Annex 5 - Background document Borkum Reef Grounds

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

This document was drafted by the Dutch ministry of Agriculture, Fisheries, Food Security and Nature in collaboration with the following research institutes:

Wageningen Marine Research (Oscar Bos, Jacqueline Tamis, Ruud Jongbloed, Robbert Jak, Niels Hintzen)
Wageningen Economic Research (Katell Hamon, Bea Deetman, Jamal Roskam)

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 2 and 4 of the area-specific Background Documents and chapters 3, 6 and 7 of the General Background Document.

Contents

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 Borkum Reef Grounds necessary to comply with Union Environmental legislation, such as the Habitat Directive, Birds Directive or Marine Strategy Framework Directive. The Borkum Reef Grounds is designated under the Marine Strategy Framework Directive for protection of the seabed. The Borkum Reef Grounds have unique ecological values such as geogenic and biogenic reef structures. As a conservation measure, circa 682 km^2 will be closed to all bottom contacting towed gear (beam trawls, demersal trawls and seines, and dredges). See also the Joint Recommendation for conservation measures. In the period 2014-2019 an average of 47 fishing days was realised mainly in the southern half of the Borkum Reef Grounds by Dutch and German flagged vessels. The predominant gear was shrimp trawl (TBS) and main target species common shrimp (*Crangon crangon*). The average Gross Value Added per year (2015-2019) was 141.000 EUR (NL: 106.000 EUR, DE: 33.000 EUR). Also other humans activities that affect the seabed take place on the Borkum Reef Grounds, such as: oil and gas exploration, pipelines and cables, shipping, sand/shell/gravel extraction and the construction of offshore wind parks in the surroundings. Although multiple human activities that affect the seabed take place, the conservations measures that are taken under the Marine Strategy Framework Directive focus on demersal fishing activities, since these are considered to be the main human activity adversely affecting the integrity of the seabed. The conservation objective for the Borkum Reef Grounds is the recovery of substantial parts of the seabed ecosystem from a disrupted state towards a natural condition. The conservation measures will contribute to the return and recovery of biogenic reefs, including flat oyster banks and by protecting reefs of all types. By the exclusion of all bottom contacting towed gear, it is foreseen that seabed integrity is maintained. This will allow the development of the typical characteristics of the seabed community of geo-morphological reef structures, of *Lanice* reefs and of the sandy seafloor. No specific information on effects of displacement is available for this area. Since the majority of the fishery effort concerns shrimp trawling in the southern part of the area, it is expected that the fishery will redistribute in the areas open to shrimp fisheries in and around Natura 2000 area North Sea Coastal Zone.

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 Borkum Reef Grounds 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 the Good Environmental Status (GES) of the North Sea under the Marine Strategy Framework Directive (MSFD) (Directive 2008/56/EC). The Borkum Reef Grounds is partially located in the 12-mile zone of the Netherlands.

This document is submitted as an Annex to the Joint Recommendation on the Borkum Reef Grounds (Figure 1) by the initiating Member State the Netherlands. Final approval of the Joint Recommendation was agreed by those Member States with a direct fisheries management interests in the Scheveningen High Level Group and submitted to the European Commission by its Chair.

This chapter provides the introduction of this area-specific Background Document. Chapter two elaborates on the area 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 Borkum Reef Grounds. In Chapter six the conclusion leading to the current Joint Recommendation is summarised.

The content of this 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.

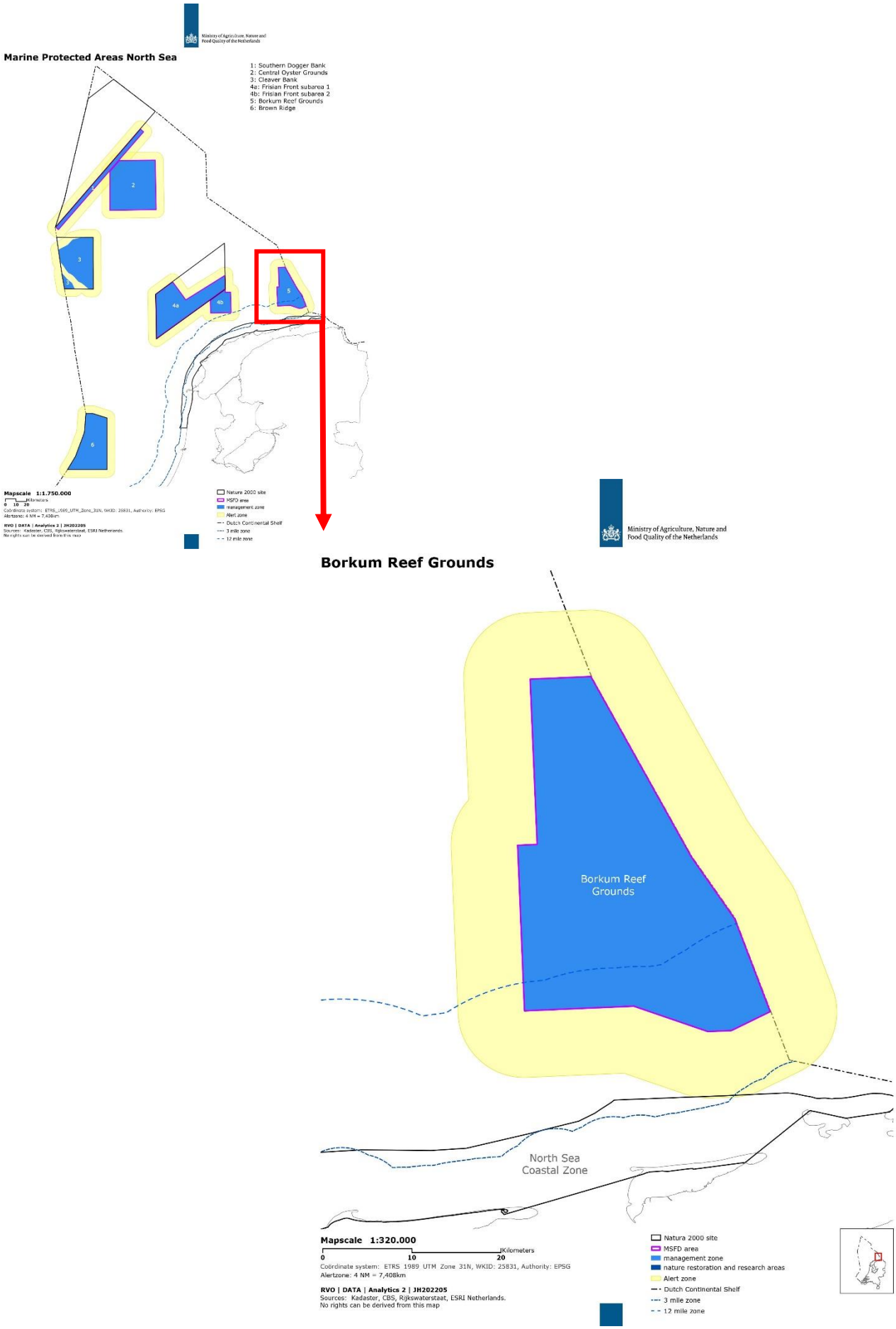

Figure 1. North Sea protected areas with a detailed map of the site Borkum Reef Grounds.

2 Area description

2.1 Legal status

Protection of the seabed ecosystem of the Borkum Reef Grounds is offered on the basis of article 13.4 of the MSFD.

The MSFD is implemented in art. 4.6 and 4.16 of the Water Decree under the Dutch Water Act. Nature 2000 areas and MFSD area protection are part of the Dutch Policy Document on the North Sea 2022-2027 (IenW, 2022a) and Marine Strategy for the Dutch part of the North Sea 2022-2027, Part 3 Programme of Measures MSFD (IenW, 2022b). These documents are part of the Dutch Water Plan under article 4.1 paragraph 3b of the Dutch Water Act.

Protection of the area contributes to achieving Good Environmental Status (GES) under the MSFD. How protection of the Borkum Reef Grounds could contribute to relevant GES and environmental targets is listed in Table 1. The main characteristics are listed in Table 2.

In the Netherlands, the benthic habitat quality status is evaluated by use of the Benthic Indicator Species Index (BISI) (Wijnhoven and Bos, 2017; Wijnhoven, 2019), which is specifically designed for areas of special ecological value and used for MSFD status reporting (IenW & LNV, 2018). For the Borkum Reef Grounds no benthic habitat quality status report has yet been made, see paragraph 2.5 Monitoring.

Table 1: Overview of environmental targets under the Dutch Marine Strategy (IenW & LNV, 2018) to which conservation measures in the Borkum Reef Grounds will contribute.

Good Environmental Status	Environmental target	Contribution Borkum Reef Grounds
D6 Habitats		
Overarching: improvement in the size, condition and global distribution of populations of the community of benthos species.	D6T1: 10-15% of the area of the Netherlands' part of the North Sea is not notably disrupted by human activities. D6T5: Return and recovery of biogenic reefs such as flat oyster beds.	D6T1: protection of Borkum Reef Grounds (BRG) will help reaching 10-15 % D6T5: The oyster reef restoration project in the southeast of BRG is a successful pilot: oysters survive and grow, larvae and recruits are present. BRG also offers settlement space to larvae produced in adjacent areas such as those from oyster restoration pilots in Offshore Windpark Gemini north of BRG and in the German oyster pilot just east of BRG.
Physical disturbance of the seabed – D1 (biological diversity), D6 (sea-floor integrity		
Overarching: physical disruption of the seabed due to human activities is restricted to ensure that the scale, condition and global distribution of populations of the community of characteristic benthos species increases, and targets for specific habitats are achieved.	D6T1: 10-15% of the surface of the Netherlands' part of the North Sea is not notably disrupted by human activities. D6T3: no rise in the physical disturbance due to fishing activities over time on the total seabed of the NCP and on the habitats described in the framework of the MSFD. D1T3: achieving the conservation objective for habitat types and species in the Natura 2000 areas at sea (BHD)	D6T1: protection of Borkum Reef Grounds will help reaching 10-15% D6T3: fishery measures will contribute to this target. D1T3: protection of the seabed will contribute to conservation objectives for habitat type Reefs, and probably marine mammals (foraging habitat).
D1 Species/marine mammals and birds		

D1C2 - The population of the grey seal (H1364), harbour seal (H1365) and porpoise (H1351) comply with the favourable reference value for the population size (FRP) according to the Habitats Directive. D1C4 - Distribution of harbour porpoise and harbour seal satisfies the favourable reference value for population range (FRR) according to the Habitats Directive. Also relevant is the extent to which the area and quality of habitats of marine mammals continue to develop: (D1C5) – Preservation of the size and quality of the habitat of the grey seal (H1364), the harbour seal (H1365) and the porpoise (H1351).	D1T2: recovery of undisturbed situation for sea mammals and birds through reduction of fishery on the Raan Flats and in the North Sea coastal zone (in the framework of the VIBEG agreement). D1T3: achieving the maintenance targets for habitat types and species in the Natura 2000 areas at sea (BHD).	D1T2: the Borkum Reef Grounds are an important foraging habitat for harbour porpoise and both seal species. The specific significance of the area to birds is less clear. D1T3: Borkum Reef Grounds serve as feeding grounds for marine mammals and protection of habitat type Reefs would be beneficial
D1 Species/fish community		
D1C2 - Improving the population abundance of sharks and rays in the North Sea and above all in the coastal zone. D1C2 – Rise in the proportion of vulnerable species of fish in the fish community (OSPAR).	D1T5: research into sharks and rays in combination with the taking of mitigating measures as laid down in the Shark and Ray action plan	D1T5: Thornback ray (*Raja clavata*) is present in the area. Protection of its habitat is beneficial for the species.

Table 2: Summary of characteristics of Borkum Reef Grounds (BRG) and the VIBEG II Area

Characteristic	Description
Area	The current proposal encompasses a closure of circa 682 km^2. Two earlier versions of a marine protected area have been considered: BRG 653 km^2 (North Sea Agreement; OFL, 2020, including VIBEG II 95 km^2) BRG 554 km^2 (Lindeboom et al., 2005)
Habitats	Reefs make the area (all versions) unique compared to large part of the rest of the Dutch North Sea. Habitat types: Sand/mud *Lanice conchilega* reefs Hard substrate (circa 14.5km^2)
Benthos	Typical hard substrate species present in reef areas, dense aggregations of *Lanice conchila* with associated biodiversity.
Fish	Present: clupeid fish, such as sprat, herring and anchovy, a number of commercial flatfish species (dab, plaice, flounder, whiting, plaice), commercial demersal roundfish species (whiting, grey gurnard), but also OSPAR-listed species, notably thornback ray
Marine mammals	Important feeding Grounds for grey seals and harbour seals.
Birds	Area does not appear to hold any notable concentrations of seabirds
European flat oysters	Area was part of the historical European flat oyster reef habitat; currently a small oyster restoration pilot takes place in the site and three restoration pilots near the site.
Fisheries	Fishery dominated by shrimp fishery (96%). Intensity is highest in the southern part (adjacent to the coastal zone) and low in the northern part. Other types of fishery than shrimp fisheries almost absent. Compared to the fishery intensity south of the area, the intensity inside the area is low.

2.2 Natural features

Borkum Reef Grounds partly lies within the Dutch territorial waters and partly beyond the territorial waters in the Dutch Exclusive Economic Zone (EEZ). Figure 2 shows that Borkum Reef Grounds is bordered in the east by the German EEZ and territorial sea. The area borders the German Natura 2000 area Borkum Riffgrund (Figure 3).

The Borkum Reef Grounds was identified in 2005 as a potential area with special ecological values (Lindeboom et al., 2005; Lindeboom et al., 2008). Subsequent research has shown that the area contains a rich benthic biodiversity. This is due to the presence of coarse sediments and stony reefs, as well as dense aggregations of the sand mason worm *Lanice conchilega* (Bos et al. 2014, Coolen et al., 2015) (Figure 3). Additional fieldwork in December 2021 confirmed the presence of some stony reefs in the northern part, close to Offshore Wind Park Gemini (O. Bos, pers. com).

Historically, the Borkum Reef Grounds are known for the occurrence of stones and rocks and oyster beds. The 1915 German Fishery map (in Gercken & Schmidt, 2014) shows the presence of stony reefs at that time, as well as oyster beds. Also a map made by the Dutch Ministry of LNV (mid-20th century) for fishery

research shows that Borkum Reef Grounds is classified as 'reef area'. Current research shows that abiotic reefs are present in the centre part of the area (Figure 3), and also in the northern tip. In total, they cover an estimated 14.5 km^2 (Bos et al., 2014), about 2% of the proposed area. In the adjacent German Natura 2000 area Borkum Riffgrund stony reefs are also present, covering 23 km^2. The main part of the area of the Dutch Borkum Reef Grounds consists of sandbanks. Other habitat types in the Dutch Borkum Reef Grounds are dense aggregations of the sand mason worm *Lanice conchilega*, coarse sands, and sandy or muddy seabed (Bos et al 2014; Coolen et al. 2015). Additional observations (Álvarez et al., 2020) confirm the presence of these habitat types.

