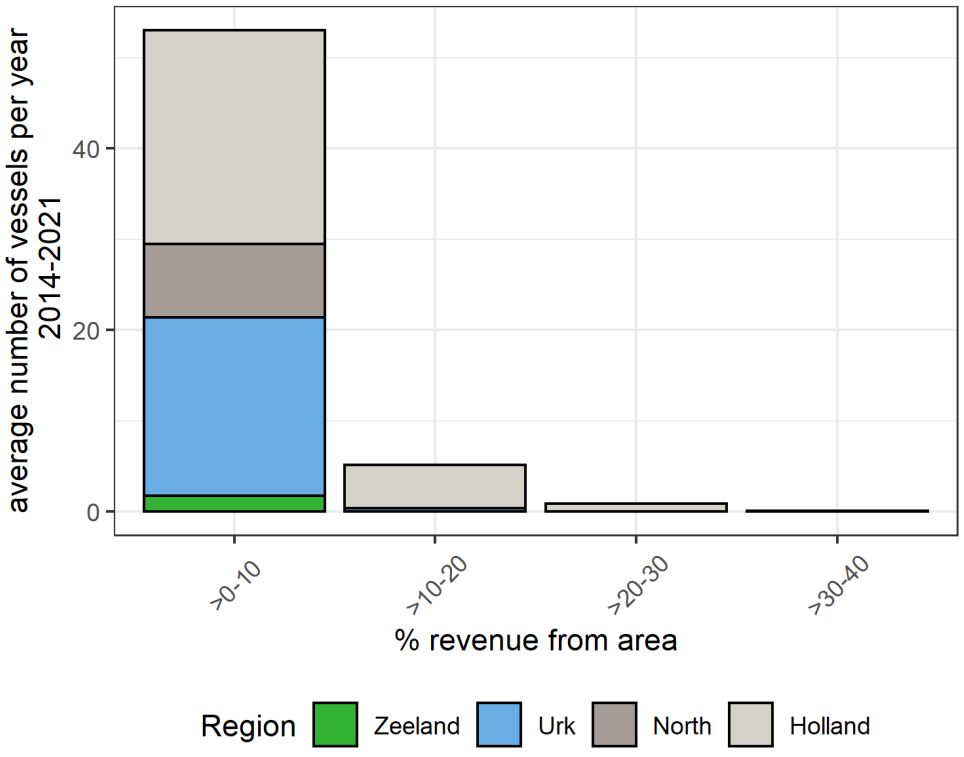


*Figure 24. Average number of vessels per region and revenue dependency*

The majority of the fishing revenue from the Brown Ridge, about 3.1m euros per year was obtained with beam trawls targeting flatfish (TBB) (Figure 25). The second most important gear was Scottish seines (SSC) with an average annual revenue of about 300 thousand euros. While Scottish seiners mostly have a dependency lower than 10%, about half of the revenue by beam trawlers came from vessels with an annual dependency higher than 10% (up to 30%).

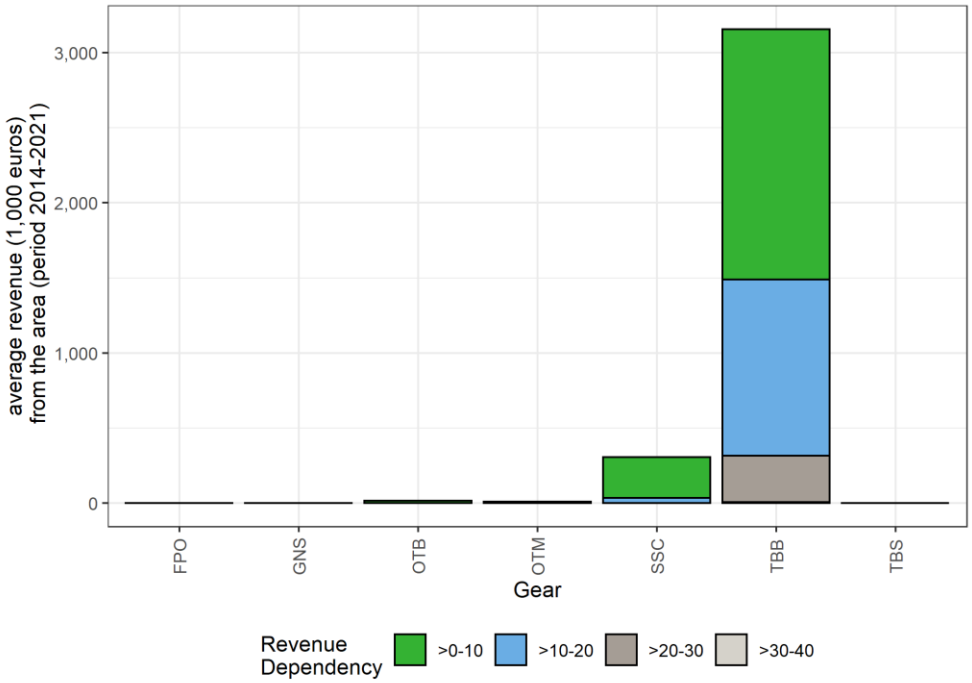


*Figure 25. Total of the average revenues (x 1,000 euros) of the vessels with different dependencies on the area per gear type*

## 2.4 Other human activities

This paragraph provides an overview of predominant human activities on the Brown Ridge (Figure 27 and Table 10). Information on the (spatial distribution of the) activities is taken from the Noordzeeloket[3], a website of the Dutch Government that provides government information on the North Sea (e.g. management, policy, functions and use). Activities present in the area (Table 10) are discussed in the separate sections below.

