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# Environmental report for the draft maritime spatial plan for the German Exclusive Economic Zone in the North Sea

## – unofficial translation –

Hamburg, 25 September 2020

# Content

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## List of abbreviations

| | |
|---|---|
| AC | Alternating Current (alternating current) |
| AIS | Automatic identification system (for ships) |
| ASCOBANS | Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas |
| AWI | Alfred Wegener Institute for Polar and Marine Research |
| BBergG | Federal Mining Act |
| BfN | Federal Agency for Nature Conservation |
| BFO | Federal Offshore Plan |
| BFO-N | Federal Sectoral Plan Offshore North Sea |
| BFO-O | Federal Offshore Baltic Sea Plan |
| BGBl | Federal Law Gazette |
| BMUB | Federal Ministry for the Environment, Nature Conservation, Construction and Reactor Safety |
| BNatSchG | Law on nature conservation and landscape management (Federal Nature Conservation Act) |
| BSH | Federal Maritime and Hydrographic Agency |
| CMS | Convention on the Conservation of Migratory Species of Wild Animals |
| CTD | Conductivity, Temperature, Depth Sensor |
| DC | Direct Current (direct current) |
| EEZ | Exclusive Economic Zone |
| EIA | Environmental impact assessment |
| EMSON | Survey of marine mammals and seabirds in the German EEZ of the North Sea and Baltic Sea |
| EnWG | Law on electricity and gas supply (Energy Act) |
| EUNIS | European Nature Information System |
| EUROBATS | Agreement on the conservation of European bat populations |
| Federal Network Agency | Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway |
| FEP | Area development plan |
| FFH | Flora Fauna Habitat |
| FFH DIRECTIVE | Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) |
| FFH-VP | Impact assessment in accordance with Art. 6 para. 3 FFH Directive and Art. 34 BNatSchG |
| FPN | North Sea Research Platform |
| HELCOM | Helsinki Convention |
| IBA | Important bird area |
| ICES | International Council for the Exploration of the Sea |
| IfAÖ | Institute for Applied Ecosystem Research |
| IOW | Leibniz Institute for Baltic Sea Research Warnemünde |
| IUCN | International Union for Conservation of Nature and Natural Resources (Weltnaturschutzunion) |

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|---|---|
| K | Kelvin |
| LRT | Habitat type under the Habitats Directive |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MINOS | Marine warmbloods in the North and Baltic Seas: Principles for the assessment of wind turbines in the offshore sector |
| MRO | Maritime spatial planning |
| MSRL | 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 (Marine Strategy Framework Directive) |
| NAO | North Atlantic Oscillation |
| NSG | Nature reserve |
| NN | Normal zero |
| OSPAR | Oslo-Paris Agreement |
| OWP | Offshore wind farm |
| PAH | polycyclic aromatic hydrocarbons |
| POD | Porpoise Click Detector |
| PSU | Practical Salinity Units |
| R & D | Research and Development |
| ROP | Spatial development plan |
| ROP 2009 | Regional development plan for the German EEZ 2009 |
| ROP-E | Draft spatial development plan for the German EEZ 2021 |
| SCANS | Small Cetacean Abundance in the North Sea and Adjacent Waters |
| SeeAnlV | Ordinance on Installations on the seaward side of the German territorial sea (Offshore Installations Ordinance) |
| SEL | Sound event level |
| SPA | Special Protected Area |
| SPEC | Species of European Conservation Concern (Important species for bird conservation in Europe) |
| StUK4 | Standard "Investigation of the effects of offshore wind energy plants". |
| StUKplus | "Ecological accompanying research on the alpha ventus offshore test field project |
| SUP | Strategic Environmental Assessment |
| SUP-RL | Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (SEA Directive) |
| TFEU | Treaty on the Functioning of the European Union |
| TSO | Transmission System Operator |
| UVPG | Law on environmental impact assessment |
| UBA | Federal Environment Agency |
| UVS | Environmental impact study |
| VARS | Visual Automatic Recording System |
| VMS | Vessel Monitoring System |

| | |
|---|---|
| V-RL | Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive) |
| WindSeeG | Act on the development and promotion of offshore wind energy (Wind Energy at Sea Act - WindSeeG) |
| WTG | Wind turbine |

# 1 Introduction

## 1.1 Legal bases and environmental assessment tasks

Maritime spatial planning in the German Exclusive Economic Zone (EEZ) is the responsibility of the Federal Government under the Regional Planning Act (Raumordnungsgesetz, ROG)[1]. In accordance with Article 17(1) of the ROG, the competent Federal Ministry, the Federal Ministry of the Interior, Building and Community (BMI), in agreement with the federal ministries concerned, draws up a spatial plan for the German EEZ as a statutory instrument. In accordance with Article 17(1) Sentence 3 of the ROG, the BSH carries out the preliminary procedural steps for drawing up the spatial plans (Raumordnungsplans, ROP) with the consent of the BMI. When drawing up the ROP, an environmental assessment is carried out in accordance with the provisions of the ROG and, where applicable, those of the Environmental Impacts Assessment Act (Gesetz über die Umweltverträglichkeitsprüfung, UVPG)[2], the so-called Strategic Environmental Assessment (SEA).

The obligation to carry out a strategic environmental assessment, including the preparation of an environmental report, is a result of the updating, amendment and cancellation of the existing spatial plans from 2009, from Articles 7(7) and (8) of the ROG, in conjunction with Article 35(1) No. 1 of the UVPG and No. 1.6 of Annex 5.

According to Article 1 of the SEA Directive 2001/42/EC, the aim of the Strategic Environmental Assessment is to ensure a high level of environmental protection in order to promote sustainable development and to contribute to ensuring that environmental considerations are adequately taken into account during the preparation and adoption of plans well in advance of the actual project planning. According to Article 8 of the ROG, the Strategic Environmental Assessment has the task of determining the likely significant impacts of implementing the plan and to describe and evaluate them in an environmental report at an early stage. It serves to ensure effective environmental precautions in accordance with the applicable laws and is performed according to uniform principles and with public participation. All protected resources under Article 8(1) of ROG are to be considered:

- people, including human health
- fauna, flora, and biodiversity
- site, soil, water, air, climate and landscape
- cultural and other material resources
- the interactions between the above-mentioned protected resources.

In the context of spatial planning, definitions are mainly made in the form of priority and reserved areas and other objectives and principles.

The requirements and content of the environmental report to be prepared are specified in Annex 1 of Article 8(1) of the ROG.

Accordingly, the environmental report consists of an introduction, a description and assessment of the environmental impacts identified in the environmental review, in accordance with Article 8(1) of the ROG, and additional information.

[1] Of 22 December 2008 (BGBl. I p. 2986), last amended by Article 159 of the Ordinance of 19 June 2020 (BGBl. I p. 1328).

[2] In the version promulgated on 24 February 2010, BGBl. I p. 94, last amended by Article 2 of the Act of 30 November 2016 (BGBl. I p. 2749).

According to No. 2d) of Annex 1 of Article 8 of the ROG, other planning options that may be expressly considered should also be named, taking into account the objectives and the geographical scope of the ROP.

## 1.2 Outline of the content and main objectives of the spatial plan

According to Article 17(1) of the ROG, the spatial plan for the German EEZ must take into account any interaction between land and sea, as well as safety aspects

1. to ensure safety and ease of navigation,
2. for further economic uses,
3. for scientific uses and
4. to protect and improve the marine environment.

According to Article 7(1) of the ROG, spatial plans for a specific planning area and a regular medium-term period must contain specifications as **objectives and principles** of spatial planning for the development, order and safeguarding of the area, in particular for the uses and functions of the area.

Under Article 7(3) of the ROG, these provisions may also designate areas. For the EEZ, these may be the following areas:

**Priority areas** intended for certain spatially significant functions or uses and excluding other spatially significant functions or uses in the area, where these are incompatible with the priority functions or uses.

**Reserved areas,** which are to be reserved for certain spatially significant functions or uses, to which particular weight is to be attached when comparing them to competing spatially significant functions or uses.

**Suitability areas for the marine area** in which certain spatially significant functions or uses do not conflict with other spatially significant interests, whereby these functions or uses are excluded elsewhere in the planning area.

In the case of priority areas, it may be stipulated that they also have the effect of suitability areas under Article 7(3) Sentence 2 No. 4 of the ROG.

According to Article 7(4) of the ROG, the spatial plans should also contain spatially significant planning provisions and measures by public bodies and entities under private law according to Article 4(1) Sentence 2 of the ROG which are suitable for inclusion in spatial plans, are necessary for the coordination of spatial claims, and can be secured by objectives or principles of spatial planning.

## 1.3 Relationship to other relevant plans, programmes and projects

In Germany, there is a tiered planning system for the coordination of all spatial requirements and concerns arising in a given area, consisting of Federal, State and Regional planning authorities. According to Article 1(1) Sentence 2 of the ROG, this system is used to coordinate different spatial requirements in order to balance out conflicts arising at the respective planning level and to make provisions for individual uses and functions of the space.

The tiered system allows the planning to be further specified by the subsequent planning levels. According to Article 1(3) of the ROG, the development, organisation and safeguarding of the subspaces should be integrated into the conditions and requirements of the overall area, and the development, organisation and safeguarding of the overall area should take into account the conditions and requirements of its subspaces.

The Federal Ministry of the Interior, Building and Community (BMI) is responsible for spatial planning at federal level in the EEZ. In contrast, the respective federal state is responsible for state planning for the entire area of the state, including the respective coastal waters.

In addition to spatial planning for the respective areas of responsibility, there are sectoral plans based on sectoral laws for certain planning areas. Sectoral plans serve to define details for the respective sector, taking into account the requirements of spatial planning.

### 1.3.1 Spatial plans in adjacent areas

In the interests of coherent planning, coordination processes with the plans of the coastal federal states and neighbouring states are advisable and must be taken into account in the cumulative assessment of impacts on the marine environment. At present, the spatial planning of both Lower Saxony and Schleswig-Holstein is being updated. Regional spatial planning programmes of the coastal regions will be taken into account, provided that significant definitions are made for the coastal waters.

#### 1.3.1.1 Lower Saxony

The spatial plan for the state of Lower Saxony, including the coastal sea of Lower Saxony, is the State Spatial Planning Programme (Landesraumordnungsprogramm, LROP). The Ministry of Food, Agriculture and Consumer Protection of Lower Saxony, as the highest state planning authority, is responsible for drawing up and amending it; the final decision on the LROP is the responsibility of the state government. The LROP is based on a directive from 1994 and has been updated several times since then, most recently in 2017. At the end of 2019, the procedure for a new update was initiated.

#### 1.3.1.2 Schleswig-Holstein

In Schleswig-Holstein, the State Development Plan (Landesentwicklungsplan, LEP S-H) is the basis for the state's spatial planning. The Ministry of the Interior, Rural Areas, Integration and Equality of Schleswig-Holstein (MILIG) is responsible for drafting it and amending it. The current LEP S-H, from 2010, forms the basis for the spatial planning of the state until 2025. The state of Schleswig-Holstein has initiated the procedure for updating the LEP S-H 2010 and carried out a participation procedure in 2019.

#### 1.3.1.3 Netherlands

The Netherlands is in the fourth revision cycle and is currently preparing the planning phase. The plan is binding and covers a planning area.

#### 1.3.1.4 United Kingdom

England consists of 11 planning areas and each area is to receive its own plan. These are to be designed for a long-term period of about 20 years and updated every three years. It is envisaged that all plans will be in place by 2021.

The Scottish Plan is currently being revised and is in its second cycle. The consultation on the revision of the first plan has just been completed. Scotland has one national maritime spatial plan and 11 spatial planning areas. The spatial plans are also binding in Scotland.

#### 1.3.1.5 Denmark

Denmark is at an advanced stage of the spatial planning process. Denmark is currently drafting the first spatial plan as a comprehensive plan for the North Sea and the Baltic Sea, which will be binding and last until 2050.

### 1.3.2 MSFD programme of measures

Each Member State must develop a marine strategy to achieve good status for its marine waters, which for Germany is the North Sea and the Baltic Sea. The key to this is the establishment of a programme of measures to achieve or maintain good environmental status and the practical implementation of this programme of measures. The establishment of the programme of measures (BMUB, 2016) is regulated in Germany by Article 45h of the Federal Water Act (Wasserhaushaltsgesetz, WHG). Under Objective 2.4 "Oceans with sustainably and carefully used resources", the current MSFD programme of measures mentions maritime spatial planning as a contribution of existing measures to achieving the operational objectives of the MSFD. In addition, the catalogue of measures also formulates a concrete review mandate for updating the spatial plans with regard to measures for the protection of migratory species in the marine area. Both the environmental objectives of the MSFD and the MSFD programme of measures are taken into account in the SEA.

### 1.3.3 Management plans for the North Sea EEZ nature reserves

On 17 November 2017, the Federal Agency for Nature Conservation (Bundesamt für Naturschutz, BfN) initiated the participation procedure under Article 7(3) of the Regulation on the Establishment of the "Borkum Riffgrund" Nature Conservation Area (NSGBRgV)[3], Article 7(3) of the Regulation on the Establishment of the Doggerbank Nature Conservation Area (NSGDgbV) [4]and Article 9(3) of the Regulation on the Establishment of the "Sylt Outer Reef - Eastern German Bight" Nature Conservation Area (NSGSylV)[5] on the management plans for the nature conservation areas in the German North Sea EEZ. On 13 May 2020, the management plans "Borkum Riffgrund"[6], "Doggerbank" [7]and "Sylt Outer Reef - Eastern German Bight" were [8]published in the Federal Gazette.

### 1.3.4 Tiered planning procedure for offshore wind energy and power lines (central model)

For some uses in the German EEZ, such as offshore wind energy and power cables, a multi-stage planning and approval process—i.e. a subdivision into several stages—is envisaged. In this context, the instrument of maritime spatial planning is at the highest and superordinate level. The spatial plan is the forward-looking planning instrument which coordinates the most diverse interests of users in the fields of industry, science and research as well as protection claims. A strategic environmental assessment must be carried out when the spatial plan is drafted. The SEA for the ROP is related to various downstream environmental assessments, in particular the directly downstream SEA for the site development plan (FEP).

The next level is the FEP. Within the framework of the so-called central model, the FEP is the control instrument for the orderly expansion of offshore wind energy and electricity grids in a tiered planning process. The FEP has the character of a sectoral plan. The sectoral plan is designed to plan the use of offshore wind energy and the electricity grids in a targeted manner and as optimally as possible under the given framework conditions—in particular the requirements of spatial planning—by defining areas and sites as well as locations, routes and route corridors for grid connections or for cross-border submarine cable systems. In principle, a SEA is carried out to accompany the establishment, updating and modification of the FEP.

In the next step, the sites for offshore wind turbines defined in the FEP will undergo a preliminary examination. If the requirements of Article 12(2) of the Wind Energy At Sea Act (WindSeeG) are met, the preliminary examination is followed by the determination of the suitability of the site for the construction and operation of

[3] Of 22 September 2017 (BGBl. I p. 3395).

[4]"Of 22 September 2017 (BGBl. I p. 3400).

[5] Of 22 September 2017 (BGBl. I p. 3423).

[6] Published on 17 April 2020, BAnz AT 13.05.2020 B9.

[7] Published on 13 May 2020, BAnz AT 13.05.2020 B10.

[8] Published on 13 May 2020, BAnz AT 13.05.2020 B11.

offshore wind energy installations. The preliminary investigation is also accompanied by a SEA.

If the suitability of a site for the use of offshore wind energy is established, the site is put out to tender and the winning bidder or corresponding entitled entity can submit an application for approval (planning approval or planning permission) for the erection and operation of wind turbines on the area specified in the FEP. As part of the planning approval procedure, an environmental impact assessment is carried out if the prerequisites are met.

While the sites defined in the FEP for the use of offshore wind energy are pre-examined and tendered, this is not the case for defined sites, routes and route corridors for grid connections or cross-border submarine cable systems. Upon application, a planning approval procedure including an environmental assessment is usually carried out for the construction and operation of grid connection lines. The same applies to cross-border submarine cable systems.

Under Article 1(4) of the UVPG, the UVPG also applies where federal or state legislation does not specify the environmental impact assessment in more detail or does not comply with the essential requirements of the UVPG.

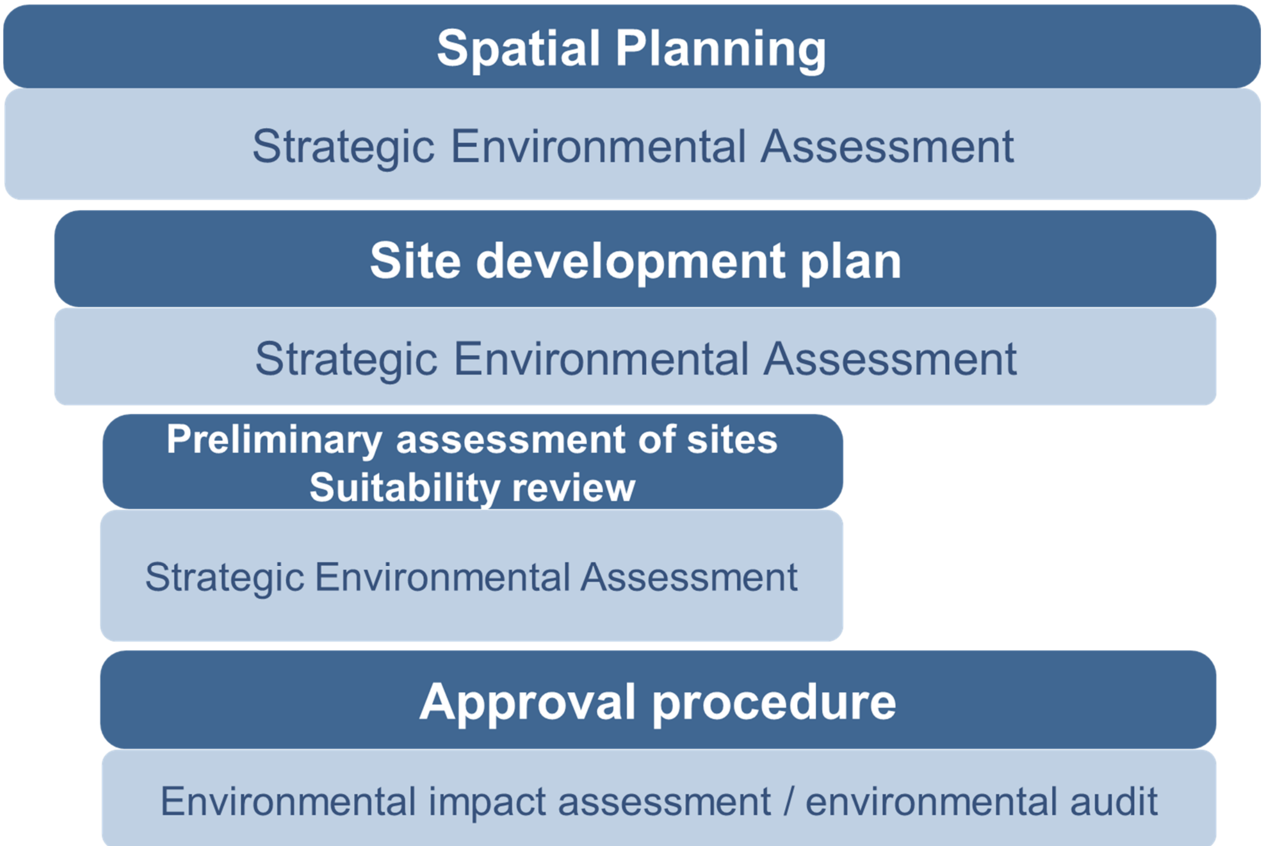


Figure 1: Overview of the tiered planning and approval process in the EEZ.

In the case of multi-stage planning and approval processes, it follows from the relevant legislation (e.g. Federal Regional Planning Act, WindSeeG and BBergG) or, more generally, from Article 39(3) of the UVPG that, in the case of plans, when defining the scope of the investigation, it should be determined at which of the process stages certain environmental impacts are to be assessed. In this way, multiple assessments are to be avoided. The nature and extent of the environmental impacts, technical requirements, and the content and subject matter of the plan must be taken into account.

In the case of subsequent plans and subsequent approvals of projects for which the plan sets a framework, the environmental assessment pursuant to Article 39(3) Sentence 3 of the UVPG shall be limited to additional or other significant environmental impacts as well as to necessary updates and more detailed investigations.

As part of the tiered planning and approval process, a common feature of all reviews is that environmental impacts on the protected resources specified in Article 8(1) of the ROG and Article 2(1) of the UVPG are considered, including their interactions.

According to the definition in Article 2(2) of the UVPG, environmental impacts within the meaning of the UVPG are direct and indirect impacts of a project or the implementation of a plan or programme on the protected resources.

According to Article 3 of the UVPG, environmental assessments comprise the identification, description and assessment of the significant impacts of a project or a plan or programme on the protected resources. They serve to ensure effective environmental protection in accordance with the applicable laws and are carried out according to uniform principles and with public participation.

In the offshore sector, avifauna has become established as a sub-category of the objects of protection of animals, plants and biological diversity: seabirds/resting and migratory birds, benthos, biotope types, plankton, marine mammals, fish and bats.

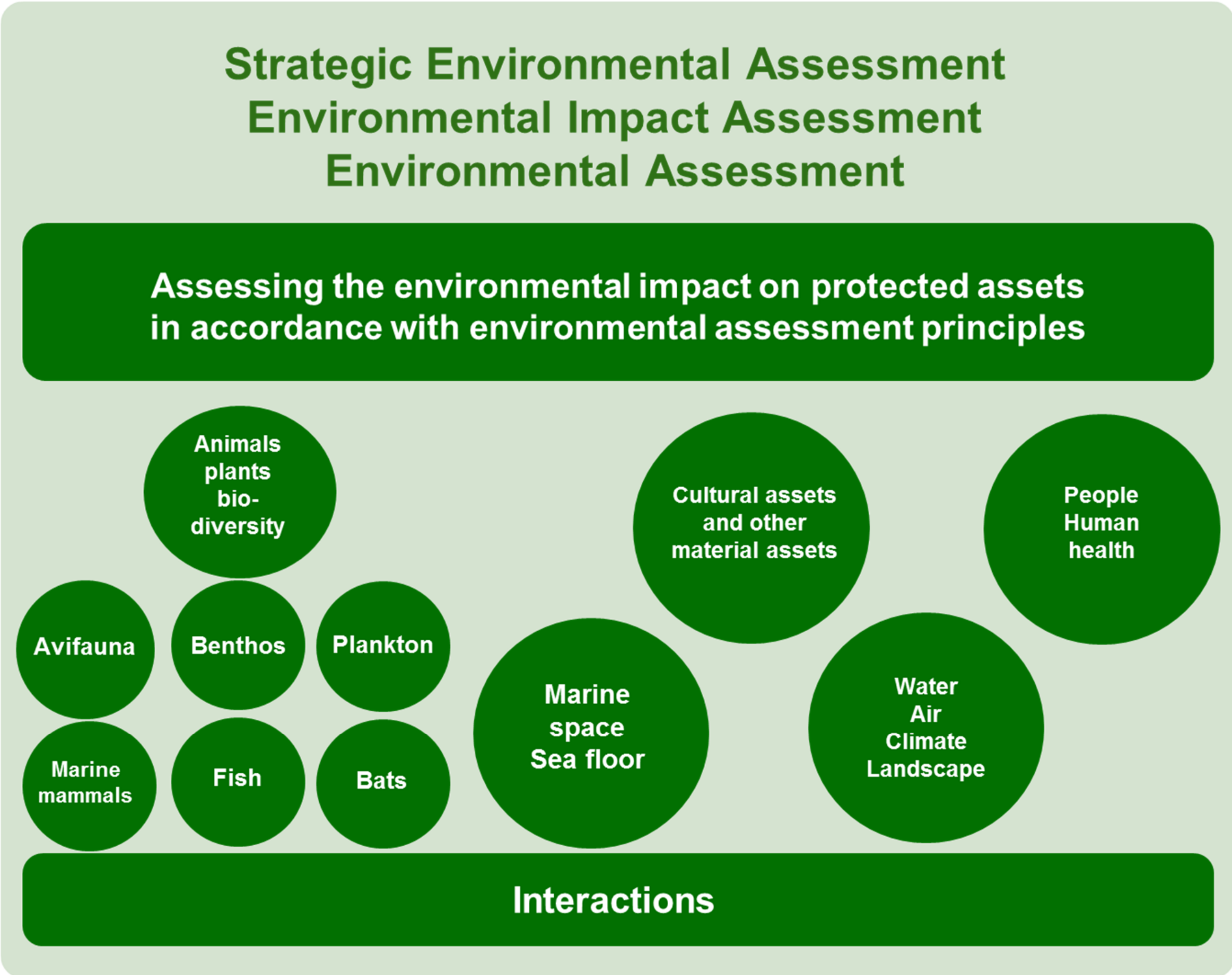


Figure 2: Overview of the protected resources in the environmental assessments.

The detail of the tiered planning process is as follows:

#### 1.3.4.1 Maritime spatial planning (EEZ)

At the highest and superordinate level is the instrument of maritime spatial planning. For sustainable spatial planning in the EEZ, the BSH prepares a spatial plan on behalf of the competent Federal Ministry, which comes into force in the form of statutory orders.

The spatial plans should **define**, taking into account possible interactions between land and sea, and safety aspects

- to ensure the safety and ease of navigation,
- for further economic uses,
- for scientific uses and
- to protect and improve the marine environment.

In the context of spatial planning, specifications are mainly made in the form of priority and reserved areas and other objectives and principles. According to Article 8(1) of the ROG, when drafting spatial plans, the body responsible for the spatial plan must carry out a strategic environmental assessment in which the likely significant impacts of the respective spatial plan on the resources to be protected, including interactions, must be identified, described and evaluated.

The **aim** of the instrument of spatial planning is to optimise overall planning solutions. A wider spectrum of uses and functions is considered. Fundamental strategic questions should be clarified at the beginning of a planning process. In this way, the instrument primarily functions, within the framework of the legal provisions, as a controlling planning instrument for the planning administrative bodies in order to create a framework for all uses which is compatible with the spatial and natural environment as far as possible.

In spatial planning, the **depth of examination** is generally characterised by a greater scope of investigation, i.e. a fundamentally greater number of planning options, and a lesser depth of investigation in terms of detailed analyses. Above all, regional, national and global impacts as well as secondary, cumulative and synergetic effects are taken into account.

The **focus** is therefore on possible cumulative effects, strategic and large-scale planning options and possible transboundary impacts.

#### 1.3.4.2 Site development plan

The next level is the FEP.

The **specifications** to be made by the FEP and to be examined within the framework of the SEA result from Article 5(1) of the WindSeeG. The plan mainly specifies areas and sites for wind energy plants as well as the expected capacity to be installed on these sites. In addition, the FEP also specifies routes, route corridors and sites. Planning and technical principles are also laid down. Although these also serve, among other things, to reduce environmental impacts, they may in turn lead to impacts, so that an assessment is required as part of the SEA.

With regard to the FEP's **objectives,** it deals with the fundamental questions of the use of offshore wind energy and grid connections on the basis of the legal requirements, especially with the need, purpose, technology and the identification of sites and routes or route corridors. Therefore, the primary function of the plan is as a steering planning instrument in order to create a spatially and, as far as possible, nature-compatible framework for the implementation of individual projects, i.e. the construction and operation of offshore wind energy plants, their grid connections, cross-border submarine cable systems and interconnections.

The **depth of the assessment** of the likely significant environmental effects is characterised by a wider scope of investigation, i.e. a larger number of alternatives and, in principle, a lower depth of investigation. At the level of sectoral planning, detailed analyses are generally not yet performed. Above all, local, national and global impacts, as well as secondary, cumulative and synergistic impacts in the sense of an overall view, are taken into account.

As with the instrument of maritime spatial planning, the **focus** of the audit is on possible cumulative effects as well as possible cross-border impacts. In addition, the FEP focuses on strategic, technical and spatial alternatives, especially for the use of wind energy and power lines.

#### 1.3.4.3 Suitability test as part of the preliminary examination

The next step in the tiered planning process is the suitability testing of sites for offshore wind turbines.

In addition, the power to be installed is determined on the site in question.

In accordance with Article 10(2) of the WindSeeG, the suitability test assesses whether the construction and operation of offshore wind energy installations on the site conflicts with the criteria for the inadmissibility of defining a site in the site development plan, in accordance with Article 5(3) of the WindSeeG or, insofar as they can be assessed independently of the later design of the project, with the interests relevant for the plan approval in accordance with Article 48(4) Sentence 1 of the WindSeeG.

Both the criteria of Article 5(3) of the WindSeeG and the matters of Article 48(4) Sentence 1 of the WindSeeG require an assessment of whether the marine environment is endangered. With regard to the latter concerns, there must be an assessment of whether pollution of the marine environment within the meaning of Article 1(1) No. 4 of the United Nations Convention on the Law of the Sea is at risk and whether bird migration is endangered.

Therefore, the preliminary examination with the suitability assessment or determination is the instrument connected between the FEP and the individual approval procedure for offshore wind energy plants. It refers to a specific site designated in the FEP and is thus much smaller than the FEP. It is distinguished from the plan approval procedure by the fact that an inspection approach which is independent of the later specific type of plant and layout is to be applied. So, the impact prognosis is based on model parameters, e.g. in two scenarios or ranges of scenarios which are intended to represent possible realistic developments.

Compared to the FEP, the SEA of the proficiency test is characterised by a smaller examination area and a greater **depth of examination**. In principle, fewer and spatially limited alternatives are seriously considered. The two primary alternatives are the determination of the suitability of a site on the one hand and the determination of its (possibly partial) unsuitability (see Article 12(6) of the WindSeeG) on the other. Restrictions on the type and extent of development, which are included as specifications in the determination of suitability, are not alternatives in this sense.

The **focus** of the environmental assessment within the framework of the suitability test is on considering the local impacts of a development with wind energy plants in relation to the site and the location of the development on the site.

#### 1.3.4.4 Approval procedure (planning approval and planning licensing procedure) for offshore wind turbines

The next step after the preliminary examination is the approval procedure for the installation and operation of offshore wind turbines. After the site under examination has been put out to

tender by the BNetzA, the winning bidder can, once BNetzA has accepted the bid, submit an application for planning approval or—if the prerequisites are met—for planning permission for the construction and operation of offshore wind energy plants, including the necessary ancillary plants on the site under examination.

In addition to the legal requirements of Article 73(1) Sentence 2 of the VwVfG, the plan must include the information contained in Article 47(1) of the WindSeeG. The plan may only be established under certain conditions listed in Article 48(4) of the WindSeeG, and only if, inter alia, the marine environment is not endangered, in particular if there is no cause for concern about pollution of the marine environment within the meaning of Article 1(1) No.4 of the Convention on the Law of the Sea, and if bird migration is not endangered.

Under Article 24 of the UVPG, the competent authority prepares a summary of

- the environmental impact of the project
- the characteristics of the project and the site, which are intended to prevent, reduce or offset significant adverse environmental effects
- measures to prevent, reduce or offset significant adverse environmental impacts
- the replacement measures in case of interventions in nature and landscape.

Under Article 16(1) of the UVPG, the project developer must submit a report to the competent authority on the expected environmental impacts of the project (EIA report), which must contain at least the following information:

- a description of the project, including information on the location, nature, scale and design, size and other essential characteristics of the project
- a description of the environment and its components within the project's sphere of influence
- a description of the characteristics of the project and of the location of the project to exclude, reduce or offset the occurrence of significant adverse environmental effects of the project
- a description of the measures planned to prevent, reduce or offset any significant adverse effects of the project on the environment and a description of planned replacement measures
- a description of the expected significant environmental effects of the project
- a description of the reasonable alternatives, relevant to the project and its specific characteristics, that have been considered by the developer and the main reasons for the choice made, taking into account the specific environmental effects of the project
- a generally understandable, non-technical summary of the EIA report.

Pilot wind energy plants are only dealt with in the context of the environmental assessment in the approval procedure and not at upstream stages.

#### 1.3.4.5 Approval procedure for grid connections (converter platforms and submarine cable systems)

In the tiered planning process, the establishment and operation of grid connections for offshore wind energy plants (converter platform and submarine cable systems, if applicable) is examined at the level of the approval procedures (planning approval and planning permission procedures) when implementing the spatial planning requirements and the specifications of the FEP at the request of the respective project executing agency—the responsible TSO.

According to Article 44(1) in conjunction with Article 45(1) of the WindSeeG, the construction and operation of facilities for the transmission of electricity require planning approval. In addition to the legal requirements of Article 73(1) Sentence 2 of the VwVfG, the plan must include the information contained in Article 47(1) of the WindSeeG. The plan may only be approved under certain conditions listed in Article 48(4) of the WindSeeG and only if, inter alia, the marine environment is not endangered, in particular if there is no cause for concern about pollution of the marine environment within the meaning of Article 1(1) No.4 of the Convention on the Law of the Sea, and no threat to bird migration.

Moreover, according to Article 1(4) of the UVPG, the requirements for the environmental impact assessment of offshore wind energy installations, including ancillary installations, apply accordingly to the performance of the environmental assessment.

#### 1.3.4.6 Cross-border submarine cable systems

According to Article 133(1) in conjunction with Article 133(4) of the BBergG (Federal Mining Act), the construction and operation of an underwater cable in or on the continental shelf requires a permit

- from a mining point of view (through the competent state mining authority)
- concerning the organisation of the use and exploitation of waters above the continental shelf and the airspace above these waters (through the BSH).

In accordance with Article 133(2) of the BBergG, the above-mentioned permits may only be refused if there is a risk to the life or health of persons or material resources or an impairment of overriding public interests which cannot be prevented or compensated for by a time limit, conditions or requirements. An impairment of overriding public interests exists in particular in the cases specified in Article 132(2) No. 3 of the BBergG. In accordance with Article 132(2) No. 3 b) and d) of the BBergG, an impairment of overriding public interests with regard to the marine environment exists in particular if the flora and fauna would be impaired in an unacceptable manner or if there is reason to believe that the sea will be polluted.

In accordance with Article 1(4) of the UVPG, the essential requirements of the UVPG must be observed for the construction and operation of transboundary submarine cable systems.

## Tabular overview of environmental audits: Focus of the investigations

| Maritime spatial planning<br>SEA | FEP<br>SEA | Preliminary study<br>SEA suitability test | Approval procedure<br>(planning approval or planning permission) grid connections<br>EA | Approval procedure<br>Transboundary submarine cable systems<br>EA |
|---|---|---|---|---|
| ***Strategic planning for designations*** | ***Strategic planning for designations*** | ***Strategic decision on suitability of sites for OWF*** | **Request for environmental assessment** | **Request for environmental assessment** |
| **Specifications and subject matter** | | | | |
| Priority and reservation areas<br>• To ensure the safety and efficiency of navigation,<br>• To further economic uses. especially offshore wind energy and pipelines<br>• To enable scientific uses and to protect and improve the marine environment<br><br>Objectives and principles<br><br>Application of the ecosystem approach | • Areas for offshore wind turbines<br>• Areas for offshore wind turbines, including the expected capacity to be installed<br><br>• Platform locations<br>• Routes and route corridors for submarine cable systems<br>• Technical and planning principles | • Verification of the suitability of the site for the construction and operation of wind turbines, including the capacity to be installed<br>• On the basis of the available and collected data (STUK) as well as other information that can be determined with reasonable effort<br>• Specifications in particular on the type, extent and location of the development | • The construction and operation of platforms and interconnectors<br>• In accordance with the requirements of maritime spatial planning and the site development plan | • The construction and operation of transboundary submarine cable systems<br><br>• According to the requirements of regional planning and the FEP |
| **Environmental impact analysis** | | | | |
| Analyses (identifies, describes and assesses) the likely significant effects of the plan on the marine environment | Analyses (identifies, describes and assesses) the likely significant environmental effects of the plan on the marine environment | Analyses (determines, describes and evaluates) the likely significant environmental impacts of the construction and operation of wind turbines, which can be assessed independently of the later design of the project, on the basis of model assumptions | Analyses (determines, describes and evaluates) the environmental impacts of the specific project (platform and connecting undersea cable, if applicable). | Analyses (identifies, describes and evaluates) the environmental impacts of the specific project. |
| **Objective** | | | | |
| Aims at the optimisation of overall planning solutions, i.e. comprehensive packages of measures.<br><br>Consideration of a wider range of uses.<br><br>Begins at the beginning of the planning process to clarify strategic issues of principle, i.e. at an early stage when there is even greater scope for action. | For the use of offshore wind energy, addresses the fundamental questions of<br>• Needs or statutory objectives<br>• Purpose<br>• Technology<br>• Capacities<br>• Finding locations for platforms and tracks. | For the use of wind turbines, deals with the fundamental questions of<br>• Capacity<br>• Suitability of the area<br><br>Provides information on the site required by law for the submission of bids. | Deals with questions regarding the concrete design ("how") of a project (technical equipment, construction - building permits).<br><br>Assesses the environmental compatibility of the project and formulates conditions for this. | Deals with questions regarding the concrete design ("how") of a project (technical equipment, construction - building permits).<br><br>Assesses the environmental impact of the project and also formulates conditions. |

| | | | | |
|---|---|---|---|---|
| | Searches for environmentally sound packages of measures without absolutely assessing the environmental compatibility of the planning. | Searches for environmentally sound packages of measures without assessing the environmental compatibility of the specific project. | | |
| Essentially functions as a controlling planning instrument of the planning administrative bodies to create an environmentally compatible framework for all uses. | Acts mainly as a steering planning instrument to create an environmentally sound framework for the realisation of individual projects (wind turbines and grid connections, transboundary submarine cables) | Acts as an instrument between the FEP and the approval procedure for wind turbines on a specific site. | Serves primarily as a passive assessment instrument that reacts to requests from the project developer. | Serves primarily as a passive assessment instrument that reacts to requests from the project developer. |
| **Assessment depth** | | | | |
| Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses)<br><br>Considers spatial, national and global impacts as well as secondary, cumulative and synergistic impacts in the sense of a comprehensive perspective . | Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses)<br><br>Takes into account local, national and global impacts as well as secondary, cumulative and synergistic impacts in the sense of an overall view. | Characterised by a smaller assessment area, greater depth of study (detailed analyses).<br><br>The determination of suitability may include specifications for the subsequent project, in particular with regard to the type and extent of the development of the site and its location. | Characterised by a narrower scope of study (limited number of alternatives) and greater depth of study (detailed analyses).<br><br>Assesses the environmental compatibility of the project and formulates conditions for this.<br><br>Considers primarily local impacts in the vicinity of the project. | Characterised by a narrower scope of study (limited number of alternatives) and greater depth of study (detailed analyses).<br><br>Considers primarily local impacts in the vicinity of the project. |
| **Focus of the assessment** | | | | |
| **Cumulative effects**<br>Overall perspective<br>Strategic and large-scale alternatives<br>Possible transboundary effects | **Cumulative effects**<br>Overall perspective<br>Strategic, technical and spatial alternatives<br>Possible transboundary effects | **Local effects in** relation to the site and its location. | Environmental impacts of turbines, construction and operation<br><br>Turbine dismantling<br><br>Study in relation to the specific installation design.<br><br>Intervention, compensation and replacement measures. | Environmental impacts of turbines, construction and operation<br><br>Study in relation to the specific installation design.<br><br>Intervention, compensation and replacement measures. |

**Approval procedure (plan approval or plan permit) for wind turbinesEIA**

## Assessment subject

**Environmental impact assessment on request for**

- The installation and operation of wind turbines
- The site defined and pre-examined in the FEP
- According to the designations of the FEP and the specifications of the preliminary study.

## Environmental impact assessment

Analyses (determines, describes and evaluates) the environmental impacts of the specific project (wind turbines, platforms and internal cabling of the wind farm, if applicable)

Under Section 24 UVPG, the competent authority prepares a summary

- Of the environmental impacts of the project,
- Of the characteristics of the project and of the site, which are intended to prevent, reduce or offset **significant adverse environmental effects,**
- Of the measures to prevent, reduce or offset **significant negative environmental impacts**, and
- Of the replacement measures in the event of interference with nature and landscape (note: exception under Section 56 subsection 3 BNatSchG

### Objective

Addresses the questions of the specific design ("how") of a project (technical equipment, construction).

Serves primarily as a passive assessment instrument that reacts to requests from the tender winner/project developer.

### Assessment depth

Characterised by a narrower scope of study, i.e. a limited number of alternatives, and greater depth of study (detailed analyses).

Assesses the environmental compatibility of the project on the site under study and formulates conditions for this.

Considers mainly local effects in the vicinity of the project.

### Focus of the assessment

The main focus of the assessment is formed by:

- Environmental impacts from construction and operation.
- Assessment in relation to  the specific installation design.
- Installation dismantling.

Figure 3: Overview of key aspects of environmental assessments in planning and approval procedures.

### 1.3.5 Cables

On the upper level is the instrument of spatial planning. In this framework, areas or corridors for pipelines and data cables are defined.

According to Article 8(1) of the ROG, the likely significant effects of the pipeline provisions on the protected resources must be identified, described and assessed.

According to Article 133(1) in conjunction with Article 133(4) of the BBergG, the construction and operation of a transit pipeline or underwater cable (data cable) in or on the continental shelf requires a permit

- from a mining point of view (through the competent state mining authority) and
- concerning the organisation of the use and exploitation of waters above the continental shelf and the airspace above these waters (through the BSH).

According to Article 133(2) of the BBergG, the above-mentioned permits may only be refused if there is a risk to the life or health of persons or material resources or an impairment of overriding public interests which cannot be prevented or compensated for by a time limit, conditions or requirements. An impairment of overriding public interests exists in particular in the cases specified in Article 132(2) No. 3 of the BBergG. In accordance with Article 132(2) No. 3 b) and d) of the BBergG, an impairment of overriding public interests with regard to the marine environment exists in particular if the flora and fauna are impaired in an unacceptable manner or if there is reason to believe that the sea will be polluted.

In accordance with Article 133(2a) of the BBergG, the construction and operation of a transit pipeline, which is also a project within the meaning of Article 1(1) No.1 of the UVPG, is subject to an environmental impact assessment in the licensing procedure with regard to the organisation of the use and exploitation of the waters above the continental shelf and the airspace above these waters, as stipulated in the UVPG.

In accordance with Article 1(4) of the UVPG, the essential requirements of the UVPG must be observed for the construction and operation of data cables.

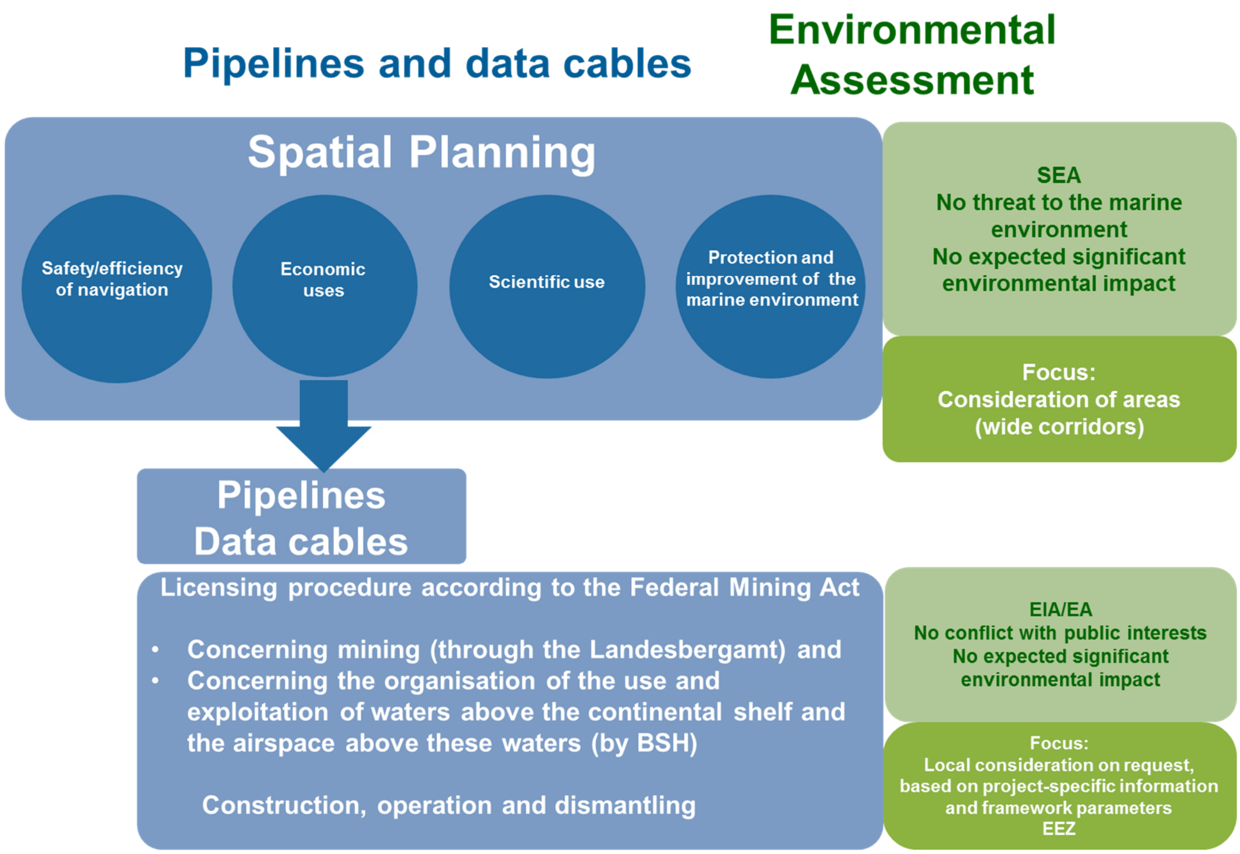


Figure 4: Overview of the focal points of the environmental assessment for pipelines and data cables.

### 1.3.6 Raw material extraction

In the German North and Baltic Seas, various mineral resources are sought and extracted, e.g. sand, gravel and hydrocarbons. As a superordinate instrument, spatial planning addresses possible large-scale spatial definitions, possibly including other uses. The anticipated significant environmental effects are reviewed (cf. also Chapter 1.5.4).

During implementation, the extraction of raw materials is regularly divided into different phases: exploration, development, operation and aftercare phase.

The exploration serves the purpose of exploring raw material deposits in accordance with Article 4(1) of the BBergG. In the marine area, it is regularly carried out by means of geophysical surveys, including seismic surveys and exploration drilling. In the EEZ, the extraction of raw materials includes the extraction (loosening, release), processing, storage and transport of raw materials.

In accordance with the Federal Mining Act, mining permits (permission, licence) must be obtained for exploration in the area of the continental shelf. These grant the right to explore for and/or extract mineral resources in a specified field for a specified period. Additional permits in the form of operating plans are required for development (extraction and exploration activities) (cf. Article 51 of the BBergG). For the establishment and management of an operation, main operating plans must be drawn up for a period not normally exceeding two years, which must be continuously updated as required (Article 52(1) Sentence 1 of the BBergG).

In the case of mining projects requiring an EIA Act, the preparation of a general operating plan is mandatory, and a planning approval procedure must be carried out for its approval (Article 52(2a) of the BBergG). Framework operation plans are generally valid for a period of 10 to 30 years.

In accordance with Article 57c of the BBergG in conjunction with the Regulation on the Environmental Impact Assessment of Mining Projects (UVP-V Bergbau), the construction and operation of production platforms for the extraction of oil and gas in the area of the continental shelf requires an EIA. The same applies to marine sand and gravel extraction on mining sites of more than 25 ha or in a designated nature reserve or Natura 2000 area.

The licensing authorities for the German North Sea and Baltic Sea EEZ are the state mining authorities.

#### 1.3.7 Shipping

In the context of spatial planning, the shipping sector is regularly defined in terms of areas (priority and/or reserved areas), objectives and principles. There is no tiered planning and approval process for the shipping sector, as is the case for the offshore wind energy sector, grid connections, cross-border submarine cables, pipelines and data cables.

With regard to the consideration of the likely significant effects of the provisions on the shipping sector, reference is made to Chapter 1.5.4.3

#### 1.3.8 Fisheries and marine aquaculture

Fisheries and aquaculture are considered as concerns in the context of spatial planning. There is no tiered planning and approval process. The framework for authorised catches, fishing techniques and gear is set within the framework of the EU's Common Fisheries Policy (CFP).

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

#### 1.3.9 Marine scientific research

Marine scientific research projects can have an adverse effect on the marine environment, e.g. through underwater noise generated during seismic surveys. On its website, the BfN mentions, among other things, the construction of artificial islands, installations or structures, the use of explosives, or measures of direct relevance to the exploration and exploitation of resources, which are in principle likely to have a significant effect on the area and must be assessed for their compatibility with the purpose of protecting potentially affected Natura 2000 protected areas before they are approved.

In this case, a nature conservation examination and approval are also required as part of the approval procedure. Notification is required for projects which do not require authorisation, and which may significantly affect Natura 2000 sites.

In the reserved areas, research is predominantly carried out by the Thuenen Institute under the technical supervision of the BMEL, especially within the framework of the CFP and reporting obligations within ICES. This takes place within the framework of long-term regular sampling and is not subject to authorisation in the EEZ.

#### 1.3.10 National and alliance defence

National and alliance defence is considered a concern in the context of spatial planning. There is no tiered planning and approval process.

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

#### 1.3.11 Leisure

The issue of leisure is also considered. There is no tiered planning and approval process.

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

## 1.4 Presentation and consideration of environmental protection objectives

The ROP and the SEA will be drafted and implemented with due regard for the objectives of environmental protection. These provide information on the environmental status that is to be achieved in the future (environmental quality objectives). The objectives of environmental protection can be found in an overview of the international, EU and national conventions and regulations dealing with marine environmental protection, on the basis of which the Federal Republic of Germany has committed itself to certain principles and objectives. The environmental report will contain a description of how compliance with the requirements is checked and what specifications or measures are taken.

### 1.4.1 International conventions on the protection of the marine environment

The Federal Republic of Germany is party to all relevant international conventions on marine environmental protection.

#### 1.4.1.1 Globally applicable conventions that are wholly or partly aimed at protecting the marine environment

- the 1973 Convention for the Prevention of Pollution from Ships, as amended by the 1978 Protocol (MARPOL 73/78)
- 1982 United Nations Convention on the Law of the Sea
- Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (London, 1972) and the 1996 Protocol

#### 1.4.1.2 Regional agreements on marine environmental protection

- Trilateral Wadden Sea Cooperation (1978) and Trilateral Monitoring and Assessment Programme of 1997 (TMAP)
- 1983 Agreement for Co-operation in Dealing with Pollution of the North Sea by Oil and Other Harmful Substances (Bonn Agreement)
- 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)

#### 1.4.1.3 Agreements specific to protected resources

- 1979 Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
- 1979 Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

Under the Bonn Convention, regional agreements for the conservation of the species listed in Appendix II were concluded in accordance with Article 4 No. 3 of the Bonn Convention:

- 1995 Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)
- 1991 Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)
- 1991 Agreement on the Conservation of Seals in the Wadden Sea
- 1991 Agreement on the Conservation of Populations of European Bats (EUROBATS)
- 1993 Convention on Biological Diversity

### 1.4.2 Environmental and nature protection requirements at EU level

The relevant EU legislation must be taken into account:

- Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning (MSP Directive)
- Council Directive 337/85/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (Environmental Impact Assessment Directive, EIA Directive)
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD)
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (Strategic Environmental Assessment Directive, SEA Directive)
- 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 (Marine Strategy Framework Directive, MSFD),
- Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (Birds Directive).

### 1.4.3 Environmental and nature conservation requirements at national level

There are also various legal provisions at national level, the requirements of which must be taken into account in the environmental report:

- Law on nature conservation and landscape management (Federal Nature Conservation Act - BNatSchG)
- Water Resources Act (WHG)
- Law on Environmental Impact Assessment (UVPG)
- Regulation on the establishment of the nature reserve "Sylt Outer Reef - Eastern German Bight", the regulation on the establishment of the nature reserve "Borkum Riffgrund", and the regulation on the establishment of the nature reserve "Doggerbank" in the North Sea EEZ
- Management plans for nature conservation areas in the German North Sea EEZ
- Energy and climate protection targets of the Federal Government

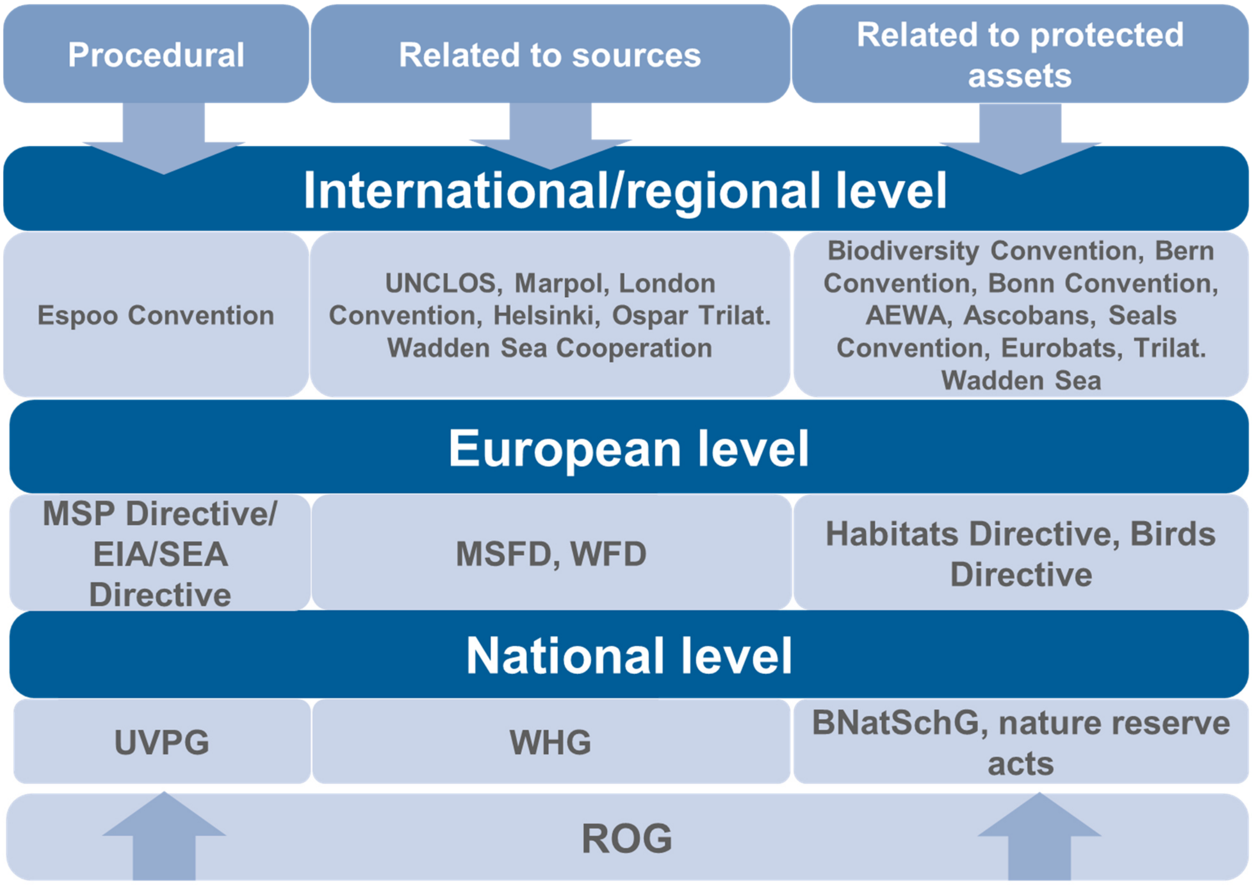


Figure 5: Overview of the levels of standardisation of the relevant legal acts for SEA.

### 1.4.4 Support for the objectives of the Marine Strategy Framework Directive

Spatial planning can support the implementation of individual objectives of the MSFD and thus contribute to good environmental status in the North Sea and Baltic Sea.

The following environmental goals (BMUB 2016) are taken into account when defining goals and principles:

- Environmental objective 1: Oceans unaffected by anthropogenic eutrophication—consideration in the objectives and principles for ensuring the safety and ease of navigation.
- Environmental objective 3: Oceans without deterioration of marine species and habitats due to the impact of human activities—consideration in the objectives and principles for offshore wind energy and nature conservation
- Environmental objective 6: Oceans without adverse impacts from anthropogenic energy inputs—consideration in the objectives and principles for offshore wind energy and pipelines

In the environmental assessment, avoidance and mitigation measures are formulated to support objectives 1, 3 and 6.

In addition, the spatial plan counteracts the deterioration of the environment by making certain uses possible only in geographically defined areas and for a limited period of time. The principles of environmental protection must be taken into account. At the permit level, the design of the use is specified in detail, with conditions if required, in order to prevent adverse effects on the marine environment.

An essential basis of the MSFD is the ecosystem approach regulated in Article 1(3) of the MSFD, which ensures the sustainable use of marine ecosystems by managing the overall

burden of human activities in a way that is compatible with the achievement of good environmental status. The application of the ecosystem approach is outlined in Chapter 4.3.

## 1.5 Strategic Environmental Assessment methodology

In principle, different methodological approaches can be considered when conducting the Strategic Environmental Assessment. The present environmental report builds on the methodology already applied in the Strategic Environmental Assessment of the federal sectoral plans and the site development plan with regard to the use of offshore wind energy and electricity grid connections.

For all other uses for which specifications are made in the ROP-E, such as shipping, extraction of raw materials and marine research, sector-specific criteria for an assessment of possible impacts are used.

The methodology is based primarily on the provisions of the plan to be examined. Within the framework of this SEA, each of the specifications is identified, described and assessed to see whether the specifications are likely to have significant effects on the protected resources concerned. According to Article 1(4) of the UVPG in conjunction with Article 40(3) of the UVPG, the competent authority shall provisionally assess the environmental impacts of the specifications in the environmental report with a view to effective environmental precautions in accordance with the applicable laws. Criteria for the assessment are to be found, inter alia, in Annex 2 of the Federal Regional Planning Act.

The purpose of the environmental report is to describe and assess the likely significant effects of the implementation of the ROP-E on the marine environment for provisions on the use and protection of the EEZ. The examination is carried out in each case on the basis of the protected resources.

According to Article 7(1) of the ROG, spatial plans must contain provisions as spatial planning **objectives and principles** for the development, organisation and safeguarding of areas, in particular on the uses and functions of areas. In accordance with Article 7(3) of the ROG, these provisions may also designate areas.

Specifications on the following uses are the subject of the environmental report, in particular

- Shipping
- Wind energy at sea
- Cables
- Raw material extraction
- Fisheries and marine aquaculture
- Marine Research
- Nature conservation/marine landscape/open space

In accordance with Article 17(1) No. 4 of the ROG, provisions for the protection and improvement of the marine environment also play a role.

### 1.5.1 Examination area

The description and assessment of the state of the environment refers to the North Sea EEZ, for which the spatial plan stipulates conditions. The SEA examination area covers the German North Sea EEZ (Figure 7). It should be noted that the data situation within the North Sea EEZ is significantly better for the area up to shipping route 10 than for the area northwest of shipping route 10. This is due to the project-related monitoring data available.

For the area north-west of shipping route 10, the spatial plan also defines the area. Based on the available sediment data and findings from monitoring for the "Doggerbank" protected area, it is also possible to describe and assess the environmental status of this area and evaluate potential environmental impacts.

The adjoining territorial sea and the adjacent areas of the riparian states are not the subject

of this plan, but they are included in the cumulative and transboundary consideration in the context of this SEA.

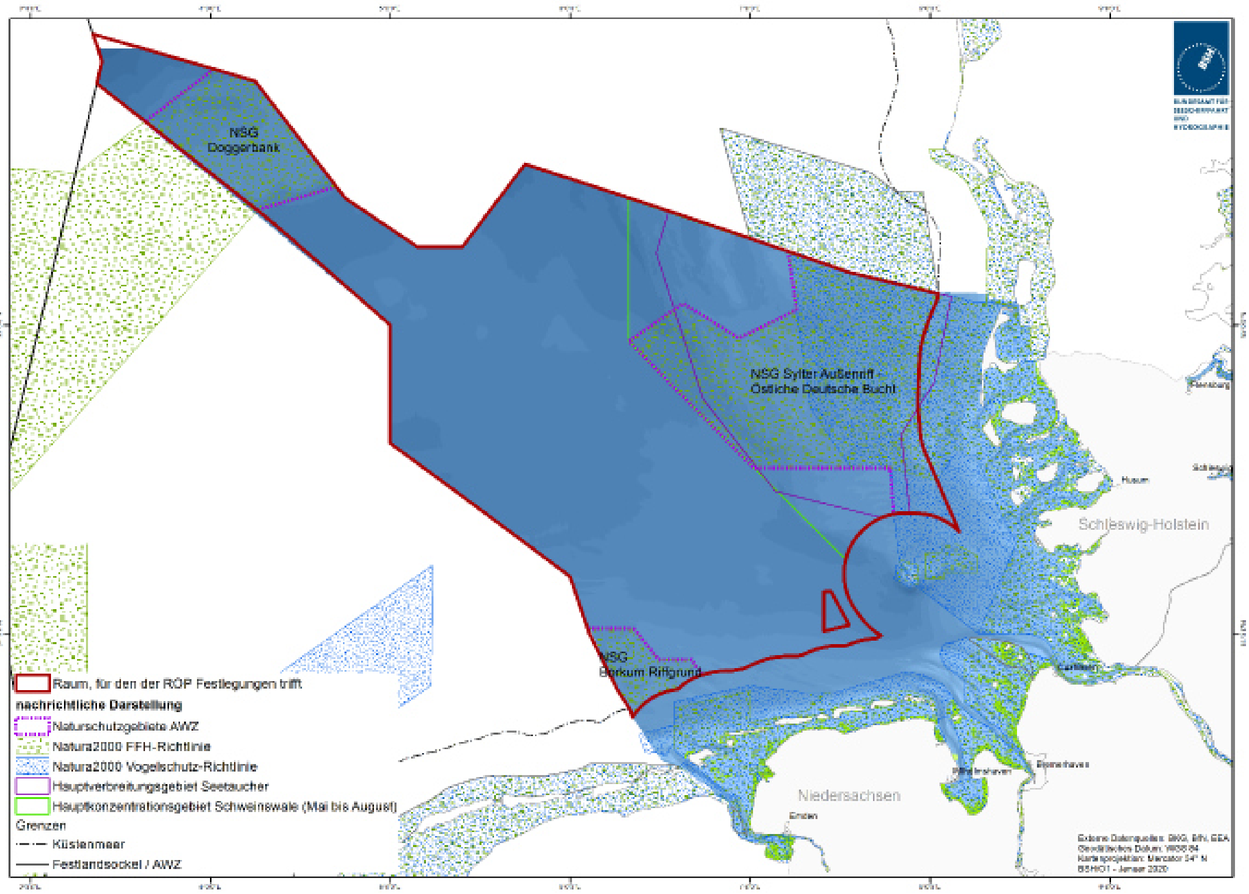


Figure 6: Boundary of the SEA investigation area (Environmental Report ROP-E EEZ North Sea).

### 1.5.2 Implementation of the environmental assessment

The assessment of the likely significant environmental effects of the implementation of the spatial plan shall include secondary, cumulative, synergistic, short-, medium- and long-term, permanent and temporary, positive and negative effects in terms of the resources to be protected. Secondary or indirect effects are those which are not immediate and therefore, may take effect after some time and/or in other places. Occasionally we also speak of consequential effects or interactions.

Possible impacts of the plan implementation are described and evaluated in relation to the protected areas. A uniform definition of the term "significance" does not exist, since it is an "individually determined significance" which cannot be considered independently of the "specific characteristics of plans or programmes" (SOMMER, 2005, 25f.). In general, significant effects can be understood to be effects that are serious and significant in the context under consideration.

According to the criteria of Annex 2 of the ROG, which are decisive for the assessment of the likely significant environmental effects, the significance is determined by

- "the probability, duration, frequency and irreversibility of the effects
- the cumulative nature of the effects
- the cross-border nature of the effects
- the risks to human health or the environment (e.g. in the event of accidents)
- the scale and spatial extent of the effect

- the importance and sensitivity of the area likely to be affected, due to its specific natural characteristics or cultural heritage, the exceeding of environmental quality standards or limit values and intensive land use
- the impact on sites or landscapes whose status is recognised as protected at national, Community or international level"

Also relevant are the characteristics of the plan, in particular

- the extent to which the plan sets a framework for projects and other activities in terms of location, type, size and operating conditions, or through the use of resources
- the extent to which the plan influences other plans and programmes, including those in a planning hierarchy
- the importance of the plan for the integration of environmental considerations, in particular with a view to promoting sustainable development
- the environmental issues relevant to the plan
- the relevance of the plan for the implementation of Community environmental legislation (e.g. plans and programmes relating to waste management or water protection) (Annex II of the SEA Directive)

In some cases, further details on when an effect reaches the significance threshold can be derived from sectoral legislation. Thresholds were developed under the law in order to be able to make a delimitation.

The description and assessment of potential environmental impacts is carried out for the individual spatial and textual specifications on the use and protection of the EEZ in relation to the protected property, including the status assessment.