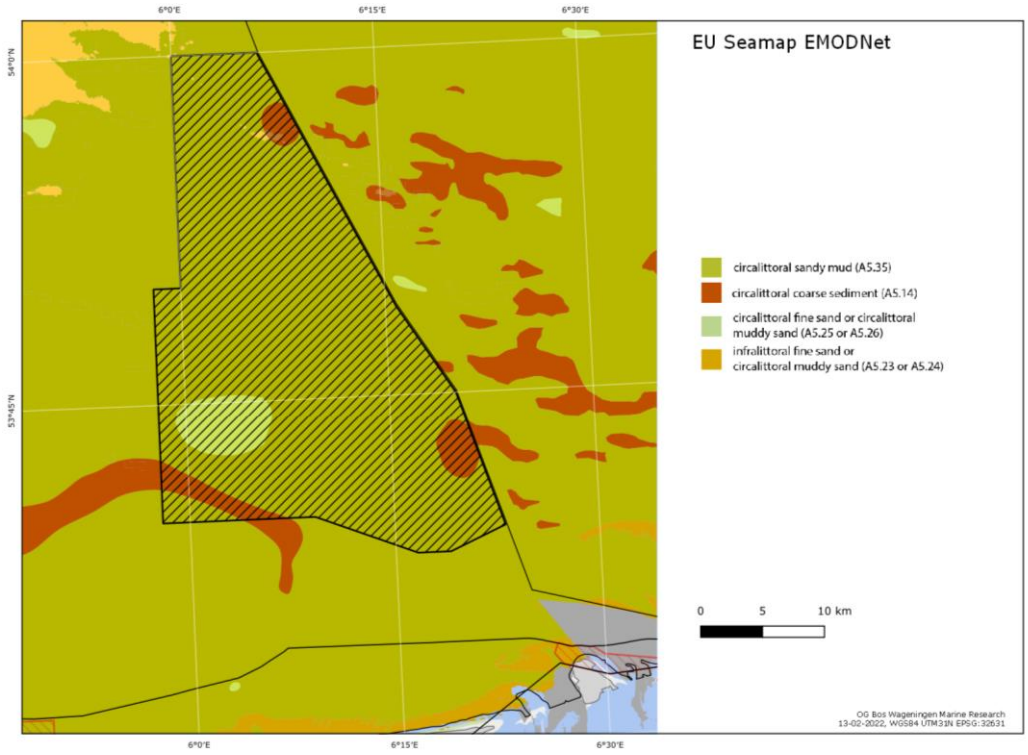

Figure 3. Distribution of EUNIS habitats (source: EMODnet).

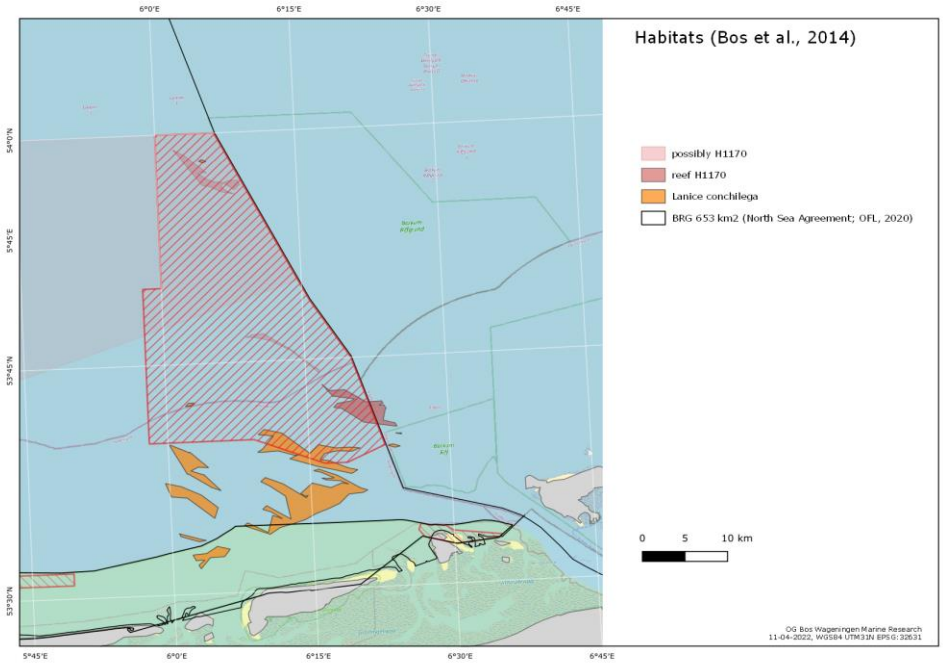

Figure 2. Distribution of habitat types reefs (H1170, red) and Lanice conchilega (orange). Also the German Natura 2000 area Borkum Riffgrund is visible, as well as the military training zone (pink zone). (Based on data from Bos et al., 2014).

2.2.1 Depth contours

The Borkum Reef Grounds are located in shallow to deep water with average depths between approximately 20 and 30 m. Depth contours are shown in Figure 4.

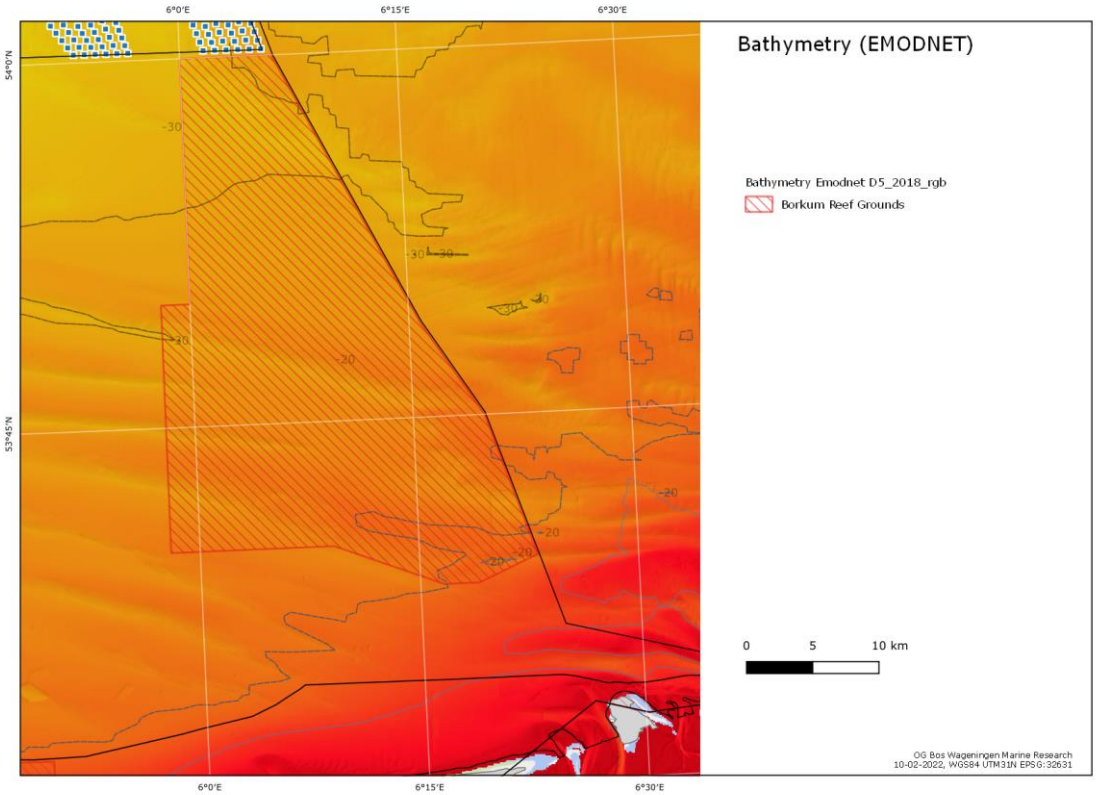

Figure 4. Bathymetry of the Borkum Reef Grounds. Source: EMODNET.

2.2.2 Sediment type

The area mainly consists of sand and sandy mud and to a lesser extend of coarse sediments (Figure 2 Distribution of EUNIS habitats (source: EMODnet) & Figure 3).

2.2.3 Benthic community

Van Stralen & Craeymeersch (2018) analysed benthic data for the southern Borkum Reef Grounds area, to define fishery closures. Compared to other parts of the North Sea Coastal zone, the biodiversity is high in the southern Borkum Reef Grounds in terms of species richness, total densities, densities of infauna and epifauna in general, and *Lanice conchilega* and heart urchin (*Echinocardium cordatum*) specifically. In 2013, 193 different taxa were found in the rocky, *Lanice* and sandy habitats (Bos et al., 2014; Coolen et al. 2015).

Borkum Reef Grounds is currently used as an offshore pilot site for European flat oyster restoration (Didderen et al. 2019, 2020) ('WWF pilot') and the results are quite promising. Also three other oyster restoration pilots take place near the area: in the offshore windfarm Gemini and in the adjacent German and Dutch areas (Figure 1). Oyster reefs attract a wide variety of organisms and thus contribute to an increased biodiversity. Historical analyses indicate that oyster reefs did frequently occur in this region and attempts to restore these structures would enhance the area-specific biodiversity. In the WWF pilot, a total of 28 species were observed in 2019 during underwater visual census biodiversity transects including reef building ross worm *Sabellaria spinulosa*, juvenile queen scallop *Aequipecten opercularis* and red striped

mullet *Mullus surmuletus*. Dead man's finger *Alcyonium digitatum*, a species that depends on hard substrate, was found on an artificial reef structure.

2.2.4 Fish community

For the Borkum Reef Grounds, a number of different surveys provide insight into the fish community. International Beam Trawl Survey (IBTS) data show that the demersal fish community consists of clupeid fish, such as sprat, herring and anchovy, a number of commercial flatfish species (dab, plaice, flounder, whiting, plaice), commercial demersal roundfish species (whiting, grey gurnard), but also OSPAR-listed species, notably thornback ray. At the WWF Oyster pilot several visual census transects (dropcam, scuba) have showed the presence of typical reef fish near hard substrate, such as the goldsinny wrasse (Didderen et al., 2020). eDNA analyses (environmental DNA) at the same area showed the presence of sandeel species, greater sandeel and gobies (Ecofriend project, O.G. Bos, WMR, pers. com).

2.2.5 Birds

Based on the latest data from 2018-2019 (Fijn et al., 2019), the area around Borkum Reef Grounds does not appear to hold any notable concentrations of seabirds, with the abundance of species being similar, or even lower, to other areas along the coast.
Nevertheless, in the North Sea Agreement (OFL, 2020) an agreement was reached on research of six potential Special Protection Area's (SPA) under the Bird Directive (BD). The Borkum Reef Grounds is one of these areas. In 2021 a desk study is carried out to verify if the area qualifies under the BD. In case insufficient data is available to do a verification, additional field research will be carried out in 2022-2025. If the area qualifies it will be a designated area under the BD in 2025 at the latest.

2.2.6 Marine mammals

From aerial counts (Geelhoed & Scheidat, 2018), there are no indications that the Borkum Reef Grounds have higher densities of harbour porpoises than other parts of the Dutch North Sea. Average densities in summer (2014, 2015, 2017) for the southern part of the North Sea ('Area C: Frisian Front') are between 0.45-1.83 animals/km^2.

Tagging studies show that harbour seals use the Borkum Reef Grounds Grounds intensively to forage (Aarts et al. 2019; Brasseur et al 2019). Grey seals also use the area intensively as feeding grounds. Seals typically travel out from sandbanks in the Wadden Sea (haul-out areas) to the coastal zone. There they feed at sea for a period and move back to the same haul-out or to a different area. Harbour seals need about 4-5kg of fish per day and mainly hunt demersal fish species such as flatfish (flounder, sole, dab), gadoids (e.g. cod) and sandeel. During their time at sea, the seals usually dive to the bottom, move along the bottom to hunt, and return to the surface to breath (Aarts et al., 2019; Brasseur et al., 2019).

2.2.7 Protected habitats and species

In the area, habitat types 1170 Reefs (Figure 3) and 1110 Sandbanks are present. Historically, the area was part of areas where European flat oyster habitat occurred (Olsen, 1883). Flat European oyster reefs are listed on the OSPAR list of threatened and/or declining species and habitats (OSPAR Commission, 2013). WWF started a pilot flat oyster bed restoration project within the stony reef area (Figure 1) (Didderen et al, 2020). In addition, a number of oyster restoration pilots have started in adjacent areas: in Gemini Offshore Wind park, close by in Germany and south of the area near a shipwreck. *Lanice conchilega* reefs could be considered biotic reefs. The OSPAR listed thornback ray (*Raja clavate*) is present in the area. Furthermore, the area is used by harbour porpoise, harbour seal and grey seal as foraging area. Birds use the area, but the area does not appear to hold important concentrations.

2.3 Fishing activities

2.3.1 Impact of fishing activities

The general impact of fisheries activities on the integrity of the seafloor and natural values is described in chapter 3.5 of the General Background Document. The Borkum Reef Grounds are located entirely within the plaice box, a management area covering coastal areas of The Netherlands, Germany and Denmark. It was installed in 1989 to protect young plaice (Beare et al, 2013). Management measures consist of a year-round fishing ban for trawlers larger than 300hp. This means that fishing with large trawlers is not allowed in the area. Smaller trawlers are allowed, and the most deployed fishing activity by the Dutch and German fleets in the area is fishing for shrimp (*Crangon crangon*) with shrimp trawlers. This type of fishing is restricted to shallower waters, and therefore mainly occurs in the south of the area, as is illustrated in *Figure 9* and Figure 10.

The vulnerability of geogenic reefs on the Borkum Reef Grounds is related to its physical features (e.g., cobbles, coarse gravel and sand in a mosaic pattern, great clarity of the water column) and the biological characteristics (e.g., sessile epifauna, trophic position) and the life histories of the typical species (e.g., longevity). The resilience of reef habitats is assumed to be low (Deerenberg et al., 2010 and Rijnsdorp, 2015). The reef part of the Borkum Reef Grounds is expected to have a higher sensitivity to trawl disturbance as compared to the more sandy habitats that are exposed to higher shear bed stress (ICES, 2009). The reef habitat is therefore assessed as being highly sensitive to all types of bottom contacting towed gear, even gears with small subsurface impact, and larger surface impact. The effect on *Lanice conchilega* reefs is less clear. The species itself can probably recover relatively quickly after disturbance by bottom contacting fishing activities, but the associated biodiversity that is formed over time may not be able to do so. This is still a knowledge gap.

2.3.2 Fleet activity in effort

Information on data sources and processing, fishing effort calculations and fishing gears and groups can be found in chapter 3 of the General Background Document (GBD) and in Jongbloed et al. (2023). Fisheries effort was originally calculated for the Borkum Reef Grounds 2021 proposal, based on a data call among member states. In 2022 the delimitation of the Borkum Reef Grounds area was adapted after a stakeholder process. The 2022 proposed area largely overlaps with the 2021 proposal. To obtain effort data without setting up a new data call for the member states, a correction of the original effort data was made. The correction factor was determined per gear group, based on the effort maps. First, the total effort per gear group (bottom trawl, beam trawl, pelagic trawl, flyshooting seine, nets, anchored seine, dredge) was calculated from the effort maps for the 2021 and 2022 proposals. Then the ratio between these two effort values was calculated, which was then used to correct the effort data provided for the 2021 proposal (See Table A1 in Annex 1).

Data on the fishing activity of fleets, gear types and gear groups on the Borkum Reef Grounds for each year in the period 2014 to 2021 is shown in

Table 3,
Table 4, Table 5 and Figure 5. The extent and trends in the fishing activity are described in the next sections. The tables 3 and 6 plus figures 5 and 6 (country) 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.

Table 3: Overview of fishery effort (fishing days) per year of fleet nationality in the proposed management zone of the Borkum Reef Grounds.

Country	2014	2015	2016	2017	2018	2019	2020	2021	Average
Belgium			1				0	1	0
Denmark		0	0			0	0	1	0
France									0
Germany	6	3	9	13	3	3	18	26	10
Netherlands	16	16	14	22	11	7	78	221	48
Total	*23*	*19*	*24*	*34*	*15*	*10*	*95*	*249*	*59*

Table 4: Overview of fishery effort (fishing days) per year of gear types in the proposed management zone of the Borkum Reef Grounds.

Gear type	2014	2015	2016	2017	2018	2019	2020	2021	Average
TBB+	0.8	0.8	0.3	0.2	0.2	0.8	0.6	1.7	0.7
TBS*	19.6	15.0	11.8	30.6	12.1	5.3	82.6	188.1	45.6
OTB		0.1			0.1	0.2	0.4	0.2	0.1
OTT	0.2	0.0					0.3	0.6	0.1
SSC	1.2	2.8	11.9	2.1	1.7	2.5	1.5	5.1	3.6
SDN						0.6			0.1
**GNS		0.8	0.3	1.5	0.4	0.7			0.4
**FPO	0.7					0.2	10.0	51.9	7.8
**OTM			0.1		0.2	0.0	0.1	1.0	0.2
Total	*22.5*	*19.5*	*24.4*	*34.5*	*14.6*	*10.2*	*95.4*	*248.6*	*58.7*

Table 5: Overview of fishery effort (fishing days) per year of gear groups in the proposed management zone of the Borkum Reef Grounds.