[3] https://www.noordzeeloket.nl/en/functions-and-use/

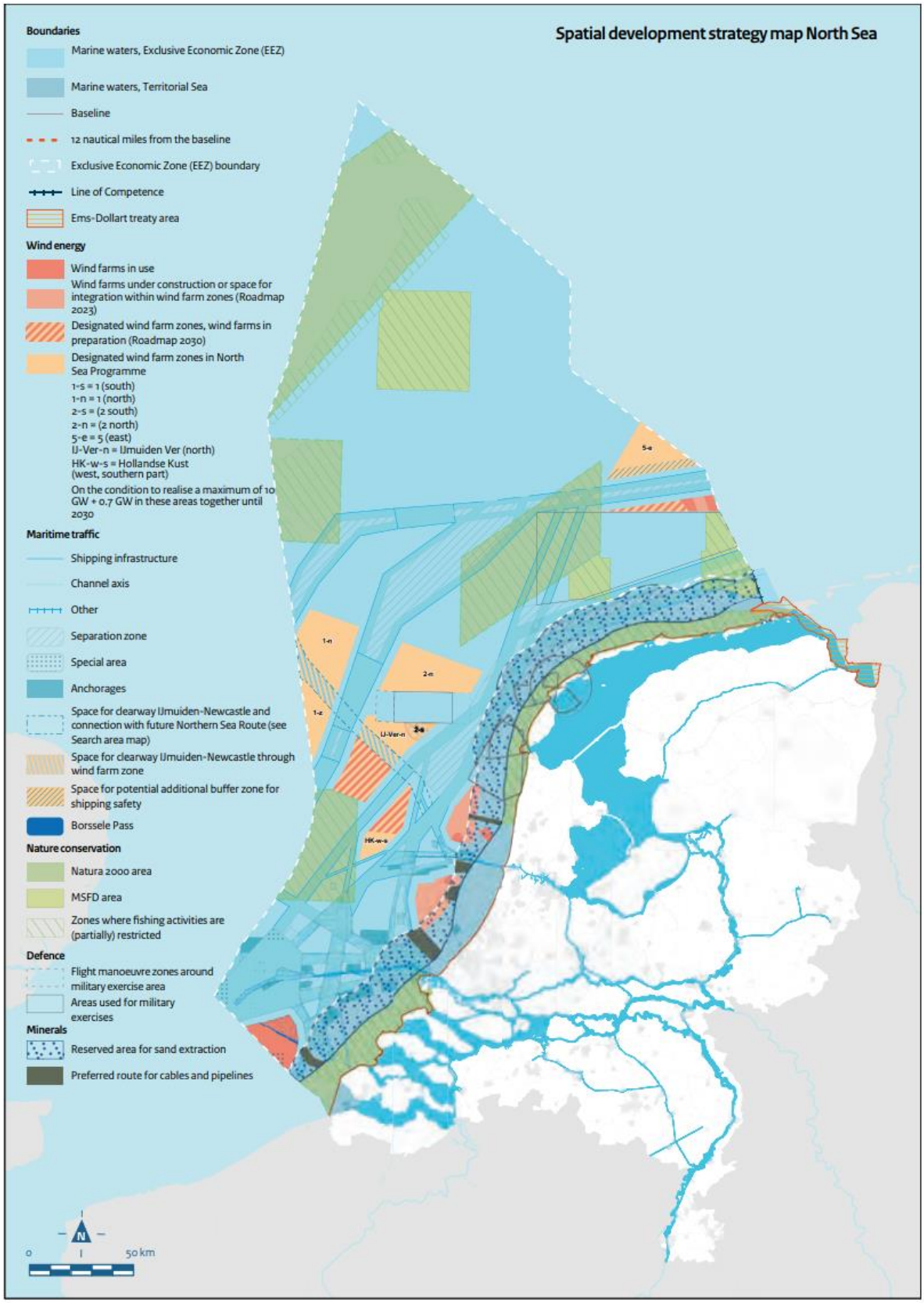


*Figure 26. Spatial development strategy map of the North Sea. Source: National Water Program 2022–2027 (The Dutch Ministry of Infrastructure and Water Management et al., 2022). The red colour indicates the offshore wind farms in use.*

*Table 10: Activities on the Brown Ridge (based on information from Noordzeeloket[4])*

| Activity | Brown Ridge |
|---|---|
| Fishery | Presence of fisheries |
| Oil and Gas | Presence of oil and/or gas platforms |
| Cables and pipelines | Presence of cables and pipelines |
| Shipping | Presence of shipping lanes |
| Military use | Partly designated for military use |
| Surface mineral (sand/shell) extraction | No mineral extraction |
| Dredging spoil | No discharge of dredged material |
| Wind energy | Partly designated wind energy area |
| Recreation | Indication of recreational shipping routes |

### 2.4.1 Oil/gas platforms (or exploration)

Within the boundaries of the Brown Ridge, two subsea installations and one production platform are situated (Figure 28).

The placement and removal of the platform, the placement of the pipelines, the drilling of wells and the discharge of drilling mud and cuttings have a direct effect on the habitat. By placing facilities on the seabed, part of the surface is no longer available for the original biological use and (part of) the biota present there will be destroyed. For the physical loss due to a platform for (oil and) gas extraction, a circular surface with a radius of 100 meters is used (The Dutch Ministry of Infrastructure and Water Management & the Dutch Ministry of Agriculture, Nature and Food Quality, 2018). Oil and gas pipelines are described in section 2.4.2. When placing a platform new (hard) substrate is introduced, on which other species can settle (Coolen, 2017). Each platform has a safety zone; no fishing, shipping or other use is allowed in a 500-metre zone around the platforms. In case fisheries are excluded completely, a refugium can arise (Duineveld et al., 2007).

Continuous noise is (temporarily) caused by transportation (ships and helicopters) to- and from the drilling- and production platforms. Impulse noise is caused by seismic surveys and sometimes piling during the drilling phase (before drilling starts, a heavy metal pipe with a large diameter is driven or drilled several tens of meters into the ground at the site of the well) (Tamis et al., 2019). Main concern about noise pollution is the threat to marine mammals. Noise pollution can lead to physical damage, stress, disturbance of communication and / or behavioural change of individuals. This in turn can lead among others to abandonment of the habitat or to a decrease in reproduction. (Sub) -lethal effects of underwater noise have also been demonstrated for fish, lobster, squid and bivalves (Tamis et al., 2019 and references therein). On the other hand, in certain cases, habituation can also occur, especially with continuous sound.

Above sea level, the lighting on oil and gas installations during night-time may disturb birds within a radius of 5 km. Optical disturbance by the silhouette of the installations may occur to a lesser extent. Other oil/gas activities related threats to birds are contamination with floating oil, grease or chemicals and disturbance by transportation.