Furthermore, where necessary, a differentiation is made according to different technical designs. The description and assessment of the likely significant effects of the implementation of the plan on the marine environment also relate to the protected resources presented. All contents of the plan that could potentially have significant environmental effects are examined.

Both permanent and temporary—e.g. construction-related—effects are considered. This is followed by a presentation of possible interactions, a consideration of possible cumulative effects and potential cross-border impacts.

The following protected resources are considered when assessing the state of the environment:

- Site
- Soil
- Water
- Plankton
- Biotope types
- Benthos
- Fish
- Marine mammals
- Avifauna
- Bats
- Biodiversity
- Air
- Climate
- Landscape
- Cultural and other material resources (underwater cultural heritage)
- People, in particular human health
- Interactions between protected resources

In general, the following methodological approaches are used in environmental assessment:

- Qualitative descriptions and assessments
- Quantitative descriptions and assessments
- Evaluation of studies and technical literature, expert opinions
- Visualisations
- Worst-case scenarios
- Trend assessments (e.g. on the state of the art of installations and the possible development of shipping traffic)
- Assessments by experts/the professional public

An assessment of the impacts resulting from the provisions of the plan is made on the basis of the status description and status assessment, and the function and significance of the individual areas for the individual protected resources on the one hand, and the impacts emanating from these provisions and the resulting potential impacts on the other. A forecast of the project-related impacts when the ROP-E is implemented is based on the criteria of intensity, range and duration or frequency of the effects (cf. Figure 7). Further assessment criteria are the probability and reversibility of the impacts, as specified in Annex 2 of Article 8(2) ROG.

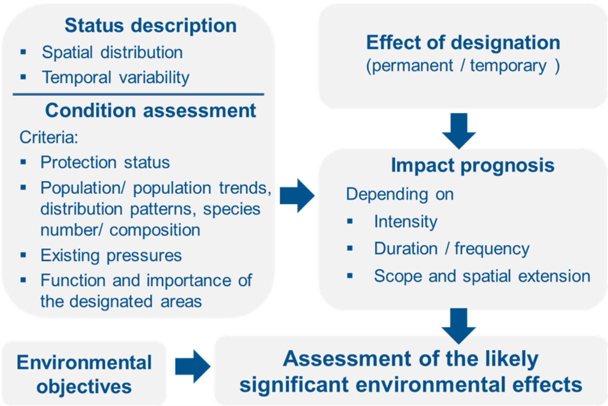


Figure 7: General methodology for assessing likely significant environmental effects.

### 1.5.3 Criteria for the description and assessment of the condition

The condition of the individual protected resources is assessed on the basis of various criteria. For the protected resources of site/soil, benthos and fish, the assessment is based on the aspects of rarity and vulnerability, diversity and peculiarity, and existing impacts. The description and assessment of marine mammals and marine and resting birds is based on the aspects listed in the figure. Since these are highly mobile species, a similar approach to that for the protected resources of site/soil, benthos and fish is not appropriate. For seabirds, resting birds and marine mammals, the criteria used are protection status, assessment of occurrence, assessment of spatial units and prior contamination. For migratory birds, the aspects of rarity, endangerment and existing pressures are taken into account, as are the aspects of occurrence assessment and the area's significance for bird migration over a large area. There is currently no reliable data source for a criteria-based assessment of bats as a protected species. The biodiversity protected resource is evaluated in text form.

The following is a summary of the criteria used for the status assessment of the respective protected resource. This overview deals with the protected resources which can be meaningfully delimited on the basis of criteria and which are considered in the focus area.

**Site/Soil**

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|---|
| **Aspect: Rarity and endangerment** |
| Criterion: Percentage of sediment on the seabed and distribution of the morphological inventory of forms. |
| **Aspect: Diversity and individuality** |
| Criterion: Heterogeneity of the sediment on the sea floor and formation of the morphological inventory of forms. |
| **Aspect: Prior contamination** |
| Criterion: Extent of the anthropogenic prior contamination of the sediment on the sea floor and the morphological inventory of forms. |

**Benthos**

| |
|---|
| **Aspect: Rarity and endangerment** |
| Criterion: Number of rare or endangered species based on the Red List species identified (Red List by RACHOR et al. 2013). |
| **Aspect: Diversity and individuality** |
| Criterion: Number of species and composition of the species communities. The extent to which species or communities that are characteristic of the habitat occur and how regularly they occur is assessed. |
| **Aspect: Prior contamination** |
| For this criterion, the intensity of fishing exploitation, which is the most effective disturbance variable, will be used as a benchmark. Eutrophication can also affect benthic communities. For other disturbance variables, such as vessel traffic, pollutants, etc., there is currently a lack of suitable measurement and detection methods to be able to include them in the assessment. |

**Biotope types**

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|---|
| **Aspect: Rarity and endangerment** |
| Criterion: national conservation status and endangerment of biotope types according to the Red List of Endangered Biotope Types in Germany (FINCK et al., 2017) |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences. |

**Fish**

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| **Aspect: Rarity and endangerment** |
| Criterion: Proportion of species considered endangered according to the current Red List of Marine Fish (THIEL et al. 2013) and for the diadromous species on the Red List of Freshwater Fish (FREYHOF 2009) and assigned to Red List categories. |
| **Aspect: Diversity and individuality** |
| Criterion: The diversity of a fish community can be described by the number of species (α-Diversity, 'Species richness'). The species composition can be used to assess the specific nature of a fish community, i.e. how regularly habitat-typical species occur. Diversity and specificity are compared and assessed between the North Sea and the German EEZ as a whole, and between the EEZ and individual areas. |
| **Aspect: Prior contamination** |
| Criterion: Through the removal of target species and bycatch, as well as the impact on the seabed in the case of bottom-dwelling fishing methods, fisheries are considered to be the most effective disturbance to the fish community and therefore, serve as a measure of the pressure on fish communities in the North Sea. There is no assessment of stocks on a smaller spatial scale such as the German Bight. The input of nutrients into natural waters is another pathway through which human activities can affect fish communities. For this reason, eutrophication is used to assess the existing pollution. |

### Marine mammals

| Aspect: Protection status |
|---|
| Criterion: Status under Annex II and Annex IV of the Habitats Directive and the following international protection agreements: Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, CMS), ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas), Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) |
| **Aspect: Assessment of the occurrence** |
| Criteria: Population, population changes/trends based on large-scale surveys, distribution patterns and density distributions |
| **Aspect: Evaluation of spatial units** |
| Criteria: Function and importance of the German EEZ and the areas defined in the FEP for marine mammals as transit areas, feeding grounds or breeding grounds |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences and climate change. |

### Seabirds and resting birds

| Aspect: Protection status |
|---|
| Criterion: Status under Annex 1 Species of the Birds Directive, European Red List by BirdLife International |
| **Aspect: Assessment of the occurrence** |
| Criteria: Population in the German North Sea and EEZ, large-scale distribution patterns, abundances, variability |
| **Aspect: Evaluation of spatial units** |
| Criteria: Function of the areas defined in the FEP for relevant breeding and migratory birds as resting areas, location of protected areas |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences and climate change. |

### Migratory birds

| Aspect: The importance of bird migration over a large area |
|---|
| Criterion: Guidelines and areas of concentration |
| **Aspect: Assessment of the occurrence** |
| Criterion: migration and its intensity |
| **Aspect: Rarity and endangerment** |

| |
|---|
| Criterion: Number of species and endangered status of the species involved according to Annex I of the Birds Directive, the Bern Convention of 1979 on the Conservation of European Wildlife and Natural Habitats, the Bonn Convention of 1979 on the Conservation of Migratory Species of Wild Animals, the AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds) and SPEC (Species of European Conservation Concern). |
| **Aspect: Prior contamination** |
| Criterion: Prior contamination/endangerment due to anthropogenic influences and climate change. |

### 1.5.4 Assumptions used to describe and assess the likely significant effects

The description and assessment of the likely significant effects of the implementation of the ROP-E on the marine environment is carried out for the individual provisions on the use and protection of the EEZ on a protected resource basis, taking into account the status assessment described above. The following table lists, on the basis of the main impact factors, the potential environmental impacts which arise from the respective use and which are to be examined both as a prior impact, in the event the plan is not implemented, or as a likely significant environmental effect resulting from the provisions in the ROP. The effects are differentiated according to whether they are permanent or temporary.

Table 1: Overview of potentially significant effects of the uses identified in the spatial plan.

| Use | Effect | Potential effect | Protected Assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Sea birds and resting birds | Migratory birds | Marine mammals | Bats | Plancton | Biotoptype types | Biodiversity | Soil | Surface | Water | Air | Climate | Humans/ health | Cultural and material goods | Landscape |
| **Maritime uses with designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **Areas for offshore wind energy** | Placement of hard substrate (foundations) | Habitat change | x | | | | | | | x | x | x | | | | | | x | |
| | | Loss of habitat and land | x | x | | | | | | x | x | x | x | | | | | x | |
| | | Attraction effects, increase in species diversity, change in species composition | | x | | | | | | | x | | | | | | | | |
| | | Change in hydrological conditions | | x | | | | | | | | | | x | | | | | |
| | Scouring/sediment relocation | Habitat change | | | | | | | | x | | x | x | | | | | | |
| | Sediment swirls and turbidity plumes (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| | Resuspension of sediment and sedimentation (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | Noise emissions during pile driving (construction phase) | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| | | potential disruption/damage | | x t | | | x t | | | | | | | | | | | | |
| | Visual disturbance due to construction work | Local scaring and barrier effects | | | x t | | | | | | | | | | | | | | |
| | Obstacle in airspace | Scaring effects, loss of habitat | | | x | | | | | | | | | | | | | | |
| | | Barrier effect, collision | | | x | x | | x | | | | | | | | | | | x |
| | Light emissions (construction and operation) | Attraction effects, collision | | | x | x | | x | | | | | | | | | | | x |
| | wind farm related shipping traffic (maintenance, construction traffic) | see shipping | x | x | x | x | x | x | x | x | x | x | x t | x | x | x | x | x | |
| **Cables Routes for submarine cable systems and pipelines** | Introduction of hard substrate (stone fill) | Habitat change | x | | | | | | | x | | x | | | | | | x | |
| | | Loss of habitat and space | x | | | | | | | x | | x | x | | | | | x | |
| | Heat emissions (current-carrying cables) | Impairment/displacement of cold water-loving species | x | | | | | | | | x | | | | | | | | |
| | Magnetic fields (current-carrying cables) | Impairment | x | | | | | | | | | | | | | | | | |
| | | Impairment of the orientation behaviour of individual migratory species | | x | | | | | | | | | | | | | | | |
| | Turbidity plume (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| **Shipping** | Underwater Sound | Impairment / scaring effect | | x | | | x | | | | | | | | | | | | |
| | Emissions and discharges of hazardous substances (accidents) | Impairment/ damage | x | x | x | | x | | x | x | x | x | | x | | | x | | |
| | Physical disturbance during anchoring | Impact on the seabed | x t | | | | | | | x t | | x t | x t | | | | | x | |
| | Emission of air pollutants | Impairment of air quality | | | x | x | | x | | | | | | | x | x | x | | |
| | Introduction and spread of invasive species | Change in species composition | x | x | | | | | | | x | | | | | | | | |
| | Bringing in waste | Impairment/ damage | x | x | x | | x | | | | | | | x | | | x | | |
| | Risk of collision | Collision | | | | x | x | | | | | | | | | | | | |
| | Visual agitation | Impairment / scaring effect | | | x | | | | | | | | | | | | | | |

| Use | Effect | Potential effect | Protected Assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Sea birds and resting birds | Migratory birds | Marine mammals | Bats | Plancton | Biotoptype types | Biodiversity | Soil | Surface | Water | Air | Climate | Humans/ health | Cultural and material goods | Landscape |
| **Maritime uses with designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **Raw materials Sand and gravel mining / Seismic investigations** | Removal of substrates | Veränderung von Habitaten | x | x | | | | | | x | x | x | | | | | | x | |
| | | Lebensraum- und Flächenverlust | x | x | | | | | | x | x | x | x | | | | | x | |
| | Turbidity plumes | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| | Physical disturbance | Impact on the seabed | x | | | | | | | x | | x | x | | | | | | |
| | Underwater sound during seismic surveys | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| **Marine Research** | Sampling of selected species | Reduction of stocks | | x | | | | | | | | | | | | | | | |
| | | Deterioration of the food base | | | | | | | | | | | | | | | | | |
| | Physical disturbance by trawls | Impairment/ damage | x | | | | | | | x | | x | | | | | | | |
| **Maritime uses without designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **National defense** | Underwater sound | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| | Introduction of hazardous substances | Impairment | x | x | x | | x | | | x | x | x | | x | | | x | | |
| | Risk of collision | Collision | | | | | x | | | | | | | | | | | | |
| | Surface sound | Impairment / scaring effect | | | x | x | | x | | | | | | | | | x | | |
| **Recreation (-traffic)** | Taking of species (fishing) | Reduction of stocks | | x | | | | | | | | | | | | | | | |
| | Underwater Sound | Impairment / scaring effect | | x | | | x | | | | | | | | | | | | |
| | Emission of air pollutants | Impairment of air quality | | | x | x | | x | | | | | | | x | x | x | | |
| | Bringing in waste | Impairment | x | x | x | | x | | | | | | | x | | | x | | |
| | Visual agitation | Impairment / scaring effect | | | x | | | | | | | | | | | | | | |
| **Aquakultur** | Introduction of nutrients | Impairment | x | x | | | | | x | | | | | x | | | | | |
| | Installation of fixed installations | Habitat change | x | x | | | | | | x | | | | | | | | | x |
| | | Loss of habitat and land | x | x | | | | | | | | | x | | | | | | x |
| **Fischerei** | Sampling of selected species | Reduction of stocks | | x | | | | | | | x | | | | | | | | |
| | | Deterioration of the food base | | | x | | x | | | | | | | | | | | | |
| | Bycatch | Reduction of stocks | | x | | | x | | | | | | | | | | | | |
| | Physical disturbance by trawls | Impairment / damage | x | | | | | | | x | | x | | | | | | | |

x potential effect on the protected resource

x potential temporary effect on the protected resource

In addition to the impacts on the individual protected resources, cumulative effects and interactions between protected resources are also examined.

#### 1.5.4.1 Cumulative consideration

In accordance with Article 5(1) of the SEA Directive, the environmental report also includes an assessment of cumulative effects. Cumulative effects arise from the interaction of various independent individual effects which either add up as a result of their interaction (cumulative effects) or reinforce each other and thus generate more than the sum of their individual effects (synergistic effects) (e.g. SCHOMERUS et al., 2006). Both cumulative and synergetic effects can be caused by the coincidence of effects in time and space. The effect can be reinforced by similar uses or different uses with the same effect, thereby increasing the effect on one or more protected resources.

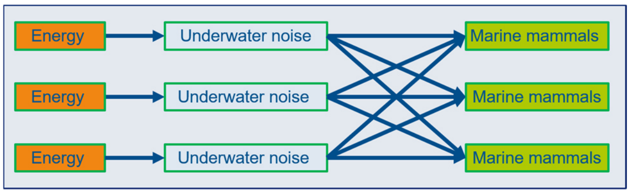



Figure 8: Exemplary cumulative effect of similar uses.

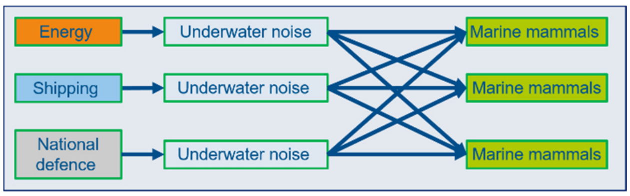



Figure 9: Exemplary cumulative effect of different uses.

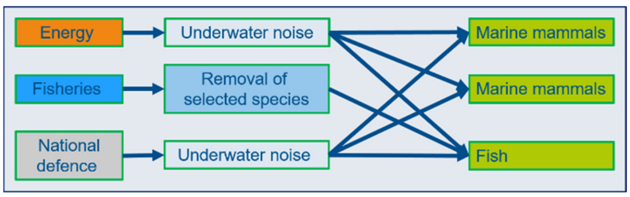



Figure 10: Exemplary cumulative effect of different uses with different effects.

In order to examine the cumulative effects, it is necessary to assess the extent to which the provisions of the plan, when taken together, can be expected to have a significant adverse effect. An examination of the provisions is performed on the basis of the current state of knowledge within the meaning of Article 5(2) of the SEA Directive. The position paper on the cumulative assessment of loons habitat loss in the German North Sea (BMU, 2009) and the BMUB's noise abatement concept (2013) form an important basis for assessing the effects of habitat loss and underwater noise.

#### 1.5.4.2 Interactions

In general, effects on a protected resource lead to various consequences and interactions between the protected resources. The essential interdependence of the biotic protected resources exists via the food chains. Due to the variability of the habitat, interactions can only be described in very imprecise terms overall.

#### 1.5.4.3 Specific assumptions for the assessment of the likely significant environmental effects

In detail, the analysis and examination of the respective provisions is as follows:

**Offshore wind energy**

With regard to the priority and reserved areas for offshore wind energy, a worst-case scenario is generally assumed. For the consideration of protected resources, certain parameters are assumed in this SEA in the form of ranges spatially separated into zones 1 and 2 and zones 3 to 5. In detail, these are, for example, the power output per installation [MW], hub height [m], rotor diameter [m] and total height [m] of the installations.

As input parameters, the SEA takes particular account of:

- installations already in operation or undergoing the licensing procedure (as reference and existing load)

- Transfer of the average parameters of the plants commissioned in the last 5 years on the sites defined in the FEP 2019
- Forecast of certain technical developments for the offshore wind energy priority and reserved areas, which are also defined in the ROP on the basis of the parameters presented. It should be noted here that these are only partly estimation-based assumptions, as project-specific parameters are not or cannot be checked at the SEA level.

Table 2: Parameters for the consideration of areas for offshore wind energy

| **WTG Parameters** | **Range** *Zones 1 and 2* from | to | **Range** *Zones 3-5* from | to |
|---|---|---|---|---|
| Output per plant [MW] | 5 | 12 | 12 | 20 |
| Hub height [m] | 100 | 160 | 160 | 200 |
| Rotor diameter [m] | 140 | 220 | 220 | 300 |
| Total height [m] | 170 | 270 | 270 | 350 |

For the connecting cables of the priority areas for offshore wind energy, the route length (EEZ) varies between about 10 km and 160 km. For the priority areas in Zones 4 and 5, an average route length of about 250 km is assumed. For the assessment of the construction and operational environmental effects, certain widths of the cable trench [m] and a certain site of the intersection structures [$m^2$] are assumed for submarine cable system rout corridors. Above all, the environmental effects due to construction, operation and repair are considered.

For the route corridors for pipelines, cross-border submarine cable systems or data cables, the cable lengths result from the specifications. For pipelines, a width of 1.5 m is assumed for the assessment of environmental effects for the overlying pipeline plus 10 m each for impairments due to "reef effect" and sediment dynamics.

For other uses, evaluation criteria or parameters for the environmental assessment have to be developed or specified in the later procedure.

**Shipping**

In order to assess the environmental effect of shipping, there must be an examination of which additional effects can be attributed to the provisions of the ROP-E.

The priority areas identified must be kept free of building use. This control in the ROP-E should prevent or at least reduce collisions and accidents. Based on the provisions in the ROP, the frequency of traffic in the priority areas is expected to increase, in particular due to the increase in offshore wind farms along the shipping routes. Vessel movements on the shipping routes SN1 to SN17 and SO1 to SO5 vary considerably, with the most heavily used route, SN1, sometimes carrying more than 15 vessels per km² per day, while on the other, narrower routes there are usually about 1-2 vessels per km² per day (BfN, 2017).

The BSH has commissioned an expert report on the traffic analysis of shipping traffic, which is expected to include current evaluations.

The designation of priority areas for shipping only is not an expression of increased use, but rather serves to minimise risk.

The general effects of shipping are presented in Chapter 2 as prior contamination, especially for

birds and marine mammals. The effects of service traffic to the wind farms are dealt with in the chapter on wind energy.

**Raw material extraction**
When assessing the potential environmental effect of raw material extraction, a distinction must be made between sand and gravel extraction and hydrocarbon extraction.

Sand and gravel extraction:

Sand and gravel are extracted by means of floating suction dredgers. The extraction field is driven over in strips of approximately 2 m width and the subsoil is extracted to a depth of approximately 2 m. The seabed remains unstressed between the excavation strips. During mining, a sediment-water mixture is pumped on board the suction dredger. The sediment in the desired grain size is screened out and the unused portion is returned to the sea on site. Turbidity plumes result from the mining and discharge. Potential temporary effects result from the turbidity plumes, which can frighten and result in adverse effects for the marine fauna. Potential permanent effects arise from the removal of substrates and physical disturbance causes habitat and area loss, habitat alteration and seabed degradation.

Sand and gravel extraction is carried out on the basis of operational plans on portions of the authorised approval fields.

Gas production:

Exploratory and production wells are drilled for the exploration and exploitation of gas deposits. Drilling through the rock lying above the deposit results in drilling abrasion. This is brought to the surface by means of drilling fluids. The drilling fluids have either a water or oil base. If a water-based drilling fluid is used, it is discharged into the sea together with the cuttings. If oil-based drilling fluids are used, they are disposed of on land together with the cuttings.

Seismic methods are used in the exploration of hydrocarbon reservoirs, which lead to chase effects in marine mammals.

Operationally discharges of material into the sea result from the discharge of production and spray water, wastewater from the sewage treatment plant, and the shipping traffic caused. Production water is essentially reservoir water that may contain components from underground, such as salts, hydrocarbons and metals. As the deposit ages, the amount of gas in production water increases. Production water can also contain chemicals that are used in mining to improve extraction or to prevent corrosion of production equipment. The production water is discharged into the sea after treatment in accordance with the state of the art and compliance with national and international standards.

**Fisheries and marine aquaculture**

In the area of the southern silt floor, the sediment provides a particularly suitable habitat for this species, which can be quite clearly defined spatially. The nephrops population in the North Sea is considered stable and is classified as "least concern" in the IUCN Red List (Bell, 2015). For the German fishing fleet, the nephrops fishery represents a valuable and reliable source of income. Adverse effects of fishing in this area mainly affect the seabed, sediment and the habitats affected by it, which can be affected by the trawls used.

Table 3: Parameters for the consideration of fisheries.

| | |
|---|---|
| **Fishing effort (German fleet)** | Approximately 8,000 hrs/year (2013) to 14,000 hrs/year (2018)<br>12 (2014) - 18 (2015) vehicles |
| **Fishing gear used** | Bottom trawls |
| **Catches** | 200 - 350 t / year (plus non-German fisheries) |

### Marine Research

The designated areas for scientific marine research (3 in the North Sea, 4 in the Baltic Sea) correspond to standard investigation areas ("boxes") of the Thuenen Institute in the North Sea and the Baltic Sea. In the North Sea, the German Small-Scale Bottom Trawl Survey (GSBTS), which has been carried out since 1987, has been collecting data on the development of fish populations over many years. The data sets form an important basis for assessing long-term changes in the bottom fish fauna (commercial and non-commercial species) of the North Sea and the Baltic Sea caused by natural (e.g. climatic) influences or anthropogenic factors (e.g. fisheries).

The GSBTS uses a standardised bottom trawl net or a high-density GOV otter trawl to sample small-scale bottom fish communities to determine abundances and distribution patterns. In parallel, epibenthos (using a 2 m beam trawl), infauna (using a Van Veen grab) and sediments will be studied, and hydrographic and marine chemical parameters in habitats typical of the region will be recorded.

Effects are to be expected from the equipment used, in particular on the soil/sediment and the habitats affected by it. To this end, fish of various ages and sizes are taken (cf. also Chapter 5.5.3).

Table 4: Parameters for the consideration of marine research

| | |
|---|---|
| **Frequency of surveys per year/number of hauls/duration per haul (approximate values, vary from trip to trip)** | 2 / in the range of approx. 40 - 50 (only GSBTS) / 30 min. |
| **Gear used (target species)** | Standardised bottom trawlers, using high-density otter trawls (bottom fishing communities)<br>2-metre beam trawl (epibenthos)<br>Van Veen grab (Infauna) |
| **Catches** | Total quantities for all (sampled) boxes (partly with other research activities) in double-digit tonnes |

### Nature conservation / marine landscape / open space

The nature conservation rules in the spatial plan are not expected to have any significant adverse environmental effects.

The rules contribute to the long-term preservation and development of the marine environment in the EEZ as an ecologically intact open space over a large area. The scope of the rules is of particular importance in this context, with the EEZ accounting for 37.92% of the area of the North Sea. The nature conservation priority areas contribute to securing open spaces by excluding uses which are incompatible with nature conservation. This helps to avoid possible disturbances caused by the conversion of wind energy and to ensure the protection of the marine environment. Keeping the protected areas free of building structures also contributes to the protection of open spaces and the marine landscape on a large scale.

The designation of the main distribution area of harbour porpoises and the main concentration area of loons as reserved areas is of outstanding conservation importance for the protection of the disturbance-sensitive group of loons and harbour porpoise species.

The guiding principles of the careful and economical use of natural resources in the EEZ, as well as the application of the precautionary principle and the ecosystem approach, are intended to avoid or reduce damage to the balance of nature.

The spatial plan thus contributes to achieving the objectives of the MSFD. However, the ability of

spatial planning to influence this is limited and cannot affect all objectives.

**National and alliance defence**

The ROP-E contains textual provisions on national and alliance defence.

## 1.6 Data sources

The basis for the SEA is a description and assessment of the environmental status in the study area. All protected resources must be included. The data source is the basis for the assessment of the likely significant environmental effects, the site and species protection assessment and the assessment of alternatives.

According to Article 8(1) Sentence 3 of the ROG, the environmental assessment refers to what can reasonably be required on the basis of the current knowledge and generally accepted assessment methods, and the content and level of detail of the spatial plan.

On the one hand, the environmental report will describe and assess the current state of the environment, and describe the likely development if the plan is not implemented. It will also forecast and assess the likely significant environmental effects of implementing the plan.

The basis for the assessment of potential effects is a detailed description and assessment of the state of the environment. The description and assessment of the current state of the environment and the likely development in the event the plan is not implemented will be carried out with regard to the following protected resources

- Site/Soil
- Water
- Plankton
- Biotope types
- Benthos
- Fish
- Bats
- Biodiversity
- Air
- Climate
- Landscape
- Cultural and other material resources
- Marine mammals
- Avifauna
- People, especially human health
- Interactions between protected resources.

### 1.6.1 Overview data source

The data and knowledge has improved significantly in recent years, in particular as a result of the extensive data collection in the context of environmental impact studies, the construction and operational monitoring for the offshore wind farm projects, and the accompanying ecological research.

This information also forms an essential basis for monitoring the 2009 spatial plans under Article 45(4) of the UVPG. Accordingly, the results of the monitoring are to be made available to the public and taken into account when the plan is reinstated. The results of the accompanying plan for monitoring the current plans are summarised in the status report on the updating of spatial planning in the German North Sea and Baltic Sea EEZ, which is published in parallel (Chapter 2.5).

In general terms, the following data sources are used for the environmental report:

- Data and findings from the operation of offshore wind farms
- Data and findings from approval procedures for offshore wind farms, submarine cable systems and pipelines
- Results of the preliminary site investigations
- Results from the monitoring of Natura 2000 areas
- Mapping instructions for Article 30 biotope types
- MSRL initial and progress assessment
- Findings and results from R&D projects commissioned by the BfN

and/or the BSH and from accompanying ecological research
- Results from EU cooperation projects, such as Pan Baltic Scope and SEANSE
- Studies/Technical literature
- Current red lists
- Comments from the technical authorities
- Comments from the (specialist) public

A detailed overview of the individual data and knowledge sources is included in the annex to the framework of the study.

### 1.6.2 Indications of difficulties in compiling the documents

In accordance with No. 3a of Annex 1 to Article 8(1) of the ROG, indications of difficulties encountered in compiling the information, such as technical gaps or lack of knowledge, must be presented. There are still gaps in knowledge in some places, particularly with regard to the following points:

- Long-term effects from the operation of offshore wind farms
- Effects of shipping on individual protected resources
- Effects of research activities
- Data for assessing the environmental status of the various protected resources in the outer EEZ.

In principle, forecasts on the development of the living marine environment after the ROP has been carried out remain subject to certain uncertainties. There is often a lack of long-term data series or analytical methods, e.g. for combining extensive information on biotic and abiotic factors, in order to better understand the complex interrelationships of the marine ecosystem.

In particular, there is a lack of detailed area-wide sediment and biotope mapping outside the nature reserves of the EEZ. As a result, there is a lack of a scientific basis on which to assess the effects of the possible use of strictly protected biotope structures. At present, sediment and biotope mapping is being carried out on behalf of the BfN and in cooperation with the BSH, research and higher education institutions and an environmental office, with a focus on the nature conservation areas.

In addition, there is a lack of scientific assessment criteria for protected resources, both with regard to the assessment of their status and with regard to the effects of anthropogenic activities on the development of the living marine environment, in order to fundamentally consider cumulative effects over time and space.

Various R&D studies on assessment approaches, including those for underwater noise, are currently being carried out on behalf of the BSH. The projects serve the continuous further development of a uniform, quality-assured basis of marine environmental information for assessing the potential impacts of offshore installations.

The environmental report will also list specific information gaps or difficulties in compiling the documents for the individual protected resources.

## 1.7 Application of the ecosystem approach

The application of the ecosystem approach contributes to the achievement of "sustainable spatial planning that reconciles the social and economic demands on the spatial environment with its ecological functions and leads to a sustainable, balanced order over a large area" (Article 1(2) of the ROG). The application of the ecosystem approach is a requirement under Article 2(3) No. 6 p. 9 of the ROG with the aim of controlling human activities, sustainable development and supporting sustainable growth (cf. Art. 5(1) of the

Maritime Spatial Planning Directive (MSPD) in conjunction with Art. 1(3) of the MSFD).

Recital 14 of the MSPD specifies that spatial planning should be based on an ecosystem approach in accordance with the MSFD. It is also clear here—as in Preamble 8 of the MSFD—that sustainable development and use of the seas should be compatible with good environmental status.

In accordance with Article 5(1) of the MSPD: “When establishing and implementing maritime spatial planning, Member States shall consider economic, social and environmental aspects to support sustainable development and growth in the maritime sector, applying an ecosystem-based approach, and to promote the coexistence of relevant activities and uses.”

Article 1(3) of the MSFD specifies that “Marine strategies shall apply an ecosystem-based approach to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of good environmental status and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while enabling the sustainable use of marine goods and services by present and future generations.”

The ecosystem approach allows a holistic view of the marine environment, recognising that humans are an integral part of the natural system. Natural ecosystems and their services are considered together with the interactions resulting from their use. The approach is to manage ecosystems within the "limits of their functional capacity" in order to safeguard them for use by future generations. In addition, understanding ecosystems enables effective and sustainable use of resources.

A comprehensive understanding, protection and improvement of the marine environment and an effective and sustainable use of resources within the bearing capacity limit will safeguard marine ecosystems for future generations. The ecosystem approach can therefore contribute—at least in part —to good status in the marine environment.

Based on the so-called 12 Malawi Principles of the Biodiversity Convention, the ecosystem approach has also been substantiated by the HELCOM-VASAB working group on maritime spatial planning and specified for maritime spatial planning (HELCOM/VASAB, 2016). The key elements formulated there represent a suitable approach for structuring the application of the ecosystem approach in the spatial plan for the German EEZ.

The combination of content-related and process-oriented key elements is intended to promote an overall picture that is as comprehensive as possible:

- Best available knowledge and practice;
- Precautions;
- Alternative development;
- Identification of ecosystem services;
- Prevention and mitigation;
- Relational understanding;
- Participation and communication;
- Subsidiarity and coherence;
- Adaptation.

The application of the ecosystem approach aims at a holistic perspective, the continuous development of knowledge about the oceans and their use, the application of the precautionary principle and flexible, adaptive management or planning. One of the greatest challenges is dealing with gaps in knowledge. Understanding the cumulative effects that the combination of different activities can have on species and habitats is of great importance for sustainable use. It is important for the planning process to promote communication and participation processes in order to use the broadest possible knowledge base of all stakeholders and to achieve the greatest possible acceptance of the plan.

Figure 11 shows the understanding of the application of the ecosystem approach. This takes place equally in the planning process, the ROP and in the Strategic Environmental Assessment (SEA). The SEA has proven to be the central instrument for applying the ecosystem approach (grandfather, 2019) and offers versatile points of contact in the content- and process-oriented key elements (see below).

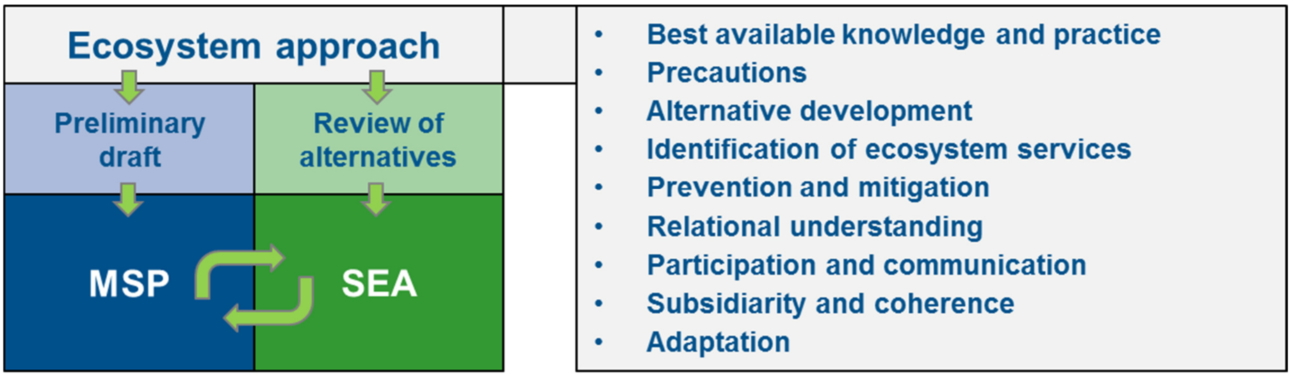



Figure 11: The ecosystem approach as a structuring concept in the planning process, the ROP and the Strategic Environmental Assessment

The ecosystem approach is anchored in the mission statement as the basis of the spatial plan. Its importance is also explicitly emphasised in the following principles:

- General requirements for economic uses: Principle of Best Environmental Practice (8.1) and Monitoring (8.2)
- Principle of nature conservation Preservation of the EEZ as a natural area (5)

The graphic and textual rules on marine nature conservation make a fundamental contribution to the protection and improvement of the state of the marine environment (see ROP model). In addition, the ROP's rules promote the resilience of the marine environment to the effects of economic uses and to the changes caused by climate change.

Due to a lack of data and knowledge, it is not possible to conclusively quantify the bearing capacity of the ecosystem. This represents a task for the future development of the ecosystem approach. Even if quantification is not possible at present, SEA and cumulative consideration must ensure that the ROP and the definitions of economic uses contained therein do not exceed the limits of ecosystem functioning.

The assessment of the likely significant environmental effects of the implementation of the spatial plan is methodologically described in Chapter 1.5.2The ecosystem approach does not itself constitute an assessment but does encompass a large number of important aspects and instruments for sustainable spatial planning. Of these, the SEA serves comprehensively to identify, describe and assess the impacts on the marine environment.

**Application of the key elements**

The ecosystem approach is highly complex due to its diversity and the comprehensive view of the relationship between the marine environment and economic uses. The key elements also interact with each other, underlining the interconnectedness and holistic perspective. Figure 12 portrays the relationships between the key elements. This approach becomes tangible and applicable when viewed at the level of the individual key elements, in particular those of the HELCOM/VASAB Directive (2016).

The application in the spatial plan for the German EEZ is based on the understanding that this approach needs to be continuously developed. Existing gaps in knowledge and the need for conceptual broadening result in the need to

consider the ecosystem approach as a permanent task of further development.

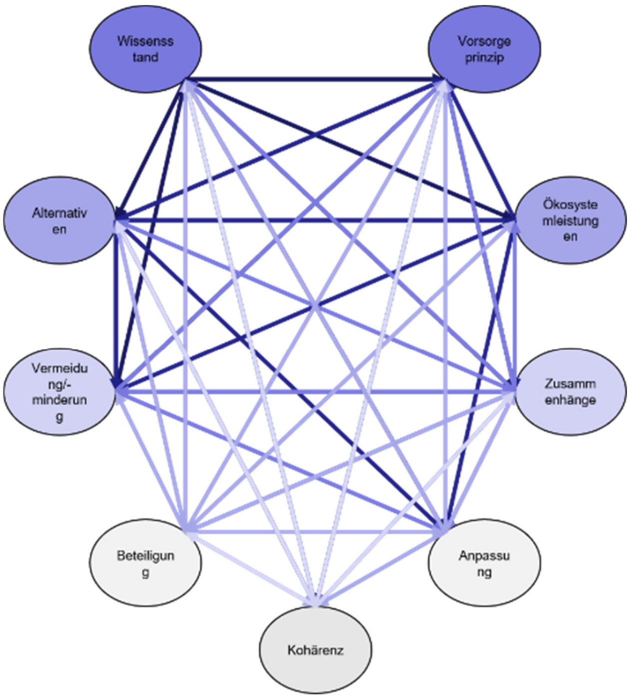



Figure 12: Networking between the key elements

**Best available knowledge and practice**

"The allocation and development of human uses shall be based on the latest state of knowledge of the ecosystems as such and the practice of safeguarding the components of the marine ecosystem in the best possible way." (HELCOM/VASAB, 2016).

The use of the current (sound) level of knowledge is fundamentally indispensable for planning processes and forms the basis of the planning understanding for updating the spatial plan. This key element thus also affects the other elements mentioned, such as the precautionary principle, the avoidance and reduction of impacts and the understanding of interrelationships.

As part of the updating process, the knowledge base is supplemented by the sector-specific expertise of the stakeholders through an early and comprehensive participation process. Thematic workshops and technical discussions with various stakeholders were held even before the concept for the update was developed.

The Scientific Advisory Board (WiBeK) for the continuation of maritime spatial planning in the North Sea and Baltic Sea EEZ advises, from a scientific perspective, on questions of content, the procedure and the participation process.

Results from projects and findings on procedures for plan preparation in neighbouring countries within the framework of international cooperation are taken into account for the process of plan preparation. In addition to improving the level of knowledge, this contributes to the key element of "subsidiarity and coherence".

In-house research and development, such as databases and other tools, are developed, validated and applied at the BSH for a wide range of uses: e.g. MARLIN and MarineEARS. These can support the planning process and the subsequent plan monitoring with well-founded information and make an important contribution to the continuous improvement of the level of knowledge.

The following stipulations of the spatial plan promote the use of the current level of knowledge in economic uses as a basic guideline:

- General requirements for economic uses: Principle of Best Environmental Practice (8.1)
- Shipping: Principle of Protection of the Marine Environment (3)
- Offshore wind energy: Protection of the Marine Environment (6.1)
- Marine research: Principle of Protection of the Marine Environment (5).

The SEA is based on very detailed and comprehensive data on all relevant biological and physical aspects and conditions of the marine environment—in particular from EIA studies and monitoring of offshore wind farm projects according to StUK—scientific research activities, and from national and international monitoring programmes.

**Precautions**

"A far-sighted, anticipatory and preventive planning shall promote sustainable use in marine areas and shall exclude risks and hazards of human activities on the marine ecosystem. Those activities that according to current scientific knowledge may lead to significant or irreversible impacts on the marine ecosystem and whose impacts may not be in total or in parts sufficiently predictable at present require a specific careful survey and weighting of the risks." (HELCOM/VASAB, 2016).

The precautionary principle has a high priority in spatial planning, particularly because of the complexity of marine ecosystems, far-reaching chains of effects and existing gaps in knowledge. This is already emphasised in the ROP's mission statement.

The provisions of the spatial plan make it clear that the precautionary principle is taken into account as a fundamental requirement in the case of economic uses (Principle 5 Nature conservation/marine landscape/open space) and in the case of subsequent uses:

- Maritime transport: Objective Priority areas Maritime transport (1)
- General requirements for economic uses: Objective Decommissioning (3) Principle of Site Conservation (2) and Best Environmental Practice (8.1)
- Lines Marine environment Principle (8)
- Fisheries and Marine Aquaculture: Sustainable Management Principle (2)
- Nature Conservation: Principle Preservation of the EEZ as a Natural Area (5).

The SEA examines the significance of the effects of the ROP's provisions on uses on the protected resources (Chapter 3).

**Alternative development**

"Reasonable alternatives should be developed to find solutions to avoid or mitigate adverse effects on the environment and other areas, as well as on ecosystem goods and services." (HELCOM/VASAB, 2016).

The consideration of alternatives was given a high priority in the process of updating the spatial plans and was integrated into the contribution at an early stage.

In the conception for the further development of the spatial plans (BSH, 2020) three planning options were developed as overall spatial planning alternatives, which represent the utilisation requirements of the different sectors from different perspectives:

- Planning option A: Perspective on traditional uses
- Planning option B: Climate protection perspective
- Planning option C: Marine nature conservation perspective

The alternatives presented as planning options are integrated approaches which take into account spatial and content-related dependencies and interactions over a large area.

The early and comprehensive consideration of several planning options represents an essential planning and review step in the updating of the spatial plans.

A preliminary assessment of selected environmental aspects was carried out before this environmental report was prepared. The preliminary assessment of selected environmental aspects in the sense of an early examination of variants and alternatives should support the comparison of the three planning options from an environmental point of view.

The design and preliminary assessment of selected environmental aspects were consulted, so that the knowledge and assessments of the stakeholders involved were contributed to the planning process.

An alternative assessment is carried out in the SEA (cf. Chapter 8), where the focus is on the conceptual/strategic design of the plan, and in particular on spatial alternatives.

**Identification of ecosystem services**

"In order to ensure a socio-economic evaluation of effects and potentials, the ecosystem services provided need to be identified." (HELCOM/VASAB, 2016).

The identification of ecosystem services is an important step for the further development of the spatial plan and the ecosystem approach in maritime spatial planning. Ecosystem services can contribute to a broader understanding and illustrate the multiple functions that ecosystems can provide. Particularly noteworthy are their function as natural carbon sinks and other contributions to climate protection and adaptation. This need should be taken into account in future updates of the spatial plan and the development of the necessary tools should be continued.

With the specialist application MARLIN (Marine Life Investigator), BSH is currently developing a large-scale, high-resolution information network on marine ecological data from environmental investigations within the framework of environmental impact studies, preliminary site investigations and monitoring of offshore wind farm projects. Various data analyses at different spatial and temporal levels are possible in order to support the tasks of the BSH in line with requirements. MARLIN also combines the integrated marine ecological data with various environmental data to support the understanding of the effects and interrelationships of marine ecosystem services.

In the future, MARLIN will serve as a validated basis for ecosystem modelling to better assess the impact of cumulative effects. For example, in future it will be possible to consider all offshore wind farm processes and to carry out large-scale studies. Building on this, it may then be possible to identify ecosystem services. MARLIN's holistic approach enables new approaches to the analysis and modelling of ecological patterns and processes and creates a platform for the development and application of advanced tools for marine management and regulation.

**Prevention and mitigation**

“The measures are envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan.” (HELCOM/VASAB, 2016).

The ROP's mission statement defines the contribution to the protection and improvement of the state of the marine environment, also by specifying how to avoid or reduce disturbances and pollution from uses.

The provisions of the spatial plan illustrate this consideration with measures to avoid and mitigate adverse effects of individual uses:

- Shipping: Principle of Protection of the Marine Environment (3)
- General requirements for economic uses: Principle of Best Environmental Practice (8.1)
- Offshore wind energy: Protection of the Marine Environment (6.1)
- Management: Principles Avoidance of Crossings (5) and Marine Environment (8)
- Raw material extraction: Principle of the Loon (3)
- Nature conservation: Principles Reserved Area for Loons (2) and Reserved Area for Harbour Porpoise (3)

In the SEA, measures to avoid, reduce and offset significant adverse effects of the implementation of the spatial plan are presented in detail in Chapter 7.

**Relational understanding**

"It is necessary to consider various effects on the ecosystem caused by human activities and interactions between human activities and the ecosystem, as well as among various human activities. This includes direct/indirect, cumulative, short/long-term, permanent/temporary and positive/negative effects, as well as interrelations including sealand interaction." (HELCOM/VASAB, 2016).

The understanding of interrelations and interdependencies is of great importance for the tasks of spatial planning and the planning process. In this sense, the mission statement of the ROP-E emphasises the holistic approach and includes the consideration of land-sea relations.

In the Strategic Environmental Assessment, this is taken up and examined in Chapters 4.9Interactions and 0Cumulative consideration.

For technical support, the BSH is currently developing the specialist application MARLIN (Marine Life Investigator) as a large-scale, high-resolution information network for marine ecological data from environmental investigations within the framework of environmental impact studies, preliminary site investigations and monitoring of offshore wind farm projects. Various data analyses at different spatial and temporal levels are possible in order to support the tasks of the BSH as required. MARLIN also combines integrated marine ecological data with various environmental data. MARLIN's holistic approach enables new directions for the analysis and modelling of ecological patterns and processes and creates a platform for the development and application of advanced tools for marine management and regulation. This will support the understanding of impacts and interrelationships.

Further experience, e.g. on cumulative consideration, has been gained in European cooperation projects (Pan Baltic Scope, SEANSE) and will be incorporated into the further conceptual development, as will findings from the participation process.

An overview of the project results can be found on the respective pages:

- http://www.panbalticscope.eu/results/reports/
- https://northseaportal.eu/downloads/

**Participation and communication**

“All relevant authorities and stakeholders as well as a wider public shall be involved in the planning process at an early stage. The results shall be communicated.” (HELCOM/VASAB, 2016).

This key element is an example of the networking and relationships between the key elements. The knowledge gained can contribute to all other key elements.

As part of the updating process, participation and communication have been carried out intensively right from the start. Early and comprehensive participation therefore contributes significantly to broadening the knowledge base through the sector-specific expertise of stakeholders and evaluations received.

The basis for this was the development of a participation and communication concept. In the course of the update, topic-specific workshops and technical discussions were held with representatives at sectoral level. On 18 and 19 March 2020, the concept and draft of the study framework were consulted in the participation meeting (scoping).

Interim results and information on stakeholder meetings are communicated on the BSH's blog "Offshore aktuell" (wp.bsh.de).

Additional support for the process is provided by the Wissenschaftlicher Begleitkreis (WiBeK). Since 2018, for the continuation of maritime spatial planning in the Exclusive Economic Zone in the North and Baltic Seas, the WiBeK has been advising from a scientific perspective on questions of content, the course of the procedure and the participation process, among other things.

**Subsidiarity and coherence**

“Maritime spatial planning with an ecosystem-based approach as an overarching principle shall be carried out at the most appropriate level and shall seek coherence between the different levels.” (HELCOM/VASAB, 2016).

Spatial planning aims to produce coherent plans in the North and Baltic Seas through co-ordination with coastal countries and partners from neighbouring countries. Many years of bi-lateral exchange, participation in the HELCOM and VASAB working group on maritime spatial planning and cooperation in international projects on maritime spatial planning contribute to this.

Project results and findings on procedures for plan preparation in neighbouring countries within the framework of international cooperation are taken into account for the process of plan preparation. The international consultation procedures represent a further contribution.

The ROP-E's mission statement sets out this cooperation as a contribution to coherent international maritime spatial planning and coordinated planning with coastal countries.

At the level of definitions, Principles 3 and 4 for pipelines emphasise this sectoral coordination requirement for the planning of cross-border linear structures.

In the context of SEA, the cross-border impacts on the neighbouring areas of the neighbouring states are considered (Section 4.11).

**Adaptation**

“The sustainable use of the ecosystem should apply an iterative process including monitoring, reviewing and evaluation of both the process and the outcome.” (HELCOM/VASAB, 2016).

Monitoring and evaluation within the framework of spatial planning for the German EEZ take place at various levels.

The first step will be to evaluate the plan and its implementation. A monitoring and evaluation concept will be developed for this purpose.

In addition, in Chapter 10 the SEA lists the planned measures for monitoring the effects of the implementation of the spatial plan on the environment.

The effects of economic uses on the marine environment are to be investigated and evaluated at project level by means of effect monitoring. This is laid down in Principle 8.2 of the General Requirements for Economic Uses in the ROP.

**Summary**

In summary, and beyond this, the key elements and their implementation in the planning process, the ROP, and the SEA all show how the ecosystem approach as an overall concept supports the holistic perspective of spatial planning and thus contributes to the protection and improvement of the state of the marine environment.

## 1.8 Taking climate change into account

Anthropogenic climate change is one of the greatest challenges facing society and is of particular importance for changes in the oceans and their use. Figure 13 shows the links between climate change, the marine ecosystem, uses and maritime spatial planning, and also how they are a tool for achieving sustainable development goals.

In changing seas, the consideration and integration of climate impacts in MSP is of great importance in order to do justice to the precautionary and forward-looking nature of MSP and to develop long-term sustainable plans.

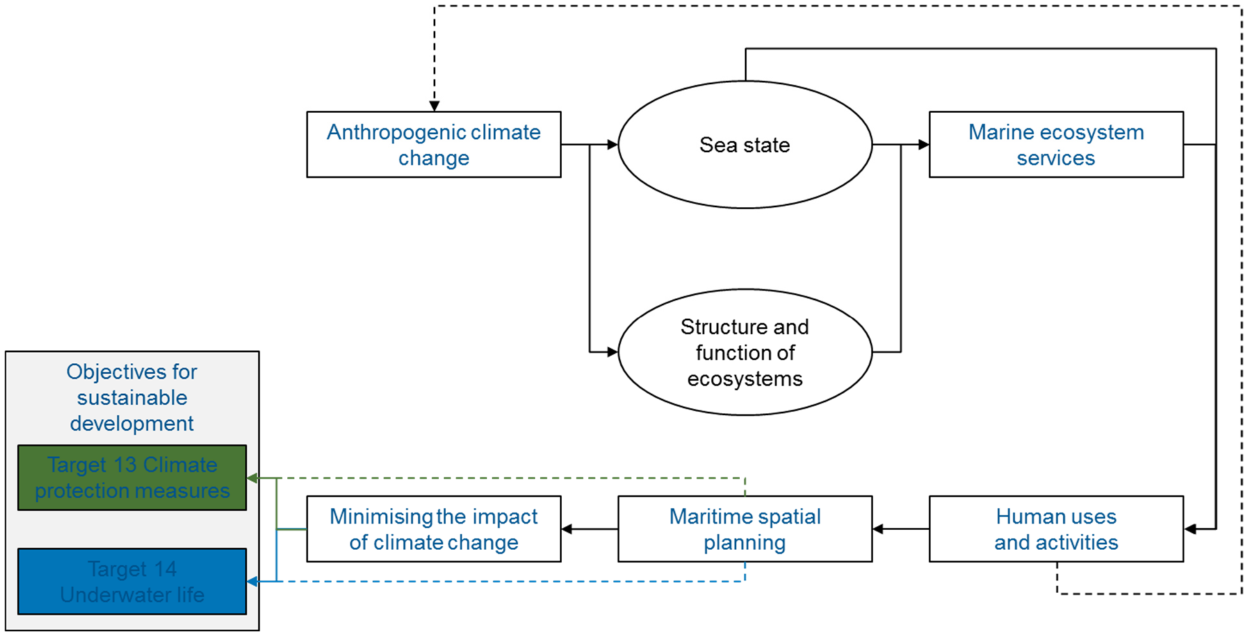



Figure 13: Representation of the interrelationships between climate change, marine ecosystems and maritime spatial planning, according to (Frazão Santos, 2020)

Climate change will alter the physical, chemical and biological conditions in the North and Baltic Seas. This will inevitably have an impact on marine ecosystems, their structure and functions, which may also change ecosystem services. The changes may also have a direct impact on the uses to which they are put, e.g. shipping, renewable energy or extraction of raw materials (Frazão Santos, 2020).

The following table shows projections for some relevant parameters.

Table 5: Climate projections for selected parameters [1] (UBA, in Vorbereitung), [2] (IPCC, 2019), [3] (Pity N, in preparation)

| | North Sea | Baltic Sea |
|---|---|---|
| Increase in mean sea surface temperature for 2031-2060 (in the 50th percentile of the RCP8.5 scenario compared to 1971-2000)[1] | 1 – 1.5 °C | 1.5 – 2 °C |
| Increase in mean sea surface temperature for 2071-2100 (in the 50th percentile of the RCP8.5 scenario compared to 1971-2000)[1] | 2.5 – 3 °C | 2.5 – 3.5 °C |
| Global sea level rise 2100 (RCP8.5 scenario vs. 1986-2005)[2] | 61 - 110cm | 61 - 110cm |
| Increase in extreme wind speeds (RCP8.5 scenario compared to 1971-2000)[3] | 0 - 0.5 m/s | No majority significant increases |

As a contribution to climate protection, the offshore wind energy provisions should be mentioned at the outset. Assuming that the current $CO_2$ factor of electricity from offshore wind energy is continued (UBA, 2019), by 2040, this results in an average annual $CO_2$ avoidance potential of 62.9 Mt $CO_2$

equivalents per year for the period between 2020 and 2040. By way of comparison, the annual emissions from power plants in the energy industry in 2016 were 294.5 Mt $CO_2$ equivalents per year (BMU, 2019).

Table 6 shows the abatement potential for the years 2020 and 2040 and the annual average for the entire period.

Table 6: Calculation of the $CO_2$ avoidance potential of the offshore wind energy provisions

| | Installed capacity | Full load hours | Annual electricity production | $CO_2$ avoidance factor | $CO_2$ avoidance |
|---|---|---|---|---|---|
| | GW | h/a | GWh/a | g CO2eq/kWh | Mt CO2eq/a |
| 2020 | 7.2 | 3800 | 27360 | 701 | 19.2 |
| 2040 | 40 | 3800 | 152000 | 701 | 106.6 |
| Average $CO_2$ avoidance per year | | | | | 62.9 |

Furthermore, keeping the priority areas of nature conservation free and the potential of ecosystems as natural carbon sinks contributes to climate protection. The designation of priority and reserved areas of nature conservation can also serve to strengthen the resilience of ecosystems and thus support the precautionary principle.

The mission statement shows that the use of climate-friendly technologies in the ocean supports energy security and the achievement of national and international climate targets.

The development of risk and vulnerability analyses to climate change and adaptation measures in the relevant sectors should be communicated to spatial planning. The holistic perspective of spatial planning can help to coordinate the compatibility of measures with other uses and marine nature conservation and to avoid conflicts. To promote this, a dialogue could be initiated to ensure that a joint discussion takes place in a spatial planning forum with stakeholders from the sectors.

For climate change to be fully integrated into MSP, institutional strengthening, including international cooperation in the North and Baltic Seas, is necessary. Projects in particular offer the opportunity to develop coherent approaches with neighbouring countries or to use joint data pools, for example.

One focus should be on the conceptual development of marine ecosystem services and, above all, the potential of natural carbon sinks.

# 2 Description and assessment of the state of the environment

According to section 8 ROG in connection with Annexes 1 and 2 to section 8 ROG, the environmental report contains a description of the characteristics of the environment and the current state of the environment in the SEA area under review. The description of the current state of the environment is necessary to be able to forecast its change when the plan is implemented. The object of the inventory are the protected assets listed in 8 section 1 ROG and the interrelationship between them. The presentation is problem-oriented. The focus is thus on possible legacy impacts, environmental elements requiring special protection and on the protected assets that will be most affected by the implementation of the plan. In spatial terms, the description of the environment is based on the respective environmental impacts of the plan. Depending on the type of impact and the protected asset concerned, these impacts vary in extent and may extend beyond the boundaries of the plan.

## 2.1 Soil/surface

The protected assets soil and surface are considered together. Where it is sensible or necessary, the factor area is dealt with in more detail.

### 2.1.1 Data availability

An important basis for describing the surface sediments of the North Sea EEZ is the map of sediment distribution in the German North Sea, at the scale of 1:250,000 (LAURER et. al, 2014; Project GPDN - Geopotential German North Sea, Figure 14). This map was initially only available for the German Bight and was updated and extended to the entire German EEZ of the North Sea with the GPDN project and the map by Laurer et al. 2014. Like the previous version, the mapping is based on point distributed grain size distributions from surface bottom samples, which were classified according to the sediment classification system of Figge (1981) and interpolated into the area. Within the framework of the sediment mapping EEZ project, area-wide sediment mapping using hydroacoustic methods has been carried out for several years now (BSH, 2016). In addition to the larger scale of 1:10,000, the applied methodology offers the advantage that spatial interpolation of point samples is no longer necessary. The resulting detailed maps enormously improve the knowledge of small-scale structure and sediment changes at the seabed surface (Figure 15a/b). In particular, existing knowledge gaps regarding the distribution of coarse-sand-fine gravel areas and residual sediments in the form of gravel, stones and blocks (Figure 15) can be closed. Therefore they are a valuable data source for detailed biotope mapping. The maps are currently not yet available for the entire North Sea EEZ, and the protected areas are largely covered (see Figure 14) and www.geoseaportal.de).

The descriptions of the structure of the near-surface subsoil are essentially based on drillings, pressure soundings and reports of the subsoil investigations, from projects such as "Shelf GeoExplorer Baugrund" (SGE-Baugrund) and the GPDN project, the literature as well as own investigations and evaluations of the BSH.

The data and information used to describe the distribution of pollutants in the sediment, suspended solids and turbidity as well as nutrient and pollutant distribution are collected during the annual monitoring cruises of the BSH.

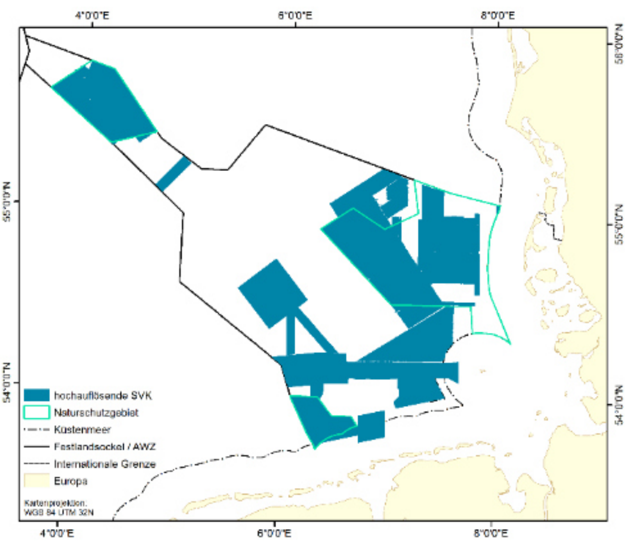



Figure 14: Detailed sediment distribution maps scale 1 : 10,000 (current data availability)

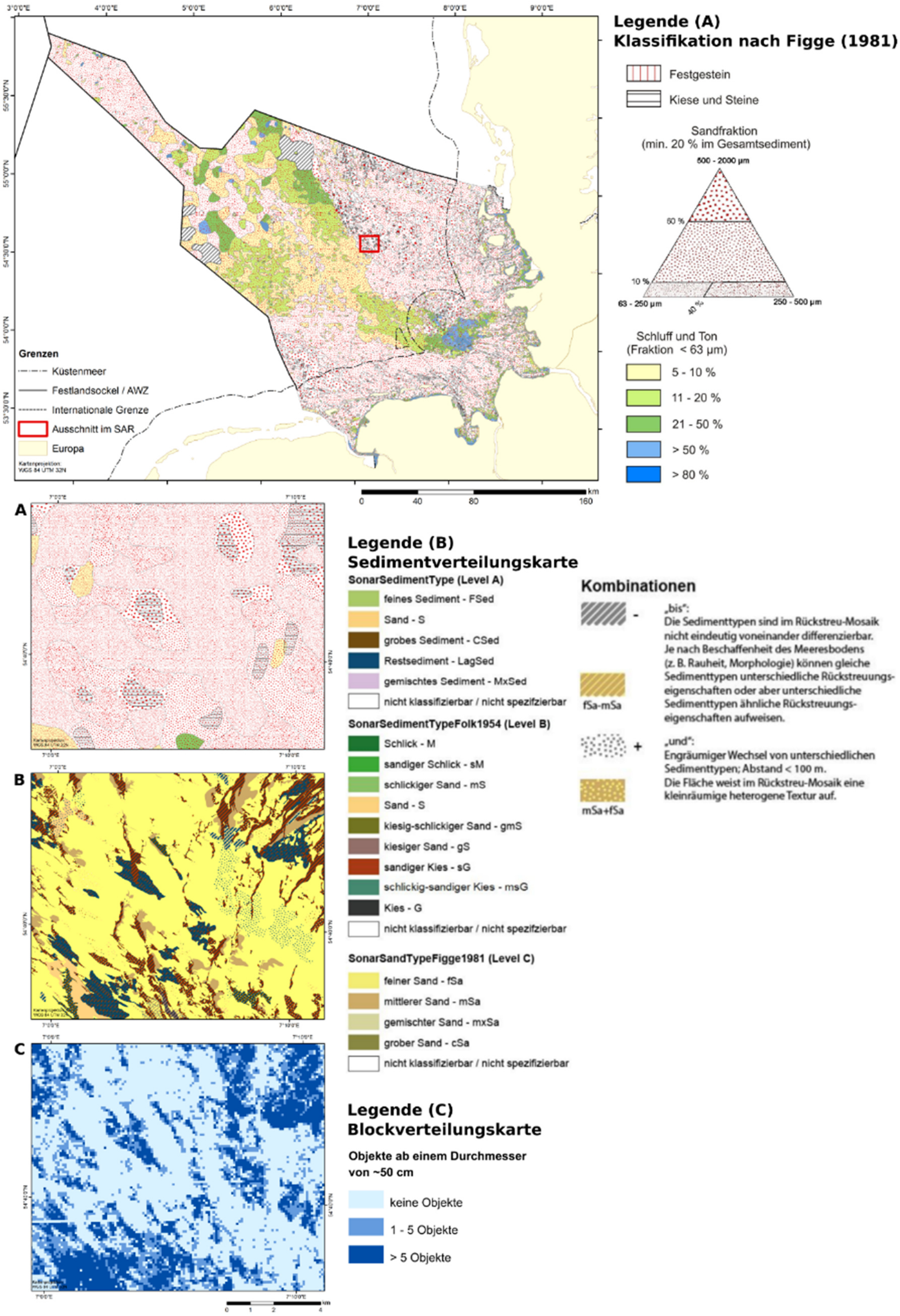



Figure 15: a/b) Comparison of interpolated and area-based sediment distribution maps. c) Block distribution map

### 2.1.2 Geomorphology and sedimentology

The area under review - the German EEZ of the North Sea - extends from the seaward boundary of the coastal waters of Lower Saxony and Schleswig-Holstein to the so-called "Duck's Bill", the elongated extension in the extreme north-west of the German EEZ, which reaches into the central North Sea. The bathymetry of this area is shown in Figure 16.

The formerElbe Glacial ValleyElbe Glacial Valley divides the EEZ of the North Sea into a western and an eastern section, which results in a regional geological division into 4 regions (Figure 16):

- Borkum and Norderney Reef Grounds (1),
- North of Helgoland (2),
- Elbe Glacial Valley and western plains (3),
- Dogger and Northern Shell Bank (4).

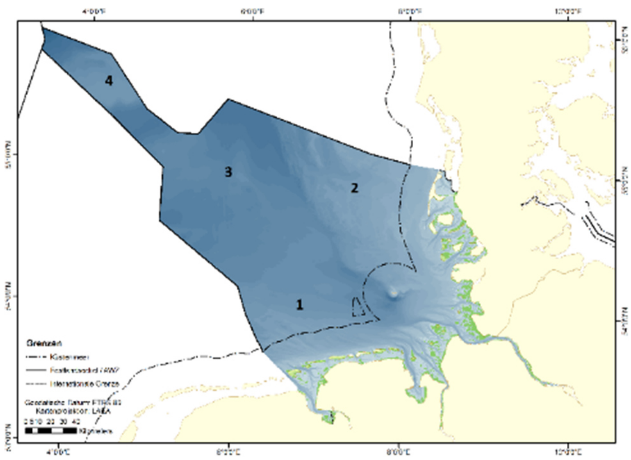


Figure 16: Bathymetry in the EEZ and regional geological classification

**Borkum and Norderney Reef Grounds**

This sub-area covers the area of the Borkum and Norderney Reef Grounds between the two traffic separation areas "German Bight Western Approach" and "Terschelling German Bight" and borders in the east on the 12-nautical mile limit off Helgoland.

The seabed drops evenly from 18 m in the south-west to 42 m in the north and 36 m in the east. Along the 12nautical mile limit with the coastal waters of Lower Saxony, the extensions of the tongue reefs (shoreface connected sand ridges) as defined by REINECK (1984) extend into the EEZ. They run in a northwest-southeast direction and are subject to pronounced sediment dynamics. Their core remains largely stable, while their surface layer is subject to horizontal changes of between 100 and 200 m per year (ANTIA, 1996). On a small scale, ripple fields of varying intensity are observed on the sandy areas, which indicate recent sediment transport or sand relocation.