Gear group	2014	2015	2016	2017	2018	2019	2020	2021	Average
Beam trawl	20.4	15.8	12.1	30.8	12.3	6.1	83.2	189.8	46.3
Bottom trawl	0.2	0.1			0.1	0.2	0.7	0.8	0.3
Flyshooting seine	1.2	2.8	11.9	2.1	1.7	2.5	1.5	5.1	3.6
Anchored seine						0.6			0.1
**Nets		0.8	0.3	1.5	0.4	0.7			0.4
**Traps	0.7					0.2	10.0	51.9	7.8
**Pelagic trawl			0.1		0.2	0.0	0.1	1.0	0.2
Total	*22.5*	*19.5*	*24.4*	*34.5*	*14.6*	*10.2*	*95.4*	*248.6*	*58.7*

**not part of the proposed fishery measures.

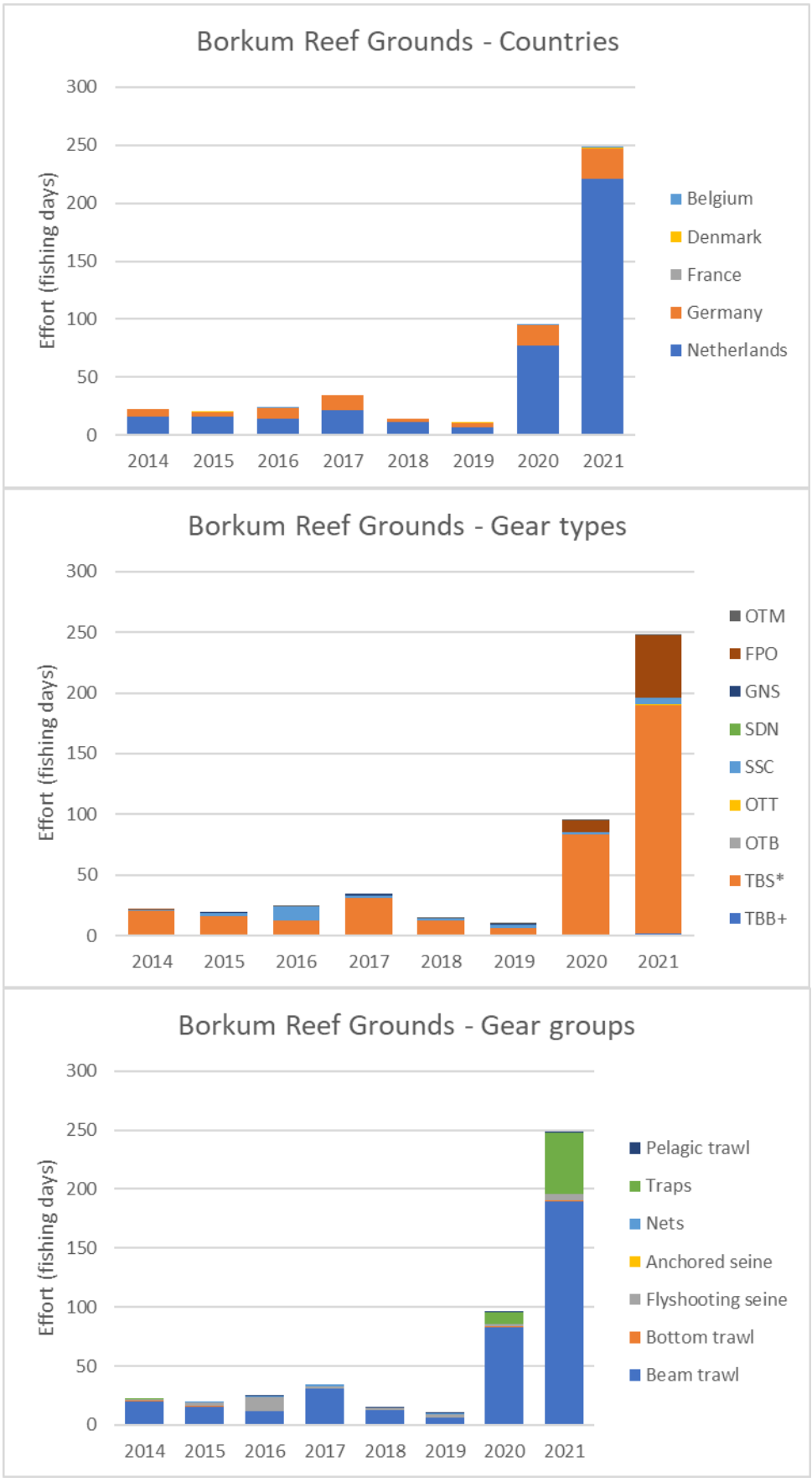

Figure 5. Fishery effort (fishing days) per year in the proposed management zone Borkum Reef Grounds for fleets (countries), gear types and gear groups. Gear types 'OTM', 'FPO' and 'GNS' and gear groups 'Pelagic trawl', 'Traps' and 'Nets' are not part of the proposed fishery measures.

2.3.3 Fleet activity by state

Nearly all fishing effort in the Borkum Reef Grounds is carried out by the Dutch fleet and the German fleet with on average 82% and 17% of the total effort of 59 fishing days per year for the five countries considered (

Table 3). There was a negligible share of the Belgian fleet (0.32%) and Danish fleet (0.20%) and no fishing activity of the French and Swedish fleet (Jongbloed et. al., 2023).

Over the period 2014-2021 there was an irregular trend of the total fishery activity, with a sharp increase in the last 2 years. This increase occurred for both the Dutch and German fleet. Comparing the effort in 2021 with the one in 2014 the decrease was 10-fold for all fleets combined, 14-fold for the Dutch fleet and 4-fold for the German fleet.

2.3.4 Gears and gear groups

In the period 2014-2021 fishing took place with nine different gear types in the Borkum Reef Grounds. The fishing effort was heavily dominated by shrimp trawling (TBS*) with a percentage of 77.8% and also considerable fishing with pots (FPO) occurred (13.4%). A small percentage was taken by SSC (6.1%), TBB+ (1.1%) and GNS (0.8%). The share of OTB, OTM and OTT was below 0.3% (Figure 5). This means that 85.6% of all fishery effort was caused by fishing gear contacting the seafloor.

Over the 2014-2021 period there was a trend of in the effort for the shrimp trawling and pot fishery. The shrimp fishery effort showed a 10-fold increase in 2021 as compared with 2014.

2.3.5 Seasonal variation in fishing activity

Data on the fishing activity per month of fleets, gear types and gear groups in the Borkum Reef Grounds in the period 2014-2012 is shown in Table 6, Table 7,

Table 8 and Figure 6. There was a clear seasonal pattern for the fishing activity in the Borkum Reef Grounds (Figure 6). The relative fishing activity over an average year is the highest in the period October-January. This seasonal pattern for overall effort is caused by the effort of the Dutch and German shrimp fishery fleet (TBS*).

Table 6: Overview of fishery effort (fishing days) per month of fleets nationality in the proposed management zone of Borkum Reef Grounds. 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	0.02		0.01		0.06	0.00			0.02		0.07		0.02
Denmark	0.01					0.01	0.06	0.05					0.01
France													0.00
Germany	1.19	0.54	0.45	0.56	0.25	0.02	0.36	0.85	0.43	1.28	3.00	1.33	0.85
Netherlands	3.73	2.93	1.87	1.63	1.22	2.59	2.52	1.16	1.03	3.31	17.13	9.02	4.01
Total	*4.95*	*3.47*	*2.34*	*2.18*	*1.54*	*2.61*	*2.94*	*2.05*	*1.48*	*4.59*	*20.21*	*10.35*	*4.89*

Table 7: Overview of fishery effort (fishing days) per month of gear types in the proposed management zone of Borkum Reef Grounds.

Gear	1	2	3	4	5	6	7	8	9	10	11	12	Average
TBB+	0.11	0.03	0.05	0.05	0.05	0.10	0.01	0.03	0.04	0.02	0.12	0.05	0.06
TBS*	4.34	3.05	1.94	1.72	0.04	0.01	1.02	1.04	0.71	3.82	18.84	9.13	3.80
OTB	0.01	0.02	0.00	0.03	0.01	0.02	0.00	0.03	0.01				0.01
OTT	0.01	0.04	0.02		0.01			0.02	0.03		0.01		0.01
SSC				0.02	0.80	1.79	0.83	0.12	0.06				0.30
SDN						0.07							0.01
**GNS	0.00				0.18		0.22		0.05				0.04
**FPO	0.48	0.34	0.33	0.37	0.46	0.62	0.80	0.76	0.58	0.75	1.23	1.14	0.65
**OTM	0.01					0.01	0.06	0.06			0.01	0.03	0.01
Total	*4.95*	*3.47*	*2.34*	*2.18*	*1.54*	*2.61*	*2.94*	*2.05*	*1.48*	*4.59*	*20.21*	*10.35*	*4.89*

** 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 Borkum Reef Grounds.

Gear group	1	2	3	4	5	6	7	8	9	10	11	12	Average
Beam trawl	4.45	3.08	1.99	1.77	0.09	0.11	1.03	1.07	0.75	3.84	18.96	9.18	3.86
Bottom trawl	0.02	0.05	0.02	0.03	0.02	0.02	0.00	0.05	0.05		0.01		0.02
Flyshooting seine				0.02	0.80	1.79	0.83	0.12	0.06				0.30
Anchored seine					0.00		0.00		0.00				0.01
**Nets					0.18		0.22		0.05				0.04
**Traps	0.48	0.34	0.33	0.37	0.46	0.62	0.80	0.76	0.58	0.75	1.23	1.14	0.65
**Pelagic trawl	0.01					0.01	0.06	0.06			0.01	0.03	0.01
Total	*4.95*	*3.47*	*2.34*	*2.18*	*1.54*	*2.61*	*2.94*	*2.05*	*1.48*	*4.59*	*20.21*	*10.35*	*4.89*

** Not part of the proposed fishery measures.

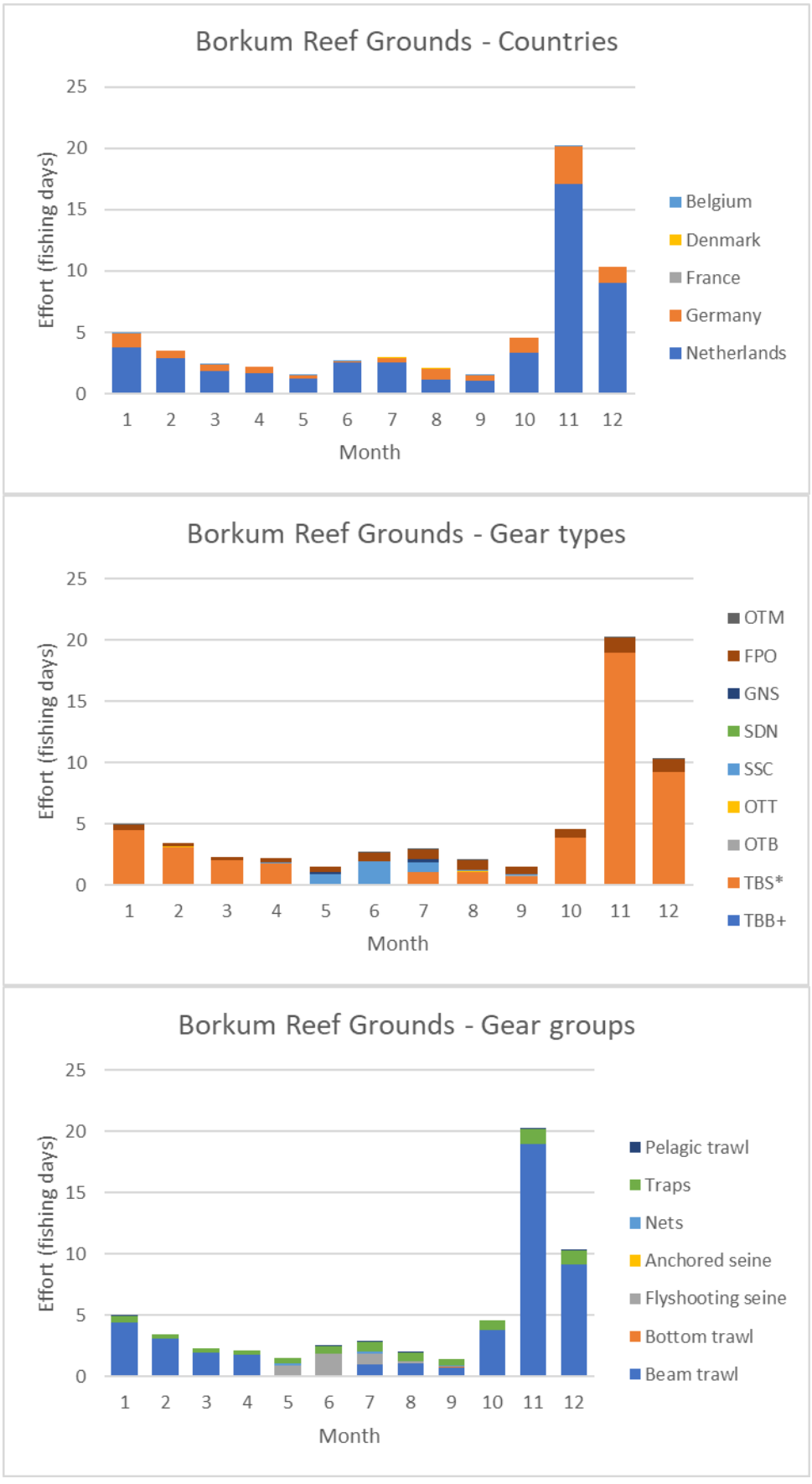

Figure 6. Fishery effort (fishing days) per month in the proposed management zone Borkum Reef Grounds for fleets (countries), gear types and gear groups. Months are numbered on the x-axis.

2.3.6 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 seven distinguished gear groups in a part of the North Sea with all protected areas, are shown in Figure 7 and Figure 8. The Borkum Reef Grounds and their close surroundings are shown in Figure 9 and Figure 10. The main fisheries is shrimp fisheries (TBS*), which takes place in the southern part of he area, closest to the coast and outside the proposed area for fisheries measures. This is shown in more detail for the Dutch shrimp fisheries (Figure 1).

