Draft

Joint recommendation for fisheries management measures under Article 11 and Article 18 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy in the Natura 2000 sites within the German EEZ

Bonn, 09. January 2018

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2 General principles and overview of the proposed measures

2.1 Background

Under 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, Habitats Directive), EU Member States undertook to establish a consistent network of protected areas. The Natura 2000 sites (also known as Sites of Community Importance or SCI) together with the European bird protection areas known as Special Protection Areas (SPA) pursuant to 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, p. 7, Birds Directive) comprise the Natura 2000 system of nature protection areas. The aim of this network is to conserve and restore terrestrial and marine biological diversity.

In the German exclusive economic zone (EEZ; zone ranging from 12 to 200 nautical miles from the base line) of the North Sea and the Baltic Sea, the area map contains ten Natura 2000 sites which the Federal Republic of Germany proposed to the European Commission (EU COM) in May 2004. These sites comprise approximately 31% of the area covered by the German EEZ. Two of the Natura 2000 sites for the protection of seabirds have been designated national nature conservation areas since September 2005. The EU recognised the eight other Natura 2000 sites (under the Habitats Directive) in November 2007; their status as Natura 2000 sites (Sites of Community Importance) took legal effect upon publication in January 2008.

Preparatory analyses for the development of fisheries management measures in marine Natura 2000 sites in the German EEZ, made in accordance with the guidelines[1] of the EU Commission, were made available to the Member States concerned within the scope of the 2005-2008 EMPAS project (Environmentally Sound Fisheries Management in Protected Areas[, ICES 2009, Pedersen et al. 2008; BfN 2010 and in the 2011 catalogue of measures, Sell et al. 2011).

2.1.1 Natura 2000 sites in the German EEZ in the North Sea

In the German EEZ in the North Sea, the following Natura 2000 sites have been designated (see Figure 1): Sylt Outer Reef, Borkum Reef Ground and Dogger Bank as Sites of Community Importance under the FFH Directive, and the Natura 2000 site Eastern German Bight as European Bird Protection Area under the Birds Directive.

[1]EU Commission 2008,
http://ec.europa.eu/environment/nature/natura2000/marine/docs/fish_measures.pdf

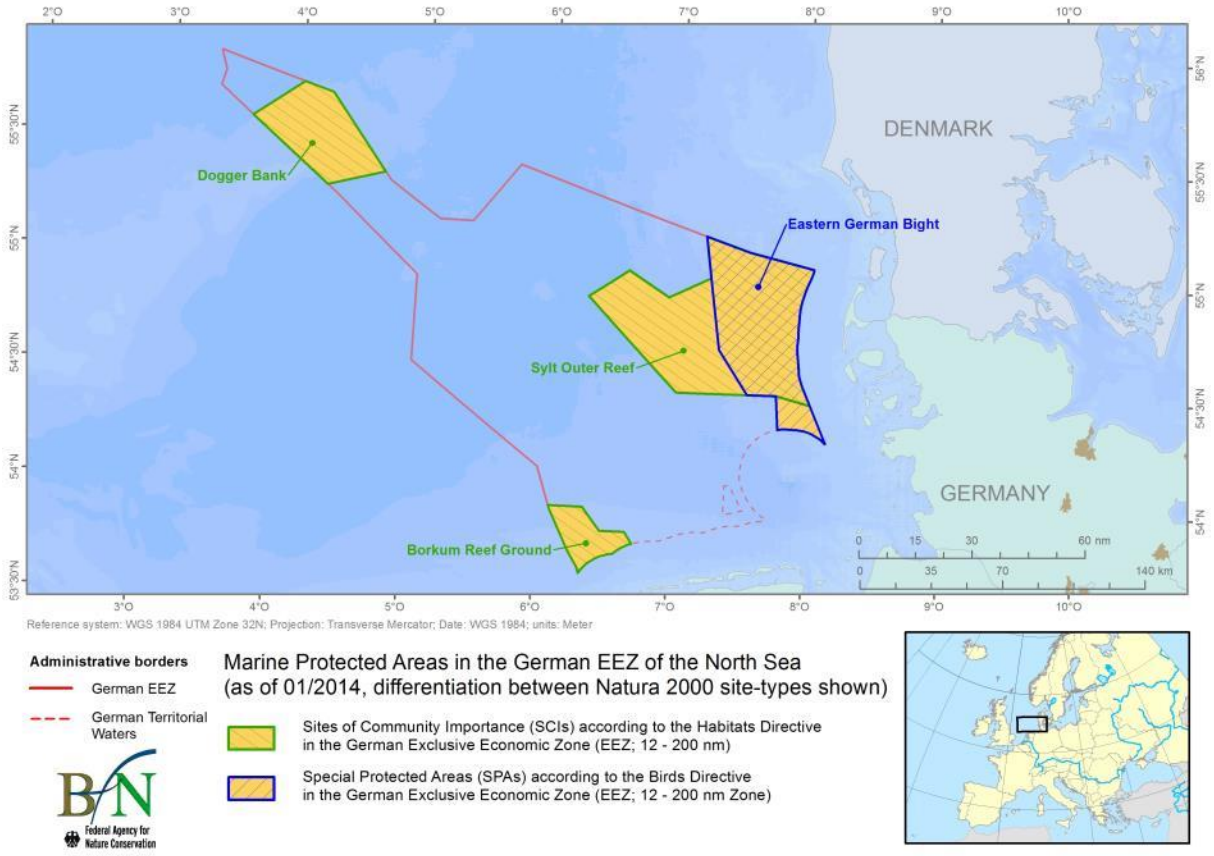

Figure 1: Natura 2000 sites in the German EEZ in the North Sea designated on the basis of the Habitats Directive and the Birds Directive.

2.2 Key objectives and contents of the proposal

In accordance with Article 4, paragraph 4 of the Habitats Directive, once the sites are entered in the European Commission's Community list, Germany is obliged to draft management plans as soon as possible, and at the latest within six years, to ensure the maintenance or restoration of the favourable conservation status of species and habitats.

Germany is also obliged to establish measures which need to be taken in order to achieve or maintain a “good environmental status” according to the Marine Strategy Framework Directive (MSFD). Based on the initial assessment for the German North Sea (pursuant to Article 8 MSFD human pressure upon the North Sea is too high and species such as marine mammals and seabirds and biotope types of the North Sea have not achieved good environmental status (GES) in German waters Thus, as basis for the development of measures, Germany has established environmental targets for the German North Sea pursuant to Article 10 of the MSFD and the German programme of measures according to Art. 13 includes the establishment of fisheries management measures to improve i. a. the status of habitat types and biological features listed in Annex III Table 1 MSFD.

The overall aim of this joint recommendation is:

- to ensure the protection of sand banks (habitat type 1110) and reef structures (habitat type H1170), sea birds and harbour porpoises within the German Natura 2000 sites in the German EEZ in the North Sea from negative impacts of fisheries, thereby contributing to the obligation to ensure the maintenance or restoration of the favourable conservation status of these habitat types and species in accordance with Article 6 of the Habitats Directive and Article 4 of the Birds Directive
- to reach progress towards the targets of the Marine Strategy Framework Directive (MSFD; Directive 2008/56/EC) specifically in relation to descriptor 1 "biological diversity" and descriptor 6 "sea-floor integrity" by protecting seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' from negative impacts of fisheries which has been identified as "other habitat type" according to the MSFD, Annex III, table 1. This biotope type also being protected by § 30 of the German Federal Nature Conservation Act was ascertained in the vicinity of reefs and sandbanks. For a description see (chapter 10.1)

The European Commission (DG Environment and DG MARE) provided guidelines[2] in 2008 for the implementation of fisheries management measures in marine Natura 2000 sites. This document outlines requirements (11 points) that Member States should observe when requesting fisheries management measures for their Natura 2000 sites. The present proposal is based on the eleven requirements laid out in these guidelines. Points 1 through 3 were already part of the Federal Government's nomination process, i.e. (1) description of the natural features, (2) scientific rationale and (3) spatial extent of the site boundary.

In accordance with Articles 11 and 18 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy (OJ L 354, 28.12.2013, p. 22, CFP Basic Regulation), the present document proposes the following fisheries management measures in the Natura 2000 sites in the German EEZ in the North Sea (Figure1)

[2]EU Commission 2008,
http://ec.europa.eu/environment/nature/natura2000/marine/docs/fish_measures.pdf
New guidelines are under development

I. Protection of the habitat types 1110 'Sandbanks' and 1170 'Reefs' and seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas'

Natura 2000 sites" Sylt Outer Reef" and "Eastern German Bight"

Year-round exclusion of all mobile bottom-contacting gears (for gear codes see Chapter 5.1) from two management zones in the central area of the Natura 2000 site Sylt Outer Reef to protect the habitat type 1170 'Reefs' and seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' (Figure 6).
Year-round exclusion of any kind of fisheries from 25% (northern part) of the area of the sandbank Amrum Bank in the Natura 2000 site Sylt Outer Reef to protect the habitat type 1110 'Sandbanks' (Figure 7)

Natura 2000 site "Borkum Reef Ground"

Year-round exclusion of all mobile bottom-contacting gears (for gear codes see Chapter 5.2) from the entire Natura 2000 site Borkum Reef Ground to protect the habitat types 1110 'Sandbanks' and 1170 'Reefs' and seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' (Figure 10)

Natura 2000 site "Dogger Bank"

Year-round exclusion of all mobile bottom-contacting gears (for gear codes see Chapter 5.3) (from 50% of the area of the Natura 2000 site Dogger Bank to protect the habitat type 1110 'Sandbanks'. (Measure is subject of an international cooperation between NL, UK and DE)

II. Protection of harbour porpoises and birds

Natura 2000 sites "Sylt Outer Reef" and "Eastern German Bight"

Year-round exclusion of fisheries with set gillnets and entangling nets (for gear codes see Chapter 5.1) from the northern and southern part of the Natura 2000 site Eastern German Bight, on the grounds of year-round bird protection in the southern part and a combination of bird and porpoise protection in the northern part of the Natura 2000 site (Figure 8).

Seasonal exclusion of fisheries with set gillnets and entangling nets (for gear codes see Chapter 5.1) from the western part of the Natura 2000 site Sylt Outer Reef from 1 March to 31 October to protect harbour porpoises from by-catch in phases of high animal aggregation including the calving and mating season (Figure 9).

Natura 2000 sites "Borkum Reef Ground" and "Dogger Bank"

Limitation of fishing effort with passive gears (gillnets and entangling nets, for gear codes see Chapter 5.4) to the average effort of the last 6 years before the coming into force of the corresponding delegated act. to protect porpoises in the entire area of the Natura 2000 sites Borkum Reef Ground and Dogger Bank.

2.3 International coordination

The Federal Republic of Germany (initiating Member State) is striving to take measures concerning all fishing vessels, including EU vessels with fishing rights in the German EEZ under non-German flag. In accordance with the CFP Basic Regulation and with the aim to apply the measures to all fishing vessels, Germany consulted the Member States concerned, i.e. Denmark, the Netherlands, Belgium, France and the United Kingdom of Great Britain and Northern Ireland.

The fundamentals for the preparation of the international consultations were elaborated in the course of the 2005-2008 EMPAS project [(ICES 2009; Pedersen et al. 2008; BfN 2010)] and, in accordance with the guidelines[3] of the EU Commission, provided to the Member States in the 2011 catalogue of measures (Sell et al. 2011).
The first international consultation took place in 2011 in oral and written form. At the invitation of the Federal Ministry of Food and Agriculture (BMEL), a hearing with the Member States concerned was held in Bonn on 13 October 2011. Four Member States (Belgium, Denmark, the Netherlands, the United Kingdom) commented on the proposed measures in writing.

[3]EU Commission 2008,
http://ec.europa.eu/environment/nature/natura2000/marine/docs/fish_measures.pdf
New guidelines are under development

A draft joint recommendation (version 23 February 2016) has been subject to a national stakeholder consultation on 22 March 2016. Subsequently the draft has been submitted to member states having a direct fisheries management interest in the protected areas, to the North Sea Regional Advisory Council (NSAC) and the European Commission according to Article 11 and 18 of the CFP Basic Regulation. Informal consultations with member states (DK, NL, BE, FR and UK), the NSAC and the European Commission took place in Bonn on 27 June 2016.
Taking into account remarks and observations resulting from the informal consultation round of 30 June 2016 a redrafted version (6 December 2016) is presented hereby.
As soon as an agreement has been reached at expert group level, the joint recommendation for fisheries management measures in Natura 2000 sites in the German EEZ will be adopted by the High Level Group of the Scheveningen Group and submitted to the EU Commission.

3 Evaluation of fishing activities in Natura 2000 sites

3.1 Data situation

Fishing activities in EU waters are usually documented by time and geographic position. However, assessing the fishing effort in Natura 2000 sites via the Electronic Reporting System (ERS), the so-called "e-logbook", alone would be inadequate. The geographic information is limited to the ICES statistical rectangles with a side length of approx. 30*30 nautical miles. The present, detailed geographic analyses are therefore based on Vessel Monitoring System (VMS) data (a satellite based control system). At nationally defined intervals, data on the position, heading and speed of vessels are reported to the fisheries authorities (in Germany: Federal Office for Agriculture and Food; BLE). Under Council Regulation (EC) No 1224/2009 of 20 November 2009 (OJ L 343, 22.12.2009, p. 1, EU Fisheries Control Regulation), VMS is mandatory for EU vessels with a length of 15 metres or more (12 metres or more since 1 January 2012). It can be assumed that over 90% of all fishing vessels in the North Sea are equipped with VMS.

Fishing activities in the German EEZ in the North Sea

The international fishing activities in the region are described in detail in a supplement document (Schulze 2018). This report is based on aggregated data delivered by the member states since confidential economic information is required. To gain comparable values for all member states it was agreed between member states that Germany provides a proposed workflow (R-Code) to extract the requested data.

To evaluate the relevance of an area proposed for management to the fishing industry, the revenues gained in an area (measure) are compared with the revenue of the

FAO subregion 27.4.b (Table 1; data downloaded from STECF https://stecf.jrc.ec.europa.eu/dd/fleet on 15th of December 2017: 2017-07_STECF 17-12 - EU Fleet Landings FAO Gear levels_final.xlsx).

Table 1: Revenues (euro) in the reference area (subregion 27.4.b; from STECF database) of the fleets of Belgium, Germany, Denmark, The Netherlands, Great Britain and Sweden of the years 2012 to 2016 in comparison with the revenues (euro and as percentage of the reference area) of the same fleets using the same gears in the areas proposed for management (Measures: M1, M2, M3, M4, M5, M6, M7). A) Revenues of mobile bottom contacting gears (dredges, otter boards, seines, beam trawls). B) Revenues of entangling gears (gill and trammel nets). *): No data in STECF database were available for Denmark for the year 2016.
Please note that
Measures 1-6 result in an *exclusion* of the relevant fishing activities, while measure 7 aims at a *freezing* of the effort of the relevant fishing activity. For Measure 1 and 7 also data for *subareas* (a+b) are given for a more detailed description. Measure 6 (Dogger Bank) is mentioned *for information purposes* only, the measure is not part of this Joint Recommendation.

A) Mobile bottom contact gears
DRB, DRH, OTB, OTT, PTB, SB, SDN, SPR, SSC, TBB

	2012	2013	2014	2015	2016*)	mean of years
Revenues in reference area (euro, subregion 27.4.b)	352 787 307	321 496 433	330 222 858	314 145 541	*)	329 663 035
Revenues in area of measure (euro)						
M1_SyltOutReef_cntrl	1 506 082	1 715 423	900 398	674 489	344 023	1 028 083
M1a_SyltOutReef_cntrlNorth	*12 924*	*447 506*	*142 796*	*128 448*	*54 487*	*157 232*
M1b_SyltOutReef_cntrlSouth	*1 493 158*	*1 267 917*	*757 601*	*546 040*	*289 536*	*870 851*
M2_Amrumbank_25Proz	91 643	61 357	61 658	52 647	88 148	71 091
M5_Bork_Reefgrnd	37 749	34 799	22 955	36 808	31 696	32 801
M6_Doggerbank	1 715 016	1 424 722	859 475	1 111 909	1 503 265	1 322 877
Revenues in area of measure (percentage of reference area)						
M1_SyltOutReef_cntrl	0.43%	0.53%	0.27%	0.21%	*)	0.36%
M1a_SyltOutReef_cntrlNorth	*0.00%*	*0.14%*	*0.04%*	*0.04%*	**)*	*0.06%*
M1b_SyltOutReef_cntrlSouth	*0.42%*	*0.39%*	*0.23%*	*0.17%*	**)*	*0.31%*
M2_Amrumbank_25Proz	0.03%	0.02%	0.02%	0.02%	*)	0.02%
M5_Bork_Reefgrnd	0.01%	0.01%	0.01%	0.01%	*)	0.01%
M6_Doggerbank	0.49%	0.44%	0.26%	0.35%	*)	0.39%

B) entangling gears
GNS, GND, GNC, GTR, GTN

	2012	2013	2014	2015	2016*)	mean of years
Revenues in reference area (euro, subregion 27.4.b)	15 351 338	11 783 595	13 130 206	13 717 852	*)	13 495 748
Revenues in area of measure (euro)						
M3_EstGerBight_whYear	345	0	0	0	0	69
M4_SyltOutReef_MarOct	700	137	2 077	234	0	630
M7_BrgDog_EffFreez	51 664	16 983	295 461	101 019	43 856	101 797
M7a_Dog_EffFreez	*51 586*	*16 435*	*295 204*	*99 627*	*43 856*	101 342
M7b_Brg_EffFreez	*78*	*548*	*257*	*1 393*	*0*	455
Revenues in area of measure (percentage of reference area)						
M3_EstGerBight_whYear	0.00%	0.00%	0.00%	0.00%	*)	0.00%
M4_SyltOutReef_MarOct	0.00%	0.00%	0.02%	0.00%	*)	0.01%
M7_BrgDog_EffFreez	0.34%	0.14%	2.25%	0.74%	*)	0.87%
M7a_Dog_EffFreez	*0.34%*	*0.14%*	*2.25%*	*0.73%*	**)*	*0.86%*
M7b_Brg_EffFreez	*0.00%*	*0.00%*	*0.00%*	*0.01%*	**)*	*0.00%*

4 Other human activities in the Natura 2000 sites

Figure 2 shows the human activities - besides commercial fisheries - taking place in the German EEZ of the North Sea. These activities are described briefly below.

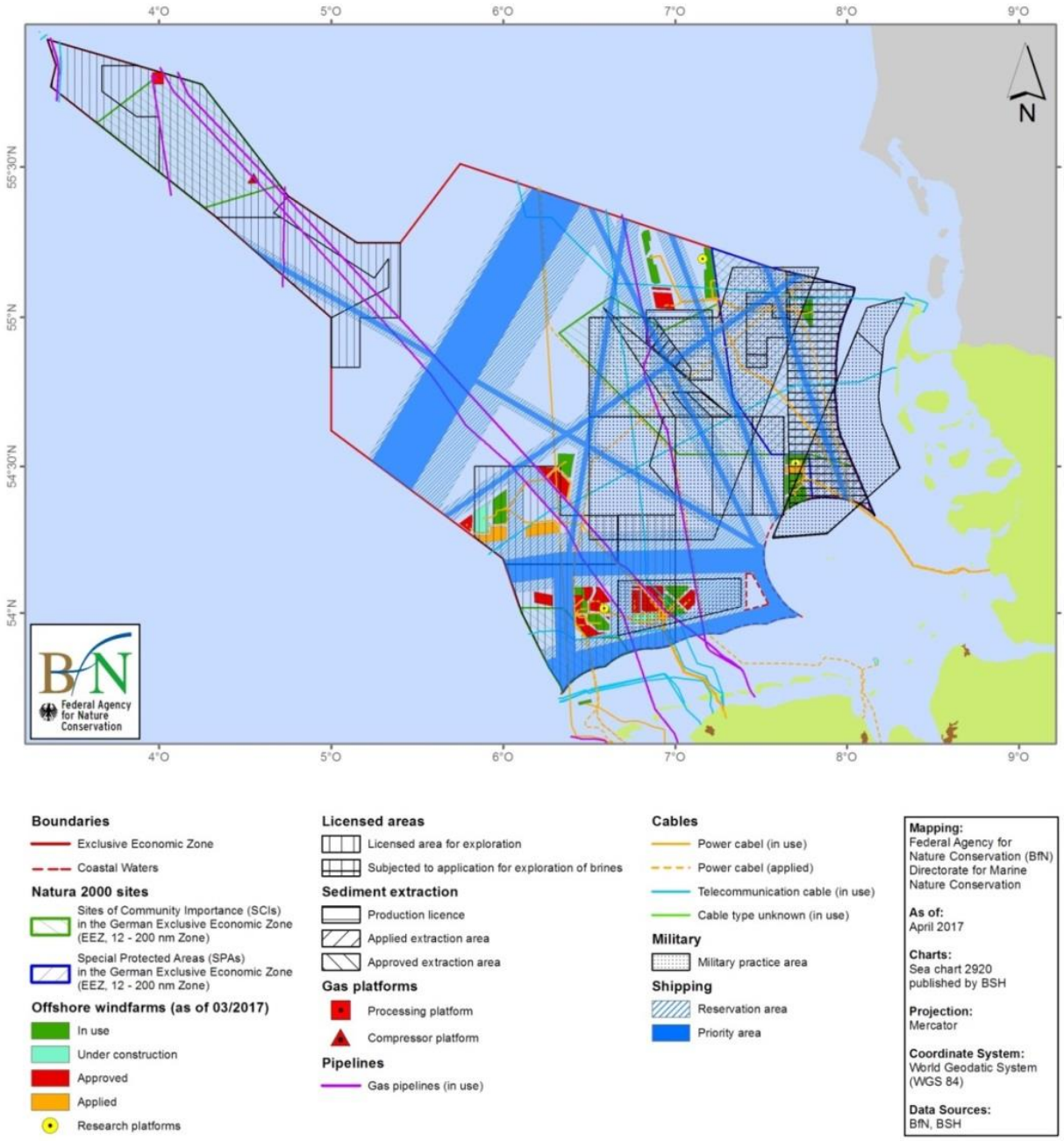

Figure 2: Human activities (besides fisheries) in the Natura 2000 sites in the German EEZ of the North Sea: Offshore windfarms, sediment extraction, gas platforms, cables, military and shipping (Federal Agency for Nature conservation).

Art. 6 (3) and (4) of the Habitats Directive (92/43/EEC) were implemented in § 34 of the German Federal Conservation Act, which sets out that plans or projects likely to have a significant effect on a German Natura 2000 site, either individually or in combination with other plans or projects, are subject to an appropriate assessment of significance. The competent national authorities will agree only after having ascertained that these plans or projects will not adversely affect the integrity of the site concerned. If a plan or project must be carried out for imperative reasons of overriding public interest where no alternative solutions exist and where adverse impacts remain, compensatory measures will be taken to ensure that the overall coherence of the Natura 2000 network as a whole is maintained.
To implement Art 6(1) and (2) of the Habitats Directive in these sites Germany is presently developing site specific ordinances to regulate human activities, which will be complemented by site specific management plans. These, however, do not regulate commercial fisheries.

Potential effects of human activities:

Offshore Wind Energy
According to the German regulation on spatial planning (EEZ North Sea ROV 2009) no offshore wind farm (OWF) will be approved in any Natura 2000 site in the German EEZ of the North Sea. There is only one concession for an OWF (“Butendieck”), in the Natura 2000 site Sylt Outer Reef -Eastern German Bight which was granted before 2009.
OWF can have negative effects on sea birds, but responses of sea birds to offshore wind farms vary from species to species. While some gull species appear to be attracted to wind farms, others such as guillemots and northern gannet occur less frequently in wind farm areas after construction than before (Hill et al. 2014). Species sensitive to disturbance such as divers (red-throated and black-throated divers) in particular avoid wind farms and its surroundings up to several kilometers around the OWF (Dierschke et al. 2016).
Harbour porpoises can be harmed by construction noise (pile driving) and also by the intensive shipping related to the construction and operation of the wind farm (e.g. underwater noise, risk of collisions). The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety developed a specific concept for the protection of harbour porpoises from excessive sound exposures during the construction of Offshore Wind Farms in the German North Sea (Sound Protection Concept, implemented in December 2013), which has to be applied in all OWF projects.
For the environmental effects of OWF connections to the power grid see the section on ‘Cables.’

Sand and gravel extraction

The effects of sand and gravel extraction in the North Sea are described in Kenny & Rees 1994 & 1996, ICES 2009 and Boyd et al. 2005. Most important effects are degradation or even loss of benthic biotopes.

Areas for marine sand and gravel extraction, which were licensed before the designation of the Natura 2000 sites, are located in the Natura 2000 site Sylt Outer Reef - Eastern German Bight. Extraction activities have been subject to appropriate assessments. Extraction activities are running on an area of 4 km^2 corresponding to 0.07% of the total area of this Natura 2000 site. The habitat types reefs and sandbanks are not significantly affected. For activities beyond 2019 a new appropriate assessment will be necessary.

Gas extraction

Natural gas is being extracted since 2000 at the northern border of the “Dogger Bank” The concession was granted before the designation of the area as a Natura 2000 site. There are small-scale effects caused by habitat and biotope changes and loss respectively, noise and pollutant emissions as well as visual disturbances. Service vessels and sound emissions may affect harbour porpoise and seabirds sensitive to disturbance especially red-throated and black-throated divers. Flaring off of unusable gas can attract migratory birds at night or in conditions of poor visibility.

Cables

A number of cables (marine power cables, communication cables) and pipelines cross the Natura 2000 sites Borkum Reef Ground and Sylt Outer Reef - Eastern German Bight. In operation, high-voltage power cables emit heat and electromagnetic fields, therefore these cables are bared and buried for safety reasons. The laying and burial of both power and telecommunication cables and the associated sediment displacement can cause loss or alteration of seabed communities. It also temporarily creates turbidity plumes that may affect the surroundings. Negative effects are minimized by compensatory measures.

Shipping

The regulation of shipping the EEZ is in not within national competence, Commercial shipping in the southern area of the German Bight is currently taking place in two traffic separation schemes (TSS) resulting in straight lines with high ship densities. One of these lines (“Approach German Bight”) crosses the southern part of the Natura 2000 site Borkum Reef Ground covering about 30% of the site. The permanent high shipping density especially in the TSS in the Borkum Reef Ground causes a disturbing effect and risk of collision for harbour porpoises. Shipping in Sylt Outer Reef /Eastern German Bight is concentrated in two corridors in north-south direction in the centre of the Natura 2000 site but with lower densities in comparison to the TSS in the Borkum Reef Ground

Dredging in General:
Dredging for any purpose could potentially also have an impact on the availability of prey species and thereby adversely affect Harbour Porpoise. Any proposals or projects that will undertake such activity will be subject to impact assessment and monitoring."

Military activities
The precise impact of military activities on the marine environment is very hard to assess, partly because access to information on the nature and scale of such activities is severely restricted. The fauna - especially marine mammals and seabirds - in the Natura 2000 sites is presumably disturbed by military activities.

5 Assessment of the main conflicts between protected species/habitats and fishing activities

5.1 Benthic habitats

Conflicts between mobile bottom contacting gears and benthic habitats

The following assessment of the pressures of fisheries on benthic habitats and their communities represents the current state of scientific knowledge including the findings from the FishPact project (Schröder et al. 2008), the recent EU-Project BENTHIS (e.g. Eigaard et al. 2016), and earlier EU projects such as MAFCONS (Managing Fisheries to Conserve Groundfish and Benthic Invertebrate Species Diversity), IMPACT (e.g. Jennings et al. 2001, Hiddink et al. 2006, Kaiser et al. 2006, ICES 2009, Fock et al. 2011). and the first analysis of the main risks arising from bottom-contacting fishing gear for benthic habitats and species in German waters of the North Sea (Sell et al. (2011)

The mortality of benthic organisms, that can be differentiated between infauna (living within the bottom substratum) and epifauna (living on the bottom substratum), can be the direct result of mechanical damage or the result of unwanted by-catch which in many cases results in high mortality even when returned to the sea.