The sediment distribution on the seabed in the area of the Borkum and Norderney Reef Grounds is predominantly heterogeneous. Mainly medium to coarse sandy sediments are found here, with gravel as a secondary source. Stones can occur in the entire area of the reef grounds. New findings from the comprehensive sediment mapping show a wide range of stones, blocks and boulders in the Borkum Reef Ground. Towards the northeast and east, and with increasing water depth, the sediments turn into medium to fine sands, whose share of silt and clay reaches up to 10% in places, and can rise to 20% in the area of the formerElbe Glacial ValleyElbe Glacial Valley (Laurer et al, 2014).

Holocene and Pleistocene sediment layers can be identified in the shallow subsurface. Under a 0.5 to 2.5 m thick cover of North Sea sands (Nieuw Zeelandgronden Formation), periglacial fine sands of the late Weichselian period are found, which contain clay layers and stones in places (Twente Formation) and can reach thicknesses of up to 16 m. In the area of the reef grounds, both formations wedge out; there, worked up ground moraine deposits from the Saale Cold Period are located under a coarse sandy to gravelly residual sediment cover on the seabed. The sandy-clayey boulder clay, which can locally carry boulders or stones, is deposited on Eemian sea sands, which consist of a sandy sedimentary sequence from the late Elster and early Holstein periods and can reach several metres in thickness. In the respective horizons, former gullies or depressions are encountered, whose fill material can have a heterogeneous sediment composition ranging from silt and clay to gravel. Peat can also be expected in layers. The channels meander in the subsoil, but according to previous findings they are spatially limited.

**North of Helgoland**

This sub-area extends from the 12-nautical mile limit off North Frisia seawards to the eastern bank of the formerElbe Glacial ValleyElbe Glacial Valley and ends in the north at the EEZ border with Denmark.

Water depths range from 9 m on the western edge of the Amrumbank to 50 m in the northwest of the sub-area. Morphologically, the western part in particular is characterised by a relief that is very unsettled for conditions in the German Bight. Particularly noteworthy are the prominent submarine Geestkante along theElbe Glacial Valley, the western edge of the Amrumbank and the ridges in the northern area extending from the Danish base into the German EEZ. Characteristic inventory of forms are large or megaripple fields, coarse sand strips and erosion furrows, the formation of which is closely related to sediment availability, grain size composition and hydrodynamic forces (DIESING et al., 2006). In addition, biogenic structures such as mussel fields are observed in sonograms (side scan sonar recordings) (WERNER, 2004).

The sub-area is characterised by a pronounced heterogeneous sediment distribution on the seabed. In addition to fine and middle sands, coarse sands and gravel are also common. The proportion of fine grains rarely exceeds 5% (Laurer et al, 2014). Pleistocene altitudes were worked up and partially levelled during sea-level rise. They show the characteristic covering with residual or relic sediments (coarse sand, gravel, boulders and erratic blocks). Between these residual sediment deposits, fine to middle sand areas occur, which are usually 0.5 to 2 m thick, but may be missing in places. In exceptional cases, the boulder clay within these residual sediment fields is located directly on the seabed. In contrast to the Borkum and Norderney Reef Grounds, a higher density of rocks on the seabed can be observed in this sea area, which are concentrated in northwest-southeast facing structures (SCHWARZER and DIESING, 2003).

The current results of area-wide sediment mapping show extensive areas with stony residual sediments and blocks on the seabed surface, particularly to the east of the formerElbe Glacial ValleyElbe Glacial Valley (cf. Figure 15a-c).

The structure of the upper seabed is largely determined by the Saalian glacier advance (Warthe stage). The subsoil is traversed to varying degrees by filled meltwater channels and depressions. According to the data available to date, it can be assumed that the main drainage of this glacial channel system is directed NW to W. These structures contain clastic sediments such as sands, clays, silt and gravels as well as organogenic sediments such as peat.

**Elbe Glacial Valley and western plains**

This sub-area extends northwest of Helgoland to the German-Danish or German-Dutch EEZ border, but excludes the area of the so-called Duck's Bill. To the east is the eastern bank of the formerElbe Glacial Valley, which is a striking

Geestkante on the seabed, the border to the sub-area "North of Helgoland". This area north of the traffic separation areas has water depths between about 30 m and 50 m and slopes slightly from southeast to west and north. In the centre of the sub-area is the White Bank, which rises about 3 m from the surrounding seabed. The seabed in this sub-area has a very balanced relief and is largely flat. Occasionally, side-scan sonar images reveal depression-like formations, in which the content of finer-grained material usually increases. Occasionally ripple fields occur, probably caused by ground currents. The sea bed surface consists of fine sands with significant contents of silt and clay. In the area of theElbe Glacial Valley, the recent surface sediments show an increase in clay and silt contents of up to 50%, which correlates with the water depth. The fine sands show a good to very good grading. Occasionally, small-scale gravel deposits can occur locally. In the plains to the west of the formerElbe Glacial Valley, stone deposits are also to be expected to a small extent.

The defining element in the subsoil is theElbe Glacial Valley located in the eastern part of the area, which runs along the submarine edge of the Geestkante to the northwest and north. This formerly approx. 30 km wide valley has been filled up in the course of the Holocene sea transgression, first with an alternating layer of fine sandy and silty-clayey sediments, later mainly with sandy sediments. The thickness of the sediment filling reaches about 20 m. Whereas in the area of the western bordering plains, thicknesses of 1 m are only exceeded in exceptional cases. Below this, mostly dense fine to middle sands with coarse sand intercalations follow. They can contain gravel and shell layers , occasionally also clays, silt or peat.

**Dogger and northern Shell Bank**

This area includes the area known as the "Duck's Bill", the elongated extension in the extreme northwest of the EEZ, which lies in the central North Sea and extends to the EEZ borders of Denmark, Great Britain and the Netherlands.

The seabed morphology is determined by the Dogger Bank, whose northeastern foothills, the Tail's End, crosses the area as a submarine ridge. The shallowest water depths of 29 m are found on Dogger Bank, while the deepest depths of 69 m are measured on its northwestern flank. Pronounced bottom shapes such as sand waves or large or megaripple fields, as found on the British side, have not been observed in this subarea. The seabed is generally relatively poor in structure.

Sedimentologically, the seabed surface mainly consists of a very well sorted fine sand cover, occasionally interrupted by patchy deposits of silt and clay or coarse sand sediments.

The Dogger Bank contains a Pleistocene core of Weichselian sediments (Dogger Bank Formation), which is located under Holocene North Sea sands up to 15 m thick. The Dogger Bank Formation consists of stiff to very stiff, silty clay, which locally carries gravel and stones and can reach a thickness of several tens of metres. The sediments of the Dogger Bank Formation probably extend to the southeastern border of the Duck's Bill. Late Weichselian gullies occur in its area, which are filled with soft, silty clays. In the northwestern slope area of Dogger Bank the Holocene sand cover thins out or is completely missing in places. Between the Dogger Bank and the northern Shell Bank, the 2 to 16 m thick periglacial fine sands occur, which may locally contain clay layers and stones. These are deposited on the marine fine sands from the Eemian warm period, which can be traced through the entire sub-area with thicknesses between 2 and 16 m.

### 2.1.3 Distribution of pollutants in the sediment

**Metals**

The seabed is the most important sink for trace metals in the marine ecosystem. However, it can also act as a regional source of pollution by resuspension of historically deposited, more highly contaminated material. The absolute metal content in the sediment is strongly dominated by the regional grain size distribution. Higher contents are observed in regions with high silt content than in sandy regions. The reason is the higher affinity of the fine sediment content for the adsorption of metals. Metals accumulate mainly in the fine grain fraction.

Especially the elements copper, cadmium and nickel are found in most regions of the German EEZ at low levels or in the range of background concentrations. All heavy metals show elevated levels near the coast, and less pronounced levels along the East Frisian islands than along the North Frisian coast. These very distinct gradients, with increased contents near the coast and very low contents in the central North Sea, indicate a dominant role of freshwater inflows as a source of metal pollution. Added to this are possible discharges of metals from maritime shipping and the offshore industry (e.g. from corrosion protection measures), the additional contribution of which cannot be estimated at present. In detail, lead in the central North Sea in particular also shows significantly increased contents in the fine grain fraction. These are even higher than the values measured at stations near the coast. In contrast, the spatial distribution of the nickel contents in the fine grain fraction of the surface sediment is only characterised by very weakly pronounced gradients. The spatial structure does not allow any conclusions to be drawn about the main areas of stress. Although the values for Pb and Hg in the last MSRL Report (Status of German North Sea Waters 2018) are still above the threshold values, heavy metal pollution in the surface sediment of the EEZ has generally tended to decline (Cd, Cu, Hg) or show no clear trend (Ni, Pb, Zn) over the past 30 years.

**Organic substances**

Most of the organic pollutants are of anthropogenic origin. Some 2,000 mainly industrially produced substances are currently considered environmentally relevant (pollutants) because they are hazardous (toxic) or persistent in the environment (persistent) and/or may accumulate in the food chain (bioaccumulative). Since their properties can vary greatly, their distribution in the marine environment depends on a wide range of factors. In addition to input sources, input quantities and input pathways (directly via rivers, offshore industry or diffuse via the atmosphere), the physical and chemical properties of the pollutants and the dynamic-thermodynamic state of the ocean are relevant for dispersion, mixing and distribution processes. For these reasons, the various organic pollutants in the sea show an uneven and varying distribution and occur in very different concentrations.

During its monitoring cruises, the BSH determines up to 120 different pollutants in the seawater, suspended solids and sediments. For most pollutants in the German Bight, the Elbe is the main input source. For this reason, the highest pollutant concentrations are generally found in the Elbe plume off the North Frisian coast, which generally decreases from the coast to the open sea. The gradients are particularly strong for non-polar substances, as these substances are predominantly adsorbed on suspended matter and are removed from the water phase by sedimentation. Outside the coastal regions rich in suspended matter, the concentrations of non-polar pollutants are therefore usually very low. However, many of these substances are also introduced into the sea by atmospheric deposition or have direct sources in the sea (such as PAHs (polycyclic aromatic hydrocarbons), which can be introduced by the oil and gas industry and shipping. Therefore, land-based sources must also be taken into account in the distribution of these substances.

According to the current state of knowledge, the observed concentrations of most pollutants in the sediment of the German EEZ do not pose an immediate threat to the marine ecosystem. PAHs in the German EEZ in the North Sea are below the OSPAR threshold values. Only PCB-118 does currently not meet the criteria (status of German North Sea waters in 2018).

**Radioactive substances (radionuclides)**

For decades, the radioactive contamination of the North Sea was determined by discharges from nuclear fuel reprocessing plants. As these discharges are very low today, the radioactive contamination of the North Sea does not pose any danger to people or nature according to current knowledge.

**Inherited waste**

Possible inherited waste in the North Sea includes munitions remnants. In 2011, a federal and federal states working group published a basic report on the ammunition contamination of German marine waters, which is updated annually. According to official estimates, the seabed of the North and Baltic Seas holds 1.6 million tonnes of old ammunition and various types of explosive ordnance. A significant proportion of these ammunition dumps originate from the Second World War. Even after the end of the war, large quantities of ammunition were sunk in the North and Baltic Seas to disarm Germany. According to current knowledge, the explosive ordnance load in the German North Sea, especially in the coastal waters, is estimated at up to 1.3 million tonnes. The overall data availability is insufficient, so that it can be assumed that explosive ordnance is also to be expected in the area of the German EEZ (e.g. remnants of mine closures and combat operations). For the only known ammunition dumping area in the North Sea EEZ (approx. 15 nautical miles west of Sylt) there is little and unclear information on the type and quantity of conventional ammunition dumped.

The ammunition remnants can in principle be silted up or exposed on the seabed if the sediment properties are appropriate. In addition, storms or strong currents can cause ammunition bodies in the sediment to be exposed. Thus, ammunition bodies can constitute artificial hard substrates.

Current research results indicate that the corrosion state of ammunition stored at sea may be advanced. Whether and to what extent this may cause adverse effects on the marine environment through the release of the toxic components (e.g. explosives such as TNT) is the subject of current research and part of the work to implement the resolutions of the 93rd Conference of Environment Ministers, TOP 27.

The location of the known ammunition dump sites can be found on the official nautical charts and in the 2011 report (which also includes suspected areas for ammunition contaminated areas). The reports of the federal federal states working working wroup are available at www.munition-im-meer.de. Information on ammunition finds, including the EEZ, is also provided by the OSPAR Commission at https://odims.ospar.org/.

### 2.1.4 Status assessment of the protected asset soil

#### 2.1.4.1 Rarity and endangerment

The aspect "rarity and endangerment" takes into account the portion of the sediments on the seabed and the distribution of the morphological form inventory throughout the North Sea. The sediment types and bottom shapes in the plan area are found throughout the North Sea. Thus, the aspect "rarity and vulnerability" is rated as "low".

#### 2.1.4.2 Diversity and uniqueness

The aspect "diversity and uniqueness" considers the heterogeneity of the described surface sediments and the characteristics of the morphological forminventory.

The sediment composition of the surface sediments in the plan area is quite heterogeneous. Besides the widely spread fine sands, medium and coarse sands are also frequently found. Residual sediments, gravel and stones occur as well. In the area of the Borkum and Norderney Reef Grounds and north of Helgoland, special morphological forms such as tongue reefs and large and megaripple fields occur. A pronounced geest edge forms the border to theElbe Glacial Valley.

The aspect "diversity and uniqueness" is rated "medium".

#### 2.1.4.3 Legacy impacts

***Natural factors***

Climate change and sea level rise: The North Sea region has experienced dramatic climate change over the last 11,800 years, which has been associated with a profound change in the land/sea distribution due to the global sea level rise of 130 m. For about 2,000 years the sea level of the North Sea has reached its present level. Off the German North Sea coast, the sea level rose by 10 to 20 cm in the 20th century. Storms cause changes to the seabed. All sedimentary-dynamic processes can be traced back to meteorological and climatic processes, which are largely controlled by the weather patterns in the North Atlantic.

Tectonic and isostatic movements, earthquakes: the tectonic and isostatic processes are secular processes, i.e. they cover periods of several millennia. They are caused by the plate tectonic movements of the earth's crust and therefore occur over large areas. The analysis of earthquake frequency and intensity for the North Sea makes it clear that the German EEZ is not an earthquake-prone area. However, there are indications that about 8,000 years ago a seaquake triggered the submarine Storegga landslide in the Norwegian Sea, which subsequently caused a tsunami wave that spread across the entire North Sea.

***Anthropogenic factors***

*Eutrophication:* due to anthropogenic inputs of nitrogen and phosphorus via rivers, the atmosphere and diffuse sources, increased primary production leads to increased sedimentation of organic matter. This is largely degraded by microbial activity in the water column or on the seabed surface, so that its share in the sediment composition (grain size distribution) can be neglected.

*Fisheries:* In the North Sea, bottom trawling uses otter trawls and beam trawls. Otter trawls are mainly used in the northern North Sea and are pulled diagonally across the seabed. Their roller gear avoids getting caught on stones, but sometimes turns them over in the process. Beam trawls have been used mainly in the southern North Sea since the 1930s. Since the 1960s, there has been a sharp increase in beam trawl fishing, which has declined slightly over the last decade due to catch regulations and the decline in fish stocks. The skids of the beam trawlers leave tracks of 30 to 50 cm in width. In particular, their skids or chain nets have a greater impact on the bottom than otter trawls. In the sediment, bottom trawls create specific furrows which can be a few millimetres to 8 cm deep on boulder clay and sandy soils and up to 30 cm deep in soft silt (PASCHEN et al., 2000). In addition, the use of bottom trawls has the effect of smoothing the seabed by levelling ripple structures or small elevations. The distribution of the time taken by international trawling activities in the North Sea shows a regional variation in fishing effort with a concentration in the southern part. In purely arithmetical terms, in a heavily fished area, 100% of the area is swept by a beam trawl about 4 ×per year, whereas in less fished areas only 2% of the area is affected. In reality, fishing takes place on already "cleaned" routes, so that some sub-areas are fished several times a year, while others are fished only occasionally over a period of several years (RUMOHR, 2003).

*Sand and gravel extraction:* In the North Sea EEZ, the extraction of gravel and sand is carried out with a suction trailer hopper dredging and usually leads to the formation of dm-deep furrows. With a maximum excavation depth of 2.5 m (including dredging tolerance), a residual thickness of the sediment worthy of extraction must be maintained in order to preserve the original substrate for repopulation. In the case of refilling of the extraction structures, finer-grained sediments usually provide the backfill material (ZEILER et al., 2004). In the subfields currently being mined in the EEZ, the extraction of the gravel sand deposits is selective, i.e. only the sandy or gravelly sediment fraction is extracted and the corresponding residual fraction is returned to the seabed. As a result of this selective extraction, the sediments on the seabed are coarsened or refined in the extraction fields on the one hand, while on the other hand a furrowed or trough-shaped relief is retained to a certain extent because the recent hydrodynamic and sediment dynamic processes in the EEZ cannot lead to complete refilling with the original sediment due to the sediment supply. During sand and gravel extraction, cloudiness plumes are formed to varying degrees, which, depending on the proportion of silt and clay, mainly re-sediment on the seabed within a radius of about 500 m around the extraction point.

*Wind turbines:* The erection of wind turbines and the associated scour protection leads - in addition to temporary sediment uplift - to a long-term small-scale sealing of the seabed.

*Submarine cables* (telecommunications, power transmission): As a result of the infiltration process when cables are laid in the seabed, the water column becomes turbid as a result of sediment turbulence, but this turbidity is distributed over a larger area due to the influence of tidal currents. The suspension content decreases to the natural background values due to dilution effects and sedimentation of the stirred up sediment particles. As a rule, the sediment dynamic processes lead to a complete levelling of the laying tracks, especially after periods of bad weather. In the area of cable crossings, stone fills are applied, which represent a locally limited hard substrate that is foreign to the location.

*Natural gas production:* Natural gas has been produced in the NW corner of the Duck's Bill since 2000. To date there is no evidence of subsidence phenomena in the vicinity of the "A6-A" production facility, as described in the area of facilities on the Dutch or Norwegian continental shelf of the North Sea (e.g. FLUIT and HULSCHER, 2002; MES, 1990). For the former natural gas deposit "Ekofisk", a total subsidence of up to 6 m is expected (SULAK and DANIELSEN, 1989). It cannot be ruled out that after several years of production in the vicinity of the A6-A platform, subsidence of the seabed will occur, which will depend on the geological conditions in the subsoil and will essentially be limited to the area of the deposit (approx. 15 km²).

*Shipping:* In the case of an anchor cast, the seabed is locally stirred up to a maximum depth of 1 m, depending on the size of the anchor and the type of sediment. Depending on water depth, type and available amount of sediment, wrecks can be silted up and uncovered. Depending on their size, they influence the small-scale sediment dynamics by causing scouring in the vicinity or sedimentation of sands in the current shadow.

Anthropogenic factors affect the seabed in the following ways:

- Erosion
- Mixing
- Off-bottom suspension (resuspension)
- Material sorting
- Sealing
- Displacement and
- Compression (compaction).

In this way, the sediment structure, the natural sediment dynamics (sedimentation/erosion) and the material exchange between sediment and soil water are influenced.

For the assessment of the aspect "legacy impacts", the extent of the pre-existing anthropogenic pollution of the sediments and the morphological form inventory is decisive. With regard to the criterion "legacy impacts", the protected asset soil/surface is assigned a medium pollution, since the legacy impacts do not cause a loss of ecological function.

## 2.2 Water

The North Sea is a relatively shallow shelf sea with a wide opening to the North Atlantic Ocean in the north. The oceanic climate of the North Sea - characterised by salinity and temperature - is largely determined by this northern opening to the Atlantic. In the southwest, the Atlantic has a smaller influence on the North Sea due to the shallow English Channel and the narrow Dover Strait.

### 2.2.1 Currents

The currents in the North Sea consist of a superposition of the half-day tidal currents with the wind- and density-driven currents. In general, the North Sea is characterised by large-scale cyclonic, i.e. counterclockwise, circulation, with a strong inflow of Atlantic water at the northwestern edge and an outflow into the Atlantic Ocean via the Norwegian Gully. The strength of the North Sea circulation depends on the prevailing air pressure distribution over the North Atlantic, which is parameterised by the North Atlantic Oscillation Index (NAO), the standardised air pressure difference between Iceland and the Azores.

Based on an analysis of all current measurements carried out by the BSH and the German Hydrographic Institute (DHI) between 1957 and 2001 (KLEIN 2002), the mean values of current velocity (scalar mean including tidal current) and residual current velocities (vector mean) were determined for various areas of the German Bight near the surface (3 - 12 m water depth) and near the bottom (0 - 5 m distance to the bottom) (Table 7). All time series with a length of at least 10 days and a water depth of more than 10 m were considered in this analysis. The aim of the analysis was to estimate the conditions in the open sea. The mean values are shown in Table 7. The tidal currents were determined by the connection to the gauge Helgoland, i.e. the measured currents are related to the tidal range and flood times observed there (KLEIN & MITTELSTAEDT 2001)..

Table 7: Mean current velocities, residual and tidal currents in the German Bight.

| | **Surface proximity (3 – 12 m)** | **Ground level (0 - 5 m distance to the ground)** |
|---|---|---|
| Mean amount | 25 - 56 cm/s | 16 - 42 cm/s |
| Vector mean (residual current) | 1 - 6 cm/s | 1 - 3 cm/s |
| Tidal current | 36 - 86 cm/s | 26 - 73 cm/s |

Figure 17 shows the current conditions in the near-surface layer (3 - 12 m measuring depth) for various areas in the German Bight. In the illustration, the values in area GB3 correspond to the (geological) sub-area "Borkum and Norderney Reef Grounds", GB2 corresponds to the sub-area "North of Helgoland" and GB1 corresponds to the sub-area "Elbe Glacial Valley and western plains".

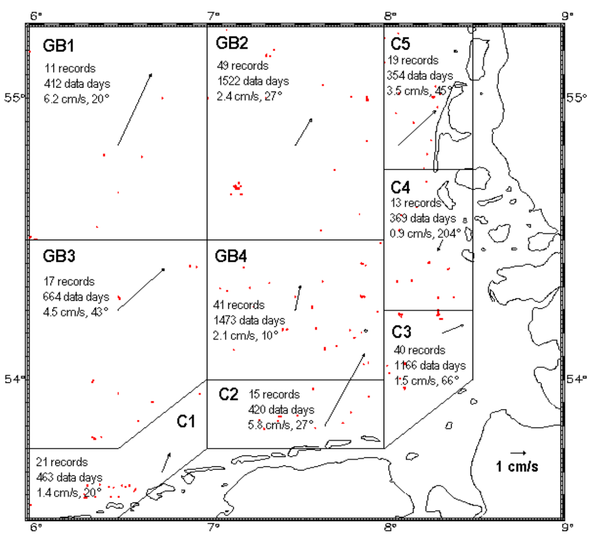



Figure 17: Vector mean of the flow in the near-surface layer (measuring depth 3 to 12 m). The measuring positions are marked with a red dot (BSH 2002).

### 2.2.2 Sea state

For the sea state, a distinction is made between waves generated by the local wind, the so-called wind sea, and swell. Swells are waves that have left their area of origin and enter the sea area under consideration. The swell entering the southern North Sea is generated by storms in the North Atlantic or the northern North Sea. The swell has a longer period than the wind sea. The height of the wind sea depends on the wind speed and the time over which the wind acts on the water surface (duration of action) and on the length of the swell (fetch), i.e. the distance over which the wind acts. For example, the strike length in the German Bight is significantly smaller for easterly and southerly winds than for northerly and westerly winds. The significant or characteristic wave height, i.e. the mean wave height of the upper third of the wave height distribution, is given as a measure of the wind sea.

During the climatological year (1950-1986), the highest wind speeds in the inner German Bight occur in November with about 9 m/s and then drop to 7 m/s by February. In March, the speed reaches a local maximum of 8 m/s, after which it drops rapidly and remains at a flat level of around 6 m/s between May and August, before rising just as rapidly from mid-August to the maximum in late autumn (BSH, 1994). This annual trend, based on monthly averages, is transferable to the height of the sea state. For the inner German Bight, the directional distribution of the sea state of the unmanned lightship UFS German Bight (formerly UFS German Bight) - analogous to the distribution of wind direction - shows a distribution with a maximum in swell from west southwest and a second maximum from east southeast (LOEWE et al. 2003).

### 2.2.3 Temperature, salinity and seasonal stratification

Water temperature and salinity in the German EEZ are determined by large-scale atmospheric and oceanographic circulation patterns, freshwater inputs from the Weser and Elbe rivers and energy exchange with the atmosphere. The latter applies in particular to the sea surface temperature (LOEWE et al. 2003). The seasonal minimum temperature in the German Bight usually occurs at the end of February/beginning of March, seasonal warming begins between the end of March and the beginning of May, and the temperature maximum is reached in August. Based on spatial mean temperatures for the German Bight, SCHMELZER et al. (2015) find extreme values for the period 1968-2015 of 3.5 °C in February and 17.8 °C in August. This corresponds to an average amplitude of 14.3 K, with the annual difference between maximum and minimum varying between 10 and 20 K. With the onset of seasonal warming and increased irradiation, thermal stratification sets in between the end of March and the beginning of May in the northwestern German Bight at water depths of over 25-30 m. With pronounced stratification, vertical gradients of up to 3 K/m are measured in the temperature jump layer (thermocline) between the warm top layer and the colder bottom layer; the temperature difference between the layers can be up to 10 K (LOEWE et al. 2013). Flatter areas are generally mixed, even in summer, due to turbulent tidal currents and wind-induced turbulence. With the beginning of the first autumn storms, the German Bight is again thermally vertically mixed.

The time series of the annual mean spatial temperatures of the entire North Sea based on the temperature maps published weekly by the BSH since 1968 show that the course of the s*ea surface temperature* (SST) is not characterised by a linear trend, but by regime changes between warmer and colder phases (see also Fig. 3-28 in BSH 2005). The extreme warm regime of the first decade of the new millennium, in which the annual mean of the North Sea SST fluctuated around a mean level of 10.8 °C, ended with the cold winter of 2010 (Figure 18). After four significantly cooler years, the North Sea SST reached its highest annual mean of 11.4 °C in 2014.

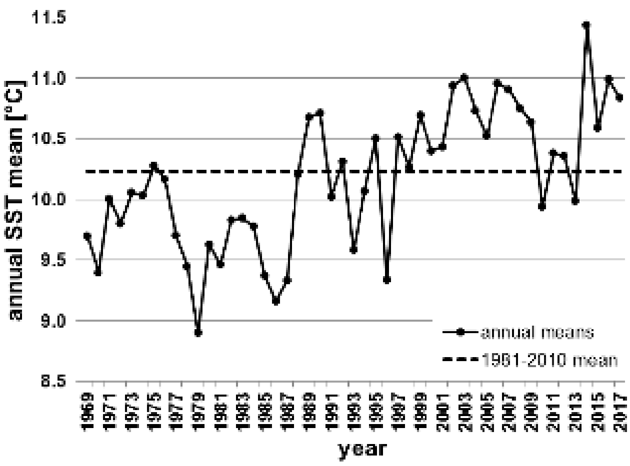



Figure 18: Annual average North Sea surface temperature for the years 1969-2017

Regarding climate-related changes, QUANTE et al. (2016) expect an increase in SST of 1-3 K by the end of the century. Here the different projections come to consistent results despite considerable differences in the model simulations with regard to setup, drive from global climate model, bias corrections, etc. (KLEIN et al. 2018).

In contrast to the temperature, the salt content does not have a clearly pronounced annual cycle. Stable salinity stratifications occur in the North Sea in the estuaries of the major rivers and in the area of the Baltic outflow. Due to tidal turbulence, the fresh water discharge of the major rivers within the estuaries mixes with the coastal water at shallow depths, but at greater depths it stratifies over the North Sea water in the German Bight. The intensity of stratification varies depending on the annual course of river discharges, which in turn exhibit considerable inter-annual variability, e.g. due to high meltwater runoff in spring after heavy snow winters. For example, the salinity at Helgoland Reede is negatively correlated with the discharge volumes of the Elbe, which shows that fresh water discharges cause a significantly reduced near-surface salinity near the coast (LOEWE et al. 2013), with the Elbe having the greatest influence on the salinity of the German Bight with a discharge of 21.9 km³/year.

Since 1873 the salinity measurements of Helgoland Reede have been available, since about 1980 also the data at the positions of the former lightships, which were at least partly replaced by automated measuring systems later. The relocation of lightship positions and methodical problems, also with the measurements at Helgoland, led to breaks and uncertainties in the long time series and made reliable trend estimations more difficult (HEYEN & Dippner 1998). For the annual mean surface salinity at Helgoland, no long-term trend is apparent for the years 1950-2014. This also applies to the annual discharge rates of the Elbe. Projections of the future development of salinity in the German EEZ currently still differ considerably with regard to temporal development and spatial patterns, more recent projections indicate a decrease in salinity between 0.2 and 0.7 PSU by the end of the century (KLEIN et al. 2018).

### 2.2.4 Ice conditions

In the open German Bight, the heat reserve of the relatively salty North Sea water in early winter is often so large that ice can only form very rarely. The open sea area off the North and East Frisian islands is ice-free in two thirds of all winters. On average over many years, the ice edge extends right behind the islands and into the outer estuaries of the Elbe and Weser. In normal winters, ice occurs on 17 to 23 days in the protected inner fairways in the North Frisian Wadden area, and only on 2 to 5 days in the open fairways - similar to the East Frisian Wadden area.

In ice-rich and very ice-rich winters, on the other hand, ice occurs on average on 54 to 64 days in the protected inner fairways in the North Frisian Wadden area, and on 31 to 42 days in the open fairways similar to the East Frisian Wadden area. In the inner tidal flats, mainly solid ice forms. In the outer tidal flats, mainly floe ice and ice slurry form, which are kept in motion by wind and tidal effects. Further information can be found in the Climatological Ice Atlas 1991-2010 for the German Bight (SCHMELZER et al. 2015).

### 2.2.5 Fronts

Fronts in the sea are high-energy mesoscale structures (of the order of a few tens of kilometres to a few hundred kilometres) which have a major impact on the local movement dynamics of the water, on biology and ecology and - due to their ability to bring $CO_2$ to greater depths - also on the climate. In the coastal areas of the North Sea, especially off the German, Dutch and English coasts, the so-called river plume fronts with strong horizontal salinity and suspended matter gradients are located between the freshwater input area of the major continental rivers and the continental coastal waters of the North Sea. These fronts are not static formations but consist of a system of smaller fronts and eddies with typical spatial scales between 5 and 20 km. This system is subject to great temporal variability with time scales from 1 to about 10 days. Depending on the meteorological conditions, the discharge rates of the Elbe and Weser rivers and the circulation conditions in the German Bight, frontal structures continuously dissolve and form. Only under extremely calm weather conditions can discrete frontal structures be observed over longer periods of time. During the period of seasonal stratification (approx. from the end of March to September), the tidal mixing fronts, which mark the transition area between the thermally stratified deep water of the open North Sea and the shallower, vertically mixed area due to wind and tidal friction, are located approximately in the area of the 30 m depth line. Due to their dependence on topography, these fronts are relatively stationary (OTTO et al. 1990). KIRCHES et al. (2013a-c) analysed satellite based remote sensing data from 1990 - 2011 and established a climatology for SST, chlorophyll, yellow and suspended matter fronts in the North Sea. This shows that fronts occur all year round in the North Sea, with the strength of the spatial gradient generally increasing towards the coast.

Fronts are characterised by significantly increased biological activity; and adjacent areas play a key role in the marine ecosystem. They influence ecosystem components at all stages, either directly or as a cascading process through the food chain (ICES 2006). Vertical transport on fronts brings nutrients into the euphotic zone, thereby increasing biological productivity. The increased biological activity on fronts, due to the high availability and effective use of nutrients, results in increased atmospheric $CO_2$ binding and transport to deeper layers. The outflow of these $CO_2$-enriched water masses into the open ocean is known as "shelf sea pumping" and is an essential process for the absorption of atmospheric $CO_2$ by the world ocean. The North Sea is a $CO_2$ sink in large parts all year round, with the exception of the southern areas in the summer months. Over 90% of the $CO_2$ absorbed from the atmosphere is exported to the North Atlantic.

### 2.2.6 Suspended matter and turbidity

The term "suspended matter" refers to all particles suspended in seawater with a diameter >0.4 µm. Suspended matter consists of mineral and/or organic material. The proportion of organic suspended matter is strongly dependent on the season. The highest values occur during plankton blooms in early summer. During stormy weather conditions and the resulting high waves, the suspended matter content in the entire water column increases strongly due to the swirling up of silty-sandy bottom sediments. This is where the swell has the greatest effect. When hurricane lows pass through the German Bight, increases in the suspended matter content of up to ten times the normal values are easily possible. As water samples cannot be taken during extreme storm conditions, corresponding estimates are derived from the records of anchored turbidimeters. If one considers the temporal variability of the suspended sediment content at a fixed position, there is always a distinct half-day tidal signal. Ebb and flood currents transport the water in the German Bight on average about 10 nautical miles from or towards the coast. Accordingly, high levels of suspended matter (SPM = Suspended Particular Matter) are transported 'back and forth' and cause the strong local fluctuations. Further variability in SPM is caused by material transport (advection) from rivers such as the Elbe and Weser and from the south-east coast of England.

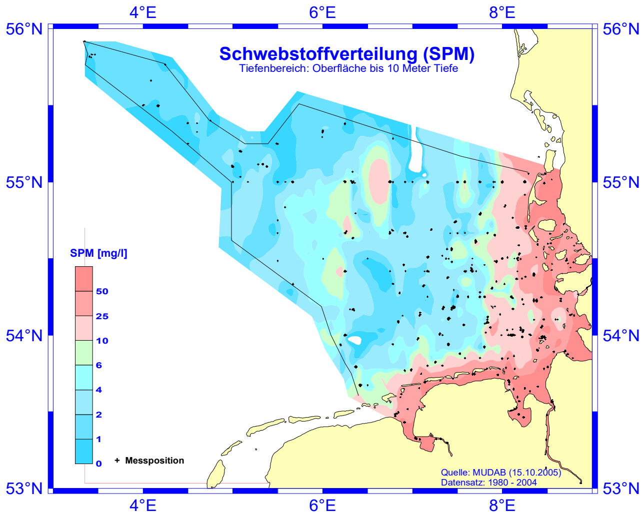



Figure 19: Mean suspended matter distribution (SPM) for the German North Sea. Figure 19 shows an average suspended matter distribution for the German Bight. The graph is based on all SPM values stored in the Marine Environmental Database (MUDAB) as of 15 October 15 2005. The data set was reduced to the range "surface to 10 metres depth" and to values ≤150 mg/l. The underlying measured values were only obtained in weather conditions in which research vessels are still operational. Difficult weather conditions are therefore not reflected in the average values shown here. Figure 19 shows average values of around 50 mg/l and extreme values >150 mg/l measured in the tidal flats landwards of the East and North Frisian islands and in the large estuaries. Further seawards, the values quickly decrease to a range between 1 and 4 mg/l. A little east of 6° E, there is an area with increased levels of suspended matter. The lowest SPM mean values around 1.5 mg/l are found in the northwestern edge of the EEZ and above the sandy areas between the Borkum Reef Ground and the Elbe Glacial Valley.

### 2.2.7 Status assessment with regard to nutrient and pollutant distribution

#### 2.2.7.1 Nutrients

Nutritive salts such as phosphate and inorganic nitrogen compounds (nitrate, nitrite, ammonium) and silicate are essential for marine life. They are vital substances for the formation of phytoplankton (microscopic unicellular algae floating in the sea), on whose biomass production the entire marine food chain is based. Since these trace substances promote growth, they are called nutrients. An excess of these nutrients, which occurred in the 1970s and 1980s due to extremely high nutrient inputs caused by industry, transport and agriculture, leads to a high accumulation of nutrients in seawater and thus to eutrophication. This continues to this day in coastal regions. As a result, there may be an increased occurrence of algal blooms (phytoplankton and green algae), reduced visibility depths, a decline in seagrass beds, shifts in the species spectrum and oxygen deficiency near the seabed.

To monitor nutrients and oxygen levels in the German Bight, the BSH carries out several monitoring cruises per year. The nutrient concentrations show a typical annual cycle, with high concentrations in winter and low concentrations in the summer months. All nutrients show similar distribution structures. A gradual decrease in concentrations can be observed from the river estuary towards the open sea. The highest concentrations are measured in the Elbe tributary area and in coastal regions. The nutrient input from the Elbe is clearly visible here (

Figure 20).

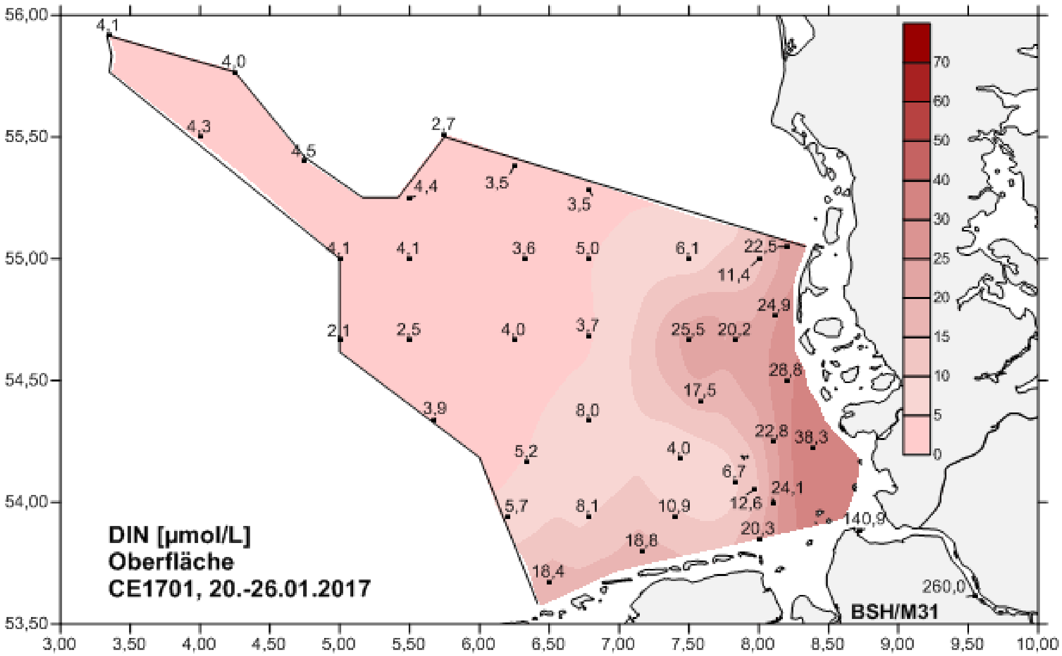



Figure 20: Distribution pattern of soluble inorganic nitrogen compounds (DIN).

Thanks to measures such as the expansion of wastewater treatment plants, the introduction of phosphate-free detergents, etc., nutrient inputs into the North Sea have been reduced by around 50% since 1983, and phosphorus inputs by as much as 65% (UBA 2017). Nevertheless, according to the eutrophication assessment under the OSPAR Common Procedure, the coastal waters and large parts of the German EEZ (a total of 55% of German North Sea waters) are classified as eutrophic in the 2006-2014 assessment period (Brockmann et al. 2017). Only in the outer German Bight (Duck's Bill) a good environmental status was achieved (6% of German North Sea waters). This assessment serves as the basis for the follow-up assessment under the EU MSFD, so that a good environmental status under MSFD continues to fall short of descriptor 5 (eutrophication) (BMU 2018).

#### 2.2.7.2 Metals

Metals occur naturally in the environment. The detection of metals in the environment is therefore in no way necessarily to be regarded as pollution. In addition to the naturally occurring element contents, human activities sometimes mobilise, transport, partially transform and re-enrich considerable additional quantities of individual elements in the environment. In general, the metal contents of seawater are determined by the structure, dynamics and strength of the sources, the large-scale circulation of marine water masses and the efficiency of their sink processes. Major sources of the anthropogenically induced metal signal in marine ecosystems are the run-off of contaminated freshwater masses via the continental river systems, the transport of pollutants via the atmosphere and the interrelationship with the sediment. Other inputs are caused by offshore activities, such as exploration for raw materials and extraction and dumping of dredged material.

Metals are dissolved and suspended in the water body. With increasing distance from the coast, i.e. with rising salinity, the suspended matter content in the water column decreases. Thus, the proportion of surfaces available for adsorption processes decreases and a proportionally increasing part of the metal content remains in solution.

Similar to the nutrients, some metals in the dissolved fraction show periodic seasonal variations in concentration. This seasonal profile corresponds roughly to the biological growth and remineralisation cycle, as it is also the case for the nutrient contents dissolved in seawater.

Mainly elements (Cu, Ni, Cd), which are mainly dissolved, but also mercury, form a distinct gradient that decreases from the coast to the open sea. As a rule, the current transports the water masses from the west into the German Bight and out of it to the north. Accordingly, the discharge plume of the Elbe, starting from the estuary, is clearly pronounced towards the north.

#### 2.2.7.3 Organic substances

The BSH currently determines up to 120 different pollutants in the seawater, suspended solids and sediments during its monitoring cruises. As the Elbe is the main source of most pollutants in the German Bight, the highest pollutant concentrations are generally found in the Elbe plume off the North Frisian coast, which generally decreases in the open sea. The gradients for non-polar substances are particularly strong, as these substances are mainly adsorbed (attached) to suspended matter and removed from the water phase by sedimentation. Outside the coastal regions rich in suspended matter, the concentrations of non-polar pollutants are therefore usually very low. Water pollution by petroleum hydrocarbons is low, although numerous acute oil spills from shipping can be detected by visible oil films. Most hydrocarbons originate from biogenic sources; only occasionally are traces of acute oil pollution in the water phase observed.

In recent years, new analytical methods have been used to detect a large number of "new" pollutants (emerging pollutants) with polar properties in the environment. Many of these substances (e.g. the herbicides isoproturon, diuron and atrazine) occur in much higher concentrations than the classical pollutants.

According to current knowledge, the observed concentrations of most pollutants in seawater do not pose any immediate threat to the marine ecosystem. An exception is the pollution caused by tributyltin (TBT), which was formerly used in marine paints and whose concentration near the coast partly reaches the biological threshold. Furthermore, seabirds and seals can be damaged by oil films floating on the water surface as a result of acute oil spills. In the ecotoxicological assessment, the toxicity of individual pollutants is not sufficient; rather, the cumulative effect of the large number of pollutants present must be considered, which may be enhanced by synergy effects.

#### 2.2.7.4 Radioactive substances (radionuclides)

For decades, the radioactive contamination of the North Sea was determined by discharges from nuclear fuel reprocessing plants. As these discharges are very low today, the radioactive contamination of the North Sea water body does not pose any danger to man or nature according to current knowledge.

## 2.3 Plankton

Plankton includes all organisms that drift in the water. These mostly very small organisms form a fundamental component of the marine ecosystem. Plankton includes plant organisms (phytoplankton), small animals and developmental stages of the life cycle of marine animals, such as eggs and larvae of fish and benthic organisms (zooplankton) as well as bacteria (bacterioplankton) and fungi.

### 2.3.1 Data availability

For plankton, only a few monitoring programmes exist. Previous findings on the spatial and temporal variability of phyto- and zooplankton come from research programmes, a few long-term studies and ecosystem modelling. Remote sensing has also contributed significantly to improving data availability in recent years. Since 1932, the Continuous Plankton Recorder (CPR) from the Northeast Atlantic and the North Sea has been providing a valuable long-term series (REID et al. 1990, BEAUGRAND et al. 2003). The CPR recordings have identified approx. 450 different phyto- and zooplankton taxa, in the North Sea a total of more than 100 phytoplankton species have been determined (EDWARDS et al. 2005).

The most important data source for the German Bight is the long-term data series Helgoland Reede, which has been continuously collected by the Biological Institute Helgoland (BAH in the AWI Foundation) since 1962 (WILTSHIRE & Manly 2004). At the Helgoland Reede station, studies of nutrient concentrations with simultaneous recording of temperature, salinity and oxygen are carried out every working day. Since 1967, the phytoplankton biomass has been determined.

Since 1975, the zooplankton of the Helgoland Reede has also been continuously and systematically studied (GREVE et al. 2004).

There is a lack of such long-term series in the German EEZ. Only in the years 2008 to 2011, plankton (phyto- and mesozooplankton) was investigated at 12 selected stations in the German EEZ by the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) on behalf of the BSH within the framework of biological monitoring. Samples were taken five times a year in parallel with the nutrient sampling (WASMUND et al. 2012). For this reason, the description of the current state will be limited to the investigations at the Helgoland Reede station and to information from the four-year investigations of the IOW. It should be noted that Helgoland is not representative for the EEZ in terms of associated communities of hydrography and phytoplankton. Between March 2003 and December 2004, zooplankton samples were also taken and analysed at the FINO1 research platform in the area of the EEZ (OREJAS et al. 2005). The hydrographic conditions in this area of the EEZ vary considerably from those in the Helgoland Reede, in particular due to water depth and the prevailing currents. However, a pronounced variability in succession, as observed at the Helgoland Reede, was also documented from this area.

### 2.3.2 Spatial distribution and temporal variability of phytoplankton

Phytoplankton is the lowest living component of the marine food chains and comprises small organisms, mostly up to 200 µm in size, which are taxonomically classified as belonging to the plant kingdom. They are micro-algae, usually consisting of a single cell or capable of forming chains or colonies from several cells. Phytoplankton organisms have a predominantly autotrophic diet, i.e. through photosynthesis they are able to use the inorganic nutrients dissolved in water to synthesise organic molecules for growth. Phytoplankton also includes micro-organisms that can feed heterotrophically, i.e. from other micro-organisms. There are also mixotrophic organisms that can feed auto- or heterotrophically, depending on the situation. Many microalgae are, for example, able to change their diet during their life cycle. Bacteria and fungi also form separate groups phylogenetically (in terms of evolutionary history). When looking at phytoplankton, bacteria, fungi and those organisms that are closer to the animal kingdom due to their physiological properties are also taken into account. In this report the term phytoplankton is used in this extended sense.

Important taxonomic groups of the phytoplankton of the southern North Sea and the German Bight arediatoms (Bacillariophyta),

- dinoflagellates or flagellate algae (Dinophyceae) and
- microalgae or microflagellates of different taxonomic groups.

The phytoplankton serves as a food source for organisms that specialise in filtering the water for food intake. The main primary consumers of phytoplankton include zooplanktonic organisms such as copepods and water fleas (Cladocera).

Phytoplankton growth in the German Bight shows fixed patterns during the year. In spatial terms, spring growth and thus algal bloom (masses of algae) only begin in the areas far from the coast, i.e. in the outer part of the German EEZ. From year to year, different species of diatoms are responsible for the spring algal bloom. *Thalassiosira rotula* forms spring algal blooms particularly frequently (VAN BEUSEKOM et al. 2003).

In summer the phytoplankton has a low biomass and is dominated by dinoflagellates and other small flagellates. Another diatom bloom usually follows in autumn (HESSE 1988; REID et al. 1990).

The spatial distribution of the phytoplankton depends primarily on the physical processes in the pelagial. Hydrographic conditions, in particular temperature, salinity, light, currents, wind, turbidity, fronts and tides, influence the occurrence and species diversity of the phytoplankton. The North Sea can roughly be divided into two areas that are fundamentally different for the occurrence of plankton: The area with a water body that is mixed throughout the year and the area with strong stratification (vertical stratification) of the water body. As a rule, these areas also have different nutrient concentrations. The encounter of mixed and stratified water masses is referred to as oceanographic fronts (cf. Chapter

Fronts ). These largely determine the occurrence of phytoplankton. Phytoplankton occurs in high abundance in stratified water bodies near the thermocline (layer boundary between superimposed water masses with different temperatures).

In the German Bight, the geographical positions of fronts change depending on weather conditions, freshwater input from rivers, tides and wind-induced currents. However, they occur preferentially in the inner areas of the German Bight. In general, nutrient levels in the area of the German coastal waters off the coast of Lower Saxony and in the southern part of the Schleswig-Holstein coast in the area of the Elbe water plume are twice as high as in the northern part of the Schleswig-Holstein coastal waters off Sylt. This is also reflected in phytoplankton growth and chlorophyll concentrations (VAN BEUSEKOM et al. 2005).

A spatially sharp delineation of habitat types is therefore only possible to a very limited extent for phytoplankton, in contrast to e.g. benthos. The spatial and temporal distribution of microplankton in the German Bight was specified by HESSE (1988). Large-scale investigations identified three water masses in the German Bight with which the occurrence of phytoplankton is associated. The displacement of these main water masses can influence the temporal and spatial development of the phytoplankton. In 2010, 144 taxa were determined in biological monitoring, while 140 taxa were determined in 2011 (WASMUND et al. 2011, WASMUND et al. 2012). The majority of the species were diatoms. In the course of the investigations from 2008 to 2011, new species were found every year, while some species from the first years of investigation were no longer found. A total of 193 phytoplankton taxa were found during the four years of investigation (WASMUND et al. 2012). In 2011, the species *Cyclotella choctawhatcheeana* was probably sighted for the first time, while the otherwise often common species *Thalassiosira pacifica, Proboscia indica, Planktolyngbya limnetica, Coscinodiscus granii,* and *Prorocentrum minimum* were no longer sighted in 2011 (WASMUND et al. 2012).

### 2.3.3 Spatial distribution and temporal variability of zooplankton

Zooplankton includes all marine animals that drift or migrate in the water column. Zooplankton plays a central role in the marine ecosystem, firstly as the lowest secondary producer within the marine food chain as the food source for carnivorous zooplankton species, fish, marine mammals and seabirds.

On the other hand, zooplankton has a special significance as a primary consumer (Grazer) of phytoplankton. Eating away or grazing can stop the algae bloom and regulate the degradation processes of the microbial cycle by consuming the cells.

The succession of zooplankton in the German Bight shows distinct seasonal patterns. Maximum abundances are generally reached in the summer months. The succession of zooplankton is of critical significance for secondary consumers of the marine food chains. Predator-prey ratios or trophic relationships between groups or species regulate the balance of the marine ecosystem. Temporally or spatially staggered occurrence of succession and abundance of species leads to the interruption of food chains. In particular, temporal displacement, so-called trophic mismatch, results in food shortages at different developmental stages of organisms, with effects on the population level.

Zooplankton is divided into, based on the organisms' life strategies

- Holozooplankton: The entire life cycle of organisms takes place exclusively in the water column. Among the best-known holoplanktonic groups that are important for the southern North Sea are crustaceans such as copepods and cladocera (water fleas).
- Merozooplankton*:* Only certain stages of the life cycle of organisms, mostly the early life stages such as eggs and larvae, are

planktonic. The adult individuals then change over to benthic habitats or join the nekton. These include early life stages of bristle worms, bivalves, snails, crustaceans and fish. Pelagic fish eggs and fish larvae are abundant in merozooplankton during the reproduction period.

The transport and distribution of larvae are of particular significance for the spatial occurrence and population development of both nektonic and benthic species. The distribution of larvae is determined both by the movements of the water masses themselves and by endogenous or species-specific characteristics of the zooplankton. Environmental factors that may influence the distribution, metamorphosis and settlement of larvae are sediment type and structure, meteorological and hydrographic conditions, light and chemical solutes released into the water by adult individuals of the species.

The characterisation of habitat types due to the presence of zooplankton is difficult. As already explained for phytoplankton, the zooplankton habitat is actually made up of water masses. In 2010, a total of 157 zooplankton taxa were determined within the scope of biological monitoring, with arthropods being the most common group with 80 taxa, followed by Cnidaria with 27 taxa, Polychaeta with 15 and Echinodermata larvae with 9 taxa. The total number of taxa exceeded that of 2009 by 14 taxa and that of 2008 by 40 taxa. A lower diversity was observed in the whole region off the North Frisian Islands (stations HELGO, AMRU2 and SYLT1, Figure 21). This observation is accompanied by the large-scale water transport off the coast towards Jutland. In 2008, this zone was characterised by an "estuary plume" with lower salinity and higher chlorophyll values (WASMUND et al., 2009). The spatial distribution of taxa according to the Margalef species richness index shows a pattern typical for estuaries. The values increase with increasing distance from the station near Helgoland, which is closest to the Elbe estuary, towards the central North Sea. This experience was already gained in the first reporting year, 2008. The result was supported by the then changing copepod composition, according to which the proportion of marine genera increased from 20% to over 80% with increasing distance from the coast (WASMUND et al. 2009 and 2011).

In 2011, 139 zooplankton taxa were recorded, with arthropods also being the most common group (WASMUND et al. 2012).

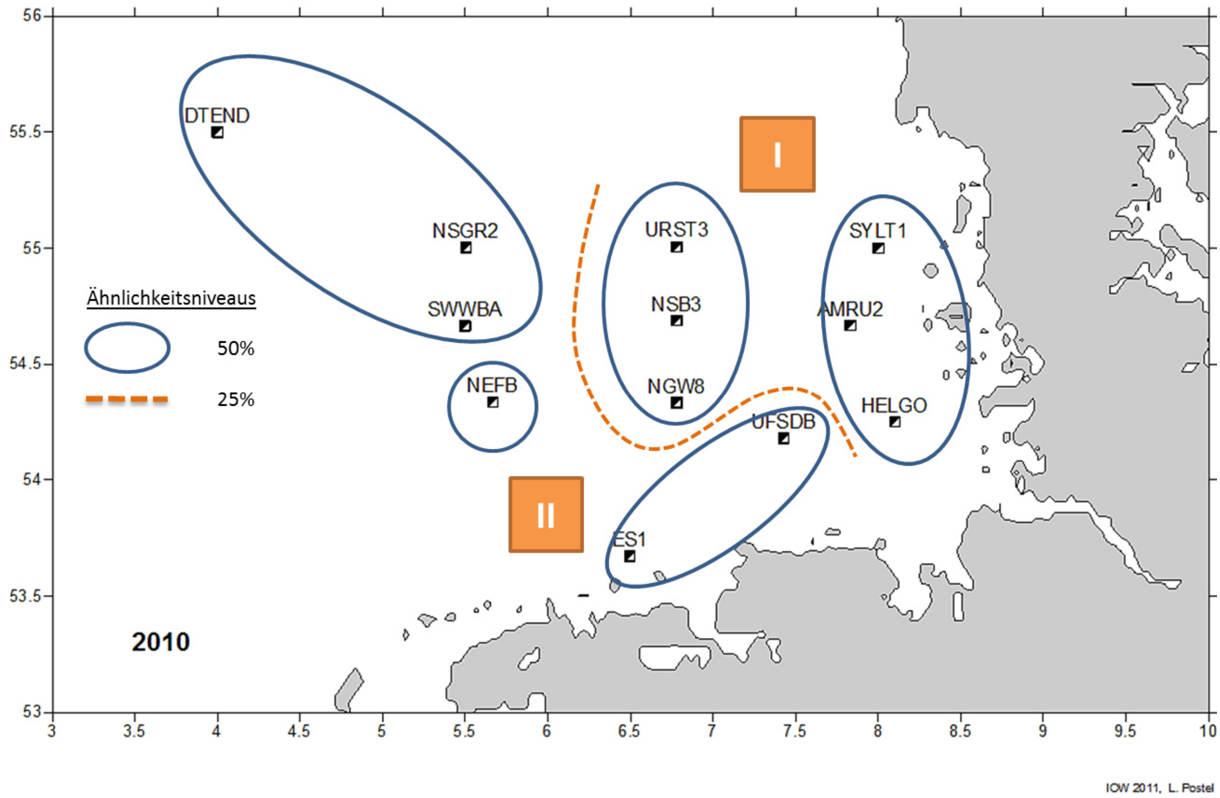



Figure 21: Spatial distribution of mesozooplankton communities according to cluster analysis based on the abundances of all taxa and their developmental stages in the German EEZ 2010 (WASMUND et al. 2011).

### 2.3.4 Status assessment of plankton

Overall, taking into account all available long-term data (CPR, Helgoland Reede), changes can be observed in both phytoplankton and zooplankton in the North Sea since the late 1980s and in the 1990s. The slowly progressing changes affect species spectrum as well as abundance and biomass (ALHEIT et al. 2005, WILTSHIRE & MANLY 2004, BEAUGRAND 2004, REID ET al. 1990).

The evaluation of the **phytoplankton data** of the Helgoland Reede shows a significant increase in biomass since the beginning of the records. This increasing trend in biomass seems to be related to the development of flagellates. For the area of the German Bight, a decrease in diatoms in favour of small flagellates has been observed since the early 1970s (HAGMEIER & BAUERNFEIND 1990, von WESTERNHAGEN & DETHLEFSEN, 2003). The changes in phytoplankton also concern a weakening of the late summer diatom bloom, a prolongation of the growth phase and the occurrence of algal blooms of non-native species.

In addition to natural variability, these changes may be related to anthropogenic influences such as eutrophication and, not least, the North Atlantic Oscillation (NAO) and the observed increase in water temperature in the North Sea. However, as plankton is influenced by a wide range of natural and anthropogenic factors, and because very few studies have been carried out in this area, it remains unclear to what extent eutrophication, climate changes, or simply natural variability contribute to the changes in phytoplankton (EDWARDS & Richardson 2004).

Increasingly, non-native species are also influencing succession. The number of alien species that spread in the North Sea for anthropogenic reasons has increased significantly in recent years. Alien species are introduced via ballast water from ships and mussel aquaculture.

Effects of non-native plankton species on the species composition of native species through displacement, changes in biomass, and primary production cannot be ruled out. Throughout the North Sea, 17 non-native phytoplankton species have been detected in samples (GOLLASCH &

TUENTE 2004). Some of the non-native phytoplankton species are now developing pronounced algal blooms in the German coastal waters and the North Sea EEZ. For example, the non-native thermophile diatom species *Coscinodiscus wailesii* has slowly established itself in the German Bight since 1982 and even formed the spring bloom in 2000. A total of 15 non-native species have been found in the zooplankton of the North Sea since 1990 (GOLLASCH 2003).

Based on evaluations of the long-term series of the Helgoland Reede, WILTSHIRE & Manly (2004) have for the first time established a direct link between the rise in water temperature and the shift in phytoplankton occurrence in the North Sea. The authors have correlated the observed 1.13 °C increase in water temperature between 1962 and 2002 with the mean diatom day (MDD), a calculated parameter of the diatom occurrence. It was shown that the temperature increase in the above mentioned period of 40 years caused a shift in the occurrence of phytoplankton. Thus, following a relatively warm winter quarter, the MDD shifts more towards the end of spring. In such cases diatoms reach a high abundance.

On the basis of these results and other studies, the authors point out that although the living conditions of marine organisms have not yet reached the limits, the control mechanisms of seasonal and spatial events have changed significantly (BEAUGRAND et al. 2003). It can be assumed that this also applies to the German EEZ. In addition to the above-mentioned temporal shift or delay in phytoplankton succession (WILTSHIRE & Manly 2004), a possible species shift could also have consequences for primary and secondary consumers of the food chains.

Changes in the species composition, abundance and biomass of plankton have consequences both for the primary production of water bodies and for the occurrence and stocks of fish, marine mammals and seabirds. For example, the reduced abundance of diatoms in favour of small flagellates could have a negative impact on the food chain (VON WESTERNHAGEN & Dethlefsen 2003), since, for example, the introduced C. wailesii, which is now highly abundant in the German Bight, is not eaten by primary consumers. Changes in the seasonal growth of phytoplankton can also lead to trophic mismatch within the marine food chains: a delay in diatom growth can affect the growth of primary consumers.

Under certain conditions, phytoplankton can pose a threat to the marine environment. In particular, toxic algal blooms pose a major threat to secondary consumers of the marine ecosystem and to humans. According to REID et al (1990), a number of phytoplankton taxa are known to exist in the North Sea, which may have toxic or potentially toxic effects.

A creeping change since the early 1990s can also be demonstrated for **zooplankton.** For example, the species composition and dominance ratios have changed. While the number of non-native species has increased, many species typical of the area have declined, including those that are part of the ecosystem's natural food resources. In general, the abundance of native cold-water species in the holoplankton has decreased significantly. In contrast, meroplankton has increased (LINDLEY & Batten 2002). The proportion of echinoderms larvae has increased conspicuously. This is mainly associated with the spread of the opportunistic species *Amphiura filiformis* (KRÖNCKE et al. 1998).

The seasonal development or succession of zooplankton in the German Bight correlates mainly with changes in water temperature. However, the changes in seasonal development vary from species to species.

Overall, in warm years, abundance maxima of various key species occur up to 11 weeks earlier than usual in the long-term trend (GREVE 2001). The growth phase of many species has been extended overall.

According to HAYS et al. (2005), climate change has had a particular impact on the distribution limits of species and groups of the North Sea marine ecosystem. For example, zooplankton associations of warm-water species in the Northeast Atlantic have shifted their distribution almost 1,000 km northwards. In contrast, the areas of cold-water associations have diminished. In addition, climate changes have an impact on the seasonal occurrence of abundance maxima of various groups. For example, the copepod *Calanus finmarchicus* reaches the abundance maximum 11 days earlier, while its main food, the diatom species *Rhizosolenia alata* reaches its concentration maximum even 33 days earlier and the dinoflagellate species *Ceratium tripos* 27 days earlier. This delayed stock development can have consequences for the entire marine food chain. EDWARDS & RICHARDSON (2004) even suggest that temperate marine ecosystems are particularly at risk due to changes or time shifts in the development of different groups.

The threat arises from the direct dependence of the reproductive success of secondary consumers (fish, marine mammals, seabirds) on plankton (food source). Evaluations of long-term data for the period 1958 to 2002 on 66 marine taxa have confirmed that marine planktonic associations react to climate change. However, the responses vary considerably in terms of association or group and seasonality.

## 2.4 Biotopes

According to VON NORDHEIM & MERCK (1995), a marine biotope is a characteristic, typified marine habitat. With its ecological conditions, a marine biotope provides largely uniform conditions for marine biocoenoses which differ from other types. Typification includes abiotic (e.g. moisture, nutrient content) and biotic features (occurrence of certain vegetation types and structures, plant communities, animal species).

The majority of the types of Central Europe are also characterised in their specific features by the prevailing anthropogenic uses (agriculture, transport, etc.) and impairments (pollutants, eutrophication, leisure use, etc.).

### 2.4.1 Data availability

The distribution of sandbanks and reefs in the German North Sea EEZ is widely known. However, there is currently no comprehensive mapping of the distribution of biotopes in the North Sea EEZ, so that the occurrence of other marine biotopes cannot be adequately represented at present. On the basis of information from the BfN database LANIS Habitat Mare, a spatial distribution pattern of superordinate biotopes was drawn up according to FINCK et al (2017) (**Fehler! Verweisquelle konnte nicht gefunden werden.Fehler! Verweisquelle konnte nicht gefunden werden.**). On this basis, however, it is not possible to present sufficiently scientifically verifiable areas of the marine biotopes. A detailed and comprehensive mapping of marine biotopes in the EEZ is currently being prepared as part of ongoing BfN R&D projects.

As part of the procedures for the COBRAcable and NordLink cross-border cables (interconnectors), detailed investigations of the biotopes located in the vicinity of the planned cable routes were carried out, particularly in the area of the Borkum Reef Ground and the Sylt Outer Reef. These findings on the occurrence of protected biotopes are being used in current procedures for route planning that is as environmentally friendly as possible. In addition to information from environmental impact studies, current findings on biotopes from wind farm projects are available for the defined areas (BIOCONSULT 2016b, 2017, 2018; IBL 2016; PGU 2012a, b, 2015; IFAÖ 2015 a, b, 2016).

Natural biotope complexes ("mosaics"), such as the residual sediment deposits which occur mainly on the eastern slope of the Elbe Glacial Valley (Sylt Outer Reef) and on the Borkum Reef Ground, are of particular significance from a nature conservation perspective. These biotopes are associated with gravel fields, coarse, medium and fine sand areas, and even sometimes in small sinks, silt sandy substrates (usually only a thin layer of silt, which is remobilised again depending on hydrodynamic conditions). This structural diversity, together with the protection provided by the stones, results in an overall high species diversity.

In the shallower sea areas (approx. below 30 m), sands found there are regularly displaced in large areas (especially with fine and middle sands) by swell, so that the fauna living there can be very variable (RACHOR & GERLACH 1978).

Small stone fields can be so strongly influenced by sand movements (over-sanding, exposure) that long-lived reef communities cannot survive.