Offshore oil- and gas activities are expected to decline on the Dutch EEZ. Exhausted gas fields can be used for the storage of $CO_2$. The entire EEZ is designated as a search area for $CO_2$ storage locations (The Dutch Ministry of Infrastructure and the Environment and The Dutch Ministry of Economic Affairs, 2015).

[4] https://www.noordzeeloket.nl/en/functions-and-use/recreatie-toerisme/

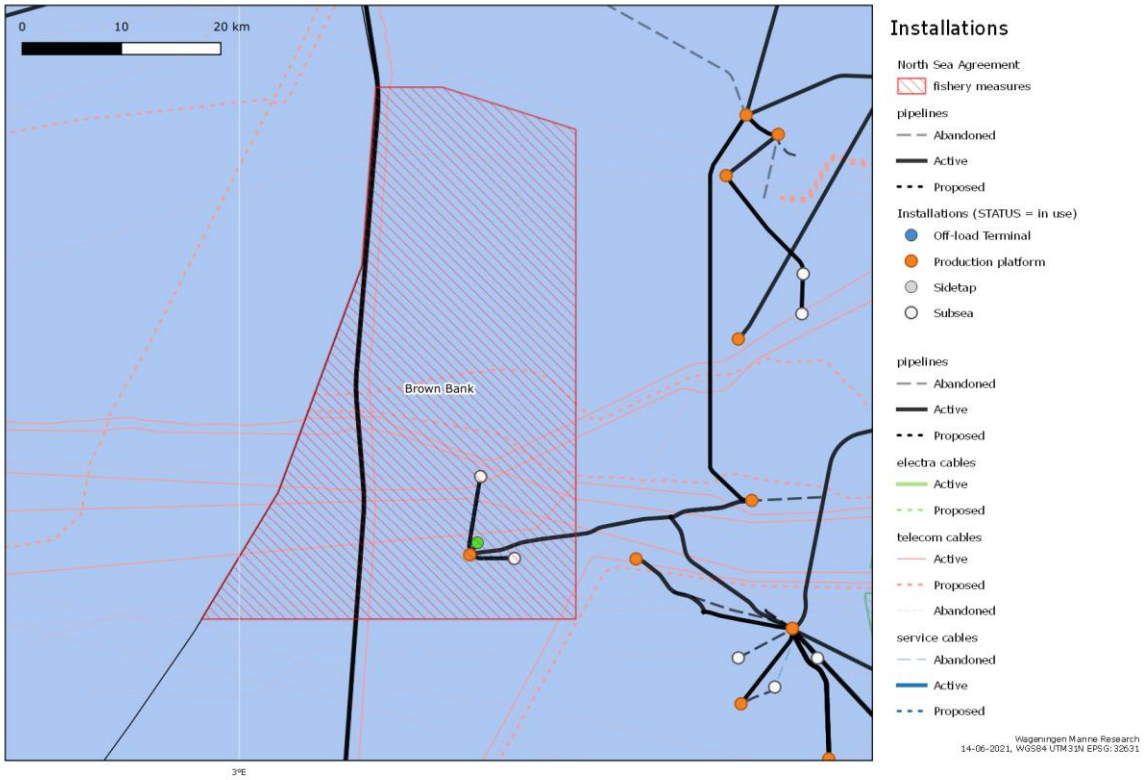


*Figure 27. Installations and pipelines in the area of the Brown Ridge.*

### 2.4.2 Cables and pipelines

On the DCS, cables stretch over about 4500 km, of which approximately half is no longer in use. The length of pipelines is an estimated 6000 km (CBS et al., 2019).

**Fout! Verwijzingsbron niet gevonden.** 33 shows the cables and pipelines within and around the proposed closures of the Brown Ridge. Several telecom cables are found, and more are planned traversing the area. A pipeline crosses the from north to south at the western edge of the Brown Ridge. Another pipeline is connected to the oil and/or gas facilities (see section 2.4.1).

Cables and pipelines are generally buried and thus there is no loss of surface. Rock dumping is only used at intersections, with an estimated surface area of 500 $m^2$ being lost (The Dutch Ministry of Infrastructure and Water Management & the Dutch Ministry of Agriculture, Nature and Food Quality, 2018). The installation causes some physical disturbance of the seafloor, for approximately 10 m at each side (Tamis et al., 2011).

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.

### 2.4.3 Shipping routes

Several deep water shipping routes cut through the Brown Ridge (Figure 29). Compared to the rest of the North Sea, the area is used relatively intensively. 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 around 30 years, but is not linked to present shipping.