The vulnerability of a species to mobile bottom-contacting gear is depending on several factors like its mobility, its ability to withstand a physical impact, its position in or on the sea floor (Infauna or epifauna) or its ability to rebury after being unearthed (Hiddink et al.2006, Kaiser et al. 2006). The effects on the local populations are not only depending on the vulnerability of individual specimens, but also on the recovery time of the affected populations, which strongly depends on population parameters such as life span, mode of reproduction, reproduction rates and age structure and is

also influenced by mobility and feeding behaviour.. Whereas short-lived, fast growing species have a comparatively short recovery time, slow growing long-lived species may need several years to recover (Jennings et al. 2001, Kaiser et al. 2006). Generally speaking, mobile bottom trawling has the potential to impact long-lived species significantly more due to their e.g. mostly longer recovery rates than short-lived opportunistic species.

Negative effects of mobile bottom contacting gears have been demonstrated by several studies:
Bottom trawling causes high mortality rates among epifaunal species (e.g. Lindeboom & de Groot 1998; Bergman & van Santbrink 2000). and has a particularly negative impact on sessile, colonial epifauna and bushy animals, long lived surface dwellers, and a positive effect on deposit feeders, opportunists and small animals (Peterson et al. 1987, Collie et al. 1997, Thrush et al. 1998, Watling & Norse 1998, Collie et al. 2000, Rumohr & Kujawski 2000, Bradshaw et al. 2003, Bremner et al. 2003). According to e.g. Collie et al. (2000), Bradshaw et al. (2003), sites with lower intensity of bottom trawling showed a greater proportional biomass of attached epifauna and filter feeders. According to Bolam et al. (2017), especially benthic communities living on gravel seem to be more sensitive to trawling, since they consist of a higher proportion of larger, long-lived, and sessile epifauna on average that are particularly sensitive to trawling (Tillin et al 2006). Hinz et al. (2009) found out that chronic bottom otter trawling had a significant, negative effect on benthic infauna abundance, biomass, and species richness (Nephrops fishery on a muddy habitat in the Irish Sea): infauna abundance was reduced by 72%, biomass by 77%, and species richness by 40%. Abundance of benthic epifauna and species richness also showed a significant, negative response, reductions of 81% and 14%, respectively, whereas the epibenthic biomass did not show such a negative effect (Hinz et al. 2009). According to Hinz et al. (2009), chronic trawl disturbance led to clear changes in community composition of benthic infauna and epifauna. Several studies showed that bottom trawling shifts the species composition of benthos from long lived taxa to short lived taxa (e.g. Jennings & Kaiser 1998, Thrush et al. 2005, Jennings et al. 2005, Tillin et al. 2006, Kaiser et al. 2006, Rijnsdorp et al. 2016) and may cause breakdown of benthic - pelagic coupling, in turn leading to potential irreversible ecosystem regime shifts (Choi et al. 2004, Hinz et al 2009).

ICES WGECO lately examined the variation of the relationship between trawling frequency (1/y) and longevity of benthic species varies with sediment position (ICES 2017a). The investigation shows significant negative relationships between trawling frequency and biomass weighted average longevity in a sediment position 0-5 cm and surprisingly a slightly positive and significant relationship between trawl frequency and longevity among exclusive surface dwelling organisms. This finding could be explained by a great abundance of mobile species among the surface dwellers, which may recolonize recently fished locations quite fast.

One of the most important conservation objectives in the Natura 2000 sites of the German EEZ is the recovery of benthic communities, which can be characterized e.g. by an increase in the proportion of long-lived species. As a result of the advancements in handling VMS based fisheries data, numerous models assessing the impact of mobile bottom contacting gears on benthic communities of the North Sea evolved over the past decade (Schröder 2008, Fock et al. 2011, Lambert et al. 2014, Stelzenmüller et al. 2015, Rijnsdorp et al. 2016, ICES WKFBI 2016, ICES WKBENTH 2017, see also EU-Project Benthic Ecosystem Fisheries Impact Studies;-www.benthis.eu). In general, those models incorporate the spatial distribution of fishing effort, the spatial distribution of benthic communities and a parametrisation of vulnerability of these communities to fishing, hence resulting in benthic impact maps representing the current state of scientific knowledge.

The early study by Schröder et al. (2008) suggests that a persistent fishing pressure in the above-mentioned protected areas of the German EEZ could change the composition of the benthic communities and reduce their total abundance and biomass.

Further, the modelled demographic reactions of the zoobenthic species show that the first and second fishing events cause the largest relative loss among benthic organisms, while other fishing event increase the absolute loss but have only little effect on the relative loss (Cook et al. 2013, Schröder et al. 2008). For this reason, those areas with very little fishing activity may have particularly great potential for achieving a favourable conservation status.

According to ICES WKTRADE (ICES 2017b) most sensitive species are already affected at low trawling intensities, thus the pressure at low trawling intensities should be eliminated or reduced. However, marginal increase in the pressure at high trawling intensities will have little effect since the benthic community in these areas primarily consists of species resilient to trawling. Additionally, various management scenarios have been tested in the WKTRADE report and the results show that spatial management measures focusing on protecting the peripheral fishing grounds (instead of the core fishing ground) and replacing effort to the core fishing ground will improve the average status of the seafloor.

Fock et al. (2011) developed an indicator comparing benthic mortality by trawling to the relative recovery potential at a given location. Building on this concept Stelzenmüller et al. (2015) predicted the current state of benthic disturbance for the German EEZ of the North Sea. The benthic disturbance indicator based on projections of the recovery potential of ten benthic infaunal communities (as described in Pesch et al. 2008) after a trawl event (see Figure 3).

The relative benthic mortality was calculated by combining the fishing frequencies of six different fishing fleets. The disturbance indicator was calculated on two different assumptions: Assuming an equal impact of all gears (Figure 3 , left) and assuming a higher impact of beam trawls targeting flatfish in comparison to other bottom contacting gears (Figure 3 right)

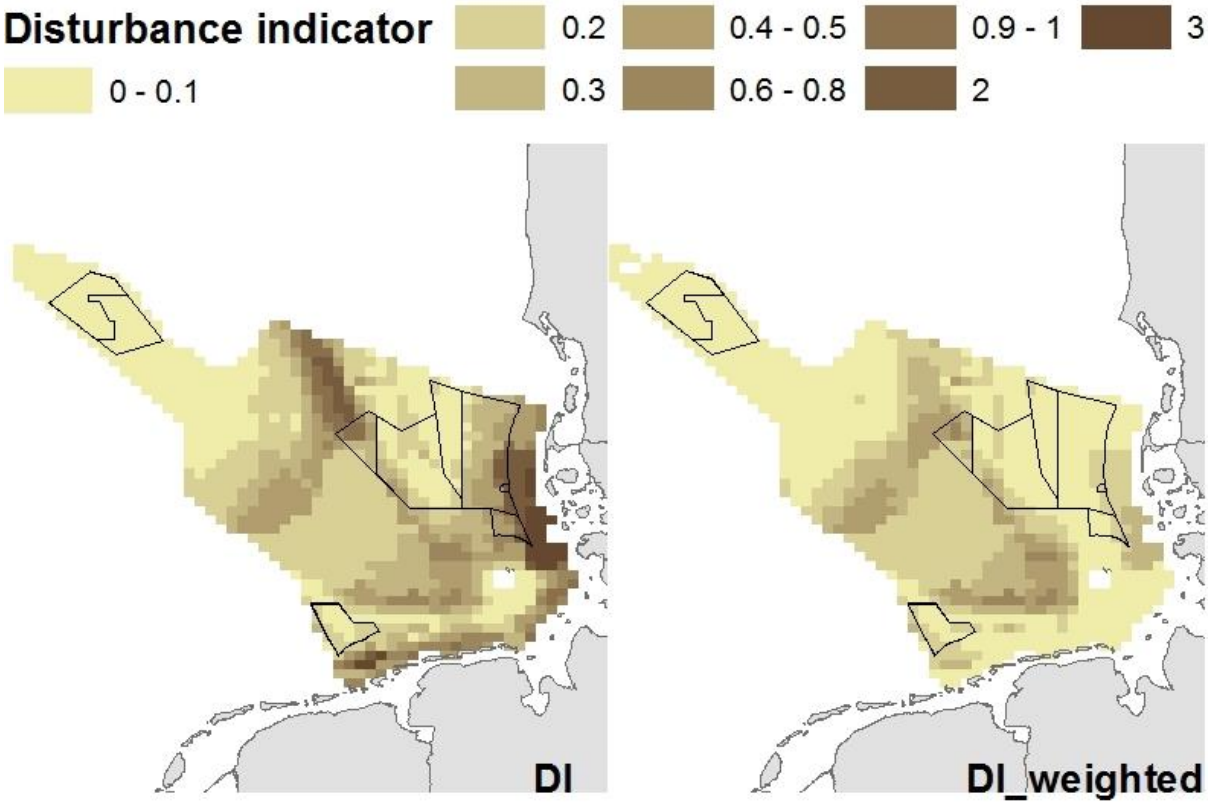

Figure 3: Estimated values of the disturbance indicator (DI) based on an overall local mortality rate assuming equal impact of six fishing fleets (left), and assuming different weights for the impact of the six fishing fleets with highest weight for the flatfish fishery (right) (after Stelzenmüller et al. (2015)).

Alternatively, the longevity approach (Rijnsdorp et al., 2016) assesses impact of trawling to the benthic assemblage as a whole by considering the longevity of benthic invertebrates in relation to trawling intensity. It's performance has been recently improved by incorporating environmental effects on longevity in the model increasing the sensitivity gradient throughout the North Sea. However, similar to the DI, this changed and partly reversed the picture of benthic impacts from showing highest impact in areas with highest fishing intensities, which is often observed in near coastal areas, to showing highest impacts in more sensitive areas. In the latter case low impact is predicted for shallow waters, because habitats are already exposed to a high degree of natural disturbance.

As a third alternative, the indicator 'Extent of physical damage to special and predominant habitats (BH3), developed according to the requirements of the MSFD, was used during the workshop WKBENTH 2017 (ICES 2017c). It combines data on the distribution and intensity of fishing pressures with the extent and distribution of seabed habitats and their specific sensitivities (OSPAR 2016). Habitat sensitivity is based on resistance and resilience classes of species and habitats, derived from di-

rect evidence of impacts, species traits and ecology or expert judgement, mainly based on Tillin & Tyler-Walters (2014).

A matrix combining pressure intensity and habitat sensitivity results in a classification in ten categories of disturbance (none to very high). Figure 4 shows BH3 estimates in the southern North Sea based on fishing intensities aggregated for the years 2010-2015. Because of the fact, that the underlying sensitivity gradient in the southern North Sea is assumed to be low, the map largely visualises gradients in fishing intensity.

However, all currently available impact models still inherent a certain uncertainty and the improvement of such models is an ongoing process (ICES 2017c).

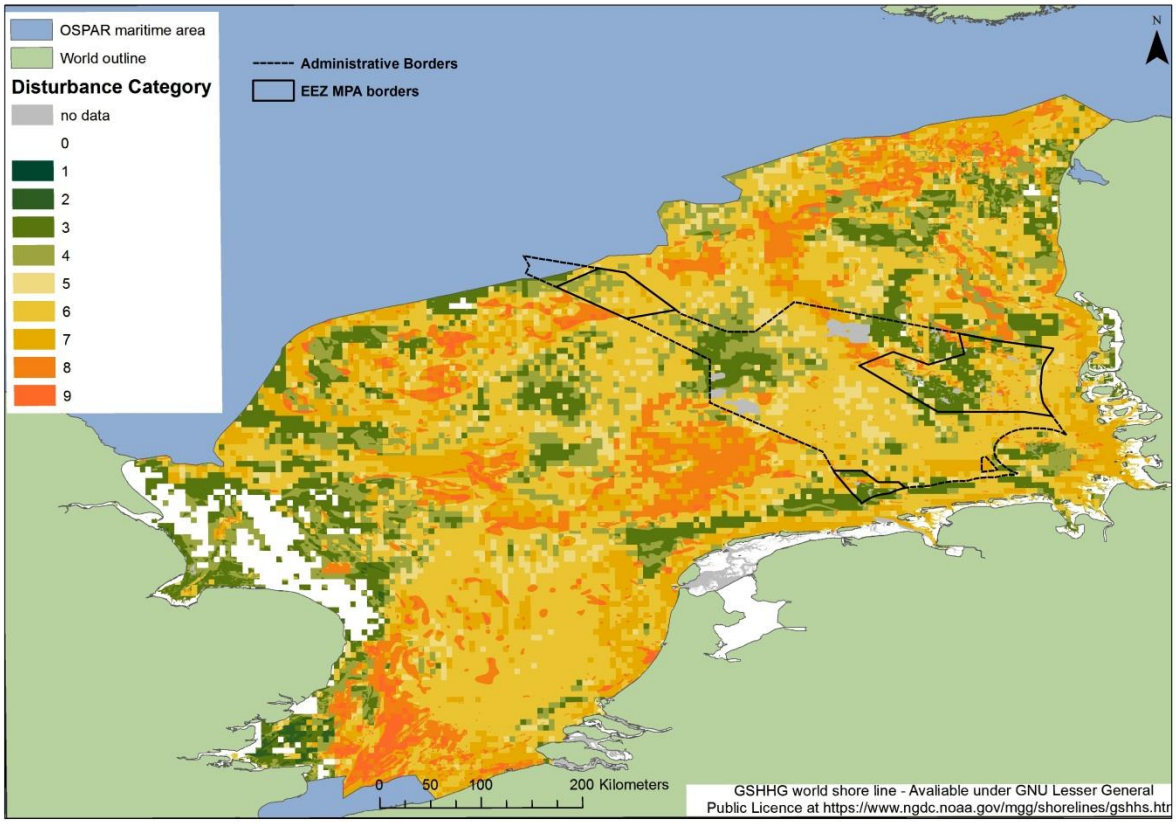

Figure 4: Distribution of disturbance in the southern North Sea, aggregated results (surface and subsurface abrasion) for 2010-2015. German EEZ and Natura 2000 sites are added (BH3 Assessment Sheet, OSPAR 2016)

Although the above described impact models differ in their methodologies, in assessing benthic sensitivity and show local discrepancies in impact estimates the results consistently show potential adverse effects of fishery with all mobile bottom-contacting gear on benthic communities. Further, because benthic communities were characterised on rather coarse spatial scales (usually EUNIS level 3 habitats) and mostly relate to infaunal communities, benthic impacts can be locally more severe than expected.

The impact of individual fishing gears

WKBENTH (ICES 2017c) pointed out the importance of understanding the impact of individual fishing gears on the seabed which was also highlighted in Eigaard et al. (2016). They analysed the interactions of bottom contacting gears including demersal seines (Scottish seines and Danish seines), otter and beam trawls and dredges with the seabed at the level of individual fishing operations. A so-called gear "footprint" was defined as the relative contribution from individual gear components like ground gear, trawl doors and sweeps to the total area and severity of the cumulative impact of each gear. According to Eigaard et al. (2016), beam trawls and dredges are the gear types with the largest proportion of impact at the subsurface level (Figure 5) The demersal seiners showed the largest hourly footprints of the major gear types on the surface level (Eigaard et al. 2016). The estimation of surface and subsurface abrasion represents a step forward for impact assessments and has been used e.g. by WKBENTH (ICES 2017c). It provides the opportunity to give more robust pressure estimates differentiating between gear types. Nevertheless, the actual impact on benthic communities still depends on their sensitivity and cannot be derived from fishing pressure indicators alone. It is thus necessary to combine pressure estimates with habitat types like in the modelling studies described above. However, direct evidence of benthic impacts from experimental trawling is still missing for most gear type/ habitat type combinations and impact estimates thus include a high degree of uncertainty.

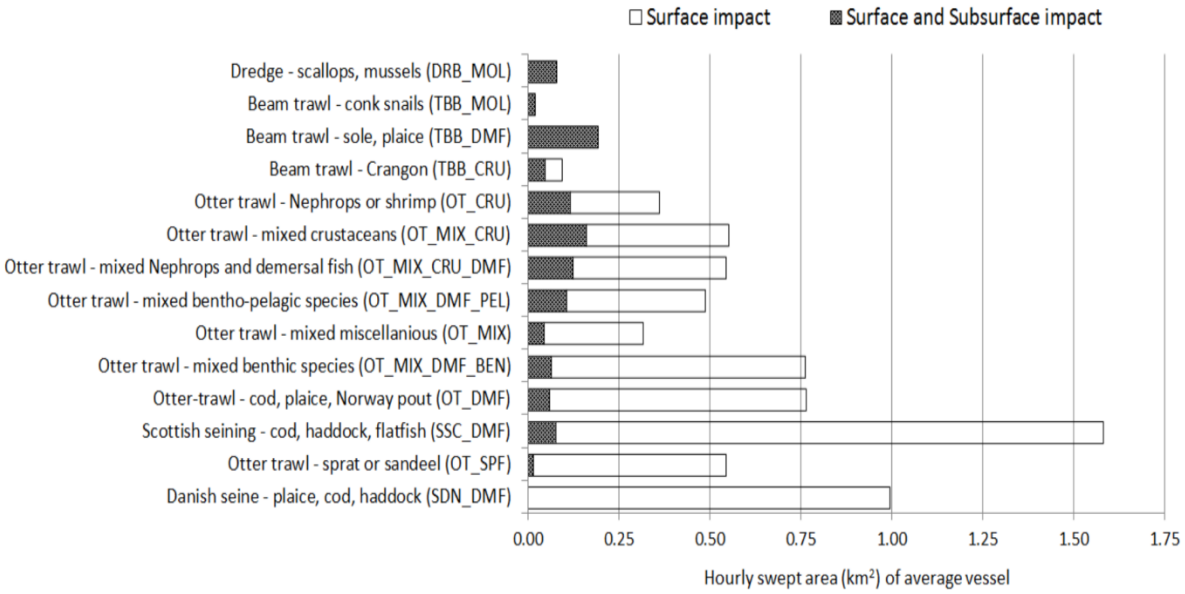

Figure 5: Area of seabed swept in 1 h of fishing with an average-sized vessel with impact at the surface level (white bars), and at both the surface and the subsurface level (black bars) for the 14 BENTHIS metiers (from Eigaard et al. 2016)

Eastwood et al. (2007) showed that demersal trawling had a greater footprint than all other physical pressures, such as wind farms, oil and gas, cables, aggregate extrac-

tion, waste disposal, and fishing, combined in a study assessing direct, physical anthropogenic pressures on the seabed in United Kingdom (UK) waters.
In a recently published study, Hiddink et al. (2017) showed that otter trawls remove 6% of biota per pass and penetrate the seabed on average down to 2.4 cm, whereas hydraulic dredges remove 41% of biota and penetrate the seabed on average 16.1 cm. Median recovery times posttrawling (from 50 to 95% of unimpacted biomass) ranged between 1.9 and 6.4 years. The study based on a global analysis of available data for experimental and comparative studies of trawling impacts.
The different types of towed fishing gear were analysed by Kaiser et al. (2006) and showed strongly habitat-specific effects. Scallop-dredging and otter trawls caused the most severe initial impacts in biogenic habitats. Intertidal dredging showed the most severe initial impacts in sand and muddy sand habitats, followed by beam trawls. Kaiser et al. (2006) also investigated the response of different feeding guilds to disturbance from fishing and showed that both deposit- and suspension-feeders were consistently vulnerable to scallop dredging across gravel, sand and mud habitats. In contrast, different habitat types played a crucial role in the response of these groups to beam-trawling. In particular, the biota of muddy sands were very sensitive to this fishing gear, with predicted recovery times measured in years.

For demersal seines, early studies within the FIMPAS project – pre-assessment of the impact of fisheries on the conservation objectives of Dutch marine protected areas – assumed a relatively low gear-impact of seine fishing for the habitat type 1110 _C (submerged sandbanks) (Deerenberg et al. 2010). The disturbance of the habitat structure was considered as relatively low or hardly relevant because of the nature of the investigated habitat type and relatively light contact of the footrope with the sea bottom. Nevertheless, the authors noted that if benthic structures are present the rope might cause some damage (Deerenberg et al. 2010).
According to results of the EU project BENTHIS (Benthic Ecosystem Fisheries Impact Study) by Rijnsdorp et al. (2015) the biggest impact (largest area of impact) of seine fishing comes from the seine ropes, when they are pulled together in the first phase of fishing operation. Especially when using thick ropes the physical impact is similar to that of the sweeps of a trawl (Rijnsdorp et al. 2015).
According to Eigaard et al (2016) the gear footprint also differs between seine types In the currently available scientific literature, the physical impact of demersal seines on seabed habitats has not been studied. However, the impact of Danish Seines is assumed to be less than for otter trawling since the ground gear is lighter and there are no trawl doors while the impact of Scottish Seines can be characterized as something between bottom trawling and Danish seining. Since Scottish Seiners use larger seine rope diameters (see above) and higher vessel engine power than Danish Seiners, they are able to fish on rougher grounds and thus presumably have a more intensive bottom contact than the Danish Seiners. The analyses of Eigaard et al. (2016) further showed that Scottish seining has the largest overall gear footprint of 1.6 km^2 h-1 but has a relatively small proportion of abrasion at the subsurface level (0,08km^2 sediment penetration ≥ 2 cm). In contrast, the impact of beam trawls for

flatfish at the subsurface level is substantially higher (0.19 km^2 h^{-1}) but the impact of this gear type was comparatively low when assessing overall footprint size per hour.

According to the N2K group (2016) demersal seines have negative physical and biological effects on benthic habitats and communities as a result of contact of gear with the seabed. This contact can result in damage and mortality of benthic organisms, impacts on the abundance of several (target and non-target) fish species and changes in benthic community structure, which may be damaged and/or replaced. The vulnerability of the habitat types sandbank and reefs to all demersal seines has been assessed as “probable” (= the habitat is known to be vulnerable to the fishing method in most instances) by the N2K group (2016).

The biotope type “species-rich gravel, coarse sand and shell-gravel areas” being protected by § 30 of the Federal Nature Conservation Act (see chapter 2.2, 10.1) is particularly sensitive to seine fishing due to its inventory of sessile epifauna-species according to the analysis by BioConsult (2017a), see Annex X.

Conclusion:

In summary, all mobile bottom contacting gears will have an impact on benthic habitats and communities as a result of contact of the gear / ropes with the seafloor. Different fishing gears have different impacts on the seafloor, depending on gear type, deployment and habitat type. While there is a general consensus that the impact of all mobile bottom contacting gears on reefs is detrimental to the conservation status, the available gear-specific habitat sensitivity information and methodology currently is not elaborated enough to allow a final assessment of benthic impacts for all combinations of mobile bottom contacting gear types and benthic habitats with respect to the favourable conservation status and good environmental status. Therefore, following the precautionary principle we have to assume that the use of all mobile bottom contacting gears not only on reefs, but also on sandbanks and species-rich gravel, coarse sand and shell-gravel areas constitutes a significant risk that a favourable conservation status / good environmental status cannot be reached or maintained for these habitats / biotopes,

5.2 Harbour porpoises

Conflict between harbour porpoises and set gillnets and entangling nets

Bycatch Data

The risk of being bycaught in set gillnets and entangling nets poses a particular threat to harbour porpoises (*Phocoena phocoena)* and a number of studies indicates incidences of harbour porpoise bycatches on a regional and global basis (Tregenza

et al. 1995, Kock & Benke 1996, Berggren & Carlström 1999, Northridge & Hammond 1999, Vinther 1999,, Bjørge et al. (2013), Kaschner 2003, Vinther and Larsen 2004, Read et al. 2006, Reeves et al. 2013, Kindt-Larsen et al. 2012, 2016, ICES 2016b). In the course of the EMPAS project, the potential threat to harbour porpoises posed by set gillnets and entangling nets was analysed on the basis of the temporal and geographic distribution of harbour porpoises and these nets (Herr et al. 2009, ICES 2009). The analysis revealed a positive geographic and temporal correlation between the occurrence of harbour porpoises and fisheries activities with gillnets and entangling nets, and a risk potential resulting from this.

Very high rates of by-caught harbour porpoises in set gillnets and entangling nets have been demonstrated yet, e.g. 4,500-7,000 animals/year during the period 1992-98 in the North Sea by Danish fisheries (Vinther 1999). Vinther (1999) showed that high by-catch rates of harbour porpoises occurred in gillnets and entangling nets of cod and turbot fisheries. ICES (2010) examined the bycatch rates in the North Sea collected by observers at sea and calculated lower figures than Vinther (1999). Vinther & Larsen (2004) estimated 2867 - 7566 and 3887 - 7366 harbour porpoise bycatches respectively in the Danish set gillnets and entangling nets fisheries during 1987-2001 in Danish waters using two methods involving extrapolation of observer data. However, it has to be considered that observer data are only sampled on vessels >15m. Bjørge et al. (2013) estimated a bycatch of 20,719 and 20,989 porpoises (results of the two best models; i.e. 6900 harbour porpoise bycatches per year) during 2006–2008 in Norwegian Waters of which approximately 800 per year were from south of 62ºN (Hammond et al (2013). UK gill/tangle net fishing effort in the North Sea generated an estimated average annual bycatch number of 370 porpoises in 2003–2007 (cited in Hammond et al. 2013; http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/biodiversity/documents/indicator/200812m6.pdf).

The ICES WGBYC Report 2015 (ICES 2015) provides an overview of potential bycatch mortality estimates of harbour porpoises in the North Eastern Atlantic. For this purpose, WGBYC has calculated an annual bycatch rate (projections of bycatch rate per day at sea) also for the North Sea including ICES subdivisions VIID and IIIA. Projections yielded an annual bycatch range from 1235 (lower 95% confidence interval CI) to 1990 harbour porpoises (higher 95% CI) in the North Sea - this means that 0.73% of the harbour porpoise population of the North Sea is bycaught if the upper 95% confidence limit bycatch rate and 0,45% if the lower 95% confidence limit bycatch rate is applied. These values are below the limit of 1% established by ASCOBANS exclusively as bycatch limit (ASCOBANS 2016). However, the actual estimates of harbor porpoise bycatch rates for the North Sea are accompanied by a high degree of uncertainty:

- The proportion of observers on vessels fishing with set gillnets and entangling nets is very low, instead monitoring is focused on the trawl fleet, which known to have low bycatch rates (ICES 2015, 2016b).
- Fishing effort data have been reported only by certain member states that have filed reports with the Commission on observation activities conducted under EU Reg. 812/2004. Fishing effort of smaller vessels <10m is not represented (Log book obligation only for vessels >10m, Regulation (EU) No 1224/2009, EU Fisheries Control Regulation) and therefore fishing effort data are likely to be underestimated.
- Method of calculation (days at sea taken as effort of set gillnets and entangling nets fishery) is very uncertain, since it did not consider the wide range of vessel types and métiers and their differences, from small vessels using a few tens or hundreds metres of nets to large vessels fishing many tens of km of netting. Also neither differences between or among vessels that were sampled and those of the fleet as a whole, nor of any spatial heterogeneity nor of any differences in mesh sizes or other important gear characteristics nor soak times have been considered.