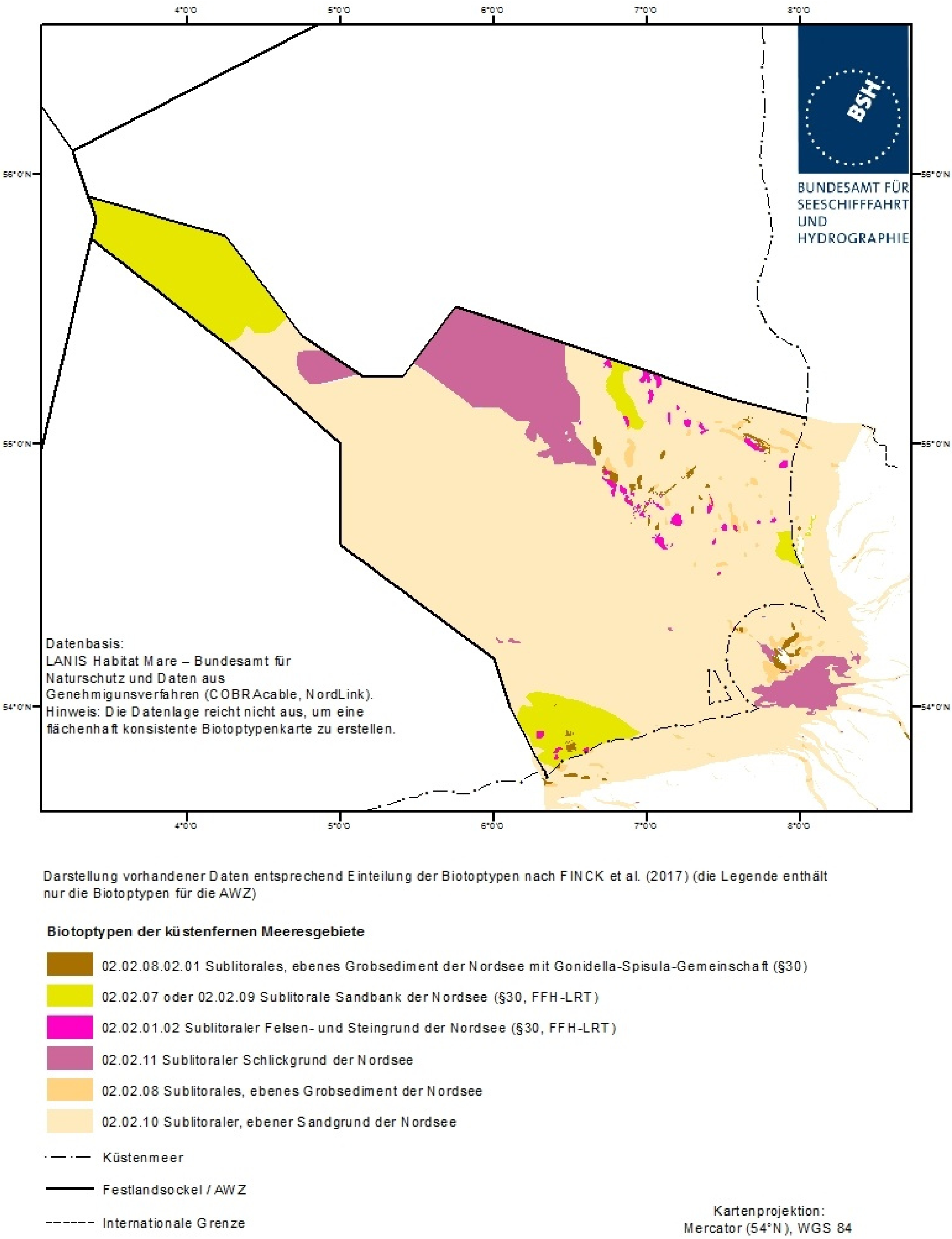



Figure 22: Map of the biotopes in the German North Sea that can be defined on the basis of existing data.

### 2.4.2 Legally protected marine biotopes as per section 30 BNatSchG and FFH habitat types

In the German EEZ of the North Sea, the biotopes of type 1110 "Sandbanks" and 1170 "Reefs" which are to be protected under EU law (Habitats Directive, Annex I) have so far been identified. Reefs and sandbanks are FFH-LRT and at the same time protected under section 30 BNatSchG.

A number of marine biotopes are subject to direct protection under federal law as per section 30 of the Federal Nature Conservation Act. Section 30 (2) BNatSchG fundamentally prohibits actions that could cause destruction or other significant impairment of the listed biotopes. This does not require the designation of a protected area. This protection was extended to the EEZ with the 2010 amendment of the BNatSchG. In the North Sea EEZ, the following four marine and coastal biotopes are subject to statutory biotope protection under section 30 subsection 2 No. 6 BNatSchG: Reefs (also FFH-LRT), sublittoral sandbanks (also FFH-LRT), species-rich gravel, coarse sand, and shell layers as well as seapen and burrowing megafauna communities. The biotope "Seagrass beds and other marine macrophyte populations", which is also protected, does not occur in the North Sea EEZ.

#### 2.4.2.1 Reefs

The LRT 1170 "Reefs" according to the Habitats Directive is defined as follows: "Reefs can be either biogenic adhesions or of geogenic origin. They are hard substrates on firm and soft subsoil, rising from the seabed in the sublittoral and littoral zone. Reefs can promote the proliferation of benthic communities of algae and animal species as well as adhesions of coral formations" (DOC.HAB. 06-09/03). The hard substrate includes rocks (including soft rocks such as chalk cliffs) as well as boulders. Since 9 July 2018, the "BfN Mapping Instructions for "Reefs" in the German Exclusive Economic Zone (EEZ)" (BFN 2018) have been published, which have not yet been applied in the projects.In the view of the BfN, such reefs and reef-like structures are found in some areas of the North Sea EEZ. In particular, areas around the Borkum Reef Ground, the eastern slope of theElbe Glacial Valley, and the Helgoland Stone Ground. However, there are currently no mapping instructions for the FHH-LRT "Reefs".

For the areas of the Sylt Outer Reef and the Borkum Reef Ground, current knowledge about the occurrence of the LRT "Reefs" in the area of the planned cable route COBRAcable is available. For the recording of the biotope "Reefs" in the German EEZ, the corresponding mapping instructions of the BfN are to be consulted (BFN 2018).

#### 2.4.2.2 Sandbanks

LRT 1110, which is protected under the Habitats Directive, designates "sandbanks with only weak permanent inundation by seawater" and is defined as follows: "Sandbanks are elevated, elongated, rounded or irregular topographical features, which are constantly flooded by water and are predominantly surrounded by deeper waters. They consist mainly of sandy sediments, but may also contain coarse rock and stone fragments or smaller grain sizes, including silt. Benches whose sandy sediments appear as a layer over hard substrate are classified as sandbanks if the biota living in them depends more on sand than on hard substrate for life". (DOC.HAB. 06-09/03).

From a nature conservation perspective, several sandbanks worthy of protection have been identified in the German North Sea EEZ. Large sandbanks are Dogger Bank and the somewhat smaller Amrumbank. From a nature conservation perspective, the Borkum Reef Ground is an example of a sandbank with stone fields or stony and gravelly areas as reef-like structures. In several BfN study areas, typical sandbank habitats were found which develop depending on the sediment type (fine, medium, coarse sand) and water depth. Areas in which different biocoenoses alternately occur side by side are particularly worthy of protection. For these reasons, large areas of the identified sandbanks have been protected by the FFH area notifications

"Dogger Bank" (DE 1003-301), "Sylt Outer Reef" (DE 1209-301) and "Borkum Reef Ground" (DE 2104-301) and, in the meantime, also by the legal Regulation of 22 September 2017 establishing the "Sylt Outer Reef - Eastern German Bight" nature conservation area, the legal regulation of 22 September 2017 establishing the "Dogger Bank" nature conservation area and the legal regulation of 22 September 2017 establishing the "Borkum Reef Ground" nature conservation area in the North Sea EEZ. There are currently no mapping instructions for the FFH-LRT "Sandbanks with only weak permanent inundation by seawater".

#### 2.4.2.3 Species-rich gravel, coarse sand, and shell layers in marine and coastal areas

This biotope includes species-rich pure or mixed sublittoral occurrences of gravel, coarse sand, or shell layers of the seabed, which are colonised by a specific endofauna (e.g. sand gap fauna) and macrozoobenthos community, irrespective of their large-scale location. These sediments are colonised in the North Sea by a macrozoobenthos community that is richer in species than the corresponding middle sand types.

This biotope may be associated with the occurrence of stones or mixed substrates and the occurrence of mussel beds or occur in close proximity to the "Sandbank" and "Reef" biotopes. Reefs and species-rich gravel, coarse sand, and shell layers regularly occur together. In the North Sea sublittoral, thisbiotope is generally colonised by the *Goniadella-Spisula* community*.* This can be identified by the occurrence of various typical macrozoobenthos species such as *Spisula elliptica, Branchiostoma lanceolatum, Aonides paucibranchiata.*

The species richness or the high proportion of specialised species in these sediment types results from the occurrence of relatively stable interstitial spaces between sediment particles with a large pore water content and relatively high oxygen content. RACHOR & NEHMER (2003) have shown that the Goniadella-Spisula community occurs in the North Sea EEZ in two forms: the more species-rich on coarse sand and gravel and the less species-rich on coarse-sand middle sand. If stones occur in the area, a typical epibenthic macrofauna also occurs. In the North Sea, with the exception of the area around Heligoland, the species-rich expression generally occurs at depths of more than 20 m (ARMONIES 2010). The settlement of this biotope is spatially highly heterogeneous.

The biotope "Species-rich gravel, coarse sand, and shell layers in marine and coastal areas" generally occurs in relatively small-scale expressions throughout the North Sea. It is not found in the German North Sea in the Dogger Bank area and north of it. The distribution is generally small-scale and patchy (cf. BFN 2011a).

For the areas of the Sylt Outer Reef and the Borkum Reef Ground, current knowledge is available on the occurrence of species-rich gravel, coarse sand, and shell layers in the area of the COBRA cable cable route.

#### 2.4.2.4 Seapen and burrowing megafauna communities

The biotope "Seapen and burrowing megafauna communities" is determined by the occurrence of sea feathers (Pennatularia), which is particularly sensitive to mechanical disturbances and damage. In addition to sea feathers, thebiotope is characterised by an increased density of digging crustaceans (especially *Nephrops norvegicus, Calocaris macandreae, Upogebia deltaura, Upogebia stellata, Callianassa subterranea*). Each digging species forms characteristic vein systems in the seabed. These create the conditions for oxygen-rich water to penetrate deep into the seabed, thus providing habitats for other species.

"Seapen and burrowing megafauna communities" occur in the North Sea and in the Northeast Atlantic. The potential distribution area results from the distribution of all characterising species. In the German EEZ of the North Sea, it includes in particular theElbe Glacial Valley and the adjacent areas with fine substrate sediments at depths of more than 15 m. "There are currently no known occurrences of sea feathers in the German North Sea" (BFN 2011b). Without the occurrence of this character species, there is also no evidence of the biotope "Seapen and burrowing megafauna communities".

As there has been no comprehensive mapping of the above-mentioned biotopes in the German North Sea to date, it is currently not possible to identify any specific areas in the North Sea EEZ where the biotopes "Species-rich gravel, coarse sand, and shell layers in coastal and marine areas" and "Seapen and burrowing megafauna communities" occur. To record the biotopes of species-rich gravel, coarse sand, and shell layers, as well as seapen and burrowing megafauna communities, BfN has published definitions and mapping instructions in consultation with BMU (BFN 2011a & b).

### 2.4.3 Assessment of the status

The stock assessment of biotopes occurring in the German marine area is based on the national conservation status and the threat to these biotopes according to the Red List of endangered biotopes in Germany (FINCK et al. 2017). The legally protected biotopes mentioned above are generally of high significancein this context. In the North Sea, these biotopes are endangered above all by current or past nutrient and pollutant inputs (including wastewater discharge, oil pollution, dumping, waste and debris dumping), by fisheries in contact with the bottom, and possibly also by the effects of construction activities. Since bottom-contact fishing is largely excluded within the wind farms, a certain degree of recovery of the biotopes occurring in the wind energy areas can be expected.

#### 2.4.3.1 Significance of the areas for wind energy for biotopes

***Area EN1***

In area N-1, the legally protected biotopes "Sublittoral sandbank" and "Species-rich gravel, coarse sand, and shell layers" occur. A northwestern extension of the 90,000 ha sandbank "Borkum Reef Ground" extends into the eastern part of the project area "Borkum Riffgrund West 1" and covers almost 50% of the project area. The numerous suspected areas of "Species-rich gravel, coarse sand, and shell layers" in the EN1 area are in part large-area deposits that occupy larger areas of the project areas "Borkum Riffgrund West 1", "Borkum Reef Ground West 2" and "OWP West" (BIOCONSULT 2016b, 2017). In the view of BfN, a larger area in the western part of the project area "Borkum Riffgrund West 2" is a biotope protected under section 30 of the Federal Nature Conservation Act. To date, not all known suspected areas in area EN1 have been investigated as per BfN mapping instructions (BFN 2011a).

The EN1 area is accorded high overall significance due to the extensive occurrence of the biotopes "Sublittoral sandbanks" and "Species-rich gravel, coarse sand, and shell layers".

***Area EN2***

A large part of the EN2 area is located on the sandbank "Borkum Reef Ground". South to southwest of the EN2 area there are occurrences of the legally protected biotopes "Reefs" and "Species-rich gravel, coarse sand, and shell layers, especially in the area of the "Borkum Reef Ground" nature conservation area. There are no known occurrences of these biotopes within the EN2 area.

The EN2 area is of high overall significance for biotopes due to the extensive occurrence of the "Sublittoral sandbank" biotope.

***Area EN3***

In the EN3 area, the near-surface sediments consist mainly of a fine to middle sandy cover layer, the upper decimetres of which are regularly displaced by hydrodynamic processes of the North Sea. Occurrences of legally protected biotopes are not known for a large part of the EN3 area. Only a small part of the area extends into the sandbank "Borkum Reef Ground", which has been designated by the BfN. According to BfN estimates, there is no evidence of qualitative-functional peculiarities of the biotope character for this part of the sandbank.

Due to the only slight overlap of the EN3 area with the "Borkum Reef Ground" sandbank and the otherwise predominantly homogeneous, fine- to middle-sand sedimentary conditions, the EN3 area as a whole is accorded a low significance and in the southwestern sub-area an average significance with regard to the protected asset biotopes.

***Area EN4***

In the EN4 area, there is as yet no evidence of the occurrence of legally protected biotopes (IBL 2016). The EN4 area is therefore of minor significance with regard to the protected asset biotopes.

***Area EN5***

Due to its location in the area of the Sylt Outer Reef, the EN5 area contains extensive occurrences of the legally protected biotopes and FFH-LRT "Reefs" and "Sublittoral sandbanks". In addition, the legally protected biotope "Species-rich gravel, coarse sand, and shell layers" occurs in the EN5 area. The sandbank in the western part of the EN5 area designated by BfN is largely located within the "Sandbank" wind farm.

Due to the partly extensive occurrence of the biotopes "Sublittoral sandbank", "Reefs" and "Species-rich gravel, coarse sand, and shell layers", the EN5 area is of great importance with regard to biotopes.

***Areas EN6, EN7, EN8, EN9, EN10, EN11, EN12, EN13***

The occurrence of legally protected biotopes and FFH-LRTs in the areas EN6 to EN13 can be excluded according to the available knowledge (PGU 2012a, b, PGU 2015, IFAÖ 2015 a,b, IFAÖ 2016, BIOCONSULT 2018). Despite the occurrence of sediments with a sometimes high portion of seapen and burrowing megafauna communities (chapter Benthos), the absence of sea feathers also means that the legally protected biotope "Seapen and burrowing megafauna communities" can be excluded. Consequently, areas EN6 to EN13 are of little significance for the protected asset biotopes.

***Areas EN14 to EN19***

For the areas EN14 to EN18, there is little knowledge of biotope occurrences. The area EN19 is located within an occurrence of LRT 1110 "Sandbanks with only weak permanent washing over by seawater" (see also chapter Sandbanks ) protected under the Habitats Directive.

## 2.5 Benthos

Benthos is the term used to describe all biological communities bound to substrate surfaces or living in soft substrates at the bottom of water bodies. Benthic organisms are an important component of the North Sea ecosystem. They are the main food source for many fish species and play a crucial role in the conversion and remineralisation of sedimented organic material (KRÖNCKE 1995). According to RACHOR (1990a), benthos includes micro-organisms, such as bacteria and fungi, unicellular animals (protozoa) and plants, as well as inconspicuous multicellular organisms and large algae and animals, including bottom-dwelling fish. Zoo benthos are animals that live predominantly in or on the ground. These creatures largely restrict their activities to the vertical border area between the free water and the uppermost soil layer, which is usually only a few decimetres in size.

In the case of the so-called holobenthic species, all phases of life take place within this community close to the ground. However, the majority of animals are merobenthic, i.e. only certain phases of their life cycle are linked to this ecosystem (TARDENT 1993). These usually spread via planktonic larvae. In older stages, on the other hand, the ability to change location is less. Overall, most representatives of the benthic species are characterised by a lack of or limited mobility compared to those of plankton and necton. As a result, the soil fauna is generally hardly able to avoid natural and anthropogenic changes and impacts due to the relative stability of location, and is thus in many cases an indicator of changed environmental conditions (RACHOR 1990a).

The North Sea seabed largely consists of sandy or silty sediments allowing the animals to penetrate the bottom. Therefore, a typical infauna living in the soil (syn. endofauna) has developed in addition to the epifauna living on the soil surface. Micro-animals of less than 1 mm body size (micro- and meiofauna) make up the majority of these soil dwellers. Better known than these tiny animals, however, are the larger animals, the macrofauna, and especially the more sedentary forms such as annelids, mussels and snails, echinoderms and various crustaceans (RACHOR 1990a). For practical reasons, macrozoobenthos (animals >1 mm) are therefore studied internationally on behalf of the entire zoobenthos (Armonies & ASMUS, 2002). The zoobenthos of the North Sea is composed of a large number of systematic groups and shows a wide variety of behaviour. All in all, this fauna has been quite well studied and therefore allows comparisons with conditions a few decades ago.

### 2.5.1 Data availability

The description and assessment of the macrozoobenthos status in the North Sea is based on the available literature and, in particular, on data collected in the course of various environmental impact assessments of offshore wind farm projects and accompanying ecological research. Evaluations of the R&D project "Assessment approaches for spatial planning and licensing procedures with regard to the benthic system and habitat structures" (Dannheim ET al. 2014a) form an essential basis. Within the framework of the project, a comprehensive database on benthic invertebrates and demersal fish was established, which allows for both temporal and spatially large-scale analyses of the occurrence of the animals in the German North Sea EEZ. For this purpose, benthos data from environmental impact studies during approval procedures of offshore wind farm and submarine cable procedures as well as from research projects were subjected to harmonisation and quality control and integrated into a database. In addition, between 2008 and 2011, benthos was investigated by the IOW at 12 selected stations in the German EEZ on behalf of the BSH and as part of biological monitoring. Samples were taken twice a year (WASMUND et al. 2011).

A data set for the whole North Sea was produced in April 1986 as part of the North Sea Benthos surveys. These surveys were initiated by the ICES Benthos Ecology Working Group (DUINEVELD et al. 1991). Various data sets are available for the German North Sea, ranging from several years to periods of two to three decades. The first benthic surveys in the German Bight were conducted by HAGMEIER (1925) in the 1920s. These investigations provide basic information on the structure of macrozoobenthos communities. These investigations were continued between 1949 and 1974 by ZIEGELMEIER (1963, 1978). RACHOR (1977, 1980) examined the macrofauna communities of the inner German Bight from 1969 onwards and found a decrease in species numbers. RACHOR & GERLACH (1978) analysed sandy areas of the German Bight with regard to the effects of heavy storms on benthic communities.

Von KRÖNCKE (1985) and VON WESTERNHAGEN et al. (1986) studied the influence of extremely low oxygen concentrations on macrozoobenthos in the German Bight and Danish waters during the summer of 1981 to 1983. The investigations showed a decrease in species numbers and biomass and an increase in opportunistic species.

In the subsequent years 1984 to 1989 without oxygen deficiency situations, a rapid regeneration of these macrozoobenthos communities was determined (NIERMANN 1990 and NIERMANN et al. 1990).

The analysis of long-term data sets showed changes in the composition of the macrobenthos. In the comparison of data sets from the German Bight between 1923 and 1965 - 1966, carried out by STRIPP (1969 a/ b), no significant change in benthic communities could be detected in comparison to Hagmeier's investigations. NIERMANN (1990) compares Hagmeier's and Stripp's data with his investigations from 1984 to 1989 and describes a doubling of the biomass caused, among other things, by the increase in *Echinocardium cordatum* and opportunistic species such as *Phoronida.* SALZWEDEL et al. (1985), in turn, examined the entire German Bight and found an increase in biomass compared to earlier investigations. As possible reasons, they cite nutrient richness.

RACHOR (1990b) describes changes in macrozoobenthos communities on different sediment types as a result of eutrophication. According to these studies, sandy sediments are more affected by the input of organic material than silt. During investigations of the epibenthos of the German Bight, REISE & BARTSCH (1990) discovered that the fauna was more diverse in the past than during their surveys. Further investigations show that fishing with heavy bottom gears leads to changes in benthic communities, with a decline in long-lived and fragile species within the communities studied (FRID et al. 1999; LINDEBOOM & DE GROOT 1998).

Analyses by KRÖNCKE et al (2011) of the entire North Sea for the period 1986 to 2000 show slight changes in the large-scale distribution of macrofauna. Changes in abundance and regional distribution of individual species were largely associated with temperature changes.

Results from DANNHEIM et al (2014a) were used to describe the biocoenoses in the defined areas. Based on data from 41 wind farm projects and 15 AWI projects in the period 1997-2014, this study carried out analyses of the benthic communities, on the one hand on a large scale for the entire EEZ and on the other hand regionally on an area scale.

### 2.5.2 Spatial distribution and temporal variability

The spatial and temporal variability of zoobenthos is largely controlled by climatic factors and anthropogenic influences. Important climatic factors are winter temperatures, which cause high mortality rates of some species (BEUKEMA 1992, ARMONIES et al. 2001). The analysis of a long-term data set from 1981-2011 by GHODRATI SHOJAEI et al. (2016) could confirm that winter temperatures and the North Atlantic Oscillation (NAO) are the predominant environmental factors determining the temporal variability of macrozoobenthos in the German Bight. Regional oscillations of temperature, salinity and near-surface currents caused by the NAO have a strongly structuring character on benthic communities, especially seasonally but also in the medium term (KRÖNCKE et al. 1998, TUNBERG & Nelson 1998). A spatial distribution of benthic organisms projected to the year 2099 due to expected climate changes suggests a northward shift and a high degree of habitat loss for a number of key species, particularly in the southern North Sea, with possible impacts on ecosystem function (WEINERT et al. 2016).

Wind-induced currents are responsible for the distribution of the planktonic larvae and for a redistribution of the bottom-living stages through current-induced sediment redistribution (ARMONIES 1999, 2000a, 2000b). Among the anthropogenic impacts, disturbance of the soil surface by fisheries is of particular importance alongside nutrient and pollutant inputs (RACHOR et al., 1995). Fishing with bottom trawls can impair the structure and trophic function of benthic biotic communities (DANNHEIM et al. 2014b), even in areas that have already been severely damaged (REISS et al. 2009).

The following natural classification of the German North Sea EEZ from a benthological perspective differs from the natural classification according to sedimentological criteria. Although macrozoobenthos shows a strong link to sediment structure (KNUST et al. 2003), water temperature and the hydrodynamic system (currents, wind, water depth) are among the main natural factors in the German Bight that are responsible for the composition of macrozoobenthos. RACHOR & NEHMER (2003) therefore divided the area into seven natural units (abbreviations A - G), which are listed in Table 8 and graphically illustrated in Figure 23.

TheElbe Glacial Valley and - in the outer area - the Dogger Bank form the central guiding structures in the German North Sea EEZ. These are important, for example, for the networking of habitats, as stepping stones and as retreat areas. Dogger Bank is also a biogeographical divide between the northern and southern North Sea.

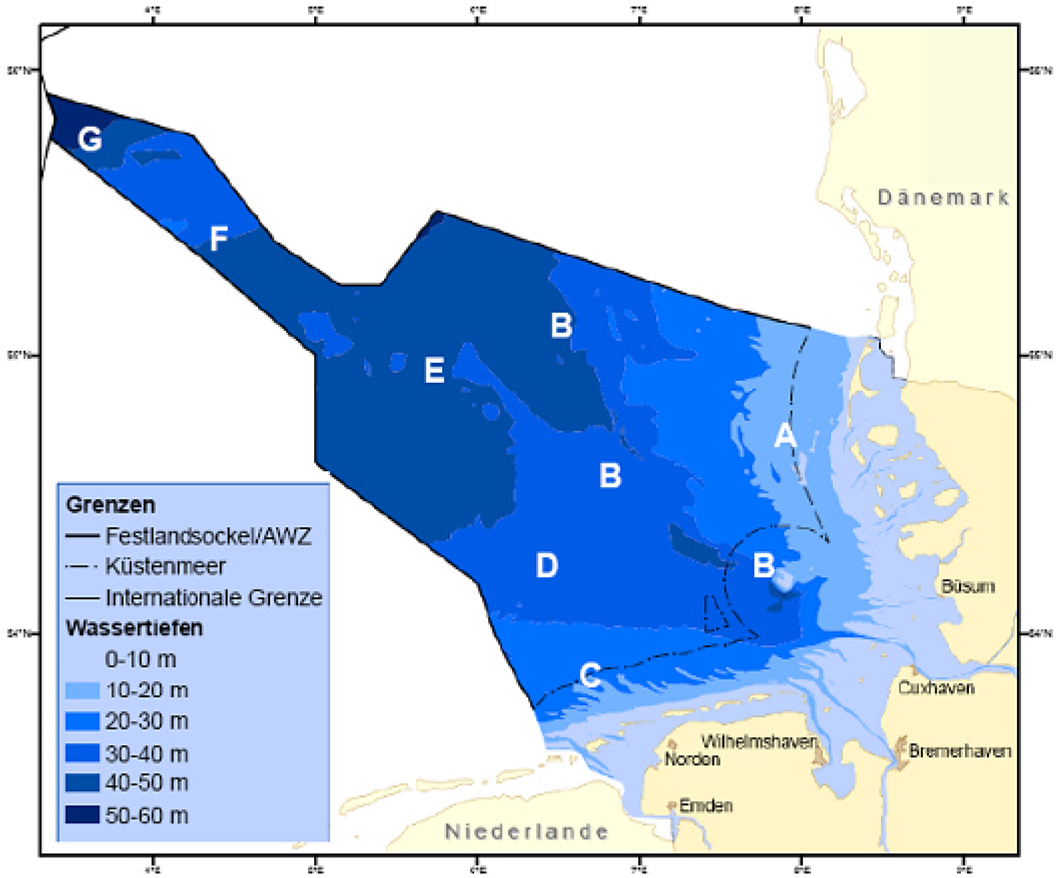



Figure 23: Natural space classification of the German North Sea EEZ according to RACHOR & NEHMER (2003), final report for BfN.

Table 8: Natural Area Units of the German North Sea EEZ (after RACHOR & NEHMER 2003)

| BRIEF Cf. Figure 23 | NAME | HYDROGRAPHY | TOPO-GRAPHY | SEDIMENT* | BENTHOS |
|---|---|---|---|---|---|
| A | Eastern German Bight (North Frisian EEZ) with Sylt Outer Reef | changing salinity with frontal systems between North Sea water and freshwater input of the major rivers; high nutrient concentration, higher pollutant concentration than in the rest of the EEZ; northward directed residual current (CCC) | from -10 to 43 m | Heterogeneous sediment distribution from fine to coarse sand, isolated gravel and stone areas | Predominantly **Tellina fabula community** (dominant species: ribbed tellina and spionid annelids), adaptable; towards the coast the sublittoral variant of the Macoma Balthica community; **Goniadella Spisula community.** High species diversity in biotope mosaics with often lower population densities |
| B | Elbe Glacial Valley | Water bodies temporarily stratified seasonally, regionally with oxygen depletion; | elongated hollow form, steeper on the eastern | Fine sands with silt content that increases with water depth | **Amphiura-filiformis community** (dominant species: brittle star); drilling megafauna possible in some ar- |

| BRIEF Cf. Figure 23 | NAME | HYDROGRAPHY | TOPO-GRAPHY | SEDIMENT* | BENTHOS |
|---|---|---|---|---|---|
| | | coastal water with lower salinity may lie above water with higher salinity | slope up to -50 m | | eas; Nucula-nitidosa community in coastal silt and muddy sand areas |
| **C** | Southwestern German Bight (coastal East Frisian EEZ with Borkum Reef Ground) | inflow of Atlantic water from the Channel and the western North Sea; eastern current | from -20 to-36 m | heterogeneous sediment distribution of fine to coarse sand, occasional gravel and individual stone deposits | Predominantly **Tellina fabula community** (dominant species: ribbed tellina and spionids), adaptable; as well as **Goniadella spisula community** High species diversity in biotope mosaics, often with lower population densities |
| **D** | Northwestern German Bight (offshore East Frisian EEZ) | under North Sea water influence; low east current | from -30 to -40 m | Silty fine sand | **Amphiura-filiformis community** (dominant species: brittle star); drilling megafauna possible in some areas |
| **E** | Transition area between German Bight and Dogger Bank | low tidal dynamics with low amplitude; stratified water body in summer; high salinity with low variability; oxygen deficiency possible | Depths from -38 (flat bottom white bench) to -50 m | Silty fine sand | **Amphiura-filiformis community** (dominant species: brittle star); drilling megafauna possible in some areas |
| **F** | Dogger Bank | on the slopes, vortex and frontal formation; strong vertical mixing on the bank, water bodies rarely stratified | Depths from 29 to -40m, becoming shallower after W | Fine to middle sand | Offshore fine sand community **Bathyporeia-Tellina community** |
| **G** | Central North Sea north of Dogger Bank | Water regularly stratified in the summer months | depths over - 40 m | fine sands, in places boulder clay or clay | Benthic community of the central North Sea, Myriochele |

*modified BSH

#### 2.5.2.1 Current species spectrum of the North Sea EEZ

At present, a total of about 1,500 marine macrozoobenthos species are known to occur in the North Sea. Of these, an estimated 800 are found in the German North Sea area, and probably 700 in the sublittoral of the open southeastern North Sea (RACHOR et al. 1995). Investigations into the benthos of the EEZ were carried out in May/June 2000 as part of the R&D project "Survey and assessment of ecologically valuable habitats in the North Sea" (Rachor & NEHMER 2003) using Van Veen grab samples at 181 stations and additional 79 beam trawl hauls. A total of 483 taxa (361 of which were identified by species) of endo- and epifauna including demersal fish were identified. The groups of polychaeta (polybristle) with 129 species, crustacea (crabs) with 101 species and mollusca (molluscs) with 66 species accounted for the largest share. A total of 336 macrozoobenthos invertebrate species were detected.

The spectrum of species recorded by RACHOR & NEHMER (2003) can be supplemented by the investigations carried out within the framework of various offshore wind farm and submarine cable projects as well as additional research projects of the AWI. Based on a taxonomic harmonisation of this extensive benthic database, 573 species were recorded between 1997 and 2014 for the benthic infauna alone in the area of the German EEZ (DANNHEIM et al. 2016). This results in a total species count of invertebrate macrozoans in the area of the German EEZ of approximately 750 species. In the ranking of species diversity of individual large groups, the group of polychaeta is the richest in species, followed by crustaceans and molluscs.

Within the framework of the biological monitoring of the IOW, a total number of species (spring and autumn sampling of all stations combined) of 286 was recorded in 2010. Along the stations, species diversity ranged from 37 in the area of the North Frisian Islands to 121 in the Duck's Bill. Considering spring and autumn samples separately, the number of species in spring varied between 16 in the area of the North Frisian Islands and 90 in the Duck`s Bill. In autumn, the species diversity was always higher (WASMUND et al. 2011).

#### 2.5.2.2 Red List species

In May 2014, the current Red List of bottom-dwelling invertebrate marine organisms by RACHOR et al. (2013) was published by BfN. By including additional animal groups compared to the 1998 Red List, assessments for a total of 1,244 macrozoobenthos taxa have been carried out within the framework of the current Red List. According to this, 11.7% of all assessed taxa are endangered, and a further 16.5% of species are potentially endangered although probably stable on a large scale, but extremely rare. If the 3.9% of missing species are added (48 of the total of 49 missing species were found only in the area of Helgoland), a total of 32.2% of all assessed species are assigned to a Red List category.

In a recent study by DANNHEIM et al (2016), a total of 98 species of benthic invertebrates were identified in the German EEZ between 1997 and 2014, which according to RACHOR et al (2013) are listed as endangered or extremely rare.

Two of the detected species are considered extinct (*Modiolula phaseolina* and *Ascidia virginea*). According to the latest findings, the detection of the sea squirt *Ascidia virginea* is considered a false positive. According to the re-determination, this is most likely the extremely rare (Red List Cat. R) species *Ascidiella scabra* (J. DANNHEIM pers. communication, species list currently under revision).

The two species *Nucula nucleus* and *Spatangus purpureus are* classified as endangered (Red List cat. 1). Another seven species (*Buccinum undatum, Echiurus echiurus, Ensis enis, Modiolus modiolus, Sabellaria spinulosa, Spisula elliptica, Upogebia stellata*) are critically endangered (Red List cat. 2). Nine other species are classified as endangered (Red List Cat. 3). A total of 33 species are assumed to be endangered to an unknown extent (Red List Cat. G), 45 species are extremely rare (Red List Cat. R). In addition to these 98 Red List species, a further 17 species are on the early warning list. The taxonomic major groups with the highest number of Red List species are bivalves (Bivalvia, 30 species), polychaeta (26 species) and amphipods (20 species).

According to a recent study by Dannheim et al. (2016), the benthic species on the Red List are not homogeneously distributed in the German EEZ. Overall, more Red List species occur with increasing distance from the coast, with up to 15 Red List species per station in the Dogger Bank area. Local hotspots in terms of species numbers and abundance of Red List species are mainly found in the area of Dogger Bank, the Sylt Outer Reef and northwest of the Sylt Outer Reef (Figure 24). According to Dannheim et al. (2016), the distribution of Red List species in the German EEZ is determined not only by distance from the coast but also by water depth, temperature and sediment properties, and thus does not differ significantly from the distribution patterns of the rest of the benthic fauna.

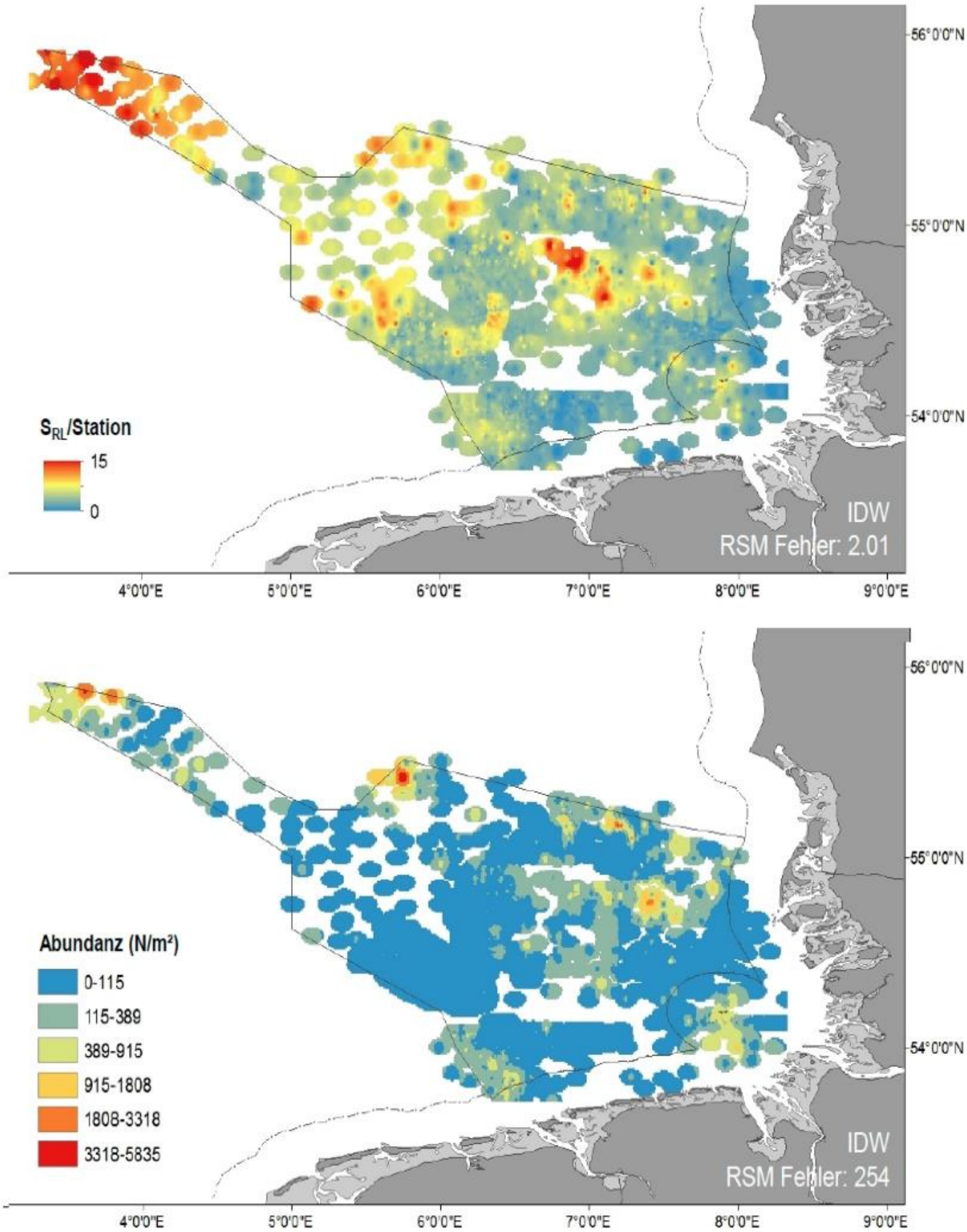



Figure 24: Number of species (top) and abundance (bottom) of Red List benthic species in the German EEZ (from DANNHEIM et al. 2016).

#### 2.5.2.3 Biocoenoses

In general, the infauna is distributed in correlation to water depth and sediment. The distribution pattern of soil animal communities described by SALZWEDEL et al. (1985) and in principle already by HAGMEIER (1925) has been confirmed again and again, although there are differences in dominance relations and in the occurrence of individual species as well as in small-scale details, depending on the study or time period. The overall distribution of benthic endofauna communities in the North Sea based on mapping coordinated by ICES' Benthos Ecology Working Group and carried out in 1986 is described by KÜNITZER et al (1992). A clear south-north zoning was identified (HEIP et al. 1992), which is mainly due to the water depths and the associated temperature and stratification conditions. Within this large-scale zoning, the distribution of communities is mainly determined by the sediments.

The settlement areas of the macrozoobenthos (RACHOR & NEHMER 2003), which was recorded in 2000 with bottom grabbers in the southeastern North Sea, are shown in simplified form in Figure 25. The largest areas in the EEZ are occupied by the *Amphiura filiformis*, *Tellina fabula* and *Nucula nitidosa* communities; the Dogger Bank is mainly home to the *Bathyporeia tellina* community.

These communities show signs of change, mainly due to fishing with heavy bottom gears; some formerly common species such as *Arctica islandica* are now almost non-existent.

The variants of the *Goniadella*-*Spisula* community, which are often associated with stone reefs and stone fields, occur in the area of the Borkum Reef Ground and especially east of theElbe Glacial Valley. Larger stone accumulations provide a certain degree of protection from bottom fishing; however, these biotope mosaics are now threatened by gravel and sand mining.

The *myriochele* community found in the transition area to the central North Sea north of Dogger Bank is widespread outside the German EEZ. However, this community is unique for German waters. This is one of the reasons why this area is home to a particularly large number of species on the Red List drawn up for the German marine area by RACHOR et al. (2013) (cf. Table 8).

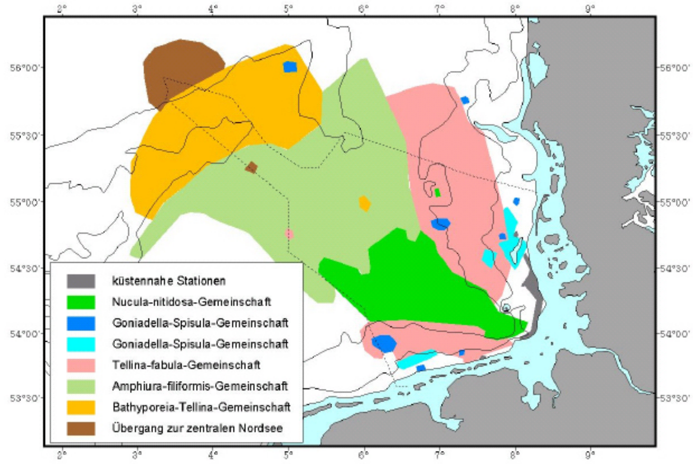



Figure 25: Settlement areas of the most important soil animal biocoenoses (macrozoobenthos, according to soil grab samples) in the German EEZ of the North Sea and adjacent areas (from RACHOR & NEHMER 2003, final report for BfN); in the area of the coastal waters the representation is incomplete.

Based on data from 41 wind farm projects and 15 AWI projects in the period 1997-2014, DANNHEIM et al. (2014a) have carried out analyses of benthic biocoenoses on the one hand on a large scale for the entire EEZ and on the other hand regionally on an area scale.

For the benthic **epifauna,** six significantly different communities could be identified on a large and regional scale (Figure 26). However, the identified associations are not clearly distinguishable spatial units, but rather reflect gradual changes in the abundance ratios between near-coastal and far-off stations in an essentially constant structural species composition. Dominant and regularly occurring character species in the entire EEZ are *Asterias rubens* (common starfish), *Astropecten irregularis* (sand sea star), *Crangon* spp. (shrimps), *Liocarcinus holsatus* (common swimming crab), *Ophiura ophiura* (large brittle star), *Ophiura albida* (small brittle star) and *Pagurus bernhardus* (hermit crab). Especially the communities near the coast are characterised by some dominant species (e.g. *Crangon* spp. and *Ophiura albida*), while the dominance is more balanced in the regions far from the coast. The more productive coastal regions also have higher abundances and biomass values than the more remote regions.

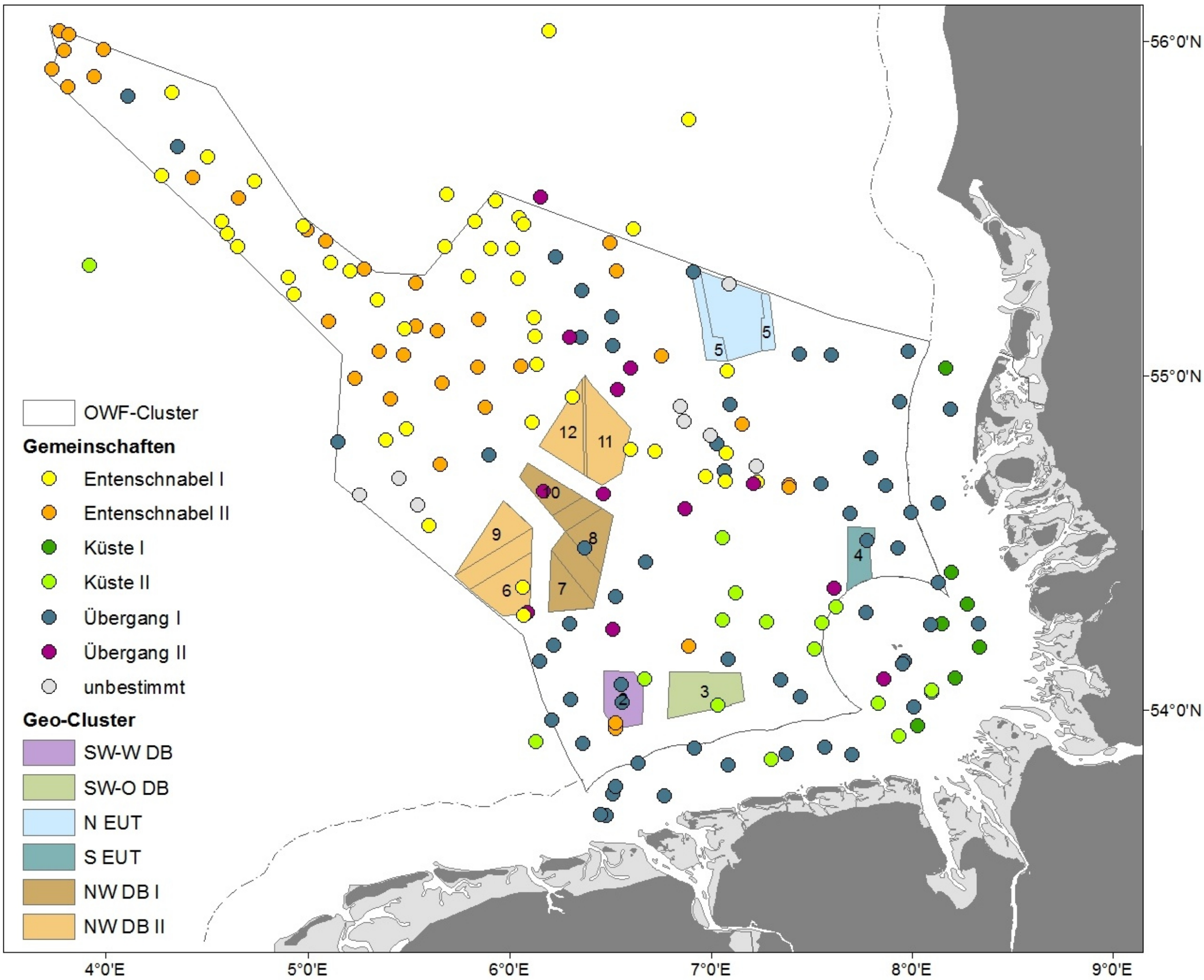



Figure 26: Identified large-scale communities and regional geo-clusters based on abundances of epifauna in the German North Sea EEZ (according to DANNHEIM et al. 2014a). SW-W DB = Western Southwestern German Bight, SW-O DB = Eastern Southwestern German Bight, N EUT = Northern Elbe Glacial Valley, S EUT = Southern Elbe Glacial Valley, NW DB I = Northwestern German Bight I, NW DB II = Northwestern German Bight II.

For the benthic **infauna,** the communities of the German EEZs described by SALZWEDEL et al. (1985) and RACHOR & NEHMER (2003) could be confirmed with the corresponding character species ( In addition to the established biocoenoses, seven further communities were identified, which essentially represent gradual transitional communities between the established associations. In contrast to the epifauna, no clear gradients are discernible for the infauna as a function of distance from the coast. Rather, according to DANNHEIM et al. (2014a), sediment properties have the greatest influence on the composition of the infauna. This in turn requires a relatively high degree of small-scale variability in the faunistic structure of the infauna, especially in sedimentologically heterogeneous areas, such as the Amrum Bank and the Sylt Outer Reef.

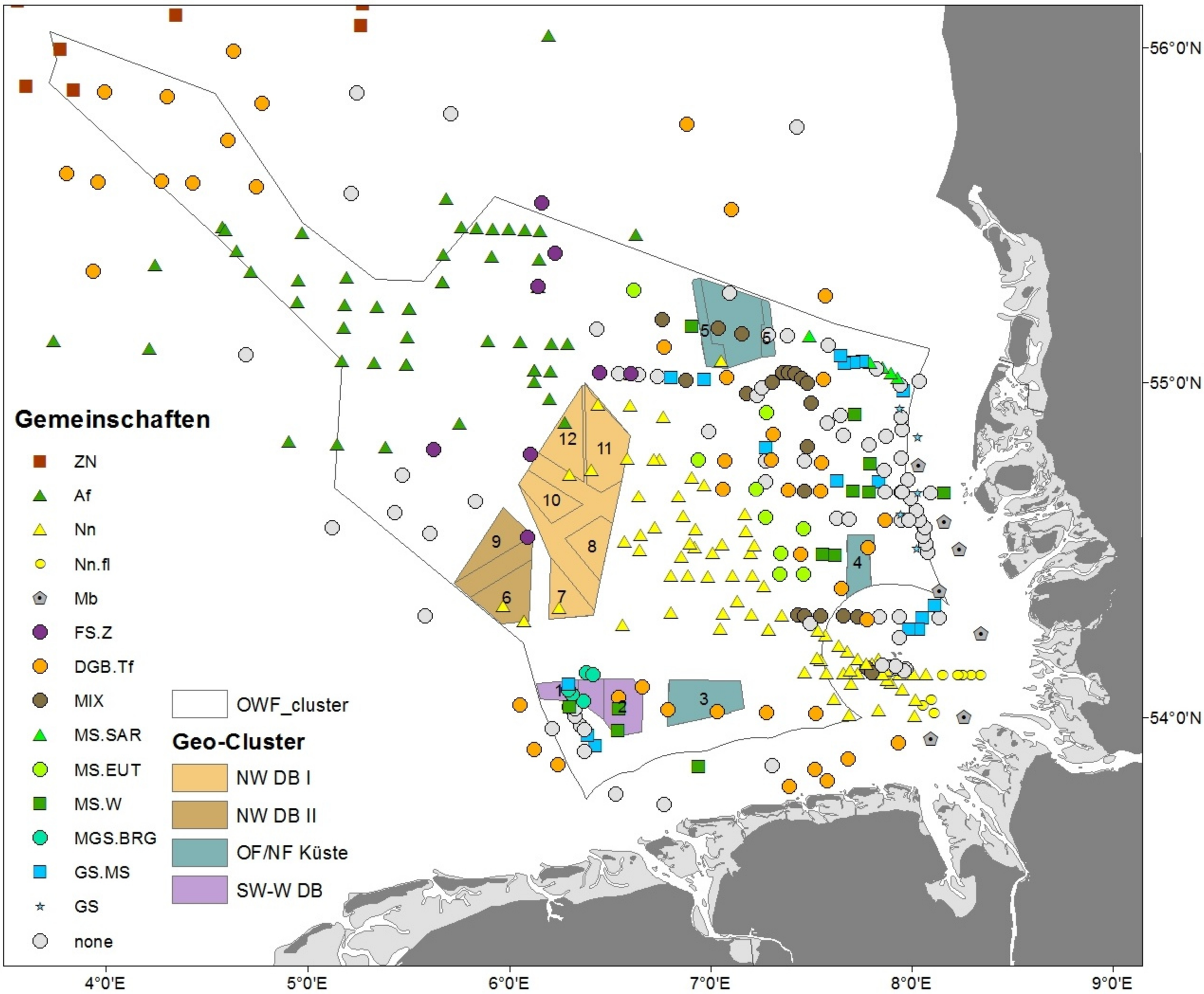



Figure 27: Identified large-scale communities and regional geo-clusters based on abundances of infauna in the German North Sea EEZ (according to DANNHEIM et al. 2014a). Cluster: ZN = Central North Sea, Af = Amphiura filiformis community, Nn = Nucula nitidosa community, Nn.fl = flat Nucula nitidosa community, Mb = Macoma balthica community, FS.Z = fine sand central, DBG.Tf = Dogger Bank/Tellina fabula community, MIX = heterogeneous sands, MS.SAR = middle sand Sylt Outer Reef, MS.EUT = middle sand Elbe Glacial Valley, MS.W = middle sand west, MGS.BRG = middle coarse sand Borkum Reef Ground, GS.MS = coarse sand middle sand, GS = Goniadella/Spisula middle coarse sand, none = not defined. Geo-cluster: SW-W DB = western southwestern German Bight, OF/NF coast = East Frisian/North Frisian coast, NW DB I, II = northwestern German Bight I, II.

### 2.5.3 Status assessment of the protected asset benthos

The benthos of the North Sea EEZ is subject to changes due to both natural and anthropogenic influences. In addition to natural and weather-related variability (severe winters), the main influencing factors are demersal fishing, sand and gravel extraction, the introduction of alien species and eutrophication of the water body, and climate change.

***Criterion: Rarity and endangerment***

The number of rare or vulnerable species is taken into account. The rarity/endangerment of the stock can be assessed on the basis of the confirmed species on the Red List.

According to current studies, the macrozoobenthos of the North Sea EEZ is considered to be average due to the proven number of Red List species. This assessment is supported by the fact that in the Red List by RACHOR et al (2013) a total of 400 species out of 1,244 assessed species are assigned to a Red List category. The 400 species represent over 30% of the total population.

In the current investigations by DANNHEIM et al. (2016), 98 endangered or extremely rare Red List species were identified in the North Sea EEZ in the years 1997-2014, representing approximately 13.1% of the total number of recorded species (750).

Two species considered extinct (Red List Cat. 0) and two species threatened with extinction (Red List Cat. 1) have been identified. The detection of one species considered extinct has now proved to be a false positive (J. DANNHEIM pers. communication). RACHOR et al. (2013), on the other hand, list 49 Red List Cat. 0 species and eight Red List Cat. 1 species. The individual examination of the natural units defined by RACHOR & NEHMER (2003) does not lead to a divergent assessment of the macrozoobenthos status.

***Criterion: Diversity and uniqueness***

This criterion refers to the number of species and the composition of the species communities. The extent to which characteristic species or biocoenoses occur in the habitat and how regularly they occur is assessed.

The inventory of species in the North Sea EEZ is average, with currently around 750 known macrozoobenthos species (excluding fish), since a total of around 1,500 marine macrozoobenthos species are currently known to occur in the North Sea, of which RACHOR et al. (1995) estimates that 800 are found in the German North Sea region. The benthic biocoenoses do not exhibit any special features either, since the main natural factors that structure the composition of macrozoobenthos in the German Bight are water temperature, the hydrodynamic system (currents, wind, water depth) and the resulting sediment composition (KNUST et al. 2003).

According to the predominant sediments, the largest spaces are occupied by the *Amphiura-filiformis*, *Tellina-fabula* and *Nucula-nitidosa communities.* In coarse sandy areas the *Goniadella-Spisula* community predominates. However, its occurrence extends beyond the German EEZ. The *myriochele* community *joins* north of Dogger Bank and is widely distributed outside the German EEZ (RACHOR et al. 1998). Overall, all benthic biocoenoses found in the area are not of outstanding importance. According to KRÖNCKE (2004), the six benthic biocoenoses found in the North Sea are characterised by frequently represented leading forms. This does not mean, however, that their respective species inventories are limited to individual biocoenoses. Only the frequencies are characteristic, but the individual species are also present in the other biocoenoses. Therefore, it is not possible to distinguish between these biocoenoses in terms of their value, but all biocoenoses have the same value.

***Criterion: Legacy impacts***

For this criterion, the intensity of fishing exploitation, which is the most effective disturbance variable, will be used as a benchmark. Eutrophication can also affect benthic biocoenoses. For other disturbance variables, such as vessel traffic, pollutants, etc., there is currently a lack of suitable measurement and detection methods to be able to include them in the assessment.

With regard to the pre-existing impacts criterion, the benthos deviates from its original state due to prior impacts (fisheries, eutrophication and pollutant inputs). Particularly noteworthy are the disturbances of the bottom surface due to intensive fishing activity, which causes a shift from long-lived species (mussels) to short-lived, rapidly reproducing species. As a result, neither the species composition nor the biomass of zoobenthos today corresponds to the state that would be expected without human use (ARMONIES & ASMUS 2002).

In summary, the North Sea EEZ is not of major importance in terms of the benthic organisms inventory. The benthos of the North Sea EEZ is typical of the German North Sea and reflects in particular the sediment and depth conditions and the legacy impacts from anthropogenic influences.

### 2.5.3.1 Significance of the areas for benthic biocoenoses

The benthic biocoenoses will be assessed on the basis of criteria that have already proved their worth in the environmental impact assessment tests of the offshore wind farm projects in the EEZ.

***Priority areas wind energy EN1 and EN2***

The SW-W DB (Western Southwest German Bight) regional geo-cluster identified by DANNHEIM et al (2014a) on the basis of a comprehensive analysis of data from wind farm and AWI projects covers the areas EN1 and EN2 ( Figure 27). When comparing the two areas, the EN1 area shows an overall greater structural heterogeneity of benthic biocoenoses and the second highest heterogeneity of all areas. The predominant character species in EN1 and EN2 were the polychaetes *Magelona* spp., Spiophanes bombyx, Nephtys cirrosa, and amphipods of the Bathyporeia spp. genera. With regard to the number of species and abundance of Red List species, EN1 and EN2 have local hotspots (Figure 24). The variants of the *Goniadella-Spisula* community found in these areas are of high importance in terms of rarity and endangerment due to the relatively high number of Red List species. In the more species-poor expression, this community is of medium importance in terms of diversity and uniqueness. However, it is of great importance in areas which are classified as "Species-rich gravel, coarse sand, and shell layers" under section 30 BNatSchG. Legacy impacts on the *Goniadella-Spisula* community are low to medium due to a relatively low overall fishing intensity (<1 event per year) in the area of the Borkum Reef Ground. Overall, the legacy impacts of the specied-poor variant of the *Goniadella-Spisula* community occurring in areas EN1 and EN2 are rated as medium but as high for the species-rich expression.

***Areas wind energy EN3, EN4 and EN5***

The coastal geo-cluster "OF/NF Coast" (East Frisian/North Frisian coast) in areas EN3, EN4 and EN5, which was defined on the basis of the analysis by DANNHEIM et al. (2014a), is similar in the species composition of the biocoenosis in areas EN1 and EN2. Here too, the polychaetes *Magelona* spp. and *Spiophanes bombyx* were the predominant character species, along with Nemertea and Phoronida. The communities found in these areas showed the highest abundances. The highest structural heterogeneity of benthic biocoenoses compared to all areas was found in area EN5, mainly due to the high variability in the "Dan Tysk" and "Sandbank" wind farms.

The biocoenosis found in the EN3 area is mainly the *Tellina fabula* community. In the northern part of the EN3 area there is a transition area to the *Nucula-nitidosa* community. The high presence of the polychaetes *Magelona johnstoni* and *Spiophanes bombyx* in this area is confirmed by the geo-cluster "OF/NF Coast" described in DANNHEIM et al (2014a).

The benthic biocoenoses identified in the EN3 area are neither rare nor endangered in the North Sea EEZ. Overall, the benthic biocoenoses can be considered to be of low to medium importance due to an average species diversity and number of Red List species, as well as the legacy impacts from fisheries.

***Priority areas wind energy EN6 and EN9***

In the area of the EN6 and EN9 areas, DANNHEIM et al. (2014a) identified the geo-cluster NW DB II (Northwest German Bight II). The biocoenosis occurring in these areas essentially corresponds to the *Amphiura filiformis association* with elements of the *Nucula nitidosa association*, which are added mainly in area EN6. The predominant character species in areas EN6 and EN9 were the mud shrimp *Callianassa subterranea*, the polychaet *Nephtys hombergii*, the brittle star *Amphiura filiformis* and the phoronida. Overall, these areas had the lowest mean abundance and species numbers compared to the other geo-clusters.

The number of Red List infauna species according to RACHOR et al. (2013) varied between 15 and 21 species in the EN6 area. The bivalve mollusc *Spisula elliptica*, which is considered critically endangered (Red List category 2), as well as the bivalve molluscs *Arctica islandica* and *Goodallia triangularis, which are* classified as endangered, and the scale worm *Sigalion mathildae* were each detected with only a few individuals. In addition, two species of seapen and burrowing megafauna communities have been identified. The species *Callianassa subterranea,* which is not endangered, was found relatively frequently, while the species *Upogebia deltaura,* which is classified as endangered to an unknown extent, was only found in small numbers.

Despite the average species diversity and number or abundance of Red List species, the benthic biocoenosis in the area of the EN6 site is considered to be of average to above-average importance due to the occurrence and ecological significance of the seapen and burrowing megafauna communities.

On the basis of data collected in 2008-2009, the benthic community in the EN9 area can be assigned to the *Amphiura filiformis* association. Within the EN9 area, between 128 and 130 macrozoobenthos taxa were detected (PGU 2012a, b; PGU 2015). Despite a relatively large temporal variability in the species composition, the same species, *Nucula nitidosa, Corbula gibba, Nephtys hombergii,* and *Amphiura filiformis,* dominated the benthic community as in the EN6 area. In addition, the dominant species were the horseshoe worm *Phoronis* spp., the mud shrimp *Callianassa subterranea* and polychaetes of the genus Nephtys. With regard to biomass, the heart urchin *Echinocardum cordatum* and the auger shell *Turritella communis* were also dominant in the EN9 area.

A total of 12 species of the Red List according to RACHOR et al. (2013) have been identified, as well as three species of seapen and burrowing megafauna communities, *Callianassa subterranea, Upogebia deltaura* and *Upogebia stellata. Upogebia stellata* is considered critically endangered (Red List category 2) and the *Arctica islandica* is considered endangered (Red List category 3).

Due to the occurrence of species of seapen and burrowing megafauna communities, the benthic community in the EN9 area is assigned an average to above-average importance.

***Priority areas wind energy EN7, EN8, EN10, EN11, EN12 and EN13***

In the area of areas EN7 and EN8 as well as EN10 to EN12, DANNHEIM et al. (2014a) identified the geo-cluster NW DB I (Northwest German Bight I). These offshore areas are mainly characterised by the bivalve mollusc *Nucula nitidosa* and the polychaetes *Nepthys hombergii.*

The benthic community in the EN13 area is primarily the *Amphiura filiformis* community with some elements of the *Nucula nitidosa* community (IFAÖ 2015c, d). Characteristic species of these communities in the investigations were mainly the brittle star *Amphiura filfiformis*, the bivalve molluscs *Mysella bidentata*, *Nucula nitidosa*, *Abra alba,* and the Polychaet *Scalibregma inflatum*.

The overall biodiversity and number of Red List species can be described as average for the areas mentioned. Due to the ecological importance of the seapen and burrowing megafauna communities identified in the studies of the areas, benthos is of average to above-average importance overall in these areas.

With regard to the description of the benthic biocoeneses in the EN7 area, results of the benthic surveys from 2002 to 2010 can be used for this. Essentially, the EN7 area is a transitional community of the *Nucula nitidosa* community with the *Tellina fabula* community bordering to the south and the *Amphiura filiformis* community to the north. These communities are widely distributed and not endangered in the North Sea EEZ.

The diversity of the infauna in the southern part of the EN7 area comprised 122 taxa, with the polychaeta being the most species-rich, followed by the crustacea and mollusca. The most dominant species was the nutmeg *Nucula nitidosa*. Other dominant species were the Polychaeta *Nepthys hombergii* and the bivalve mollusc *Corbula gibba*. The biomass was determined by the heart urchin *Echinocardium cordatum* and auger shell *Turritella communis.* Of the two species of seapen and burrowing megafauna communities, *Callianassa subterranea* was found relatively frequently, while *Upogebia deltaura was* found in relatively small numbers.

Due to the occurrence of seapen and burrowing megafauna communities, the benthic community in the EN7 area is assigned an average to above average importance. The species diversity and number of Red List species in this area can be regarded as average.

The benthos in the area of EN8 and therefore also in the area of N-8.4 can be assigned to the *Amphiura filiformis* community, but also shows elements of the *Nucula nitidosa* community. In the EN8 area, between 146 and 169 taxa of the benthic infauna and 22 to 38 taxa of the benthic epifauna were identified (IFAÖ 2016, BIOCONSULT 2018). Dominant species with regard to abundance were above all the brittle star *Amphiura filiformis*, the bivalve molluscs *Nucula nitidosa* and *Corbula gibba,* and the horseshoe worm *Phoronis* spp. The biomass was dominated by the heart urchin *Echinocardium cordatum* and the auger shell *Turritella communis.*

In the EN8 area, 23 to 31 species of infauna and between 16 and 23 species of epifauna have so far been identified as endangered or rare according to the Red List of RACHOR et al (2013). The bivalve molluscs *Ensis ensis* and *Mya truncata*, the whelk *Buccinum undatum*, the Polychaet *Sabellaria spinulosa,* and the mud shrimp *Upogebia stellata* have been identified as critically endangered (Red List category 2) in isolated cases. In addition, the endangered (Red List category 3) *Arctica islandica*, the Polychaet *Sigalion mathildae* and the sea anemone *Sagartiogeton undatus were* also found in low abundance in the EN8 area. *Callianassa subterranea*, *Upogebia deltaura*, *U. stellata* and *Nephrops norvegicus,* four species of seapen and burrowing megafauna communities have been identified, but only the species *Callianassa subterranea, which is considered* harmless, has been found in higher abundances.

Due to the average species diversity, an above-average number or abundance of Red List species, and the occurrence of several species of seapen and burrowing megafauna communities, the importance of benthos in the EN8 area can be rated as average to above average.

***Reservation areas wind energy EN14 to EN18***

In the area of areas EN14 to EN18 (shipping route 10 and the southern part of the Duck's Bill), DANNHEIM et al. (2014a) primarily identified the *Amphiura filiformis* community, which occurs widely on silty sands of the North Sea EEZ. In the northeastern area of EN16 or in the proposed Nephrops Fishing Reserve (NFi1), the occurrence of seapen and burrowing megafauna communities (e.g. *Nephrops norvegicus* and *Callianassa subterranea*) is known and this area is considered the traditional main Nephrops area (DUNES 2020).

Due to the presence of the widespread Amphiura filiformis community, benthos in these areas has an average importance, and in subareas with occurrences of seapen and burrowing megafauna communities an above average importance.