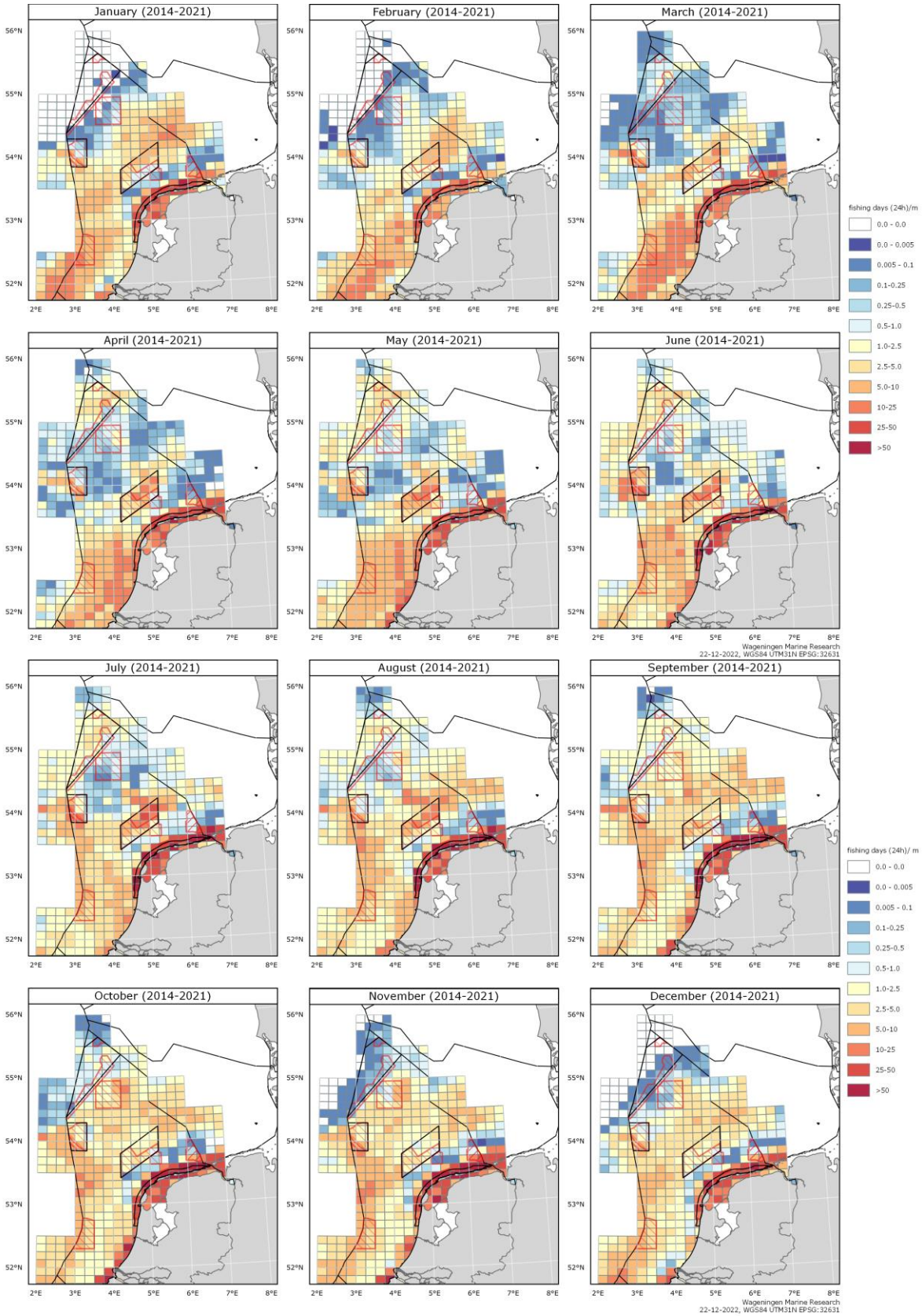

Figure 7. Fishing effort per month, of all gears groups combined (fishing days/month) in the Dutch part of the North Sea.

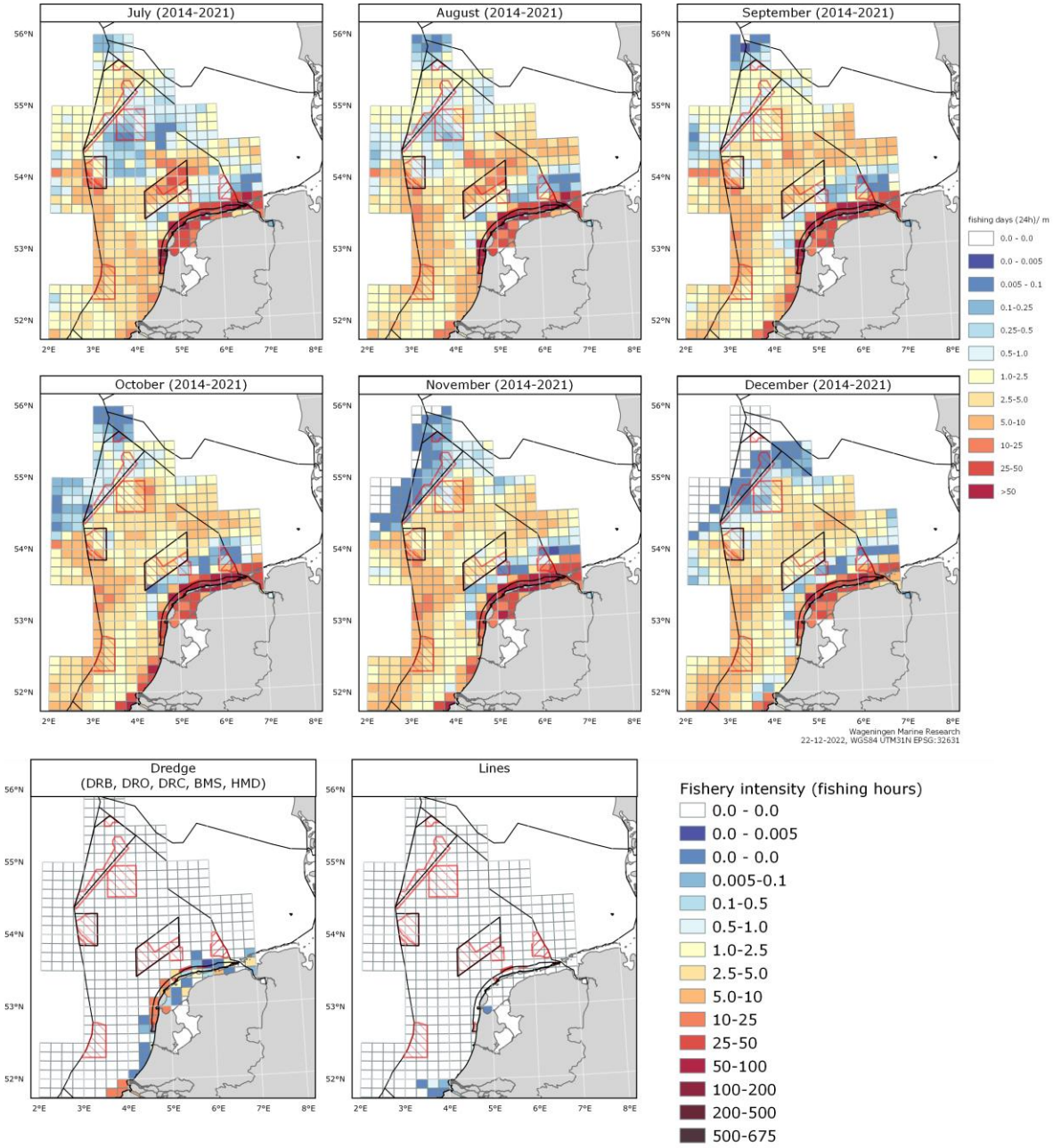

Figure 8. Fishing effort (fishing days/year) per gear group in the Dutch part of the North Sea.

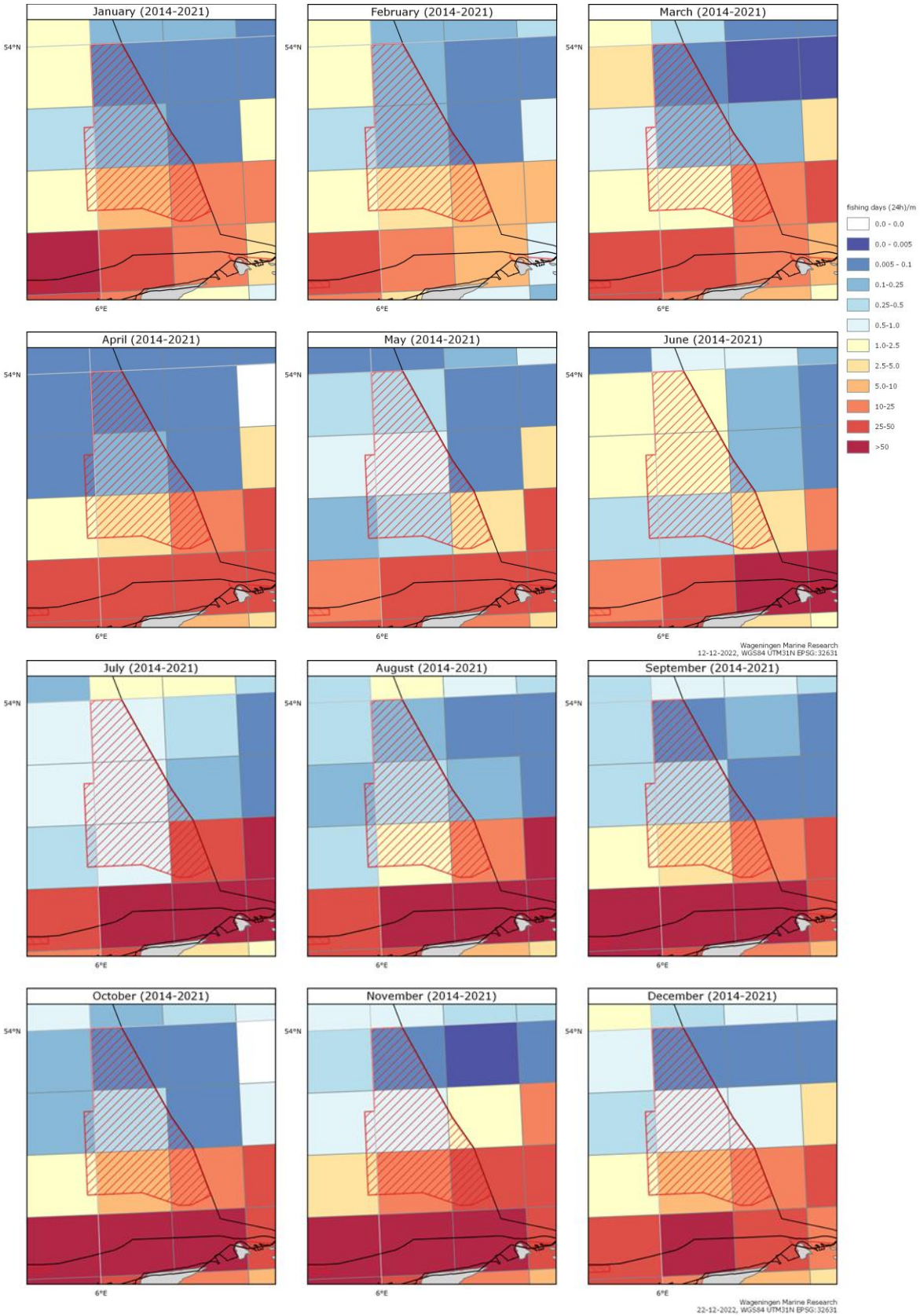

Figure 9. Borkum Reef Grounds: Fishing effort per month, of all gears groups combined (fishing days/month).

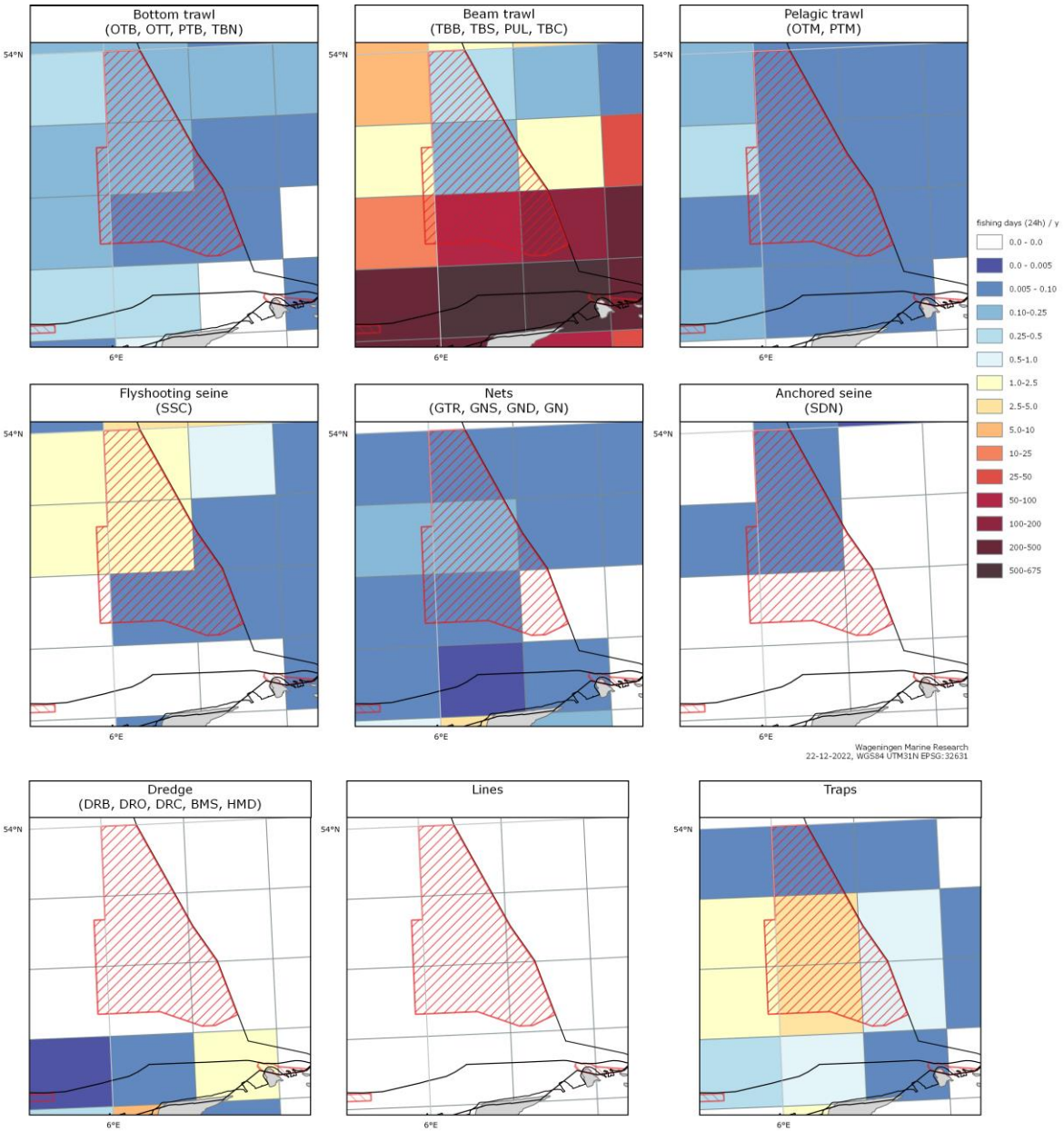

Figure 10. Borkum Reef Grounds: Fishing effort (fishing days/year) per gear group. Gear groups 'Pelagic trawl', 'Nets', 'Lines' and 'Traps' are not part of the proposed fishery measures.

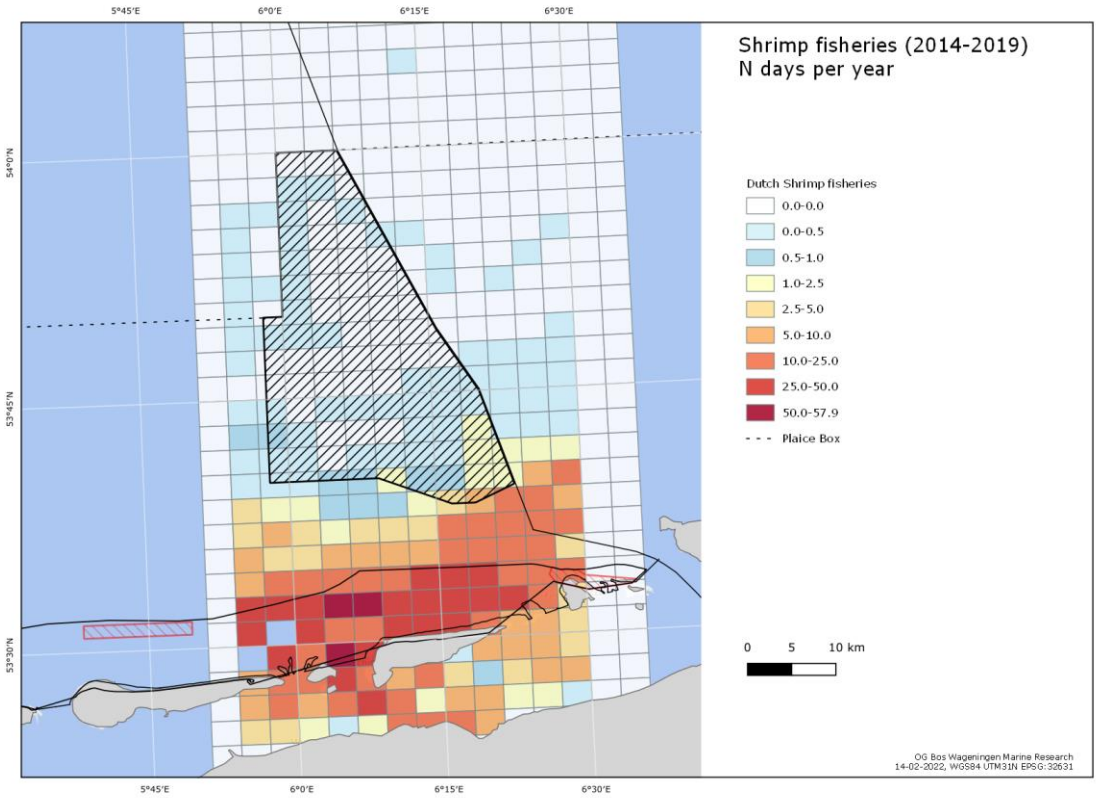

Figure 11. Borkum Reef Grounds: Detailed map for the Dutch shrimp fisheries. Fishing effort (fishing days (24 hours)/year).