The uncertainty of logbook data has been shown in the study of Kindt-Larsen et al (2012): Comparisons between the visual analysis of the REM data and fishers logbooks showed that the REM system delivered more reliable results since fishers did not, in many instances, observe the bycatch while working on the deck because bycaught porpoises dropped out of the net before coming on board (Kindt-Larsen et al. 2012).
In the German EEZ including the Natura 2000 sites, bycatch rates of harbour porpoises in set gillnets and entangling nets are unknown. This is due to the lack of dedicated bycatch studies, lack of effort data of set gillnets and entangling nets fisheries as well as due to the lack of a directed bycatch monitoring program for harbour porpoises, being a problem also in several other EU member states. Bycatch of harbour porpoise is only registered via the regular EU fisheries data collection program DCF, even though mandatory according to Council Regulation EC 812/2004 and also a requirement of Habitats Directive where impacts maybe having a significant negative effect on FCS.

Strandings
The number of harbour porpoises found dead at the German North Sea coast varied between 96 and 225 specimens/year in the period 2004-2014. Since 2011, there has been a continuous increase with a peak value of 225 animals in the year 2012; in total, 1877 dead harbour porpoises have been found at the German North Sea coast in the years 2004-2014 (ASCOBANS National reports). Currently, no estimates concerning the amount of bycaught animals of those strandings exist.

In French, Belgian and Dutch coastal waters harbour porpoise strandings have increased in the last decades (Jauniaux et al. 2008, Haelters and Camphuysen 2009, Haelters et al. 2011). In the Netherlands and in Belgium more than 400 harbour porpoises p.a. were found dead at the coast (Haelters and Camphuysen 2009), 38% of Dutch strandings are suspected to be victims of bycatch (Camphuysen and Siemensma 2011). A recent study on strandings in the Netherlands reported a total of 4,346 animals with a minimum per annum number of 345 in 2008 and a maximum number of 873 in 2013 (Keijl et al. 2016).

Impact of different set gillnets and entangling nets fisheries

Set gillnets and entangling nets targeting different fish species differ in their technical setting like the mesh size, net string length and the net drop and soak time. It is therefore important to analyse the impact of different type of these nets on the bycatch rate of harbor porpoise. Kindt-Larsen et al. (2016) have studied the bycatch of harbour porpoises in Danish set net fishery for cod, hake and plaice. The three set net fisheries showed differences concerning the mesh size, soak time and net string length: The cod fishery used the largest mean mesh size (154 mm) and the hake fishery the smallest (130 mm). Mean soak time was shortest for the hake fishery (6 h) and longest for plaice (12 h). The shortest mean net string length (671 m) was found in the cod fishery and the longest in the plaice fishery (1974 m). Harbour porpoise bycatch was observed in all fisheries monitored in this study, but the bycatch number was highest in the cod fishery. Nevertheless, target species was rejected from the best-fitting model.
The results of the modelling in Kindt-Larsen et al. (2016) showed that bycatches were not distributed evenly but depended on porpoise density and fishing intensity (soak time) in the area. Other studies have likewise shown that longer soak times have a positive correlation with bycatch (Palka et al. 2008, Orphanides 2009). Earlier studies in the North Sea also reported porpoise bycatches in cod, plaice and hake fisheries, but bycatch rates were found to vary in relation to the target species (Vinther 1999).
Beside the above mentioned factors bycatch rate could also be influenced by the drop of the net. A lower drop of a net as often used in the flatfish gillnet fishery should thus reduce bycatch because the probability of entangling in the net should be lower. According to the study of Pfander et al. (2012) conducted in the Baltic Sea in 24 out of 33 investigated cases bycatch occurred in nets with a drop of 1.3 m or lower. Also in Belgian waters sole nets (low net drop) are known to catch harbour porpoises at least occasionally (Haelters and Camphuysen 2009). Vinther (1999) found no bycatch in sole nets, but the available data did not allow to assign this result to properties of the nets like mesh size, soak time, robustness of netting material. The author assessed his result for bycatch in sole fisheries as “too optimistic” i. A. because of the low density of harbor porpoise in the sampling period and area. Furthermore, ef-

fort was relatively modest in the investigated area (i.a. short soak time). Bycatch rate is expected to be higher when sole is fished in a mixed fishery with longer soak times. A possible explanation for bycatch also in set gillnets and entangling netswith a drop of 1.3m or lower is the vertical orientation of harbour porpoises observed in captivity when they are feeding at the bottom (Lockyer et al. 2001, cited in Pfander et al. 2012) - a likely typical behavior in which porpoises direct their echolocation beam into the bottom in order to detect benthic fish which takes place just above the bottom in the reach of any bottom-set net regardless of the drop of the net (Pfander et al. 2012). Wisniewska et al. (2016) showed on the basis of dive profiles and sea-floor echoes of wild harbour porpoises that animals switched between near-surface, pelagic, and benthic foraging during the day but performed primarily pelagic dives at night.
In summary, there is currently no scientific evidence that bycatch of harbour porpoises would only occur in specific types of set gillnets and entangling nets or could be prevented e.g. by the use of low net drop.

Impact of pingers

Pingers in fisheries with set gillnets and entangling nets are used to reduce bycatch levels of harbour porpoises, but also deter porpoises from important habitats designated for their protection. Studies on pingers conducted so far (e.g. Gearin et al. 2000, Cox et al. 2001, Palka et al. 2008, Carretta and Barlow 2011, Dawson et al. 2013, Larsen et al 2013) showed that pingers can be an effective mitigation measure, but bycatch can occur even though they are deployed correctly. The effective range of pingers can vary which depends on e.g. the area, noise level frequency, depth, bottom type and background sound level (see Kindt-Larsen 2015 and cited literature therein).
Thus, less effective pingers results in bycatch and effective pingers means that a certain degree of habitat exclusion has to be expected, especially if pingers are used at high densities in areas of preferred porpoise habitat (Dawson et al. 2013). Carlström et al. (2009) confirmed an effective expulsion up to 500m (average 300m) by investigating the spatial and temporal responses of porpoises to simulated bottom-set nets equipped with periodically operating Dukane NetMark 1000 pingers in two nearby locations in the waters off West Scotland, UK. After a study period of 50 days, habituation was observed at two of nine PODs. Kindt-Larsen (2015) investigated the behaviour of porpoises in relation to two different pinger types (AQUAmark100 and AQUAmark 300) with different acoustic at three different locations and observed clear habituation effects in studies with the AQUAmark 300.
Kyhn et al. 2015 showed a large-scale and long-term expulsion when using pingers (Airmar: 10 kHz tone; SaveWave Black Saver: 30-160 kHz sweep). During the continuous-exposure scenario (pingers were continuously active for 28 days), the detection rate through acoustic data loggers (T-PODS) was reduced by 65% without a sign of habituation. In the control areas (2.5, 3 and 5 km distant), neither a decrease nor

an increase in detection rate was observed, indicating that harbour porpoises were displaced either <2.5 km or >5 km away.

Another problem of pingers is the increased background noise and last but not least the possible high costs of purchasing (and maintaining) the pingers. The increased underwater noise in general is especially harmful for harbour porpoise since this species is particularly sensitive to anthropogenic disturbances (Dähne et al. 2013, Wisniewska et al. 2016). As “aquatic shrews” any prolonged declines or recurrent disruptions in energy acquisition increase the danger of starvation (Wisniewska et al. 2016, van Beest et al. 2017).

In a recent study, van Beest et al (2017) developed a spatially explicit individual-based simulation model (IBM) to assess the effectiveness of two bycatch mitigation measures: pingers (Aquamark100) and seasonal closures for set net fishery implemented in areas and periods with the highest bycatch risk. Both the direct positive effects (i.e., reduced bycatch) and any indirect negative effects (i.e., reduced foraging efficiency) on the population size were analysed using the inner Danish waters as a biological system. The IBM simulation showed that when pingers are widely implemented in a crucial habitat for harbour porpoises, no bycatches occurred but frequent and recurrent deterrence behaviour had a negative impact on foraging success with adverse effects on individual survival and ultimately population size. The simulations was conducted with the assumption that pingers are 100% effective based on the studies of Larsen et al. (2013) and Larsen and Eigaard (2014). The studies revealed a positive effect of seasonal closures for set gillnets and entangling nets on the harbor population. The simulations also show that the negative effect on the population size through pingers has been minimised when pingers have been used together with seasonal fishing closures. Furthermore, the overall positive effect on the population was larger when using both mitigation measures than in the case when the mitigation measures have been used independently (van Beest et al. 2017).

According to van Beest et al. (2017) a widespread application of pingers can interfere with (inter) national conservation strategies due to the negative effects of pinger noise on the porpoise population. According to Article 6(2) of the Habitats directive, disturbance of the species for which the areas have been designated shall be avoided. Hence, for German waters where harbour porpoise have an unfavourable conservation status, the application of underwater noise through active pingers as a large-scale conservation strategy is considered inappropriate for German waters as it will contribute to a further increase in underwater noise levels and disturbance of marine populations that have unfavourable conservation status in those waters (Slabbekoorn et al. 2010, Francis and Barber 2013, Nowacek et al. 2015, van Beest et al. 2017).

Summary and conclusions:

- Whenever there is a geographic and temporal correlation between the occurrence of harbour porpoises and fisheries activities with gillnets and entangling nets, there is a severe risk of bycatch. – even though the use of pingers is obligatory for vessels >12m..
- The estimates on the total bycatch rates of WKBYC (ICES 2015) are below the bycatch limit of 1,0% established by ASCOBANS (2016) but have a high level of uncertainty due to a low number of data (few observers in set net fisheries and missing reports from member states). In addition, neither the fishing effort of small boats (no VMS/no logbook data), nor their bycatch rate is known and therefore not enclosed in these estimations.
- Bycatch rates may differ depending on mesh size, net string length and the net drop and soak time, but there is no indication of a specific set gillnet or entangling net having no bycatch.
- Pingers are used to deter harbour porpoises. If pingers are used in important habitats of harbour porpoises, and these pingers are effective, harbour porpoises will be deterred from using these habitats with negative impacts on individual fitness and ultimately on the conservation status of the population. Less efficient pingers or habituation would show this effect to a lesser extent but would increase bycatch in turn. Hence, pingers should not be implemented in important habitats of harbour porpoise designated for their protection in German waters where this species has an unfavourable conservation status.
- Permanent or seasonal closures of areas for set gillnets and entangling nets with high bycatch risks can have positive effects on population size and therefore may have a beneficial influence the conservation status of harbor porpoise

Risk analysis:

The conflict between harbour porpoise and set gillnets and entangling nets and potential mitigation measures were explained in detail in this chapter.
Though fishing activity with these nets is actually low or zero in the German Nature 2000 sites, this type of fisheries could occur or increase in the future.
There is no reason to assume that the effects described above would be different in the Natura 2000 sites in German waters.
In order to prevent the introduction or intensification of the use of set gillnets and entangling nets, their use will be regulated in order to avoid the deterioration of the conservation status of harbour porpoise in German waters.

According to the latest status report under the Habitats Directive, the conservation status of harbor porpoise in German waters of the North Sea has been assessed as

“unfavourable - inadequate” (see chapter 7). Consequently, measures aimed at improving the conservation status of the harbour porpoise in German waters under the provisions of Article 6(1) of the Habitat Directive must be implemented in the form of management measures under Article 11 and 18 of the CFP basic regulation within German waters.

5.3 Seabirds

Conflict between seabirds and set gillnets and entangling nets

Passive set net fisheries using gillnets and entangling nets represent a major threat to seabirds as the birds may become entangled and drown when diving for prey fish or benthic food (Zydelis et al. 2009, EU Commission 2012: Action Plan Seabirds). Bird species diving for food e.g. red-throated diver, black-throated diver, common guillemot, razorbill, northern gannet and common scoter are particularly at risk of being bycaught in set net fisheries, (Sonntag & Garthe 2010). These species feed on mobile fish species and chase their food underwater in horizontal dives. Moreover, black-throated divers, red-throated divers, common guillemots and razorbills are particularly susceptible to gillnet induced mortality due to their reproductive strategy (Sonntag & Garthe 2010, Sonntag et al. 2012, Zydelis et al. 2013). This strategy depends on adult longevity coupled with a late sexual maturity and a low reproductive rate. Thus, those seabird species have a low ability to buffer additional anthropogenic induced adult mortality. As decreasing bird populations are less prone to recover during periods of improved conditions, factors that increase mortality of adult birds have a strong negative impact on the population dynamics of these species.

As part of the EMPAS project, the intensity of the conflict between the incidence of seabirds and passive fishing gear (in particular gillnets and entangling nets) was determined on the basis of the geographic and temporal overlapping of fishing effort and the distribution of the protected species in the German EEZ and the bordering coastal areas (ICES 2009).

Seabird bycatch in set gillnets and entangling nets is documented in Denmark (common scoter, velvet scoter Durinck et al. 1993; common guillemot and northern fulmar Vinther 1995), in Norway (common guillemot, black guillemot etc. (Follestad & Runde 1995) and in Scotland (common guillemot, razorbill Murray et al. 1994). The findings of a study by Zydelis et al. (2009) indicate, based on of local and small-scale studies, an annual bird by-catch of approximately 100,000 -200,000 birds in the North Sea and the Baltic Sea. The bycatch rate differs between sites and bird species. It has been shown to range from 0.01-0.61 birds/1000 net meter days (NMD, Bellebaum 2011, Bellebaum et al. 2013) to 1.2 birds/1000 NMD (Mentjes & Gabriel 1999) in different locations in the Baltic Sea. As the degree of unintentional underreporting often cannot be estimated, records have to be treated as minimum estimates of actual bycatch rates (Spencer et al. 2001, Bellebaum et al. 2013). Bycatch rate alone may be

a poor measure for impact of gill nets on birds as it is dependent on abundance of birds (Bellebaum et al. 2013). Degel et al. (2010) showed that a combination of bird density and fishing intensity can predict bycatch rates. When taking into account their abundance, red-throated and black-throated divers are particularly vulnerable to being bycaught and appeared to be ten times more vulnerable than the next most vulnerable species (Dagys & Zydelis 2002). Studies have shown that up to approximately 10% of the staging population may be killed due to bycatch (Dagys & Zydelis 2002 & unpubl. data). Ideally, the bycatch rate should be recorded per time (soak time) and net length. These data are not recorded by fishermen, because they are not legally obliged to do so.
Although there may not be sufficient information on the population level effects of bycatch on seabirds yet, studies have clearly shown that seabird bycatch can lead to high mortality, for example up to 10-20% of affected wintering populations (Stempniewicz 1994).

Pingers in general do not constitute a solution to the problem of seabird bycatch (Koschinski & Strempel 2012). Only in the case of common guillemots the use of pingers (of an unknown frequency) lead to a reduction of bycatch by approximately 50%, whereas even in species closely related to the common guillemot no reduction could be detected (Melvin et al. 1999).

6 Proposed measures

Annex III to Regulation (EU) No 1379/2013 of the European Parliament and of the Council of 11 December 2013 on the common organization of the markets in fishery and aquaculture products (OJ L 354, 28.12.2013, p. 1) and the Commission Implementing Regulation (EU) No 404/2011 of 8 April 2011 (OJ L 112, 30.4.2011, p. 1) serve as references for gear classification and gear codes.
The conservation objectives for Sylt Outer Reef, Eastern German Bight, Borkum Reef Ground and Dogger Bank relevant for the proposed fisheries management measures in the Natura 2000 sites in the German EEZ are described under
http://www.bfn.de/0314_nordsee_meeresschutzgebiete+M52087573ab0.html

6.1 Proposed measures for the Natura 2000 sites Sylt Outer Reef & Eastern German Bight

6.1.1 Measure 1: Year-round exclusion of all mobile bottom-contacting gears in two management zones within the central area of the Natura 2000 site Sylt Outer Reef

This measure aims to protect the habitat type 1170 'Reefs' and seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' (Figure 6)

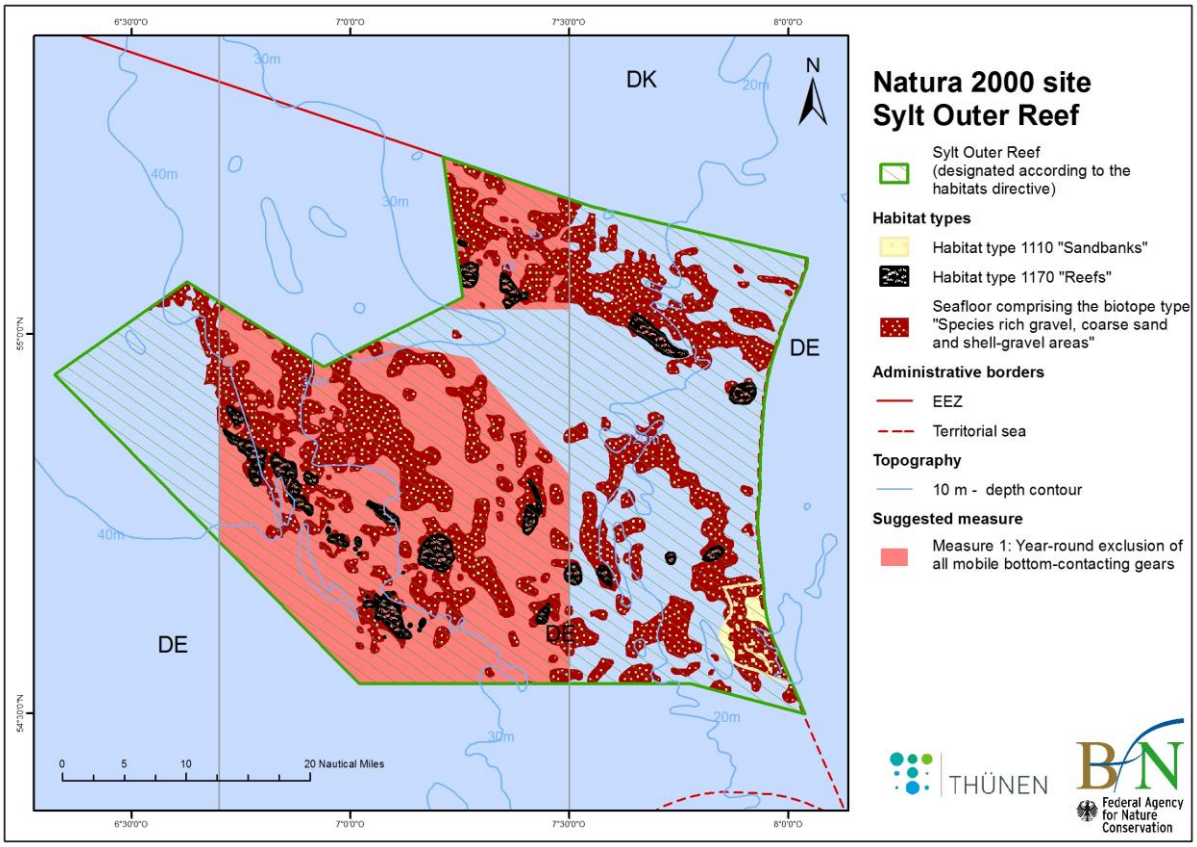

Figure 6: Measure 1: Year-round exclusion of all mobile bottom-contacting gears in two management zones within the central area of the Natura 2000 site Sylt Outer Reef.

This includes the following gear types:

- beach seines SB
- Danish seines SDN
- Scottish seines SSC
- pair seines SPR
- beam trawls TBB
- bottom otter trawls OTB
- bottom pair trawls PTB

- otter twin trawls OTT
- boat dredges DRB
- hand dredges used on board a vessel DRH
- mechanised dredges including suction dredges HMD
- bottom trawls (in general) TB
- nephrops bottom trawls TBN
- shrimp bottom trawls TBS
- seines (unspecified) SX
- boat seines SV

Rationale:

The exclusion of mobile bottom-contacting gears is the most effective management measure to ensure the conservation or restoration of the favourable conservation status of the relevant Natura 2000 habitat types and the good environmental status of the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' according to Annex III Table 1 of Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (OJ L 164, 25.6.2008, p. 19, Marine Strategy Framework Directive, MSFD) (ICES 2008).

Habitats Directive

The measure 1 (Figure 6) aims to reach favourable conservation status of the habitat type reefs and of its typical benthic communities within the Natura 2000 site Sylt Outer Reef

Overall conservation status of the reefs in the Natura 2000 sites in the German EEZ is unfavourable and a favourable conservation status cannot be achieved due to the impact of fisheries with mobile bottom-contacting gears.
For a detailed description of the conservation objectives regarding habitat type1170 ‘reefs’ in the Sylt Outer Reef according to the Habitats Directive see http://www.bfn.de/0314_sylter-aussenriff+M52087573ab0.html.

MSFD

Germany intends to reach progress towards the Marine Strategy Framework Directive targets (MSFD; Directive 2008/56/EC) through the proposed fishery management measures in its EEZ waters (see also chapter 2.2).

An important aim is to improve biological diversity as well as seafloor integrity by reducing fisheries with mobile bottom contacting gears and thus contribute to the obli-

gation of achieving good environmental status under the MSFD. To reach the seafloor integrity (descriptor 6 of the MSFD) Germany defined the following environmental target: “Fishing does not adversely affect the other ecosystem components (non-target species and benthic biocoenosis to such an extent as to jeopardise the achievement or maintenance of their specific good environmental status” (environmental target notified to the European Commission in 2012 pursuant to Article 10 of the MSFD).

The Natura 2000 site Sylt Outer Reef contains major seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel which has been identified as “special habitat type” according to the MSFD, Annex III, table 1. (Appendix, chapter 11.1.1, Figure S1b). This biotope type is characterized by particularly high species diversity shows a special ecological linkage between reefs and sandbanks in the Natura 2000 site (see Appendix, chapter 11.1.1). For maintaining the specific biodiversity value of the area it is necessary to protect a representative set of all occurring benthic biotope types and the close linkage in which they occur rather than single spots of specific biotopes. Protection of representative sets of benthic biotope types in the particular marine areas is a key intention of the MSFD.
Furthermore, the favourable conservation status of habitat type 1170 and its typical species in the Natura 2000-site of the Sylt Outer Reef depends on the good environmental status of the surrounding habitats.

In addition, these management zones support the establishment zones for retreat and resting as one of the “operational environmental targets” for the German North Sea (see chapter 2.3).

Exclusion of all mobile bottom-contacting gear

The assessment of the conflict between benthic habitats and fishing activities in Chapter 5.1 comes to the following result:

Though different types of mobile bottom-contacting fishing gear have different effects on benthic habitats depending on area covered, width, weight, sediment penetration depth and the typical speed at which the associated fishing vessel travels, all mobile bottom contacting will hinder the recovery or maintenance of benthic communities, especially long-living and large epibenthic species. (A detailed analysis is given in chapter 5.1).

In conclusion, benthic habitats and species GES under the MSFD and favourable conservation status under the Habitats Directive, respectively, can only be achieved or maintained by excluding all fishing activities with mobile bottom contacting gears in the proposed management zones.

The measure is limited to the central area of the Natura 2000 site Sylt Outer reef, though the habitat type 1110 Reefs and the seafloor areas comprising the biotope

type 'Species-rich gravel, coarse sand and shell-gravel" is also present in the eastern part of the area.

This spatial limitation is based on the following considerations:

Currently fisheries intensity in the eastern part is much higher than in the central part of the Natura 2000 site. Taking into account that the first trawls have the relative highest negative impact on the conservation status, a closure for mobile bottom contacting gears in the central area will make a much higher contribution to the favourable conservation status than an equivalent effort reduction in the eastern part of the Natura 2000 site (ICES 2009, Schröder et al. 2008, Fock et al. 2011).

Also according to ICES 2017b, spatial management measures that focus on protecting peripheral fishing grounds and replacing effort on the core fishing ground will improve the average conservation status of the seafloor. Consequently, the eastern area has a lower potential to reach the favourable conservation status and its closure would have noticeable economic effects on fisheries and lead to a certain displacement while closing the two management areas in the central part will have a higher potential for achieving a favourable conservation/ good environmental status and will lead to less displacement.

Economic effects of the measure:
Fishing effort and economic value of the excluded gears in the management area is low. The average revenue 2012 – 2016 was about 1 million €/year, which is equivalent to approximately 0.36% of the revenue in FAO subregion 27.4.b (Table 1Table 1). Consequently, the closure of the area for the listed gears will lead to some justifiable displacement. Taking also into account that almost half of the Natura 2000 site Sylt Outer Reef remains open for fisheries the measure is regarded as proportionate (see also Chapter 8).

6.1.2 Measure 2: Year-round exclusion of any kind of fisheries from 25% (northern part) of the area of the "Amrum Bank in the Natura 2000 site Sylt Outer Reef.

This measure aims to protect the habitat types 1110 'Sandbanks' and seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' (Figure 7)

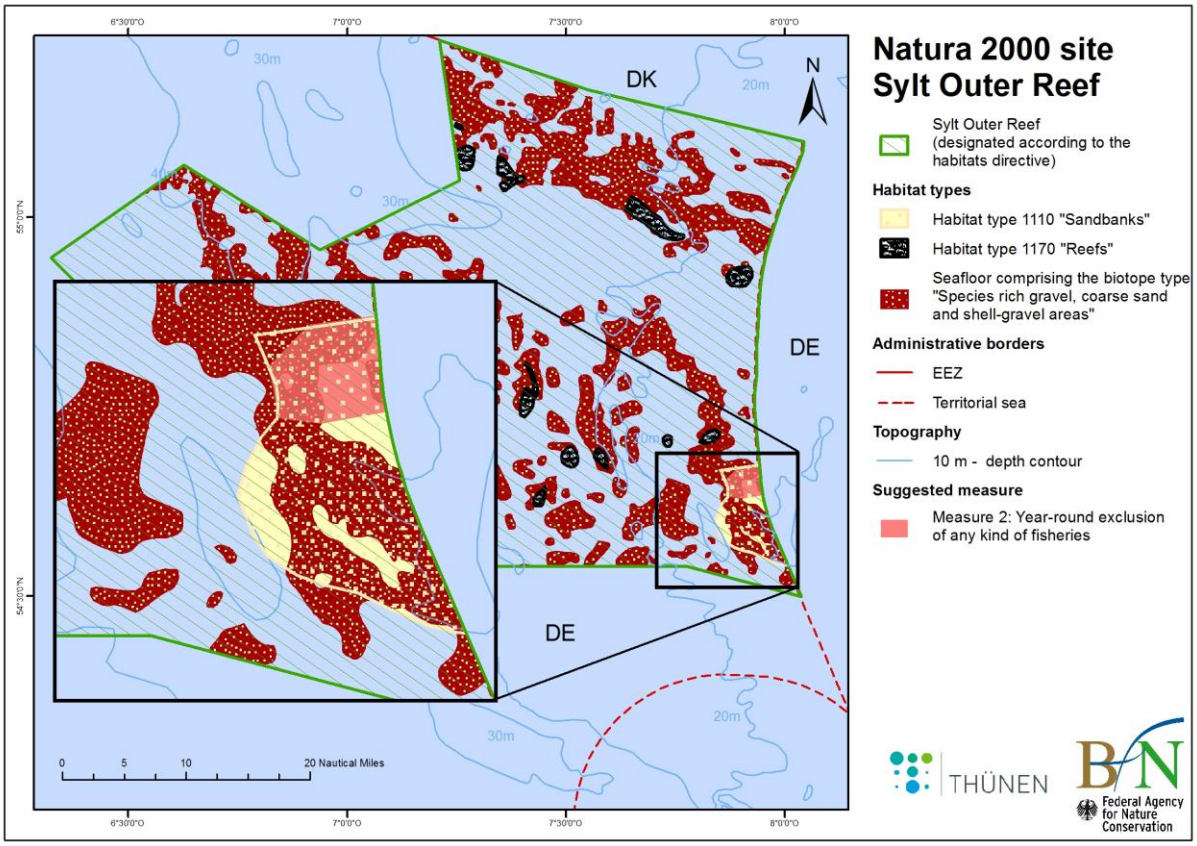

Figure 7: Measure 2: Year-round exclusion of any kind of fisheries from 25% (northern part) of the area of the Sandbank "Amrum Bank" in the Natura 2000 site Sylt Outer Reef (see area marked in red).