**Reservation area wind energy EN19**

The northern part of the Duck's Bill is characterised by the presence of two communities of epifauna and two communities of infauna (DANNHEIM et al. 2014a). Overall, this area shows a higher diversity and equivalence compared to the coastal regions due to more balanced dominance ratios. However, there is less abundance and biomass far from the coast compared to the more productive regions near the coast (DANNHEIM et al. 2014a). According to DANNHEIM et al. (2016), the offshore region of the Duck's Bill is characterised by a higher number of Red List species. In addition to distance from the coast, the distribution of Red List species in the German EEZ is largely determined by water depth, temperature and sediment properties, and thus does not differ significantly from the distribution patterns of the remaining benthic fauna (DANNHEIM et al. 2016).

From the 50 m depth contour in the area of EN19, a change in the composition of the benthic fauna takes place. This boundary corresponds to the boundary between mixed and stratified water masses and the associated strong changes in the biotic and abiotic environment, which result in a clear separation of fauna (NEUMANN et al. 2008). DANNHEIM et al. (2014a) identified the benthic community of the central North Sea for this area, which, at 44 ± 9 m-2 , had the highest species number and diversity of all communities in the North Sea EEZ, compared with the other communities in the area.

All in all, benthos is therefore of above-average importance in this area. While the community of the central North Sea is limited to the EN19 area within the EEZ, it is relatively widespread outside the German EEZ.

***Reservation areas raw material extraction SKN1 and SKN2***

In the SKN1 and SKN2 sand and gravel extraction reservation areas in the "Sylt Outer Reef - Eastern German Bight" nature conservation area, areas of species-rich gravel-, coarse sand, and shell layers of the Goniadella-Spisula community are populated by the eponymous species Goniadella bobretzkii and Spisula subtruncata and the typical representatives *Aonides paucibranchiata, Branchiostoma lanceolatum, Ophelia limacina, Polygordius* spp., *Goodallia triangularis,* and *Protodorvillea kefersteini* (IFAÖ 2019). In these areas benthos are of above-average importance.

## 2.6 Fish

As the most species-rich of all vertebrate groups living today, fish are equally important in marine ecosystems as predators and prey. Bottom-living fish feed predominantly on invertebrates living in and on the bottom, while pelagic fish species feed almost exclusively on zooplankton or other fish. In this way, biomass produced in and on the seabed and in open water, and the energy it binds, is also available to seabirds and marine mammals.

For a first subdivision of the fish fauna, the way of life of the adult animals lends itself. Bottom-living (demersal) species can be distinguished from those that live in open water (pelagic). Mixed forms of these (benthopelagic) are also widespread. However, this separation is not strict: demersal fish regularly ascend into the water column, while pelagic fish stay temporarily near the bottom. At almost 60%, demersal fish are the most common in the North Sea, ahead of pelagic (20%) and benthopelagic (15%) species. Only about 5% cannot be assigned to any of the three habitats due to a close habitat link (FROESE & PAULY 2000). The individual life stages of the species often differ more in form and behaviour than the same stages of different species: the pelagic herring *Clupea harengus* lays its eggs in thick mats on sandy and gravelly bottom or sticks them to suitable substrate such as algae or stones (DICKEY-COLLAS et al. 2015), all flatfish have pelagic larvae which, with metamorphosis into their characteristic body shape, change to bottom life (VELASCO et al. 2015), and benthopelagic fish such as cod have pelagic eggs and larvae (HISLOP et al. 2015). The vast majority of fish species found in the North Sea complete their entire life cycle from egg to adult fish ready to spawn in the North Sea, and are therefore termed *permanent residents* (LOZAN 1990). They include commercially exploited species such as sandeel *Ammodytes spec.*, mackerel *Scomber scombrus,* or sole *Solea solea*, as well as economically insignificant species such as eel mother *Zoarces viviparus* or dwarf sole *Buglossidium luteum.*

Other marine species occur regularly in the North Sea as so-called "summer visitors", mainly in summer, but without clear signs of reproduction. Examples are the tub gurnard *Chelidonichthys lucernus* and the striped mullet *Mullus surmuletus*. However, very small juveniles of these two species have been recorded recently, suggesting that reproduction in the area is possible (HEESSEN 2015, DÄNHARDT 2017).

Some species occur irregularly in the North Sea, regardless of the season, including the rabbit fish *Chimaera monstrosa*, **Ray's bream** *Brama brama*, Witch flounder *Glyptocephalus cynoglossus,* and halibut *Hippoglossus hippoglossus*. Of these and other so-called "misguided" species, only single specimens are usually caught.

Unlike the marine fish in the three categories mentioned above, the life cycle of the diadromous species spans sea and freshwater. The eel *Anguilla anguilla* is the only so-called catadromous species that occurs in the German EEZ. It spawns in the sea and spends most of its adult life in fresh or brackish water. Much more common are anadromous species that spawn in freshwater and otherwise live in the sea. In the EEZ, smelt *Osmerus eperlanus*, twaite shad *Alosa fallax* and sea lamprey *Petromyzon marinus* are examples.

The most important influences on fish populations are fishing and climate change (HOLLOWED et al. 2013, HEESSEN et al. 2015). The current warming of the North Sea may lead to a weakening of the synchronicity between temperature-controlled zooplankton development and day-length-controlled phytoplankton development. As a result of this "mismatch" (CUSHING 1990, BEAUGRAND et al. 2003), fish larvae could find a reduced density of zooplankton if they are dependent on external food after consuming their yolk sac. The significance of this phenomenon is due to the fact that the survival rates of early life stages have a disproportionate effect on population dynamics across species (HOUDE 1987, 2008). This variability can propagate up to predators at the top of the food web (DURANT et al. 2007, DÄNHARDT & BECKER 2011) and has an impact on the management of fish stocks.

Effects of fisheries and climate change interact and their relative impact on fish population dynamics is difficult to distinguish (DAAN et al. 1990, VAN BEUSEKOM et al. 2018). For example, the dominance relationships within a fish species community may follow long-term, periodic climate fluctuations (PERRY et al. 2005, BEAUGRAND 2009, GRÖGER et al. 2010, HISLOP et al. 2015). However, these cannot be explained without considering fisheries (FAUCHALD 2010). Despite its complexity, a holistic view of the effects of various stressors on the fish fauna offers the possibility of identifying negative effects early on and, if necessary, initiating targeted measures.

### 2.6.1 Data availability

As data are available almost exclusively from bottom trawling and not from pelagic sampling, the following assessment can be made for demersal fish only. Reliable estimates for pelagic fish are not possible. The bases for the status assessment of the protected asset (bottom-living) fish are

- the analyses of the R & D project "Assessment approaches for spatial planning and licensing procedures with regard to the benthic system and habitat structures" (Dannheim ET al., 2014).
- current (from 2014) results from environmental impact studies and cluster investigations for the preparation of current species lists (only areas N-1 to N-8).
- the International Council for the Exploration of the Sea (ICES) trawl survey database (DATRAS) (accessed 12 March 2018). Only the standard areas and grid squares covering the German North Sea EEZ were considered. In standard roundfish area 6, these are the plan squares 37F6, 38F5-F8, 39F5 and 40F4-F7. The catch data from the 1st and 3rd quarters of the most recent year (2017) have been combined. For 2018, data from the 1st quarter were already available and were combined with the data from the 3rd quarter of 2017.

For a historical reference, EHRICH et al (2006) and KLOPPMANN et al (2003) were considered. The classification into the North Sea-wide context was carried out with the help of HEESSEN et al. (2015). For the current assessment (2017/2018) of the stocks exploited, the Internet portal "Fish stocks online" (BARZ & ZIMMERMANN 2018) was used, which provides a clear summary of the scientific assessment of stocks by ICES.

### 2.6.2 Spatial distribution and temporal variability

The spatial and temporal distribution of fish is determined first and foremost by their life cycle and the associated migrations of the various developmental stages (HARDEN-JONES 1968, WOOTTON 2012, KING 2013). The framework for this is set by many different factors that take effect on different spatial and temporal scales. Hydrographic and, to a large extent, climatic factors, such as swell, tides and wind-induced currents, as well as the large-scale circulation of the North Sea, have an impact over a large area. The medium (regional) to small (local) space-time scale is affected by water temperature and other hydrophysical and hydrochemical parameters as well as food availability, intra- and inter-species competition and predation, which also includes fisheries. Another decisive factor for the distribution of fish in time and space is habitat, which in a broader sense does not only mean physical structures, but also hydrographic phenomena such as fronts (MUNK et al. 2009) and upwelling areas (GUTIERREZ et al. 2007), where prey aggregates and can thus set in motion and maintain entire trophic cascades. The diverse human activities and influences are further factors that structure the fish distribution. They range from nutrient and pollutant discharges to the obstruction of migration routes of migratory species and fisheries, and to structures in the sea. Newly introduced structures can serve fish as spawning substrate (sheet piling for herring spawning), food source (growth on artificial structures) or even as a refuge (wind farms) (EEA 2015).

### 2.6.2.1 Red List species in the German North Sea area

For the 107 established fish and lamprey species in the North Sea, the Red List has been used to assess the endangerment of the species, based on the current stock situation and long-term and short-term stock trends (THIEL et al. 2013). According to the Red List, 23.4% (25 species) of the established marine fish and lamprey species in the North Sea are classified as extinct or at risk of extinction. Taking extremely rare species into account, the proportion of Red List species increases to 27.1% (29 species). Five of these species (shad, **twaite** shad, North Sea houting, river and sea lamprey) are also listed in Annex II of the Habitats Directive.

Within the framework of a research and development project, DANNHEIM et al (2014) derived "Assessment approaches for spatial planning and licensing procedures with regard to the benthic system and habitat structures" from data from 30 wind farm projects and nine research projects of the Alfred Wegener Institute for Polar and Marine Research. According to this, 15 of the 89 fish species analysed (16.9%) had a Red List endangerment status: allis shad, thornback ray, and spurdog are threatened with extinction (category 1), European eel, dogfish, and haddock are considered to be at high risk (category 2), while twaite shad, st**arry ray** , river lamprey, **weever fish** and poor cod are at risk (category 3). The authors identified an endangerment of unknown extent (category G) for the *snake pipefish* , ling, great pipefish, and the ballan wrasse is extremely rare (category R).

### 2.6.2.2 Typical regional fish communities in the EEZ

KLOPPMANN et al. (2003) identified a total of 39 fish species in a one-off survey to record FFH Annex II fish species in the German EEZ in the areas of Borkum Reef Ground, Amrum Outer Ground, east slope of the Elbe Glacial Valley and Dogger Bank in May 2002. The study identified a gradual change in the species composition of the fish communities from the inshore to the offshore areas due to hydrographic conditions. These changes were confirmed by DANNHEIM et al (2014), who were able to distinguish four fish communities in the German EEZ geographically using effort-corrected catch figures: The largest was the central community (ZG), which could be delimited in the north by the two Duck's Bill communities (ES I and ES II) and along the coast by a coastal community (KG) (Figure 28 and Figure 29). Areas with fewer than six stations were not assigned to any fish community (grey symbols in Figure 28).

The four identified fish communities had a similar species composition in principle, but with different species-specific abundances. Dab were generally dominant and very regular, while plaice and American plaice dominated in the offshore community ES II. Plaices were also regularly found in the central transitional community. Dragonets and hooknoses were characteristic of the coastal community of demersal fish. Solenettes and dragonets were also regularly found in the central transitional community. The species composition and distribution of demersal fish showed gradual changes from the offshore community to the central community to the nearshore areas. The species count of the community ES I was significantly lower (ES I: 2 ± 1 * Hol-1) than that of the other communities with an average species count of 6 ± 2 Hol-1 (ES II) and 7 ± 2 * Hol-1 (KG) respectively.

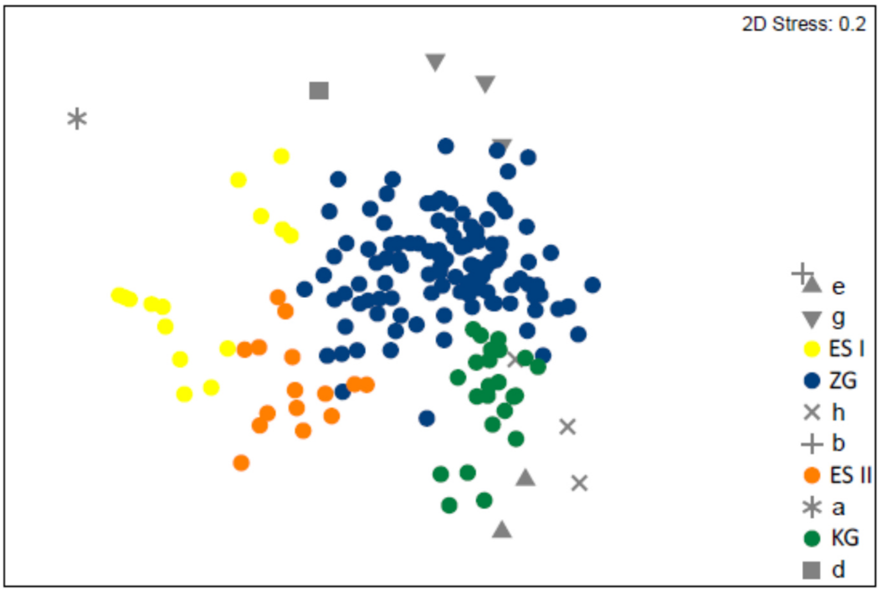



Figure 28: Relative similarity of species composition and species-specific abundances of bottom-dwelling fish in the German North Sea EEZ. The central community (ZG, blue dots), the coastal community (KG, green dots) and two Duck`s Bill communities (ES I & II, yellow and orange dots) can be clearly distinguished. Areas with fewer than six stations have not been assigned to any fish community (grey symbols e, g, h, b and d). Non-metric multi-dimensional scaling based on √-transformed and effort normalised abundance data from catches taken with a 2-m beam trawl; N = 173 stations) From DANNHEIM et al (2014).

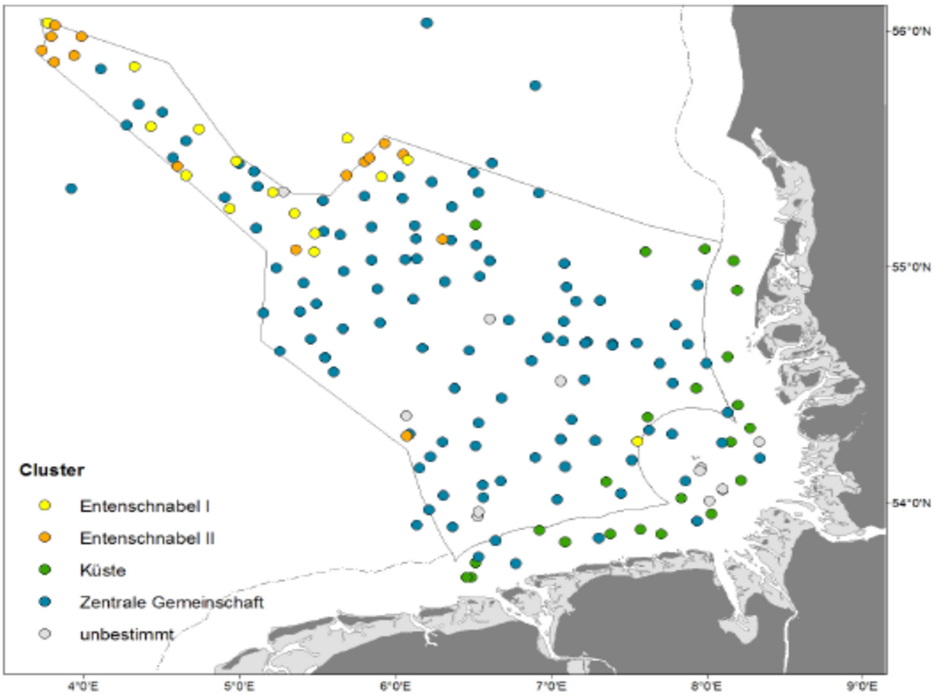



Figure 29: Map of the spatial variability of the fish communities identified in the German North Sea EEZ based on abundance data corrected for effort. Abbreviations, analytical methods, colour codes and sample size as in Figure 28. From DANNHEIM et al (2014).

As with the number of species, the abundance of demersal fish increased with proximity to the coast, from 4,454 ± 3,598 individuals * km-2 in ES I off-shore to 95,128 ± 44,582 individuals * km-2 in the coastal community (a). The biomass, on the other hand, did not show a directional geographical trend, with the lowest biomass being found in ES I (108 ± 112 kg * km-2). The largest biomass was found in ES II with 801 ± 513 kg * km-2 (b).

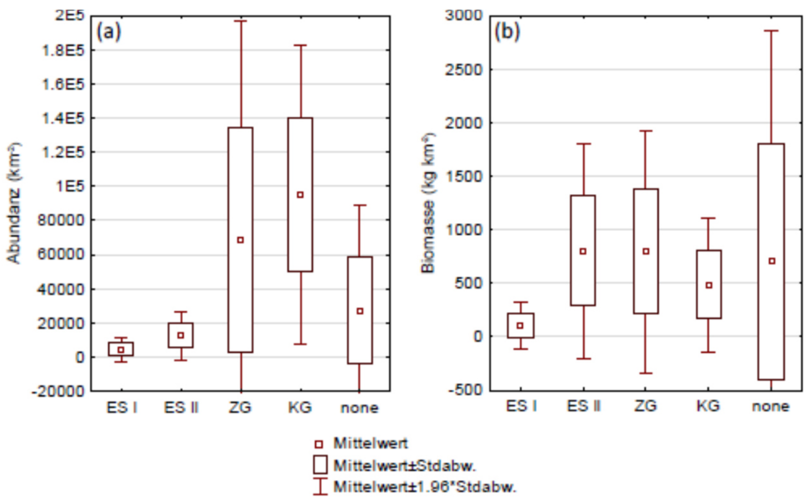



Figure 30: Box whisker plots of (a) abundance (individuals * km-2) and (b) biomass (kg * km-2) of the identified fish communities in the German North Sea EEZ. Abbreviations, analytical methods and sample sizes as shown in. From DANNHEIM et al (2014).

On the basis of high-resolution data from environmental impact studies for individual offshore wind farms, the demersal fish community was studied on a smaller scale (DANNHEIM et al. 2014). For this purpose, the data for the community analyses were grouped according to wind farm clusters as defined in the Spatial Offshore Grid Plan (BSH 2017). In the following, these wind farm areas will be referred to numerically as OWF areas 1-12 (below). In order to exclude temporal effects on the spatial analyses, data from all OWF areas were evaluated in pairs, separated by years and seasons (top left ). The individual OWF areas were compared in pairs by means of single factor similarity analyses (ANOSIM), whereby the mean R-value was calculated as a measure of the mean dissimilarity between predefined groups (here: the OWF areas). R-values close to 0 indicate an absence of differences, R-values close to 0.25 indicate that groups are almost impossible to separate, R-values close to 0.50 indicate that it is possible to separate the groups, R-values close to 0.75 indicate that the groups are easy to separate, while finally R-values close to 1.00 mark the complete separation of the groups (CLARKE & GORLEY 2001). Without the influence of temporal effects, in the southwestern German Bight off the East Frisian coast, western OWF areas 1 and 2 (SW-W DB) could be separated from eastern OWF area 3 (SW-O DB) (). The analyses also showed a separation of the coastal OWF areas 4 (S EUT) and 5 (N EUT) along the edge of the Elbe Glacial Valley. The greatest similarity (characterised by low R-values) in terms of species-specific fish abundance was found between OWF areas 6 to 12 in the northwestern German Bight (NW DB).

The differences between the five geo-clusters identified by ANOSIM (SW-W DB, SW-O DB, N EUT, S EUT, NW DB Figure 31 were clearly evident, although the degree of dissimilarity also varied considerably between neighbouring geo-clusters. While OWF areas 5 and 6 were very similar (mean R=0.42), the fish community of OWF area 12 differed significantly from that of OWF area 10 within the NW DB geocluster (R=0.84) (top left Figure 31. The separation of the geo-clusters on the basis of species-specific abundance should therefore be understood as a spatial gradient in the community characteristics rather than a sharp demarcation of different demersal fish communities. The number of demersal fish species is generally very similar between the geo-clusters: In the SW-W DB geo-cluster, 13 ± 3 species per haul were caught on average, while the fewest fish species (11 ± 3) were found in the N EUT geo-cluster. Furthermore, the geo-clusters did not show any geographically clear differences in the total abundance and total biomass of all species. The highest abundance was recorded in the SW-O DB geo cluster (82,040 ± 70,335 individuals * km-2), the lowest in the NW DB geo cluster (20,010 ± 22,847 individuals * km-2). The average biomass varied between 750 ± 447 kg * km-2 (NW DB) and 1563 ± 657 kg * km-2 (SW-O DB). The species composition also hardly differed between the geo-clusters: More than 60% of the species were found across different areas. Only five species were relevant for the dissimilarity between the geo-clusters. Dwarf tongue, dab and plaice were found in all geo-clusters, but they contributed to the similarity to a varying degree. S*caldfish* were characteristic of the western geo-clusters (SW-W DB, SW-O DB, NW DB), while gobies were characteristic of the geo-clusters along the Elbe Glacial Valley and eastern areas (N EUT, S EUT). Structural differences in species composition are hardly present between the geo-clusters. Differences are based solely on the different abundances of species.

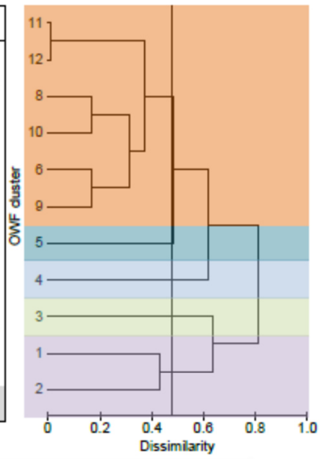
### 2.6.3 Status assessment of the protected asset fish

The status of the demersal fish community in the German North Sea EEZ is assessed on the basis of i) rarity and endangerment, ii) diversity and uniqueness, and iii) legacy impacts. These three criteria are defined below and applied separately to areas 1-3, area 4, area 5, areas 6-8 and areas 9-13.

*Rarity and endangerment*

The rarity and endangerment of the fish community is assessed on the basis of the proportion of species that are considered endangered according to the current Red List marine fish (THIEL et al. 2013) and for the diadromous species on the Red List freshwater fish (FREYHOF 2009) and have been assigned to one of the following Red List categories: Extinct or missing (0), threatened with extinction (1), critically endangered (2), endangered (3), endangered to an unknown extent (G), extremely rare (R), early warning list (V), data insufficient (D) or not endangered (*) (THIEL et al. 2013). Particular attention is paid to the risk situation of species listed in Annex II of the Habitats Directive. They are the focus of Europe-wide conservation efforts and require special protection measures, e.g. for their habitats.

| Cluster | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0,43 | **0,60** | **0,77** | **0,67** | | **0,80** | | | | |
| 2 | | | **0,67** | **0,77** | **0,60** | **0,78** | **0,79** | **0,96** | **0,93** | **0,85** | **1,00** |
| 3 | | | | **0,69** | **0,68** | **0,76** | **0,71** | **0,97** | **0,95** | **0,89** | |
| 4 | | | | | **0,54** | | **0,70** | | | | |
| 5 | | | | | | 0,42 | **0,55** | | | | |
| 6 | | | | | | | 0,24 | 0,17 | 0,22 | 0,21 | |
| 8 | | | | | | | | 0,47 | 0,17 | 0,10 | 0,37 |
| 9 | | | | | | | | | 0,34 | 0,49 | |
| 10 | | | | | | | | | | 0,21 | **0,84** |
| 11 | | | | | | | | | | | 0,01 |
| 12 | | | | | | | | | | | |



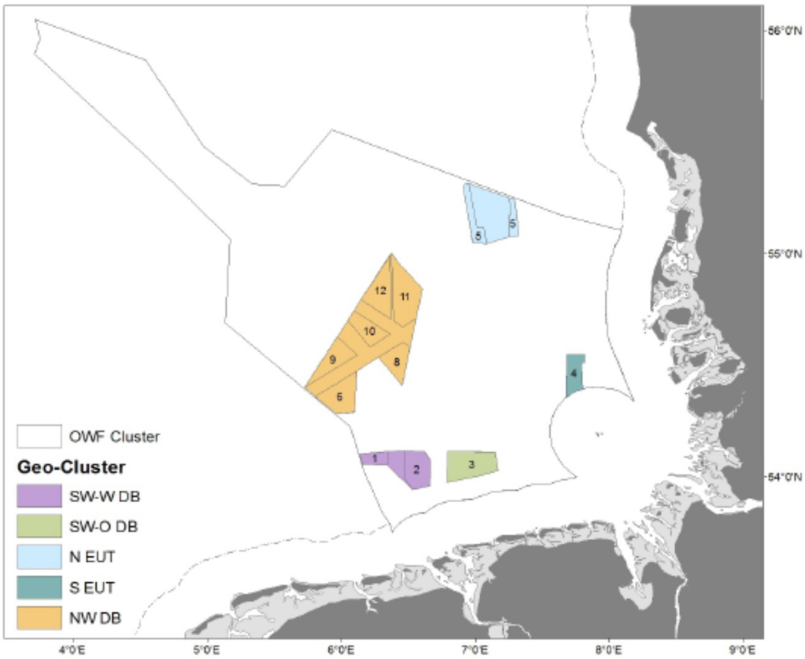




Figure 31: Top: R-values for the diversity of OWF areas (single factor ANOSIM) based on abundance data of demersal fish. The R-values correspond to the mean R-value of the individual pairwise tests between the OWF areas. Above: Differences between the identified geo-clusters in different colours. Below: Map of the OWF areas (numbers) and location of the geo-clusters determined from the R-values (single factor ANOSIM) (colours, see map legend). SW-W DB: western southwestern German Bight, SW-O: eastern southwestern German Bight, N EUT: northern Elbe Glacial Valley, S EUT: southern Elbe Glacial Valley, NW DB: northwestern German Bight. From DANNHEIM et al (2014).

In the sea areas where **areas 1, 2 and 3 are** located, a total of 37 fish species were identified during the environmental impact assessment and fish monitoring for stock assessment in the above-mentioned period (Chapter 2.6.1). According to THIEL et al. (2013), none of these species is considered extinct or missing (0), the thornback ray *Raja clavata* (1 species, 2.7%) is threatened with extinction (1), and no highly endangered species (2) were detected. The greater weever *Trachinus draco* is considered endangered (3) (1 species, 2.7%). The greater pipefish *Syngnathus acus* and the snake pipefish *Entelurus aequoreus* are considered to be endangered to an unknown extent (G) (2 species, 5.4%). None of the species detected in areas 1-3 are extremely rare (R), while mackerel *Scomber scombrus*, turbot *Scophthalmus maximus* and sole *Solea solea* are on the early warning list (3 species, 8.1%). For the small sandeel *Ammodytes marinus*, the reticulated dragonet *Callionymus reticulatus*, the greater spotted sandeel *Hyperoplus lanceolatus*, the spotted goby *Pomatoschistus pictus,* and the bullhead *Taurulus bubalis* (5 species, 13.5%), data availability is considered insufficient for an assessment (D). Of the 37 species recorded, 25 (67.6%) are considered safe (*), including the three-spined stickleback *Gasterosteus aculeatus,* which was included in the Red List of freshwater fish (FREYHOF 2009) ().

In the sea areas where **Area 4 is** located, a total of 37 species were identified during the environmental impact assessments and fish monitoring for stock assessment, of which, according to THIEL et al. (2013), no species is considered extinct or missing (0), threatened with extinction or critically endangered (2). One species, the thorny skate *Amblyraja radiata*, is considered endangered (3) (1 species, 2.7%). The snake pipefish *Entelurus aequoreus is considered to be endangered to an* unknown extent (G) (1 species, 2.7%), while smelt *Osmerus eperlanus* (assessed in FREYHOF 2009), mackerel *Scomber scombrus*, turbot *Scophthalmus maximus* and sole *Solea solea* are on the early warning list (4 species, 10.8%). For a further three species (8.1%), the small sandeel *Ammodytes marinus*, the reticulated dragonet *Callionymus reticulatus,* and the greater spotted sandeel *Hyperoplus lanceolatus, the* available data are insufficient for an assessment (D). 28 species (75.7%) are considered to be safe (*) (Table 9).

A total of 35 species have been identified in the sea area covered by **Area 5** during the environmental impact assessment and fish monitoring for stock assessment. According to THIEL et al (2013), no species is considered extinct or missing (0), threatened with extinction (1), critically endangered (2) or extremely rare (R). Likewise, none of the species found in Area 5 is endangered to an unknown extent (G). FREYHOF (2009) considers the river lamprey *Lampetra fluviatilis* to be at risk (3) (2.9%), and, as in the areas already covered, mackerel *Scomber scombrus*, turbot *Scophthalmus maximus* and sole *Solea solea are* on the early warning list (3 species, 8.6%). Data on the small sandeel *Ammodytes marinus*, the Tobias fish *Ammodytes tobianus*, the reticulated dragonet *Callionymus reticulatus* and the greater spotted sandeel *Hyperoplus lanceolatus* are considered insufficient and 27 species (77.1%) are considered safe (*) (Table 9).

A total of 39 species have been identified in the sea areas where **areas 6-8 are** located during the environmental impact assessments and fish monitoring for stock assessment. Of these, according to THIEL et al (2013), no species is considered extinct or missing (0), and the thornback ray *Raja clavata* (1 species, 2.6%) is threatened with extinction (1). The European eel *Anguilla anguilla* and the tope shark *Galeorhinus galeus* (2 species, 5.1%) are highly endangered (2), thorny skate *Amblyraja radiata* and twaite shad *Alosa fallax* are considered endangered (3) (2 species, 5.1%), while the greater pipefish *Syngnathus acus* is considered to be endangered to an unknown extent (G) (1 species, 2.6%). The spotted ray *Raja montagui* (1 species, 2.6%) is extremely rare (R), mackerel *Scomber scombrus*, turbot *Scophthalmus maximus,* and sole *Solea solea* are on the early warning list (V) (3 species, 7.7%). For the small sandeel *Ammodytes marinus* and the greater spotted sandeel *Hyperoplus lanceolatus, the* available data are insufficient for an assessment (D) (2 species, 5.1%), 27 species (69.2%) are considered safe (*) (Table 9).

No environmental impact assessments have yet been carried out in the sea areas where **zones 9-13 are located**. The assessment is therefore based solely on fish monitoring data for stock assessment, and therefore on a smaller number of hauls, which may affect species numbers. In areas 9-13, a total of 29 species were identified, none of which, according to THIEL et al. (2013), is considered extinct or missing (0), critically endangered (2) or extremely rare (R), or endangered to an unknown extent (G). The spurdog shark *Squalus acanthias* is threatened with extinction (1) (1 species, 3.4%), the thorny skate *Amblyraja radiata* is considered endangered (3) (1 species, 3.4%). As in all other clusters considered, mackerel *Scomber scombrus*, turbot

*Scophthalmus maximus* and sole *Solea solea* are on the pre-warning list (3 species, 10.3%). For the small sandeel *Ammodytes marinus*, the greater spotted sandeel *Hyperoplus lanceolatus* and for the hake *Merluccius merluccius, the* available data are insufficient for an assessment (D) (3 species, 13.8%). 20 species (69%) are considered to be safe (*) (Table 9).

Table 9: Relative proportion of Red List categories in the fish species detected in zones 1-3, 4, 5, 6-8 and 9-13 Extinct or missing (0), threatened with extinction (1), critically endangered (2), endangered (3), endangered to an unknown extent (G), extremely rare (R), early warning list (V), data insufficient (D) or not at risk (*) (Thiel et al. 2013). (EIA data from 2014 for clusters 1-8 and data from 2017/2018 from ICES' DATRAS database, see 2.8.1). For comparison, the relative proportions of the assessment categories of the North Sea Red List (Thiel et al. 2013) are shown.

| **Area** | **Red List Category** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **G** | **R** | **V** | **D** | ***** |
| **1-3** | 0 | 2,7 | 0 | 2,7 | 5,4 | 0 | 8,1 | 13,5 | 67,6 |
| **4** | 0 | 0 | 0 | 2,7 | 2,7 | 0 | 10,8 | 8,1 | 75,7 |
| **5** | 0 | 0 | 0 | 2,9 | 0 | 0 | 8,6 | 11,4 | 77,1 |
| **6-8** | 0 | 2,6 | 5,1 | 5,1 | 2,6 | 2,6 | 7,7 | 5,1 | 69,2 |
| **9-13** | 0 | 3,4 | 0 | 3,4 | 0 | 0 | 10,3 | 13,8 | 69 |
| **North Sea (Thiel et al. 2013)** | **2,8** | **7,5** | **6,5** | **1,9** | **4,7** | **3,7** | **6,5** | **22,4** | **43,9** |

In the Red List of marine fish, 27.1% of the species assessed were assigned to a risk category (0, 1, 2, 3, G or R), 6.5% are on the early warning list and for 22.4% no assessment is possible due to lack of data. A total of 43.9% of species are considered to be safe (Thiel et al. 2013) (). By comparison, in all the clusters considered, significantly fewer species with an endangerment status were recorded (1-3: 10.8%, 4: 5.4%, 5: 2.9%, 6-8: 18.0%, 9-13: 6.8%), while there were always considerably more non-endangered species than those on the Red List (1-3: 67.6%, 4: 75.7%, 5: 77.1%, 6-8: 69.2%, 9-13: 69.0%).

No extinct or missing species (category 0) were found in any of the areas. For endangered (1) and critically endangered (2) species, the importance of the areas is below average, while endangered species (3) were relatively more common in all areas than in the Red List. For these species, the areas are of above average importance. In areas 1-3, a higher proportion of species in category G (endangered to an unknown extent) was recorded, otherwise their relative proportion was below the Red List, as was the case for extremely rare species (R). Relatively more species in categories V (early warning list) and * (not endangered) were found in all areas, which means that they have above-average importance for species in these two categories. The proportion of species (D) that could not be assessed for lack of data was significantly below the proportion of this category in the Red List in all areas (Table 9). A total of two species protected under the Habitats Directive and the Regulation on Protected Areas for the "Sylt Outer Reef - Eastern German Bight" were identified, namely the twaite shad *Alosa fallax* (Areas 6-8) and the river lamprey *Lampetra fluviatilis* (Area 5).

Against this background, the rariteness and vulnerability of the fish fauna in the areas under consideration is rated as average to above average.

*Diversity and uniqueness*

The diversity of a fish community can be described by the number of species (α-Diversity, 'Species richness'). The species composition can be used to assess the specific nature of a fish community, i.e. how regularly habitat-typical species occur. The following section compares and assesses the diversity and individual characteristics of the entire North Sea and the German EEZ, and of the EEZ and the individual areas.

Over 200 species of fish have been recorded in the North Sea to date (Daan 1990: 224, Lozan 1990: >200, Fricke et al. 1994, 1995, 1996: 216, Froese & Pauly 2000: 209). The vast majority of these are rare individual records. Less than half of them reproduce regularly in the German EEZ or are found as larvae, young or adult specimens. According to these criteria, only 107 species are considered established in the North Sea (Thiel et al. 2013). The International Bottom Trawl Survey (IBTS) has identified 99 fish species in the entire North Sea between 2014 and 2018. In the German EEZ, represented here by area-related fish data from environmental impact studies (from 2014) and the ICES DATRAS database (IBTS data 2017 & 2018), a total of 56 species were identified. With the exception of areas 9-13, the number of species in the individual areas ranged from 35 to 39 (see "Rarity and endangerment"). Most species were found in areas 6-8, followed by areas 4, 1-3 and 5, while only 29 species were found in areas 9-13 in zone 3 (Table 10), although this may be at least partly explained by the lower coverage in this area.

All typical demersal flat and round fish species have been identified across the area. The steady and characteristic flatfish species scaldfish *Arnoglossus laterna*, dwarf sole *Buglossidium luteum*, dab *Limanda limanda*, Limande *Microstomus kitt*, plaice *Pleuronectes platessa*, turbot *Scophthalmus maximus*, brill *Scophthalmus rhombus,* and sole *Solea solea* were present in all areas considered. Flounder *Platichthys flesus* were caught in 4 out of 5 areas despite their coastal and estuarine affinity (Table 10).

Although the bottom trawls used are not suitable for capturing pelagic fish, herring *Clupea harengus*, mackerel *Scomber scombrus*, *sprat Sprattus sprattus* and dolphinfish *Trachurus trachurus were* found to be typical of the pelagic part of the fishing community in all areas (Table 10).

Table 10 Total list of detected fish species in zones 1-3, 4, 5, 6-8 and 9-13 (EIA data from 2014 for zones 1-8 and 2017/2018 data from ICES DATRAS database).

| | | CLUSTER | | | | |
|---|---|---|---|---|---|---|
| Artname | Deutscher Trivialname | 1, 2 & 3 | 4 | 5 | 6, 7 & 8 | 9-13 |
| Agonus cataphractus | Steinpicker | ■ | ■ | ■ | ■ | |
| Alosa fallax | Finte | | | | ■ | |
| Amblyraja radiata | Sternrochen | ■ | ■ | | ■ | ■ |
| Ammodytes marinus | Kleiner Sandaal | | ■ | ■ | ■ | ■ |
| Ammodytes tobianus | Tobiasfisch | | | ■ | | |
| Anguilla anguilla | Europäischer Aal | | | | ■ | |
| Arnoglossus laterna | Lammzunge | ■ | ■ | ■ | ■ | ■ |
| Belone belone | Hornhecht | | ■ | | ■ | |
| Buglossidium luteum | Zwergzunge | ■ | ■ | ■ | ■ | ■ |
| Callionymus lyra | Gestreifter Leierfisch | ■ | ■ | ■ | ■ | ■ |
| Callionymus reticulatus | Ornament-Leierfisch | ■ | ■ | ■ | | |
| Chelidonichthys lucernus | Roter Knurrhahn | ■ | ■ | ■ | ■ | ■ |
| Ciliata mustela | Fünfbärtelige Seequappe | | | ■ | | |
| Clupea harengus | Hering | ■ | ■ | ■ | ■ | ■ |
| Dicentrarchus labrax | Wolfsbarsch | | ■ | | | |
| Echiichthys vipera | Vipernqueise (=Kleines Petermännchen) | ■ | ■ | ■ | ■ | ■ |
| Enchelyopus cimbrius | Vierbärtelige Seequappe | ■ | ■ | | ■ | ■ |
| Engraulis encrasicolus | Sardelle | | ■ | ■ | ■ | ■ |
| Entelurus aequoreus | Große Schlangennadel | ■ | ■ | | ■ | ■ |
| Eutrigla gurnardus | Grauer Knurrhahn | ■ | ■ | ■ | | |
| Gadus morhua | Kabeljau | ■ | ■ | ■ | ■ | ■ |
| Galeorhinus galeus | Hundshai | | | | ■ | |
| Gasterosteus aculeatus | Dreistachliger Stichling | ■ | ■ | ■ | ■ | |
| Hippoglossoides platessoides | Doggerscharbe | | ■ | | ■ | ■ |
| Hyperoplus lanceolatus | Gefleckter großer Sandaal | ■ | ■ | ■ | ■ | ■ |
| Lampetra fluviatilis | Flussneunauge | | | ■ | | |
| Limanda limanda | Kliesche | ■ | ■ | ■ | ■ | ■ |
| Liparis liparis | Großer Scheibenbauch | | | ■ | | |
| Merlangius merlangus | Wittling | ■ | ■ | ■ | ■ | ■ |
| Merluccius merluccius | Seehecht | | | | | ■ |
| Microstomus kitt | Limande | ■ | ■ | ■ | ■ | ■ |
| Mullus surmuletus | Streifenbarbe | ■ | ■ | ■ | ■ | ■ |
| Myoxocephalus scorpius | Seeskorpion | ■ | ■ | ■ | ■ | ■ |
| Osmerus eperlanus | Stint | | ■ | | | |
| Pholis gunnellus | Butterfisch | ■ | ■ | | | |
| Platichthys flesus | Flunder | ■ | ■ | ■ | ■ | |
| Pleuronectes platessa | Scholle | ■ | ■ | ■ | ■ | ■ |
| Pomatoschistus minutus | Sandgrundel | ■ | ■ | ■ | ■ | |
| Pomatoschistus pictus | Strandgrundel | ■ | | | | |
| Raja clavata | Nagelrochen | ■ | | | ■ | |
| Raja montagui | Fleckrochen | | | | ■ | |
| Sardina pilchardus | Sardine | | | ■ | ■ | |
| Scomber scombrus | Makrele | ■ | ■ | ■ | ■ | ■ |
| Scophthalmus maximus | Steinbutt | ■ | ■ | ■ | ■ | ■ |
| Scophthalmus rhombus | Glattbutt | ■ | ■ | ■ | ■ | |
| Scyliorhinus canicula | Kleingefleckter Katzenhai | ■ | | | ■ | ■ |
| Solea solea | Seezunge | ■ | ■ | ■ | ■ | ■ |
| Sprattus sprattus | Sprotte | ■ | ■ | ■ | ■ | ■ |
| Squalus acanthias | Dornhai | | | | | ■ |
| Syngnathus acus | Große Seenadel | ■ | | | ■ | |
| Syngnathus rostellatus | Kleine Seenadel | ■ | ■ | ■ | | |
| Syngnathus typhle | Grasnadel | | | ■ | | |
| Taurulus bubalis | Seebull | ■ | | | | |
| Trachinus draco | Großes Petermännchen | ■ | | | | |
| Trachurus trachurus | Holzmakrele (=Stöcker) | ■ | ■ | ■ | ■ | ■ |
| Zeus faber | Heringskönig (=Petersfisch) | | ■ | | | ■ |
| | Anzahl Arten | 37 | 38 | 35 | 39 | 29 |

Of the 56 species recorded in the German EEZ during the period in question, only 19 species were found in all areas, 10 species were found in four areas, 5 species were recorded in three areas and 6 species in only two areas (). The remaining 16 species were each caught in only one area, with anadromous species such as twaite shad *Alosa fallax*, river lamprey *Lampetra* *fluviatilis* or smelt *Osmerus eperlanus*, and coastal species such as three-spined stickleback *Gasterosteus aculeatus*, flounder *Platichthys flesus* or gobies of the genus *Pomatoschistus* or species dependent on coastal habitats (seagrass meadows) such as the Nilsson's pipefish *Syngnathus rostellatus* appeared as expected in the coastal clusters. These species were absent in the areas away from the coast (areas 9-13). On the other hand, hake *Merluccius merluccius* and spurdog shark *Squalus acanthias* were caught only in the offshore areas (table 7).

The composition of fish species between the areas appears to differ in terms of individual, rare species, while there are major similarities in the more common, characteristic species (Table 10).

Between 1982 and 2002, EHRICH et al (2006) identified 104 species of fish in the North Sea, and KLOPPMANN et al (2003) found 39 species at a much lower recording effort and a shorter recording period. Also in all areas, the typical and characteristic species of both the pelagic and demersal components of the fish communities under consideration were represented. The overall diversity and characteristics can be considered as average in all areas.*Legacy impacts*

The southern North Sea has been intensively used for centuries. Fisheries are probably the most damaging to the natural habitat and the fish community. Nutrient pollution can also affect the natural habitat. In addition, fish are subject to other direct or indirect human influences such as shipping traffic, pollutants, sand and gravel extraction. However, these indirect influences and their effects on the fish fauna are difficult to prove. In principle, it is not possible to reliably separate the relative effects of individual anthropogenic factors on the fish community and their interactions with natural biotic (predators, prey, competitors, reproduction) and abiotic (hydrography, meteorology, sediment dynamics) parameters of the German EEZ. However, due to the removal of target species and by-catch and the impact on the seabed in the case of bottom fishing methods, fishing is considered to be the most effective source of pollution for the fish community. There is no assessment of stocks on a smaller spatial scale such as the German Bight. Consequently, the assessment of this criterion cannot be carried out at area level, but only for the whole North Sea.

Of the 107 species considered established in the North Sea, 21 are fished commercially (THIEL et al. 2013). The assessment of the impact of fishing is based on the "Fisheries overview - Greater North Sea Ecoregion" of the International Council for the Exploration of the Sea (ICES 2018a). Fisheries have two main effects on the ecosystem: the disturbance or destruction of benthic habitats by bottom-set nets and the taking of target species and by-catch species. The latter often include protected, endangered or threatened species, including not only fish but also birds and mammals (ICES 2018b). Some 6600 fishing vessels from 9 nations fish in the North Sea. The largest quantities were landed in the early 1970s and catches have been declining since then. However, a reduction in fishing effort has only been observed since 2003.

The intensity of bottom trawling is concentrated in the southern North Sea and is also by far the predominant form of fishing in the German EEZ (ICES 2018a). Flatfish trawling in the German EEZ target plaice and sole, using not only heavy bottom gears but also relatively small meshes, as a result of which by-catch rates of small fish and other marine organisms can be very high.

Commercial fisheries and the size of spawning stocks are assessed against Maximum Sustainable Yield (MSY), taking into account the precautionary approach. A total of 119 stocks have been considered in terms of fishing intensity, 43 of which have been scientifically assessed (Figure 32). Of the 43 stocks assessed, 25 are managed sustainably. 38 of the 119 stocks have been assessed in terms of their reproductive capacity (spawning biomass), with 29 stocks being able to use their full reproductive capacity (Figure 32).

The biomass share of the total catch (5,350,000 t in 2017) which is managed with excessive fishing intensity outweighs the share of sustainably caught and unevaluated fish stocks in the North Sea (Figure 32). Fish from stocks whose reproductive capacity is above the reference value account for the majority of the biomass share in the catch (3,709,000 t, Figure 32).

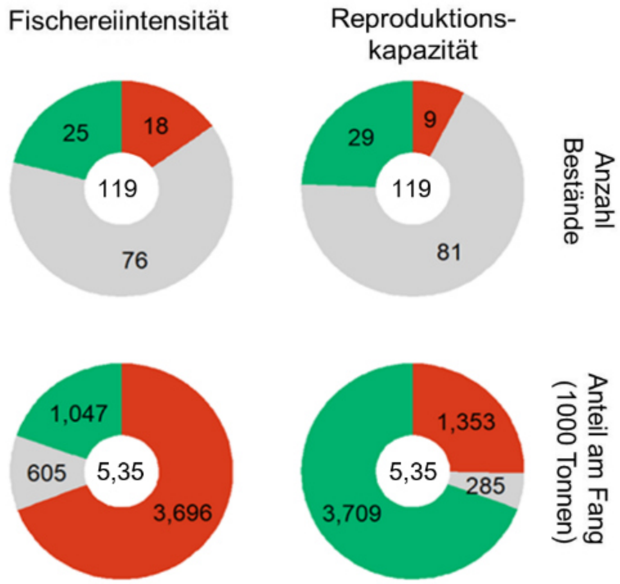



Figure 32: Summary of the status of fish stocks in the North Sea in 2017, focusing on fishing intensity and reproductive capacity. On the left: Fishing intensity indicates the number of stocks (top) and the biomass share of the catch (bottom; in 1,000 tonnes) that is below (green) or above (red) the reference level (fishing intensity for sustainable yield, FMSY). Right: Reproductive capacity indicates the number of stocks (top) and the biomass share of the catch (bottom) that is above (green) or below (red) the reference level - (spawning biomass, MSY Btrigger). Grey indicates the number or biomass share of the catch of stocks for which no reference points have been defined and for which no stock assessment is therefore possible. A total of 119 stocks were considered, which together provided 5,350,000 tonnes of catch. Amended according to ICES 2018a.

Overall fishing mortality of demersal and pelagic fish has decreased significantly since the late 1990s and for most of these stocks spawning biomass has been increasing since 2000 and is now above or close to individually defined reference points. Nevertheless, fishing mortality rates for many stocks are also above the established reference levels, e.g. for cod *Gadus morhua*, whiting *Merlangius merlangus* or mackerel *Scomber scombrus*. Moreover, for the vast majority of the stocks exploited, no reference levels are defined, which makes it impossible to carry out scientific stock assessments.

Alongside fisheries, eutrophication is one of the greatest ecological problems for the marine environment in the North Sea (BMU 2018). Despite reduced nutrient inputs and lower nutrient concentrations, the southern North Sea is subject to a high eutrophication load in the period 2006 - 2014. Nitrates and phosphates are mainly discharged via rivers, resulting in a pronounced gradient of nutrient concentrations from the coast to the open sea (Brockmann et al. 2017). Major direct effects of eutrophication are increased chlorophyll-a concentrations, reduced visibility depths, local decline in seagrass areas and vegetation density with associated mass reproduction of green algae. Above all, the seagrass meadows of the Wadden Sea perform an important protective function for the fish spawn and provide a protection and feeding area for numerous young fish between the stalks. With the increasing decline of the seagrass beds due to eutrophication, there are fewer retreat areas and potentially higher predation rates. The indirect effects of nutrient enrichment, such as oxygen deficiency and a changed species composition of macrozoobenthos, may also have an impact on the fish fauna. For many species, the survival and development of fish eggs and larvae depends on oxygen concentration (Serigstad 1987). Depending on how much oxygen is needed, lack of oxygen can lead to the death of the fish spawn and larvae. In addition, the altered species composition of benthic organisms can also affect the biodiversity of the fish community, especially that of food specialists.

Due to the fact that, according to ICES, the abundance of fish species in the North Sea has not decreased for 40 years (number of species per 300 hauls; catch data from the International Bottom Trawl Survey, IBTS), and that the commercially exploited stocks are also subject to strong natural fluctuations, the biota of the fish fauna in the German EEZ was assessed as average. This assessment is supported by a summary of fishery indicators and the ecosystem effects of bottom fishing (WATLING & NORSE 1998, Hiddink ET al. 2006).

#### 2.6.3.1 Significance of the areas for fish

The overriding criterion for the importance of the areas for fish is the relation to the life cycle, within which different stations are associated with stadium-specific habitat requirements - through more or less extensive migrations between them. The overview of species records by area did not show any particular significance of a specific area for the constant, common character species (Table 10). However, there is a tendency for areas closer to the coast to be home to more species. Although this could be an artefact of the different numbers of wood, an overlap between the habitat of inshore fish species and existing and future wind farm sites is - quite plausible in view of the mobile lifestyle and life cycle of most species. The higher proportion of species with an affinity for the coast in the areas close to the coast could therefore be an indication that areas EN1 to EN3, area EN4 and area EN5 are more important for fish with an affinity for the coast, such as butterfish, smelt and pipefish, than the areas farther away from the coast. These areas also lie along the migratory route of herring spawning along the east coast of the UK in autumn and winter. The larvae first reach the near-coastal nursery areas with the counterclockwise residual current of the North Sea (DICKEY-COLLAS et al. 2009), from where they recruit as one- or two-year-old fish, also along the coast, to the adult population. Plaice spawning in the central North Sea migrate to their nursery areas along the coast (BOLLE et al. 2009), crossing all the areas under consideration here, which may thus be significant as transit areas for one of the most common fish species in the North Sea. The fact that spiny dogfish have only been caught in areas EN9 to EN13 may not yet be sufficient to establish a special importance of these areas for this species, as spiny dogfish are also found along the coast. In areas EN6 to EN8, slightly higher percentages of endangered, critically endangered, vulnerable and endangered species were found than in other areas, which were also above the Red List average. For these species, this area could be of greater importance than other areas where evidence is lacking.

## 2.7 Marine mammals

Three species of marine mammals regularly occur in the German North Sea EEZ: Harbour porpoises (*Phocoena phocoena*), grey seals (*Halichoerus grypus*) and seals (*Phoca vitulina*). All three species are characterised by high mobility. Migrations (especially in search of food) are not limited to the EEZ, but also include the territorial sea and large areas of the North Sea across borders.

Both seal species have their resting and whelping places on islands and sandbanks in the coastal waters. To search for food, they undertake extensive hikes in the open sea from the moorings. Due to the high mobility of the marine mammals and the use of very extensive areas, it is necessary to consider the occurrence not only in the German EEZ, but in the entire area of the southern North Sea.

Occasionally, other marine mammals are also observed in the German North Sea EEZ, such as white-sided dolphins (*Lagenorhynchus acutus*), white-beaked dolphins (*Lagenorhynchus albirostris*), bottlenose dolphins (*Tursiops truncatus*) and minke whales (*Balaenoptera acutorostrata*).

Marine mammals are among the TOP predators of the marine food chains. They are therefore dependent on the lower components of the marine food chains: On the one hand from their direct food organisms (fish and zooplankton) and on the other hand indirectly from phytoplankton. As consumers at the top of the marine food chains, marine mammals also influence the occurrence of food organisms.

### 2.7.1 Data availability

The occurrence of harbour porpoises in the North Sea and in particular in German waters has been extensively studied over the last 25 years.

The most important of these are the three so-called SCANS (Small Cetacean Abundance in the North Sea and adjacent waters) studies, which cover the entire North Sea, Skagerrak, Kattegat, Western Baltic/Beltsea, Celtic Sea, and other parts of the North East Atlantic.

The German waters currently belong to the areas of the North Sea which have been systematically and very intensively investigated for the presence of marine mammals since 2000. Most of the data is provided by the investigations carried out as part of environmental impact studies and construction and operational monitoring for offshore wind farms. In addition, studies for monitoring nature conservation areas are regularly carried out on behalf of BfN. Finally, data are also collected within the framework of research projects that investigate specific issues.

Data availability can currently be described as very good for the areas EN1 to EN13 in the German EEZ. Data are also systematically quality-assured and used for studies, so that the current state of knowledge on the occurrence of marine mammals in German waters can be classified as good.

The current findings relate to different spatial levels:

- the whole North Sea and adjacent waters: Studies carried out under SCANS I, II and III in 1994, 2005 and 2016,
- Research projects in the German EEZ and in coastal waters (including MINOS, MINOSplus (2002 - 2006) and StUKplus (2008 - 2012)),
- Investigations into compliance with the requirements of the UVPG within the scope of licensing and planning approval procedures of the BSH and from the construction and operational monitoring of offshore wind farms since 2001 and continuously,
- Monitoring of the nature conservation areas on behalf of the BfN since 2008 and continuously.

For the German EEZ area, the most comprehensive data are collected in the context of environmental impact studies and in the context of construction and operational monitoring of offshore wind farms. Marine mammals are recorded from aircraft. With the introduction of the StUK4, the airborne acquisition is carried out with the help of high-resolution digital photo and video technology.

In addition, since 2009, acoustic data on the habitat use by harbour porpoises have been continuously collected using underwater measurement systems such as C-PODs. Since 2009, operators of offshore wind farms have been maintaining a network of CPOD stations in the German EEZ. The station network provides the most comprehensive and valuable data on harbour porpoise habitat use in the areas of the German North Sea EEZ to date.

Information on the occurrence of marine mammals is also provided by observations within the framework of the ship-based recording of resting and seabirds according to StUK.

Current findings are obtained from the monitoring of offshore projects in priority areas EN1, N2 and EN3 (investigation cluster North of Borkum), in priority area EN4 (investigation cluster North of Helgoland), as well as from individual projects in priority areas EN5 and EN6 to EN8 and partly EN9. The results from the construction and operational monitoring of offshore wind farms thus provide extensive spatially and temporally high-resolution data on the occurrence of marine mammals.

The priority areas EN10 to EN13 are on the periphery of the investigations for offshore wind farms and the investigation of nature conservation areas. Data availability for the priority areas EN14 to EN19 consists exclusively of the results of research projects and individual surveys for the "Dogger Bank" nature conservation area.

The large-scale distribution and abundance in the German EEZ is surveyed as part of the monitoring of Natura 2000 sites on behalf of BfN (monitoring reports on behalf of BfN 2008, 2009, 2011, 2012, 2013, 2016).

### 2.7.2 Spatial distribution and temporal variability

The high mobility of marine mammals depending on specific conditions of the marine environment leads to a high spatial and temporal variability of their occurrence. Both the distribution and abundance of the animals vary over the course of the seasons. In order to be able to draw conclusions about seasonal distribution patterns and the use of areas as well as the effects of seasonal and interannual variability, large-scale long-term studies are particularly necessary.

#### 2.7.2.1 Harbour porpoises

The harbour porpoise (*Phocoena phocoena*) is the most common and widespread cetacean species in the temperate waters of the North Atlantic and North Pacific and in some marginal seas such as the North Sea (EVANS, 2020). Due to its hunting and diving behaviour, the distribution of harbour porpoise is limited to continental shelf seas with water depths predominantly between 20 m and 200 m (READ 1999, EVANS, 2020). The animals are extremely mobile and can cover long distances in a short time. Satellite telemetry has shown that harbour porpoises can travel up to 58 km in one day. The marked animals have behaved very individually in their migration. Between the individually selected staging points, the migrations ranged from a few hours to a few days (READ & WESTGATE 1997).

In the North Sea, the harbour porpoise is the most widespread species of cetacean. In general, harbour porpoises occurring in German and neighbouring waters of the southern North Sea are assigned to a single population, the population of the North Sea including the Skagerrak, northern Kattegat and eastern part of the English Channel (ASCOBANS 2005, EVANS 2020).

The best overview of the occurrence of harbour porpoises throughout the North Sea is provided by the large-scale surveys of small cetaceans in northern European waters in 1994 and 2005, which were carried out as part of the SCANS surveys (HAMMOND et al. 2002, HAMMOND & Macleod 2006, Hammond ET al. 2017). The large-scale SCANS surveys make it possible to estimate stock size and population trends in the entire area of the North Sea, which is part of the habitat of highly mobile animals, without the need for detailed mapping of marine mammals in sub-areas (seasonal, regional, small-scale). The abundance of harbour porpoises in the North Sea in 1994 was estimated at 341,366 animals on the basis of the SCANS I survey. In 2005, a larger area was covered by the SCANS II survey and, as a result, a larger number of 385,617 animals was estimated. However, the abundance calculated on an area of the same size as in 1994 was approximately 335,000 animals. The most recent survey in 2016 showed an average abundance of 345,373 (minimum abundance 246,526, maximum abundance 495,752) animals in the North Sea. As part of the statistical evaluation of the data from SCANS-III, the data from SCANS I and II were recalculated. The results of SCANS I, II and III do not indicate a decreasing trend in harbour porpoise abundance between 1994, 2005 and 2016 (HAMMOND et al., 2017). However, the regional distribution in 2005 and 2016 differs from the distribution in 1994 in that more animals were counted in the southwest than in the northwest in 2005 (LIFE04NAT/GB/000245, Final Report, 2006) and in 2016 high abundances were recorded throughout the English Channel. The results of the latest SCANS survey (SCANS III) can be summarised as follows: The calculated abundance of harbour porpoise in the North Sea in 2016 is 345,000 (CV = 0.18) animals, comparable to the abundance in 2005 (355) and 1994 (289,000 (CV = 0.14) animals) (HAMMOND et al. 2017).

The abundance calculated in SCANS I, II and III is also comparable with the statistical value of 361,000 (CV 0.20) from the modelling of the data from 2005 to 2013 inclusive in a study (GILLES et al. 2016). The study by GILLES ET al (2016) provides a very good overview of the seasonal distribution patterns of harbour porpoises in the North Sea. Data from the UK, Belgium, the Netherlands, Germany and Denmark for the years 2005 to 2013 inclusive were considered together in the study. Data from large-scale and cross-border visual surveys, such as those collected in the SCANS-II and Dogger Bank projects, as well as extensive data from smaller-scale national surveys (monitoring, EIS) were validated and seasonal and habitat-specific distribution patterns were projected (GILLES et al. 2016). The results of the habitat modelling were verified and confirmed in the course of the study using data from acoustic surveys. This study is one of the first to take into account dynamic hydrographic variables such as surface temperature, salinity and chlorophyll as well as food availability, especially of sandeels. The food availability was modelled by the distance of the animals to known sandeel habitats in the North Sea. The habitat modelling showed significantly high densities in the area west of Dogger Bank, especially in spring and summer. The study concludes that the distribution patterns of harbour porpoises in the North Sea indicate the high spatial and temporal variability of hydrographic conditions, frontal formation and associated food availability (GILLES et al. 2016).

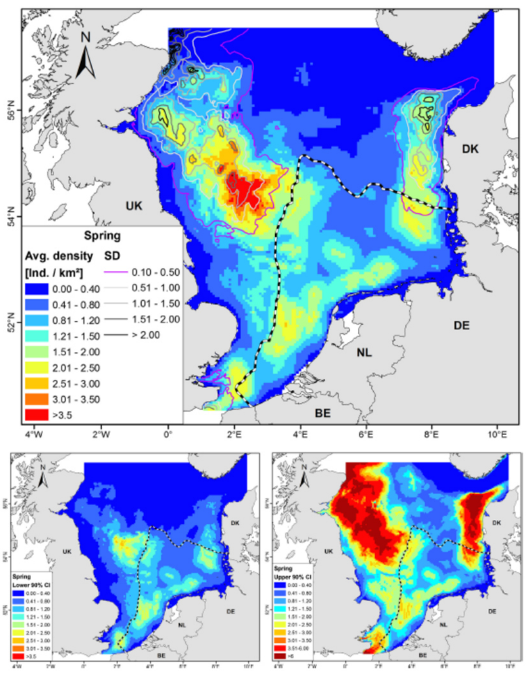



Fig. 35. Occurrence of harbour porpoises in the North Sea in spring (March to May inclusive): The figure above shows the averaged modelled density. The two figures below show the confidence intervals (Gilles et al., 2016).

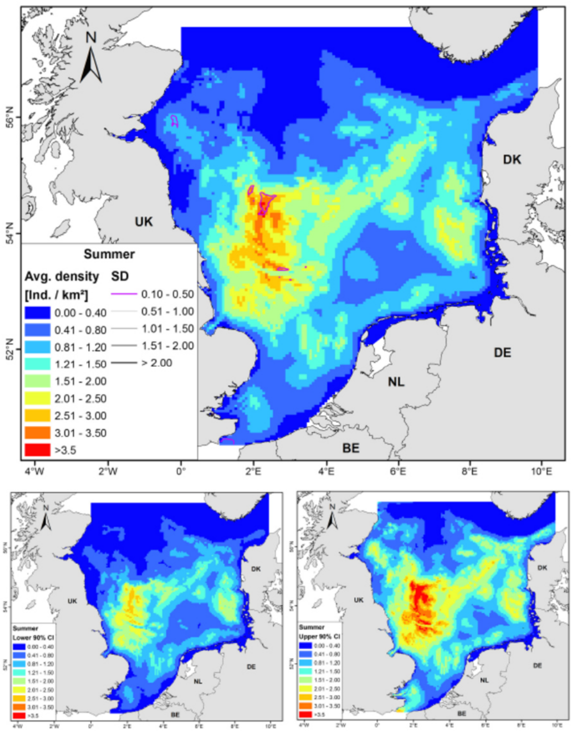



Fig. 36. Occurrence of harbour porpoises in the North Sea during the summer months (June to August inclusive): The figure above shows the averaged modelled density. The two figures below show the confidence intervals (Gilles et al., 2016).

The results of the habitat modelling are shown in Figures 35 and 36. The projected mean harbour porpoise density varies spatially and seasonally in the area under consideration (Gilles et al., 2016).

### Occurrence of harbour porpoises in the German North Sea

The German EEZ belongs to the North Sea harbour porpoise habitat. The northeastern part of the German EEZ is part of a larger contiguous area with high harbour porpoise sighting rates (REID et al. 2003, GILLES et al., 2016). In comparison, the remaining areas of the German EEZ have lower sighting rates.

Especially in the summer months, the area of the coastal waters and the German EEZ off the North Frisian Islands, especially north of Amrum and near the Danish border, is intensively used by harbour porpoises (Siebert et al. 2006). In addition, the occurrence of mother-calf pairs is always confirmed there during the summer months (Sonntag et al, 1999).

The large-scale studies on the distribution and abundance of harbour porpoises and other marine mammals carried out as part of the MINOS and MINOSplus projects from 2002 to 2006 (Scheidat et al. 2004, Gilles et al. 2006) provide an overview of the occurrence in German waters of the North Sea. Based on the results of the MINOS surveys (Scheidat et al. 2004), the abundance of harbour porpoises in German waters of the North Sea was estimated at 34,381 animals in 2002 and 39,115 animals in 2003. In addition to the pronounced temporal variability, a strong spatial variability was also observed. The seasonal analysis of the data showed that up to 51,551 animals may have been temporarily present in the German North Sea EEZ, for example in May/June 2006 (Gilles et al. 2006). Since 2008, the abundance of harbour porpoises has been determined as part of the monitoring of Natura 2000 sites. Although the abundance varies from year to year, it remains at high levels, especially in the summer and spring months. In May 2012, the highest abundance recorded to date in the German North Sea was 68,739 animals.

The recording of harbour porpoises from 2013 onwards will cause fluctuations in the population in the EEZ with a high incidence in the nature conservation areas. In particular, the occurrence in the "Borkum Reef Ground" nature conservation area has been confirmed. The occurrence of harbour porpoises in the German North Sea EEZ can be categorised on the basis of habitat modelling of data from 2006 to 2013 inclusive on the continuous habitat of harbour porpoises in the North Sea (Gilles et al., 2016).