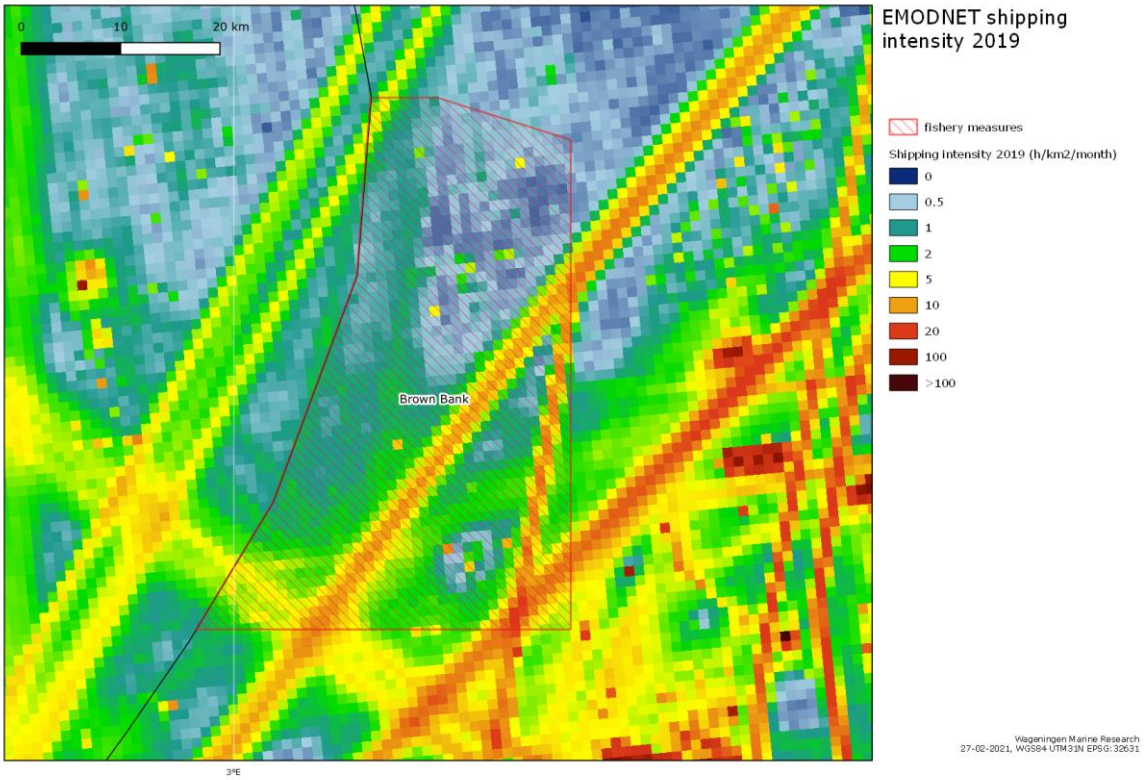


*Figure 28. Shipping intensity (2019) in the area of the Brown Ridge.*

### 2.4.4 Wind energy

There are no wind farms located in the Brown Ridge (Figure 30) and future wind farms have been planned outside the area. Specifically, the northern part of the Dutch side of the bank overlaps with IJmuiden Ver, a commissioned large offshore wind energy development area, with a planned capacity of 4 GW (Heinis et al., 2019). The development of IJmuiden Ver wind farm will likely have significant negative effects and cause habitat loss for seabirds, cetaceans and benthic fauna in Brown Ridge (Bos and Bemmelen, 2012). Although the Dutch government's recent Offshore Wind Energy Roadmap 2030 states that "part of the southern side" of the IJmuiden Ver area will not be used for wind farms, "given the (potential) designation of the partially overlapping "Bruine Bank" area as a Natura 2000 area," (Wiebes, 2018). A second wind farm included in the same plans lies on the eastern edge of Brown Ridge; the 1.4 GW Hollandse Kust (west) wind farm. The tendering phase ran in 2021 (Wiebes, 2018). Since then the permit for this wind farm has been granted to the RWE renewables.

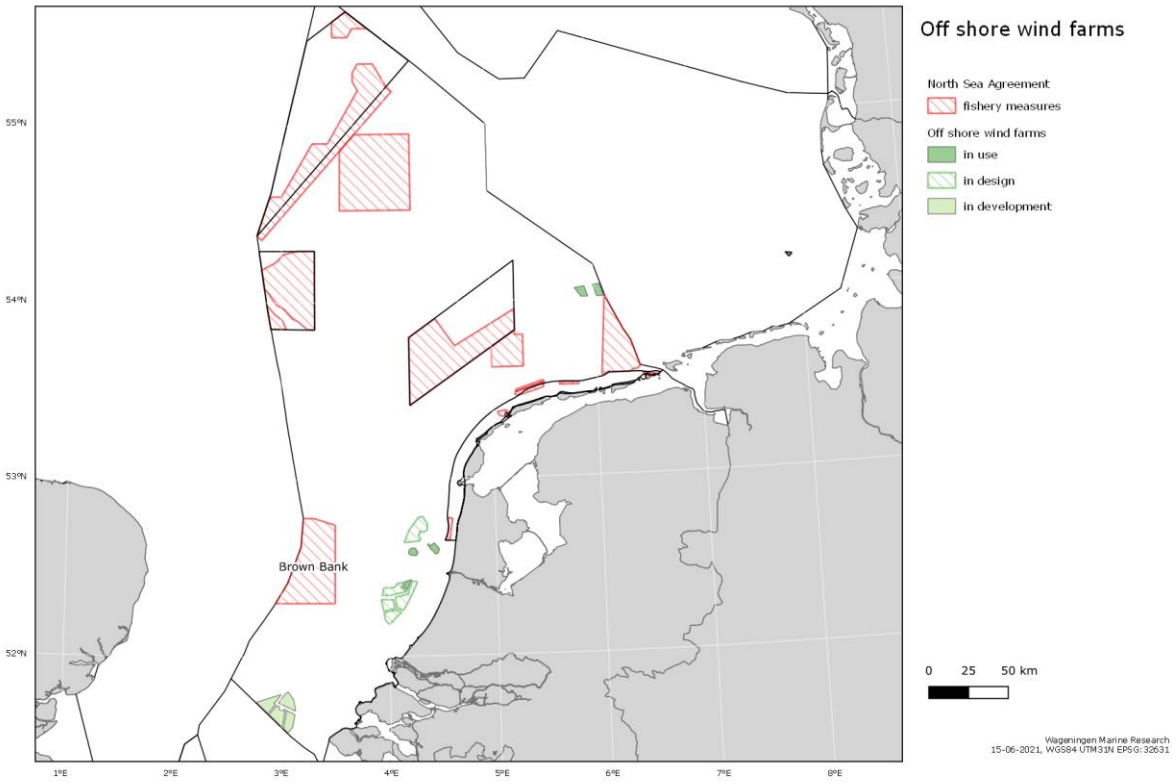


*Figure 29. Wind farms on the DCS. For current and future plans, see figure 27.*

### 2.4.5 Air traffic

There is no information known for air traffic which can have an significant negative effect on the survival and reproduction in their area of distribution mentioned in Annex I of the BD on the Brown Ridge.

### 2.4.6 Shell/sand/gravel extraction

There is no information known for shell/ sand/ gravel extraction which can have an significant negative effect on the survival and reproduction in their area of distribution mentioned in Annex I of the BD on the Brown Ridge.

### 2.4.7 Dredging

There is no information known for dredging which can have an significant negative effect on the survival and reproduction in their area of distribution mentioned in Annex I of the BD on the Brown Ridge.

### 2.4.8 Coastal protection

There is no information known for coastal protection which can have an significant negative effect on the survival and reproduction in their area of distribution mentioned in Annex I of the BD on the Brown Ridge.

### 2.4.9 Recreation

There is no information known for recreation which can have an significant negative effect on the survival and reproduction in their area of distribution mentioned in Annex I of the BD on the Brown Ridge.