Rationale:

As a typical sandbank of the North Frisian marine area, the Amrum Bank is ecologically characterised by a mosaic of various, habitat-typical biotope types with a likewise characteristic diversity of species. For a detailed description of the conservation objectives of the Amrum Bank according to the Habitats Directive see http://www.bfn.de/0314_sylter-aussenriff+M52087573ab0.html

The measure 2 (Figure 7) aims to protect the Amrum Bank (sandbank according to the Habitats Directive) and the benthic biotope type 'Species-rich gravel, coarse sand

and shell-gravel areas' according to the MSFD from any disturbance of any fishing activities.

The measure also establishes a no-take zone, which would serve as an important recovery area for marine organisms and therefore also as an important reference area. To reach GES in the North Sea according to the MSFD, Germany has formulated specific environmental targets (see also chapter 2.3) also regarding no-take zones as follows:

Environmental target 3.1: "There are adequate zones for retreat and resting – as regards both space and periods of time – for ecosystem components. To protect marine life from anthropogenic disturbance, for example, areas and periods of time where fishing is prohibited and/or restricted (no-take zones and no-take times based on the CFP rules) are established (cf. for example, MSFD Recital 39)."

The conservation status of habitat type 1110 is currently assessed as unfavourable bad, mainly due to the quality of the habitat and disturbance of the biological community which result from impacts of bottom contacting gears on the seafloor. Based on the analysis in chapter 5.1 it is assumed that in the Amrum Bank area the favourable conservation status for the habitat type 1110 cannot be reached with ongoing fishing activities and intensities with mobile bottom contacting fishing gear (Schroeder et al. 2008).

Economic effects of the measure:
Although a larger management area would be beneficial to reach the conservation targets of the Habitats Directive and Marine Strategy Framework Directive the closure was limited to 25% of the area for socio-economic reasons since the Amrum Bank is intensively fished (Schulze 2018).
According to Table 1 the average revenue 2012 – 2016 was about 70 thousand €/year, which is equivalent to approximately 0.02% of the revenue in FAO subregion 27.4.b. The closure of the area for the listed gears will only lead to minimal displacement. Therefore, and because 75% of the area will remain open for fisheries the measure is regarded as proportionate (see also Chapter 8)
The effects of the measure will be intensively monitored and its contribution for the achievement of a favorable conservation status will be re-evaluated in the future.

6.1.3 Measure 3: Year-round exclusion of fisheries with set gillnets and entangling nets in the Natura 2000 sites Eastern German Bight and parts of Sylt Outer Reef.

This measure aims to protect the endangered seabird populations (red-throated and black-throated divers, razorbills and guillemots in particular) in the Natura 2000 site Eastern German Bight and harbour porpoises in parts of the Natura 2000 site Sylt Outer Reef (Figure 8).

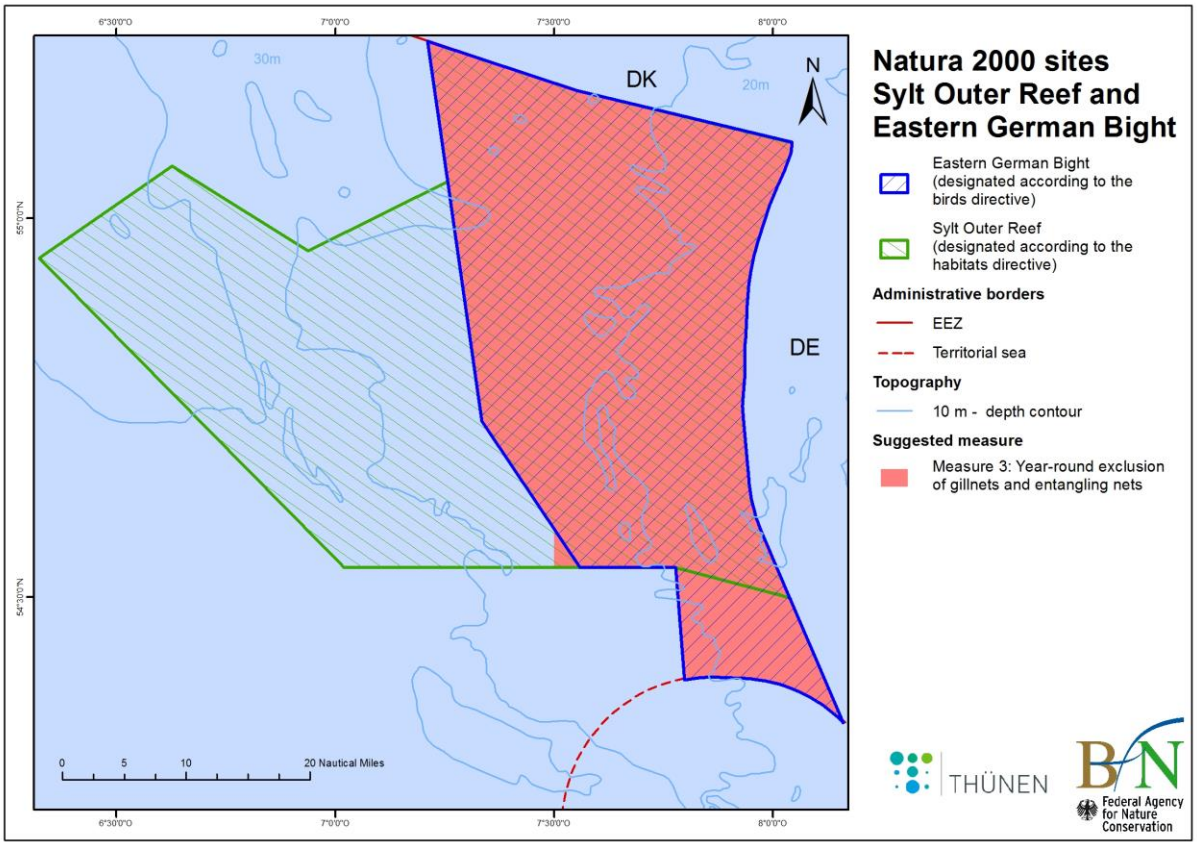

Figure 8: Measure 3: Year-round exclusion of fisheries with set gillnets and entangling nets to protect the endangered seabird populations in the Natura 2000 site Eastern German Bight and harbour porpoises in parts of the Natura 2000 site Sylt Outer Reef.

This includes the following gear types:

- gillnets GN
- set (anchored) gillnets GNS
- driftnets GND
- encircling gillnets GNC
- trammel nets GTR
- combined trammel and gillnets GTN

The measure foresees a geographically and temporally differentiated exclusion of fisheries with set gillnets and entangling nets from the Natura 2000 site Eastern German Bight and parts of the Natura 2000 site Sylt Outer Reef in order to achieve the conservation objectives
(see
http://www.bfn.de/0314_oestliche-deutsche-bucht+M52087573ab0.html) for seabirds and
http://www.bfn.de/0314_sylter-aussenriff+M52087573ab0.html for harbour porpoise).

The year-round closure results from a combination of protection requirements regarding harbour porpoises and seabirds in the German North Sea:

- Northern area of “Eastern German Bight”: Exclusion of fisheries with set gillnets and entangling nets during the winter months from 1 October until 15 May to protect especially the red-throated and black-throated diver populations (red-throated divers in particular), razorbills and guillemots which are particularly susceptible to set gillnet induced mortality due to their reproductive strategy (see chapter 5.3).
- Southern area of “Eastern German Bight”: Year-round exclusion of fisheries with set gillnets and entangling nets to protect the two diver populations (red-throated divers in particular) and auk species during the winter months (October-May) as well as the breeding auk species of Helgoland in summer (June-September).
- Area of Sylt Outer Reef overlapping with “Eastern German Bight”: seasonally exclusion of gillnets and entangling nets from 1 March to 31 October to protect harbour porpoises from by-catch in phases of high animal aggregation including the calving and mating season.
- The combination of these three temporal measures results in an all-year-closure for set gillnets and entangling nets in the area shown in Figure 8.

Rationale:

Currently set gillnets and entangling nets fisheries effort is zero in the Natura 2000 site Eastern German Bight. Therefore, harbour porpoise and sea bird populations are currently not harmed by bycatch mortality.
Aim of the measure is to prevent a possible effort shift in set net fisheries within the Natura 2000 site - i.a. as a consequence of the prohibition of other gears in this area - and to avoid the deterioration of the conservation status of seabirds and harbour porpoise (currently in an unfavourable-inadequate status) in German waters following the precautionary principle. The precautionary principle was applied according to the principles set by the Commission (COM(2000) 1).

The fact that the fishing activity with set gillnets and entangling nets fisheries is actually low cannot justify postponing or failing to take necessary conservation measures

since the status of harbour porpoise in German waters was assessed as "unfavourable-inadequate" in the latest German status report for protected species and habitats under the Habitats Directive for the 2007-2012. Germany is obliged to improve the conservation status of harbour porpoise in its waters and therefore appropriate measures have to be established in German Natura 2000 sites.

Scientific evidence:

Harbour porpoise:
The risk of being bycaught in set gillnets and entangling nets poses a particular threat to harbour porpoises (see chapter 5.2). Dedicated monitoring within the Sylt Outer Reef (conducted annually since 2002, see German monitoring reports https://www.bfn.de/0314_monitoringberichte.html and Gilles et al. 2009, 2011) has shown that the area holds exceptionally high numbers of harbour porpoises compared to other areas in the German EEZ of the North Sea, making it a key site for conservation of the species in the German North Sea. The longtime monitoring and analysis of the distribution of harbour porpoises showed that the species is present throughout the year in the Natura 2000 site Sylt Outer Reef (Gilles et al. 2009, 2014, 2016) and is therefore susceptible to bycatch any time set gillnets and entangling nets fishery is carried out (Herr et al. 2009). Gilles et al. (2016) aggregated dedicated survey data from all German Bight neighbours to develop seasonal habitat-based density models for the harbour porpoise in the region of the central and southern North Sea, where high densities were predicted in the area of the Sylt Outer Reef.
Sylt Outer Reef also has above all an outstanding importance as calving, mating and feeding ground for harbour porpoises in the German North Sea (Gilles et al. 2009). Aggregations with very high local densities and a high proportion of mother/calf pairs (in summer) occur regularly in spring and summer, during calving time and the subsequent mating season May 1st –End of August (Herr et al. 2009, see Appendix, chapter 10.1.2, Figure S2 a-d). However, harbour porpoises are present in the Sylt Outer Reef all year round (Gilles et al. 2014), since it is an important breeding and feeding ground in German waters and mother-calf-pairs are not only present from May-August (calves stay with their mothers for up to 1 year) (Herr et al. 2009, Gilles et al. 2014).
The importance of Sylt Outer Reef was questioned referring to the results of SCANS III, but a large scale survey such as SCANS-III should not be used to draw conclusions for smaller areas, since the survey block crossing the German Bight Block was not designed to survey Sylt Outer Reef and only a fraction of effort was actually within this area. As mentioned above, the regular national marine mammal monitoring is conducted several times each year in the German Natura 2000 sites since 2002. This regular monitoring applies a specific study design tailored to each Natura 2000 site and provides the basis for the proposed fisheries management measures and also includes the presence of mother-calf-pairs.

Seabirds:
There is a national nature conservation ordinance in place for the Eastern German Bight bird protection area (Ordinance issued by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety on 15 September 2005 on the establishment of the Eastern German Bight Nature Conservation Area; Federal Law Gazette Part I, p. 2782).
Passive set-net fisheries using gillnets and entangling nets represent a major threat to seabirds as the birds may become entangled and drown when diving for prey fish or benthic food (see Chapter 5.3). Red-throated diver, black-throated diver, common scoter, common guillemot, razorbill and northern gannet occur in significant numbers (see chapter 11.1.3) in the SPA Eastern German Bight and its surrounding waters, leading to the designation of the SPA. Data were obtained from a seabird monitoring scheme performed on behalf of the Federal Agency for Nature Conservation (BfN) (e.g. Markones et al. 2014, 2015) and from other research programmes.
The Natura 2000 site Eastern German Bight is the most important wintering area for red-throated and black-throated divers (*Gavia stellata & G. arctica*) in the entire German EEZ in the North Sea (more details: see Appendix, chapter 11.1.3, Figure S3, but also in spring high numbers of divers (*Gavia stellata & G. arctica*) have been documented in the Natura 2000 site. Other gillnet-sensitive species, such as auks (*Uria aalge & Alca torda*), show main occurrence in the Natura 2000 site in autumn and winter, Common Scoters (*Melanitta nigra*) in winter and Northern Gannets (Sula bassana) in spring and summer (see chapter 11.1.3, FTZ unpubl. data).

So far, there are no published studies available on the bycatch of birds in set gillnets and entangling nets in the Eastern German Bight and in the whole German North Sea (Sonntag & Garthe 2010) due to the fact that there is no bycatch monitoring program for seabirds as well as due to the low fishing effort with these nets in the SPA. However, there are several bycatch studies from adjacent waters (see chapter 5.3).
According to the EU Birds Directive, the contracting parties are obliged to prevent deterioration of the conservation features. Thus, Germany is legally obliged to prevent deterioration of seabird populations in the SPA Eastern German Bight. The negative effects of set gillnets and entangling nets on the species present in the German protected areas have been demonstrated in several studies in adjacent waters and there is no reason to assume that the effects would be different in the German protected areas. The fact that the fishing activity with these nets is actually low in these areas cannot justify postponing or failing to take necessary conservation measures since this type of fisheries could occur or increase in the future. Consequently, set gillnets and entangling nets shall be regulated to avoid a deterioration of the conservation status by seabird bycatch of the above-mentioned vulnerable species (see conservation objectives https://www.bfn.de/0314_oestliche-deutsche-bucht+M52087573ab0.html).

Proportionality:

- The Natura 2000 site currently is characterised by the absence of fishing intensity with set gillnets and entangling nets in 2013-2016 (Table 1). Therefore, the potential loss of value due to the fishing restrictions will be practically zero and so will be the displacement of fisheries. Given the importance of the Natura 2000 site for gillnet-sensitive harbour porpoises and seabirds the closure of this type of fishery is the only option to prevent deterioration of conservation objectives by preventing a potential future introduction of set net fishery and the resulting bycatch risks for harbour porpoises and seabirds.
- The proposed measures apply to all fishermen and will be constantly reviewed in the light of scientific developments, i.e. results of monitoring and available new scientific data.

Therefore, the measure is regarded as proportionate (see also Chapter 8 and Schulze 2018).

6.1.4 Measure 4: Seasonal exclusion of fisheries with set gillnets and entangling nets from the western part of the Natura 2000 site Sylt Outer Reef during the period 1 March–31 October

This measure aims to protect harbour porpoises in the Natura 2000 site Sylt Outer Reef (Figure 9)

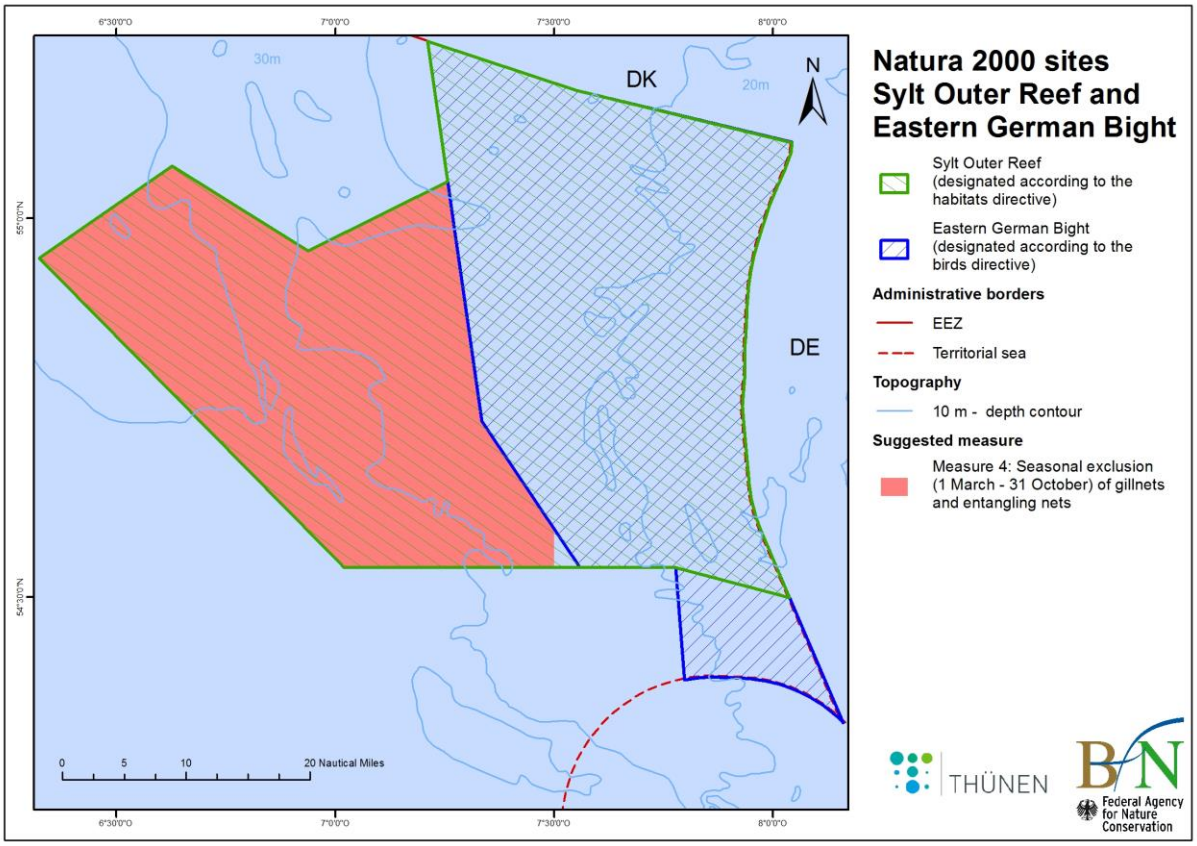

Figure 9: Measure 4: Seasonal exclusion of fisheries with set gillnets and entangling nets from the western part of the Natura 2000 site Sylt Outer Reef during the period 1 March–31 October to protect harbour porpoises.

This includes the following gear types:

- gillnets GN
- set (anchored) gillnets GNS
- driftnets GND
- encircling gillnets GNC
- trammel nets GTR
- combined trammel and gillnets GTN

Rationale:

Measure 4 (Figure 9) aims to protect harbour porpoises from by-catch in set gillnets and entangling nets from 1 March to 31 October (phase of high animal aggregation including the calving and mating season).

The measure corresponds to Measure 4 but is limited to the protection of harbour porpoise only.

Economic effects of the measure:

According to Table 1 the average revenue 2012 – 2016 was about 600 €/year, which is equivalent to approximately 0.01% of the revenue in FAO subregion 27.4.b. The closure of the area for the listed gears will only lead to minimal displacement. Therefore, the measure is regarded as proportionate (see also Chapter 8)

Rationale, scientific evidence, scientific uncertainty and risk evaluation, potential consequences of inaction, participation, proportionality, displacement and economic effects **see measure 3**

6.2 Proposed measures for the Natura 2000 site Borkum Reef Ground

6.2.1 Measure 5: Year-round exclusion of all mobile bottom-contacting gears from the entire Natura 2000 site Borkum Reef Ground

This measure aims to protect the habitat types 1110 'Sandbanks' and 1170 'Reefs' and seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' (Figure 10)

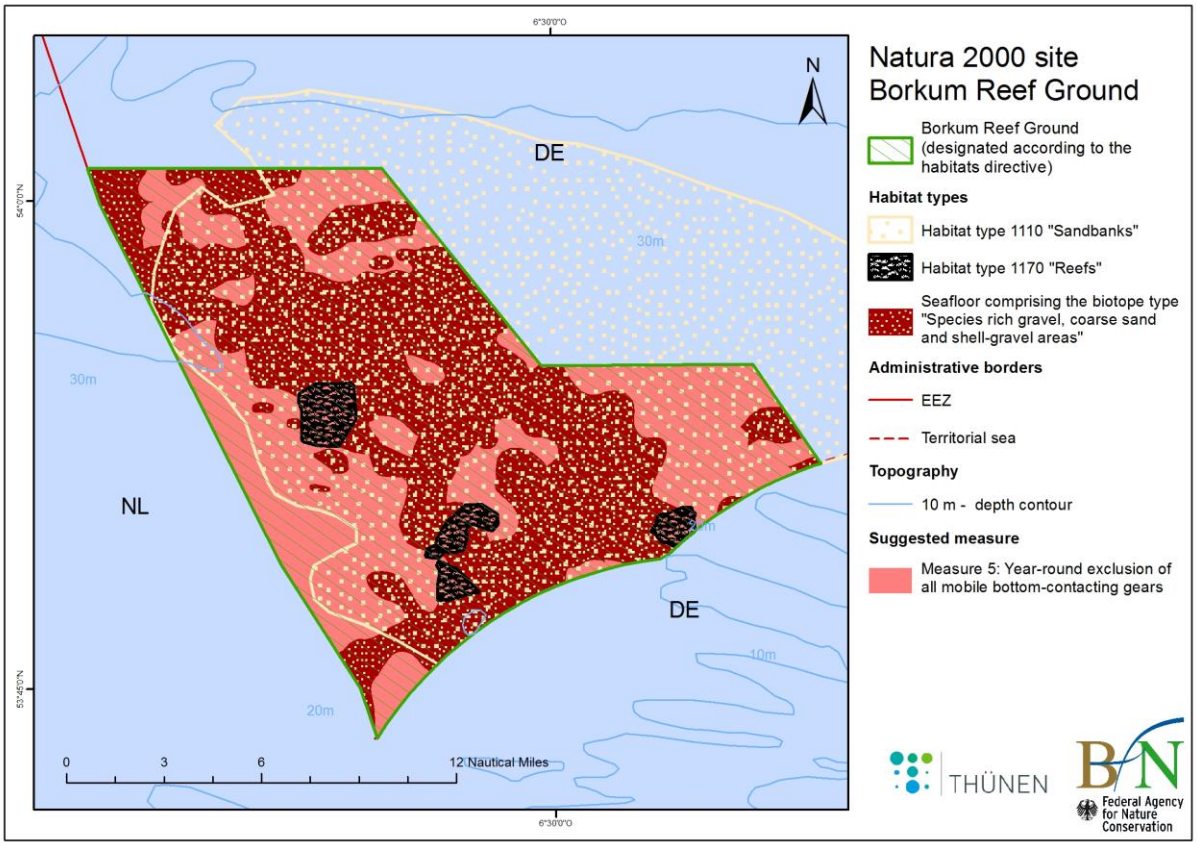

Figure10: Measure5: Year-round exclusion of all mobile bottom-contacting gears from the entire Natura 2000 site Borkum Reef Ground .

This includes the following gear types:

- beach seines SB
- Danish seines SDN
- Scottish seines SSC
- pair seines SPR
- beam trawls TBB
- bottom otter trawls OTB
- bottom pair trawls PTB
- otter twin trawls OTT
- boat dredges DRB

- hand dredges used on board a vessel DRH
- mechanised dredges including suction dredges HMD
- bottom trawls (in general) TB
- nephrops bottom trawls TBN
- shrimp bottom trawls TBS
- seines (unspecified) SX
- boat seines SV

Rationale:

Measure 5 (Figure 10) aims to provide efficient protection of the habitat types reefs and sandbanks in the Natura 2000 site Borkum Reef Ground under the Habitats Directive, and of seafloor areas comprising the benthic biotope type 'Species-rich gravel, coarse sand and shell-gravel areas', and of their benthic communities, against the negative impact of mobile bottom-contacting gears. Conservation objectives according to the Habitats Directive regarding sandbanks and reefs are described under http://www.bfn.de/0314_borkum-riffgrund+M52087573ab0.html.
The complex habitat and substrate structure with mosaic-like sandbank and reef structures and the species-rich benthic communities specifically adapted to those conditions in the Natura 2000 site Borkum Reef Ground have been described in several studies (Figge 1981; Rachor & Nehmer 2003).

Habitats Directive
The Natura 2000 site Borkum Reef Ground includes significant and representative occurrences in the German North Sea of the habitat types sandbank and reef listed in Annex I of the Habitats Directive (92/43/EEC). Recent data show that they are closely interlinked with seafloor areas comprising the biotope type `Species-rich gravel, coarse sand and shell-gravel areas" (see Appendix 11.1.1, Figure S1b).
The parts of the sandbank (habitat type 1110) within the SCI encompass areas distinguished by an increasingly diverse substrate and habitat structure and a species-rich bottom fauna characteristic of that structure. The central part additionally includes the characteristic epibenthic communities of the scattered reefs (habitat type 1170). The presence of a large number of Red List species demonstrates the site's ecological importance (see Appendix 11.1.1).
The sandbank, reefs and the species-rich benthic communities specifically adapted to the conditions in the Natura 2000 site Borkum Reef Ground form a interlinked complex, which should be protected as one unit to achieve a favourable conservation status for habitat type 1170 and 1110.

MSFD

Germany also intends to reach progress towards the Marine Strategy Framework Directive targets (MSFD; Directive 2008/56/EC) through the proposed fishery management measure 6 in its EEZ waters.

An important aim is to improve biological diversity as well as seafloor integrity by reducing fisheries with mobile bottom contacting gears and thus contribute to the obli-

gation of achieving good environmental status under the MSFD. To reach the seafloor integrity (descriptor 6 of the MSFD) Germany defined the following environmental target: “Fishing does not adversely affect the other ecosystem components (non-target species and benthic biocoenoses) to such an extent as to jeopardise the achievement or maintenance of their specific good environmental status” (environmental target notified to the European Commission in 2012 pursuant to Article 10 of the MSFD).

The key intention of the MSFD is to protect a representative set of all occurring benthic biotope types in the particular marine area, thus the protection of the closely interlinked complex of the biotope types reef, sandbank and seafloor areas comprising `Species-rich gravel, coarse sand and shell-gravel areas´ contributes to the implementation of MSFD in the German North Sea.

Exclusion of all mobile bottom-contacting gear

Results from the currently available studies provide clear evidence that ongoing bottom trawling activities in Borkum Reef Ground will hamper full recovery of benthic communities, especially long living and sessile, colonial epifauna species (see chapter 5.1).

For maintenance of the specific biodiversity value of the area it is necessary to protect a representative set of the occurring benthic biotope types in the entire particular marine areas and the mosaic in which they occur rather than single spots of specific biotopes.
The exclusion of all mobile bottom-contacting fisheries is the most effective management measure to ensure the conservation or restoration of the favourable conservation status of the relevant habitat types in the Natura 2000 site Borkum Reef Ground (ICES 2009).
Overall, only a small portion of the occurring habitat types H1110 und H1170 in the German EEZ of the North Sea is proposed to be closed for mobile bottom-contacting gear.

Economic effects of the measure:
Fishing effort and economic value in the management area is comparably low, according to Table 1 the average revenue 2012 to 2016, was about 33 thousand€/year, which is equivalent to approximately 0.01% of the revenue in FAO subregion 27.4.b. The closure of the area for the listed gears will also lead only to minimal displacement. Therefore, the measure is regarded as proportionate (see also Chapter 8).

The fact that the fishing activity with bottom trawling fisheries is comparably low cannot justify postponing or failing to take necessary conservation measures since this type of fisheries could increase in the future, e.g. because of the exclusion of other gear types in the area or its surroundings.

6.3 Proposed measures for the Natura 2000 site Dogger Bank

6.3.1 Measure 6: Year-round exclusion of mobile bottom-contacting gears in a part of the Natura 2000 site "Doggerbank"

Measure 6, aimed at protecting the habitat type 1110 'Sandbanks', is discussed within the scope of the work of the Dogger Bank Steering Group (DBSG), which is composed of representatives from the EU Member States United Kingdom, the Netherlands and Germany. It will be presented to the Scheveningen Group as part of a "Joint recommendation" for all Natura 2000 sites on the Dogger Bank drafted by Germany, the Netherlands and the United Kingdom. The measure is mentioned here for information purposes only and is not part of this Joint Recommendation.