The distribution of harbour porpoises in the German North Sea EEZ based on current data for the years 2012 to 2018 inclusive from monitoring of the nature conservation areas and from research projects also confirms known patterns with higher occurrences in the nature conservation areas and in the harbour porpoise reserve and a rather low occurrence in the areas east/southeast of the "Sylt Outer Reef - Eastern Bight" nature conservation area and north/northwest of the "Borkum Riff Ground" nature conservation area (Fig. 37 from Gilles et al., 2019).

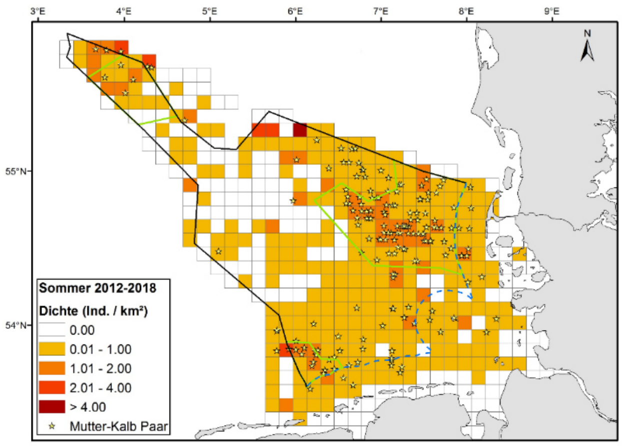



Fig. 37. occurrence of harbour porpoises in the German North Sea EEZ based on data from monitoring of the nature conservation areas and from research projects from 2012 to 2018 inclusive (Gilles et al., 2019)

**Occurrence in nature conservation areas**

Based on the results of the MINOS and EMSON[9] surveys, three areas of particular importance for harbour porpoises were defined in the German EEZ. These were notified to the EU as offshore protected areas under the Habitats Directive and in November 2007 were recognised by the EU as Sites of Community Importance (SCI): Dogger Bank (DE 1003-301), Borkum Reef Ground (DE 2104-301) and in particular Sylt Outer Reef (DE 1209-301). Since 2017, the three FFH areas in the German North Sea EEZ have been granted nature conservation area status:Regulation on the designation of the "Borkum Reef Ground" nature conservation area (NSGBRgV), Federal Law Gazette I, I p. 3395 of 22 September 2017,Regulation on the designation of the "Dogger Bank" nature conservation area (NSGDgbV), Federal Law Gazette I, I p. 3400 of 22 September 2017,Regulation on the designation of the "Sylt Outer Reef - Eastern German Bight" nature conservation area (NSGSylV), Federal Law Gazette I, I p. 3423 of 22 September 2017.

The BfN has published an up-to-date description of the occurrence of harbour porpoises in the nature conservation areas, taking into account current knowledge (BfN, 2017).

The "Sylt Outer Reef - Eastern German Bight" nature conservation area is the main distribution area for harbour porpoises in the EEZ. The highest densities are often found here in the summer months. The "Sylt Outer Reef - Eastern German Bight" nature conservation area has the function of a nursery area. In the period from 1 May to the end of August, mother-calf pairs are frequently recorded in the "Sylt Outer Reef - Eastern German Bight" nature conservation area.

The "Borkum Reef Ground" nature conservation area is of great importance for harbour porpoises in spring and partly in the first summer months. Significant densities are regularly recorded during this period.

The "Dogger Bank" nature conservation area has a lower occurrence compared to the other two nature conservation areas. In the Dogger Bank area, animals were recorded mainly during the summer months. Mother-calf pairs also occur here. Their presence during the summer months also suggests the rearing function of this area.

Results from the monitoring of Natura 2000 sites as well as from the monitoring of offshore wind farms have shown a high occurrence of harbour porpoises in conservation areas until 2013, especially in the area of the Sylt Outer Reef (GILLES ET AL., 2013, GILLES ET AL., 2019). However, current findings from the monitoring of Natura 2000 areas show a change in the populations in the German EEZ, which particularly affects the "Sylt Outer Reef - Eastern German Bight" nature conservation area (GILLES ET AL., 2019).

**Occurrence in the harbour porpoise r area in the German EEZ**

As part of the noise abatement concept for the North Sea (BMU, 2013), a main concentration area of harbour porpoises in the summer months of May to August inclusive was identified west of Sylt on the basis of data from the period 2005 to 2010 inclusive. The main concentration area comprises the nature conservation area "Sylt Outer Reef – Eastern German Bight and areas to the west and northwest of it.

Figure 38 shows the main concentration area of harbour porpoises in the German EEZ identified in the BMU's noise abatement concept (2013).

9 Survey of marine mammals and seabirds in the German EEZ of the North Sea and Baltic Sea

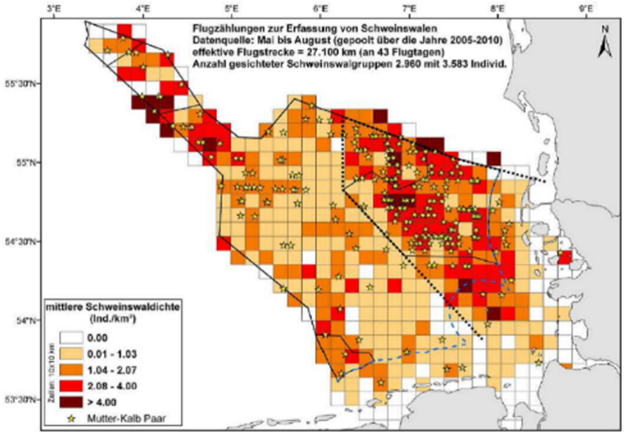



Figure 38: Raster representation of the distribution of harbour porpoises in the German North Sea and sightings of mother-calf pairs (Gilles, unpublished, cited in BMU, 2013).

The main area of concentration is defined as a reservation area for harbour porpoises because of its particular importance for the conservation of the population. The special importance of the reservation is due to the regular occurrence of harbour porpoise mother-calf pairs within this area during the summer months. Depending on the weather, the nutrient-rich frontal system running west of the North Frisian coast extends in the area of the reservation and creates high-quality habitats for marine predators. The distribution patterns of harbour porpoises and in particular of mother-calf pairs within the reservation area vary between years depending on hydrographic conditions and associated nutrient availability. The variability of occurrence within the reservation area may reflect the spatial and temporal extent of the frontal system, as shown in Chapter 3.2.5 (Fronts).

**Occurrence in priority areas EN1, EN2, and EN3**

Information on the occurrence of marine mammals in the EN1, EN2 and EN-3 priority areas for the period 2008 to 2012 is provided by the investigations carried out during the third year of the investigation and the construction and operational monitoring of the "alpha ventus" project. For this purpose, extensive airborne surveys of marine mammals according to the StUK were carried out in the entire area of the German EEZ between the traffic separation areas TGB and GBWA, in which the project area is also located. In parallel to the visual surveys, acoustic surveys of harbour porpoises were also carried out using acoustic underwater detectors (ROSE et al. 2014).

In the period 2009-2012, additional surveys of marine mammals were conducted for the "alpha ventus" test site as part of the accompanying ecological research (StUKplus project). The study area of the airborne surveys covered a large area of the plan area. Here, too, the focus of ecological research was on recording the effects of the noise-intensive pile driving and on recording possible behavioural reactions of harbour porpoises to the wind turbines in operation. The highest densities were always found to the west of areas EN2 and EN3 in the "Borkum Reef Ground" nature conservation area. The highest density in 2010 was 2.58 ind./km$^2$ and was recorded in summer (GILLES et al. 2014).

Since 2013 and on an ongoing basis, large-scale so-called cluster studies have been carried out as per the BSH standard for investigating the impact of offshore wind turbines on the marine environment (StUK4) in the area north of the East Frisian islands. The entire EN1, EN2 and EN3 areas are included in the large area under review of the cluster North of Borkum, in which nine wind farms have been erected between 2009 and 2018 and six of which are already in regular operation. This provides up-to-date data on the occurrence of harbour porpoises and on possible impacts from construction and operation phases of the wind farms already implemented in the entire area north of Borkum.

Findings from the construction and operational monitoring of the "alpha ventus" test site in the years 2010 to 2013 inclusive, from the accompanying research for the "alpha ventus" test site, and from the monitoring of the Natura 2000 sites indicate intensive use of the environment by harbour porpoises. The highest densities were always found to the west of the project area in the "Borkum Reef Ground" nature conservation area. The highest density in 2010 was 2.58

ind./km$^2$ and was recorded in summer (GILLES ET AL., 2014, ROSE ET AL., 2014).

The results of the cluster studies "North of Borkum" have shown a change in the occurrence of harbour porpoises since 2014, with a tendency towards lower densities (Krumpel et al., 2017, Krumpel et al., 2018, Krumpel et al., 2019). The results of the cluster studies north of the traffic separation areas, north of Helgoland and north of Amrumbank also indicate a trend towards lower harbour porpoise densities since 2013. The results of the cluster studies "North of Borkum" thus fit into the overall picture of changes in the occurrence of harbour porpoises in the German North Sea EEZ and in the southern North Sea. Compared to the occurrence of harbour porpoises in other areas of the German North Sea EEZ, however, the changes are smallest in the area north of Borkum. The entire area north of Borkum with the "Borkum Reef Ground" nature conservation area and the three areas for offshore wind energy utilisation N-1, N-2 and N-3 also show a relatively high and stable occurrence of harbour porpoises in the years 2013 to 2018.

The data from the acoustic survey of harbour porpoises in the "Northern Borkum" cluster studies also show continuous use of the area by harbour porpoises, which is also more intensive in spring and summer. The results from visual and acoustic surveys of the cluster studies also confirm a higher abundance and use by harbour porpoises in the western part of the study area, in particular the FFH area "Borkum Reef Ground". The abundance of harbour porpoises and habitat use decreases in the area north of Borkum towards the east, with occasional high densities being found in various sub-areas. Distribution patterns seem to be related to food availability (KRUMPEL ET AL., 2017, KRUMPEL ET AL., 2018, KRUMPEL ET AL., 2019, GILLES ET AL., 2019).

Within the framework of the large-scale survey of 2016, SCANS III showed a further shift of the stock from the southeastern area of the North Sea more towards the south-western area in the direction of the English Channel (HAMMOND ET AL., 2017). A first evaluation of research data and data from the national monitoring of protected areas also indicates a shift in the stock, with the authors considering several factors as possible reasons for the observed change (GILLES ET AL., 2019). The results of visual and acoustic surveys also confirm that there is still a higher abundance and use by harbour porpoises in the western part of the study area, in particular the Borkum Reef Ground Habitat Area. The abundance and use seem to decrease towards the east.

**Occurrence in the EN4 reservation area and the EN13 priority area**

The EN4 reservation area is located in the study area C_South of the monitoring of Natura 2000 sites. The findings from the monitoring on behalf of the Federal Agency for Nature Conservation (BfN) confirm lower densities in EN4 area compared to area C_North of the monitoring, in which area N-5 is located. In contrast to the low occurrence of harbour porpoises in the monitoring area C_South, the monitoring area C_North with sub-area I of the "Sylt Outer Reef - Eastern German Bight" nature conservation area shows high seasonal densities in late spring and summer. In summer 2009, for example, an average density of 0.58 ind./km$^2$ was recorded in the indirect vicinity of area N-4, while in sub-area I of the "Sylt Outer Reef – Eastern German Bight" nature conservation area the average density of 1.64 ind./km$^2$ was almost three times as high (including the monitoring report on marine mammals by BfN , 2009-2010). The differences in mean density and abundance were also confirmed during the surveys from 2012 onwards.

In May 2012 in particular, the mean density in the area EN4 of only 0.50 ind./km$^2$ was significantly lower than in the study area C-North or in sub-area I of the protected area "Sylt Outer Reef - Eastern German Bight" with 2.89 ind./km$^2$ (monitoring report of BfN - Marine Mammals, 2011-2012).

In the course of the investigations of the cluster "North of Helgoland" for the three wind farms "Meerwind Süd/Ost" (*Sea Wind South/East)*, "NordseeOst" (North Sea East), and "Amrumbank West", which are also located in the

EN4 area, it was shown that harbour porpoises use this area evenly and continuously, independent of the construction and operation of the wind farms. While the acoustic survey using CPODs shows a weak positive trend at some long-term stations, the investigations using digital recording show a rather lower occurrence in the wind farm sites than in areas outside the wind farms (IBL, BioConsult-SH, IfAÖ, 2017, 2018).

On the basis of the new findings, areas EN4 and EN13 as well as part of area EN11 (near the nature conservation area) are of medium, and in summer even high, importance for harbour porpoises and are part of the main area of identified concentration of harbour porpoises in the German North Sea (BMU, 2013).

**Occurrence in reservation area EN5**

The sub-areas of the EN5 reservation area are regularly used by harbour porpoises for crossing and staying as well as for feeding and breeding. All studies in the area of cluster 5 from research projects such as MINOS, MINOSplus and SCANS surveys, from EISs and monitoring for offshore wind farm projects, and from monitoring of Natura 2000 sites always confirm a high calf population in the summer months. Due to the high proportion of sighted calves, the waters to the west of Sylt are considered to be the breeding grounds for harbour porpoises. The N-5 area is therefore part of a large area used as a feeding and breeding ground for harbour porpoises.

Current findings from the monitoring of Natura 2000 sites on behalf of the BfN also confirm high seasonal densities in late spring and summer in the area of the sub-areas of the EN5 site. The EN5 area is located in area C_North of the study area for the Natura 2000 sites. In 2008, an average density of 2.28 ind./km² was determined for the study area C_North (Monitoring report of the BfN - Marine Mammals, 2008-2009). In summer 2009, the density in the area C_North was only 1.64 ind./ $km^2$ (Monitoring report of BfN - Marine Mammals, 2009-2010). In June 2010 a density of 2.12 ind./ $km^2$ was recorded again (Monitoring report of BfN - Marine Mammals, 2010-2011). These values were also confirmed by monitoring in the following years. The abundance for the study area C_North amounted to 23,163 animals in May 2012. This corresponds to an average density of 2.89 ind./km², which was significantly higher than in the adjoining study area C_South (Monitoring report of BfN - Marine Mammals, 2011-2012, 2014-2015).

Extensive information is also provided by the surveys that were initiated as part of the monitoring for the wind farm projects "DanTysk", "Sandbank" and "Butendiek": Over the entire monitoring period, harbour porpoises were sighted in the "DanTysk/Sandbank" study area, - western area of the EN5 area, with a total of 1,702 animals recorded in 2011, for example. The highest occurrence was mainly observed in summer. The average density in the summer months was 3.8 individuals per km² and the proportion of calves varied between 10 and 25%. The highest calf percentages were observed in the months of June, July and August (BioConsult SH 2012a).

In the "Butendiek" study area immediately to the east, it was found that from September to March, harbour porpoise numbers remained low and did not increase until the end of April. High densities, on the other hand, were observed in the summer months. The highest density of 5.9 individuals per km² was recorded in June. The calculated mean density in summer was 2.2 ind./ km² and was thus in the range of the densities determined during the BfN monitoring (BioConsult SH 2012b). Within the scope of the high-frequency investigations for both areas under review of the projects "DanTysk" and "Butendiek" described here, the high variability of occurrence between the individual investigation days in summer was striking.

The data from the ongoing operational monitoring of the "Butendiek" wind farm fit well into the long-term data series from this area of the German Bight and show that in the last three to five years - including the construction of the "Butendiek" wind farm - interannual fluctuations in the abundance of harbour porpoises have occurred throughout the study area. However, a clear trend is not discernible after a slight decrease in harbour porpoise numbers was observed between the first years of the baseline survey (2001-2003) and the 3rd year of the baseline survey (2011). This observation is supported by literature data and indicates a longer-term summer population shift of harbour porpoises between 2003 and 2013 from coastal areas of the eastern North Sea towards the west. However, as this decrease started well before construction began, the construction and operation of the wind farm is not related to this. The continuous data from acoustic monitoring using C-PODs show the highest detection rates determined in late spring and early summer; in contrast to the other investigation methods, acoustic monitoring also revealed high detection rates at some stations in autumn. Trend analyses of the permanent C-POD stations in thearea under review confirm the results from flight and ship surveys of the last years and shows a weak positive trend over the last five years. Overall, the data from all survey methods show that harbour porpoises are continuously present throughout Area 5 and their occurrence follows a relatively stable phenological pattern over the years. On a small scale, however, there are considerable spatial and temporal fluctuations. Due to these fluctuations, the increased immigration into the area from April/May and the occurrence of calves in combination with a high summer density, this area of the EEZ can still be regarded as an important feeding and reproduction area (BIOCONSULT SH 2018).

**Occurrence in the priority areas EN6, EN7, EN8, EN9, EN10, EN11 and EN12**

Up-to-date information on the occurrence of harbour porpoises in the German EEZ sub-area of the priority areas EN6 to EN10, EN12 and partly EN11 is provided by the operational monitoring for the projects "BARD Offshore I", "Veja Mate", "German Bight" as well as "EnBW Hohe See" and "Albatros". Higher densities occur mainly in spring and late summer, low densities mainly in autumn and early winter. The annual average absolute frequencies in the years 2008 to 2013 with values between 0.34 individuals/km² and 0.98 individuals/km² are slightly to significantly above the values determined in the years 2004-2006. In the course of the year, average densities of 0.5 harbour porpoises/km² can be expected in this area of the German EEZ, with daily values generally varying between 0 and 2 individuals/km² depending on the season. The results of the acoustic monitoring carried out since 2008 and to date confirm the occurrence. In addition, the results of the acoustic monitoring indicate that high harbour porpoise activity also occurs in the winter months. The proportion of calves recorded in the years 2008-2013 still does not suggest that the area is of particular importance for the reproduction of the species. While the abundance of harbour porpoises was relatively stable in the years 2005 to 2012, it decreased in the following years. It is only from the end of 2016 onwards that a steady increase in the occurrence of harbour porpoises in the central part of the German EEZ in the North Sea is becoming apparent again (final report on the construction phase of the OWP "BARD Offshore 1", PGU 2014, Cluster Monitoring Cluster 6, Report Phase I (01/15 - 03/16) for the OWP's "BARD Offshore I", "Veja Mate" and "German Bight", PGU 2017, environmental monitoring in the cluster "East of Austerngrund" Annual Report 2016 - April 2015 - March 2016).

**Occurrence in the reservation areas *EN14 to EN19***

The area of the reservation areas EN14 to EN18 includes shipping route 10 and the southern area of the Duck's Bill. The reservation area EN19 covers the northern part of the Duck's Bill.

The entire area of the reservation areas EN14 to EN19 has not yet been investigated as intensively as the areas EN1 to EN13 described above. There are only individual surveys within the framework of the monitoring for the "Dogger Bank" nature conservation area, which also provide information on these areas (BfN, 2012, BfN 2014). As part of the monitoring of the Natura 2000 sites, an exceptionally high occurrence of harbour porpoises was recorded in May 2012 in this area of the German EEZ, which was even higher than in the area of the Natura 2000 site "Sylt Outer Reef" or area I of the "Sylt Outer Reef – Eastern German Bight" nature conservation area. However, the observations in 2012 remained exceptional overall due to comparatively lower densities in the summer months in the nature conservation areas. Investigations carried out in 2009, 2013 and 2015, as part of research projects, among other things, show that the EN19 area tends to be the peripheral area of the main distribution range of harbour porpoises from the west coast of the UK to Dogger Bank (Gilles et al. 2012, Geelhoed et al. 2014, Cucknell et al. 2017).

The occurrence of harbour porpoises in the EN14 to EN19 reservation areas can be determined using habitat modelling based on data from 2006 to 2013 inclusive and from the contiguous habitat of harbour porpoises in the North Sea (Gilles et al., 2016). Taking into account all available data up to and including 2013, the habitat modelling shows that the areas EN14 to EN18 are among the areas of the North Sea with lower harbour porpoise abundance. In contrast, EN19 is located at the edge of the large contiguous high-density harbour porpoise range east of the British Isles, which extends to Dogger Bank.

The distribution of harbour porpoises in the German North Sea EEZ based on current data for the years 2012 to 2018 inclusive from monitoring of the nature conservation areas and from research projects also confirms a low occurrence in areas EN14 to EN18 inclusive and a comparatively higher occurrence in the "Dogger Bank" nature conservation area and in area EN19 (Gilles et al., 2019).

#### 2.7.2.2 Seals and grey seals

The common seal is the most widespread seal species in the North Atlantic and is found along the coastal regions throughout the North Sea. Throughout the Wadden Sea, regular aerial surveys are carried out at the height of the change of coat in August. In 2005, 14,275 harbour seals were counted in the entire Wadden Sea (ABT et al. 2005). As there is always a part of the animals in the water and not counted, this is the minimum population.

Suitable undisturbed moorings are crucial for the presence of seals. In the German North Sea, sandbanks in particular are used as resting places (Schwarz & Heidemann, 1994). Telemetric studies show that adult harbour seals, in particular, rarely move more than 50 km away from their original moorings (TOLLIT et al. 1998). On feeding trips, the radius of action is usually around 50 to 70 km from the resting places to the hunting grounds (e.g., THOMPSON & MILLER 1990) although in the Wadden Sea area it can be 100 km (ORTHMANN 2000).

Censuses of grey seals at the time of hair change have so far only been carried out occasionally in the German North Sea. In 2005, 303 grey seals were counted in Schleswig-Holstein at the time of moulting. For Lower Saxony, 100 animals are estimated (AK SEEHUNDE 2005). These figures are only a snapshot.

Strong seasonal fluctuations are reported (ABT et al. 2002, ABT 2004). The numbers observed in German waters must be seen in a broader geographical context, as grey seals sometimes migrate very far between different resting places throughout the North Sea region (MCCONNELL et al. 1999). The grey seals observed in the resting places in coastal waters probably have their feeding grounds partly in the EEZ.

The compilation of the BfN data sources confirms the already known picture of the occurrence of harbour seals and grey seals along the German coast in the North Sea (BfN, 2020a).

### 2.7.3 Status assessment of the protected asset marine mammal

The harbour porpoise is the key species in the German waters of the North Sea that is used in the BMU's noise abatement concept (2013) to assess the potential impacts of impulsive noise inputs. Furthermore, within the framework of the implementation of the MSFD, the harbour porpoise is the indicator species for assessing cumulative impacts of uses and, finally, for assessing good environmental status in the OSPAR area.

The population of harbour porpoises in the North Sea has decreased over the last centuries. The general situation of the harbour porpoise has already deteriorated in earlier times. In the North Sea, the population has declined mainly due to by-catch, pollution, noise, over-fishing and food restrictions (ASCOBANS 2005). However, there is a lack of concrete data to calculate or forecast trends. The best overview of the distribution of harbour porpoises in the North Sea can be obtained from the "Atlas of the Cetacean Distribution in North-West European Waters" (REID et al. 2003). However, when calculating abundance or population based on flights or exits, the authors point out that the occasional sighting of a large population (group) of animals within an area that is surveyed in a short period of time can lead to the assumption of unrealistically high relative densities (REID et al. 2003). The recognition of distribution patterns or the calculation of populations is made more difficult in particular by the high mobility of the animals.

The population of harbour porpoises throughout the North Sea has not changed significantly since 1994, or significant differences between SCANS I, II and III data have not been found (HAMMOND & MACLEOD 2006, Hammond ET al. 2017, Evans, 2020).

The statistical evaluation of data from the large-scale surveys carried out as part of research projects and, since 2008, as part of the monitoring of Natura 2000 sites on behalf of the Federal Agency for Nature Conservation (BfN) indicates a significant increase in harbour porpoise densities in the southern German North Sea between 2002 and 2012. In the area of the Sylt Outer Reef, too, the trend analysis indicates stable stocks in the summer over the years 2002 to 2012 (GILLES et al. 2013). The western area in particular shows a positive trend for spring and summer, while no clear trend can be detected in autumn. Harbour porpoise densities in the eastern area have remained largely constant over the years and significant differences between the hotspots in the west and lower density in the southeastern German Bight have been found.

Current findings from the large-scale cluster studies of offshore wind farms do not provide any indication of a decreasing trend in the abundance of harbour porpoise or of changes in seasonal distribution patterns in the German North Sea EEZ from 2001 to the present. The multi-annual data from the CPOD station network confirm a continuous use of the habitats by harbour porpoises.

In general, there is still a north-south density gradient of harbour porpoise occurrence from the North Frisian to the East Frisian area.

However, a current assessment of the stock trend in German waters in the North Sea based on data from monitoring of nature conservation areas and research projects for the years 2012 to 2018 has shown a stock shift. Declining trends were observed in the "Sylt Outer Reef - Eastern German Bight" and "Dogger Bank" nature conservation areas as well as in the central area of the German Bight. In contrast, a positive trend has emerged in the "Borkum Reef Ground" nature conservation area and in the EN1, EN2, and EN3 areas. The causes of stock relocation are not yet known and could be related both to the impacts of human activities and to the relocation of fish stocks (Gilles et al., 2019).

#### 2.7.3.1 Significance of priority and reservation areas wind energy for marine mammals

According to the current state of knowledge, it can be assumed that the German EEZ is used by harbour porpoises for traversing, staying and also as a food and area-specific breeding ground. On the basis of the available information, it can be concluded that the EEZ is of medium to high importance for harbour porpoises in certain areas. Habitat use varies in different areas of the EEZ. Marine mammals and, of course, harbour porpoises are highly mobile species that use large areas variably in search of food, depending on hydrographic conditions and food supply. It is therefore not very useful to consider the importance of individual sites such as the sites covered by the plan or individual wind farm sites. In the following, the importance of areas that belong to a natural area unit and that were additionally covered by intensive project-related studies will be assessed separately.

**Priority areas EN1, EN2, and N3**

According to current knowledge, priority areas EN1 to EN3 are of medium to - seasonal in spring - high importance for harbour porpoises. The investigations carried out as part of the monitoring of the Natura 2000 sites and as part of the monitoring for the offshore wind farm projects always confirm a significantly higher occurrence in the "Borkum Reef Ground" conservation area with decreasing densities in an easterly direction.

- The areas are used by harbour porpoises all year round for crossing, staying and probably for feeding.
- The use of the areas by harbour porpoises is significantly higher in spring.
- The use of the areas by harbour porpoises in summer is rather average compared to the use of the waters west of Sylt.
- The sightings of calves in the areas are rather sporadic and irregular and therefore most likely exclude the use of the area as a rearing area.
- There is no evidence of a continuous specific function of areas EN1, EN2 and EN3 for harbour porpoises.

For grey seals and harbour seals, these three priority areas have a low to medium importance, partly in the southern area.

**Reservation area EN4 and priority area EN13**

According to current knowledge, areas EN4 and EN13 and even the eastern section of area EN11 (near the nature conservation area) are of medium, and in summer even high, importance for harbour porpoises and are part of the main identified concentration area of harbour porpoises in the German North Sea (BMU 2013):

- The areas are used by harbour porpoises all year round for crossing, staying and probably for feeding.
- The occurrence of harbour porpoises in the vicinity of areas EN4 and EN13 is relatively high, but lower compared to the high occurrence in the waters west of Sylt (area EN5)
- Regular sightings of calves in these areas, albeit in comparatively small numbers, suggest that these areas should be considered as peripheral to the large rearing area in the German North Sea EEZ.
- Due to their function as feeding and temporary nursery areas, areas EN4 and EN13 are of medium to seasonal importance for harbour porpoises.

The EN4 area is located at the western edge of the distribution area of seals and harbour seals from the Schleswig-Holstein Wadden Sea and is therefore of medium importance for both species.

The EN13 area is of minimal importance for seals and harbour seals.

**Reservation area EN5**

The EN5 area is regularly used by harbour porpoises for crossing and staying as well as for feeding and breeding.

According to current knowledge, the area in which the EN5 site is located is of great importance for harbour porpoises and represents the core area of the main concentration area of harbour porpoises identified in the German North Sea (BMU 2013):

- The area is used by harbour porpoises all year round for crossing, staying and feeding.
1 Harbour porpoise use of the EN5 area is particularly intensive in summer.
- The EN5 area is used by harbour porpoises as a breeding ground during the summer months.
- The density of harbour porpoises in this area is high compared to other areas of the EEZ.
- The EN5 area is of great importance for harbour porpoises, especially as a feeding and breeding ground.

The EN5 area is located at the western edge of the distribution area of seals and harbour seals from the Schleswig-Holstein Wadden Sea and is therefore of rather medium importance for the two species.

**Priority areas EN6 to EN12**

The priority areas EN6, EN7, EN8, EN9, EN10, EN11 and EN12 are regularly used by harbour porpoises for crossing and staying or - depending on the seasonal food supply - as a feeding ground.

Due to the very few sightings of mother-calf pairs, the use of the area as a rearing area can almost certainly be ruled out. Based on current knowledge, these areas can be classified as having a medium overall importance for harbour porpoises:

- The areas are used by harbour porpoises all year round for crossing, staying and probably for feeding.
- The use of the areas by harbour porpoises is significantly higher in spring and summer.
- The occurrence of harbour porpoises in these areas is average compared to the high occurrence in the waters west of Sylt.
- The irregular sighting of individual mother-calf pairs precludes the use of these areas as a rearing ground with a high probability.
- There is no evidence of a continuing specific function of the areas for harbour porpoises.

For the two seal species, the priority areas have no particular significance due to the distance to the nearest resting and whelping areas.

**Reservation areas EN14 to EN19**

The data available for the reservation areas EN14 to EN19 is not sufficient to assess the occurrence of harbour porpoise and the importance of the areas. There is a lack of systematic studies to date to capture seasonal patterns, variability between years and abundance. Based on the available data, it can be assumed that EN19 is of medium importance for the reserve area and that it is of high seasonal - summer - importance.

- The EN14 to EN18 reservation areas are used by harbour porpoises all year round for crossing, staying and probably for feeding.
- The occurrence of harbour porpoises in these areas is average compared to the high occurrence in the waters west of Sylt.
- The abundance of harbour porpoises in the surrounding EN19 reserve is higher during the summer months.
- Mother and calf pairs occur in the EN19 reserve during the summer months.

For the two seal species, the reservation areas are of no particular importance due to the distance to the nearest resting and whelping areas.

### 2.7.3.2 Conservation status

Harbour porpoises are protected under several international conservation agreements. They fall under the conservation mandate of the European Habitats Directive (Directive 92/43/EEC) on the conservation of natural habitats and of wild fauna and flora, under which special areas are designated to conserve the species. The harbour porpoise is listed in both Annex II and Annex IV of the Habitats Directive. As a species listed in Annex IV, it enjoys strict general protection under Articles 12 and 16 of the Habitats Directive.

The porpoise is also listed in Appendix II to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, CMS). The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) was also adopted under the auspices of CMS.

In addition, the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), in Annex II of which the harbour porpoise is listed, should also be mentioned. In Germany the harbour porpoise is also included in the Red List of endangered animals (Binot et al., 1998). Here it was classified in risk category 2 (critically endangered).

Grey seal and common seal are also listed in Annex II of the Habitats Directive. In the Red List, the grey seal has also been classified in risk category 2. The common seal has been classified in risk category 3 (endangered).

The conservation objectives of the nature conservation areas in the German North Sea EEZ include the maintenance and restoration to a favourable conservation status of the species listed in Annex II of the Habitats Directive, in particular harbour porpoise, grey seal and common seal, and the conservation of their habitats (NSGBRgV, 2017. Bundesgesetzblatt I, I p. 3395, NSGDgbV), Bundesgesetzblatt I, I p. 3400 of 22.09.2017, NSGSylV), Bundesgesetzblatt I, I p. 3423 of 22.09.2017).

#### 2.7.3.3 Legacy impacts

The North Sea harbour porpoise population is affected by a wide range of anthropogenic activities, changes in the marine ecosystem, diseases and climate change.

Legacy impacts on marine mammals result from fishing, attacks by dolphin-like creatures, physiological effects on reproduction, diseases possibly related to high levels of pollution and underwater noise. The main endangerment for harbour porpoise stocks in the North Sea results from fishing, through by-catch in bottom trawls and bottom-set gillnets, depletion of prey fish stocks through over-fishing and the resulting reduction in food availability (Evans, 2020). An analysis of dead and stranded fish from the British Isles between 1991 and 2010 has identified the causes as follows: 23% infectious diseases, 19% attacks by dolphins, 17% by-catch, 15% starvation and 4% were stranded alive (Evans, 2020).

Current anthropogenic uses in the areas' vicinity with noise pollution include shipping, seismic exploration, military use and the detonation of non-transportable ammunition. The endangerment of marine mammals can be caused during the construction of wind turbines and converter platforms with deep foundations, in particular by noise emissions during the installation of the foundations by means of pile driving, if no mitigation or preventive measures are taken.

In addition to impacts caused by the discharge of organic and inorganic pollutants or oil spills, the stock is also endangered by diseases (of bacterial or viral origin) and climate change (especially impacts on the marine food chain).

## 2.8 Seabirds and resting birds

According to the "Quality standards for the use of ornithological data in spatially significant planning" (Deutsche Ornithologen-Gesellschaft 1995), resting birds are defined as "birds which stay in an area outside their breeding territory, usually for a long period of time, e.g. for moulting, feeding, resting, wintering". Feeding guests are defined as birds "which regularly seek food in the area under review, do not breed there, but breed or might breed in the wider region" (DEUTSCHE ORNITHOLOGEN-GESELLSCHAFT 1995).

Seabirds are species of birds that are mainly bound to the sea with their way of life and only come ashore for breeding for a short time. These include, for example, fulmars, gannets and aukes (guillemots, razorbills). Terns and gulls, on the other hand, are usually more common near the coast than seabirds.

### 2.8.1 Data availability

In order to be able to draw conclusions about seasonal distribution patterns and the use of different marine areas (sub-areas), good data sources are necessary. In particular, large-scale long-term studies and extensive evaluations of existing data are required to identify correlations in distribution patterns and the effects of intra- and interannual variability.

The findings on the spatial and temporal variability of seabird abundance in the southern North Sea are based on surveys by ESAS (European Seabirds at Sea) and on several spatially and temporally limited research projects (e.g. MINOS, MINOSplus, EMSON, StUKplus, HELBIRD, DIVER, TOPMarine). In recent years, the database has expanded considerably due to a large number of new investigation programmes for monitoring the Natura 2000 areas, within the framework of environmental impact studies, monitoring of offshore wind farm projects during construction and operation, but also research projects and studies focusing on scientific evaluation of existing data in the German North Sea EEZ. The existing data sources can therefore be considered very good for the majority of the EEZ. Only for the area of the so-called "Duck's Bill" far from the coast no comprehensive data are available, which is why the comments on this area do not go into detail.

### 2.8.2 Spatial distribution and temporal variability

Seabirds are highly mobile and therefore able to cross large areas during their search for food or to track species-specific prey organisms such as fish over long distances. This high mobility - depending on the specific conditions of the marine environment - leads to a high degree of spatial and temporal variability in the occurrence of seabirds. The distribution and abundance of birds vary over the course of the seasons.

The distribution of seabirds in the German Bight is determined in particular by the distance from the coast or breeding grounds, hydrographic conditions, water depth, the composition of the bottom and the food supply. In addition, the occurrence of seabirds is influenced by strong natural events (e.g. storms) and anthropogenic factors such as nutrient and pollutant inputs, shipping and fisheries. Seabirds, as consumers at the top of the food chain, feed on species-specific fish, macrozooplankton and benthic organisms. They are thus directly dependent on the occurrence and quality of benthos, zooplankton and fish.

As a number of studies show, some areas of the German coastal waters and parts of the North Sea EEZ are of great importance not only nationally but also internationally for seabirds and waterfowl and were identified very early on as areas of special importance for seabirds, so-called "Important Bird Areas - IBA" (SKOV et al. 1995, HEATH & EVANS 2000). Particular mention should be made here of sub-area II of the nature conservation area "Sylt Outer Reef - Eastern German Bight", which was already designated as a Special Protected Area (SPA) as per Council Directive 79/409/EEC by the Regulation of 22 September 2017, and which was designated as such by the Regulation of 15 September 2005.

With regard to the group of loons, a main concentration area was identified in spring in the German Bight as part of a comprehensive evaluation and assessment of existing data sets (BMU 2009).

#### 2.8.2.1 Abundance of seabirds and resting birds in the German North Sea

There are 19 species of seabirds in the German North Sea EEZ, which are regularly recorded as resting birds in larger populations. The following

Table 11 contains population estimates for the most important seabird species in the EEZ and the entire German North Sea in the seasons with the highest density.

Table 11: Stocks of the most important resting bird species in the German North Sea and EEZ in the seasons with the highest density according to MENDEL et al (2008). Spring stocks of red-throated divers according to SCHWEMMER et al (2019), spring stocks of black-throated divers according to GARTHE et al (2015).

| German name (*scientific name*) | Season | Stock German North Sea | Stock German EEZ |
|---|---|---|---|
| Red-throated diver (*Gavia stellata*) | Winter | 3.600 | 1.900 |
| | Spring | 22.000 | 16.500 |
| Black-throated diver (*Gavia arctica*) | Winter | 300 | 170 |
| | Spring | 1.600 | 1.200 |
| Gannets (*Morus bassanus*) | Summer | 1.400 | 1.200 |
| Great black-backed gull (*Larus marinus*) | Winter | 15.500 | 9.000 |
| | Autumn | 16.500 | 9.500 |
| Lesser black-backed gull (*Larus fuscus*) | Summer | 76.000 | 29.000 |
| | Autumn | 33.000 | 14.500 |
| Common Gull (*Larus canus*) | Winter | 50.000 | 10.000 |
| Little Gull (*Hydrocoloeus minutus*) | Winter | 1.100 | 450 |
| Kittiwake (*Rissa tridactyla*) | Winter | 14.000 | 11.000 |
| | Summer | 20.000 | 8.500 |
| Sandwich tern (*Thalasseus sandvicensis*) | Summer | 21.000 | 130 |
| | Autumn | 3.500 | 110 |
| Common Tern (*Sterna hirundo*) | Summer | 19.500 | 0 |
| | Autumn | 5.800 | 800 |
| Arctic tern (*Sterna paradisaea*) | Summer | 15.500 | 210 |
| | Autumn | 3.100 | 1.700 |
| Razorbill (*Alca torda*) | Winter | 7.500 | 4.500 |
| | Spring | 850 | 800 |
| Common Guillemot (*Uria eel*) | Winter | 33.000 | 27.000 |
| | Spring | 18.500 | 15.500 |

#### 2.8.2.2 Frequently occurring species and species of particular importance for the "Sylt Outer Reef - Eastern German Bight nature conservation area

The occurrence of seabirds shows a very high spatial and temporal variability. Long-term observations or systematic censuses provide information on recurring seasonal distribution patterns of the most common species in German waters of the North Sea. In the following, the most common and specially protected species are examined individually due to species-specific differences in spatial and temporal distribution.

Red-throated diver (*Gavia stellata*) and black-throated diver (*Gavia arctica*)

The two types cannot always be reliably distinguished from each other in airborne and shipborne counts. For this reason, the two species are presented together in this case. According to all findings to date, the proportion of black-throated divers is approx. 8 to 11%.

Sea divers are regularly found along the coast of the southeastern North Sea in winter. Towards spring, the main portion of the population shifts further to the north, especially to the area west of Sylt. The distribution at this time of year extends almost 100 km into the EEZ (MENDEL et al. 2008). On the basis of many years of data collection in the German EEZ, a main distribution area (main concentration area) of loons was identified and defined off the North Frisian islands in spring (BMU 2009). An evaluation of data from research projects, environmental impact studies and monitoring of offshore wind farm projects from 2000 to 2013 prior to the construction of the wind farms showed that the seasonal distribution of loons in the German Bight had remained largely constant over a longer period of time. At the same time, there was a clear expansion of the loon population in a westerly direction, which confirmed the importance of the main concentration area (GARTHE et al. 2015). A study commissioned by the FTZ on behalf of the BSH and the BfN, which, in addition to the data sources of the study from 2015, takes into account data from the construction and operation phase of the offshore wind farm projects in the years 2014-2017, shows a shift of the sea diver occurrence after construction of the wind farms to the central area of the main concentration area with the maximum distance to the realised projects (GARTHE et al. 2018, GARTHE et al. 2019, Figure 33). A recent study commissioned by the German Offshore Wind Farm Operators Association (BWO) confirms this observation (BIOCONSULT SH et al. 2020).

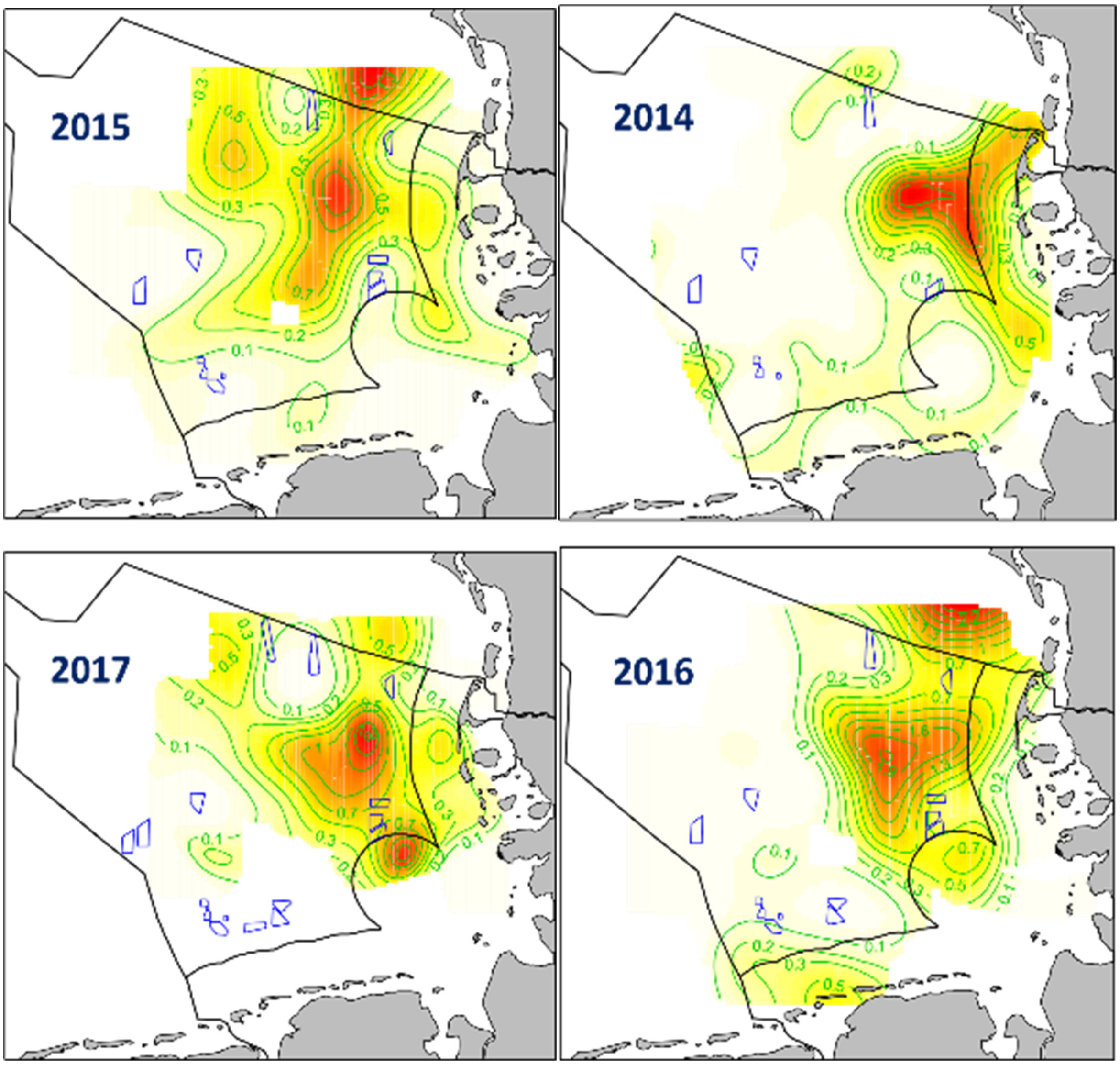



Figure 33: Interpolated loon densities in the German Bight in spring 2014 - 2017. The offshore wind farm projects in operation at the time of data collection are outlined in blue. Figures indicate interpolated densities (GARTHE et al. 2019).

Little gull (*Larus minutus*)

The German Bight, where lesser black-backed gulls only reach low population densities, is located at the northeastern edge of the winter distribution of European lesser black-backed gulls (GLUTZ von BLOTZHEIM & BAUER 1982). In general, a considerable proportion of the Northwest European population flies over the coastal areas of the German North Sea coast during migration and return, as long-term observations from research projects and EIAs unanimously show. Particularly in the area of the Elbe estuary, the observed densities are high in these periods (MARKONES et al. 2015). During the breeding season and in summer, only isolated individuals are found in the German EEZ (MENDEL et al. 2008). The large number of individuals during migration is then followed by a lower, constant winter occurrence in the German North Sea, which is predominantly restricted to the territorial sea, the "Sylt Outer Reef - Eastern German Bight" and the "Borkum Reef Ground" nature conservation areas. In general, their occurrence depends strongly on the prevailing weather.

*Sandwich* tern (*Thalasseus sandvicensis*)

The distribution area of the sandwich tern in the pre-breeding period, during the breeding season and during migration runs along the coast of the

North Sea - with most birds in a 20 to 30 km wide strip and concentrations near known breeding colonies on Norderoog, Trischen and Wangerooge.

The long-term data series of the FTZ show the main occurrence of the sandwich tern in the German North Sea in the summer half of the year. Sandwich terns then occur in large areas of the entire territorial sea. In the area outside the coastal waters, sandwich terns occur only sporadically (MENDEL et al. 2008). In areas with a water depth of more than 20 m, there are hardly any terns searching for food.

Common tern (*Sterna hirundo*) and Arctic tern (*S. paradisaea*)

Common and Arctic terns cannot always be reliably distinguished under unfavourable observation conditions and are therefore treated together. Both common and Arctic terns spend the breeding season in a strip off the coast, which only extends slightly into the EEZ in the northern part. Highest densities are found near the breeding sites on the offshore islands. The distribution of the two species of terns after the breeding season is very similar to that during the breeding season. However, local centres of gravity are less clearly located near the breeding sites, which are no longer occupied at this time. The EEZ gains some importance after the breeding season, especially the area off the North Frisian islands (MENDEL et al. 2008).

Common guillemot (*Uria eel*)

Common guillemots are typical seabirds that only stay on land during the breeding season. The only breeding colony in German waters is on Helgoland and is currently estimated at around 2,811 breeding pairs (BMU 2020). During the breeding season, birds only leave the colony to forage for food within a radius of max. 30 km. The presence of the common guillemot is therefore concentrated during the breeding season in the German Bight and the spatial surroundings of the breeding colony on Helgoland. Further northwest, guillemots occur at this time of year only in low density (MENDEL et al. 2008).

From late summer and autumn onwards, the occurrence of the common guillemot shifts to areas far from the coast with water depths between 40-50 m to the so-called "Duck`s Bill" of the German EEZ (MARKONES & GARTHE 2011, Borkenhagen ET al. 2018) (see

Figure 34). During this period, adult birds are frequently observed with their young, although these are most likely to come from British breeding colonies.

In winter, common guillemots reach the highest densities and are found almost everywhere in the German North Sea EEZ (MENDEL et al. 2008). According to current knowledge, the areas of the EEZ between and north of the traffic separation zones off the East Frisian coast are intensively used by guillemots in autumn and winter. In spring, common guillemots gradually retreat towards the breeding colony.

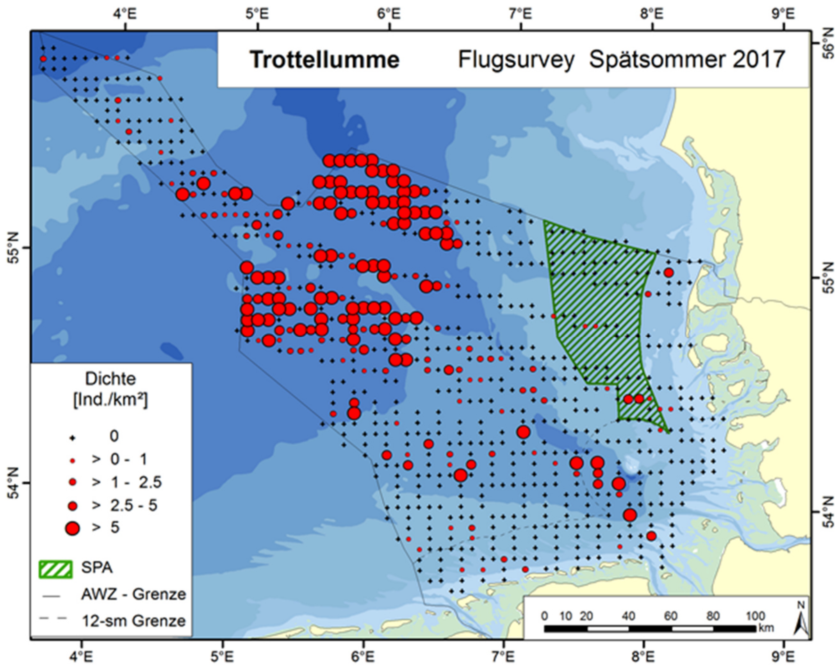



Figure 34: Distribution of sums of trottells in the German Bight in late summer 2017, based on four airborne surveys in the period 11.08. - 30.08. 2017 and one survey on 03.09.2017 (BORKENHAGEN et al. 2018)

Razorbill (*Alca torda*)

Razorbills are relatively common in winter in the coastal waters of the EEZ. A significant concentration occurs off the East Frisian Islands. At other times of the year the occurrence in German waters remains low (MENDEL et al. 2008). The long-term data series of the FTZ confirm the main occurrence of razorbill in the winter months. The highest concentrations occur north of Borkum and Norderney and extend to areas far from the coast (MENDEL et al. 2008).

*Northern* gannet (*Sula bassana*)

Northern gannets are found in large parts of the German North Sea in low densities without any particular concentrations being detected. This is confirmed by more recent studies (MARKONES et al. 2014, MARKONES et al. 2015). Despite the currently observed increase, Helgoland's breeding colony is too small to be clearly noticeable at sea. The long-term data series of the FTZ indicate a year-round, albeit low, occurrence of the Northern Gannet throughout the entire German Bight (MENDEL et al. 2008).

*Northern fulmar (Fulmarus glacialis*)

Fulmars occur in the German North Sea all year round and almost everywhere. In areas far from the coast they occur in higher densities than in areas close to the coast (MARKONES et al. 2015, BORKENHAGEN et al. 2018). The long-term data of the FTZ indicate a year-round occurrence in the German Bight. However, the highest numbers are found in summer in areas with saline and temperature-stratified North Sea water (MENDEL et al. 2008). In the course of baseline surveys for offshore wind farm projects, it was also determined that kingfishers occur in higher densities beyond the 40-m depth line. The breeding colony on Helgoland is still too small to have a significant impact on the populations at sea. Fulmars are regularly found in high densities at a distance of over 70 km from the coast, especially in summer.

*Great black-backed* gull (*Larus marinus*)

Great black-backed gulls are present all year round in the German North Sea. In low densities, they occur in spring and summer both near and far from the coast, 80 km from the coast. In autumn, the occurrence then increases steadily, leading to a high number of wintering grounds in the Elbe estuary and along the East Frisian coast. In areas far from the coast, mantled gulls then only occur sporadically (MENDEL et al. 2008). A current trend analysis based on comprehensive transect surveys from 1990 to 2013 showed a significantly negative population development of the great black-backed gull in the North Sea. However, the reason for this is not a decrease in the breeding population, but rather an increasing shift in resting populations and a decreasing importance of marine food sources (MARKONES et al. 2015).

*Larus* gull (*Larus fuscus*)

During the migration home and in the pre-breeding period, the distribution of herring gulls is concentrated around 60 km off the coast. Both during and after the breeding season, the lesser black-backed gull is a widespread species in the German Bight. The main areas of distribution are the coastal waters off Schleswig-Holstein and Lower Saxony and the adjacent areas of the EEZ, particularly west of the island of Helgoland. The lesser black-backed gull is a well-known ship follower. Its sometimes highly concentrated occurrence can therefore often be observed in connection with fishing activity. In the area around the island of Helgoland, the lesser black-backed gull is the only seabird species to occur in high densities during the summer months and is the most common seabird species in the German North Sea during this period. Recent studies show, as for the Great Black-backed Gull, a decrease in the summer occurrence of the lesser black-backed gull in the German North Sea. However, this is not due to a decline in the breeding population, but rather to a shift in occurrence to terrestrial areas (MARKONES et al. 2015).

Kittiwake (*Rissa tridactyla*)

Along with herring gulls and guillemots, kittiwakes are among the most common species in the German North Sea EEZ and occur all year round. The long-term data series of the FTZ show a clearly concentrated occurrence around Helgoland in spring and summer and in summer also in a northwesterly direction along theElbe Glacial Valley and in the area of the Duck's Bill (BORKENHAGEN et al. 2017, BORKENHAGEN et al. 2019).

In autumn, the occurrence continues to spread to areas far from the coast. In winter, the occurrence increases in areas close to the coast, but local accumulations with large numbers of individuals are also scattered in areas far from the coast (MENDEL et al. 2008). This is also shown by more recent studies carried out as part of the seabird monitoring programme commissioned by BfN (MARKONES et al. 2014).

*Common* gull (*Larus canus*)

Gulls are widespread in the eastern and southern part of the German Bight near the coast in winter. The highest densities are found in the Elbe-Weser estuary, in the area of the Ems estuary and off the North Frisian islands. The long-term data series of the FTZ indicate that gulls are present in the German North Sea all year round, but the largest populations in the off-shore area are reached in winter. The winter occurrence extends with high densities over the entire near-coastal area up to the 20 m depth contour. In areas far from the coast, gulls still occur regularly, but in much smaller numbers (MENDEL et al. 2008). In the other seasons, gulls are closer to the coast, where their breeding grounds are located (see

Figure 35). The occurrence of gulls is also highly dependent on the weather.

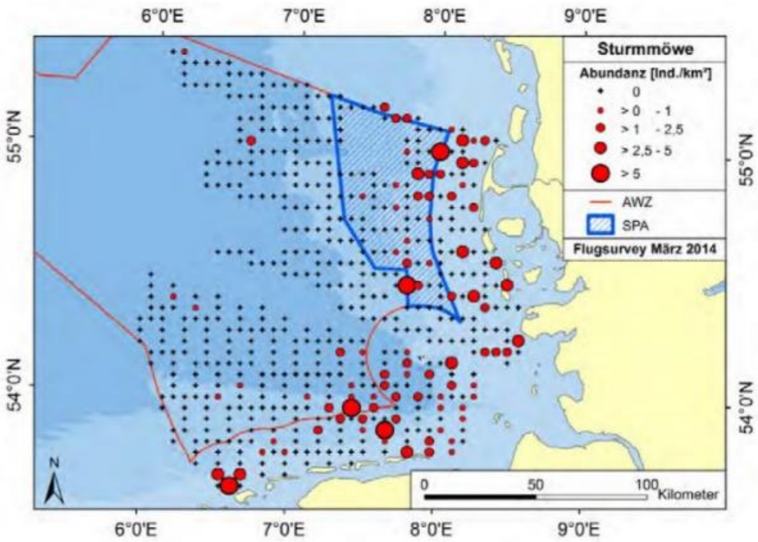



Figure 35: Occurrence of gulls in the German North Sea - survey of 4, 12 & 13 March 2014 (Markones ET al. 2015).

Skua (*Stercorarius skua*)

Skuas are very rarely seen in the German Bight (BORKENHAGEN et al. 2018). A sporadic occurrence is possible all year round, but there is a concentration during migration from late June to November. In the eastern part of the German Bight, they are often observed in connection with strong westerly winds (DIERSCHKE et al. 2011).

*Pomarine skua (Stercorarius pomarinus)*

Pomegranate skuas occur mainly during the autumn migration in the German North Sea. The occurrence is subject to strong annual fluctuations and therefore extremely variable (PFEIFER 2003).

*Common scoter (Melanitta nigra)*

Scoters are found all year round in the German North Sea, but their occurrence is concentrated in coastal and shallower offshore areas. In spring and autumn, the migration patterns determine the occurrence of scoters. In winter, the coastal areas serve as important resting habitats, and in summer a moulting migration can be observed. The "Eastern German Bight" wild bird conservation area, which is far from the coast, only records very low populations in summer and autumn compared to the entire German North Sea (MENDEL et al. 2008).

#### 2.8.2.3 Occurrence of seabirds in the "Sylt Outer Reef – Eastern German Bight nature conservation area

By decree of 22 September 2017, the nature conservation area (NSG) "Sylt Outer Reef - Eastern German Bight" was placed under protection as a complex area under national law. It covers a total area of 5,603 km$^2$. Subsection II of the NSG corresponds to the "Eastern German Bight" wild bird conservation area , which was designated as a nature conservation area with effect from 24.0.2005 and included in the list of Specially Protected Areas (SPA) as a wild bird conservation area (DE 1011-401). Sub-area II covers an area of 3,140 km$^2$. Sub-area II includes the red-throated diver, black-throated diver, little gull, sandwich tern, common and Arctic tern, as well as the common and Arctic tern, a total of six species listed in Annex I of the European Birds Directive. Regular migratory bird species include fulmar, gannet, common scoter, skua, pomarine gull, common gull, common gull, lesser black-backed gull, lesser black-backed gull, kittiwake, common guillemot, and razorbill (section 5 subsection 1 nos. 1 and 2 NSGSylV).

As part of the description and status assessment of the "Sylt Outer Reef - Eastern German Bight" nature conservation area (BfN 2017), species-specific stock figures were determined for the entire complex area and not separately for sub-area II. In the textual explanations in BfN (2017), it is explained for most species, especially those with a large-scale occurrence or a tendency to occur closer to the coast, that the stocks are concentrated in sub-area II during the high season.

The following Table 12 shows the stocks identified in the BfN (2017), with the exception of the red-throated diver stocks in spring, for the species protected under the conservation objective of sub-area II in the high seasons.

Table 12: Stocks of bird species protected in the "Sylt Outer Reef - Eastern German Bight" nature conservation area in the high season according to BfN (2017). Spring stocks of the red-throated diver in sub-area II according to Schwemmer et al (2019).

| **German name (*scientific name*)** | **Season** | **Stock NSG "Sylt Outer Reef - Eastern German Bight** |
|---|---|---|
| Red-throateddiver (*Gavia stellata*) | Spring | 6.000 |
| Black-throated diver (*Gavia arctica*) | Spring | 210 |
| Sandwich tern (*Thalasseus sandvicensis*) | Spring | 1.900 |
| Arctic tern (*Sterna paradisaea*) | Spring | 120 |
| | Summer | 160 |
| Common tern (*Sterna hirundo*) | Summer | 180 |
| Little gull (*Hydrocoloeus minutus*) | Spring | 3.000 |
| Kittiwake (*Rissa tridactyla*) | Spring | 4.200 |
| | Winter | 3.900 |
| Lesser black-backed gull (*Larus fuscus*) | Autumn | 4.700 |
| | Summer | 4.800 |
| Common gull (*Larus canus*) | Winter | 4.600 |
| Common scoter (*Melanitta nigra*) | Winter | 15.000 |
| Razorbill (*Alca torda*) | Autumn | 4.500 |
| | Winter | 2.000 |
| Common guillemot (*Uria eel*) | Autumn | 4.700 |
| | Winter | 6.000 |
| Gannets (*Morus bassanus*) | Spring | 330 |
| | Summer | 300 |
| Fulmars (*Fulmarus glacialis*) | Spring | 2.300 |
| | Summer | 2.700 |
| Skua (*Stercorarius skua*) | Summer | 6-10 |

| German name (*scientific name*) | Season | Stock NSG "Sylt Outer Reef - Eastern German Bight |
|---|---|---|
| Pomarine skua (*Stercorarius pomarinus*) | Spring | 1-5 |

#### 2.8.2.4 Occurrence of loons in the main concentration areaOn the basis of all data available in 2009 from environmental impact studies for offshore wind farms, from research projects and from Natura 2000 monitoring, the main concentration area of loons in the German Bight was defined (BMU 2009).

The main concentration area takes into account the spring period, which is particularly important for the species, red-throated and black-throated divers. On the basis of the data available at the time the main concentration area was stipulated in 2009, the main concentration area was home to around 66% of the loon population of the German North Sea and around 83% of the EEZ population in spring and is therefore particularly important from a population biology perspective (BMU 2009). Current stock calculations for the more dominant species of red-throated diver show average spring stocks of around 11,000 individuals for the main concentration area (SCHWEMMER et al. 2019, BIOCONSULT SH et al. 2020).

The main concentration area covers an area of 7,036 km$^2$. It includes all areas with a very high density of loons and most of the areas with a high density. The delimitation of the main concentration area of loons is based on data availability, which is considered to be very good, and on expert analyses which have gained broad scientific acceptance. From more detailed analyses and further studies, it is known that loon populations are subject to a high degree of temporal and spatial dynamics. The use of the various areas of the main concentration area can be linked to the likewise highly dynamic frontal systems in the eastern German Bight (SKOV & PRINS 2001, Heinänen ET al. 2018). The delimitation of the main concentration area in the west and southwest was chosen to include all important and known regular occurrences. Particularly during the spring migration of the species from the wintering to the breeding areas, however, irregular occurrences occur again and again west of the boundary of the main concentration area and also in the EEZ north of the East Frisian islands, but these are unlikely to form part of a larger, contiguous area regularly used at medium to very high density (BMU 2009). Findings from research and monitoring confirmed that the occurrence north of the East Frisian Islands is significantly lower and less stable (GARTHE et al. 2015, IFAÖ et al. 2016, IFAÖ et al. 2017).

#### 2.8.2.5 Occurrence of seabirds and resting birds in areas for wind energy

The areas for offshore wind energy utilisation in the North Sea identified in the spatial plan can be described in more detail with regard to the occurrence of seabirds, as extensive data are available from environmental impact studies and the monitoring of offshore wind farm projects during construction and operation. The data are based on many years of ship- and airborne surveys. Due to the large-scale surveys, the findings from these studies can be assumed to be representative of the seabird communities in individual sub-areas or zones of the EEZ.

***Areas EN1, EN2, EN3 (zone 1)***

The extensive investigations of seabirds within the framework of environmental impact studies and during the construction and The extensive investigations of seabirds in the context of environmental impact studies and during the construction and operation phases of offshore wind farms show for the areas EN1, EN2 and EN3 and their surroundings that a seabird community is to be found here, as is to be expected for the prevailing water depths and hydrographic conditions, the distance from the coast and the site-specific influences (IFAÖ et al. 2015a, IFAÖ et al. 2015b, IFAÖ et al. 2016, IFAÖ et al. 2016, IfAÖ et al. 2016, IfAÖ et al. 2017, IFAÖ et al. 2018, , IFAÖ et al. 2019). The seabird population is dominated by seagulls, especially those known as ship followers, which benefit from fishing waste (e.g. lesser black-backed gull). Lesser black-backed gulls occur only sporadically, while common gulls occur independently of fishing activities in autumn and winter. Seabird species such as common guillemots and razorbills are among the most common species, along with kittiwake and herring gulls. On the other hand, coastal bird species such as terns and ducks are only found in small numbers and only flying during the main migration periods. For diving sea ducks, the areas are of no particular importance as feeding grounds due to the depth of the water. Their occurrence is concentrated in coastal shallow water areas south of areas EN1 to EN3 (BIOCONSULT SH & IFAÖ 2014, IFAÖ ET al. 2015a, IfAÖ ET AL. 2015b, IfAÖ ET AL. 2016, IfAÖ ET al. 2017, IfAÖ ET AL. 2018, , IfAÖ ET al. 2019). Sea divers use this coastal area of the EEZ mainly in winter and spring. Studies show a concentrated distribution of loons within the 12-mile zone off the East Frisian Islands. Occasionally, however, they also occur within and around areas EN1 to EN3 (GARTHE et al. 2015, IFAÖ et al. 2016, IFAÖ et al. 2016, IfAÖ et al. 2017, IFAÖ et al. 2017, IfAÖ et al. 2018, IFAÖ et al. 2018, IFAÖ et al. 2019). In current evaluations of the FTZ a larger occurrence southeast of the EN3 area can be identified (GARTHE et al. 2018).

All in all, an examination of all available data suggests that the three sub-areas are used differently depending on the species. There are no discernible focal occurrences. Species-specific density gradients (e.g. near the coast versus far from the coast) and seasonal distribution patterns can be identified. All studies to date also illustrate the strong interannual variability of bird occurrence in this area.

***Area EN4 (zone 1)***

Data from the area surrounding EN4 show a medium and at times high occurrence of seabirds. The entire area of the eastern German Bight, where the EN4 area is also located, is of high importance for a total of six species (groups). These include red-throated diver, black-throated diver, little gulls, petrels, scoters and terns (common, coastal and burnt terns).