2.3.7 Main target species

The main species caught in the Borkum reef grounds with bottom contacting gears are common shrimp (*Crangon crangon;* CSH) caught by beam trawls and tub gurnard (*Chelidonnichtys lucerne;* GUU) caught by Scottish seines (Figure). In addition, the Danish and German pelagic trawlers also caught European Sprat (*Sprattus sprattus;* SPR) (Hamon & Klok, 2022). (see also chapter 3 of the General Background Document).

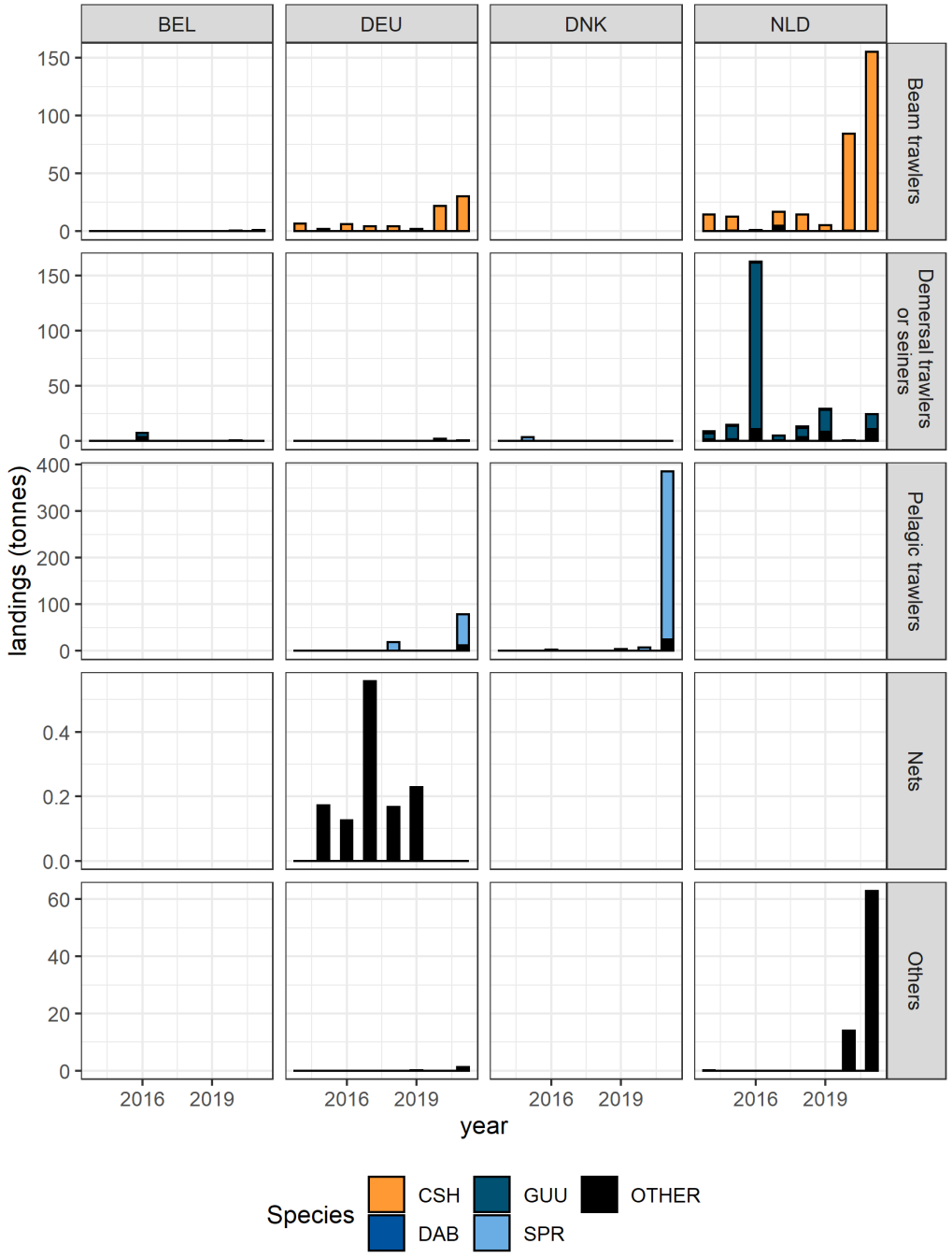

Figure 112.Historical trend by gear type of the species caught in the Borkum Reef Grounds by the Belgian, Danish and Dutch fleet. (CSH: common shrimp, DAB: dab, GUU: tub gurnard, SPR: European Sprat, OTHER: other species). Note the scale difference for landings per gear type. Source: logbook and VMS data, processed by WUR, DTUAQUA, TI< ILVO, SLU and IFREMER.

2.3.8 Economic value of the Borkum Reef Grounds

Over the 2014-2021 period, the Borkum Reef Grounds are mainly fished by the Dutch fleet and to a lesser extent the German fleet (Table 9). Belgian, Danish and Swedish fleets were virtually absent from the area and the French did not report any fishing activity there. Between 2014 and 2019, the amount of fishing effort remained stable at a low level (between 10 and 30 fishing days per year). Then, in the last two years, the effort of the Dutch fleet abruptly increased up to 78 and 221 fishing days respectively in 2020

and 2021, resulting in a total effort more than tenfold the average effort of the 2014-2019 period. Over the 2014-2020 period, the gross added value oscillated between 40 thousand euro and 190 thousand euro, culminating to 500 thousand euro in 2021.

Table 9: Overview of effort, landings and values and gross value added of the fishing sector in the Borkum reef Grounds are given by country. France has declared no fishing activity in the area for the 2014-2021 period.

	Country	2014	2015	2016	2017	2018	2019	2020	2021	Average
Effort (fishing days)	BEL	0	0	1	0	0	0	0	1	0
	DEU	7	3	9	13	3	3	18	26	10
	DNK		0	1			0	0	1	0
	NLD	16	16	14	22	11	7	78	221	48
	SWE		0	0						0
	Total	23	20	25	34	15	10	95	249	59
Landings (tonnes)	BEL	2	2	13	2	3	2	3	5	4
	DEU	8	4	8	5	24	3	24	111	23
	DNK		3	4			3	7	385	50
	NLD	26	45	166	35	29	35	99	243	85
	SWE		22	21						5
	Total	36	77	211	42	56	43	133	744	168
Value (1,000 euros)	BEL	9	9	35	10	16	10	15	20	16
	DEU	23	17	34	35	18	10	72	139	43
	DNK		1	1			1	2	113	15
	NLD	71	133	221	178	136	67	255	592	207
	SWE		5	1						1
	Total	103	164	291	223	170	88	343	865	281
Gross Value Added (1,000 euros)	BEL	4	4	21	5	9	5	8	12	8
	DEU	13	10	23	22	11	5	46	88	27
	DNK		1	1			1	2	94	12
	NLD	38	67	125	104	79	29	135	308	111
	SWE		3	0						0
	Total	55	85	170	132	99	40	191	502	159

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

Beam trawl (TBB) fishery, including the shrimp fishery, represented the most important fishing activity in the area in terms of effort for both the Dutch and German fleets (*Figure 1*). The Dutch fleet also used Scottish seine (SSC) on the Borkum reef grounds and in the last year also fishing pots (FPO). While they had no activity over the rest of the period, the Danish fleet caught 385 tonnes of fish with one day of fishing effort with midwater otter trawls (OTM) in 2021 (Hamon & Klok, 2023).

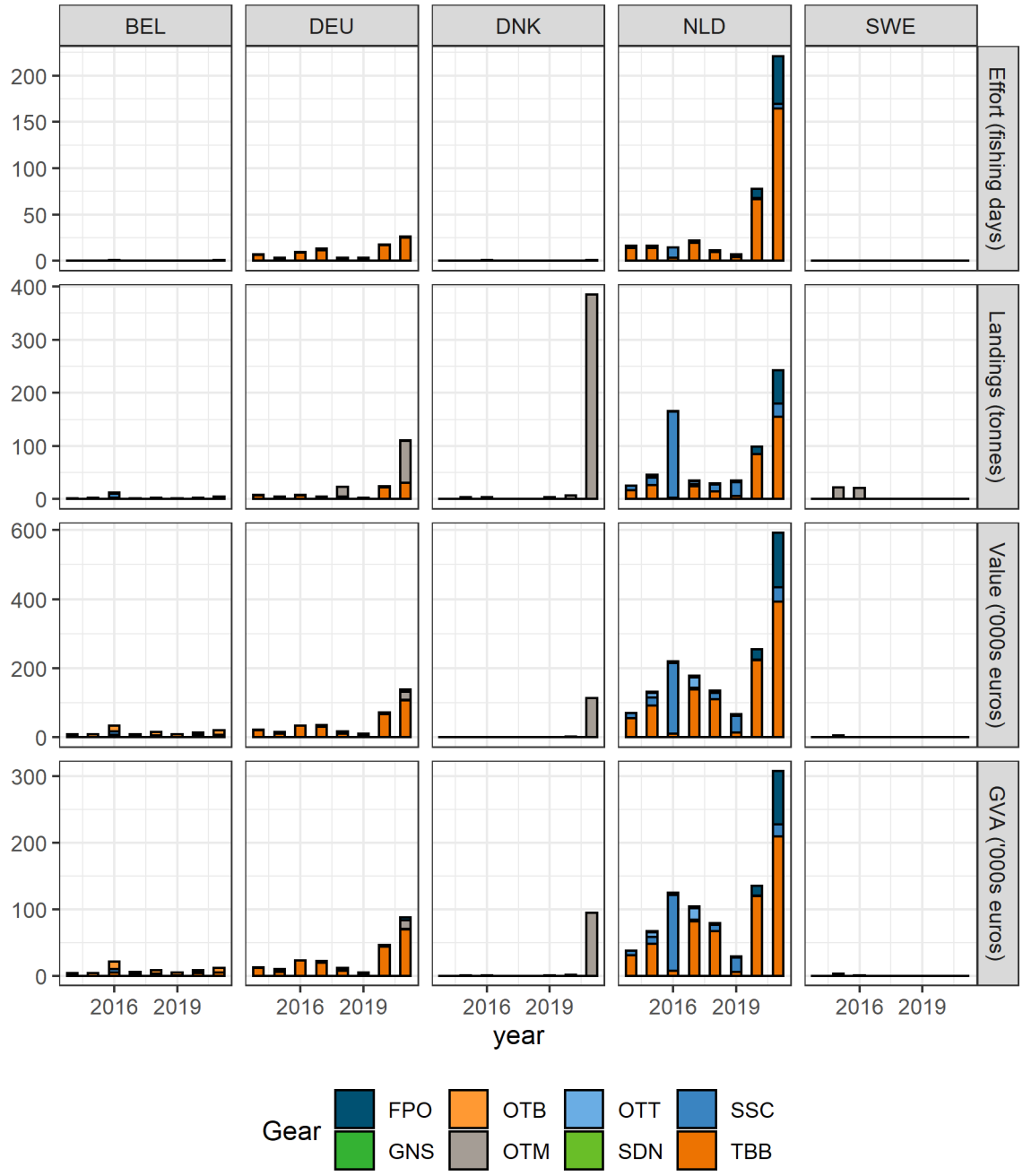

Figure 13. Historical trend of the fishing activities in the Borkum Reef Ground with different gears (FPO: fishing pots; GNS: set gillnets (anchored); OTB: bottom otter trawls; OTM: otter trawls midwater; OTT: otter twin trawls; SDN: Danish seines; SSC: Scottish seines; TBB: beam trawls including shrimp trawls) in the proposed closure of the Borkum Reef Ground 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.

2.3.9 Individual dependency of Dutch fishermen to the Borkum Reef Grounds

Given that the individual analysis only refers to the Dutch fleet, it could be rerun with the new Borkum Reef borders instead of using a fixed percentage per gear as for the analysis looking at the national fleets (see previous sections). Discrepancies between this section and the previous come from two reasons. First the ratio used for correction is based on effort only and the value of landings per unit of effort is not

constant over time and space. Second the individual analysis is only based on vessels with VMS. So it is possible to underestimate the importance of the shrimp fishery.

Figure 1 shows that the number of Dutch vessels actively fishing on the Borkum Reef Grounds has increased in the last two years of the study period, going from 20 to 40 vessels during 2014-2019 up to 80 vessels in 2021. While the revenue dependency to the Borkum Reef Grounds was lower than 10% for all vessels until 2019, in 2021, five vessels had higher dependency on the area, one vessel even having more than 50% of their revenue from the Borkum Reef Grounds.

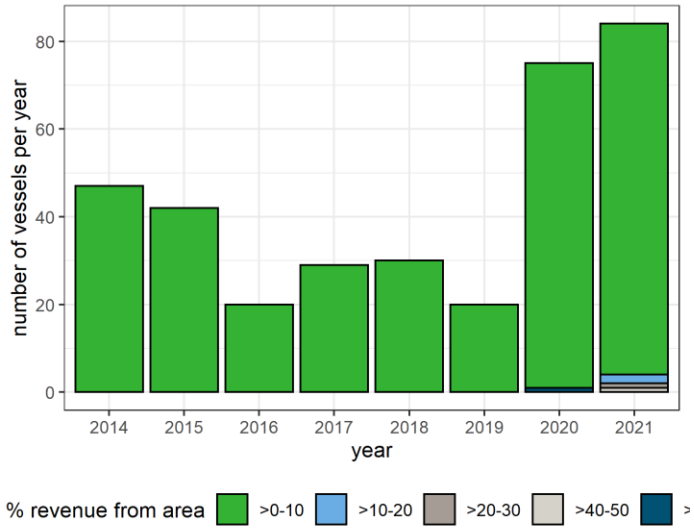

Figure 124. The number of Dutch vessels per year and the revenue dependency

Over the 2014-2021 period, the average number of vessels with fishing activities on the Borkum Reef Grounds was mainly coming from three regions: the North of the Netherlands (18 vessels), Urk (12 vessels and Holland (12 vessels) (Figure 1). Only a few vessels came from Zeeland. Of the five vessels that had once a higher revenue dependency, one (dependency >10-20%) came from the Holland region and the other four from Urk.

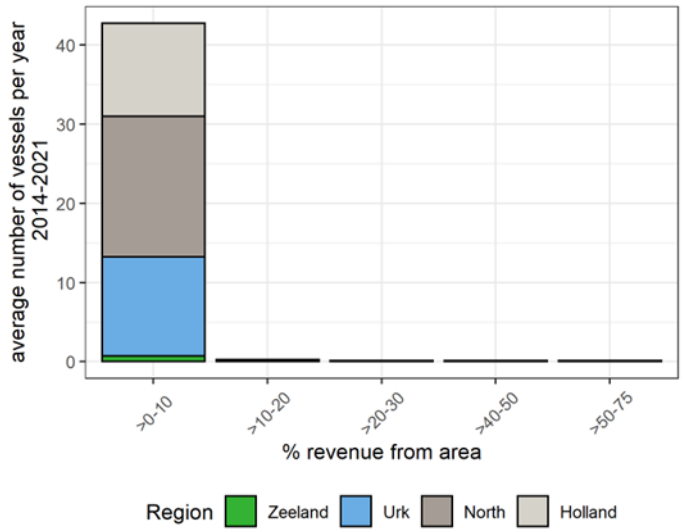

Figure 135. The average number of vessels per region and the revenue dependency.