6.4 Joint measure for the Natura 2000 sites Dogger Bank & Borkum Reef Ground

6.4.1 Measure 7: Limitation of fishing effort with passive gears (gillnets and entangling nets) to the average effort of the last 6 years before the coming into force of the corresponding delegated act. in the Natura 2000 sites Borkum Reef Ground and Dogger Bank.

This measure aims to protect harbour porpoises

This includes the following gear types:

- gillnets GN
- set (anchored) gillnets GNS
- driftnets GND
- encircling gillnets GNC
- trammel nets GTR
- combined trammel and gillnets GTN

The fishing effort with gillnets and entangling nets is limited to the average intensity of the period the last 6 years before the coming into force of the corresponding delegated act. To this end, the Member States report to the competent German fisheries authority (BLE) following data: the fishing effort of their vessels in accordance with Article 14(2) and (5), Article 27(1) and Article 111(1) of Regulation (EU) No 1224/2009 to allow for the calculation of the fishing effort in fishing days, duration of the fishing trip, and mesh size and dimension used for the respective geographical location. During a transitional period of three years, the precise values for the fishing effort will be compared with the data provided by the Vessel Monitoring System

(VMS;VMS obligation for vessels ≥12m, Regulation (EC) No 1224/2009) and a reference value for the 6 years period determined. This reference value will be published by the BLE three years after the entry into force of this provision. If the threshold value is exceeded in the following years, the Member States will be informed by the BLE and will then ensure compliance with this measure in accordance with Art. 26 of Regulation (EC) No 1224/2009.

Rationale:

Dogger Bank

In the Natura 2000 site Dogger Bank, harbour porpoises are mainly present during the spring and summer months (March – August) in densities above the averages of the German North Sea showing the importance of the site for harbour porpoise in German waters (Herr et al. 2009, Gilles et al. 2016). The importance of the Dogger Bank area in general for harbour porpoise was documented in several studies (Gilles et al. 2012, Hammond et al. 2013, Geelhoed et al. 2014, Gilles et al. 2016, Cucknell et al. 2016).

In this area, gillnets and entangling nets are primarily used during the second half of the year (June – December) The precise level of by-catch risk for harbour porpoises posed by fisheries using gillnets and entangling nets in the Natura 2000 site Dogger Bank cannot, at present, be conclusively assessed.

Borkum Reef Ground

The harbour porpoise population in the southern part of the German North Sea was analysed with the help of regular aerial survey data from the period 2002-2015. Monitoring results of the Federal Agency for Nature Conservation (BfN) show that harbour porpoise densities in spring (March – May) in the southern German North Sea during the period 2008-2015 were higher than during the period 2002-2007 (Peschko et al. 2016, Appendix, chapter 11.1.2, Figure S2a-d). In addition, it was documented that the Natura 2000 site Borkum Reef Ground was increasingly used by mother/calf pairs in summer between 2008 and 2012 (Viquerat et al. 2015; Peschko et al. 2016). Absolute densities are lower than those in the Natura 2000 site Sylt Outer Reef (Appendix, chapter 11.1.2, Figure. S2a-d).

Economic effects of the measure:

Doggerbank and Borkum Reef Ground are areas with a significant presence of harbour porpoises (see Chapter 4.3).

According to Table 1 the average revenue in Borkum Reef Ground 2012 – 2016 was about 500 €/year, which is equivalent to less than 0.01% of the revenue in FAO subregion 27.4.b, the average revenue on the Dogger Bank 2012 – 2016 was about 100 thousand €/year, which is equivalent to approximately 0,86% of the revenue in FAO subregion 27.4.b.

The limitation of fishing effort in these areas for the listed gears will lead to no displacement. Therefore, the measure is regarded as proportionate (see also Chapter 8)

Because these areas are of a lesser importance for harbour porpoise than the Natura 2000 site Sylt Outer Reef, this proposal abstains from banning gill nets from the area. Nevertheless, it is regarded as necessary to avoid the emergence (Borkum Reef Ground) or further intensification (Doggerbank) of the already existing conflict between conservation of harbour porpoises and set net fisheries by freezing the fishing effort with gillnets and entangling nets in the two Natura 2000 sites.

The fact that the fishing activity with set gillnets and entangling nets fisheries is actually low cannot justify postponing or failing to take necessary conservation measures since the status of harbour porpoise in German waters was assessed as “unfavourable-inadequate” in the latest German status report for protected species and habitats under the Habitats Directive for the 2007-2012. Germany is obliged to improve the status of harbour porpoise in its waters and therefore appropriate measures have to be established in German Natura 2000 sites.

There will be no displacement of fisheries, as fisheries are allowed to be continued as in the years before.

7 Control and enforcement

7.1 Basis

Effective controls aimed at the successful implementation of the proposed fisheries measures (see Chapter 6.4) are absolutely necessary to achieve the conservation objectives in the marine Natura 2000 sites in the German EEZ in the North Sea. Fisheries control and monitoring measures must be suitable and ensure that all fishing activities in a Natura 2000 site are recorded and reported to the competent authority (BLE).

The control and monitoring measures in the German Natura 2000 sites are carried out by the Federal Office for Agriculture and Food (BLE). Under Section 2(6) of the Sea Fisheries Act, the Federal Agency for Nature Conservation (BfN) is to be involved when it comes to determining the type and scale of the measures to monitor compliance with fisheries regulations. The following specific strategies for the control and monitoring of Natura 2000 sites will be laid down and introduced at the same time the protected areas become effective.

The provisions of Regulation (EU) No 1224/2009 (EU Fisheries Control Regulation) shall apply to all fishing vessels intending to enter into or transit through the specific fishing restricted areas laid down in chapter 5.

Transit through a fishing restricted area within the Natura 2000-sites is allowed for all fishing vessels that are not authorised to fish in these areas subject to the following conditions:

a. all gears carried on board are lashed and stowed during the transit; and

b. the speed during transit is not less than six knots except in case of force majeure or adverse conditions. In such cases, the master shall immediately inform the fisheries monitoring centre of the flag Member State which shall then inform the competent authorities of the coastal Member State.

Compliance with the requirements is controlled by the BLE by evaluating the VMS data (see 6.2) and the electronic logbook data on the fishing gear used that have been transmitted in accordance with Regulation (EC) No 1224/2009, as well as by on-the-spot monitoring (e.g. with ships) and inspections of catches, catch records and fishing gear.

If a vessel has been recorded in a Natura 2000 site, an activity analysis is carried out on the basis of the existing data. If it is suspected that fishing vessels do not comply with the applicable fisheries measures in the relevant area, on-the-spot controls are to be carried out on board of the vessels. In addition, vessel owners can be contacted in order to inform them about the conservation measures in Natura 2000 sites or to announce official measures.

The basic principles of a successful implementation of the conservation measures in the Natura 2000 sites include control and monitoring measures and the dialogue with the relevant professional groups and their representatives. The control and monitoring measures are therefore regularly checked for effectiveness and suitability and adapted to the requirements of the Common Fisheries Policy and the relevant nature conservation directives.

7.2 VMS

In accordance with Article 50(3) of Regulation (EC) No 1224/2009, the VMS signal rate is to be increased to once every 10 minutes within the marked fishing restricted areas (Figure 11). This rate is sufficient for the current VMS analysis models.

An alarm zone is established around the fishing restricted areas. In order to ensure that the reporting interval has in fact been decreased by the time the fishing vessel enters the protected area, the competent fisheries authority of the relevant Member State establishes an appropriate 4-nm alarm zone. Upon entry into the alarm zone,

the VMS reporting frequency is to be increased to 10-minute intervals which is then to be maintained as long as the vessel remains in the fishing restricted area and in the alarm zone.
The following data are to be transmitted:

a. position
b. date and time
c. heading
d. speed
e. external identification mark of the fishing vessel

The competent fishing authority is informed on the entry into, and exit from the alarm zone.

Fishing within the alarm zone is not subject to restrictions.
All fishing vessels entering the alarm zone or the fishing restricted area must be equipped with an appropriate VMS system. It is not allowed to enter such areas without this equipment. Both the fishing gear carried on board and fishing gear used are recorded in the electronic logbook.

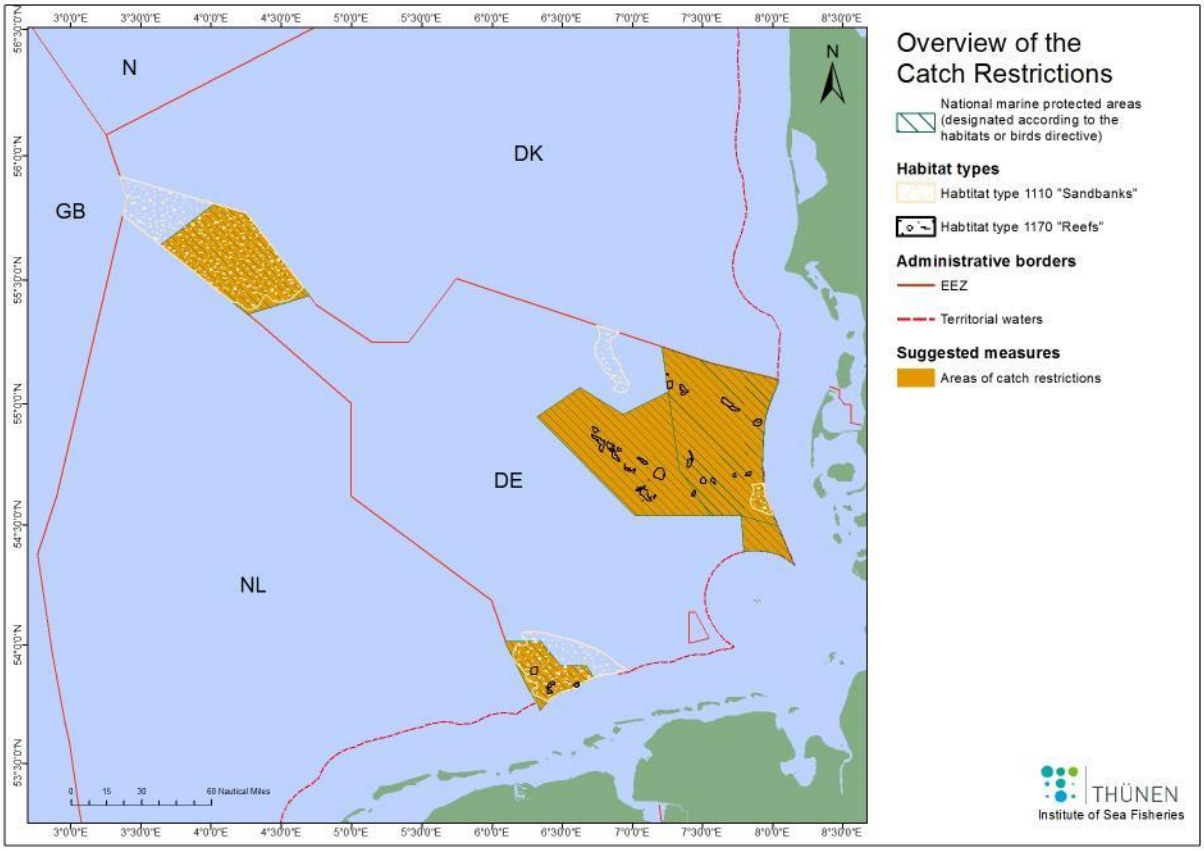

Figure11: Natura 2000 sites with fishing restricted areas in the German EEZ in the North Sea

8 Evaluation of the appropriateness of the proposed measures

The German status report for protected species and habitats under the Habitats Directive for the 2007-2012 reporting period[4] shows that the protected species and habitats in the marine Atlantic biogeographic region (MATL) are in an unfavourable state (Table 2).

Table 2: Overview of the conservation status of selected Natura 2000 habitats and species of the German EEZ in the North Sea (Atlantic biogeographic region)

Habitat / Species	Conservation status 2007-2012
Habitat type 1110	Bad conservation status, stagnating (U2 - unfavourable-bad)
Habitat type 1170	Bad conservation status, unknown trend (U2)
Harbour porpoise	Unfavourable conservation status (U1- unfavourable-inadequate)

The relevant reports on the bird populations monitored under the Birds Directive also show negative (all tern species) or stagnating trends (all diver species)[5].
On account of the most recent assessment (2007-2012 reporting period) of the relevant protected species and habitats in the German EEZ in the North Sea, fisheries measures are required to improve the conservation status of species and habitats. According to the Habitats Directive, improving the conditions in the designated Natura 2000 sites is the most important instrument to achieve a favourable conservation status for the habitat types 'Reefs' and 'Sandbanks'. In order to achieve this favourable conservation status, the Habitats Directive provides that any interference shall be subject to a cumulative assessment of its implications for the site. But the assessment of the implications for the site under the Habitats Directive does not apply to commercial fisheries in the EEZ as these are governed within the framework of the Common Fisheries Policy. As a consequence, measures aimed at improving the conservation status under the provisions of Article 6(1) of the Habitats Directive must be implemented in the form of management measures under Articles 11 and 18 of the CFP Basic Regulation.
The proposed measures are therefore necessary and appropriate in order to achieve a favourable conservation status for the species and habitats in the German EEZ in the North Sea.

Taking account of the socio-economic aspects, preferably areas with relatively low fishing activities have been chosen for the proposed fisheries management

[4] https://circabc.europa.eu/sd/a/dcb49f6a-543c-4f4d-b0af-5ec6597decfc/DE_20140528.pdf

[5] http://www.bfn.de/fileadmin/MDB/documents/themen/monitoring/Ueberwinterer_bestand_trend_barrfrei.pdf

measures or, if this was not possible, areas were limited to the smallest reasonable size in relation to the conservation goals.
As a result measured effort and revenue in the management areas is low (see Schulze 2018).
Therefore, potential losses should be easily compensable outside the management areas and the closure of these areas for the listed gears will also lead only to minimal displacement
The closure of the areas for specific gears will substantially contribute to the FCS and GES of the area and will affect fisheries only marginally.
The measures are therefore considered as proportionate."

9 Estimation of potential displacements of fisheries activities

9.1 Changes as a result of the measures

According to the analysis of the international fishing activities (Schulze 2018) Measures 3, 4 and 7 will lead to a very small displacement of fishing effortonly. This is because the measures 3 and 4 affect the current (2012-2016) fishing activities only to a very small amount (Table 1B) and measure 7 does not change the set net fishery activity at all.

Regarding all other measures (mobile bottom contacting gears) the analysis shows that commercial fisheries with fishing gears regulated by this joint recommendation only operate with low intensity in the management areas.
It can therefore be assumed that these measures in total will only lead to minor displacements of commercial fisheries activities.
Because the selection of the Natura 2000-sites as well as the selection of the management areas was based on their ecological quality, it is regarded as highly improbable that the displacement of the low actual effort with mobile bottom contacting gears present in the management areas into the surrounding areas could have a negative effect on the conservation status of habitats and species.

10 References

ASCOBANS 2016: ASCOBANS Resolution 8.5: Monitoring and Mitigation of Small Cetacean Bycatch. 8th Meeting of the Parties to ASCOBANS, Helsinki, Finland, 30 August - 1 September 2016

Barlow, J., Cameron, G. A. 2003. Field experiments show that acoustic pingers reduce marine mammal bycatch in the California drift gill net fishery. Marine Mammal Science, 19 (2), 265-283.

Bellebaum, J., Diederichs, A., Kube, J., Schulz, A. & Nehls, G. (2006): Flucht- und Meidedistanzen überwinternder Seetaucher und Meeresenten gegenüber Schiffen auf See. Ornithologischer Rundbrief für Mecklenburg-Vorpommern 45, Sonderheft 1: 86-90.

Bellebaum, J. (2011): Untersuchung und Bewertung des Beifangs von Seevögeln durch die passive Meeresfischerei in der Ostsee. BfN-Skripten 295: 79 pp.

Bellebaum J, Schirmeister B, Sonntag N, Garthe S (2013) Decreasing but still high: Bycatch of seabirds in gillnet fisheries along the German Baltic coast. Aquatic Conservation: Marine and Freshwater Ecosystems 23: 210-221.

Berggren, P. & Carlström, J. (1999). Estimating the size of porpoise bycatch in the Skagerak and Kattegatt seas. In: Harwood, J. (Eds.) Assessment and reduction of the bycatch of small cetaceans in European waters (BY-CARE). NERC Sea Mammal Research Unit, St. Andrews

Bergman M. J., Ubels S. M., Duineveld G. C. A. & Meesters E. W. G. (2015): Effects of a 5-year trawling ban on the local benthic community in a wind farm in the Dutch coastal zone. ICES Journal of Marine Science: Journal du Conseil, Oxford University Press. 72: 962-972.

BfN (2010). Environmentally Sound Fisheries Management in Marine Protected Areas (EMPAS) in Germany. Naturschutz und Biologische Vielfalt: 92. Federal Agency for Nature Conservation, Bonn. 302p.

BfN (2011): Artenreiche Kies-, Grobsand- und Schillgründe im Meeres- und Küstenbe-18 reich. Definition und Kartieranleitung Kies-, Grobsand- & Schillgründe. Stand Ok-19 tober 2011. 5 S. download: https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Marine-Biotoptypen/Biotoptyp-Kies-Sand-Schillgruende.pdf

BioConsult (2017a) Are “species-rich gravel, coarse sand and shell layers” within the Natura 2000-site “Sylt Outer Reef” sensitive to seine fishing?
Download:
http://www.bfn.de/fileadmin/BfN/meeresundkuestenschutz/Dokumente/Bioconsult-sensitivity-epifauna-KGS-Seines-2017-04-23.pdf

BioConsult (2017b) : Survey of suspected areas of the § 30 biotop type “species-rich gravel, coarse sand and shell layers
Download:
http://www.bfn.de/fileadmin/BfN/meeresundkuestenschutz/Dokumente/KGS-SAR-2016-2017-01-31.pdf

Bjørge, A., Skern-Mauritzen M., and Rossman, M.C. (2013). Estimated bycatch of harbour porpoise (Phocoena phocoena) in two coastal gillnet fisheries in Norway, 2006–2008. Mitigation and implications for conservation. Biological conservation 161: 164-173.

Boedecker, D., Krause, J. & Nordheim, v.H. (2006). Interpretation, indentification and ecological assessment of Natura 2000 habitats "sandbanks" and "reefs". In: Nordheim, v.H., Boedecker, D. & Krause, J. (Eds.) Progress in Marine Conservation in Europe. Springer, Berlin, Heidelberg: 263 p.

Bolam SG, et al. (2017) Differences in biological traits composition of benthic assemblages between unimpacted habitats. Mar Environ Res 126:1–13.

Bradshaw C, Collins P, Brand AR (2003) To what extent does upright sessile epifauna affect benthic biodiversity and community composition? Marine Biology 143:783–791

Bremner J, Frid CLJ, Rogers SI (2003) Assessing marine ecosystem health: the long-term effects of fishing on functional biodiversity in North Sea benthos. Aquat Ecosyst Health Manag 6:131–137

Callaway R., Engelhard G. H., Dann J., Cotter J., Rumohr H. (2007): A century of North Sea epibenthos and trawling: comparison between 1902-1912, 1982-1985 and 2000. Mar Ecol Prog Ser 346:27-43.

Camphuysen, C. J., and Siemensma, M. L. (2011). Conservation plan for the Harbour Porpoise Phocoena phocoena in The Netherlands: towards a favourable conservation status. NIOZ Royal Netherlands Institute for Sea Research.

Carlström J., Per Berggren P., Tregenza N. J.C. (2009): Spatial and temporal impact of pingers on porpoises. Canadian Journal of Fisheries and Aquatic Sciences, 2009, 66 (1), 72-82, 10.1139/F08-186

Choi, J. S., T. F. Kenneth, C. L. William, and K. Drinkwater. 2004. Transition to an alternate state in a continental shelf ecosystem. Canadian Journal of Fisheries and Aquatic Sciences 61:505–510.

Collie JS, Escanero GA, Valentine PC (1997) Effects of bottom fishing on the benthic megafauna of Georges Bank. Mar Ecol Prog Ser 155:159–172

Collie JS, Escanero GA, Valentine PC (2000) Photographic evaluation of the impacts of bottom fishing on benthic epifauna. ICES J Mar Sci 57:987–1001

Cook, R., Fariñas-Franco, J.M., Gell F.R., Holt R.H., Holt T., et. al. (2013). The Substantial First Impact of Bottom Fishing on Rare Biodiversity Hotspots: A Dilemma for Evidence-Based Conservation. PloS one, 8(8)

Craeymeersch J. A., Piet G. J., Rijnsdorp A. D. & Buijs J. (2000): Distribution of macrofauna in relation to the micro-distribution of trawling effort. In: Effects of fishing on non-target species and habitats: biological, conservation and socio-economic issues: 187-197. Eds. M.J. Kaiser & S.J de Groot. Blackwell Science, Oxford.

Crain C., Kroeker K. & Halpern B. D. (2008): Interactive and cumulative effects of multiple human stressors in marine systems. Ecology Letters, 11: 1304–1315. Comment on van Denderen et al. (2015) 4

Cucknell, A., Boisseau, O., Leaper, R., Mclanaghan, R., & Moscrop, A. (2016). Harbour porpoise (Phocoena phocoena) presence, abundance and distribution over the Dogger Bank, North Sea, in winter. Journal of the Marine Biological Association of the United Kingdom, 1-11. doi:10.1017/S0025315416000783

Dagys, M. & Žydelis, R. 2002. Bird bycatch in fishing nets in Lithuanian coastal waters in wintering season 2001-2002. Acta Zoologica Lituanica 12: 276-282.Dähne, M., Gilles,

A., Lucke, K., Peschko, V., Adler, S., Krügel, K., Sundermeyer, J., Siebert, U. (2013). Effects of pile-driving on harbour porpoises (Phocoena phocoena) at the first offshore wind farm in Germany. Environmental Research Letters 8: 025002 doi:10.1088/1748-9326/8/2/025002

Dare, P.J. (1982) Notes on the swarming behaviour and population density of Asterias rubens L. (Echinodermata: Asteroidea) feeding on the mussel, Mytilus edulis L. Journal du Conseil, Conseil International pour l'Exploration de la Mer, 40, 112–118.

Dawson, S., Northridge, S.P., Waples, D., Read, A., 2013. To ping or not to ping: the use of active acoustic devices in mitigating interactions between small cetaceans and gillnet fisheries. Endang. Species Res. 19, 201-221.

Degel H, Petersen IK, Holm TE, Kahlert JA. 2010. Fugle som bifangst i garnfiskeriet: Estimat af utilsigtet bifangst af havfugle i garnfiskeriet i området omkring Ærø. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet, Charlottenlund, Denmark. (DTU Aqua-rapport; 227–2010).

Dierschke, V., Furness, R. W. & Garthe, S. (2016): Seabirds and offshore wind farms in European waters: Avoidance and attraction. Biological Conservation 202: 59-68.

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.

Durinck, J., Christensen, K.D., Skov, H. & Danielsen, F. (1993). Diet of the common scoter Melanitta nigra and velvet scoter Melanitta fusca wintering in the North Sea. Ornis Fennica 70: 215-218.

Eigaard, O.R., Bastardie, F., Breen, M., Dinesen, G.E., Hintzen, N.T., Laffargue, P., Mortensen, L.O., Nielsen, J.R., Nilsson, H.C., O Neill, F.G., Polet, H., Reid, D.G., Sala, A., Skold, M., Smith, C., Sorensen, T.K., Tully, O., Zengin, M., and Rijnsdorp, A. D. (2016). Estimating seabed pressure from demersal trawls, seines, and dredges based on gear design and dimensions. – ICES Journal of Marine Science, doi: 10.1093/icesjms/fsv099.

Figge (1981). Sedimentverteilung in der Deutschen Bucht - Karte Nr. 2900.

Fock, H.O. (2011). Integrating multiple pressures at different spatial and temporal scales: a concept for relative ecological risk assessment in the european marine environment. Human and Ecological Risk Assessment 17: 187–211.

Fock, H.O., Kloppmann, M., and Stelzenmüller, V. (2011). Linking marine fisheries to environmental objectives: a case study on seafloor integrity under European maritime policies. Environmental Science & Policy, 14: 289-300.

Follestad, A. & Runde, O. (1995). Sjøfugl og fiskeredskaper: gjenfunn av ringmerkede fugler (Seabirds and fishing gears: recoveries of ringed birds). NINA Oppdragsmelding 350: 1-26.

Francis, C. D., and J. R. Barber. (2013). A framework for understanding noise impacts on wildlife: an urgent conservation priority. Frontiers in Ecology and the Environment 11:305–313.

Freeman, S.M., Seed, R. & Richardson, C.A. (in press) Seasonal abundance, spatial distribution, spawning and growth of Astropecten irregularis (Echinodermata: Asteroidea). Estuarine and Coastal Shelf Science.

Garthe S. (2003). Erfassung von Rastvögeln in der deutschen AWZ von Nord- und Ostsee. Abschlussbericht für das BfN. Büsum: 68 p.

https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Forschungsberichte/Erfassung_Rastvoegel_Nord_u_Ostsee_2002.pdf

Garthe, S., Sonntag, N (2004). Erfassung von Meeressäugetieren und Seevögeln in der deutschen AWZ von Ost- und Nordsee (EMSON): Teilvorhaben Seevögel. Zwischenbericht für das BfN. Büsum. 35p. https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Forschungsberichte/EMSON_Seevoegel_Zwischenbericht_2004.pdf

Garthe, S. (2006). Indentification of areas of seabirds concentrations in the German North Sea and Baltic Sea unsing aerial and ship-based surveys. In: Nordheim, v.H., Boedecker, D. & Krause, J. (Eds.) Progress in Marine Conservation in Europe. Springer, Berlin, Heidelberg: 263 p.

Garthe, S., N. Sonntag, P. Schwemmer, & V. Dierschke (2007): Estimation of seabird numbers in the German North Sea throughout the annual cycle and their bio-geographic importance. Vogelwelt 128: 163-178.

Garthe, S., Markones, N. & Sonntag, N. (2010). Protected areas in German offshore waters: designation, retrospective consideration and current perspectives. In: (Eds.) 1st World Seabird Conference, September 2010, Victoria, Kanada.

Garthe, S., Schwemmer, H., Markones, N., Müller, S. & Schwemmer, P. (2015). Verbreitung, Jahresdynamik und Bestandsentwicklung der Seetaucher *Gavia spec*. in der Deutschen Bucht (Nordsee) Vogelwarte 53, 121 – 138

Geelhoed, S. C. V., R. S. A. van Bemmelen, and J. P. Verdaat. 2014. Marine mammal surveys in the wider Dogger Bank area summer 2013. IMARES Report (no. C016/14) for Department for Environment, Food and Rural Affairs and Ministry of Economic Affairs, 27 pp. http://edepot.wur.nl/293005

Gilles, A., Scheidat, M., Siebert, U. (2009). Seasonal distribution of harbour porpois-es and possible interference of offshore wind farms in the German North Sea. Marine Ecology Progress Series 383: 295-307

Gilles, A. & Siebert, U. (2010). Marine Säugetiere und Seevögel in der deutschen AWZ von Nord- und Ostsee - Teilbericht marine Säuger: 56 p.: Forschungs- und Technologiezentrum Westküste und Deutsches Meeresmuseum.