However, scoters are rarely if ever seen in the EN4 area due to the water depth of more than 20 m. In current investigations, dense occurrences of common scoter have only been observed in the extreme northeastern edge of the EN4 area under review (IBL UMWELTPLANUNG et al. 2016b, IBL UMWELTPLANUNG et al. 2017a, IBL UMWELTPLANUNG et al. 2018). Common gulls occur in and around the EN4 area mainly in autumn and winter, mostly over large areas. Lesser black-backed gulls can be found all year round in the EN4 area, but they are most common in spring and winter. Terns occur mainly during migration periods. In recent studies, the occurrence was concentrated in the northern part of the EN4 area (IBL UMWELTPLANUNG et al. 2017a, IBL UMWELTPLANUNG et al. 2018). Area EN4 is located in the southern part of the main concentration area of loons in spring (BMU 2009). In the species-specific spring, from March to May, loons are regularly observed in higher densities in the area around the site, especially northwest and east of EN4 (IBL UMWELTPLANUNG et al. 2017a, IBL UMWELTPLANUNG ET AL. 2018, IBL UMWELTPLANUNG et al. 2019).

The most frequently represented species are herring gulls, kittiwakes - especially in association with fishing activities -, petrels - independent of fishing activities, especially in autumn and winter in high densities - and aukes. The latter, mainly common guillemots and razorbills, occur only on average in the area around the EN4 site, compared to the offshore areas of the EEZ. The indirect surroundings of the EN4 area are partly used as a feeding ground in summer by breeding birds from the breeding colonies of Helgoland. Northern kingfishers and gannets are rather sporadic (IBL Environmental Planning et al. 2016b, IBL Environmental Planning et al. 2017a, IBL Environmental Planning et al. 2018, IBL Environmental Planning et al. 2019).

***Area EN5 (zone 2)***

The area surrounding EN5 has a high incidence of seabirds. All results so far show a gradient in the composition of the bird community: The area east of the EN5 area marks the transition between coastal areas with water depths below 20 m and areas with increasing water depth and distance to the coast. The area surrounding EN5 thus has a mixed bird community with a high proportion of coastal birds in near-coastal areas, which to the west merges into a deep-sea bird community as water depth increases (BioConsult SH 2015). In recent studies, the common scoter was the most common species in the study area in the near-coastal area east of the EN5 area (BioConsult SH 2017, BioConsult SH 2018, BioConsult SH 2019, BioConsult SH 2020). In the immediate vicinity of the EN5 area, species of the open sea dominate with black-legged kittiwake, *Larus* gulls and black-legged kittiwake. West of the EN5 area, kingfishers also occur in late winter and summer (IfAÖ 2016a, IfAÖ 2017). Northern gannets occur in the EN5 area only in small numbers during migration periods or in summer (IfAÖ 2017, BioConsult SH 2018, BioConsult SH 2019, BioConsult SH 2020).

Species listed in Annex I of the Birds Directive (V-RL) occur regularly. All subareas of area EN5 are located in the main concentration area of loons in the German Bight (BMU 2009) in spring. From March to mid-May (species-specific spring), high densities with pronounced intra- and interannual variability are recorded around the EN5 area (Garthe et al. 2015, Garthe et al. 2018, BioConsult SH et al. 2020). According to current investigations, the occurrence of loons east of the EN5 area is concentrated within the wild bird conservation area to the south and north and south of the EN5 area. In the remaining seasons only a few loons can be observed (BioConsult SH 2017, IfAÖ 2017, BioConsult SH 2018, IfAÖ 2018, BioConsult SH 2019, IfAÖ 2019, BioConsult SH 2020). Lesser black-backed gulls are mainly found during migration periods and in winter in low densities in the EN5 area. The densities increase from west to east. Terns were observed east of the EN5 area during migration periods and in summer (BioConsult SH 2017, IfAÖ 2017, BioConsult SH 2018, IfAÖ 2018, BioConsult SH 2019, IfAÖ 2019, BioConsult SH 2020).

***Areas EN6 to EN13 (zones 2 + 3)***

The areas EN6 to EN13 north of the traffic separation areas show a medium to seasonal high occurrence of seabirds. The range of species and, above all, the abundance of species make these areas a typical habitat for the seabird community. The most common species are the guillemot, kittiwake, razorbill and lesser black-backed gull. Gulls are observed here mainly on the hunt for fishing waste. Gulls occur in small numbers in autumn and winter, independently of fishing activities. Northern fulmars and gannets are observed all year round in this area of the EEZ. However, there are strong intra- and interannual fluctuations (Planning Association Environmental Planning Offshore Wind Farm 2015, IBL Umweltplanung et al. 2016a, IBL Umweltplanung et al. 2016a, IBL Umweltplanung et al. 2017b, Planning Association Environmental Planning Offshore Wind Farm 2017, Planning Association Environmental

Planning Offshore Wind Farm 2018, IBL Umweltplanung et al. 2018).

Species of Annex I of the V-RL may occur sporadically around areas EN6 to EN13 during migration periods and in winter. The occurrence of little gulls, terns and divers does not indicate any focal points. This area of the EEZ serves as a transit area for them (IBL Umweltplanung et al. 2017b, Planungsgemeinschaft Umweltplanung Offshore Windpark 2017, Planungsgemeinschaft Umweltplanung Offshore Windpark 2018, IBL Umweltplanung et al. 2018). In comparison to the main concentration area, only low densities of loons have been recorded in spring in the areas adjacent to it (IfAÖ 2016b).

Due to the depth of the water, the areas are of no importance as resting and feeding habitats for diving sea ducks that seek their food on the sea floor. Many of the exclusively fish-eating species of seabird found here seek their food by diving in the water column. These species are attracted by the concentrated presence of fish and macrozooplankton.

Due to their nature, areas EN6 to EN13 are part of the extensive habitat of the common guillemot in the North Sea. Guillemots can be found there in large numbers, especially in autumn and winter. Environmental impact studies and monitoring have shown the occurrence of juvenile guillemots in this area of the EEZ in the post-breeding season (Markones & Garthe 2011, Markones et al. 2014, Planungsgemeinschaft Umweltplanung Offshore Windpark 2015). During this period, their occurrence depends primarily on the ocean current and is therefore variable. Common Guillemots are also not tied to specific habitats outside the breeding season (Camphuysen 2002, Davoren et al. 2002, Vliestra 2005, Crespin et al., 2006, Frederiksen et al. 2006). There is a case for this:

- the potential for resting and feeding habitat, which is extensive throughout the North Sea, based on its large-scale distribution in the EEZ,
- the high mobility also during the guidance of young birds and
- the repeatedly observed high spatial and temporal variability of the occurrence.

***Areas EN14 to EN 19 (zones 4 + 5)***

From the area of areas EN14 to EN19 in the so-called "Duck's Bill", the investigations of the FTZ's Seabird Monitoring on behalf of the BfN provide information on the seabird community. This area is one of the typical habitats of seabird species. Northern fulmars and kittiwakes occur all year round, with a focus on spring and winter. Razorbills and common guillemots are most abundant in winter, the latter also occurring in spring in this remote area of the EEZ. The Dogger Bank area within the German EEZ is one of the foothills of the distribution range of the puffin (*Fratercula arctica*). However, the occurrence within the EEZ is very low (BfN 2017, Borkenhagen et al. 2017, Borkenhagen et al. 2018, Borkenhagen et al. 2019).

### 2.8.3 Assessment of seabird and resting bird

The great amount of research carried out in recent years and the current state of knowledge allow a good assessment of the importance and status of individual sub-areas and areas as habitats for seabirds. This significance results from the assessments of the occurrence and spatial units or functions. In addition, the criteria of protected status and previous pollution are also considered at a higher level.

### 2.8.3.1 Conversation status

The following Table 13 summarises the allocation of the most common resting bird species in the EEZ to national and international risk categories.

Table 13: Assignment to the risk categories of the European Red List of the most important resting bird species of the German EEZ in the North Sea. Definition according to IUCN: LC = Least Concern, not endangered; NT = Near Threatened, Potentially Endangered; VU = Vulnerable, Endangered; EN = Endangered, Highly Endangered; CR = Critically Endangered, Threatened with extinction (BIRDLIFE INTERNATIONAL 2015a). Definition according to SPEC: SPEC 3 = not limited to Europe but with negative stock development and unfavourable conservation status. SPEC 1 = European species requiring global conservation measures, i.e. classified on a global scale as "Critically Endangered", "Endangered", "Vulnerable", "Near Threatened" or "Data Deficient" (BIRDLIFE INTERNATIONAL 2015b)

| German name (*scientific name*) | Annex IV-RL1 | Red List (Europe)[2] | Red List (EU27)[2] | SPEC3 |
|---|---|---|---|---|
| Red-throated diver *(Gavia stellata)* | X | LC | LC | 3a |
| Black-throated diver *(Gavia artica)* | X | LC | LC | 3a |
| Northern fulmar *(Fulmarus glacialis)* | | EN | VU | 3b |
| Northern annet *(Morus bassanus)* | | LC | LC | |
| Common scoter *(Melanitta nigra)* | | VU | VU | |
| Great black-backed gull *(Larus marinus)* | | LC | LC | |
| lesser black-backed gull *(Larus fuscus)* | | LC | LC | |
| Common gull *(Larus canus)* | | LC | LC | |
| Little gull *(Hydrocoloeus minutus)* | X | NT | LC | 3a |
| Kittiwake *(Rissa tridactyla)* | | VU | EN | 3b |
| Sandwich tern *(Thalasseus sandvicensis)* | X | LC | LC | |
| Common tern *(Sterna hirundo)* | X | LC | LC | |
| Arctic tern *(Sterna paradisea)* | X | LC | LC | |

| German name (*scientific name*) | Annex IV-RL1 | Red List (Europe)[2] | Red List (EU27)[2] | SPEC3 |
|---|---|---|---|---|
| Common guillemot (*Uria eel)* | | NT | LC | 3b |
| Razorbill (*Alca torda)* | | NT | LC | 1b |

1 Annex 1 V-RL

2 BIRDLIFE INTERNATIONAL (2015a) European Red List of Birds

3 BIRDLIFE INTERNATIONAL (2015b) European Birds of Conservation Concern

a Over-wintering

b Breeding

#### 2.8.3.2 Pre-existing impactsLegacy impacts

As part of the marine ecosystem, seabirds are exposed to many legacy impacts that may pose a potential endangerment but also affect their occurrence and distribution. Changes in the ecosystem may be associated with threats to seabird populations. The following factors can cause changes in the marine ecosystem and thus also in seabirds:

- ***Climate changes***: Changes in water temperature are accompanied by changes in water circulation, plankton distribution and the composition of the fish fauna. Plankton and fish fauna serve as a food source for seabirds. However, due to the uncertainty regarding the effects of climate change on the individual ecosystem components, it is hardly possible to forecast the effects of climate changes on seabirds.
- ***Fisheries***: Fisheries can be expected to have a strong influence on the composition of the seabird community in the EEZ. Fisheries can lead to a reduction in the food supply and even to food limitation. Selective fishing of fish species or fish sizes may lead to changes in the food supply for seabirds. Fishing discards provide additional food sources for some seabird species. The resulting trend towards more birds (lesser black-backed gull, herring gull, common gull and black-headed gull) has been identified by targeted research (GARTHE et al. 2006).
- ***Shipping***: Shipping can cause frightening effects on disturbance-sensitive species such as loons (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019), and also includes the risk of oil spills.
- ***Technical structures*** (offshore wind turbines, platforms): Technical structures can have similar effects on disturbance-sensitive species as shipping. In addition, there is an increase in the volume of shipping, e.g. due to supply trips. There is also a risk of collision with such structures.
- ***Other legacy impacts: In*** addition, eutrophication, accumulation of pollutants in the marine food chains and water-borne debris, e.g. parts of fishing nets and plastic parts, can affect seabirds in their occurrence and distribution. Epidemics of viral or bacterial origin may endanger populations of seabirds and resting birds.

In summary, it can be said that the seabird community in the German North Sea EEZ is clearly subject to anthropogenic influence. The seabird community in the EEZ cannot be regarded as natural for the reasons given here.

#### 2.8.3.3 Significance of sub-area II of the "Sylt Outer Reef - Eastern German Bight nature conservation area

Sub-area II of the "Sylt Outer Reef - Eastern German Bight" nature conservation area has an outstanding function in the German Bight as a feeding, wintering, moulting, transit and resting area for species listed in Annex I of the VRL (in particular red-throated diver, black-throated diver, little gull, Arctic, Caspian and Arctic tern) and regularly occurring migratory bird species (in particular the common and lesser black-backed gull, common fulmar, northern gannet, kittiwake, common guillemot and razorbill and common scoter).

The importance of individual parts of the nature conservation area for resting and migratory birds varies from year to year due to hydrographic conditions and weather patterns. Within the bird sanctuary, numerous migratory and resting birds use the high biomass available. In particular, the biomass of the mixed zone (roughly along the 20 m depth line) between estuarine and open waters represents a temporarily abundant food source.

#### 2.8.3.4 Significance of the main concentration area for loons in the German Bight

The main concentration area represents a particularly important component of the marine environment in terms of seabirds and resting birds, in particular the group of loons.

It is the most important resting place for loons in the German North Sea in spring. Every year, several thousand loons, mainly red-throated divers, visit the area for a stopover on their way to their breeding grounds.

Against the background of current stock assessments, the importance of the main concentration area for loons in the German North Sea and within the EEZ remains high (SCHWEMMER et al. 2019, BioConsult SH et al. 2020).

Since 2009, the BSH has carried out the qualitative assessment of cumulative effects on loons as part of licensing procedures, using the main concentration area as per the BMU position paper (2009) (see Chapter Seabirds and resting birds ).

#### *2.8.3.5* Significance of areas for offshore wind energy utilisation for sea birds and resting birds

***Areas EN1, EN2, EN3 (zone 1)***

Bird species listed in Annex I of the V-RL, such as loons, terns and little gulls, use the area of areas EN1 to EN3 as a feeding ground only on average and predominantly during migration periods. They do not consider the surroundings of these areas to be valuable resting habitats or preferred staging posts in the German Bight.

For breeding birds, areas EN1, EN2 and EN3 are of no importance due to the distance to the coast and to the islands with breeding colonies as feeding grounds.

Within the three areas, the abundance and distribution of seabirds show a high degree of interannual variability specific to the species, with small-scale variability occurring within the areas.

The most common species are ship followers, which benefit from fishing waste. Pre-pollution from shipping, fishing and offshore wind farms in the vicinity of areas EN1, EN2 and EN3 are of medium to sometimes high intensity for seabirds. According to current knowledge, the three areas EN1, EN2 and EN3 are of medium importance for resting and foraging birds.

The overall average importance of the areas for seabirds and resting birds is derived from the assessment of the protected status, occurrence, spatial unity and the existing impacts on seabird populations in the area between the traffic separation areas in the German Bight.

***Area EN4 (zone 1)***

The EN4 area is located in the immediate vicinity of the "Sylt Outer Reef - Eastern German Bight" nature conservation area and in the southernmost area of the main concentration area of loons in spring in the German Bight (BMU 2009). The surroundings of the EN4 area are therefore of great importance for loons, even if the densities are mostly below the densities recorded in the conservation area and in the areas northwest of the EN4 area.

The occurrence ofther species of birds listed in Annex I of the V-RL, such as terns and little gulls, is more or less average in the EN4 area. For the other seabird species to be conserved in the conservation area, the surroundings of the EN4 area are in part of high importance. The abundance and distribution of seabirds within the area show a high interannual variability. The area is of medium to highimportance as a feeding ground, depending on the species. The prior impacts of shipping, fishing and offshore wind farms in this area are of medium to seasonally high intensity for seabirds. For breeding birds of the breeding colonies on Helgoland and on the islands off the North Frisian coast, the EN4 area is of low to medium importance as a feeding ground due to its distance.

***Area EN5 (zone 2)***

All findings to date indicate that the EN5 area is of high significance to seabirds.

For the red-throated and black-throated divers listed in Annex I of the V-RL, the surroundings of the EN5 area are of very high significance. All sub-areas are located in the main concentration area of loons in the German Bight (BMU 2009) in spring. To the east of the EN5 area is sub-area II of the "Sylt Outer Reef - Eastern German Bight" nature conservation area (Regulation of 27 September 2017, Federal Law Gazette Part I No. 63, 3423). A high incidence of other protected seabird species has also been recorded here, depending on the season and species. Other bird species listed in Annex I of the V-RL, such as terns and little gulls, also occur in the EN5 area.

The EN5 area and its surroundings are in the transitional area of distribution of many coastal bird species, including diving sea ducks, within the bird sanctuary, as well as an increasing number of seabird species to the west of the area. The abundance and distribution of bird species within the area shows a high degree of interannual variability. The area's surroundings are of medium, intermittent but also high significance as a feeding ground for many species of seabirds. For loons, the EN area is of high significance as a feeding ground before returning to their breeding grounds in spring.

For breeding birds, the EN5 area is of limited significance due to its distance from the coast and islands with breeding colonies as feeding grounds. The impact of shipping, fishing and offshore wind farms in and around area EN5 is of medium to high intensity for seabirds.

***Areas EN6 to EN13 (zones 2 + 3)***

All evidence to date indicates that the areas north of the traffic separation zones are of medium significance for seabirds. Overall, the areas have a medium seabird occurrence. The areas are most commonly used by seabird species that are widely distributed throughout the North Sea, including ship followers that benefit from bycatch.

Sturgeon species such as loons are only present in the areas for short periods in search of food and during the main migration periods. The areas are located outside the main distribution area of loons in spring. For other species of seabirds particularly worth of conservation (as listed in Annex I of the V-RL), the areas are also not considered valuable resting habitats or preferred staging posts in the German Bight. The abundance and distribution of seabirds within the areas show a high degree of interannual variability. The areas are of medium significance as feeding grounds for seabird species. Due to their distance from the coast, areas EN6 to EN13 are of no significance for breeding birds. The prior impacts of shipping and fishing in the areas are of medium to sometimes high intensity for seabirds. Due to the development of individual areas (EN6 and EN8) to date, the impact of offshore wind farms in the EN6 to EN13 areas can generally be regarded as low.

***Areas EN14 to EN19 (zones 4 + 5)***

Areas EN14 to EN19 are typical habitats for seabird species such as fulmars, guillemots and kittiwakes. Due to their distance from the coast, it can be assumed that the areas are of no significance to breeding birds. The current data sources are not sufficiently updated to allow for a detailed assessment of the general seabird occurrence or the occurrence of other (high) seabird species in this area of the EEZ. It is assumed that future investigations and monitoring programmes will focus more on this area of the EEZ and thus extend the data sources.

#### 2.8.3.6 Conclusion

The North Sea EEZ can be subdivided into different sub-areas, each of which has a seabird population to be expected in view of the prevailing hydrographic conditions, distances from the coast, existing pollution and species-specific habitat requirements.

## 2.9 Migratory birds

Bird migration is usually defined as periodic migrations between the breeding area and a separate non-breeding area, which in the case of birds at higher latitudes normally contains the wintering grounds. Since bird migration takes place annually, it is also called annual migration - and is spread throughout the world. In this context, one also speaks of two-way migratory birds, which make a return journey, or annual migratory birds, which migrate every year. Often, in addition to a resting place, one or more stopovers are made, be it for moulting, to find favourable feeding grounds or for other reasons. A distinction is made between long-distance migrants and short-distance migrants, depending on the size of the distance covered and on physiological criteria.

### 2.9.1 Data availability

Surveys on bird migration across the southeastern North Sea were already conducted on Helgoland in the 19th century (Gätke 1900). Long-term observation series on migratory phenology and species-specific changes are available, particularly for species whose habitat requirements are met by the fishing grounds (HÜPPOP & Hüppop 2002, 2004). In addition, visual observations and surveys at coastal sites (e.g. HÜPPOP et al. 2004, 2005) and visual observations carried out at various offshore sites provide quantitative data on bird migration (MÜLLER 1981, DIERSCHKE 2001).

Ecological accompanying research, environmental impact studies (EIS) and the monitoring of offshore wind farm projects during construction and operation provide the most up-to-date data on bird migration over the German Bight and supplement basic work. Particularly noteworthy in this context are the bird migration surveys at FINO1, which were begun in 2003 and enable largely continuous radar measurements of bird migration in the offshore area under constant conditions. Comprehensive results were published in the reports BeoFINO (OREJAS et al. 2005) and FINOBIRD (HÜPPOP et al. 2009). Furthermore, historical data on approach and collision events of birds at formerly manned lighthouses and lightships (e.g. BLASIUS 1885 - 1903, BARRINGTON 1900, HANSEN 1954) can provide valuable information on bird migration across the North Sea. As part of the accompanying ecological research, more extensive analyses of such records were also carried out on lighthouses and lightships in the German Bight (BALLASUS 2007).

#### 2.9.1.1 Spatial distribution and temporal variability of migratory birds

According to current knowledge, migratory bird activity can roughly be divided into two phenomena: broad-fronted migration and migration along migratory routes. It is known that most migratory bird species fly across at least large parts of their transit areas on a broad front.

According to KNUST et al. (2003), this also applies to the North and Baltic Seas according to the current state of knowledge. Species that migrate at night in particular, which cannot be guided by geographical structures due to darkness, migrate across the sea in a broad frontal migration.

Seasonal migration intensity is closely linked to species- or population-specific life cycles (e.g. BERTHOLD 2000). In addition to these largely endogenously controlled annual rhythms in migratory activity, the concrete course of migratory events is mainly determined by weather conditions. Weather factors also influence the height and speed at which the animals migrate. In general, birds wait for favourable weather conditions (e.g. tailwind, no precipitation, good visibility) for their migration in order to optimise it in terms of energy. As a result, bird migration is concentrated on individual days or nights in autumn and spring. According to the results of an R&D project (Knust ET al. 2003), half of all birds migrate on only 5 to 10% of all days. Furthermore, the migration intensity is also subject to fluctuations in the time of day. About two thirds of all bird species migrate mainly or exclusively at night (HÜPPOP et al. 2009).

The broad-fronted migration is typical for the night migration of songbirds, but also for the day migration of songbirds. A current cross-project evaluation of all data from the large-scale bird migration monitoring for offshore wind farm projects showed a gradient of decreasing migration intensities with increasing distance to the coast for the nocturnal, songbird dominated bird migration over the North Sea (WELCKER 2019a). According to migratory plan observations, a number of songbirds migrating primarily during the day recorded a lower migratory intensity on Helgoland than on Sylt and Wangerooge (OREJAS et al. 2005, HÜPPOP et al. 2009). For the limper migration, radar observations, among other things, confirm a decreasing intensity towards the offshore area (DAVIDSE et al. 2000; LEOPOLD et al. 2004; HÜPPOP et al. 2006). The comparative studies by DIERSCHKE (2001) of the visible daily migration of waders and water birds between Helgoland and the (former) North Sea Research Platform (FPN) located 72 km west of Sylt also indicate a gradient between the coast and the open North Sea. This assumption is confirmed in the BeoFINO final report, as the results of the visual observations presented show a clear concentration of waterfowl near the coast. Only a few bird species are found in the offshore area in equal or larger numbers of individuals (e.g. red-throated diver, pink-footed goose).

However, reliable information on the magnitude of the decrease is not possible due to the methodological requirements. Uncertainties of the visual observations result, e.g., from lack of knowledge about the proportion of trains at higher altitudes. In addition, species such as red-throated diver or pink-footed goose also occur among waterbirds, which are observed at Helgoland with the same or higher numbers of individuals than from Sylt or Wangerooge (HÜPPOP et al. 2005, 2006). Table 14 exclusively illustrates the differences in the visible migration summed over all species for Helgoland, Sylt and Wangerooge according to HÜPPOP et al. (2009) The intensity of bird migration on Helgoland is less reduced in autumn than in spring. A certain contribution to relatively high intensities of Wangerooge and Sylt by local resting birds cannot be ruled out. It should also be noted that the difference for songbirds is probably be much smaller if night migration is taken into account.

Table 14: Mean migration intensity (Ind/h) over sea in the first three hours after sunrise for all species together at the three sites Wangerooge, Helgoland and Sylt for spring and autumn (HÜPPOP et al. 2009).

| Seawatching | Spring | Autumn |
|---|---|---|
| Wangerooge | 598,4 | 305,9 |
| Helgoland | 144,3 | 168,8 |
| Sylt | 507,2 | 554,2 |

Although the migratory intensity of selected species and species groups decreases with distance from the coast, overall there is broad frontal movement across the open sea. The special position of pronounced nocturnal migratory birds should again be noted, for which there is as yet little knowledge of decreasing migratory intensity with increasing distance from the coast. At least on FINO1, far fewer night owls are registered by radar than on Helgoland (HÜPPOP et al. 2009). Finally, the individual numbers of FPN and the *Buchan platform in the* central North Sea documented in individual migratory nights with >100,000 or 150,000 songbirds (primarily thrushes) should also be emphasised (MÜLLER 1981, Anonymus 1992). They document mass migration far from the coast and speak against pronounced gradients in migratory intensity for these species, at least temporarily. The frequency of such mass migration in the offshore area and the total proportion of the migration of a biogeographic population accounted for by it have not yet been clarified (BUREAU WAARDENBURG 1999; HÜPPOP et al. 2006).

#### 2.9.1.2 Bird migration over the German Bight

Bird migration over the German Bight is documented all year round using various methods (radar, seawatching, migratory call recording), with strong seasonal fluctuations, with the main focus on spring and autumn. The German Bight is crossed synchronously (broad front migration). According to EXO et al (2002), many birds cross the North Sea on a broad front.

EXO et al. (2003) and HÜPPOP et al. (2005) specify the number of birds migrating across the German Bight each year to be several 10-100 million. The largest proportion are songbirds, the majority of which cross the North Sea at night (HÜPPOP et al. 2005, 2006). The majority of birds come from Norway, Sweden and Denmark. For waterfowl and waders, however, breeding grounds extend far northeast into the Palaearctic and in the north and northwest to Spitsbergen, Iceland and Greenland.

Estimates of the annual migration volume over the North Sea by the BUREAU WAARDENBURG (1999) for a wider range of species involved in migration confirm the rough assumptions. For the total of 95 selected species, BUREAU WAARDENBURG (1999) estimates a minimum number of >40.91 million and a maximum number of >152.15 million birds migrating across the North Sea annually.

The German Bight is on the migration route of numerous bird species. Between 1990 and 2003, for example, between 226 and 257 (on average 242) species per year were recorded on Helgoland (according to DIERSCHKE et al. 1991-2004, cited in OREJAS et al. 2005). Other species that migrate at night but do not or rarely call out, such as the pied flycatcher (HÜPPOP et al. 2005), should also be included. If rarities are taken into account, a total of more than 425 migratory bird species have been recorded on Helgoland over the course of several years (HÜPPOP et al. 2006). At greater distances from the coast, the average migratory intensity and possibly the number of migrating species appears to decrease (DIERSCHKE 2001).

The nocturnal migration is particularly pronounced in spring from mid-March to May and in autumn in October and November (HÜPPOP et al. 2005, AVITEC RESEARCH GBR 2015). The night-time observations from the former North Sea Research Platform and the island of Helgoland confirm that night-time bird migration during the main migration periods is concentrated on nights with favourable migratory conditions and then becomes a mass migration. In spring, more than

50% of the migration detected by radar was recorded in only 11 nights, while in autumn 2003 and 2004, five out of 31 and six out of 61 measurement nights respectively accounted for more than 50% of the migration (HÜPPOP et al. 2005). Low intensities are observed from December to February and from June to August.

The migration intensity follows a distinct daily rhythm. Results of the automatic migration bird-call recording on FINO1 show an increasing migration activity in the evening and night hours, reaching its maximum in the early morning hours (HÜPPOP et al. 2009, HILL & HILL 2010). During the scheduled migration observations, the highest migration intensity was also observed in the first morning hours and then ebbed away towards noon (HILL & HILL 2010, Avitec RESEARCH GBR 2015). This rhythm can vary according to location and season.

Figure 36 shows a detailed section of the wide-front migration over the southeastern North Sea. It should be emphasised that the distances between the lines of individual migration flows merely indicate the direction of a gradient. Conclusions about the magnitude of the spatial trends must therefore never be drawn from Figure 36 Due to the thickness of the lines, differences in intensity between the migration flows are also only qualitatively illustrated.

The seasonal northeast-southwest or southwest-northeast migration dominates on a large scale (see Figure 37), although certain differences in the direction of migration and the degree of coastal orientation may exist. HÜPPOP et al. (2009) and AVITEC RESEARCH GBR 2015 also identified a clear main south-southwest direction in their radar studies on the FINO1 research platform in autumn (departure) (see Figure 37). However, the results only reflect the conditions in good weather. In spring, a clear direction (northeast) was also discernible, but only at night when no foraging birds were active.

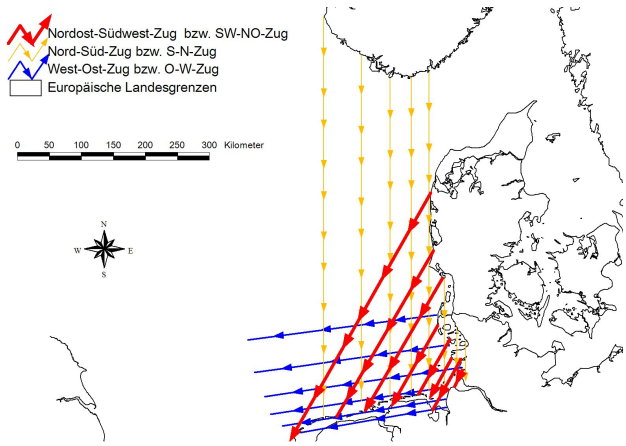



Figure 36: Scheme of main migration routes across the southeastern North Sea (shown for autumn from HÜPPOP et al. 2005a).

Radar recordings at the EIS sites also confirm this main migration direction, but there are indications of certain variations in the migration direction per location. In areas far north of the coast (Area 5), larger numbers of south-facing migratory birds were observed in autumn and north-facing in spring. However, the EIS observations were carried out in small time windows. Further statements on spatial differences in the proportion of migration directions deviating from the main northeast-southwest direction are therefore not possible at present (HÜPPOP et al. 2005a).

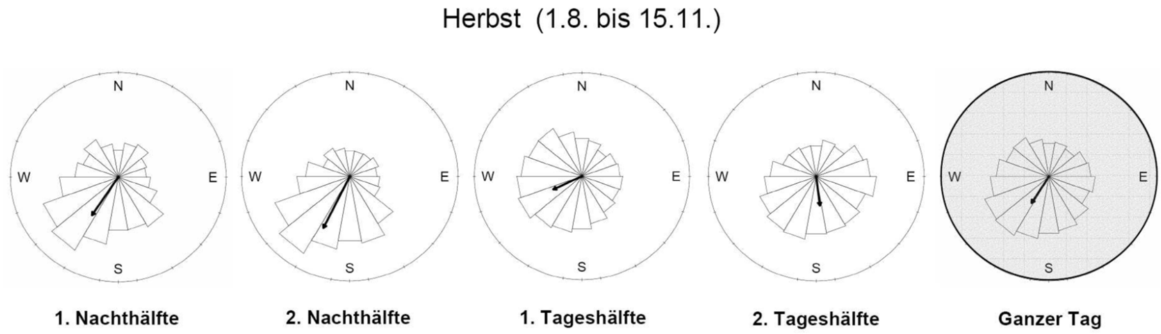



Figure 37: Relative proportions of the flight directions determined for the FINO1 research platform in autumn, for four times of the day and for the whole day (grey) averaged over the years 2005 to 2007. The sum of the individual directional shares within a circle graph is 100% in each case. The arrow direction in the centre of the circle indicates the average flight direction, the arrow length is a measure of its uniqueness (HÜPPOP et al. 2009).

The flight altitude distribution differs between the light and dark phases. In the dark phase, the flight or train takes place on average at higher altitudes. The changes in altitude distribution in the light and dark phases are also due to the species involved and their behaviour. As a rule, relatively high-flying migratory bird species occur primarily at night, while other, usually lower-flying species (such as seabirds or gulls) stop flying at night and rest on the water or on land.

Most of the signals on FINO1 were registered at all seasons up to a height of 100 m. In summer, the high level of flight activity in this area was mainly due to food-seeking individuals. The radar recordings at the "alpha ventus" test field also show more intensive use of the altitude classes below 200 m. In spring 2009, 39% of the echoes were recorded in the altitude classes up to 200 m and in autumn 2009 as much as 41% (HILL & HILL 2010). The values determined by AVITEC RESEARCH GBR (2015) in 2014 for the height classes up to 200 m are comparable with 36.1%. At night, especially in spring, more signals were recorded in the upper altitude classes. EASTWOOD & RIDER (1965) and Jellmann (1989) also recorded higher flight altitudes in the North Sea area in spring than in autumn. However, migration above 1,500-2,000 m only accounts for a small proportion of migration (JELLMANN 1979). However, the distribution of train altitudes can vary greatly between individual nights and is strongly influenced by the current weather situation (JELLMANN 1979, HÜPPOP et al. 2006).

#### 2.9.1.3 Species composition

During the course of the year and during migratory phases, the flight or migratory activity of the light phase is mostly dominated by species groups that use the area both as a resting and transit area. Among these, the seagulls, terns and seabirds with the species/grouping of herring gulls, kittiwakes, petrels, sandwich gulls, sandwich terns, common and Arctic terns and gannets reach the highest dominance values and/or continuity. Among the migratory bird species that cross the sea area exclusively, the majority of the records concern songbirds.

While songbirds are quite concentrated and relatively directed in the main migration months, seagulls are present almost all year round. This is often associated with fishing vessels or other vessels.

In some cases, large populations of songbirds dominate migration. Using automatically recorded and manually evaluated bird calls (N = 95,318 individuals), 97 species were identified on FINO1 during the FINOBIRD project (HÜPPOP et al. 2009). Three-quarters were calls from songbirds, especially thrushes. Meadow pipit, robin, chaffinch, winter goldcrest and skylark were also frequently represented in addition to the starling. The second most common group of species was the group of terns (mainly sandwich tern) with 11%. Thrushes also made up the majority of registered migratory calls in the context of migratory call recordings for "alpha ventus" (HILL & HILL 2010).

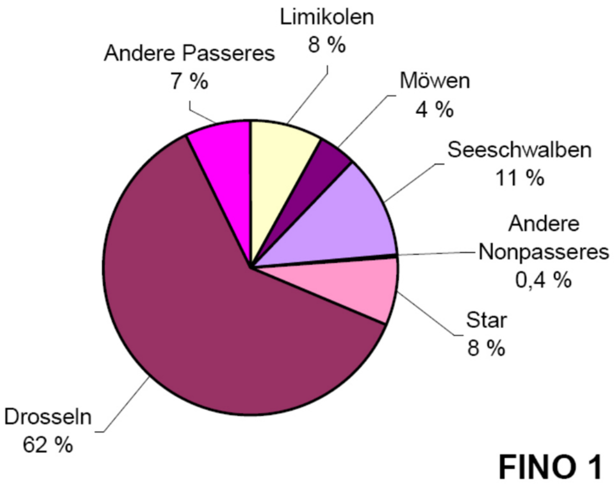



Figure 38: Proportions of species groups in all caller recordings in the vicinity of the FINO1 research platform from 12 March 2004 to 1 June 2007 (HÜPPOP et al. 2012).

### 2.9.2 Status assessment of the protected asset migratory bird

The status assessment of migratory birds in the German North Sea EEZ is assessed on the basis of the following assessment criteria:

-Large-scale significance of bird migration

-evaluation of the population

-rarity and endangerment

-Pre-existing impacts

#### 2.9.2.1 High significance on a large scale

According to current knowledge, several 10 - 100 million (max. 152 million) birds migrate across the German Bight every year. Singing birds make up the largest proportion, the majority of which cross the North Sea at night and in broad-fronted migration. A current cross-project evaluation of all data from the large-scale bird migration monitoring for offshore wind farm projects showed a gradient of decreasing migration intensities with increasing distance to the coast for the night-time bird migration over the North Sea, which is dominated by songbirds (WELCKER 2019). The majority of birds are from Norway, Sweden and Denmark. For songbirds migrating primarily during the day, there are also indications of a decrease with distance from the coast, as Helgoland has in the past recorded significantly lower migration intensity than Sylt (Hüppop et al. 2005). This trend is also confirmed for the limbicolous range by radar surveys (Hüppop et al. 2006). The same seems to apply to waterbird and wading bird migration (Dierschke 2001).

The definition of areas of concentration and guidelines for bird migration cannot be seen in a small scale in the offshore sector due to the lack of structures. An assessment of this criterion must take into account the large-scale nature of bird migration in the North Sea.

#### 2.9.2.2 Assessment of the population

The migration of an estimated 40 to 150 million individuals is immense, and it can be assumed that considerable numbers of the songbirds breeding in Northern Europe migrate across the North Sea.

A characteristic feature of nocturnal bird migration is the strong seasonal fluctuations in migration intensity, with most of the migration taking place in just a few nights. In addition to the research projects BeoFINO and FINOBIRD mentioned above, this correlation is also regularly demonstrated in environmental impact studies on offshore wind farms and in construction and operation-related monitoring.

#### 2.9.2.3 Rarity and endangerment

The species spectrum of the visible migration in the light phase in the area of the German Bight in 2003/2004 is estimated at 217 species. Other species that migrate at night must also be included.

Many bird species are listed in one or more of the following conventions and annexes on the conservation status of birds in Central Europe:

- Annex I of the V-RL,
- 1979 Bern Convention on the conservation of European Wildlife and Natural Habitats,

- 1979 Bonn Convention on the Conservation of Migratory Species of Wild Animals,
- AEWA (African-Eurasian Waterbird Agreement),
- SPEC (Species of European Conservation Concern).

SPEC classifies the bird species according to Europe's share of the population and the level of risk posed by BirdLife International.

Of the species detected, 20 are listed in Annex I of the V-RL: Red-throated and black-throated divers, sandwich, common, Arctic, little and black tern, **s**hort-eared owl, marsh harrier, hen harrier, osprey and merlin, little gull, golden plover, ringed sandpiper, wood sandpiper and bar-tailed godwit, barnacle goose, wood lark and bluethroat.

The species spectrum of over 200 migrating across the North Sea each year can be described as average in comparison to the 425 migratory bird species that have been recorded on Helgoland over the years. However, a very high proportion have an international conservation status and are endangered throughout Germany. For these reasons, the North Sea EEZ is of average to above-average significance in terms of species numbers and endangered status for bird migration.

#### 2.9.2.4 Legacy impacts

Anthropogenic factors contribute to the mortality of migratory birds in a variety of ways and, in a complex interaction, can influence population size and determine current migration patterns.

Key anthropogenic factors that increase mortality from migratory birds include active hunting, collisions with anthropogenic structures and, for waterfowl and seabirds, environmental pollution by oil or chemicals (CAMPHUYSEN et al. 1999). The various factors have a cumulative effect, so that it is usually difficult to determine the significance in isolation. Particularly in Mediterranean countries, there is still an insufficient statistical coverage of hunting (HÜPPOP & HÜPPOP 2002). TUCKER & HEATH (1994) conclude that more than 30% of European species characterised by stock decline are also threatened by hunting.

The proportion of birds ringed on Helgoland and birds killed indirectly by humans has increased in the past in all species groups and finding regions, with building and vehicle approaches being the main cause (HÜPPOP & HÜPPOP 2002). Surveys of collision victims at four lighthouses in the German Bight show that songbirds are strongly dominant. Starlings, thrushes (song thrush, red thrush, juniper thrush) and blackbirds are particularly prominent among the birds being found dead. Similar findings are available for FINO1 (HÜPPOP et al. 2009), the FPN (MÜLLER 1981) or former lighthouses on the Danish west coast (HANSEN 1954). During 36 of 159 visits to the research platform FINO1 with bird monitoring between October 2003 and December 2007, a total of 770 dead birds (35 species) were found. Thrushes and starlings were the most common, accounting for 85% of the total. The species concerned are characterised by night migration and relatively large populations. It is striking that almost 50% of the collisions registered on FINO1 occurred in only two nights. During both nights, southeasterly winds, which may have promoted migration at sea, and poor visibility conditions prevailed, which may have led to a reduction in flight altitude and increased attraction by the illuminated platform (HÜPPOP et al. 2009). The area around area N-3.7 is already partly covered with wind farms.

Global warming and climate changes also have measurable effects on bird migration, e.g. through changes in phenology or modified arrival and departure times, which are, however, of varying intensity depending on species and region (cf. BAIRLEIN & HÜPPOP 2004, Crick 2004, Bairlein & WINKEL 2001). Clear relationships between large-scale climate cycles such as the North Atlantic Oscillation (NAO) and the physical condition of songbirds captured on their spring migration have also been demonstrated (HÜPPOP & HÜPPOP 2003). Climate change can influence conditions in breeding, resting and wintering areas or the ressources of these sub-habitats.

The legacy impacts are rated as medium to temporarily high overall.

#### 2.9.2.5 Significance of the areas and sites for migratory birds

The areas EN1 to EN13 for offshore wind energy utilisation in the North Sea, as defined in the spatial plan, will be assessed separately with regard to their significance for bird migration. Due to a lack of information on bird migration in the areas EN14 to EN19 in the Duck's Bill of the EEZ, these areas are not assessed separately.

In analogy to the assessment of the status of birds in the EEZ, the significance of areas EN1 to EN13 for bird migration is assessed using the following evaluation criteria:

-Large-scale significance of bird migration

-evaluation of the population

-rarity and endangerment

For the criterion "legacy impacts", reference is made to the explanations in Chapter

*Legacy impactsHigh significance on a large scale*

Special migratory corridors are not recognisable for any migratory bird species in the North Sea EEZ area. Bird migration takes place in an unspecified broad-fronted migration across the North Sea with a tendency towards coastal orientation. For the areas EN1 to EN13 this does not result in any differences in their large-scale significance for bird migration.

*Assessment of the population*

In the sea areas in which the areas **EN1 to EN3 are** located, *echoes* were *detected almost continuously in both migration periods during the* cluster investigations "North of Borkum" (AVITEC RESEARCH 2017) in *2016 on the basis of whole migration nights or days. Focal points of bird migration were identified in spring at the end of March and the end of April and in autumn in October and early November. This resulted in bird migration events of varying intensity up to mass migration on a long-term location-specific scale. 142,764.6 bird movements during the day were extrapolated for the entire spring season; 121 echos/(h*km) and 265,039 bird movements during the night were extrapolated; 358 echos/(h*km) recorded. In autumn,* 127,648 bird movements were extrapolated from *the corresponding values*; 129 echos/(h*km) during the day and the night, extrapolated 203,236 bird movements; 217 echos/(h*km). A maximum value of *3,535.6 echos/(h*km)* was *recorded* in spring *and 1,830.4 echos/(h*km) in autumn. Migration intensities averaging over 1,000 echoes/(h*km) were determined in spring 2016 in a total of nine nights, during the day this mark was exceeded once. In autumn, migration intensities averaging over 1,000 echoes/(h*km) were determined in only four nights.*

In the cluster investigations "North of Helgoland" (IBL ET AL. 2017) in the area of the **EN4** area, the monthly average of the nightly migration rates ranged from 34 echos/(h*km) in August 2016 to 423 echos/(h*km) in March 2016. The average migration rate over the whole period was 224 echos/(h*km). The highest nocturnal migration rate was reached in the night from 26 to 27 October 2016 (3,311 echos/(h*km)). In about 39% (spring) and 67% (autumn) of the nights the migration rates were below 100 echoes/(h*km). The daytime migration rates were significantly lower, ranging from 38 echoes/(h*km) in August 2016 to 142 echoes/(h*km) in March 2016. The mean migration rate over the whole period was 93 echoes/(h*km). In total, nine nights with migration rates of more than 1,000 echos/(h*km) occurred within the 2016 reporting year (eight in spring, one in autumn). This means that the maximum migratory rates are of a similar order of magnitude as on FINO1 (cluster "North of Borkum").

The measurements within the framework of the cluster monitoring "West of Sylt" (BIOCONSULT SH 2017), also covering the **EN5** area, show that night migration is generally more pronounced than day migration as per the results of the vertical radar. During autumn migration in 2016, intensive bird migration was recorded primarily in October and November, while the months of July and August had, as expected, lower migration intensities. No mass migration days were recorded during autumn migration, the maximum migration intensity was 120 *echoes/(h*km)* and was recorded at the end of October. High migration intensities during the spring migration were recorded mainly in March and April. The maximum value of 400 *echoes/(h*km)* was clearly above the maximum value of the autumn migration. Bird migration was very irregular, especially at night. During the five nights with the highest migratory intensity 72.5% of the total number of spring migration and 52.4% of autumn migration were recorded. High rates of migration were only achieved on a few days, on most of the days recorded there was little bird migration.

The present investigations of the cluster monitoring "Cluster 6" from the year 2015 (Environmental Planning Group 2017) and the investigations of the cluster monitoring "East of Oyster Ground" (IFAÖ et al. 2017) from the year 2016 cover the areas **EN6** to **8** and are used for evaluation. Current data for the areas of **EN9** to **13 are** missing, but as these directly border the areas 6-8 in the north, the following explanations are transferable.

Within the scope of the investigations of cluster 6, nocturnal bird migration showed strong fluctuations during the recording period (January 2015 to March 2016).Strong bird migration with average migration rates of more than 1,000 *echos/(h*km) only* occurred in one night (18/19 October 2015). In spring, maximum average migration rates of about 700 *echos/(h*km)* were recorded. In about 25% of the nights the rate of migration was below 10 *echoes/(h*km)* and in about 52% of the nights below 50 *echoes/(h*km)*. The mean nightly migration rates per month ranged from 14 *echoes/(h*km)* (July 2015) to 358 *echoes/(h*km)* in October 2015, resulting in a mean migration rate of 146 *echoes/(h*km)* for the whole period. The maximum hourly values varied between 104 *echos/(h*km)* (July 2015) and 2,354 *echos/(h*km)* (March 2015). A high difference between the mean values and median within the monthly values indicates a high variance of migration rates, especially in April and October months in 2015. The seasonal distribution and intensity of the daytime migration rates as per vessel records is characterised by a strong fluctuation. The highest migration rates in spring with values between about 300 *echoes/(h*km) occurred* on two days at the end of March and on one day at the beginning of April 2015. In autumn, migration rates of more than 200 *echoes/(h*km)* were achieved on only one day (18 October 2015). The nocturnal migration rates determined by vertical radar in the cluster studies "East of Oyster Ground" showed a high variation between the individual nights. The monthly mean values of the nocturnal migration rates ranged from 29 *echos/(h*km)* (May 2016) to 361 *echos/(h*km)* in October 2016 and reached an average value of 144 *echos/(h*km)* over the whole period. The daytime migration rates were lower (mean value: 84 echos/(h*km)) and ranged from 27 echos/(h*km) in April 2016 to 125 echos/(h*km) in October 2016. The mean nocturnal migration rates were higher in spring (162 echos/(h*km)) than in autumn (131 echos/(h*km)), but the difference was not statistically significant. In contrast, the daytime migration rates differed significantly between migration periods with higher migration rates in autumn (105 echos/(h*km). There were days with stronger migration than in spring (54 echos/(h*km) especially in August and October 2016.

An approximate comparison of the above described results of migration intensities for individual areas gives roughly comparable results for all areas (**EN1-13**) with regard to the monthly averages. Differences can be seen in the maximum values. However, it must be taken into account that there is a large interannual variability.

However, a current cross-project evaluation of all data from large-scale bird migration monitoring for offshore wind farm projects showed a gradient of decreasing migration intensities with increasing distance from the coast (WELCKER

2019a) for the nocturnal bird migration across the North Sea, which is dominated by songbirds.

Taking into account the high rate of migration over the German Bight, the individual areas **EN1** to **EN13 are of** medium significance with regard to the criterion of migration intensity.

*Number of species and endangerment status of the species involved*

In terms of species numbers and endangerment status, the areas **EN1** to **EN13** do not differ significantly. In the above-mentioned current studies for 2015 and 2016, between 68 and 81 species were identified in the sea areas each year. Of the species identified, 7-13 species are listed in Annex I of the V-RL. The species numbers identified are rated as average and the endangerment status as above average.

*Conclusion*

Although guidelines and areas of concentration are missing, the areas **EN1** to **EN13** have an average to above-average significance for bird migration overall.

## 2.10 Bats and bat migration

Bats are characterised by a very high mobility. While bats can travel up to 60 km per day in search of food, nesting or summer resting places and wintering areas are several hundred kilometres apart. Migration movements of bats in search of extensive food sources and suitable resting places are very often observed on land, but predominantly aperiodically. However, migratory movements of bats over the North Sea are still poorly documented and largely unexplored.

### 2.10.1 Data availability

Data sources on bat migration over the North Sea are not sufficient for a detailed description of the occurrence and intensity of bat migration in the offshore area. In the following, reference is made to general literature on bats, findings from systematic recordings on Helgoland as well as acoustic recordings on the research platform FINO1 and other sources of knowledge in order to reflect the current state of knowledge.

### 2.10.2 Spatial distribution and status assessment

Both the sedentary and migratory behaviour of bats is highly variable. On the one hand, differences can occur depending on species and sex. On the other hand, sedentary or migratory movements can vary greatly even within the populations of a species. Based on their sedentary behaviour, bats are divided into short-distance, medium-distance and long-distance migratory species.

In their search for nesting, feeding and resting places, bats migrate short and medium-distances. Corridors along flowing waters, around lakes and Bodden waters are known to be popular for medium-distance migration (BACH & MEYER-CORDS 2005). However, long-distance migrations are still largely unexplored. Bats migratory routes are scarcely described. This particularly applies to migratory movements across the open sea. In contrast to bird migration, which has been confirmed by extensive studies, the migration of bats remains largely unexplored due to the lack of suitable methods or large-scale special monitoring programmes.

Long-distance migratory species include common noctule (*Nyctalus noctula*), Nathusius' *pipistrelle* (*Pipistrellus nathusii*), parti-coloured bat (*Verspertilia murinus*) and Leisler's *bat* (*Nyctalus leisleri*). For these four species, regular migrations over a distance of 1,500 to 2,000 km have been documented (TRESS et al. 2004, HUTTERER et al. 2005).

Long-distance migratory movements are also assumed for the soprano pipistrelle *Pipistrellus pygmaeus* and common pipistrelle *Pipistrellus pipistrellus* species (BACH & MEYER-CORDS 2005). Some long-distance migratory species occur in Germany and countries bordering the North Sea and have occasionally been encountered on islands, ships and platforms in the North Sea.

However, based on observations of bats on Helgoland, the number of bats migrating from the Danish coast across the German North Sea in autumn is estimated at around 1,200 individuals (SKIBA 2007). An evaluation of observations of bats migrating from southwest Jutland to the North Sea comes to the same conclusion (SKIBA 2011).

Although visual observations, e.g. on the coast or on ships and offshore platforms, provide initial indications, they are hardly suitable for fully understanding the migration behaviour of nocturnal bats over the sea. The recording of ultrasonic calls of bats by suitable detectors (so-called "bat detectors") provides good results on the occurrence and migratory movements of bats on land (SKIBA 2003). The results obtained so far from the use of bat detectors in the North Sea only provide initial indications. Acoustic recordings of bat migration over the North Sea on the FINO1 research platform only detected a minimum of 28 individuals between August 2004 and December 2015 (HÜPPOP & HILL 2016).

When recording bat migration over the open sea, the general occurrence, species composition and migration routes as well as the heights at which bats migrate must be considered in order to assess the potential risk of collision with offshore wind farms. The individuals surveyed by HÜPPOP & HILL (2016) were recorded between 15 - 26 m at mean sea level, depending on location and methods, which includes the area between the lower rotor blade tip and the water surface of the majority of wind farms. BRABANT et al (2018) investigated the bat occurrence at the Thornton Bank wind farm using bat detectors at 17 m and 94 m height. Only 10% of the 98 bat images were recorded at higher altitudes, i.e. significantly fewer than at 17 m..

As per Annex IV of the Habitats Directive, all bat species are among the animal and plant species of Community interest that require strict protection. Some species, such as the **Nathusius' pipistr**elle and the noctule are listed in Annex II to the 1979 Convention on the Conservation of Migratory Species of Wild Animals (CMS), "Bonn Agreement". A total of 25 bat species are native to Germany. In the current Red List of mammals (MEINIG et al. 2008), two of these species are classified as "endangered to an unknown extent", four species are classified as "critically endangered" and three species as "threatened with extinction". *Schreibers' long-fingered bat* (*Miniopterus schreibersii)* is considered "extinct or missing". Of the species that have so far been recorded more frequently in marine or coastal areas of Germany, the noctule is on the early warning list, while the common pipistrelle and the Nathusius' pipistrelle are considered "safe". For an assessment of the endangerment status of the common swift data availability is considered insufficient.

Data available for the North Sea EEZ is fragmentary and insufficient to draw conclusions on bat migration. It is not possible to draw concrete conclusions on migratory species, migration directions, migration heights, migration corridors and possible concentration ranges on the basis of the available data. What we have seen so far only confirms that bats, especially long-distance migratory species, fly over the North Sea.

## 2.11 Biological diversity

Biological diversity (or biodiversity for short) encompasses the diversity of habitats and biotic communities, the diversity of species and genetic diversity within species (Art. 2 Convention on Biological Diversity, 1992). The public focus is on species diversity. Species diversity is the result of an evolutionary process that has been going on for over 3.5 billion years, a dynamic process of extinction and species formation. Of the approximately 1.7 million species described by science to date, some 250,000 occur in the sea, and although there are considerably more species on land than in the sea, the sea is more comprehensive and phylogenetically more highly developed than the land in terms of its tribal biodiversity. Of the known 33 animal strains, 32 are found in the sea, and even 15 of these are exclusively marine (VON WESTERNHAGEN & Dethlefsen 2003).

Marine diversity cannot be directly observed and is therefore difficult to assess. For their assessment, tools such as nets, weirs, grabs, traps or optical registration methods must be used. However, the use of such gear can only provide a partial picture of the actual species spectrum, and only of the one that is specific to the fishing gear in question. Since the North Sea, as a relatively shallow marginal sea, is more easily accessible than, for example, the deep sea, intensive marine and fisheries research has been carried out for about 150 years, which has led to an increase in knowledge about its flora and fauna. This has made it possible to draw on inventory lists and species catalogues in order to document possible changes (VON WESTERNHAGEN & DETHLEFSEN 2003). According to the results of the Continuous Plankton Recorder (CPR), about 450 different plankton taxa (phyto- and zooplankton) have been identified in the North Sea. About 1,500 marine species of macrozoobenthos are known. Of these, an estimated 800 are found in the German North Sea region (RACHOR et al. 1995). According to YANG (1982), the fish fauna of the North Sea is composed of 224 fish and lamprey species. For the German North Sea, 189 species are listed (FRICKE et al. 1995). In the North Sea EEZ, 19 species of seabirds and resting birds regularly occur in larger stocks. Three of these species are listed in Annex I of the V-RL.

With regard to the current state of biodiversity in the North Sea, there is ample evidence of changes in biodiversity and species composition at all systematic and trophic levels in the North Sea. The changes in biodiversity are mainly due to human activities such as fishing and marine pollution, or to climate change.

Red lists of endangered animal and plant species have an important monitoring and warning function in this context, as they show the status of the populations of species and biotopes in a region. Using the Red Lists, it can be seen that 32.2% of all currently assessed macrozoobenthos species in the North Sea and Baltic Sea (RACHOR et al. 2013) and 27.1% of the fish and lamprey species established in the North Sea (THIEL et al. 2013, FREYHOF 2009) are assigned to a Red List category. Marine mammals form a species group in which all representatives are currently endangered, with the bottlenose dolphin having even disappeared from the German North Sea area (VON NORDHEIM et al. 2003). Of the 19 regularly occurring sea and resting bird species, three species are listed in Annex I of the V-RL. In general, the V-RL requires that all native bird species living in the wild be conserved and thus protected.

## 2.12 Air

Shipping causes emissions of nitrogen oxides, sulphur dioxides, carbon dioxide and soot particles. These can have a negative impact on air quality and are largely discharged into the sea as atmospheric deposition. Since 1 January 2015, shipping in the North Sea has been subject to stricter rules as an emission control area, the so-called Sulphur Emission Control Area (SECA). Under Annex VI, Regulation 14 of MARPOL, ships may only use heavy fuel oil with a maximum sulphur content of 0.1%. Worldwide, a limit of 3.5% is currently still in force. According to a decision of the International Maritime Organisation (IMO) in 2016, this limit is to be reduced worldwide to 0.5% from 2020.

Emissions of nitrogen oxides are particularly relevant for the North Sea as an additional nutrient load. In 2017 the IMO has therefore decided that the North Sea will be declared a "Nitrogen Emission Control Area" (NECA) from 2021. The reduction in the discharge of nitrogen oxide into the Baltic Sea region through the North Sea and Baltic Sea ECA measure is estimated at 22,000 tonnes in total (European Monitoring and Evaluation Programme (EMEP 2016)).

## 2.13 Climate

The German North Sea is located in the temperate climate zone. An important influencing factor is warm Atlantic water from the North Atlantic Current. Icing can occur in coastal areas, but is rare and only occurs at intervals of several years.

There is broad agreement among climate researchers that the global climate system is being noticeably affected by the increasing release of greenhouse gases and pollutants and that the first signs of this are already being felt.

According to a recent report by the Intergovernmental Panel on Climate Change ( (IPCC, 2019)), the large-scale consequences of climate change on the oceans are expected to be, in particular, a rise in sea surface temperature, further acidification and a decrease in oxygen. Sea levels continue to rise at an increasing rate. Many marine ecosystems are sensitive to climate change.

Global warming is also expected to have a significant impact on the North Sea, both through a rise in sea level and through changes in the ecosystem. In recent years, for example, species that were previously only found further south have increasingly spread, and the habits of long-established species have changed, sometimes considerably.

## 2.14 Landscape

The marine landscape visible today above the water column is characterised by extensive open space structures surrounded by offshore wind turbines. In the future, the landscape will continue to change due to the expansion of offshore wind energy utilisation, and the necessary lighting can also have a negative impact on the appearance of the landscape.

In addition to offshore wind farms, the area under review also includes platforms and measuring masts for research purposes, which are located within or in the immediate vicinity of the wind farms. In addition, the A6-A production platform is currently located in the Duck's Bill area (hydrocarbon extraction).

The extent to which the landscape is impaired by vertical structures depends strongly on the visibility conditions.

The space in which a building becomes visible in the landscape is the visual sphere of action.

It is defined by the visual relationship between the building and its surroundings, whereby the intensity of an effect decreases with increasing distance (GASSNER et al. 2005).

In the case of platforms and offshore wind farms planned at a distance of at least 30 km from the coastline, the impairment of the landscape as perceived from land is not very high. At such a distance the platforms and wind farms will not be massively visible even in good visibility conditions. This also applies to night-time safety lighting.

## 2.15 Cultural and other material assets (underwater cultural heritage)

### 2.15.1 Recording of the protected asset underwater cultural heritage and data availability for the underwater cultural heritage in the EEZ

Known underwater cultural heritage in the coastal waters and to some extent in the EEZ is recorded in the register of sites and monuments of the North German coastal states. However, it is important to note that this only applies to a small part of the underwater cultural heritage. The cultural authorities of the federal states are exclusively responsible for the state waters. Therefore, a systematic processing of information on the underwater cultural heritage in the EEZ has been limited. The quality of the data also varies, for example from identified historical wrecks to inaccurate information from records, and may need to be improved in order to make a concrete planning statement. The registers of sites and monuments therefore reflect the current state of knowledge, but not the actual stock of underwater cultural heritage.

An active recording of underwater obstacles - and thus also shipwrecks - in the North German coastal waters is only carried out by the Federal Maritime and Hydrographic Agency (BSH). However, this wreck search does not focus on underwater cultural heritage, but rather on the location and assessment of shipping obstacles. It therefore concentrates on objects rising from the seabed which could pose a threat to shipping or fishing. Although the findings of the BSH are regularly included in the registers of sites and monuments of coastal countries, underwater cultural heritage sites that are covered by sediment or barely visible on the seabed are not normally recorded in wreck searches.

An impression of the actual density of ground monuments in the coastal waters is provided by maritime construction projects such as submarine cable connections or pipelines, in the course of which a large number of previously unknown ground monuments regularly come to light during the preliminary investigations.

The risk of unexpected discovery of soil monuments in the course of a construction project can only be minimised by a qualified stocktaking as part of the environmental assessment of the implications.

### 2.15.2 Potential for prehistoric settlement traces in the German EEZ

In the early Holocene, areas of the German EEZ in the North Sea were also landlocked regions which were settled by humans between 10,000 and 6,000 years ago (Schmölcke et al. 2006; Behre 2003). In water depths of up to 20 m, previously preserved paleolandscape remains in the form of peat and tree remains have been identified (Tauber 2014). Archaeological cultural heritage in the form of settlement sites has been investigated at water depths of up to 10 m (Hartz et al. 2014). As a result, water depths of between 15 m and 50 m in the German North Sea EEZ are expected to yield preserved prehistoric settlement traces in paleosol landscapes. Landscape reconstructions can be used to identify special potential areas for archaeological sites. By evaluating erosion zones, areas with no longer preserved traces of occupation can be identified.

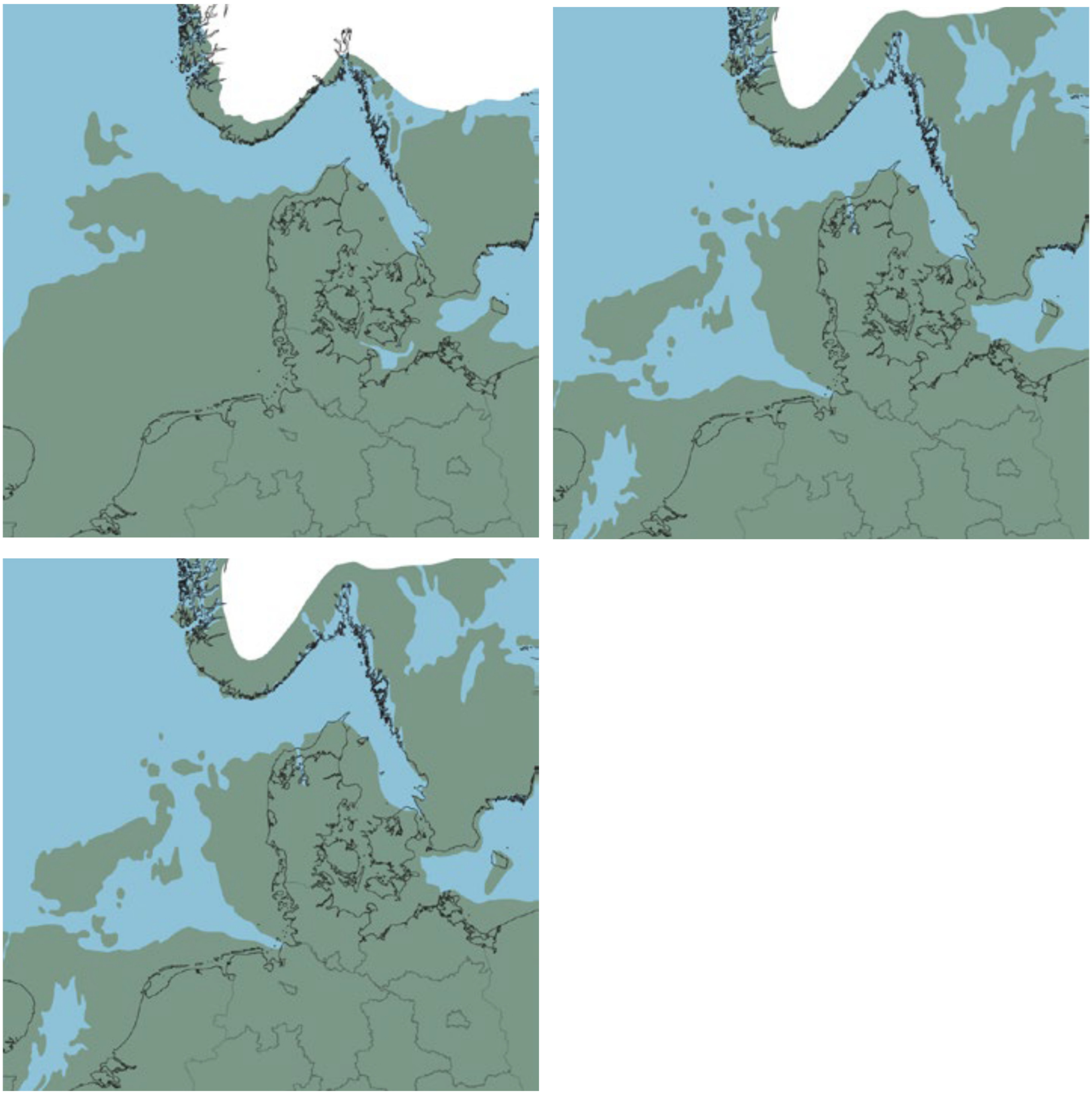


Figure 39: Sea level rise and landscape changes during the Holocene in Northern Europe (from top to bottom: 9700-9200 cal. BC (Preboreal); 8700-8000 cal. BC (Boreal); 6500-4500 cal. BC (Atlantic). Today's coastlines and the borders of the federal states are highlighted in grey, land is shown in green, seas and lakes are marked in blue, and glaciers appear in white (maps compiled by the Centre for Baltic and Scandinavian Archaeology, here taken from a specialist article on the cultural heritage of the heritage protection authorities of the coastal states of Lower Saxony, Schleswig-Holstein and Mecklenburg-Western Pomerania)

An example of an area with high potential for the preservation of Stone Age settlement sites is the Ems Glacial Valley. Using drill cores and reflection seismics, the bedrock of the North Sea basin was reconstructed and the glacial valley of the Ems, which flows into the Elbe glacial stream, was traced (HEPP et al. 2017, HEPP et al. 2019). In the Mesolithic period, river valleys formed important settlement areas for the population oriented towards hunting and fishing. Of particular importance is the finding that the primeval river Ems changed from fresh to brackish water over the course of 200 years, which corresponds to a rapid sea-level rise of around 2.5 m per year (HEPP et al. 2019, 591). Due to the rapid flooding and sedimentation, it is possible that not only individual finds but entire sites with a closed find context at the bottom of the North Sea have been preserved here.