The majority of the Dutch fishing revenue from the Borkum Reef Grounds, about 150 thousand euro per year was obtained with shrimp trawls (TBS, included with TBB in Figure 1). The second most important gear was Scottish seines (SSC) with an average annual revenue of about 60 thousand euro. The third most important gear is the fishing pots (FPO). While all Scottish seiners only have a dependency lower than 10%, some shrimp trawlers also have an annual dependency higher than 10% (up to 30%). All the potters operating in the area in 2021 highly dependent on the area, at least 40% of their revenue coming from the area (Figure 16).

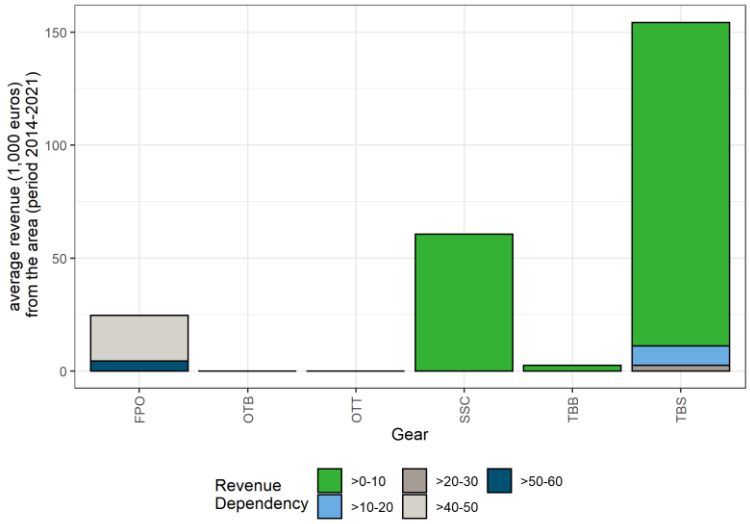

Figure 146. Total of the average revenues (x1,000 euros) of the vessels with different dependencies on the area per gear type

2.4 Other human activities

2.4.1 Oil/gas platforms (or exploration)

Concessions for two gas extraction areas and two offshore exploration gas wells have been assigned to ONE-Dyas in the Borkum Reef Grounds. Drilling of both wells in 2017 and 2018 resulted in the discovery of natural gas in gas field NO5-A, shown in Figure 17. The company holds further permits inside Borkum Reef Grounds. It expects to drill new offshore gas wells in the future, indicated in Figure 17. The gas project is called GEMS and stretches across the border between the Netherlands and Germany (ONE-Dyas, 2019). As a result, gas extraction might take place in a time period ranging from 10-25 years. In addition, two offshore gas extraction platforms are in operation, 8 NM and 7.5 NM to the southwest of the Borkum Reef Grounds. In the future Environmental Impact Assessment, it will become clear which environmental consequences drilling for gas will have in the area.

The drilling of wells disrupts the substrate due to the construction of pipes, due the drilling activity itself and the potential release of cement and spacers. The upper part of the well has a diameter of ca 90 cm. The potential release of cement could end up of the seabed and cover an area of one to a few meters around the well and could suffocate the biota in this area. In addition, to the discharge of drilling mud and cuttings affect the surrounding area as well. Drilling cuttings are expected to cover an area of 0.8 ha with a thickness of 1 mm up to 1-3 cm next to the drilling well. These data concern drilling activities in general and not drilling in the Borkum Reef Grounds specifically (Tamis, et al., 2019). The effect of these activities are not known yet. The Environmental Impact Assessment will give more clues on this. The currently proposed gas extraction platform site for NO5-A is however located at short distance (ca 750 m) from the WWF restoration site (Figure 17).

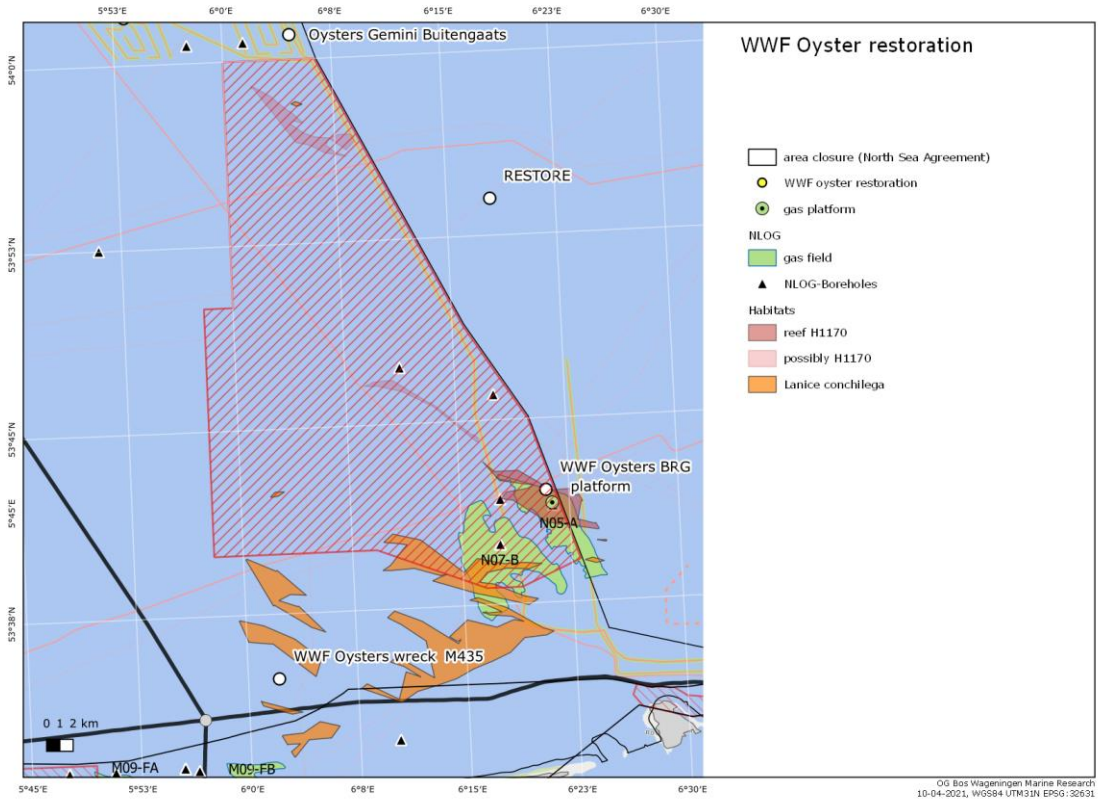

Figure 157. Proposed gas exploration platform and various oyster restoration pilot projects (white dots)(source gas data: NLOG).

2.4.2 Cables and pipelines

The route of some electricity- and communications cables pass through the Borkum Reef Grounds (Figure 8). The laying of cables leads to seabed disturbance and associated impacts of damage, displacement or disturbance of flora and fauna, increased turbidity, release of contaminants and alteration of sediments. Along with noise and visual disturbance, these effects are mainly restricted to the installation, repair works and/or removal phase and are generally temporary. In addition, their spatial extent is limited to the cable corridor (in the order of 10 m width if the cable has been ploughed into the seabed) (OSPAR, 2009).

OSPAR advices that appropriate mitigation measures should be applied:

- avoiding sensitive habitats/areas;
- scheduling laying activities to certain times of the year to avoid disturbance of sensitive species, for example, marine mammals or resting/feeding (sea) birds;
- avoidance of heavily contaminated areas in order to prevent the re-mobilisation of contaminants from sediments.

Since new cables and pipelines are submitted to licensing and an Environmental Impact Assessment, possible seafloor effects will be become clear from these procedures, where the necessary mitigating measures can be applied.

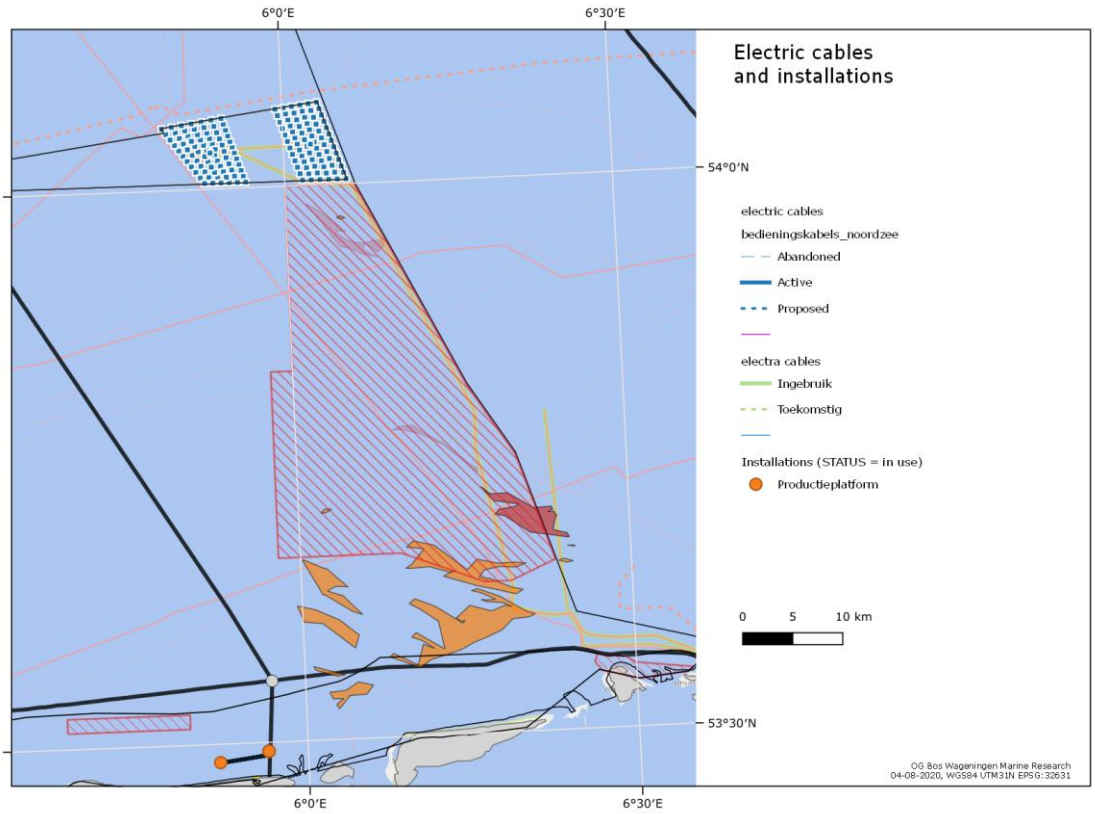

Figure 18. Location of the power- and communication cables within the Borkum Reef Grounds (source: Nationaal Georegister).

2.4.3 Shipping routes

The IMO traffic separation scheme (TSS) 'Terschelling-German Bight' crosses a large part of the area (Figure 19). Shipping possibly poses serious threats to the marine environment, due to risk of collisions with and

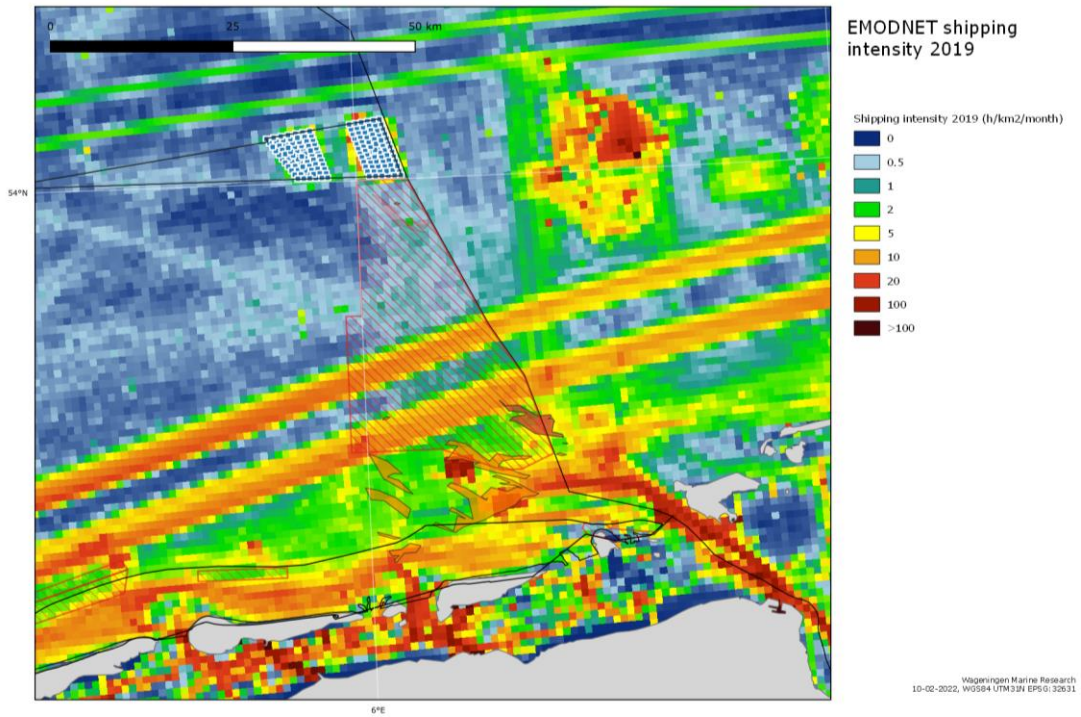

Figure 169. Shipping intensity (source: EMODnet).

behaviour changes in cetaceans, bioaccumulation of pollutants in the food web, the introduction of invasive species through ballast water, fouling organisms, and discharge of water and hazardous substances (Prins, et al, 2011; Weilgart, L.S, 2007, Min IenM & Min ELenI, 2012; Nilsson, et al., 2018, Bailey, S., 2015).
This concerns the so-called Terschelling-German Bight Traffic Separation Scheme. Due to the incident with the large container vessel MSC Zoe which lost 342 containers on the 1st of January 2019, a recent report of the Safety Investigation Council concluded that the shipping lanes above the Wadden Islands are very risky for large, wide container vessels during North-Western storm (Onderzoeksraad voor Veiligheid, 2020). As result of this conclusion shipping traffic at the shipping lane in between Borkum Reef Grounds and Gemini wind park could change in due time, but for the coming years this seems not the case. The possible threats of shipping for the proposed protection of the seabed do not call for additional measures.

2.4.4 Military activities

Military activities take place in an area northwest of the Borkum Reef Grounds. It is expected that there are no effects on the seafloor from these activities, however this has not further been investigated.

2.4.5 Air traffic

Air traffic passes (high) over the Borkum Reef Grounds. There is no specific information on this activity but effects on the seabed are expected to be low or non-existent.

2.4.6 Shell/sand/gravel extraction

In the Borkum Reef Grounds three licenses have been granted by Rijkswaterstaat for sand and/or gravel extraction. These licenses facilitate both sand nourishment for replenishment of the coastline and commercial sand extraction. In 2017 an environmental impact assessment for large-scale sand extraction from 2018 to 2027 was conducted. It enlists both licensed and search areas for sand extraction in this time period. The search areas are indicated on the map in Figure 20.