Gilles, A., V. Peschko, M. Scheidat, and U. Siebert (2012). Survey for small cetaceans over the Dog- ger Bank and adjacent areas in summer 2011. ASCOBANS working paper, AC19/Doc.5-08, 13 pp. http://tinyurl.com/j7xwene

Gilles, A., Viquerat, S. & Siebert, U. (2014). Monitoring von marinen Säugetieren 2013 in der deutschen Nord- und Ostsee. Bericht für das BfN. https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Monitoringberichte/BfN-Monitoring-Marine-Saeugetiere-2012-2013-barrierefrei.pdf

Gilles, A., Adler, S., Kaschner, K., Scheidat, M., Siebert U. (2011). Modelling harbour porpoise seasonal density as a function of the German Bight environment: im-plications for management. Endangered Species Research 14: 157-169

Gilles, A., Viquerat, S., Becker, E.A., Forney, K.A., Geelhoed, S.C.V., Haelters, J., Nabe-Nielsen, J., Scheidat, M., Siebert, U., Sveegaard, S., van Beest, F.M., van Bemmelen, R., Aarts, G. (2016). Seasonal habitat-based density models for a marine top predator, the harbor porpoise, in a dynamic environment. Ecosphere 7(6):e01367. doi: 10.1002/ecs2.1367.

Haelters, J. & C.J. Camphuysen (2009). The harbour porpoise (Phocoena phocoena L.) in the southern North Sea: abundance, threats, research and management proposals. Report. Royal Belgium Institute of Natural Sciences (RBINS/MUMM) / the Royal Netherlands Institute for Sea Research (NIOZ).

Haelters,J.,Kerckhof,F.,Jacques,T.G.,Degraer,S.,2011. The harbour porpoise (*Phocoena phocoena*) in the Belgian part of the North Sea:trends inabundance and distribution. Belg.J.Zool.141,75–84.

Hammond, P. S., Macleod, K., Berggren, P., Borchers, D. L., Burt, L., Cañadas, A., Desportes, G., Donovan, G. P., Gilles A., Gillespie, D. & Gordon, J. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation, 164, 107-122.

Hammond, P. S., Lacey, C , Gilles, A., Viquerat, S., Börjesson, P., Her,r H., Macleod, K., Ridoux, V., Santos, MB, Scheidat, M., Teilmann, J., Vingada, J., Øie, N. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys

Herr H., Fock H.O., Siebert U. (2009). Spatio-temporal associations between Harbour porpoise (Phocoena phocoena) and specific fisheries in the German Bight. Biol Conserv.;142: 2962–2972.

Hiddink, J.G., Jennings, S., Kaiser, M.J., Queirós, A.M., Duplisea, D.E. & Piet, G.J. (2006). Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats. Can. J. Fish. Aquat. Sci. 63: 721-736.

Hill, R., Hill, K., Aumüller, R., Boos, K. & Freienstein, S. (2014): „Testfeldforschung zum Vogelzug am Offshore-Pilotpark alpha ventus“ und „Auswertung der kontinuierlich auf FINO1 erhobenen Daten zum Vogelzug der Jahre 2008 bis 2012“. StUKplus-Enbericht (FKZ 0327689A/Avitec1 und Avitec2). Avitec Research, Osterholz-Scharmbeck

Hinz, H., Prieto, V., Kaiser, MJ (2009). Trawl disturbance on benthic communities: chronic effects and experimental predictions.Ecological Applications, 19(3), pp. 761–773

ICES (2009). Report of the EMPAS project (Environmentally Sound Fishery Management in Protected Areas) 2006-2008. Copenhagen: ICES.

ICES (2010). Report of the ICES Advisory Committee, 2010. ICES Advice, 2010. Books 1 - 11. 1, 56-57.

ICES 2015. Report of the Working Group on Bycatch of Protected Species (WGBYC), 2-6 February 2015, ICES Headquarters, Copenhagen, Denmark. ICES CM 2015\ACOM:26. 82 pp.

ICES (2016). Report of the Workshop on guidance on how pressure maps of fishing intensity contribute to an assessment of the state of seabed habitats (WKFBI), 31 May–1 June 2016, ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:46. 109 pp.

ICES. (2016b). Working Group on Bycatch of Protected Species (WGBYC), 1–5 February 2016, ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:27. 82 pp.

ICES. 2017a. Report of the Working Group on the Ecosystem Effects of Fishing Activi-ties (WGECO), 5–12 April 2017, Reykjavik, Iceland. ICES CM 2017/ACOM:26. 104 pp.

ICES 2017b Report of the Workshop to evaluate trade-offs between the impact on sea-floor habitats and provisions of catch/value (WKTRADE), 28–31 March 2017, Copenhagen, Denmark. ICES CM 2017/ACOM:42. 109 pp.

Jauniaux, T., Berguerie, H., Camphuysen, K., Daoust, P.-Y., Drouguet, O., Ghisbain, T., Garcia-Hartmann, M., Grondin, A., Haelters, J., Jacques, T., Kiszka, J., Leopold, M., Pezeril, S., Schnitzler, J., Coignoul, F. (2008). Causes of Death of Harbour Porpoises (Phocoena phocoena) Stranded on the Continental Coastline of the Southern North Sea (Belgium, France, and Dutch Coasts) between 1990 and 2007. ICES CM 2008/D:09. ICES, Copenhagen, Denmark.

Jennings, S., Dinmore, T.A., Duplisea, D.E., Warr, K.J. & Lancaster, J.E. (2001). Trawling disturbance can modify benthic production processes. Journal of Animal Ecology 70 (3): 459-475.

Kaiser M. J., Ramsay C. A., Richardson C. A., Spence F. E. & Brand A. R. (2000): Chronic fishing disturbance has changed shelf sea benthic community structure. J Anim Ecol 69:494– 503.

Kaiser, M.J., Clarke, K.R., Hinz, H., Austen, M.C.V., Somerfield, P.J. & Karakassis, I. (2006). Global analysis of response and recovery of benthic biota to fishing. Mar. Ecol. Prog. Ser. 311: 1-14.

Kaschner, K. (2003). Review of small cetacean bycatch in the ASCOBANS area and adjacent waters – current status and suggested future actions: 122 p.

Kindt-Larsen, L., Dalskov, J., Stage, B., Larsen, F., 2012. Observing incidental harbour porpoise Phocoena phocoena bycatch by remote electronic monitoring. Endang. Species Res. 19, 75–83

Kindt-Larsen (2015). Management of fisheries in harbour porpoise (Phocoena phocoena) marine protected areas. PhD Thesis. DTU Aqua Technical University of Denmark

Kindt-Larsen, L., Berg, C.W., Tougaard, J.,Sørensen,T.K., Geitner, K., Northridge, S., Sveegaard, S., Larsen, F. (2016) Identification of high-risk areas for harbor porpoise Phocoena phocoena bycatch using remote electronic monitoring and satellite telemetry data. Mar Ecol Prog Ser 555: 261–271.

Kock, K.H. & Benke, H. (1996). On the by-catch of harbour porpoise (Phocoena phocoena) in German fisheries in the Baltic and the North Sea. Arch. of Fish. Res. 44 (1-2): 95-114.

Koschinski, S. & Strempel, S. (2012): Strategies for the Prevention of Bycatch of Seabirds and Marine Mammals in Baltic Sea Fisheries. 69 pp. 19th ASCOBANS Advisory Committee Meeting, Galway, Ireland, 20-22 March 2012.

Krause, J., Boedecker, D., Backhausen, I., Heinicke, K., Groß, A. & Nordheim, v.H. (2006). Rational behind site selection for the Natura 2000 network in the German EEZ. In: Nordheim, v.H., Boedecker, D. & Krause, J. (Eds.) Progress in Marine Conservation in Europe. Springer, Berlin, Heidelberg: 263 p.

Kröncke I. (1995): Long-term changes in North Sea benthos. Senckenbergiana maritima 26:73-80.

Kröncke I. (2011). Changes in Dogger Bank macrofauna communities in the 20th century caused by fishing and climate. Estuarine, Coastal and Shelf Science. 94: 234-245.

Kyhn, L. A., Jørgensen, P. B., Carstensen, J., Bech, N. I., Tougaard, J., Dabelsteen, T., & Teilmann, J. (2015). Pingers cause temporary habitat displacement in the harbour porpoise *Phocoena phocoena*. *Marine Ecology Progress Series*, *526*, 253–265. http://doi.org/10.3354/meps11181

Lambert, G. I., Jennings, S., Kaiser, M. J., Davies, T. W., Hiddink, J. G. (2014). Quantifying recovery rates and resilience of seabed habitats impacted by bottom fishing. Journal of Applied Ecology 51, 1326-1336.

Larsen, F., Krog, C., Eigaard, O.R., 2013. Determining optimal pinger spacing for harbour porpoise bycatch mitigation. Endangered Species Research 20, 147-152.

Larsen, F., and O. R. Eigaard. 2014. Acoustic alarms reduce bycatch of harbour porpoises in Danish North Sea gillnet fisheries. Fisheries Research 153: 108–112.

Laurer, W.-U., Naumann, M., Zeiler, M. (2013). Sedimentverteilung auf dem Meeresboden in der deutschen Nordsee nach der Klassifikation von FIGGE (1981). - (Geopotential Deutsche Nordsee; http://www.gpdn.de/gpdn/wilma.aspx?pgId=307&WilmaLogon ActionBehavior=Default)

Lindeboom, H.J. & de Groot, S.J. (1998) The Effects of Different Types of Fisheries on the North Sea and Irish Sea Benthic Ecosystems. Netherlands Institute of Sea Research,Texel.

Markones, N., Guse, N., Borkenhagen, K., Schwemmer, H. & Garthe, S. (2014). Seevogel-Monitoring 2012/2013 in der deutschen AWZ von Nord- und Ostsee. Bericht für das BfN, Vilm.77p. https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Monitoringberichte/BfN-Monitoring-Seevoegel-2012-2013-barrierefrei.pdf

Markones, N., Guse, N., Borkenhagen, K., Schwemmer, H., & Garthe, S. (2015). Seevogel-Monitoring 2014 in der deutschen AWZ von Nord- und Ostsee. Bericht für das BfN, Vilm. http://bfn.de/fileadmin/BfN/meeresundkuestenschutz/Dokumente/Berichte-zum-Monitoring/BfN-Monitoring-Seevoegel-2014-2015-barrierefrei.pdf

Melvin, E.F., Parrish,J.K. & Conquest, L.L. (1999). Novel Tools to Reduce Seabird Bycatch in Coastal Gillnet Fisheries. Conservation Biology 13(6): 1386-1397.

Mentjes, T. & Gabriel, O. 1999. Fangtechnische Möglichkeiten zur Reduzierung des Beifangs von Meeresenten in der Dorschfischerei mit stationären Fanggeräten. Informationen für die Fischwirtschaft aus der Fischereiforschung 46: 36–41.

Murray, S., Wanless, S. & Harris, M.P. (1994). The effects of fixed salmon Salmo salar nets on guillemot Uria aalge and razorbill Alca torda in northeast Scotland in 1992. Biol. Conserv. 70: 251–256.

N2K group (2016) Overview of sensitivity, interactions and impact of commercial fishing methods on marine habitats and species protected under the EU habitats directive" requested by the European Commission" http://ec.europa.eu/environment/nature/natura2000/marine/docs/Fisheries%20interactions.pdf).

Northridge, S.P. & Hammond, P.S. (1999). Estimation of porpoise mortality in gill and tangle net fisheries in the North Sea. Scientific Committee at the 51st Meeting of the International Whaling Commission, Grenada, IWC, SC/51/SM42.

Nowacek, D. P., C. W. Clark, D. Mann, P. J. Miller, H. C. Rosenbaum, J. S. Golden, M. Jasny, J. Kraska, and B. L. Southall. (2015.) Marine seismic surveys and ocean noise: time for coordinated and prudent planning. Frontiers in Ecology and the Environment 13:378–386

OSPAR (2008): Case Reports for the OSPAR List of Threatened and/or Declining Species and Habitats. OSPAR Commission, London.

OSPAR (2016). IA2017 Common Indicator Assessment Sheet for BH3 – Extent of Physical damage to predominant and special habitats. Version of 06 October 2016. OSPAR Commission London

Palka, D.L., Rosmann, M.C., Vanatten, A., Orphanides, C.D., 2008. Effect of pingers on harbour porpoise (Phocoena phocoena) bycatch in the US Northeast gillnet fishery. J. Cetacean Res. Manage. 10, 217-226.

Pearson T. H. & Rosenberg R. (1978): Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanogr. Mar. Biol. Ann. Rev. 16:229-311.

Pedersen, S.A., Fock, H., Krause, J., Pusch, C., Sell, A.L., Böttcher, U., Rogers, S.I., Sköld, M., Skov, H., Podolska, M., Piet, G.J. & Rice, J.C. (2008). Natura 2000 sites and fisheries in German offshore waters. ICES Journal of Marine Science Advance Access: 1-15.

Perrin, W.F., Donovan, G.P., Barlow, J. (1994). Cetaceans and Gillnets. International Whaling Commission IWC, Cambridge. Special Issue 15. IWC, Cambridge.

Pesch, R., Pehlke, H., Jerosch, K., Schröder, W., Schlüter, M. (2008). Using decision trees to predict benthic communities within and near the German Exclusive Economic Zone (EEZ) of the North Sea. Environmental monitoring and assessment, 136: 313-325.

Peschko, V., Ronnenberg, K., Siebert, U., Gilles, A. (2016) Trends of harbour porpoise (Phocoena phocoena) density in the southern North Sea. Ecological Indicators 60:174-183.

Peterson CH, Summerson HC, Fegley SR (1987) Ecological consequences of mechanical harvesting of clams. Fish Bull 85:281–298

Pfander, A., Benke, H., Koschinski, S. (2012). Is limiting gillnet drop a management perspective for the protection of cetaceans in SACs? Paper submitted to the 19th Meeting of the ASCOBANS Advisory Committee, 20-22 March 2012 in Galway, Ireland

Rachor E. (1990): Changes in sublitoral zoobenthos in the German Bight with regard to eutrophica-tion. Netherlands Journal of Sea Research. 25 (1/2): 209-214.

Rachor, E. & Nehmer, P. (2003). Erfassung und Bewertung ökologisch wertvoller Lebensräume in der Nordsee - Abschlussbericht für das F+E-Vorhaben FKZ 899 85 310 (Bundesamt für Naturschutz): 175 p. Bremerhaven: Alfred-Wegener-Institut für Polar- und Meeresforschung.

Rachor, E. (2006). Search for the particularly valuable benthic areas within the German North Sea EEZ. In: Nordheim, v.H., Boedecker, D. & Krause, J. (Eds.) Progress in Marine Conservation in Europe. Springer, Berlin, Heidelberg: 263 p.

Rachor, E., R. Bönsch, K. Boos, F. Gosselck, M. Grotjahn, C.-P. Günther, M. Gusky, L. Gutow, W. Heiber, P. Jantschik, H.-J. Krieg, R. Krone, P. Nehmer, K. Reichert, H. Reiss, A. Schröder, J. Witt & M. L. Zettler (2013). Rote Liste und Artenlisten der bodenlebenden wirbellosen Meerestiere - 4. Fassung, Stand Dezember 2007, einzelne Aktualisierungen bis 2012. - Naturschutz und Biologische Vielfalt 70 (2): 81-176.

Reiss H., Greenstreet, S. P. R., Sieben K., Ehrich S., Piet G. J., Quirijn F., Robinson L., Wolff W. J. & Kröncke I. (2009): Effects of fishing disturbance on benthic communities and second-ary production within an intensively fished area. Mar. Ecol. Prog. Ser. 394: 201-213.

Read AJ, Drinker P, Northridge S (2006) Bycatch of marine mammals in U.S. and global fisheries. Conserv Biol 20:163–169

Reeves, R., McClellan, K., Werner, T., 2013. Marine mammal bycatch in gillnet and other entangling net fisheries, 1990 to 2011. Endang. Species Res. 20, 71–97

Rijnsdorp A.D., Bos O.G., Slijkerman D. (2015): Impact Assessment of the Flyshoot fishery in Natura 2000 and MSFD areas of the Dutch continental shelf. IMARES Report C162/15

Rijnsdorp A.D., Bastardie F, Bolam S.G., et al. (2016). Towards a framework for the quantitative assessment of trawling impact on the seabed and benthic ecosystem. ICES Journal of Marine Science, 73: i127-i138

Rumohr H. & Kujawski T. (2000): The impact of trawl fisheries on the epifauna of the southern North Sea. ICES J. Mar. Sci. 57: 1389-1394.

Rumohr H, Kujawski T (2000) The impact of trawl fishery on the epifauna of the southern North Sea. ICES J Mar Sci 57:1389–1394

Scheidat, M., Gilles, A. & Siebert, U. (2006). Evaluating the distribution and density of harbour porpoises (Phocoena phocoena) in selected areas in German waters. In: Nordheim, v.H., Boedeker, D. & Krause, J. (Eds.) Progress in Marine Conservation in Europe. Springer, Berlin, Heidelberg: 189-208.

Schröder, A., Gutow, L., Gusky, M. (2008). FishPact . Auswirkungen von Grundschleppnetzfischereien sowie von Sand- und Kiesabbauvorhaben auf die Meeresbodenstruktur und das Benthos in den Schutzgebieten der deutschen AWZ der Nordsee. Abschlussbericht für das BfN: 121 p. Bremerhaven: Alfred-Wegener-Institut für Polar- und Meeresforschung. https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Forschungsberichte/Auswirkungen_von_Grundschleppnetzfischerei.pdf

Schwemmer, P., Mendel, B., Sonntag, N., Dierschke, V. & Garthe, S. (2011): Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21: 1851-1860.

Schulze, T. (2018). International fishing activities in German waters in relation to the designated Natura 2000 areas and proposed management within. 174 pages. Thünen Institute of Sea Fisheries. Version 08.01.2018

Sell, A.F., Pusch, C., von Dorrien, C., Krause, J., Schulze, T., Carstensen, D. (2011). Maßnahmenvorschläge für das Fischereimanagement in Natura 2000-Gebieten der deutschen AWZ der Nord- und Ostsee. 299 p. https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Berichte-und-Positionspapiere/Bericht_AG-Nord-und-Ostsee-2011.pdf

Slabbekoorn, H., N. Bouton, I. van Opzeeland, A.Coers, C. ten Cate, and A. N. Popper. (2010) A noisy spring: the impact of globally rising underwater sound levels on fish. Trends in Ecology & Evolution 25:419–427.

Sonntag, N. & Garthe, S. (2010). Grundlagenanalysen zur Entwicklung von Maßnahmen zur Regulierung der Fischerei in den Vogelschutzgebieten in der Ausschließlichen Wirtschaftszone: 85 p. Büsum: Forschungs- und Technologiezentrum Westküste (FTZ).

Sonntag, N., Mendel, B., Garthe, S. (2007). Erfassung von Meeressäugetieren und Seevögeln in der deutschen AWZ von Ost- und Nordsee (EMSON): Teilvorhaben Seevögel. Abschlussbericht. F+E-Vorhaben FKZ: 802 85 260.Büsum.81p.

Sonntag N, Schwemmer H, Fock HO, Bellebaum J, Garthe S (2012): Seabirds, set-nets, and conservation management: assessment of conflict potential and vulnerability of birds to bycatch in gillnets. ICES Journal of Marine Science 69: 578–589.

Spencer N, Vázquez MBS, Pierce GJ. 2001. Evaluation of the state of knowledge concerning by-catches of cetaceans. Department of Zoology, University of Aberdeen: Aberdeen, UK.

Stelzenmüller, V., Maynou, F., Ehrich, S., Zauke, G.-P. (2004). Spatial Analysis of Twaite Shad, *Alosa fallax* (LACEPÈDE, 1803), in the Southern North Sea: Application of Non-Linear Geostatistics as a Tool to Search for Special Areas of Conservation. Internat. Rev. Hydrobiol. 89 2004 4 337–351.

Stelzenmüller, V., Fock, H. O., Gimpel, A., Rambo, H., Diekmann, R., Probst, W. N., Callies, U., et al. (2015). Quantitative environmental risk assessments in the context of marine spatial management: Current approaches and some perspectives. ICES Journal of Marine Science, 72: 1022-1042.

Stempniewicz, L. 1994. Marine birds drowning in fishing nets in the Gulf of Gdańsk (southern Baltic): numbers, species composition, age and sex structure. Ornis Svecica 4: 123-132

Thiel, R. & Backhausen, I. (2006). Survey of Natura 2000 fish species in the German North and Baltic Seas. In: Nordheim, v.H., Boedecker, D. & Krause, J. (Eds.) Progress in Marine Conservation in Europe. Springer, Berlin, Heidelberg: 263 p.

Thiel, M. & Winker, H. (2007). Erfassung von FFH-Anhang II-Fischarten in der deutschen AWZ von Nord- und Ostsee (ANFIOS): 108 p. Hamburg: Deutsches Meeresmuseum und Universität Rostock.

Tillin H. M., Hiddink J. G., Jennings S., Kaiser M. J. (2006). Chronic bottom trawling alters the functional composition of benthic invertebrate communities on a sea-basin scale. Mar Ecol Prog Ser 318:31-45.

Tillin, H, Tyler-Walters, H. 2013. Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 1 Report: Rationale and proposed ecological groupings for Level 5 biotopes against which sensitivity assessments would be best undertaken JNCC Report No. 512A

Tregenza, N.J.C., Berrow, S.D., Hammond, P.S., Leaper, R., (1995). Harbour porpoise (Phocoena phocoena L.) by-catch in set gillnets in the Celtic Sea. ICES Journal of Marine Science 54, 896–904.

Thrush SF, Hewitt JE, Cummings VJ, Dayton PK and 6 others (1998) Disturbance of the marine benthic habitat by commercial fishing: impacts at the scale of the fishery. Ecol Appl 8:866–879

Thrush SF, Lundquist C, Hewitt JE (2005) Spatial and temporal scales of disturbance to the seafloor: a generalized framework for active habitat management. In: Barnes PT, JP (ed) Benthic habitats and the effects of fishing. American Fisheries Society Symposium 41, pp 639–649

van Beest, F. M., L. Kindt-Larsen, F. Bastardie, V. Bartolino, and J. Nabe-Nielsen (2017). Predicting the population-level impact of mitigating harbor porpoise bycatch with pingers and time-area fishing closures. Ecosphere 8(4):e01785. 10.1002/ecs2.1785

van Denderen P. D., Bolam S. G., Hiddink J. G., Jennings S., Kenny A., Rijnsdorp A. D., & van Kooten T. (2015). Similar effects of bottom trawling and natural disturbance on composi-tion and function of benthic communities across habitats. Mar Ecol Prog Ser 541, 31-43.

van Loon W., Walvoort D., Lavaleye M., Duineveld G., Herbon C., Blandon A., Philips G., Pesch R., Schmitt P., Scholle J., Heyer K., van Hoey G. & Blomqvist M. (2017). A

regional benthos assessment method for the Southern North Sea using Margalef Diversity and reference value modelling. Ecological Indicators (submitted).

Vinther, M. (1995). DFU rapport. Investigations on the North Sea gillnet fisheries: 148 p. Charlottenlund, Denmark: Danish Institute for Fisheries and Marine Research.

Vinther, M. (1999). Bycatches of harbour porpoises (Phocoena phocoena L.) in Danish set-net fisheries. J. Cetacean Res. Manag. 1 (2): 123-135.

Vinther, M. & Larsen, F. (2004). Updated estimates of harbour porpoise (Phocoena phocoena) bycatch in the Danish North Sea bottom-set gillnet fishery. J. Cetacean Res. Manage. 6, 19-24.

Viquerat, S., Gilles, A., Herr, H. & Siebert, U. (2015). Monitoring von marinen Säugetieren 2014 in der deutschen Nord- und Ostsee. Teil A. Visuelle Erfassung von Schweinswalen. Bericht für das Bundesamt für Naturschutz. http://bfn.de/fileadmin/BfN/meeresundkuestenschutz/Dokumente/Berichte-zum-Monitoring/BfN-Monitoring-Marine-Saeugetiere-2014-2015-barrierefrei.pdf

Watling L, Norse EA (1998). Disturbance of the seabed by mobile fishing gear: a comparison to forest clearcutting. Conserv Biol 12:1180–1197

Wisniewska, D.M., Johnson, M., Teilmann, J., Rojano-Doñate, L., Shearer, J., Sveegaard, S., Miller, L.A., Siebert, U., Madsen, P.T. (2016). Ultra-High Foraging Rates of Harbor Porpoises Make Them Vulnerable to Anthropogenic Disturbance. Curr. Biol. 26, 1441–1446

Zettler, M. & Gosselck, F. (2006). Benthic assessment of marine areas of particulare ecological importance within the German Baltic Sea EEZ. In: Nordheim, v.H., Boedecker, D. & Krause, J. (Eds.) Progress in Marine Conservation in Europe. Springer, Berlin, Heidelberg: 263 p.Marine Conservation in Europe. Springer, Berlin, Heidelberg: 263 p.

Zydelis, R., Bellebaum, J., Österblom, H., Veteema, M., Schirmeister, B., Stipniece, A., Dagys, M., van Eerden, M. & Garthe, S (2009). Bycatch in gillnet fisheries - An overlooked threat to waterbird populations. Biol Conserv.;142(7): 1269–1281.

Zydelis R., Small C., French G. (2013). The incidental catch of seabirds in gillnet fisheries: A global review. Biological Conservation 162: 76-88.

11 Appendices

11.1 Appendix 1: Documentation of protected habitats and species in Natura 2000 sites in the German EEZ

11.1.1 Benthic habitat types

Annex I of the Habitats Directive lists natural habitats of Community interest whose conservation requires special conservation areas to be designated at national level. Two of these habitat types occur in the marine areas of the German EEZ in the North Sea: 'Reefs' and 'Sandbanks'. The selection and identification of the protected areas in the German EEZ in the North Sea under the Habitats Directive was partly based on the mapping of the benthic habitat types 'Sandbanks' and 'Reefs' (Boedecker *et al.* 2006; Rachor 2006; Zettler & Gosselck 2006) (Figure S1a).

The mapping of the benthic habitat types in the German North Sea waters revealed that 79% of the habitat type 'Sandbanks' and 53% of the habitat type 'Reefs' occur in the German EEZ. (Boedecker et al. 2006; Rachor 2006; Zettler & Gosselck 2006).

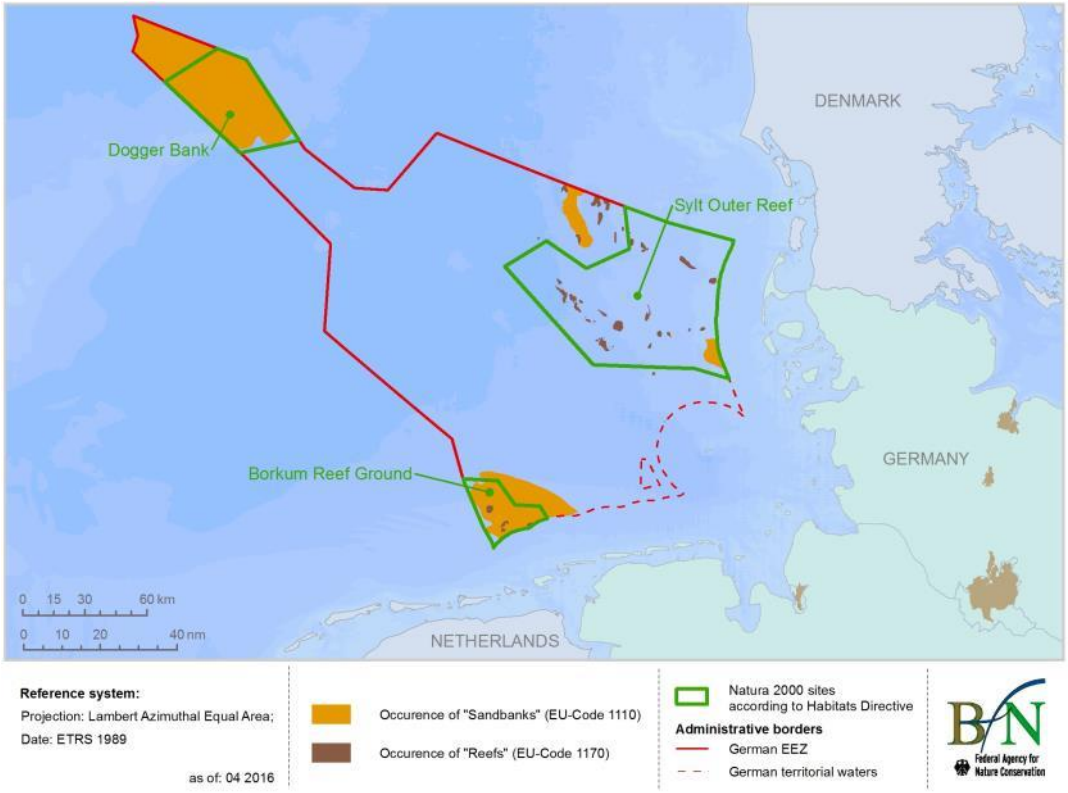

Figure S1a: Distribution of the habitat types 'Sandbanks' (1110) and 'Reefs' (1170) in the German EEZ in the North Sea, and Natura 2000 sites designated under the Habitats Directive (as of 2015).