## 2.5 Monitoring

The monitoring is described in the Natura 2000 and MSFD monitoring programme (Min I&W and Min LNV, 2020). The programme describes environmental targets, indicators, research needs, a research strategy, functional measurement needs, a monitoring strategy and a measurement plan. The resulting monitoring data provide insight in:

- the status of the indicators and 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).
- the effectiveness of the programme of measures to be implemented under the MSFD. The Marine Information and Data Centre (Informatiehuis Marien)[5] is the supporting body which plays a central role in implementing the MSFD monitoring cycle, particularly concerning monitoring quality, transparency, availability and cost efficiency. The monitoring agenda can be found at: https://www.informatiehuismarien.nl/uk/products/monitoringagenda/

To reduce costs and improve consistency, the Natura 2000 and 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.

Since 2014, seabird species have been monitored by airplane (MWTL (Monitoring Waterstaatkundige Toestand des Lands) in the Brown Ridge and its surroundings. In the 2022-2023 season, Brown Ridge was monitored in August, November 2022, January, February, April and June 2023 (van Bemmelen et al., 2023) (Figure 31). Maps of the density of the seabirds in the area can be found in van Bemmelen et al. (2023).

The monitoring programme is adaptive and is evaluated regularly.

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

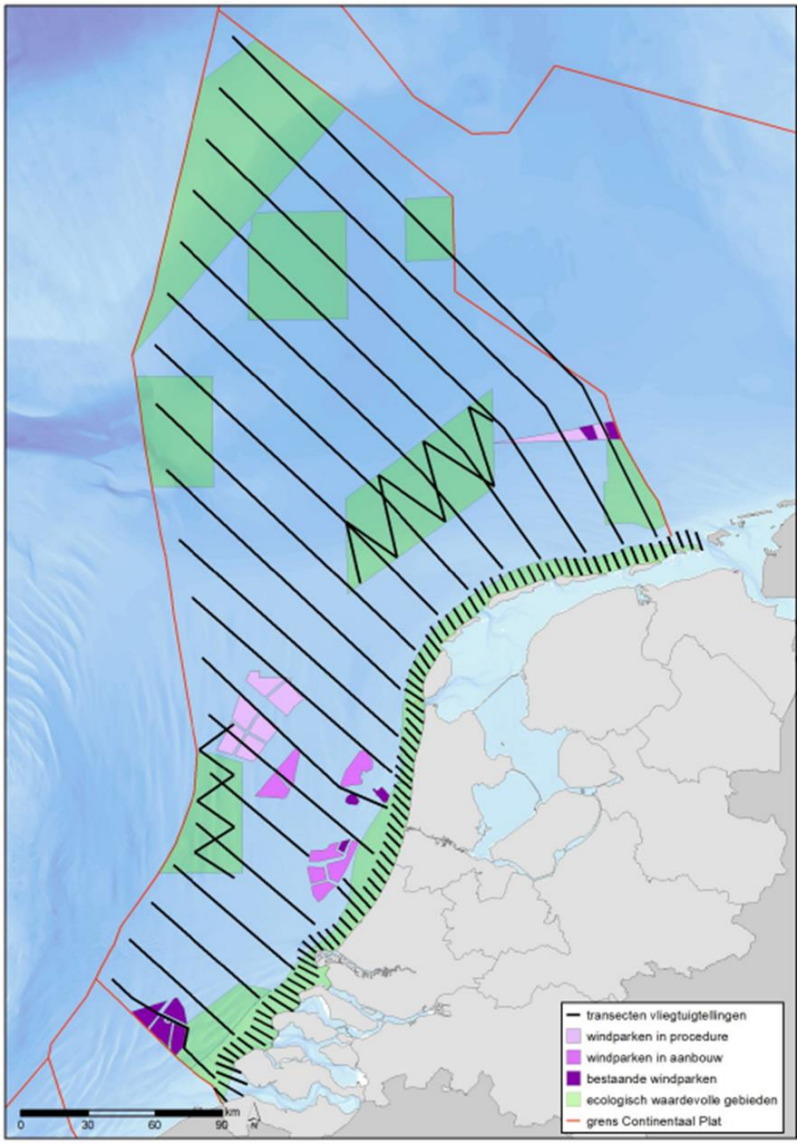


*Figure 30. Spatial coverage of the Natura 2000 MSFD (MWTL) bird monitoring programme (van Bemmelen et al., 2023)*

# 3 Rationale for conservation measures

## 3.1 Conservation objectives

The decision on designation of the Brown Ridge as SPA under the Bird Directive (Min LNV, 2021) includes designation for:

- A177 little gull (*Larus minutus*).

In addition, the area is designated for a few regularly occurring migratory birds for which the area is important as a foraging area in their migration zones:

- A016 northern gannet (*Morus bassanus*);
- A175 great skua (*Stercorarius skua*);
- A187 great black-backed gull (*Larus marinus*);
- A199 common guillemot (*Uria aalge*);
- A200 razorbill (*Alca torda*).

For all species the conservation objectives are to maintain extent and quality of the habitat to sustain maintenance of the population (Min LNV, 2021). The aim of the conservation measures is to contribute to this conservation objective.

## 3.2 Policy considerations

The conservation objectives are to maintain extent and quality of the habitat to sustain maintenance of the population (Min LNV, 2021). No agreements on conservation measures were made during the drafting of the national North Sea Agreement (OFL, 2020). It was only agreed that the Brown Ridge would be designated as a Birds Directive SPA.

The boundaries of the area are selected on the basis of ecological criteria based on results of the Monitoring Waterstaatkundige Toestand des Lands (MWTL). Seabird species on the Brown Ridge and its surroundings were monitored for four months of the year since 2014 (January, February, August, November) (Fijn and de Jong, 2019). The results provided five options for boundaries (Figure 32) which were analysed for the numbers and possible qualification status of 14 seabird species (De Jong et al., 2018; Fijn & de Jong. 2019) and all areas qualified. The selected variant is marked in Figure 32, taking the planned offshore windfarm 'IJmuiden Ver' into account.