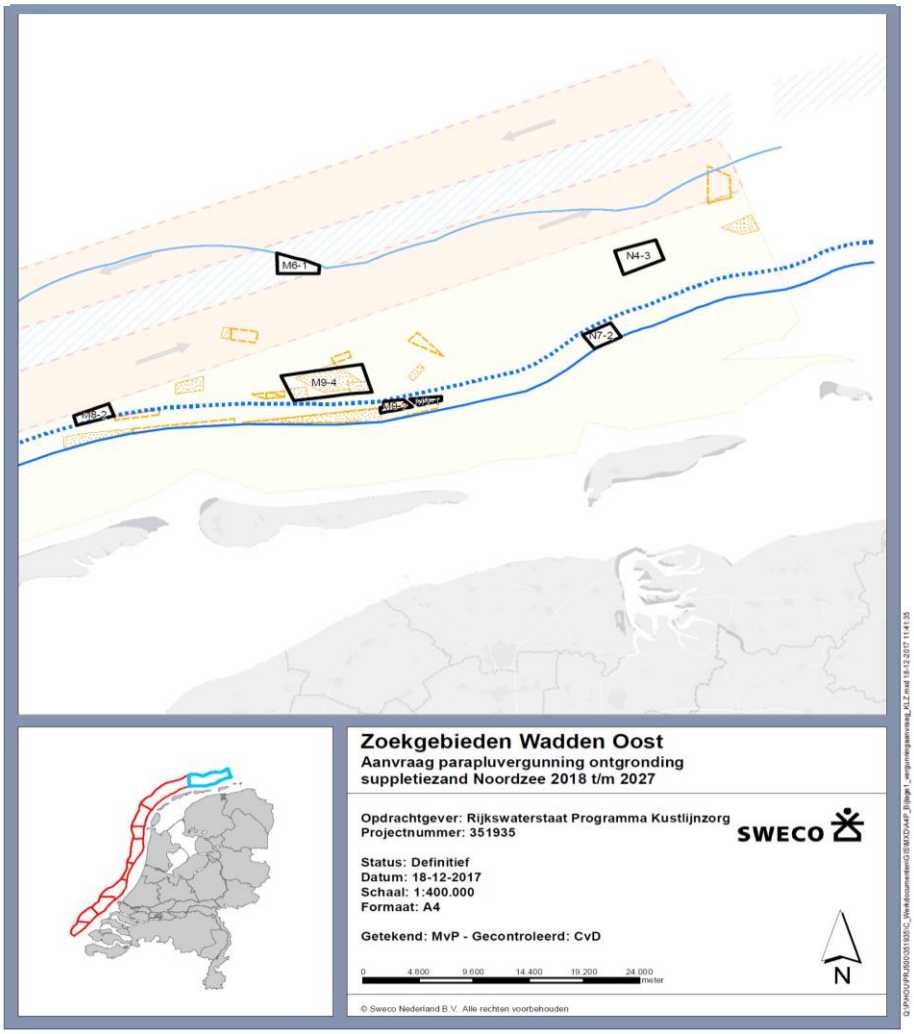

Figure 20. Search areas for sand extraction, covering part of the Borkum Reef Grounds (source: Van Duin et al., 2017).

2.4.7 Dredging

Other than dredging for extraction as described in chapter 2.4.6, dredging (e.g. to maintain depth of shipping channels) does not take place on the Borkum Reef Grounds.

2.4.8 Coastal protection

Other than dredging for sand nourishments as described in chapter 2.4.6, dredging for coastal protection does not take place on the Borkum Reef Grounds. The Borkum Reef Grounds are located between 3-24 mile of the coastline.

2.4.9 Recreation

Recreation on the Borkum Reef Grounds from recreational fishermen and divers takes place occasionally. There is no specific information on this activity but effects on the seabed are expected to be low.

2.4.10 Offshore wind farms

Offshore wind farms are developing rapidly in the North Sea. Both the construction and operation of an offshore wind farm have an impact on the environment. The seabed and benthic fauna will be affected by the construction of the piles in the sediment, noise, pressure waves and increased traffic to develop these wind farms (Brasseur et al, 2017). The possible upscaling in offshore wind for 2030 and even more untill 2050 in the southern North Sea is likely to have an impact on the functioning of the seabed in very fundamental ways. Large-scale extraction of wind energy from the lower part of the atmosphere may affect local wind patterns, wave generation, tidal amplitudes, stratification of the water column, dynamics of suspended particles and bedload transport of sediment. Furthermore, the infrastructure will provide extra hard substrate, not only on the bed (in the form of scour protection) but also providing attachment opportunities for biota in the upper layers of the water column. Such changes to the physical functioning of the North Sea may have far-reaching consequences for the ecological functioning, such as changes to the total amount and the timing of primary production, food availability of filter feeders and higher trophic levels, and habitat suitability for many species (Boon et. al, 2018, van Duren, L.A., et. al, 2021).

No offshore wind farms have been licensed within the Borkum Reef Grounds and new farms are not foreseen in this area. The Gemini project with 150 turbines located near the northwestern limit of the area, commissioned in 2017, is the only offshore windpark in the vicinity of the Borkums Reef Grounds. Also on the German side of the border a number of offshore windfarms are present. No effects on the seabed of the Borkum Reef Grounds are expected from the operations of the wind farms.

2.4.11 Nature restoration

In May 2018, WWF built a flat oyster reef in the Borkum Reef Grounds, as nature restoration pilot project (Figure 17). The project is located at 25 meters depth and consisted of 5,500 kg flat oysters from Norway (estimated to be 80,000 individual oysters), which were attached to, amongst others, 3D printed reef structures. Based on research in July 2018 and September 2019, the results are promising in terms of survival rate, growth, reproduction, good condition and the presence of oyster larvae from the placed oysters (Tamis et al, 2019; Didderen et al, 2019).

2.4.12 Cumulative effect of other human activities

At this point no insights can be given on the cumulative effects of human activities other than fisheries on the Borkum Reef Grounds. In the Dutch North Sea Programme 2022-2027 (IenW, 2022a) the Dutch government has indicated to reduce the knowledge gap on cumulative effects of human activities on the (benthic) ecosystem.

2.5 Monitoring

The Borkum Reef Grounds are not yet sampled within the MSFD-monitoring programme. Therefore, a baseline study will need to be conducted and a monitoring plan will need to be set up, in accordance with the general principles as described in the General Background Document. Monitoring locations on the Borkum Reef Grounds are shown in Figure 1.

Once every three years samples will need to be taken with a grab sampler and by video. All species found in the samples (grab and video) need to be recorded. The analysis needed for the detection of an increase in hit rate will be performed only for the indicator species. A suggestion for indicator species is provided by Bos et al. (2014, page 62). A definite list will need to be developed to fit the BISI indicator methodology (Wijnhoven and Bos, 2017; Wijnhoven, 2019). For more general information about monitoring, see the General Background Document.

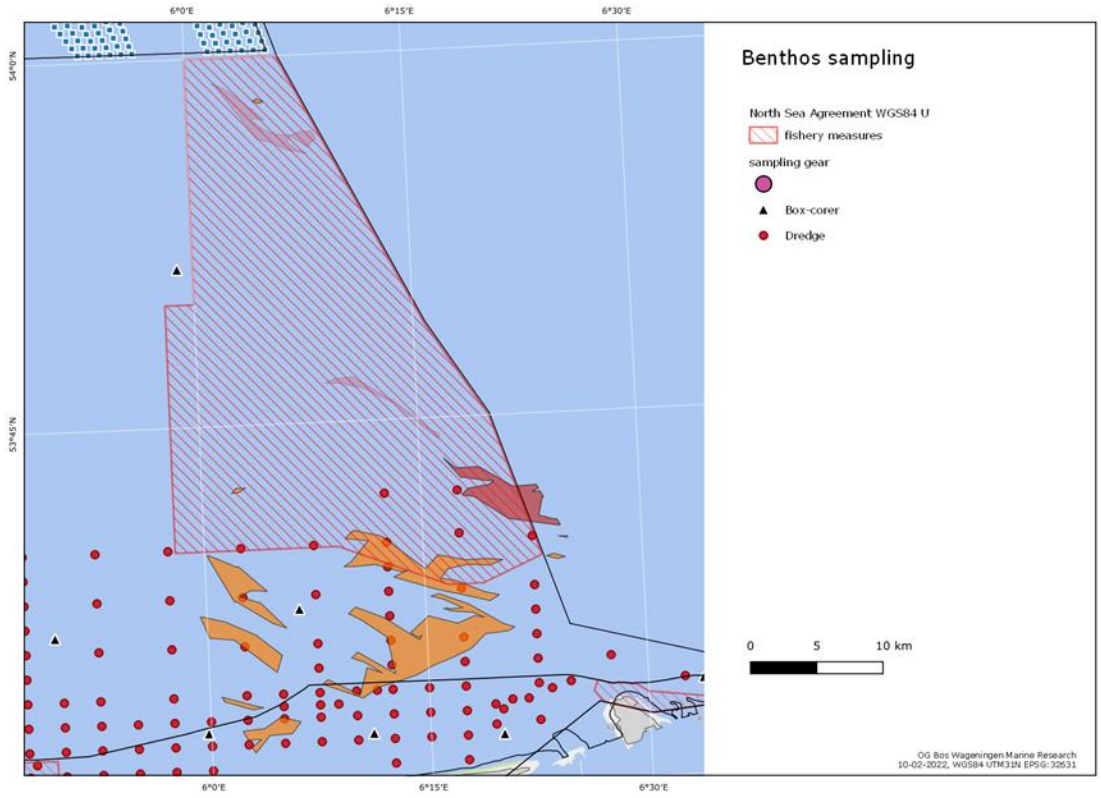

Figure 21. Overview of sampling stations that overlap with the Borkum Reef Grounds. Source: Marine Information and Data Centre. Selected sampling points: offshore MWTL survey 2021 and nearshore WOT shellfish survey 2018.

3 Rationale for conservation measures

3.1 Conservation objectives

The aim of the Marine Strategy Framework Directive (MSFD) is to reach a Good Environmental Status (GES). Despite the implementation of the measures from the previous program of measures (2015), the Marine Strategy part 1 (IenW & LNV, 2018) concludes that Good Environmental Status has not yet been reached for the Dutch North Sea: there is a remaining task for the descriptors of biodiversity (D1), seabed integrity (D6), marine litter (D10) and underwater noise (D11). Additional measures are required to achieve Good Environmental Status.

The main descriptors for the benthic habitat are D1 (biological diversity), and D6 (sea-floor integrity). The overarching goal to achieve good environmental status is to improve the size, condition and global distribution of populations of the community of benthos species. This goal is primarily supported by two criteria, being: D6C3: improvement in the quality of the assessed areas and habitats in the Dutch part of the North Sea (Benthic Indicator Species Index, BISI), and D6C5: the diversity of benthos demonstrates no further downward trend in the assessed areas (OSPAR assessment value). These criteria are supported by four environmental targets:

- D6T1: 10-15 percent of the surface of the Dutch part of the North Sea will not be notably disturbed by human activities;
- D6T2: improvement in the quality of the assessed areas and habitats;
- D6T4: further development and testing of regional assessment methods (OSPAR and ICES) which can be used in the future for assessing benthic and pelagic habitats;
- D6T5: return and recovery of biogenic reefs, including flat oyster beds.

The Program of Measures identifies measures which need to be taken in order to achieve or maintain GES, and these measures shall be devised on the basis of the initial assessment being MS1 (2018-2024) (art. 13, sub 1 of the MSFD). The Dutch draft Marine Strategy part 3 (IenW, 2022b) includes the measure for seabed protection on the Borkum Reef Grounds. The draft Marine Strategy part 3 (2022-2027), is expected to be adopted in March 2022. It is expected that the proposed conservation measures contribute to reaching the objectives as described in the MSFD and are proportionate in regards to the socio-economic impact of the proposed measure.

The Borkum Reef Grounds contributes to an ecological coherent network of marine protected areas by protection of geogenic (stony reefs) and biogenic reefs (oysters and *Lanice conchilega*). Both are rare in the Dutch part of the North Sea. Contributing to replication of protection of natural features is one of the criteria for good ecological coherence of marine protected areas (Scriberras et al.,2013).

3.2 Policy considerations

Even though the Borkum Reef Grounds is not explicitly named as an area in MS1 (2018-2022), the proposed conservation measure does support the above mentioned targets D6T1 and D6T5. The measure is also part of the national North Sea Agreement in which all relevant national stakeholders have participated (see for more information on the process of the North Sea Agreement the GBD).

The MSFD conservation objective for the Borkum Reef Grounds is the recovery of substantial parts of the seabed ecosystem from a disrupted state towards its natural condition. Currently, the seabed of the Dutch

part of the North sea is substantially disturbed. On a North Sea scale the Borkum Reef Grounds is of high ecological value due to the presence of geogenic- and biogenic reefs. Protection of these values by taking conservation measures will eventually contribute to achieving GES of the North Sea.

Geogenic reefs, such as rocks, pebbles and pebble fields, can be heavily altered by bottom contacting towed fishing activities. The rocks themselves serve as substrate for sedentary species. By protection of the geogenic reefs, these species can reproduce, create a shelter for juvenile fish, therefore contribute to increase or safeguard of biodiversity and contribute to achieving GES and in the North Sea.

Biogenic reefs, such as shell beds and other reef-forming species (e.g. *Lanice concheliga)*, have almost disappeared entirely from the Borkum Reef Grounds but do still exist in the southern part. Biogenic reefs, like geogenic reefs, contribute to safeguarding biodiversity, for exampleby offering shelter to juveniles, and therefore contribute to achieving GES in the North Sea. In the past, also biogenic reefs were present in the form of extended European flat oyster beds (Olsen, 1883), but they are long gone. Since the Borkum Reef Grounds are at least in part suitable for flat oysters, a pilot on oyster reef restoration and the comeback of this habitat building species was established in 2020 (Didderen et al., 2020).

The BISI shows that in particular large and long-lived species are clearly less common than desired, and that biological diversity is still insufficient. Areas that are ecologically most valuable should therefore be protected to ensure the conservation and recovery of the seabed ecosystem whenever possible. To qualify as ecologically valuable areas should be I) substantial in size and II) contain (as many) different habitats and gradients as possible, such as in depth or silt richness. The Borkum Reef Grounds do meet these criteria as both geogenic- as biogenic reefs are protected, the area has a surface area of 683 km^2 and connects several nature restoration projects with protected areas in de Dutch and German EEZ.

As shown paragraph 2.4, multiple activities take place on the Borkum Reef Grounds. However, fisheries with towed bottom contacting gears are considered to be the main human activity adversely affecting the seabed. The geogenic- and biogenic reef parts of the Borkum Reef Grounds are expected to have a higher sensitivity to disturbance by bottom contacting fishing activities as compared to the more sandy habitats that are exposed to higher shear bed stress (ICES, 2009). The reef habitats are therefore assessed as being highly sensitive to all types of bottom contacting towed gear, even gears with small subsurface impact, and larger surface impact. The effect on *Lanice concheliga* reefs is less clear. The species itself can probably recover relatively quickly after fishing, but the associated biodiversity that is formed over time may not be able to do so. This still is a knowledge gap. Measures should aim at averting fishing activities with all bottom contacting towed gear on the Borkum Reef Grounds. It is to be expected that conservation measures focused on reducing seabed disturbance by fishing activities are beneficial for benthic biodiversity.

The proposed measure succeeds the measure drafted in the national North Sea Coastal Fisheries Agreement (in Dutch: Noordzeekustvisserijakkoord or 'VIBEG 2'). In the VIBEG 2 agreement the Dutch government, representatives of shrimp fisherman and environmental non-governmental organizations take part. A proposed measure in the agreement was to protect 95.5 km^2 of the area encompassing sandbanks, reefs, and *L. conchilega* fields. The rationale behind this previous proposed measure was to compensate for opening a similar-sized area inside the Natura 2000 area North Sea Coastal Zone for shrimp fisheries. This development has been overruled by the adoption of the North Sea Agreement by the Dutch Government and the Dutch Parliament in 2020. In the designing process towards seabed protection the balance between environmental protection and the economic impact on the fisheries sector was taken into account. It is considered that the prospected potential for habitat recovery outweighs the social-economic effects of the measure and is therefore considered proportionate.

While GES for benthic habitats was not achieved in 2020, the Borkum Reef Grounds harbours areas with geogenic- and biogenic reefs and has been of importance for extended European flat oyster beds.

Considering these properties it is concluded that the proposed measures are a necessity to be able to reach GES and provide an important relevance to reaching the targets as mentioned in 3.1.

Taking all of the above into consideration led to the conservation measures of the current Joint Recommendation.

4 Expected effects of the conservation measures

4.1 Expected effects on the natural feature

In Table 1, an overview is given of environmental targets under the MSFD to which the conservation measures will contribute. By the exclusion of fishery types that make use of gear types that touch the seafloor, it is foreseen that seabed stability is maintained and will allow the development of the typical characteristics of the seabed community of geo-morphological reef structures, of *Lanice* reefs and of the sandy seafloor. A natural development and succession of a complex sessile biotic community will be enabled in the reef habitat as the position and orientation of the hard substrate on which it grows do not change (Watling and Norse, 1998; Rijnsdorp et al., 2018). Furthermore, the conservation measures, together with nature restoration measures, will contribute to a successful return and recovery of biogenic reefs such as flat oyster beds (for more information on restoration of oysters: see Background Document for Frisian Front and Central Oysters Grounds).