The Natura 2000 sites Sylt Outer Reef and Borkum Reef Ground also contain major seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' (see Fig. S1b). Figure S1b shows the current knowledge of its large scale spatial distribution in the German EEZ of the North Sea based on Laurer et al. (2013).

In the German North Sea, this marine biotope type comprises pure or mixed deposits of gravel-, coarse sand- and shell layer sediments on the seabed. These are colonized by a species-rich, specific endofauna (e.g. interstitial fauna), macrozoobenthos communities and partly by epibenthos. A typical macrozoobenthos community of this biotope type is the *Goniadella-Spisula*-community, which can be identified by the occurrence of typical macrozoobenthos-species (e.g. *Goniadella bobretzkii, Spisula subtruncata, Aonides paucibranchiata, Branchiostoma lanceolatum, Ophelia limacina, Polygordius spp., Goodallia triangularis, Protodorvillea kefersteini*) (Rachor&Nehmer 2003).

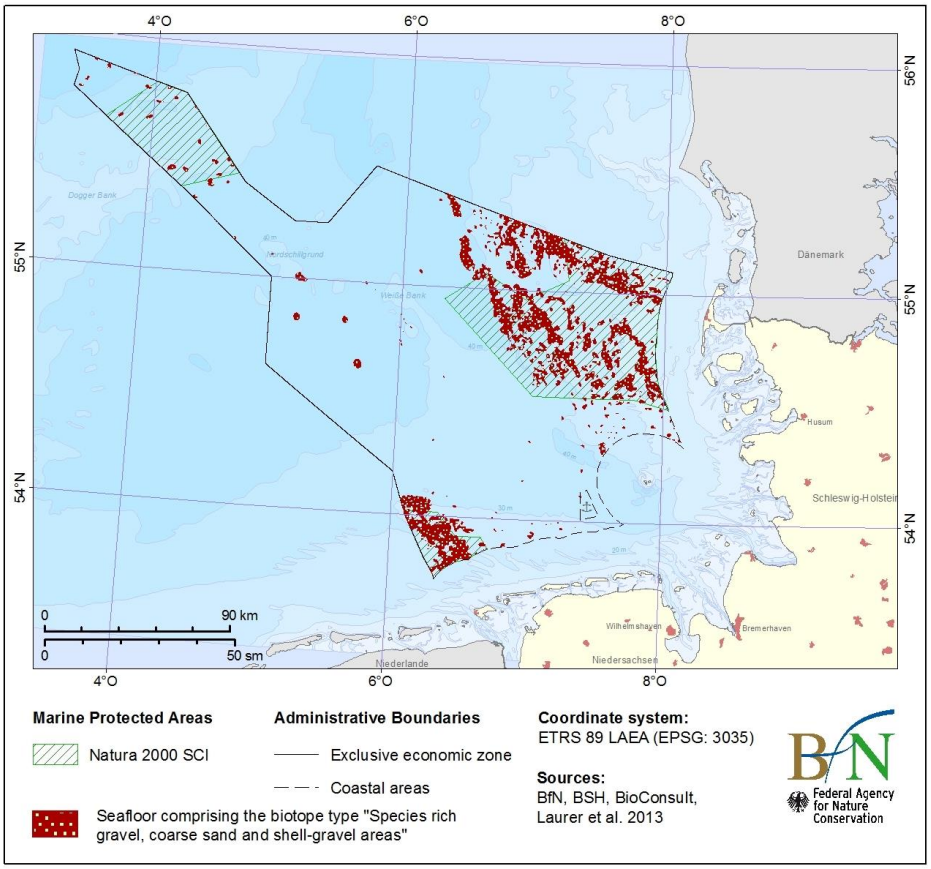

Figure S1b: Distribution of the seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' in the German EEZ in the North Sea which is protected under Section 30 of the Federal Nature Conservation Act.

Most of the 'Species-rich gravel, coarse sand and shell-gravel areas' described and defined in the North Sea so far are located in areas with a water depth of more than 20 m (except for areas around Heligoland). In the German EEZ of the North Sea, gravel and coarse sand are often associated with reefs or finer sediments in a mosaic-like interlocking structure.
As officially defined, the identification of this species enriched biotope type is associated with the sediment composition (more than 50 % coarse sand and gravel) and the occurrence of seven typical benthic species. An area is protected under the Federal Environmental Act if four or more of these species can be found
(BfN 2011,).
https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Marine-Biotoptypen/Biotoptyp-Kies-Sand-Schillgruende.pdf

Currently, areas in the Natura 2000 site Sylt Outer Reef, which have been identified by sidescan sonar as sediment type “gravel, coarse sand and shell-gravel”, are representatively sampled to verify the occurrence of the qualifying benthos species for the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas'. The scientific surveys (BioConsult 2017 b) confirm that most of the sampled areas comply with the requirements of the biotope type regarding the sediment composition (>50 % coarse sand and gravel) and the occurrence of at least 4 characteristic benthic spe-

cies. Therefore most areas sampled so far can be classified as the § 30-protected biotope type 'Species-rich gravel, coarse sand and shell-gravel areas'.
Verification of further seafloor areas which have been identified as “gravel, coarse sand and shell-gravel” sediment areas is ongoing using field sampling and geostatistical methods.

Dogger Bank

The Dogger Bank (Figure S1a) with an area of almost 18,000 km^2 is the largest sandbank in the entire North Sea dividing the sea into the ecologically distinct northern and southern regions. It is representative of the open sublittoral zone of the central North Sea and, at the same time, a typical offshore sandbank in accordance with Annex I of the Habitats Directive. The Dogger Bank area in the central part of the North Sea is of overall importance to an endofauna adapted to substrate shifting as a 'stepping stone' for the distribution of fauna elements of the entire North Sea area, as feeding ground for seabirds and marine mammals and as feeding and spawning ground for fish. The Natura 2000 site Dogger Bank extends over an area of approx. 1624 km^2.

Sylt Outer Reef

The Natura 2000 site Sylt Outer Reef comprises the offshore waters off Sylt and Amrum and the submarine moraine ridge of the north eastern flank of the Elbe glacial valley. This area contains essential and representative examples of the habitat types 'Sandbanks' (1110) and 'Reefs' (1170). As a typical sandbank of the North Frisian marine area, the Amrum Bank is ecologically characterised by a mosaic of various, habitat-typical biotope types with a characteristic diversity of habitats. Predominant are coarse-sand/gravel slopes and fine-sand areas (Rachor & Nehmer 2003).

In that site, the close linkage between reefs and coarse-sand/gravel and fine-/medium-sand biotopes has created particularly high diversity of biotopes and habitats. This unique biotope complex in the German North Sea has not only led to the development of various typical communities but has also conserved a high number of endangered and rare species in this area (Rachor & Nehmer 2003). Due to the abundance of different habitat types in a unique combination with other sediment types and heterogeneous benthic biotopes this area is as a whole a representative site for the fauna of the German Bight.
In addition, seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas' are found in the Natura 2000 site Sylt Outer Reef (see Figure S1b).
A total of 105 epifaunal species were found in the seafloor areas comprising the biotope type “Species-rich gravel, coarse sand and shell areas” in the Natura 2000 site Sylt Outer Reef, with 46 of them being sessile. The highest number of species was found for Crustacea (35 species), followed by the Hydrozoa and Bryozoa with 16 and 15 species respectively. Furthermore, four species of Ascidiacea and three species of Anthozoa have been identified (BIOCONSULT 2017).

The Natura 2000 site Sylt Outer Reef covers an area of approx. 5314 km^2.

Borkum Reef Ground

Characteristic for the Natura 2000 site Borkum Reef Ground is the high substrate and habitat diversity of the sandbank with its interspersed stony reefs. In addition to the coarse-sand communities typical for sandbank habitats (Goniadella-Spisula community), a small-scale, mosaic-like mixture of benthic communities occurs in this area (see Figure S1b). The characteristic epifauna with plumose anemones, dead man's fingers, sea cypress hydroid, ascidians, moss animals, sponges and diverse crustacean species is represented on the reefs. The special ecological quality of the Natura 2000 site, which is characterised by its particular diversity of species, is based on the close linkage between these two habitat types.

Recent scientific data show that habitat types “Sandbanks” and “Reefs” in the Natura 2000-site Borkum Reef Ground are closely interlinked with seafloor areas comprising the biotope type 'Species-rich gravel, coarse sand and shell-gravel areas'.

Since the beginning of scientific studies in 1998, a total of 165 species could be identified for the macrozoobenthos alone, including a high number of Red List species (Krause et al. 2006; Rachor & Nehmer, 2003). The Natura 2000 site Borkum Reef Ground extends over an area of 625 km^2.

11.1.2 Marine mammals

A number of projects – e.g. SCANS (Small Cetacean Abundance in the North Sea and adjacent waters), MINOS, or EMSON (survey of marine mammals and seabirds in the German EEZ in the North Sea and the Baltic Sea) – were conducted to examine the incidence and distribution of marine mammals also in German North Sea waters (Gilles et al. 2006). A long-term monitoring programme for marine mammals in the German EEZ was then developed on the basis of these results. With a view to identifying population sizes and the geographic-temporal distribution of marine mammals, animals are counted at regular intervals by vessels and aircraft along set transects (Gilles et al. 2014, Viquerat et al. 2015). Further research projects examining the spatial and temporal distribution of harbour seals in the German North Sea with the help of telemetric methods are mainly conducted by the coastal federal states.

Three marine mammal species protected under Annex II of the Habitats Directive live in the German EEZ in the North Sea:

- Harbour porpoise (*Phocoena phocoena*)
- Harbour seal (*Phoca vitulina vitulina*)
- Grey seal (*Halichoerus grypus*)

Being an Annex IV species, harbour porpoises are also subject to strict general protection under Articles 12 and 16 of the Habitats Directive. The geographic distribution of harbour porpoises in the German EEZ and the coastal waters of the North Sea is shown in Figures S2 a-d.

In the North Sea, high local densities of up to 5 animals/km² have been observed (Scheidat et al. 2006). However, harbour porpoises are not evenly distributed in the North Sea. Their distribution and density are subject to strong seasonal fluctuations . Between 1994 and 2005 a southerly shift of the harbour porpoise population in the North Sea occurred (e.g. Hammond et al. 2013).
Aggregations with very high local densities and a high proportion of mother/calf pairs (in summer) occur regularly in spring and summer, during calving time and the subsequent mating season, in German waters particularly in the Natura 2000 site Sylt Outer Reef (Figure S2a-d) (Scheidat et al. 2006; Gilles et al. 2014).

A recent evaluation of the spatial distribution of harbour porpoise calves in the German EEZ in the North Sea for the summer period 2008-2012 shows a significantly increased distribution of mother/calf pairs in the Natura 2000 site Borkum Reef Ground as compared to the period 2002-2007 (Viquerat et al 2015) (Figure S2a-d). This could indicate that the Borkum Reef Ground is of an increasing importance as a potential calving habitat.

Other marine mammals identified in the German North Sea EEZ are the white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*) and the regularly sighted mink whale (*Balaenoptera acutorostrata*), (Gilles et al. 2014).

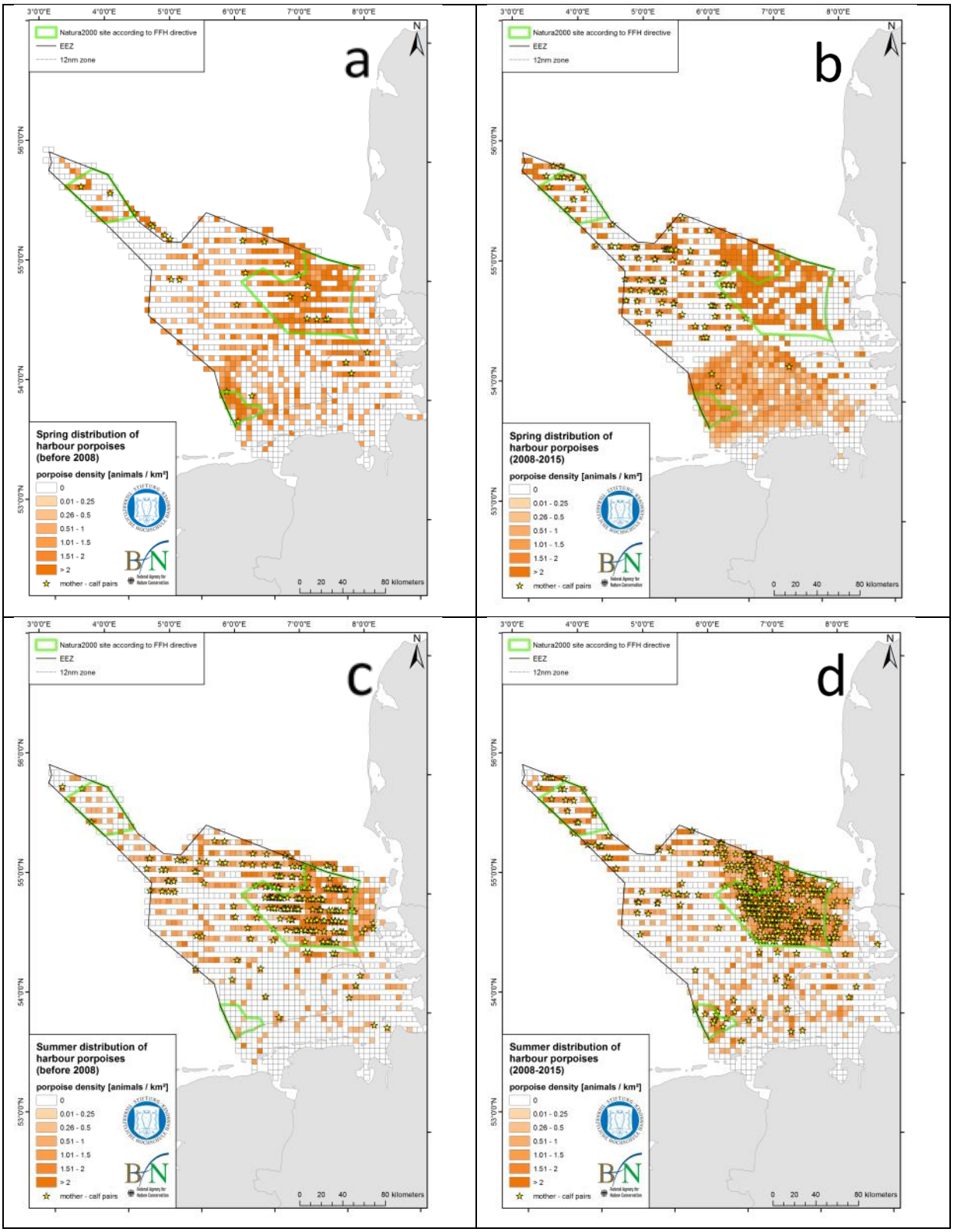

Figure S2a-d: Overview of the average spatial distribution of harbour porpoises in the German North Sea in spring (March-May) and summer (June-August) of the years 2002–2007 and 2008-2015. Mother/calf sightings are marked with asterisks. The density calculation is based on the aggregation of flight count data collected under good and moderate conditions in ETRS 1989 grid cells (BfN monitoring, Viquerat et al. 2015).

11.1.3 Seabirds

All relevant seabird species in the North Sea are protected according to a number of national and international conservation laws such as the EU Birds Directive. Red-throated diver and black-throated diver are listed under Appendix I, all other species are listed as migrating species according to the directive. Accordingly, Germany is responsible for the conservation of these bird species. In addition, all of the mentioned seabird species are subject to the Agreement of the Conservation of African-Eurasian Migratory Waterbirds (AEWA). Its action plan 2009 to 2012 demands a reduction of mortality due to bycatch in fisheries for all migratory bird species of all contracting parties. Moreover, all of these species show important concentrations in the German North Sea and inside the SPA (Garthe et al. 2012, Table 3, Garthe et al. 2015, Markones et al. 2015).
The BfN has conducted a number of surveys of the concentration areas of resting and migratory birds in the area of the German North Sea and Baltic Sea (Garthe 2006, Garthe et al. 2010). The following research projects were particularly important for determining the special protection areas in the German EEZ: Survey of marine mammals and seabirds in German EEZ in the North Sea and Baltic See, EMSON, (Garthe & Sonntag 2004, Sonntag et al. 2007); Survey of resting migratory birds in the German EEZ in the North Sea and Baltic Sea (Garthe 2003).

In addition, data on the geographic and temporal distribution of seabirds in the German marine area are regularly monitored according to the EU Birds Directive and within environmental impact studies (Markones et al. 2014, 2015, Garthe et al. 2015).

The species mentioned in Annex I to the Birds Directive are to be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Particular account is to be taken of:
a) species in danger of extinction;
b) species vulnerable to specific changes in their habitat;
c) species considered rare because of small populations or restricted local distribution.

Member States are to take conservation measures in order to ensure the birds survival and reproduction in their area of distribution. These measures explicitly include identifying areas that are most suitable in terms of number and size as Special Protection Areas.
The following six species listed in Annex I to the Birds Directive occur in the marine areas in the German EEZ in the North Sea:

- Red-throated diver (*Gavia stellata*)
- Black-throated diver (*Gavia arctica*)
- Arctic tern (*Sterna paradiesaea*)
- Common tern (*Sterna hirundo*)

- Sandwich tern (*Sterna sandvicensis*)
- Little gull (*Hydrocoloeus minutus*)

Article 4(2) of the Birds Directive stipulates that regularly occurring migratory species must also be protected through measures that develop and maintain their breeding, moulting and wintering areas and staging posts along their migration routes. This also includes avoiding pollution or the deterioration of habitats or any disturbances affecting the birds. The functional capacity of flyways must be preserved. In addition to the species listed in Annex I, a total of a further 19 species – mainly sea ducks, gulls and auks – were also relevant for the designation of protected areas in the German EEZ.

Table 3 gives an overview of the occurrence of gillnet sensitive seabird species in the German EEZ of the North Sea and SPA Eastern German Bight and their proportion relative to their German at-sea and biogeographic population numbers. The above listed species: Arctic tern, common tern, sandwich tern and little gull of Annex I are not depicted here, because they are unlikely to be caught in set nets.
The SPA hosts between 8 and 42 % of the entire German North Sea population of the different species. These numbers correspond to 3 % of the biogeographic population for red-throated divers and common scoters. It has to be noted that the numbers presented are averages for the respective season. Due to turnover and migration the overall number of individuals actually using the SPA is very likely much higher.
These numbers document the high importance of the SPA for the occurring gillnet sensitive seabird species.

Table 3: Population numbers of bird species sensitive to gillnet fishery in the SPA, during their period of maximum occurrence based on FTZ ship database 6.06 (1993 to 7/2014) and plane database 5.15 (2002 to 7/2014). Numbers of red-throated divers and black-throated divers include numbers of unidentified divers, apportioned by species proportion. Numbers of common guillemots and razorbills include numbers of unidentified auks, apportioned by species proportion. The numbers for the German North Sea are taken from Garthe et al. (2007) and include EEZ and offshore waters of Schleswig-Holstein and Niedersachsen. Biogeographic population numbers are from Wetlands International 5th Edition (WPE5).

Species	Period	SPA	German North Sea	% of German North Sea population	Biogeographic population	% of biogeographic population
Red-throated diver	March to May	6896	16500	42	260000	3
Black-throated diver	March to May	160	2000	8	350000	< 1
Common guillemot	September to November	4110	21000	20	2850000	< 1
Razorbill	December to February	916	7500	12	530000	< 1
Northern gannet	June to August	141	1400	10	390000	< 1
Common scoter	December to February	14999	130000	12	550000	3

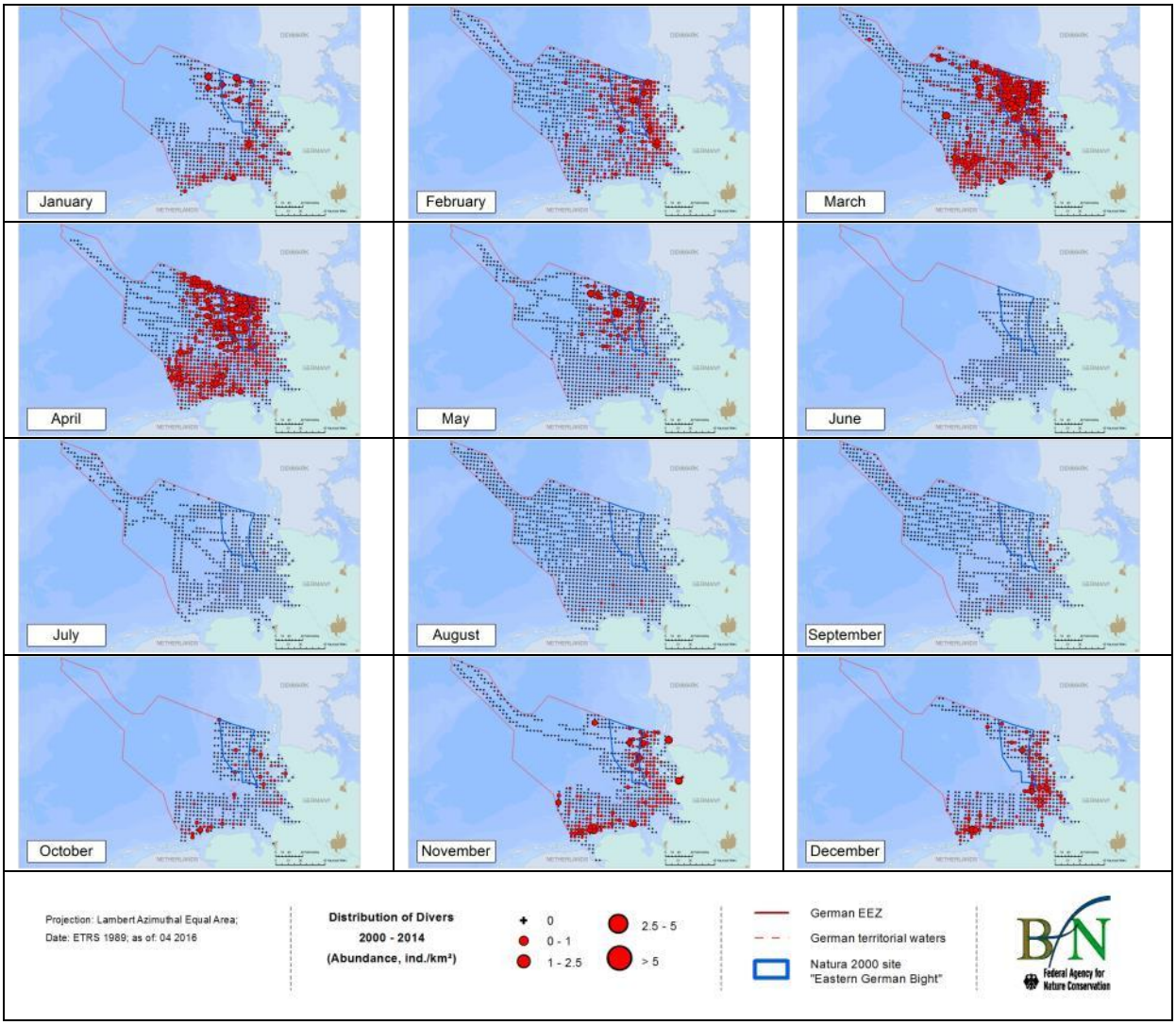

Figure S3: Abundance of gaviiformes (*Gavia sp.*) in the German North Sea in the course of the year (medium density per month) in the years 2000-2014 (source: BfN monitoring data)

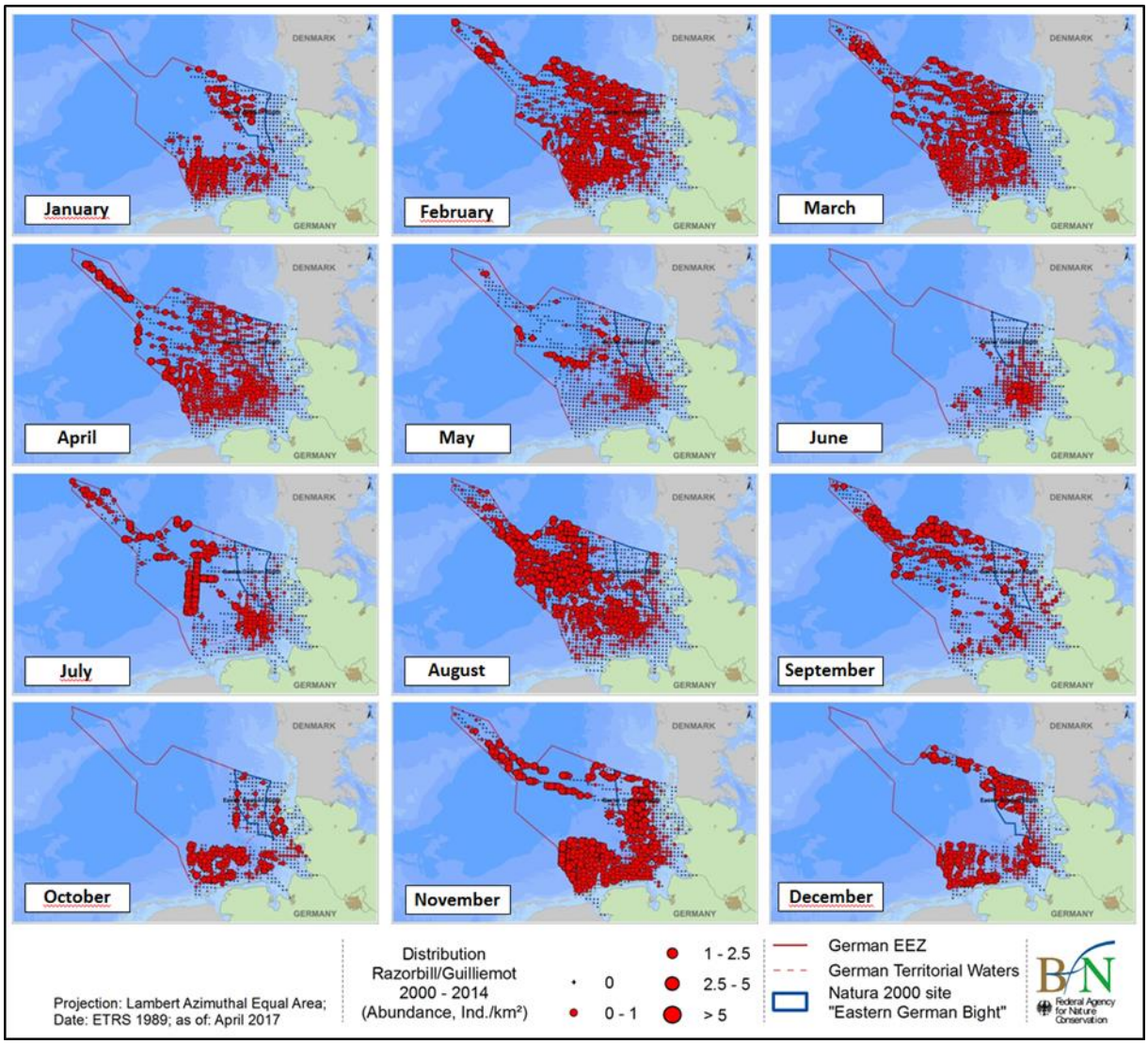

Figure S4: Abundance of Razorbill and Guillemot in the German North Sea in the course of the year (medium density per month) in the years 2000-2014 (source: BfN monitoring data)

Natura 2000 site Eastern German Bight

The Natura 2000 site Eastern German Bight is the most important wintering area for red-throated and black-throated divers in the entire German EEZ in the North Sea (see Figure S3). Furthermore, a number of other migratory bird species also use the bentho-pelagic fish stocks in this area as their forage base. The demarcation of the protection area was based on the main areas of distribution of red-throated and black-throated divers and the occurrence of sandwich, common and Arctic tern and little and common gull. In the southern part of this area are the feeding grounds of the bird, common guillemot, razorbill (see Figure S4), species black-legged kittiwake northern fulmar and northern gannet which in Germany exclusively breed on the island of Helgoland. In addition to the birds breeding on Helgoland, lesser black-backed gulls also use this area as a feeding habitat throughout the year

10.2 Appendix 2: Geographic coordinates of the proposed measures 1-9

10.2.1 Measure 1

Measure 1 refers to the central area of the Natura 2000 site Sylt Outer Reef. The measure comprises a northern and a southern part.