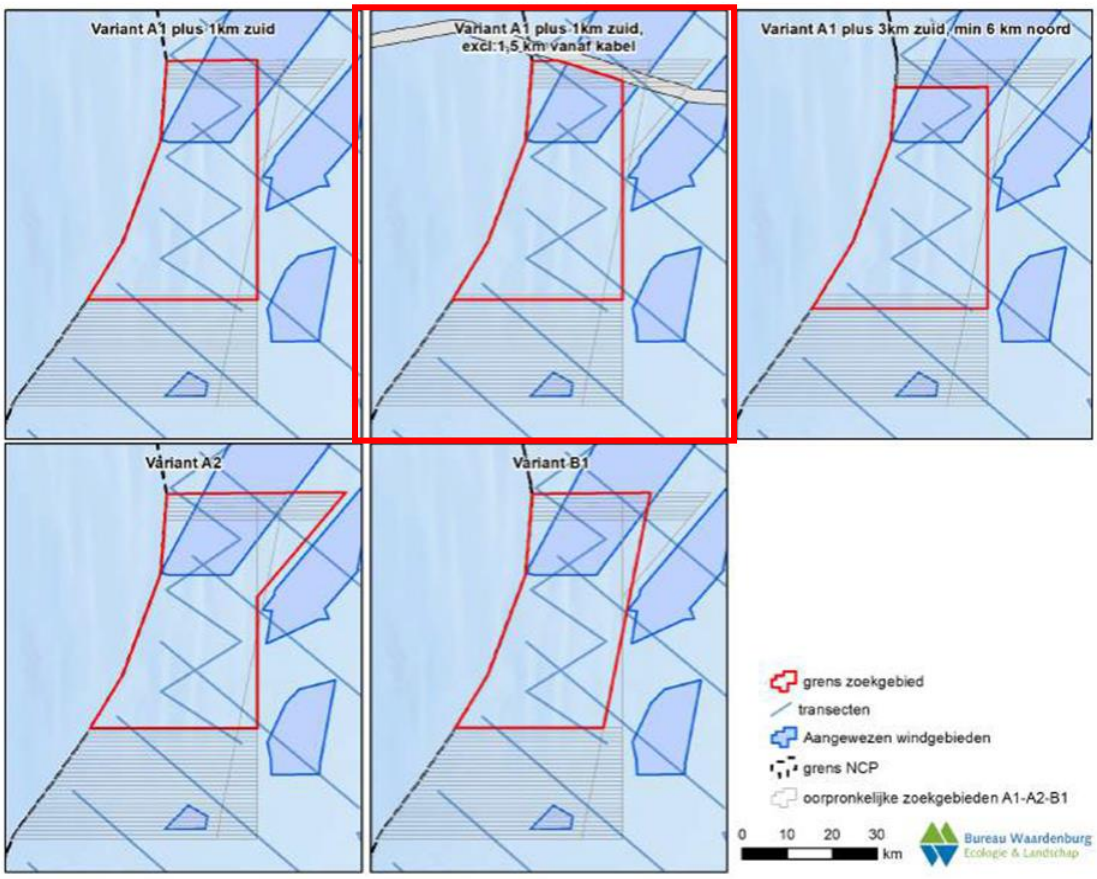


*Figure 31. Five variants as options for the borders of the Brown Ridge (source: Fijn & de Jong, 2019). Transect lines for aerial monitoring of seabirds are indicated. The selected variant for fisheries measures is the upper middle (red rectangle).*

As shown in paragraph 2.3, gillnet and entangling net fishing is a potential cause of mortality for the two diving bird species razorbill and common guillemot. Both species are easily entangled in the nets underwater while foraging. By-catch by fisheries is a serious threat to birds on the Brown Ridge (Jongbloed et al., 2019). Fish and marine mammals are also impacted through bycatch. The conservation measures should therefore limit the impact of gillnet and entangling net fisheries in order to protect the valuable species. Jongbloed et al. (2015) investigated the importance of gillnet and entangling net fisheries in the area and the overlap with the habitat of the two bird species. In Jongbloed et al. (2019) more recent data on numbers and spatial distribution of the seabirds in the area were presented, as well as more recent data for intensity and economic value of gillnet and entangling net fishery of the Dutch fleet and foreign fleets. Jongbloed et al. (2019) state that the actual magnitude of the bycatch problem is unknown. Monitoring this bycatch of diving seabirds, caused by the use gillnet and entangling nets, is recommended. The Netherlands aims with other relevant countries to reduce the incidental bycatch of threatened marine mammals, birds, turtles, sharks and rays with the CIBBRiNA project. See further paragraph 6 in the General Background Document.

The Joint Recommendation proposes to prohibit the use of gillnet and entangling nets in the period 1 October – 31 March of each year on the Brown Ridge. Historic data shows that the proposed measure is taken during the period that the protected bird species are predominantly present. Fisheries data shows that fishing activities with gillnet and entangling nets mostly takes place between 1 April to 31 September. In relation to the precautionary principle it is needed to minimise the effect of gillnet and entangling net fishing activities during the time the protected bird species are predominantly present at the Brown Ridge. In relation to the proportionality principle it is needed to balance effect of the measure on the ecosystem with the impact such a measure can have on the fishery. This measure has a minimal effect on the fisheries but a maximal effect on the protected bird species. Therefore, the proposed measure is considered to be proportionate in relation to the protection of the species and the socio-economic impact of the fisheries. Additionally this measure insures the conservation of protected bird species for the future when it might be profitable to use gillnet and entangling net fisheries in periods that protected bird species are predominantly present at the Brown Ridge.

# 4 Expected effects of the conservation measures

## 4.1 Expected effects on the natural feature

The proposed conservation measures are expected to reduce the risk of bycatch and are thus expected to be beneficial to the conservation objectives of deep diving seabird species under the BD. This may also apply for northern gannets since a considerable part of the Brown Ridge seafloor is also within reach for this species. The other species, which are shallow divers at best, are not expected to benefit from the proposed measures.

Other possible threats to the conservation of guillemots have been identified for the Frisian Front (Didderen et al., 2019), which are: contamination with floating oil, grease or chemicals; disturbance by shipping; and wind farms. These threats are also present on the Brown Ridge (see section 2.4). The proposed measures are not expected to have an effect on these threats.

The assessment of expected conservation benefits by the proposed closures is hampered because of many uncertainties, e.g. population size of bird species, bycatch rates, diet of seabirds, food availability (including the relationship between biogenic reefs and food availability) and occurrence of prey species.