The key factor to improve habitat quality of the reef habitat is to ensure that it is left undisturbed, by preventing human induced bottom disturbance (elevated dynamics). If undisturbed, cementing of the different fractions (gravel, stones) occurs, allowing for the establishment of typical sessile epibenthic species, while other infauna (those which are able to withstand movement and increased dynamics, e.g. from bottom fisheries) disappear. For *Lanice* reefs the effect of disturbance needs to be researched.

Measures aiming at avoiding disruption of the seabed by bottom contacting fishing activities will not only contribute to GES for biodiversity (descriptor 1) and sea floor integrity (descriptor 6), but also to food webs (descriptor 4) and to a limited extent commercial fish species (descriptor 3):

- descriptor 1: 'Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions'.
- descriptor 6: 'Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.'
- descriptor 4: 'All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.' Food webs normally occurring in the Borkum Reef Ground (i.e. in a undisturbed situation, matching the function and structure of the low-dynamic silty habitat) can develop.
- descriptor 3 (to a limited extent): 'Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.' Although fish are highly mobile and displacement of fisheries may occur, obviously fish and shellfish mortality due to fisheries will decrease in the protected areas.

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

In general it is expected that seabed structure will change towards natural intrinsic conditions and an increase in natural bioturbation due to e.g. mud shrimps. A benthic community in which epifauna has a larger role can develop, such as the soft coral dead man's finger *Alcyonium digitatum*. It is assumed that benthos biodiversity increases, biogenic structures develop (native oyster, *Lanice conchilega* and *Sabellaria spinulosa* reefs), scavengers and worms decrease, crustaceans and bivalves increase, as well as sensitive fish species (rays, sharks), predatory fish (e.g. cod) and large specimens of certain species. On the basis

of various studies, it is expected that the period over which a benthic community recovers may be in the order of 5 to 25 years. Furthermore, the area may become more attractive to harbour porpoise, harbour seal and grey seal, which are already using the area as a foraging area.

4.2 Expected effects on fisheries

The majority of the fishery effort concerns shrimp trawling. Compared to the area south of the proposed closure, shrimp trawling intensity is very low in the proposed closure. Hence, even though no specific information on effects of displacement is available for this area, it is expected that the effects on fisheries are minor.

4.3 Expected effects on other human activities

At this point no insight can be given on the expected effects of the proposed conservation measures on other human activities. In the Dutch North Sea Programme 2022-2027 the Dutch government has indicated that it will look into other activities in MSFD areas and if certain other activities should be managed as well.

5 Discussion

See Chapter 8 of the General Background Document.

6 Conclusion

See Chapter 9 of the General Background Document.

References

Aarts, G., Brasseur, S., Poos, J. J., Schop, J., Kirkwood, R., van Kooten, T., Mul, E., Reijnders, P., Rijnsdorp, A. D., & Tulp, I. (2019). Top-down pressure on a coastal ecosystem by harbor seals. Ecosphere, 10(1). https://doi.org/10.1002/ecs2.2538

Álvarez, H., García, S., Perry, A. L., Blanco, J., Maaholm, D. J., & Aguilar, R. (2020). Protecting the North Sea: Borkum Stones. OCEANA. https://europe.oceana.org/en/publications/reports/protecting-north-sea-borkum-stones

Bailey, S. (2015). An overview of thirty years of research on ballast water as a vector for aquatic invasive species to freshwater and marine environments. Aquatic Ecosystem Health & Management, 18, 261 268.

Beare, D., Rijnsdorp, A. D., Blaesberg, M., Damm, U., Egekvist, J., Fock, H., Kloppmann, M., Röckmann, C., Schroeder, A., Schulze, T., Tulp, I., Ulrich, C., van Hal, R., van Kooten, T., & Verweij, M. (2013). Evaluating the effect of fishery closures: Lessons learnt from the Plaice Box. Journal of Sea Research, 84, 49–60. https://doi.org/http://dx.doi.org/10.1016/j.seares.2013.04.002

Boon A.R., Caires S., Wijnant I.L., Verzijlbergh R., Zijl F., Schouten J.J., Muis S., Van Kessl T., Van Duren L. & Van Kooten T. (2018). Assessment of system effects of large-scale implementation of offshore wind in the southern North Sea. Deltares project 11202792- 002, november 2018.

Bos, O. G., Glorius, S., Coolen, J. W. P., Cuperus, J., Van der Weide, B., Aguera Garcia, A., Van Leeuwen, P. W., Lengkeek, W., Bouma, S., Hoppe, M., & Van Pelt-Heerschap, H. (2014). Natuurwaarden Borkumse Stenen. Project Aanvullende beschermde gebieden (http://edepot.wur.nl/313494). IMARES .

Brasseur, S., Kirkwood, R. & Aarts, G. (2017). Seal monitoring and evaluation for the Gemini offshore windfarm: Tconstruction - 2015 report. Report No. C004/18. Wageningen Marine Research, Wageningen, the Netherlands

Brasseur, S., Schop, J., Cremer, J., & Aarts, G. (2019). Harbour seal monitoring and evaluation for the Luchterduinen offshore windfarm : Final report (C074/18). Wageningen Marine Research (University & Research Centre). https://doi.org/10.18174/461959

Coolen JWP, Bos OG, Glorius S, Lengkeek W, Cuperus J, Van der Weide B, Aguera A (2015) Reefs, sand and reef-like sand: A comparison of the benthic biodiversity of habitats in the Dutch Borkum Reef Grounds (http://dx.doi.org/10.1016/j.seares.2015.06.010). J Sea Res 103:84-92

Deerenberg C., Teal, L.R., Beare ,D., van der Wal, J.T. (2010). FIMPAS project – Pre_assessment of the impact of fisheries on the conservation objectives of Dutch marine protected areas IMARES Report number C071/10.

Didderen, K., Lengkeek, W., Kamermans, P., Deden, B., & Reuchlin-Hugenholtz, E. (2019). Pilot to actively restore native oyster reefs in the North Sea Comprehensive report to share lessons learned in 2018. Report 19-013. Bureau Waardenburg.

Didderen, K., Lengkeek, W., Bergsma, J. H., Van Dongen, U., Driessen, F. M. F., & Kamermans, P. (2020). WWF & ARK Borkum Reef Grounds oyster pilot Active restoration of native oysters in the North Sea - monitoring September 2019 (Report No 19-227). Bureau Waardenburg.

European Commission (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., F.A. Arts, J.W. de Jong, D. Beuker, E.L. Bravo Rebolledo, B.W.R. Engels, M. Hoekstein, R- J. Jonkvorst, S. Lilipaly, M. Sluijter, K.D. van Straalen & P.A. Wolf (2019). Verspreiding, abundantie en trends van zeevogels en zeezoogdieren op het Nederlands Continentaal Plat in 2018-2019. RWS-Centrale Informatievoorziening BM 19.23. Bureau Waardenburg Rapportnr. 19-258. Bureau Waardenburg & Deltamilieu Projecten, Culemborg.

Geelhoed, S. C. V, & Scheidat, M. (2018). Abundance of harbour porpoises (*Phocoena phocoena*) on the Dutch Continental Shelf, aerial surveys 2012-2017 . Lutra, 61, 127–136.

Gercken, J. and A. Schmidt (2014). Current Status of the European Oyster (Ostrea edulis) and Possibilities for Restoration in the German North Sea. Bundesamt für Naturschutz, Bonn

IenM & ELI (2012). Netherlands Ministry of Infrastructure and Environment & Ministry of Economic Affairs, Agriculture and Innovation. 2012. Marine Strategy for the Dutch part of the North Sea 2012 2020, Part 1. Available from: http://www.noordzeeloket.nl/publish/pages/115832/marine_strategy_framework_directive_marine_strategy_for_the_ dutch_part_of_the_north_sea_2012-2020_pa.pdf

IenM & ELI (2015). Netherlands Ministry of Infrastructure and Environment & Ministry of Economic Affairs, Agriculture and Innovation. 2015. Marine Strategy for the Dutch part of the North Sea 2012 2020. Part 3. MSFD programme of measures. Appendix 5 to the National Water Plan 2016 2021. Available from: https://www.noordzeeloket.nl/en/functions-and-use/natuur/@171616/marine-strategy-1/

IenM (2015a). Ministry of Infrastructure and the Environment, Policy document on the North Sea 2016-2021

IenW & LNV (2018). Ministry of Infrastructure and Water Management & Ministry of Agriculture, Nature and Food Quality, Marine Strategy for the Dutch part of the North Sea (Part 1) Update of current environmental status, good environmental status, environmental targets and indicators 2018-2024 Main document, July 2018

IenW (2022a). Programma Noordzee 2022-2027, Ministerie van Infrastructuur en Waterstaat, Ministerie van Landbouw, Natuur en Voedselkwaliteit, Ministerie van Economische Zaken en Klimaat, Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, maart 2022

IenW (2022b). Mariene Strategie voor het Nederlandse Deel van de Noordzee 2022-2027 (deel 3) KRM-programma van maatregelen, Ministerie van Infrastructuur en Waterstaat en Ministerie van Landbouw, Natuur en Voedselkwaliteit, maart 2022

Jongbloed, R.H., N.T. Hintzen & O.G. Bos (2021). Fishing effort in protected areas in the Dutch part of the North Sea. Data for 2014-2019. Background document to the Joint Recommendation for Fisheries Management under the revised Common Fisheries Policy. Wageningen University & Research report C106/21. https://doi.org/10.18174/560805

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.

Lindeboom, H., Van Kessel, J. & Berkenbosch, L., (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

Lindeboom, H. J., Dijkman, E. M., Bos, O. G., Meesters, E. H., Cremer, J. S. M., Raad, I. de, Hal, R. van, & Bosma, A. (2008). Ecologische atlas Noordzee : ten behoeve van gebiedsbescherming. IMARES Wageningen UR. http://edepot.wur.nl/251730

Nilsson, H., van Overloop, J., Mehdi, R.A. & Pålsson, J. (2018). Transnational Maritime Spatial Planning in the North Sea: Report on Work package 4 of the North SEE Project. Available from: http://www.northsearegion.eu/northsee

OFL 2020, Overlegorgaan Fysieke Leefomgeving, Het Akkoord voor de Noordzee. Extra mijlen voor een gezonde Noordzee. The North Sea Agreement. https://doi.org/10.1080/00139157.1974.9928424

Olsen, O. T. (1883). The piscatorial atlas of the North Sea, English and St. George's Channels, illustrating the fishing ports, boats, gear, species of fish (how, where, and when caught), and other information concerning fish and fisheries. Taylor and Francis.

Onderzoeksraad voor veiligheid (2020). Veilig containertransport ten noorden van de Waddeneilanden Lessen na het containerverlies van de MSC ZOE, Den Haag, juni 2020

ONE-Dyas. (2019). GEms. Available from: https://onedyas.com/project/gems/

Ospar Commission (2009). Assessment of the environmental impacts of cables. Biodiversity Series. Publication Number: 437/2009.

OSPAR Commission (2013). OSPAR Recommendation 2013/4 on furthering the protection and conservation of Ostrea edulis in Region II and III1 of the OSPAR maritime area and Ostrea edulis beds in Regions II, III and IV of the OSPAR maritime area. https://www.ospar.org/documents?d=44059

Prins, T.C., Slijkerman, D.M.E., de Mesel, I., Schipper, C.A. & van den Heuvel Greve, M.J. (2011). Initial Assessment Implementation of the Marine Strategy Framework Directive for the Dutch part of the North Sea. Background document 1 (of 3). Report No. C112/11. IMARES and Deltares, Delft, the Netherlands.

Rijnsdorp, A. D., Bos, O. G., & Slijkerman, D. M. E. (2015). Impact Assessment of the Flyshoot fishery in Natura 2000 and MSFD areas of the Dutch continental shelf (http://edepot.wur.nl/365972) (C162/15). IMARES. http://edepot.wur.nl/365972

Rijnsdorp, A.D., Bolam, S.G., Garcia, C., Hiddink, J.G., Hintzen, N.T., van Denderen, P.D. and van Kooten, T. (2018), Estimating sensitivity of seabed habitats to disturbance by bottom trawling based on the longevity of benthic fauna. Ecol Appl, 28: 1302-1312. https://doi.org/10.1002/eap.1731

Roskam, J.L., Hamon ¸ K.G. and Deetman, B. (2021). Overview of the International Fishing Activities on Protected Areas in the North Sea; Fishing activities of the Dutch, Danish, German, Belgian, Swedish and French fleet for the period 2015-2019. Wageningen, Wageningen Economic Research, Report 2021-038. 82 pp.; 38 fig.; 12 tab.; 13 ref.

Sciberras, M., Rodriguez-Rodriguez, D., Ponge, B., Jackson, E. 2013. Criteria for assessing ecological coherence of MPA networks: A review. Report prepared by the Marine Institute and the Agence des Marines Protegees for the Protected Area Network Across the Channel Ecosystem (PANACHE) project. INTERREG programme France (Channel) – England (2007 – 2013) funded project, 48 pp (https://www.panache.eu.com/upload/iedit/10/pj/1875_5022_Criteria_for_assessing_ecological_coherence_of_MPA_networks_.pdf)

Tamis, J.E., Jongbloed, R.H. & Kamerman, P. (2019). Quickscan mogelijke effecten gaswinning bij Borkumse Stenen op platteoesterrif. Report No. C033/20. Wageningen Marine Research, Wageningen, the Netherlands.

Van Duin, C., Vrij Peerdeman, M., Jaspers, H., & Bucholc, A. (2017). Winning suppletiezand Noordzee 2018 t/m 2027 Milieueffectrapportage. Bijlage 1 (Kaarten). Sweco Nederland B.V. https://www.commissiemer.nl/projectdocumenten/00003196.pdf

Van Duren, L.A., Zijl, F., van Kessel, T., van Zeist, V.T.M., Vilmin, L.M., van der Meer, J., Aarts, G.M., van der Molen, J., Soetaert, K. en Minns, A.W.,(2021). Ecosystem effects of large upscaling of offshore wind on the North Sea – Synthesis report. https://www.noordzeeloket.nl/publish/pages/190265/synthesis-ecosystem-effects-of-large-upscaling-of-offshore-wind-on-the-north-sea.pdf

Nordheim, Henning & Boedeker, Dieter & Krause, Jochen. (2006). Progress in Marine Conservation in Europe: NATURA 2000 Sites in German Offshore Waters. 10.1007/3-540-33291-X.

van Stralen, M. R., & Craeymeersch, J. A. M. (2018). Positionering zone 2 - VIBEG II akkoord. Ontwikkeling van het voorstel en de ecologische onderbouwing daarbij. Rapport 2018.179. Onderzoeksbureau MarinX, Wageningen Marine Research. http://library.wur.nl/WebQuery/wurpubs/fulltext/440363

Watling, L., & Norse, E. (1998). Disturbance of the Seabed by Mobile Fishing Gear: A Comparison to Forest Clearcutting. Conservation Biology, 12(6), 1180-1197. Retrieved August 18, 2021, from http://www.jstor.org/stable/2989836

Weilgart, L.S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology, 85, 1091 1116.

Wijnhoven, S., & Bos, O. G. (2017). Benthische Indicator Soorten Index (BISI). (Report Series / Ecoauthor; No. 2017-02). Ecoauthor. http://ecoauthor.net/wp-content/uploads/2017/10/Eindrapport-Benthos-Indicator-Noordzee-v260917.pdf

Wijnhoven, S. (2019). Assessment tool: 'Benthic Indicator Species Index (BISI)': Application of BISI v2 in the Dutch North Sea with consolidation of earlier identified references. v311219. Ecoauthor. http://ecoauthor.net/bisi/

Annex 1:

Table A1: Average annual effort (2014-2019) per gear group, derived from the effort maps. The ratio of the two numbers is used as a correction factor.

effort (days/year 2014-2019)	BttmTrw	BemTrwl	PlgcTrw	FlyShtS	Nets	AnchrdS	Dredge
Borkum Reef Grounds 2022	0.17	64.43	0.06	3.20	0.55	0.08	0
Borkum Reef Grounds 2021	1.02	434.57	0.04	1.85	0.38	0.04	0.33
ratio	0.17	0.15	1.39	1.73	1.46	2.00	0