Sylt Outer Reef Northern part

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	7° 12,632'	55° 14,064'
1	7° 30,000'	55° 10,631'
2	7° 30,000'	55° 01,917'
3	7° 11,958'	55° 01,917'
4	7° 15,400'	55° 02,900'
5	7° 12,632'	55° 14,064'
6	7° 30,000'	55° 10,631'

Sylt Outer Reef Southern part

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	7° 03,550'	54° 59,513'
1	7° 16,590'	54° 58,107'
2	7° 30,000'	54° 48,865'
3	7° 30,000'	54° 32,333'
4	7° 01,217'	54° 32,333'
5	6° 42,000'	54° 43,640'
6	6° 42,000'	55° 02,536'
7	6° 56,283'	54° 57,433'
8	7° 03,550'	54° 59,513'

10.2.3 Measure 2

Measure 2 refers to 25% of the area of the Amrum Bank (northern part) in the Natura 2000 site Sylt Outer Reef.

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	7° 54,105'	54° 37,722'
1	7° 52,190'	54° 37,872'
2	7° 52,089'	54° 38,305'
3	7° 52,016'	54° 38,661'
4	7° 51,812'	54° 39,168'
5	7° 53,094'	54° 39,961'
6	7° 53,658'	54° 40,244'
7	7° 55,026'	54° 40,360'
8	7° 55,795'	54° 40,420'
9	7° 56,530'	54° 40,479'
10	7° 56,538'	54° 40,433'
11	7° 56,547'	54° 40,380'
12	7° 56,555'	54° 40,327'
13	7° 56,564'	54° 40,274'
14	7° 56,573'	54° 40,221'
15	7° 56,582'	54° 40,167'
16	7° 56,590'	54° 40,114'
17	7° 56,599'	54° 40,061'
18	7° 56,608'	54° 40,008'
19	7° 56,617'	54° 39,955'
20	7° 56,625'	54° 39,902'
21	7° 56,634'	54° 39,848'
22	7° 56,643'	54° 39,795'
23	7° 56,652'	54° 39,742'
24	7° 56,660'	54° 39,689'
25	7° 56,669'	54° 39,636'
26	7° 56,678'	54° 39,583'
27	7° 56,684'	54° 39,530'
28	7° 56,690'	54° 39,478'
29	7° 56,697'	54° 39,425'
30	7° 56,703'	54° 39,372'
31	7° 56,709'	54° 39,320'
32	7° 56,715'	54° 39,267'
33	7° 56,721'	54° 39,215'
34	7° 56,728'	54° 39,162'
35	7° 56,734'	54° 39,109'
36	7° 56,735'	54° 39,102'
37	7° 56,744'	54° 39,005'
38	7° 56,777'	54° 38,857'

39	7° 56,779'	54° 38,847'
40	7° 56,789'	54° 38,795'
41	7° 56,800'	54° 38,743'
42	7° 56,811'	54° 38,691'
43	7° 56,822'	54° 38,638'
44	7° 56,832'	54° 38,586'
45	7° 56,843'	54° 38,534'
46	7° 56,854'	54° 38,482'
47	7° 56,865'	54° 38,429'
48	7° 56,880'	54° 38,377'
49	7° 56,888'	54° 38,349'
50	7° 56,894'	54° 38,322'
51	7° 56,947'	54° 38,143'
52	7° 56,955'	54° 38,117'
53	7° 56,970'	54° 38,065'
54	7° 56,979'	54° 38,035'

10.2.4 Measure 3

Measure 3 refers to the Natura 2000 sites Eastern German Bight and Sylt Outer Reef.

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	8° 9,059'	54° 20,717'
1	8° 9,355'	54° 20,331'
2	8° 9,674'	54° 19,952'
3	8° 9,615'	54° 19,985'
4	8° 9,554'	54° 20,020'
5	8° 9,492'	54° 20,055'
6	8° 9,430'	54° 20,090'
7	8° 9,368'	54° 20,125'
8	8° 9,306'	54° 20,160'
9	8° 9,245'	54° 20,194'
10	8° 9,183'	54° 20,229'
11	8° 9,121'	54° 20,264'
12	8° 9,059'	54° 20,299'
13	8° 8,997'	54° 20,334'
14	8° 8,933'	54° 20,367'
15	8° 8,868'	54° 20,400'
16	8° 8,804'	54° 20,433'
17	8° 8,739'	54° 20,466'
18	8° 8,675'	54° 20,499'
19	8° 8,610'	54° 20,532'
20	8° 8,545'	54° 20,565'
21	8° 8,481'	54° 20,598'
22	8° 8,416'	54° 20,631'

23	8° 8,352'	54° 20,664'
24	8° 8,287'	54° 20,697'
25	8° 8,220'	54° 20,729'
26	8° 8,153'	54° 20,760'
27	8° 8,086'	54° 20,791'
28	8° 8,019'	54° 20,823'
29	8° 7,952'	54° 20,854'
30	8° 7,884'	54° 20,885'
31	8° 7,817'	54° 20,917'
32	8° 7,750'	54° 20,948'
33	8° 7,683'	54° 20,979'
34	8° 7,616'	54° 21,011'
35	8° 7,549'	54° 21,042'
36	8° 7,479'	54° 21,072'
37	8° 7,410'	54° 21,101'
38	8° 7,340'	54° 21,131'
39	8° 7,271'	54° 21,160'
40	8° 7,201'	54° 21,190'
41	8° 7,132'	54° 21,219'
42	8° 7,062'	54° 21,249'
43	8° 6,992'	54° 21,279'
44	8° 6,923'	54° 21,308'
45	8° 6,853'	54° 21,338'
46	8° 6,784'	54° 21,367'
47	8° 6,712'	54° 21,395'
48	8° 6,640'	54° 21,422'
49	8° 6,569'	54° 21,450'
50	8° 6,497'	54° 21,477'
51	8° 6,425'	54° 21,505'
52	8° 6,354'	54° 21,533'
53	8° 6,282'	54° 21,560'
54	8° 6,210'	54° 21,588'
55	8° 6,139'	54° 21,615'
56	8° 6,067'	54° 21,643'
57	8° 5,995'	54° 21,670'
58	8° 5,921'	54° 21,696'
59	8° 5,848'	54° 21,722'
60	8° 5,774'	54° 21,748'
61	8° 5,700'	54° 21,774'
62	8° 5,626'	54° 21,799'
63	8° 5,552'	54° 21,825'
64	8° 5,478'	54° 21,851'
65	8° 5,404'	54° 21,877'
66	8° 5,330'	54° 21,902'
67	8° 5,256'	54° 21,928'
68	8° 5,182'	54° 21,954'

69	8° 5,106'	54° 21,977'
70	8° 5,030'	54° 22,001'
71	8° 4,954'	54° 22,025'
72	8° 4,878'	54° 22,048'
73	8° 4,803'	54° 22,072'
74	8° 4,727'	54° 22,096'
75	8° 4,651'	54° 22,119'
76	8° 4,575'	54° 22,143'
77	8° 4,499'	54° 22,167'
78	8° 4,423'	54° 22,190'
79	8° 4,347'	54° 22,214'
80	8° 4,269'	54° 22,235'
81	8° 4,192'	54° 22,257'
82	8° 4,114'	54° 22,278'
83	8° 4,037'	54° 22,300'
84	8° 3,959'	54° 22,321'
85	8° 3,882'	54° 22,343'
86	8° 3,804'	54° 22,364'
87	8° 3,726'	54° 22,386'
88	8° 3,649'	54° 22,407'
89	8° 3,571'	54° 22,429'
90	8° 3,494'	54° 22,450'
91	8° 3,414'	54° 22,470'
92	8° 3,335'	54° 22,489'
93	8° 3,255'	54° 22,509'
94	8° 3,176'	54° 22,528'
95	8° 3,097'	54° 22,547'
96	8° 3,017'	54° 22,567'
97	8° 2,938'	54° 22,586'
98	8° 2,859'	54° 22,606'
99	8° 2,779'	54° 22,625'
100	8° 2,700'	54° 22,644'
101	8° 2,620'	54° 22,664'
102	8° 2,540'	54° 22,681'
103	8° 2,459'	54° 22,698'
104	8° 2,378'	54° 22,716'
105	8° 2,297'	54° 22,733'
106	8° 2,217'	54° 22,750'
107	8° 2,136'	54° 22,767'
108	8° 2,055'	54° 22,785'
109	8° 1,974'	54° 22,802'
110	8° 1,893'	54° 22,819'
111	8° 1,813'	54° 22,837'
112	8° 1,732'	54° 22,854'
113	8° 1,650'	54° 22,869'
114	8° 1,568'	54° 22,884'

115	8° 1,486'	54° 22,899'
116	8° 1,404'	54° 22,914'
117	8° 1,322'	54° 22,929'
118	8° 1,240'	54° 22,944'
119	8° 1,158'	54° 22,959'
120	8° 1,076'	54° 22,974'
121	8° 0,994'	54° 22,989'
122	8° 0,912'	54° 23,004'
123	8° 0,830'	54° 23,019'
124	8° 0,747'	54° 23,032'
125	8° 0,664'	54° 23,045'
126	8° 0,581'	54° 23,057'
127	8° 0,498'	54° 23,070'
128	8° 0,414'	54° 23,083'
129	8° 0,331'	54° 23,096'
130	8° 0,248'	54° 23,109'
131	8° 0,165'	54° 23,122'
132	8° 0,082'	54° 23,135'
133	7° 59,998'	54° 23,148'
134	7° 59,915'	54° 23,160'
135	7° 59,914'	54° 23,161'
136	7° 59,913'	54° 23,161'
137	7° 59,747'	54° 23,181'
138	7° 59,663'	54° 23,192'
139	7° 59,579'	54° 23,202'
140	7° 59,495'	54° 23,213'
141	7° 59,411'	54° 23,223'
142	7° 59,327'	54° 23,234'
143	7° 59,242'	54° 23,244'
144	7° 59,158'	54° 23,255'
145	7° 59,109'	54° 23,261'
146	7° 58,988'	54° 23,276'
147	7° 58,055'	54° 23,367'
148	7° 57,115'	54° 23,434'
149	7° 56,171'	54° 23,474'
150	7° 54,798'	54° 23,513'
151	7° 54,707'	54° 23,516'
152	7° 54,615'	54° 23,519'
153	7° 54,523'	54° 23,521'
154	7° 54,432'	54° 23,524'
155	7° 54,340'	54° 23,527'
156	7° 54,248'	54° 23,529'
157	7° 54,157'	54° 23,532'
158	7° 54,089'	54° 23,534'
159	7° 52,688'	54° 23,574'
160	7° 51,716'	54° 23,589'

161	7° 50,746'	54° 23,576'
162	7° 49,776'	54° 23,536'
163	7° 48,813'	54° 23,469'
164	7° 47,855'	54° 23,376'
165	7° 46,700'	54° 32,330'
166	7° 33,563'	54° 32,331'
167	7° 30,000'	54° 32,331'
168	7° 30,012'	54° 35,405'
169	7° 20,091'	54° 43,973'
170	7° 15,411'	55° 2,896'
171	7° 12,669'	55° 13,907'
172	7° 33,079'	55° 10,017'
173	7° 33,081'	55° 10,017'
174	7° 33,081'	55° 10,017'
175	7° 33,084'	55° 10,016'
176	8° 2,660'	55° 5,951'
177	8° 2,562'	55° 5,546'
178	8° 2,490'	55° 5,137'
179	8° 2,339'	55° 4,909'
180	8° 1,579'	55° 3,712'
181	8° 0,904'	55° 2,880'
182	8° 0,652'	55° 2,557'
183	8° 0,415'	55° 2,230'
184	7° 59,542'	55° 0,962'
185	7° 59,299'	55° 0,590'
186	7° 59,077'	55° 0,217'
187	7° 58,517'	54° 59,215'
188	7° 58,437'	54° 59,069'
189	7° 57,797'	54° 57,867'
190	7° 57,584'	54° 57,439'
191	7° 57,395'	54° 57,000'
192	7° 57,237'	54° 56,559'
193	7° 56,977'	54° 55,757'
194	7° 56,820'	54° 55,202'
195	7° 56,709'	54° 54,643'
196	7° 56,535'	54° 53,543'
197	7° 56,475'	54° 53,068'
198	7° 56,374'	54° 51,912'
199	7° 56,224'	54° 50,438'
200	7° 56,197'	54° 50,065'
201	7° 56,154'	54° 49,165'
202	7° 56,147'	54° 48,845'
203	7° 56,154'	54° 48,525'
204	7° 56,179'	54° 47,995'
205	7° 56,162'	54° 47,748'
206	7° 55,931'	54° 46,280'

207	7° 55,866'	54° 45,723'
208	7° 55,844'	54° 45,165'
209	7° 55,869'	54° 44,606'
210	7° 55,939'	54° 44,048'
211	7° 56,676'	54° 39,583'
212	7° 56,744'	54° 39,005'
213	7° 56,863'	54° 38,430'
214	7° 57,028'	54° 37,858'
215	7° 57,239'	54° 37,291'
216	7° 57,499'	54° 36,731'
217	7° 57,618'	54° 36,498'
218	7° 57,864'	54° 36,046'
219	7° 58,141'	54° 35,598'
220	7° 58,449'	54° 35,158'
221	8° 2,293'	54° 29,927'

10.2.5 Measure 4

Measure 4 refers to the western part of the Natura 2000 site Sylt Outer Reef during the period 1 March – 31 October.

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	6° 56,281'	54° 57,420'
1	7° 15,411'	55° 2,896'
2	7° 20,091'	54° 43,973'
3	7° 30,012'	54° 35,405'
4	7° 30,000'	54° 32,331'
5	7° 1,228'	54° 32,331'
6	6° 19,442'	54° 56,834'
7	6° 37,750'	55° 4,018'

10.2.6 Measure 5

Measure 5 refers to the entire Natura 2000 site Borkum Reef Ground.

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	6° 29,396'	53° 54,884'
1	6° 40,414'	53° 54,884'
2	6° 43,914'	53° 51,809'
3	6° 43,601'	53° 51,754'
4	6° 42,666'	53° 51,559'
5	6° 41,747'	53° 51,337'
6	6° 40,849'	53° 51,089'
7	6° 39,972'	53° 50,814'
8	6° 39,120'	53° 50,515'
9	6° 38,294'	53° 50,192'

10	6° 37,494'	53° 49,845'
11	6° 36,725'	53° 49,475'
12	6° 35,989'	53° 49,082'
13	6° 35,510'	53° 48,930'
14	6° 34,570'	53° 48,854'
15	6° 33,639'	53° 48,752'
16	6° 32,715'	53° 48,625'
17	6° 31,804'	53° 48,472'
18	6° 30,905'	53° 48,294'
19	6° 30,022'	53° 48,092'
20	6° 29,157'	53° 47,864'
21	6° 28,310'	53° 47,614'
22	6° 27,484'	53° 47,339'
23	6° 26,680'	53° 47,042'
24	6° 25,902'	53° 46,722'
25	6° 25,150'	53° 46,382'
26	6° 24,425'	53° 46,020'
27	6° 23,730'	53° 45,640'
28	6° 23,067'	53° 45,240'
29	6° 22,435'	53° 44,822'
30	6° 21,837'	53° 44,388'
31	6° 21,275'	53° 43,937'
32	6° 20,750'	53° 43,471'
33	6° 20,536'	53° 43,854'
34	6° 20,322'	53° 44,238'
35	6° 20,108'	53° 44,622'
36	6° 19,894'	53° 45,006'
37	6° 19,437'	53° 45,432'
38	6° 18,980'	53° 45,858'
39	6° 18,523'	53° 46,284'
40	6° 18,066'	53° 46,710'
41	6° 17,608'	53° 47,135'
42	6° 17,151'	53° 47,561'
43	6° 16,693'	53° 47,987'
44	6° 16,235'	53° 48,413'
45	6° 15,777'	53° 48,838'
46	6° 15,371'	53° 49,319'
47	6° 14,964'	53° 49,801'
48	6° 14,557'	53° 50,282'
49	6° 14,151'	53° 50,763'
50	6° 13,744'	53° 51,245'
51	6° 13,336'	53° 51,726'
52	6° 12,929'	53° 52,207'
53	6° 12,522'	53° 52,688'
54	6° 12,114'	53° 53,170'
55	6° 11,706'	53° 53,651'

56	6° 11,298'	53° 54,132'
57	6° 10,890'	53° 54,613'
58	6° 10,482'	53° 55,094'
59	6° 10,074'	53° 55,575'
60	6° 9,665'	53° 56,056'
61	6° 9,257'	53° 56,537'
62	6° 8,848'	53° 57,018'
63	6° 8,439'	53° 57,499'
64	6° 8,030'	53° 57,980'
65	6° 7,620'	53° 58,461'
66	6° 7,211'	53° 58,942'
67	6° 6,801'	53° 59,423'
68	6° 6,391'	53° 59,903'
69	6° 6,111'	54° 0,393'
70	6° 5,831'	54° 0,882'
71	6° 5,758'	54° 1,010'
72	6° 21,123'	54° 0,985'

10.2.7 Measure 6

Will be developed by the Dogger Bank Steering Group (DBSG), see 5.3.1

10.2.8 Measure 7

Measure 7 refers to the Natura 2000 sites Borkum Reef Ground and Dogger Bank.

10.2.8.1 Borkum Reef Ground

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	6° 29,396'	53° 54,884'
1	6° 40,414'	53° 54,884'
2	6° 43,914'	53° 51,809'
3	6° 43,601'	53° 51,754'
4	6° 42,666'	53° 51,559'
5	6° 41,747'	53° 51,337'
6	6° 40,849'	53° 51,089'
7	6° 39,972'	53° 50,814'
8	6° 39,120'	53° 50,515'
9	6° 38,294'	53° 50,192'
10	6° 37,494'	53° 49,845'
11	6° 36,725'	53° 49,475'
12	6° 35,989'	53° 49,082'
13	6° 35,510'	53° 48,930'
14	6° 34,570'	53° 48,854'

15	6° 33,639'	53° 48,752'
16	6° 32,715'	53° 48,625'
17	6° 31,804'	53° 48,472'
18	6° 30,905'	53° 48,294'
19	6° 30,022'	53° 48,092'
20	6° 29,157'	53° 47,864'
21	6° 28,310'	53° 47,614'
22	6° 27,484'	53° 47,339'
23	6° 26,680'	53° 47,042'
24	6° 25,902'	53° 46,722'
25	6° 25,150'	53° 46,382'
26	6° 24,425'	53° 46,020'
27	6° 23,730'	53° 45,640'
28	6° 23,067'	53° 45,240'
29	6° 22,435'	53° 44,822'
30	6° 21,837'	53° 44,388'
31	6° 21,275'	53° 43,937'
32	6° 20,750'	53° 43,471'
33	6° 20,536'	53° 43,854'
34	6° 20,322'	53° 44,238'
35	6° 20,108'	53° 44,622'
36	6° 19,894'	53° 45,006'
37	6° 19,437'	53° 45,432'
38	6° 18,980'	53° 45,858'
39	6° 18,523'	53° 46,284'
40	6° 18,066'	53° 46,710'
41	6° 17,608'	53° 47,135'
42	6° 17,151'	53° 47,561'
43	6° 16,693'	53° 47,987'
44	6° 16,235'	53° 48,413'
45	6° 15,777'	53° 48,838'
46	6° 15,371'	53° 49,319'
47	6° 14,964'	53° 49,801'
48	6° 14,557'	53° 50,282'
49	6° 14,151'	53° 50,763'
50	6° 13,744'	53° 51,245'
51	6° 13,336'	53° 51,726'
52	6° 12,929'	53° 52,207'
53	6° 12,522'	53° 52,688'
54	6° 12,114'	53° 53,170'
55	6° 11,706'	53° 53,651'
56	6° 11,298'	53° 54,132'
57	6° 10,890'	53° 54,613'
58	6° 10,482'	53° 55,094'
59	6° 10,074'	53° 55,575'
60	6° 9,665'	53° 56,056'

61	6° 9,257'	53° 56,537'
62	6° 8,848'	53° 57,018'
63	6° 8,439'	53° 57,499'
64	6° 8,030'	53° 57,980'
65	6° 7,620'	53° 58,461'
66	6° 7,211'	53° 58,942'
67	6° 6,801'	53° 59,423'
68	6° 6,391'	53° 59,903'
69	6° 6,111'	54° 0,393'
70	6° 5,831'	54° 0,882'
71	6° 5,758'	54° 1,010'
72	6° 21,123'	54° 0,985'

10.2.8.2 Dogger Bank

ID	Longitude WGS84 (E)	Latitude WGS84 (N)
0	4° 41,963'	55° 26,384'
1	4° 15,650'	55° 21,905'
2	4° 15,516'	55° 21,967'
3	4° 14,781'	55° 22,301'
4	4° 14,047'	55° 22,636'
5	4° 13,313'	55° 22,970'
6	4° 12,578'	55° 23,304'
7	4° 11,843'	55° 23,638'
8	4° 11,108'	55° 23,972'
9	4° 10,373'	55° 24,306'
10	4° 9,637'	55° 24,640'
11	4° 8,901'	55° 24,974'
12	4° 8,165'	55° 25,308'
13	4° 7,429'	55° 25,642'
14	4° 6,693'	55° 25,975'
15	4° 5,956'	55° 26,309'
16	4° 5,219'	55° 26,643'
17	4° 4,482'	55° 26,976'
18	4° 3,745'	55° 27,309'
19	4° 3,008'	55° 27,643'
20	4° 2,270'	55° 27,976'
21	4° 1,532'	55° 28,309'
22	4° 0,794'	55° 28,642'
23	4° 0,056'	55° 28,975'
24	3° 59,318'	55° 29,308'
25	3° 58,579'	55° 29,641'
26	3° 57,840'	55° 29,974'
27	3° 57,101'	55° 30,306'
28	3° 56,362'	55° 30,639'

29	3° 55,622'	55° 30,972'
30	3° 54,883'	55° 31,304'
31	3° 54,143'	55° 31,636'
32	3° 53,403'	55° 31,969'
33	3° 52,662'	55° 32,301'
34	3° 51,922'	55° 32,633'
35	3° 51,181'	55° 32,965'
36	3° 50,440'	55° 33,297'
37	3° 49,699'	55° 33,629'
38	3° 48,958'	55° 33,961'
39	3° 48,216'	55° 34,293'
40	3° 47,474'	55° 34,625'
41	3° 46,732'	55° 34,956'
42	3° 45,990'	55° 35,288'
43	3° 45,248'	55° 35,619'
44	3° 44,505'	55° 35,951'
45	3° 43,762'	55° 36,282'
46	3° 43,019'	55° 36,613'
47	3° 42,276'	55° 36,945'
48	3° 41,533'	55° 37,276'
49	3° 40,789'	55° 37,607'
50	3° 40,045'	55° 37,938'
51	3° 39,301'	55° 38,269'
52	3° 38,557'	55° 38,600'
53	3° 38,254'	55° 38,734'
54	4° 1,073'	55° 48,576'
55	4° 1,146'	55° 48,608'
56	4° 1,249'	55° 48,591'
57	4° 2,138'	55° 48,445'
58	4° 3,051'	55° 48,294'
59	4° 3,964'	55° 48,143'
60	4° 4,877'	55° 47,992'
61	4° 5,791'	55° 47,840'
62	4° 6,703'	55° 47,689'
63	4° 7,616'	55° 47,538'
64	4° 8,529'	55° 47,386'
65	4° 9,442'	55° 47,235'
66	4° 10,354'	55° 47,083'
67	4° 11,266'	55° 46,931'
68	4° 12,179'	55° 46,779'
69	4° 13,091'	55° 46,627'
70	4° 14,003'	55° 46,475'
71	4° 14,915'	55° 46,322'
72	4° 15,497'	55° 45,898'
73	4° 16,079'	55° 45,474'
74	4° 16,661'	55° 45,050'

75	4° 17,243'	55° 44,626'
76	4° 17,824'	55° 44,201'
77	4° 18,405'	55° 43,777'
78	4° 18,986'	55° 43,353'
79	4° 19,567'	55° 42,928'
80	4° 20,148'	55° 42,504'
81	4° 20,728'	55° 42,079'
82	4° 21,308'	55° 41,655'
83	4° 21,888'	55° 41,230'
84	4° 22,468'	55° 40,806'
85	4° 23,047'	55° 40,381'
86	4° 23,627'	55° 39,956'
87	4° 24,206'	55° 39,531'
88	4° 24,785'	55° 39,107'
89	4° 25,364'	55° 38,682'
90	4° 25,942'	55° 38,257'
91	4° 26,520'	55° 37,832'
92	4° 27,098'	55° 37,407'
93	4° 27,676'	55° 36,982'
94	4° 28,254'	55° 36,557'
95	4° 28,831'	55° 36,131'
96	4° 29,409'	55° 35,706'
97	4° 29,986'	55° 35,281'
98	4° 30,563'	55° 34,856'
99	4° 31,139'	55° 34,430'
100	4° 31,716'	55° 34,005'
101	4° 32,292'	55° 33,580'
102	4° 32,868'	55° 33,154'
103	4° 33,444'	55° 32,729'
104	4° 34,019'	55° 32,303'
105	4° 34,595'	55° 31,877'
106	4° 35,170'	55° 31,452'
107	4° 35,745'	55° 31,026'
108	4° 36,320'	55° 30,600'
109	4° 36,894'	55° 30,174'
110	4° 37,468'	55° 29,749'
111	4° 38,043'	55° 29,323'
112	4° 38,617'	55° 28,897'
113	4° 39,190'	55° 28,471'
114	4° 39,764'	55° 28,045'
115	4° 40,337'	55° 27,619'
116	4° 40,910'	55° 27,193'
117	4° 41,483'	55° 26,767'
118	4° 41,991'	55° 26,389'