## 4.2 Expected effects on fisheries

The majority of the fishing activity with gillnet and entangling nets takes place in the period in which an exemption for the use of gillnet and entangling nets on the Brown Ridge is possible. It is therefore expected that the effects of the proposed measures will be minimal and proportionate in relation to the conservation goals necessary for compliance with obligations under Birds directive.

It is expected that the proposed measures will contribute to a more in-depth understanding of the relationship between different types of gillnet and entangling nets and possible impact on deep diving seabirds on the Brown Ridge. The development of this knowledge is crucial for the evaluation of the measures after a period of six years. It is also expected that the results will add to policy considerations in other areas in which fisheries are restricted, for example offshore windfarms or other N2000- MSFD areas.

## 4.3 Expected effects on other human activities

At this point no insight can be given in the expected effects on other human activities.

# 5 Discussion

See Chapter 8 of the General Background Document.

# 6 Conclusion

See Chapter 9 of the General Background Document.

# References


Bos, O.G., Witbaard, R., Lavaleye, M., Van Moorsel, G., Teal, L.R., Van Hal, R., Van der Hammen, T., Ter Hofstede, R., Van Bemmelen, R., Witte R.H., Geelhoed, S., Dijkman, E.M. (2011). Biodiversity hotspots on the Dutch continental Shelf. (No. C071/11). IMARES, Yerseke.

Bos, O.G., Bemmelen, R. van. (2012) Aanvullende beschermde gebieden op de Noordzee.

Bos, O.G., Coolen, J.W.P., van der Wal, J.T. (2019). Biogene riffen in de Noordzee. Actuele en potentiële verspreiding van rifvormende schelpdieren en wormen (https://doi.org/10.18174/494566) (No. C058/19). Wageningen Marine Research, Den Helder.

Bos, O.G., Tamis, J.E. (2020). Evaluation of OSPAR recommendations for endangered and/or declining species and habitats in the Netherlands (No. C006/20EN). Wageningen Marine Research, Den Helder, The Netherlands. https://doi.org/10.18174/512841

Bos, O.G., Witbaard, R., Lavaleye, M., van Moorsel, G., Teal, L.R., van Hal, R., van der Hammen, T., ter Hofstede, R., van Bemmelen, R., Witte, R.H., Geelhoed, S., Dijkman, E.M., 2011. Biodiversity hotspots on the Dutch Continental Shelf.

CBS, PBL, RIVM, WUR, 2019. Gebruiksfuncties van de Noordzee, 2019 (indicator 0064, versie 07, 24 juni 2019 ).

Coolen, J. W. P. (2017). *North Sea reefs: benthic biodiversity of artificial and rocky reefs in the southern North Sea* (Doctoral dissertation, Wageningen University).

Didderen, K., Rebolledo, E.L.B., Mastrigt, A. Van, Fijn, R.C., Mulder, S. (2019). Doeluitwerking Friese front (No. Rapportnr. 18-081). Bureau Waardenburg, Culemborg, Culemborg.

Duineveld, G.C.A., Bergman, M.J.N., Lavaleye, M.S.S. (2007). Effects of an area closed to fisheries on the composition of the benthic fauna in the southern North Sea. ICES J. Mar. Sci. 64, 899–908. https://doi.org/10.1093/icesjms/fsm029

EC (2018). 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. Brussels, 24.5.2018 SWD(2018) 288 final. https://ec.europa.eu/fisheries/sites/fisheries/files/swd_2018_288_en.pdf

EU, 1992, Habitat Directive, Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, OJ L 206, 22.7.1992, p. 7–50;

EU, 2009, Birds Directive, Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, OJ L 20, 26.1.2010, p. 7–25;

EU, 2011, of Gear Codes in Annex XI in EU Regulation 404/2011, Commission Implementing Regulation (EU) No 404/2011 of 8 April 2011 laying down detailed rules for the implementation of Council Regulation (EC) No 1224/2009 establishing a Community control system for ensuring compliance with the rules of the Common Fisheries Policy; OJ L 112, 30.4.2011, p. 1–153;

EU, 2013, Basic Regulation 2013, Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC, OJ L 354, 28.12.2013, p. 22–61;

Fijn, R.C. & J.W. de Jong. (2019). Vogelwaarden van een mogelijk Natura 2000-gebied Bruine Bank. Populatieschattingen van kwalificerende, begrenzende en niet-kwalificerende soorten binnen drie mogelijke gebiedsbegrenzingen. Bureau Waardenburg Rapportnr. 19-042. Bureau Waardenburg, Culemborg.

García, S., Álvarez, H., Perry, A.L., Blanco, J., Maaholm, D.J., Aguilar, R. (2020). Protecting the North Sea: Brown Ridge. OCEANA, Madrid.

Heinis, F., de Jong, C.A.., von Benda-Beckmann, S., Binnerts, S. (2019). Kader Ecologie en Cumulatie – 2018 Cumulatieve effecten van aanleg van windparken op zee op bruinvissen.

Hintzen, N., Coers, A., Hamon, K. (2013). A collaborative approach to mapping value of fisheries resources in the North Sea (Part 1: Methodology), IMARES Wageningen UR IMARES Wageningen UR, p. 24p.

ICES, 2010. Report of the FIMPAS Workshop 2 Fishery Impact and Conflicts with Conservation Objectives, 30 June - 2 July 2010, Neufchatel-Hardelot, France.

ICES, 2011. Report of the FIMPAS Workshop 3. Management proposals for Dogger Bank, Cleaver Bank and Frisian Front. 24-26 January 2011, Den Helder, The Netherlands.

Jong, J.W. de, E.L. Bravo Rebolledo, R.C. Fijn. (2018). Grenzen van mogelijk Natura 2000-gebied Bruine Bank. Nieuwe inzichten op basis van recente MWTL-vliegtuigtellingen. Bureau Waardenburg Rapportnr. 17-202. Bureau Waardenburg, Culemborg.

Jongbloed, R.H., Glorius, S., Wal, J.T. van der, Hamon, K.G. (2019). Assessment of the impact of gillnet fishery on conservation objectives of seabirds in the Brown Ridge (No. C008/20). Wageningen Marine Research (University & Research Centre).

Jongbloed, R.H., M.A.M. Machiels J.T. van der Wal, K.G. Hamon & J.A.E Oostenbrugge. (2015): Assessment of the impact of gillnet fishery on conservation objectives of seabirds in the Brown Ridge. IMARES report C182/15.

Jongbloed, R.H., Slijkerman, D.M.E., Witbaard, R., Lavaleye, M.S.S. (2013). Ontwikkeling zeebodemintegriteit op het Friese Front en de Centrale Oestergronden in relatie tot bodemberoerende visserij. Verslag expert workshop (No. C212/13).

Jongbloed, R.H., N.T. Hintzen & O.G. Bos (2023). Fishing effort in protected areas in the Dutch part of the North Sea. Data for 2014-2021. Background document to the Joint Recommendation for Fisheries Management under the revised Common Fisheries Policy. Wageningen University & Research report. https://doi.org/10.18174/560805

Hamon, K. G. & Klok, A, (2023). Overview of the International Fishing Activities on Protected Areas in the
Dutch part of the North Sea; Fishing activities of the Dutch, Danish, German, Belgian, Swedish and French fleet for the period 2014-2021. Wageningen, Wageningen Economic Research, Report 2023-023. 96 pp.; 45 fig.; 14 tab.; 15 ref.

Leopold, M.F., van der Wal, J.., 2015. Kwalificerende en niet-kwalificerende vogelsoorten in het gebied "Bruine Bank."

Lindeboom, H. J., Geurts van Kessel, A. J. M., & Berkenbosch, A. (2005). Areas of special ecological values at the Dutch Continental Shelf. Report RIKZ/2005.008, Den Haag / Alterra Report 1109, Wageningen, 103 p. http://library.wur.nl/WebQuery/wurpubs/fulltext/3249

OFL. (2020). The North Sea Agreement. https://doi.org/10.1080/00139157.1974.9928424

Roskam, J.L., Hamon, K.G., Deetman, B. (2021). Overview of the International Fishing Activities on Protected Areas in the Dutch part of the North Sea. Dutch, Danish, German, Belgian, Swedish and French data for 2015-2019

Tamis, J.., Karman, C.., de Vries, P., Jak, R.., Klok, C. (2011). Offshore olie- en gasactiviteiten en Natura 2000.

Tamis, J.E., Jongbloed, R.H., Kamermans, P. (2019). Quickscan mogelijke effecten gaswinning bij Borkumse Stenen op platteoesterrif, Wageningen Marine Research rapport : C033/20. Wageningen Marine Research, 2057, Onderz. Form. I.,.

The Dutch Ministry of Infrastructure and the Environment, & The Dutch Ministry of Economic Affairs. (2015). The Policy Document on the North Sea 2016-2021. https://www.noordzeeloket.nl/en/policy/noordzeebeleid/beleidsnota-noordzee/@166985/policy-document/

The Dutch Ministry of Infrastructure and the Environment, The Dutch Ministry of Economic Affairs. (2015). The Policy Document on the North Sea 2016-2021.

The Dutch Ministry of Infrastructure and Water Management et al. (2022). Programma Noordzee 2022-2027 (p. 104). https://noordzeeloket.nl/beleid/programma-noordzee-2022-2027/

The Dutch Ministry of Infrastructure and Water Management & The Dutch Ministry of Agriculture, Nature and Food Quality. (2020). Mariene Strategie (deel 2) Actualisatie van het KRM-monitoringprogramma 2020-2026. juni 2020. https://www.informatiehuismarien.nl/producten/europese-kaderrichtlijn-mariene-strategie-krm/mariene-strategie-deel-2-monitoring/

The Dutch Ministry of Agriculture, Nature and Food Quality, 2021. Besluit Natura 2000-gebied # 168 Bruine Bank. Directoraat-generaal Natuur, Visserij en Landelijk Gebied | DGNVLG-M/2021-168 | 168 Bruine Bank

The Dutch Ministry of Infrastructure and Water Management & The Dutch Ministry of Agriculture, Nature and Food Quality. 2018. Mariene Strategie (deel 1) Actualisatie van huidige milieutoestand, goede milieutoestand, milieudoelen en indicatoren. 2018-2024.

Van Bemmelen, R. S. A., Leopold, M. F., & Bos, O. G. (2012). Vogelwaarden van de Bruine Bank:

Project Aanvullende Beschermde Gebieden. IMARES. http://edepot.wur.nl/247418

Van Bemmelen, R.S.A., de Jong, J.W., Arts, F.A., Beuker, D., Engels, B.W.R., Hoekstein, M.S.J., van der Horst, Y., Kuipe,r K., Leemans, J., Sluijter, M., van Straalen, K.D., Wolf, P.A. & Fijn, R.C. (2023). Verspreiding, abundantie en trends van zeevogels en zeezoogdieren op het Nederlands Continentaal Plat in 2022-2023. RWS-Centrale Informatievoorziening BM 23.32. Waardenburg Ecology Rapportnr. 23-443. Waardenburg Ecology & Deltamilieu Projecten, Culemborg.

Van der Reijden, K.J., Koop, L., O'Flynn, S., Garcia, S., Bos, O., van Sluis, C., Maaholm, D.J., Herman, P.M.J., Simons, D.G., Olff, H., Ysebaert, T., Snellen, M., Govers, L.L., Rijnsdorp, A.D., Aguilar, R., (2019). Discovery of Sabellaria spinulosa reefs in an intensively fished area of the Dutch Continental Shelf, North Sea. J. Sea Res. 144, 85–94. https://doi.org/10.1016/j.seares.2018.11.008

Van Duren, L.A., Gittenberger, A., Smaal, A.C., van Koningsveld, M., Osinga, R., Cado van der Lelij, J.A., de Vries, M.B. (2016). Rijke riffen in de Noordzee.

Wiebes, E. (2018). Offshore Wind Energy Roadmap 2030. Briefing to the President of the House of Representatives, from the Minister of Economic Af- fairs and Climate Policy. 27 March 2018.

Wijnhoven, S. (2018). T0 beoordeling kwaliteitstoestand NCP op basis van Benthische Indicator Soorten Index. Toestand en ontwikkelingen van benthische habitats en KRM-gebieden op de Noordzee in en voorafgaand aan 2015 (No. Ecoauthor Report Series 2018-01). Ecoauthor, Heinkenszand, The Netherlands.

Wijnhoven, S., Bos, O.G. (2017). Benthische Indicator Soorten Index (BISI).