With a total area of 18,700 $km^2$, Dogger Bank is the largest sandbank in the North Sea, extending into the "Duck`s Bill" of the German EEZ. While the North Sea has an average depth of 94 m, Dogger Bank is on average only 30 m deep. On the basis of individual finds, a settlement of the so-called Doggerland in the area of the Dogger Bank can be proven from the early Mesolithic period onwards (BALLIN, 2017); BAILEY et al. 2020, 190 ff.) A particular potential for the preservation of archaeological sites is given by a natural phenomenon that took place when Dogger Bank was still terrestrial and populated: settlements could have been preserved as a closed find context under a massive sedimentary layer that was deposited here by a tidal wave triggered by the Storegga landslide in Norway around 6225-6170 BC (BONDEVIK et al. 2012; FLEMMING 2004, 26).

### 2.15.3 Wrecks of vessels and wreckage

This type of underwater cultural heritage includes not only wrecks of watercraft but also wreckage and associated equipment, cargo and inventories. The majority of known wreck sites are made up of boats and vessels of various periods. The spectrum ranges from Stone Age dugouts to wooden trading vessels from the Middle Ages and warships from the World Wars.

Seaworthy vessels have been documented archaeologically for the North Sea area from the Bronze Age onwards. These include several boats from Great Britain, of which the Dover boat from around 1575-1520 BC is probably the best known (Clark 2004).

From the Middle Ages onwards, the sea routes of long-distance traders ran across the open sea, as the 12th chapter of the Hanseatic Sea Book in the "Hausmeer" (home sea) of the Hanseatic League shows. Although ship finds from this period have so far tended to be found in the immediate coastal area and in silted up former harbour areas, new finds in the open sea are increasingly being added. For example, during the salvage of containers in the North Sea in 2019, a merchant ship from 1536 with a cargo of copper bars was discovered by chance (van Ommeren 2019).

Shipping in the North and Baltic Seas in the 16th-18th centuries was mainly influenced by the rise of the United Netherlands as a trading power and the naval wars of the Scandinavian kingdoms for supremacy over the Baltic Sea. Examples include the Swedish flagship "Princessan Hedvig Sophia", which sank in 1715, the frigate "Mynden", which sank off the coast of Rügen in 1718, and the Danish turret ship "Lindormen" from 1644 (Auer 2004; Auer 2010; Segschneider 2014).

In the course of the 18th and 19th centuries, the volume of trade across the North and Baltic Seas increased enormously. Examples include coal exports from the British Isles and timber exports from the Baltic States. These goods were transported on wooden sailing ships and later on iron steamships. Lively maritime trade also led to an increase in shipping accidents during this period. Archaeologically investigated ship finds from this period include the wreck of the British merchant ship "General Carleton" from 1785 (Ossowski, 2008), and the wreck of a 19th century coal transporter off Rotterdam (Adams et al., 1990).

With the advent of industrial composite aircraft wrecks and iron or steel shipbuilding from the middle of the 19th century onwards, the knowledge gained from written and pictorial sources outweighs the knowledge gained from the use of the materials. Because of the often better preservation, wrecks from the 19th and 20th centuries are currently far more present in archaeological evidence than wooden wrecks (Oppelt 2019). In the longer term, however, this is likely to change due to the progressing corrosion of steel wrecks.

Due to their historical significance and the lack of written sources on certain military and war-related aspects, wrecks from the two world wars are listed as archaeological cultural monuments up to and including 1945. They also have an important function as places of remembrance (Ickerodt 2014). Particularly in the course of the 1st World War, naval battles also resulted in the loss of several vehicles in a limited space. In August 1914, for example, three small cruisers and a torpedo boat were sunk in a naval battle between the Imperial German and British navies west of Helgoland. The wrecks of these cruisers are all located in the German EEZ (Huber & Witt 2018).

Equipment or parts of cargo may provide evidence of past maritime activities. Among the most common objects are anchors which for various reasons could not be recovered after an anchor manoeuvre and remained on the seabed.

So-called ballast heaps, accumulations of stone ballast on the bottom, for example, occurred during the loading of ships in front of a natural harbour, but can also be an indication of the lightening of a vehicle that has run aground. However, it is not uncommon for ballast material to conceal a shipwreck.

### 2.15.4 Aircraft wrecks and rockets

Most of the known finds of aircraft wrecks in the North and Baltic Seas are related to World War II. The fates of countless aircraft crews, both on the Allied and the German side, are unknown. Aircraft crashes can rarely be precisely located, making it difficult to classify the wrecks. While emergency ditching can lead to relatively well-preserved aircraft wrecks, crash sites are often marked by extensive debris fields at the bottom of the water. In addition to providing insights into technical aspects of construction and deployment, the aircraft wrecks of the Second World War also bear eloquent testimony to the events of the war.

Another aspect is the possible presence of human remains. Especially wrecks from the last two wars are often not only ground monuments but also war graves.

Although prehistoric and early wreck finds were mostly discovered in coastal waters or came from burial sites, under favourable conditions such finds could also be found in the German EEZ. Medieval shipwrecks at the latest are known from the high Baltic Sea at depths of over -50 m. There, the wooden wrecks are particularly well preserved thanks to the low temperatures and low levels of infestation by wood-decomposing organisms.

In general, wooden ships or their remains may have survived undetected under sediment layers. Even if parts of the wreck are barely visible above ground, considerable remains of a ship's hull together with the ship's inventory can be hidden under the sediment. Cargo residues and parts of the equipment or armament are thus in a closed find context and, like "time capsules", allow unique insights into the past.

### 2.15.5 Potential for wrecks in the German EEZ

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### 2.15.6 Status assessment of the protected asset underwater cultural heritage

Central factors for the definition of an archaeological monument (ground monument or underwater monument) are its cultural-historical significance (monument worthiness) and the public interest in its research and preservation (monument worthiness).

The significance of the protected asset or its monument value is assessed according to the following criteria (see also the monument protection laws of the federal states; see also Ickerodt 2014):

- Historical testimonial value
- Scientific or technical value, research value
- Social significance (place of remembrance, e.g. sea grave)
- Rarity value
- Integrity (conservation level, status, endangerment)

The testimonial value varies according to the preservation and type of the site. For example, the historical testimonial value of underwater sites is generally very high due to the very good conservation conditions for organic materials. On land, Middle Stone Age sites are mostly limited to scattered flint objects. Only by preserving bones, antlers, wood and other plant remains in boggy and underwater sites, the way of life, settlement structure or social organisation of the people of that time can be researched further. The same applies to finds of organic materials from well-preserved shipwrecks, which may belong to personal equipment, cargo or armament. Well preserved wrecks with preserved inventory and construction elements have a high testimonial value.

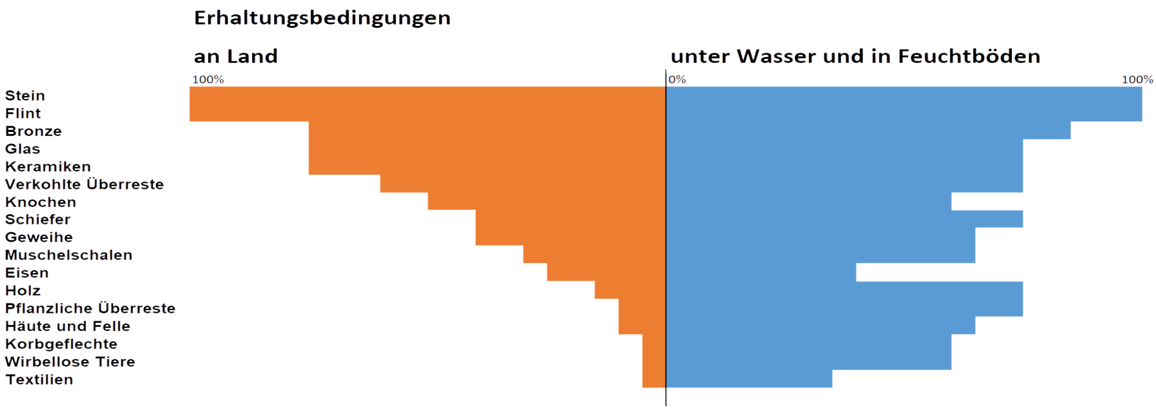



Figure 40: Comparison of preservation conditions of archaeological finds on land and under water (after Coles 1988).

The technical value can be derived from the example of watercrafts. These were among the most advanced means of transport of their time and reflect the technological know-how of a society. Merchant ships were built to transport cargo safely over long distances. Warships were not only intended to serve as effective battle platforms, but also had to meet high standards in terms of seaworthiness, manoeuvrability and speed, and also had a representative function. Therefore the scientific, technical and testimonial value of shipwrecks with well-preserved construction elements is high.

Since the loss of a vehicle with cargo and inventory records a certain moment in the past, wrecks are often referred to as "time capsules". If properly preserved, an analysis of the wreckage provides detailed insights into everyday life on board. In addition to technological progress, ship finds can therefore often also be used to draw conclusions about political, economic and scenic factors as well as the social structure of a society. This illustrates the extraordinary research value of underwater sites and also their special integrity compared to sites on land.

The social commemorative value of the wrecks of ships and aircraft from the First and Second World Wars is particularly important.

The rarity value varies according to the type and dating of the site. Prehistoric wrecks have a very high rarity value. The same applies to medieval and early modern wreck finds in good condition. Modern wreck finds can also have a high rarity value if they are characterised by special technical or construction features.

The integrity or the conservation status of an underwater site must be determined and assessed individually in each case. Both the deposition conditions during the genesis of a site or during the sinking and emplacement of a wreck, as well as subsequent destruction, for example by abiotic factors such as erosion by currents or decomposition by organisms, influence the integrity and preservation of a site or parts of a site. As already mentioned, the preservation conditions for organic materials under oxygen-tight conditions in the underwater environment are particularly outstanding. While exposed wrecks are exposed to erosion and can be damaged by various uses on the seabed, fully covered sites offer excellent conservation conditions.

The spatial location of a large number of wrecks is known on the basis of the evaluation of existing hydroacoustic recordings and the wreck database of the BSH and is recorded in the BSH's nautical charts. No further information is available for the EEZ on ground monuments such as settlement remains.

## 2.16 Protected assetuman being, including human health

Overall, the area under review for which the spatial plan makes rules is of little significance for the protected asset human being.

On the one hand, the marine environment provides the working environment for people employed on ships and fixed installations at sea, in maritime shipping, fisheries, offshore wind industry, extraction of raw materials, scientific research and defence.

Precise figures on the number of people regularly staying in the area are not available.

Its importance as a working environment can be considered as rather low. Occupational health and safety is subject to the relevant specialist legislation, for shipping e.g. international maritime law and national regulations, for offshore wind energy protection and safety concepts are drawn up as part of the approval procedures. On the other hand, the sea is a recreational and leisure area for people who use the sea space, on ferries and cruise ships, but also with sports boats and tourist vessels.

Direct use for recreation and leisure by pleasure boats and tourist vessels is seldom found in the North Sea.

Further impacts on humans or their living environment from activities at sea, e.g. as a result of shipwrecks, can occur beyond the area under review, especially on islands and along the coasts.

As the North Sea EEZ as a whole is of little importance for active recreational use and as a working environment, the prior pollution levels can be considered low. A special significance of the area under review for human health and well-being cannot be derived.

## 2.17 Interrelationships between the protected assets

The components of the marine ecosystem, from bacteria and plankton to marine mammals and birds, influence each other through complex processes. The biological protected assets plankton, benthos, fish, marine mammals and birds, which are described in detail in Chapter Introduction

Legal bases and environmental assessment tasks

Maritime spatial planning in the German Exclusive Economic Zone (EEZ) is the responsibility of the Federal Government under the Regional Planning Act (Raumordnungsgesetz, ROG). In accordance with Article 17(1) of the ROG, the competent Federal Ministry, the Federal Ministry of the Interior, Building and Community (BMI), in agreement with the federal ministries concerned, draws up a spatial plan for the German EEZ as a statutory instrument. In accordance with Article 17(1) Sentence 3 of the ROG, the BSH carries out the preliminary procedural steps for drawing up the spatial plans (Raumordnungsplans, ROP) with the consent of the BMI. When drawing up the ROP, an environmental assessment is carried out in accordance with the provisions of the ROG and, where applicable, those of the Environmental Impacts Assessment Act (Gesetz über die Umweltverträglichkeitsprüfung, UVPG), the so-called Strategic Environmental Assessment (SEA).

The obligation to carry out a strategic environmental assessment, including the preparation of an environmental report, is a result of the updating, amendment and cancellation of the existing spatial plans from 2009, from Articles 7(7) and (8) of the ROG, in conjunction with Article 35(1) No. 1 of the UVPG and No. 1.6 of Annex 5.

According to Article 1 of the SEA Directive 2001/42/EC, the aim of the Strategic Environmental Assessment is to ensure a high level of environmental protection in order to promote sustainable development and to contribute to ensuring that environmental considerations are adequately taken into account during the preparation and adoption of plans well in advance of the actual project planning. According to Article 8 of the ROG, the Strategic Environmental Assessment has the task of determining the likely significant impacts of implementing the plan and to describe and evaluate them in an environmental report at an early stage. It serves to ensure effective environmental precautions in accordance with the applicable laws and is performed according to uniform principles and with public participation. All protected resources under Article 8(1) of ROG are to be considered:

- people, including human health
- fauna, flora, and biodiversity
- site, soil, water, air, climate and landscape
- cultural and other material resources
- the interactions between the above-mentioned protected resources.

In the context of spatial planning, definitions are mainly made in the form of priority and reserved areas and other objectives and principles.

The requirements and content of the environmental report to be prepared are specified in Annex 1 of Article 8(1) of the ROG.

Accordingly, the environmental report consists of an introduction, a description and assessment of the environmental impacts identified in the environmental review, in accordance with Article 8(1) of the ROG, and additional information.

According to No. 2d) of Annex 1 of Article 8 of the ROG, other planning options that may be expressly considered should also be named, taking into account the objectives and the geographical scope of the ROP.

## 2.17 Outline of the content and main objectives of the spatial plan

According to Article 17(1) of the ROG, the spatial plan for the German EEZ must take into account any interaction between land and sea, as well as safety aspects

5. to ensure safety and ease of navigation,
6. for further economic uses,
7. for scientific uses and
8. to protect and improve the marine environment.

According to Article 7(1) of the ROG, spatial plans for a specific planning area and a regular medium-term period must contain specifications as **objectives and principles** of spatial planning for the development, order and safeguarding of the area, in particular for the uses and functions of the area.

Under Article 7(3) of the ROG, these provisions may also designate areas. For the EEZ, these may be the following areas:

**Priority areas** intended for certain spatially significant functions or uses and excluding other spatially significant functions or uses in the area, where these are incompatible with the priority functions or uses.

**Reserved areas,** which are to be reserved for certain spatially significant functions or uses, to which particular weight is to be attached when comparing them to competing spatially significant functions or uses.

**Suitability areas for the marine area** in which certain spatially significant functions or uses do not conflict with other spatially significant interests, whereby these functions or uses are excluded elsewhere in the planning area.

In the case of priority areas, it may be stipulated that they also have the effect of suitability areas under Article 7(3) Sentence 2 No. 4 of the ROG.

According to Article 7(4) of the ROG, the spatial plans should also contain spatially significant planning provisions and measures by public bodies and entities under private law according to Article 4(1) Sentence 2 of the ROG which are suitable for inclusion in spatial plans, are necessary for the coordination of spatial claims, and can be secured by objectives or principles of spatial planning.

## 2.18 Relationship to other relevant plans, programmes and projects

In Germany, there is a tiered planning system for the coordination of all spatial requirements and concerns arising in a given area, consisting of Federal, State and Regional planning authorities. According to Article 1(1) Sentence 2 of the ROG, this system is used to coordinate different spatial requirements in order to balance out conflicts arising at the respective planning level and to make provisions for individual uses and functions of the space.

The tiered system allows the planning to be further specified by the subsequent planning levels. According to Article 1(3) of the ROG, the development, organisation and safeguarding of the subspaces should be integrated into the conditions and requirements of the overall area, and the development, organisation and safeguarding of the overall area should take into account the conditions and requirements of its subspaces.

The Federal Ministry of the Interior, Building and Community (BMI) is responsible for spatial planning at federal level in the EEZ. In contrast, the respective federal state is responsible for state planning for the entire area of the state, including the respective coastal waters.

In addition to spatial planning for the respective areas of responsibility, there are sectoral plans based on sectoral laws for certain planning areas. Sectoral plans serve to define details for the respective sector, taking into account the requirements of spatial planning.

### 2.18.1 Spatial plans in adjacent areas

In the interests of coherent planning, coordination processes with the plans of the coastal federal states and neighbouring states are advisable and must be taken into account in the cumulative assessment of impacts on the marine environment. At present, the spatial planning of both Lower Saxony and Schleswig-Holstein is being updated. Regional spatial planning programmes of the coastal regions will be taken into account, provided that significant definitions are made for the coastal waters.

#### 2.18.1.1 Lower Saxony

The spatial plan for the state of Lower Saxony, including the coastal sea of Lower Saxony, is the State Spatial Planning Programme (Landesraumordnungsprogramm, LROP). The Ministry of Food, Agriculture and Consumer Protection of Lower Saxony, as the highest state planning authority, is responsible for drawing up and amending it; the final decision on the LROP is the responsibility of the state government. The LROP is based on a directive from 1994 and has been updated several times since then, most recently in 2017. At the end of 2019, the procedure for a new update was initiated.

#### 2.18.1.2 Schleswig-Holstein

In Schleswig-Holstein, the State Development Plan (Landesentwicklungsplan, LEP S-H) is the basis for the state's spatial planning. The Ministry of the Interior, Rural Areas, Integration and Equality of Schleswig-Holstein (MILIG) is responsible for drafting it and amending it. The current LEP S-H, from 2010, forms the basis for the spatial planning of the state until 2025. The state of Schleswig-Holstein has initiated the procedure for updating the LEP S-H 2010 and carried out a participation procedure in 2019.

#### 2.18.1.3 Netherlands

The Netherlands is in the fourth revision cycle and is currently preparing the planning phase. The plan is binding and covers a planning area.

#### 2.18.1.4 United Kingdom

England consists of 11 planning areas and each area is to receive its own plan. These are to be designed for a long-term period of about 20 years and updated every three years. It is envisaged that all plans will be in place by 2021.

The Scottish Plan is currently being revised and is in its second cycle. The consultation on the revision of the first plan has just been completed. Scotland has one national maritime spatial plan and 11 spatial planning areas. The spatial plans are also binding in Scotland.

#### 2.18.1.5 Denmark

Denmark is at an advanced stage of the spatial planning process. Denmark is currently drafting the first spatial plan as a comprehensive plan for the North Sea and the Baltic Sea, which will be binding and last until 2050.

### 2.18.2 MSFD programme of measures

Each Member State must develop a marine strategy to achieve good status for its marine waters, which for Germany is the North Sea and the Baltic Sea. The key to this is the establishment of a programme of measures to achieve or maintain good environmental status and the practical implementation of this programme of measures. The establishment of the programme of measures is regulated in Germany by Article 45h of the Federal Water Act

(Wasserhaushaltsgesetz, WHG). Under Objective 2.4 "Oceans with sustainably and carefully used resources", the current MSFD programme of measures mentions maritime spatial planning as a contribution of existing measures to achieving the operational objectives of the MSFD. In addition, the catalogue of measures also formulates a concrete review mandate for updating the spatial plans with regard to measures for the protection of migratory species in the marine area. Both the environmental objectives of the MSFD and the MSFD programme of measures are taken into account in the SEA.

### 2.18.3 Management plans for the North Sea EEZ nature reserves

On 17 November 2017, the Federal Agency for Nature Conservation (Bundesamt für Naturschutz, BfN) initiated the participation procedure under Article 7(3) of the Regulation on the Establishment of the "Borkum Riffgrund" Nature Conservation Area (NSGBRgV), Article 7(3) of the Regulation on the Establishment of the Doggerbank Nature Conservation Area (NSGDgbV) and Article 9(3) of the Regulation on the Establishment of the "Sylt Outer Reef - Eastern German Bight" Nature Conservation Area (NSGSylV) on the management plans for the nature conservation areas in the German North Sea EEZ. On 13 May 2020, the management plans "Borkum Riffgrund", "Doggerbank" and "Sylt Outer Reef - Eastern German Bight" were published in the Federal Gazette.

### 2.18.4 Tiered planning procedure for offshore wind energy and power lines (central model)

For some uses in the German EEZ, such as offshore wind energy and power cables, a multi-stage planning and approval process—i.e. a subdivision into several stages—is envisaged. In this context, the instrument of maritime spatial planning is at the highest and superordinate level. The spatial plan is the forward-looking planning instrument which coordinates the most diverse interests of users in the fields of industry, science and research as well as protection claims. A strategic environmental assessment must be carried out when the spatial plan is drafted. The SEA for the ROP is related to various downstream environmental assessments, in particular the directly downstream SEA for the site development plan (FEP).

The next level is the FEP. Within the framework of the so-called central model, the FEP is the control instrument for the orderly expansion of offshore wind energy and electricity grids in a tiered planning process. The FEP has the character of a sectoral plan. The sectoral plan is designed to plan the use of offshore wind energy and the electricity grids in a targeted manner and as optimally as possible under the given framework conditions—in particular the requirements of spatial planning—by defining areas and sites as well as locations, routes and route corridors for grid connections or for cross-border submarine cable systems. In principle, a SEA is carried out to accompany the establishment, updating and modification of the FEP.

In the next step, the sites for offshore wind turbines defined in the FEP will undergo a preliminary examination. If the requirements of Article 12(2) of the Wind Energy At Sea Act (WindSeeG) are met, the preliminary examination is followed by the determination of the suitability of the site for the construction and operation of offshore wind energy installations. The preliminary investigation is also accompanied by a SEA.

If the suitability of a site for the use of offshore wind energy is established, the site is put out to tender and the winning bidder or corresponding entitled entity can submit an application for approval (planning approval or planning permission) for the erection and operation of wind turbines on the area specified in the FEP. As part of the planning approval procedure, an environmental impact assessment is carried out if the prerequisites are met.

While the sites defined in the FEP for the use of offshore wind energy are pre-examined and tendered, this is not the case for defined sites, routes and route corridors for grid connections or cross-border submarine cable systems. Upon application, a planning approval procedure including an environmental assessment is usually carried out for the construction and operation of grid connection lines. The same applies to cross-border submarine cable systems.

Under Article 1(4) of the UVPG, the UVPG also applies where federal or state legislation does not specify the environmental impact assessment in more detail or does not comply with the essential requirements of the UVPG.

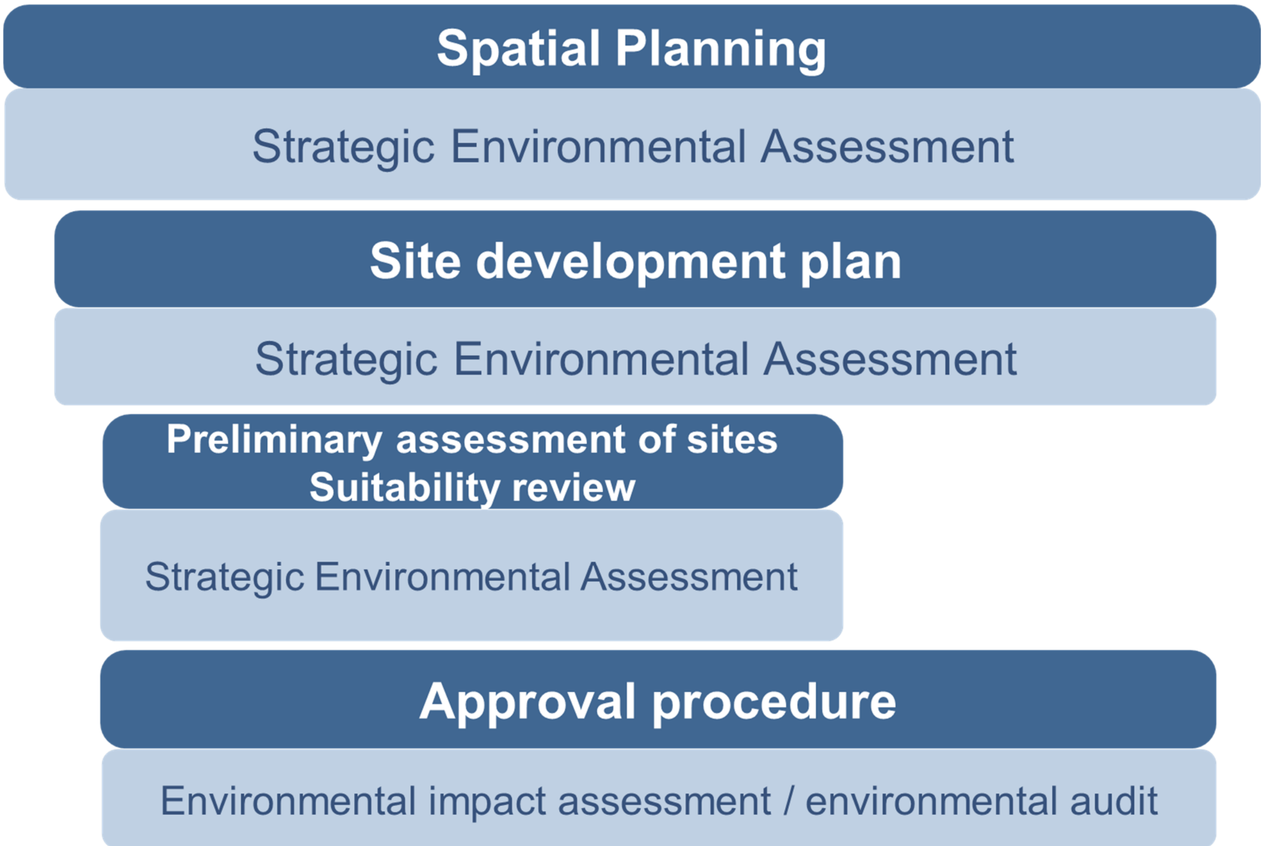



Figure 1: Overview of the tiered planning and approval process in the EEZ.

In the case of multi-stage planning and approval processes, it follows from the relevant legislation (e.g. Federal Regional Planning Act, WindSeeG and BBergG) or, more generally, from Article 39(3) of the UVPG that, in the case of plans, when defining the scope of the investigation, it should be determined at which of the process stages certain environmental impacts are to be assessed. In this way, multiple assessments are to be avoided. The nature and extent of the environmental impacts, technical requirements, and the content and subject matter of the plan must be taken into account.

In the case of subsequent plans and subsequent approvals of projects for which the plan sets a framework, the environmental assessment pursuant to Article 39(3) Sentence 3 of the UVPG shall be limited to additional or other significant environmental impacts as well as to necessary updates and more detailed investigations.

As part of the tiered planning and approval process, a common feature of all reviews is that environmental impacts on the protected resources specified in Article 8(1) of the ROG and Article 2(1) of the UVPG are considered, including their interactions.

According to the definition in Article 2(2) of the UVPG, environmental impacts within the meaning of the UVPG are direct and indirect impacts of a project or the implementation of a plan or programme on the protected resources.

According to Article 3 of the UVPG, environmental assessments comprise the identification, description and assessment of the significant impacts of a project or a plan or programme on the protected resources. They serve to ensure effective environmental protection in accordance with the applicable laws and are carried out according to uniform principles and with public participation.

In the offshore sector, avifauna has become established as a sub-category of the objects of protection of animals, plants and biological diversity: seabirds/resting and migratory birds, benthos, biotope types, plankton, marine mammals, fish and bats.

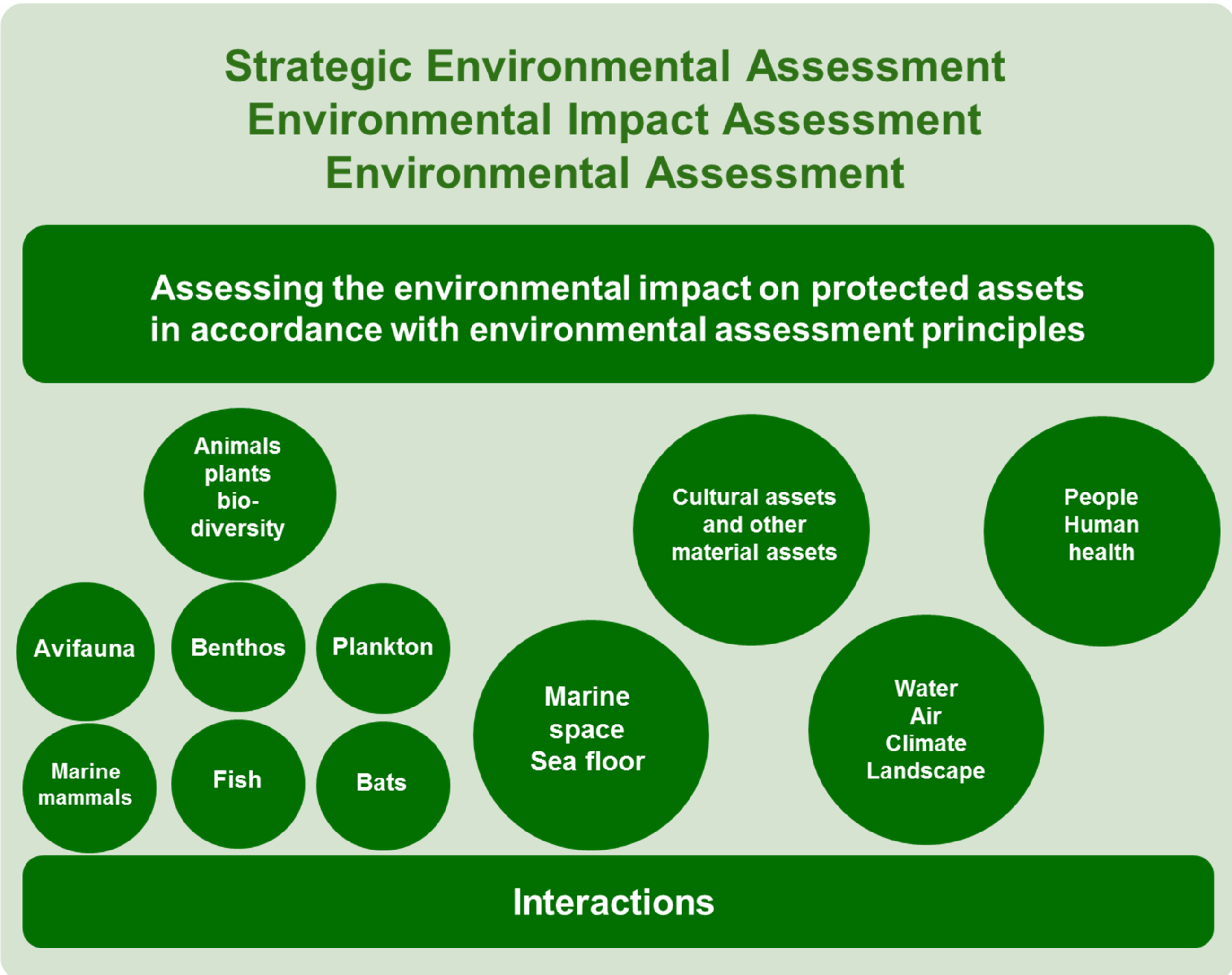



Figure 2: Overview of the protected resources in the environmental assessments.

The detail of the tiered planning process is as follows:

#### 2.18.4.1 Maritime spatial planning (EEZ)

At the highest and superordinate level is the instrument of maritime spatial planning. For sustainable spatial planning in the EEZ, the BSH prepares a spatial plan on behalf of the competent Federal Ministry, which comes into force in the form of statutory orders.

The spatial plans should **define**, taking into account possible interactions between land and sea, and safety aspects

- to ensure the safety and ease of navigation,
- for further economic uses,
- for scientific uses and
- to protect and improve the marine environment.

In the context of spatial planning, specifications are mainly made in the form of priority and reserved areas and other objectives and principles. According to Article 8(1) of the ROG, when drafting spatial plans, the body responsible for the spatial plan must carry out a strategic environmental assessment in which the likely significant impacts of the respective spatial plan on the resources to be protected, including interactions, must be identified, described and evaluated.

The **aim** of the instrument of spatial planning is to optimise overall planning solutions. A wider spectrum of uses and functions is considered. Fundamental strategic questions should be clarified at the beginning of a planning process. In this way, the instrument primarily functions, within the framework of the legal provisions, as a controlling planning instrument for the planning administrative bodies in order to create a framework for all uses which is compatible with the spatial and natural environment as far as possible.

In spatial planning, the **depth of examination** is generally characterised by a greater scope of investigation, i.e. a fundamentally greater number of planning options, and a lesser depth of investigation in terms of detailed analyses. Above all, regional, national and global impacts as well as secondary, cumulative and synergetic effects are taken into account.

The **focus** is therefore on possible cumulative effects, strategic and large-scale planning options and possible transboundary impacts.

#### 2.18.4.2 Site development plan

The next level is the FEP.

The **specifications** to be made by the FEP and to be examined within the framework of the SEA result from Article 5(1) of the WindSeeG. The plan mainly specifies areas and sites for wind energy plants as well as the expected capacity to be installed on these sites. In addition, the FEP also specifies routes, route corridors and sites. Planning and technical principles are also laid down. Although these also serve, among other things, to reduce environmental impacts, they may in turn lead to impacts, so that an assessment is required as part of the SEA.

With regard to the FEP's **objectives,** it deals with the fundamental questions of the use of offshore wind energy and grid connections on the basis of the legal requirements, especially with the need, purpose, technology and the identification of sites and routes or route corridors. Therefore, the primary function of the plan is as a steering planning instrument in order to create a spatially and, as far as possible, nature-compatible framework for the implementation of individual projects, i.e. the construction and operation of offshore wind energy plants, their grid connections, cross-border submarine cable systems and interconnections.

The **depth of the assessment** of the likely significant environmental effects is characterised by a wider scope of investigation, i.e. a larger number of alternatives and, in principle, a lower depth of investigation. At the level of sectoral planning, detailed analyses are generally not yet performed. Above all, local, national and global impacts, as well as secondary, cumulative and synergistic impacts in the sense of an overall view, are taken into account.

As with the instrument of maritime spatial planning, the **focus** of the audit is on possible cumulative effects as well as possible cross-border impacts. In addition, the FEP focuses on strategic, technical and spatial alternatives, especially for the use of wind energy and power lines.

#### 2.18.4.3 Suitability test as part of the preliminary examination

The next step in the tiered planning process is the suitability testing of sites for offshore wind turbines.

In addition, the power to be installed is determined on the site in question.

In accordance with Article 10(2) of the WindSeeG, the suitability test assesses whether the construction and operation of offshore wind energy installations on the site conflicts with the criteria for the inadmissibility of defining a site in the site development plan, in accordance with Article 5(3) of the WindSeeG or, insofar as they can be assessed independently of the later design of the project, with the interests relevant for the plan approval in accordance with Article 48(4) Sentence 1 of the WindSeeG.

Both the criteria of Article 5(3) of the WindSeeG and the matters of Article 48(4) Sentence 1 of the WindSeeG require an assessment of whether the marine environment is endangered. With regard to the latter concerns, there must be an assessment of whether pollution of the marine environment within the meaning of Article 1(1) No. 4 of the United Nations Convention on the Law of the Sea is at risk and whether bird migration is endangered.

Therefore, the preliminary examination with the suitability assessment or determination is the instrument connected between the FEP and the individual approval procedure for offshore wind energy plants. It refers to a specific site designated in the FEP and is thus much smaller than the FEP. It is distinguished from the plan approval procedure by the fact that an inspection approach which is independent of the later specific type of plant and layout is to be applied. So, the impact prognosis is based on model parameters, e.g. in two scenarios or ranges of scenarios which are intended to represent possible realistic developments.

Compared to the FEP, the SEA of the proficiency test is characterised by a smaller examination area and a greater **depth of examination**. In principle, fewer and spatially limited alternatives are seriously considered. The two primary alternatives are the determination of the suitability of a site on the one hand and the determination of its (possibly partial) unsuitability (see Article 12(6) of the WindSeeG) on the other. Restrictions on the type and extent of development, which are included as specifications in the determination of suitability, are not alternatives in this sense.

The **focus** of the environmental assessment within the framework of the suitability test is on considering the local impacts of a development with wind energy plants in relation to the site and the location of the development on the site.

#### 2.18.4.4 Approval procedure (planning approval and planning licensing procedure) for offshore wind turbines

The next step after the preliminary examination is the approval procedure for the installation and operation of offshore wind turbines. After the site under examination has been put out to

tender by the BNetzA, the winning bidder can, once BNetzA has accepted the bid, submit an application for planning approval or—if the prerequisites are met—for planning permission for the construction and operation of offshore wind energy plants, including the necessary ancillary plants on the site under examination.

In addition to the legal requirements of Article 73(1) Sentence 2 of the VwVfG, the plan must include the information contained in Article 47(1) of the WindSeeG. The plan may only be established under certain conditions listed in Article 48(4) of the WindSeeG, and only if, inter alia, the marine environment is not endangered, in particular if there is no cause for concern about pollution of the marine environment within the meaning of Article 1(1) No.4 of the Convention on the Law of the Sea, and if bird migration is not endangered.

Under Article 24 of the UVPG, the competent authority prepares a summary of

- the environmental impact of the project
- the characteristics of the project and the site, which are intended to prevent, reduce or offset significant adverse environmental effects
- measures to prevent, reduce or offset significant adverse environmental impacts
- the replacement measures in case of interventions in nature and landscape.

Under Article 16(1) of the UVPG, the project developer must submit a report to the competent authority on the expected environmental impacts of the project (EIA report), which must contain at least the following information:

- a description of the project, including information on the location, nature, scale and design, size and other essential characteristics of the project
- a description of the environment and its components within the project's sphere of influence
- a description of the characteristics of the project and of the location of the project to exclude, reduce or offset the occurrence of significant adverse environmental effects of the project
- a description of the measures planned to prevent, reduce or offset any significant adverse effects of the project on the environment and a description of planned replacement measures
- a description of the expected significant environmental effects of the project
- a description of the reasonable alternatives, relevant to the project and its specific characteristics, that have been considered by the developer and the main reasons for the choice made, taking into account the specific environmental effects of the project
- a generally understandable, non-technical summary of the EIA report.

Pilot wind energy plants are only dealt with in the context of the environmental assessment in the approval procedure and not at upstream stages.

#### 2.18.4.5 Approval procedure for grid connections (converter platforms and submarine cable systems)

In the tiered planning process, the establishment and operation of grid connections for offshore wind energy plants (converter platform and submarine cable systems, if applicable) is examined at the level of the approval procedures (planning approval and planning permission procedures) when implementing the spatial planning requirements and the specifications of the FEP at the request of the respective project executing agency—the responsible TSO.

According to Article 44(1) in conjunction with Article 45(1) of the WindSeeG, the construction and operation of facilities for the transmission of electricity require planning approval. In addition to the legal requirements of Article 73(1) Sentence 2 of the VwVfG, the plan must include the information contained in Article 47(1) of the WindSeeG. The plan may only be approved under certain conditions listed in Article 48(4) of the WindSeeG and only if, inter alia, the marine environment is not endangered, in particular if there is no cause for concern about pollution of the marine environment within the meaning of Article 1(1) No.4 of the Convention on the Law of the Sea, and no threat to bird migration.

Moreover, according to Article 1(4) of the UVPG, the requirements for the environmental impact assessment of offshore wind energy installations, including ancillary installations, apply accordingly to the performance of the environmental assessment.

#### 2.18.4.6 Cross-border submarine cable systems

According to Article 133(1) in conjunction with Article 133(4) of the BBergG (Federal Mining Act), the construction and operation of an underwater cable in or on the continental shelf requires a permit

- from a mining point of view (through the competent state mining authority)
- concerning the organisation of the use and exploitation of waters above the continental shelf and the airspace above these waters (through the BSH).

In accordance with Article 133(2) of the BBergG, the above-mentioned permits may only be refused if there is a risk to the life or health of persons or material resources or an impairment of overriding public interests which cannot be prevented or compensated for by a time limit, conditions or requirements. An impairment of overriding public interests exists in particular in the cases specified in Article 132(2) No. 3 of the BBergG. In accordance with Article 132(2) No. 3 b) and d) of the BBergG, an impairment of overriding public interests with regard to the marine environment exists in particular if the flora and fauna would be impaired in an unacceptable manner or if there is reason to believe that the sea will be polluted.

In accordance with Article 1(4) of the UVPG, the essential requirements of the UVPG must be observed for the construction and operation of transboundary submarine cable systems.

## Tabular overview of environmental audits: Focus of the investigations

| Maritime spatial planning<br>SEA | FEP<br>SEA | Preliminary study<br>SEA suitability test | Approval procedure<br>(planning approval or planning permission) grid connections<br>EA | Approval procedure<br>Transboundary submarine cable systems<br>EA |
|---|---|---|---|---|
| **Strategic planning for designations** | **Strategic planning for designations** | **Strategic decision on suitability of sites for OWF** | **Request for environmental assessment** | **Request for environmental assessment** |
| **Specifications and subject matter** | | | | |
| Priority and reservation areas<br>• To ensure the safety and efficiency of navigation,<br>• To further economic uses. especially offshore wind energy and pipelines<br>• To enable scientific uses and to protect and improve the marine environment<br>Objectives and principles<br>Application of the ecosystem approach | • Areas for offshore wind turbines<br>• Areas for offshore wind turbines, including the expected capacity to be installed | • Verification of the suitability of the site for the construction and operation of wind turbines, including the capacity to be installed<br>• On the basis of the available and collected data (STUK) as well as other information that can be determined with reasonable effort<br>• Specifications in particular on the type, extent and location of the development | • The construction and operation of platforms and interconnectors<br>• In accordance with the requirements of maritime spatial planning and the site development plan | • The construction and operation of transboundary submarine cable systems<br>• According to the requirements of regional planning and the FEP |
| **Environmental impact analysis** | | | | |
| Analyses (identifies, describes and assesses) the likely significant effects of the plan on the marine environment | Analyses (identifies, describes and assesses) the likely significant environmental effects of the plan on the marine environment | Analyses (determines, describes and evaluates) the likely significant environmental impacts of the construction and operation of wind turbines, which can be assessed independently of the later design of the project, on the basis of model assumptions | Analyses (determines, describes and evaluates) the environmental impacts of the specific project (platform and connecting undersea cable, if applicable). | Analyses (identifies, describes and evaluates) the environmental impacts of the specific project. |
| **Objective** | | | | |
| Aims at the optimisation of overall planning solutions, i.e. comprehensive packages of measures.<br>Consideration of a wider range of uses.<br>Begins at the beginning of the planning process to clarify strategic issues of principle, i.e. at an early stage when there is even greater scope for action. | For the use of offshore wind energy, addresses the fundamental questions of<br>• Needs or statutory objectives<br>• Purpose<br>• Technology<br>• Capacities<br>• Finding locations for platforms and tracks. | For the use of wind turbines, deals with the fundamental questions of<br>• Capacity<br>• Suitability of the area<br>Provides information on the site required by law for the submission of bids. | Deals with questions regarding the concrete design ("how") of a project (technical equipment, construction - building permits).<br>Assesses the environmental compatibility of the project and formulates conditions for this. | Deals with questions regarding the concrete design ("how") of a project (technical equipment, construction - building permits).<br>Assesses the environmental impact of the project and also formulates conditions. |

| | | | | |
|---|---|---|---|---|
| Essentially functions as a controlling planning instrument of the planning administrative bodies to create an environmentally compatible framework for all uses. | Searches for environmentally sound packages of measures without absolutely assessing the environmental compatibility of the planning.<br><br>Acts mainly as a steering planning instrument to create an environmentally sound framework for the realisation of individual projects (wind turbines and grid connections, transboundary submarine cables) | Searches for environmentally sound packages of measures without assessing the environmental compatibility of the specific project.<br>Acts as an instrument between the FEP and the approval procedure for wind turbines on a specific site. | Serves primarily as a passive assessment instrument that reacts to requests from the project developer. | Serves primarily as a passive assessment instrument that reacts to requests from the project developer. |
| **Assessment depth** | | | | |
| Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses)<br><br>Considers spatial, national and global impacts as well as secondary, cumulative and synergistic impacts in the sense of a comprehensive perspective . | Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses)<br><br>Takes into account local, national and global impacts as well as secondary, cumulative and synergistic impacts in the sense of an overall view. | Characterised by a smaller assessment area, greater depth of study (detailed analyses).<br><br>The determination of suitability may include specifications for the subsequent project, in particular with regard to the type and extent of the development of the site and its location. | Characterised by a narrower scope of study (limited number of alternatives) and greater depth of study (detailed analyses).<br><br>Assesses the environmental compatibility of the project and formulates conditions for this.<br><br>Considers primarily local impacts in the vicinity of the project. | Characterised by a narrower scope of study (limited number of alternatives) and greater depth of study (detailed analyses).<br><br>Considers primarily local impacts in the vicinity of the project. |
| **Focus of the assessment** | | | | |
| **Cumulative effects**<br>Overall perspective<br>Strategic and large-scale alternatives<br>Possible transboundary effects | **Cumulative effects**<br>Overall perspective<br>Strategic, technical and spatial alternatives<br>Possible transboundary effects | **Local effects in** relation to the site and its location. | Environmental impacts of turbines, construction and operation<br><br>Turbine dismantling<br><br>Study in relation to the specific installation design.<br><br>Intervention, compensation and replacement measures. | Environmental impacts of turbines, construction and operation<br><br>Study in relation to the specific installation design.<br><br>Intervention, compensation and replacement measures. |

**Approval procedure (plan approval or plan permit) for wind turbinesEIA**

## Assessment subject

**Environmental impact assessment on request for**

- The installation and operation of wind turbines
- The site defined and pre-examined in the FEP
- According to the designations of the FEP and the specifications of the preliminary study.

## Environmental impact assessment

Analyses (determines, describes and evaluates) the environmental impacts of the specific project (wind turbines, platforms and internal cabling of the wind farm, if applicable)

Under Section 24 UVPG, the competent authority prepares a summary

- Of the environmental impacts of the project,
- Of the characteristics of the project and of the site, which are intended to prevent, reduce or offset **significant adverse environmental effects,**
- Of the measures to prevent, reduce or offset **significant negative environmental impacts**, and
- Of the replacement measures in the event of interference with nature and landscape (note: exception under Section 56 subsection 3 BNatSchG

## Objective

Addresses the questions of the specific design ("how") of a project (technical equipment, construction).

Serves primarily as a passive assessment instrument that reacts to requests from the tender winner/project developer.

## Assessment depth

Characterised by a narrower scope of study, i.e. a limited number of alternatives, and greater depth of study (detailed analyses).

Assesses the environmental compatibility of the project on the site under study and formulates conditions for this.

Considers mainly local effects in the vicinity of the project.

## Focus of the assessment

The main focus of the assessment is formed by:

- Environmental impacts from construction and operation.
- Assessment in relation to the specific installation design.
- Installation dismantling.

Figure 3: Overview of key aspects of environmental assessments in planning and approval procedures.

### 2.18.5 Cables

On the upper level is the instrument of spatial planning. In this framework, areas or corridors for pipelines and data cables are defined.

According to Article 8(1) of the ROG, the likely significant effects of the pipeline provisions on the protected resources must be identified, described and assessed.

According to Article 133(1) in conjunction with Article 133(4) of the BBergG, the construction and operation of a transit pipeline or underwater cable (data cable) in or on the continental shelf requires a permit

- from a mining point of view (through the competent state mining authority) and
- concerning the organisation of the use and exploitation of waters above the continental shelf and the airspace above these waters (through the BSH).

According to Article 133(2) of the BBergG, the above-mentioned permits may only be refused if there is a risk to the life or health of persons or material resources or an impairment of overriding public interests which cannot be prevented or compensated for by a time limit, conditions or requirements. An impairment of overriding public interests exists in particular in the cases specified in Article 132(2) No. 3 of the BBergG. In accordance with Article 132(2) No. 3 b) and d) of the BBergG, an impairment of overriding public interests with regard to the marine environment exists in particular if the flora and fauna are impaired in an unacceptable manner or if there is reason to believe that the sea will be polluted.

In accordance with Article 133(2a) of the BBergG, the construction and operation of a transit pipeline, which is also a project within the meaning of Article 1(1) No.1 of the UVPG, is subject to an environmental impact assessment in the licensing procedure with regard to the organisation of the use and exploitation of the waters above the continental shelf and the airspace above these waters, as stipulated in the UVPG.

In accordance with Article 1(4) of the UVPG, the essential requirements of the UVPG must be observed for the construction and operation of data cables.

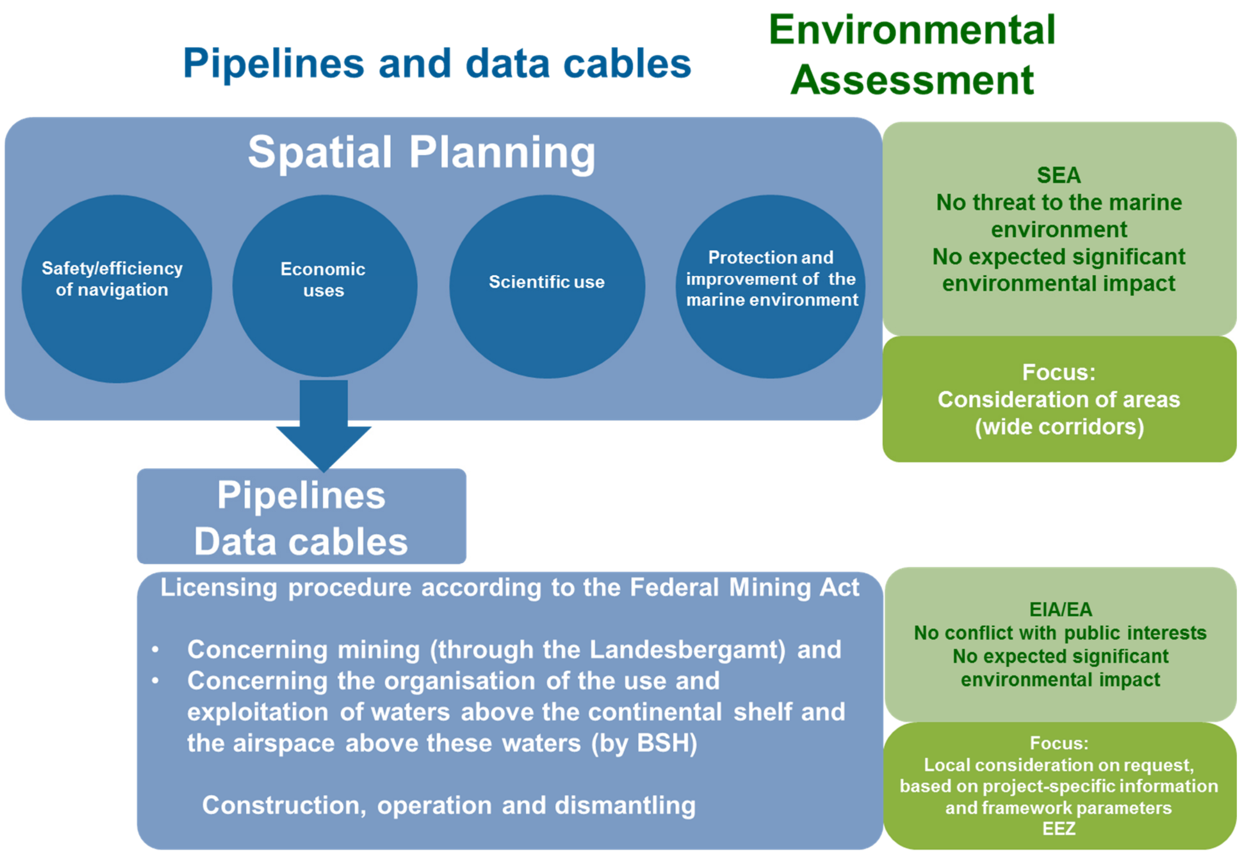



Figure 4: Overview of the focal points of the environmental assessment for pipelines and data cables.

### 2.18.6 Raw material extraction

In the German North and Baltic Seas, various mineral resources are sought and extracted, e.g. sand, gravel and hydrocarbons. As a superordinate instrument, spatial planning addresses possible large-scale spatial definitions, possibly including other uses. The anticipated significant environmental effects are reviewed (cf. also Chapter 1.5.4).

During implementation, the extraction of raw materials is regularly divided into different phases: exploration, development, operation and aftercare phase.

The exploration serves the purpose of exploring raw material deposits in accordance with Article 4(1) of the BBergG. In the marine area, it is regularly carried out by means of geophysical surveys, including seismic surveys and exploration drilling. In the EEZ, the extraction of raw materials includes the extraction (loosening, release), processing, storage and transport of raw materials.

In accordance with the Federal Mining Act, mining permits (permission, licence) must be obtained for exploration in the area of the continental shelf. These grant the right to explore for and/or extract mineral resources in a specified field for a specified period. Additional permits in the form of operating plans are required for development (extraction and exploration activities) (cf. Article 51 of the BBergG). For the establishment and management of an operation, main operating plans must be drawn up for a period not normally exceeding two years, which must be continuously updated as required (Article 52(1) Sentence 1 of the BBergG).

In the case of mining projects requiring an EIA Act, the preparation of a general operating plan is mandatory, and a planning approval procedure must be carried out for its approval (Article 52(2a) of the BBergG). Framework operation plans are generally valid for a period of 10 to 30 years.

In accordance with Article 57c of the BBergG in conjunction with the Regulation on the Environmental Impact Assessment of Mining Projects (UVP-V Bergbau), the construction and operation of production platforms for the extraction of oil and gas in the area of the continental shelf requires an EIA. The same applies to marine sand and gravel extraction on mining sites of more than 25 ha or in a designated nature reserve or Natura 2000 area.

The licensing authorities for the German North Sea and Baltic Sea EEZ are the state mining authorities.

#### 2.18.7 Shipping

In the context of spatial planning, the shipping sector is regularly defined in terms of areas (priority and/or reserved areas), objectives and principles. There is no tiered planning and approval process for the shipping sector, as is the case for the offshore wind energy sector, grid connections, cross-border submarine cables, pipelines and data cables.

With regard to the consideration of the likely significant effects of the provisions on the shipping sector, reference is made to Chapter 1.5.4.3

#### 2.18.8 Fisheries and marine aquaculture

Fisheries and aquaculture are considered as concerns in the context of spatial planning. There is no tiered planning and approval process. The framework for authorised catches, fishing techniques and gear is set within the framework of the EU's Common Fisheries Policy (CFP).

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

#### 2.18.9 Marine scientific research

Marine scientific research projects can have an adverse effect on the marine environment, e.g. through underwater noise generated during seismic surveys. On its website, the BfN mentions, among other things, the construction of artificial islands, installations or structures, the use of explosives, or measures of direct relevance to the exploration and exploitation of resources, which are in principle likely to have a significant effect on the area and must be assessed for their compatibility with the purpose of protecting potentially affected Natura 2000 protected areas before they are approved.

In this case, a nature conservation examination and approval are also required as part of the approval procedure. Notification is required for projects which do not require authorisation, and which may significantly affect Natura 2000 sites.

In the reserved areas, research is predominantly carried out by the Thuenen Institute under the technical supervision of the BMEL, especially within the framework of the CFP and reporting obligations within ICES. This takes place within the framework of long-term regular sampling and is not subject to authorisation in the EEZ.

#### 2.18.10 National and alliance defence

National and alliance defence is considered a concern in the context of spatial planning. There is no tiered planning and approval process.

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

#### 2.18.11 Leisure

The issue of leisure is also considered. There is no tiered planning and approval process.

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

## 2.19 Presentation and consideration of environmental protection objectives

The ROP and the SEA will be drafted and implemented with due regard for the objectives of environmental protection. These provide information on the environmental status that is to be achieved in the future (environmental quality objectives). The objectives of environmental protection can be found in an overview of the international, EU and national conventions and regulations dealing with marine environmental protection, on the basis of which the Federal Republic of Germany has committed itself to certain principles and objectives. The environmental report will contain a description of how compliance with the requirements is checked and what specifications or measures are taken.

### 2.19.1 International conventions on the protection of the marine environment

The Federal Republic of Germany is party to all relevant international conventions on marine environmental protection.

#### 2.19.1.1 Globally applicable conventions that are wholly or partly aimed at protecting the marine environment

- the 1973 Convention for the Prevention of Pollution from Ships, as amended by the 1978 Protocol (MARPOL 73/78)
- 1982 United Nations Convention on the Law of the Sea
- Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (London, 1972) and the 1996 Protocol

#### 2.19.1.2 Regional agreements on marine environmental protection

- Trilateral Wadden Sea Cooperation (1978) and Trilateral Monitoring and Assessment Programme of 1997 (TMAP)
- 1983 Agreement for Co-operation in Dealing with Pollution of the North Sea by Oil and Other Harmful Substances (Bonn Agreement)
- 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)

#### 2.19.1.3 Agreements specific to protected resources

- 1979 Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
- 1979 Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

Under the Bonn Convention, regional agreements for the conservation of the species listed in Appendix II were concluded in accordance with Article 4 No. 3 of the Bonn Convention:

- 1995 Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)
- 1991 Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)
- 1991 Agreement on the Conservation of Seals in the Wadden Sea
- 1991 Agreement on the Conservation of Populations of European Bats (EUROBATS)
- 1993 Convention on Biological Diversity

### 2.19.2 Environmental and nature protection requirements at EU level

The relevant EU legislation must be taken into account:

- Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning (MSP Directive)
- Council Directive 337/85/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (Environmental Impact Assessment Directive, EIA Directive)
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD)
- Directive 2001/42/EC of the European Parliament and the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (Strategic Environmental Assessment Directive, SEA Directive)
- 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 (Marine Strategy Framework Directive, MSFD),
- Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (Birds Directive).

### 2.19.3 Environmental and nature conservation requirements at national level

There are also various legal provisions at national level, the requirements of which must be taken into account in the environmental report:

- Law on nature conservation and landscape management (Federal Nature Conservation Act - BNatSchG)
- Water Resources Act (WHG)
- Law on Environmental Impact Assessment (UVPG)
- Regulation on the establishment of the nature reserve "Sylt Outer Reef - Eastern German Bight", the regulation on the establishment of the nature reserve "Borkum Riffgrund", and the regulation on the establishment of the nature reserve "Doggerbank" in the North Sea EEZ
- Management plans for nature conservation areas in the German North Sea EEZ
- Energy and climate protection targets of the Federal Government

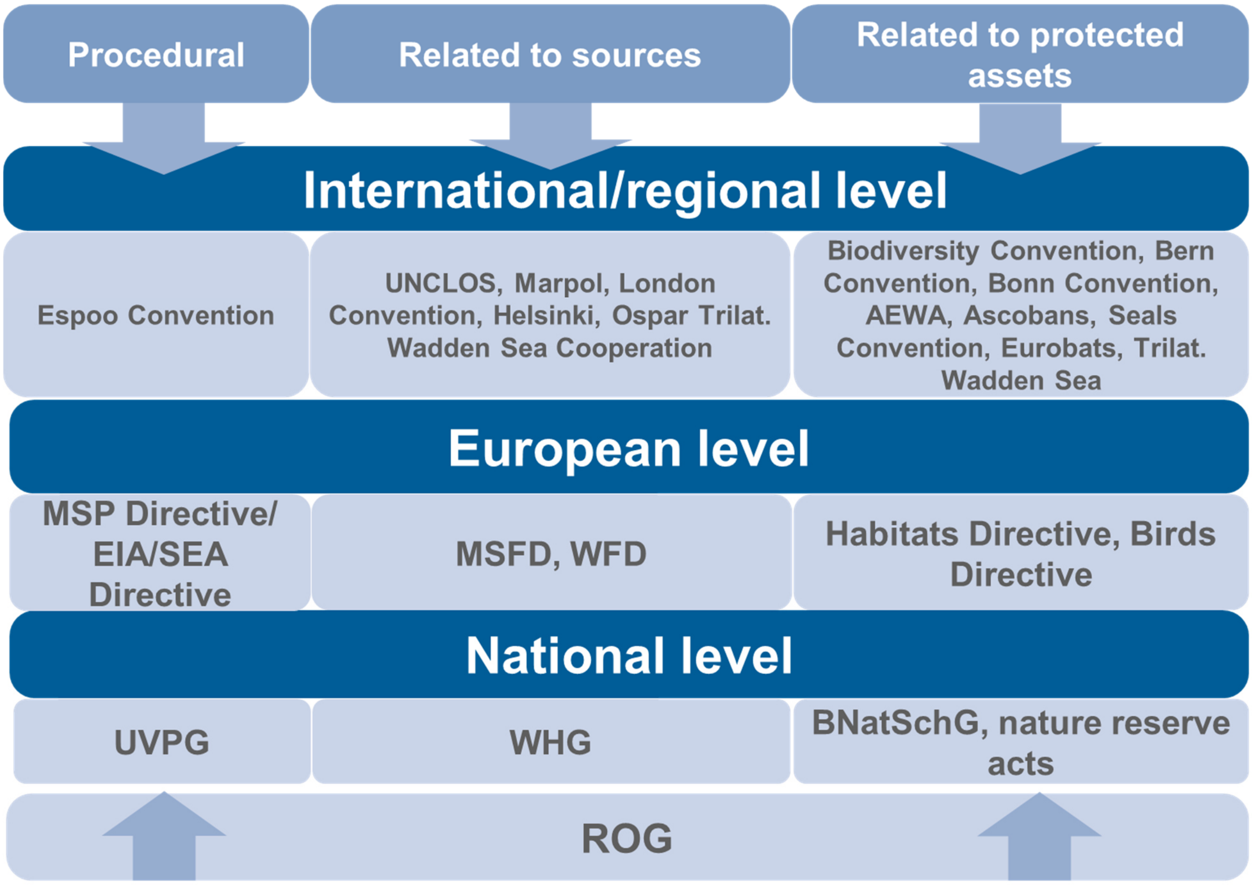



Figure 5: Overview of the levels of standardisation of the relevant legal acts for SEA.

### 2.19.4 Support for the objectives of the Marine Strategy Framework Directive

Spatial planning can support the implementation of individual objectives of the MSFD and thus contribute to good environmental status in the North Sea and Baltic Sea.

The following environmental goals (BMUB 2016) are taken into account when defining goals and principles:

- Environmental objective 1: Oceans unaffected by anthropogenic eutrophication—consideration in the objectives and principles for ensuring the safety and ease of navigation.
- Environmental objective 3: Oceans without deterioration of marine species and habitats due to the impact of human activities—consideration in the objectives and principles for offshore wind energy and nature conservation
- Environmental objective 6: Oceans without adverse impacts from anthropogenic energy inputs—consideration in the objectives and principles for offshore wind energy and pipelines

In the environmental assessment, avoidance and mitigation measures are formulated to support objectives 1, 3 and 6.

In addition, the spatial plan counteracts the deterioration of the environment by making certain uses possible only in geographically defined areas and for a limited period of time. The principles of environmental protection must be taken into account. At the permit level, the design of the use is specified in detail, with conditions if required, in order to prevent adverse effects on the marine environment.

An essential basis of the MSFD is the ecosystem approach regulated in Article 1(3) of the MSFD, which ensures the sustainable use of marine ecosystems by managing the overall

burden of human activities in a way that is compatible with the achievement of good environmental status. The application of the ecosystem approach is outlined in Chapter 4.3.

## 2.20 Strategic Environmental Assessment methodology

In principle, different methodological approaches can be considered when conducting the Strategic Environmental Assessment. The present environmental report builds on the methodology already applied in the Strategic Environmental Assessment of the federal sectoral plans and the site development plan with regard to the use of offshore wind energy and electricity grid connections.

For all other uses for which specifications are made in the ROP-E, such as shipping, extraction of raw materials and marine research, sector-specific criteria for an assessment of possible impacts are used.

The methodology is based primarily on the provisions of the plan to be examined. Within the framework of this SEA, each of the specifications is identified, described and assessed to see whether the specifications are likely to have significant effects on the protected resources concerned. According to Article 1(4) of the UVPG in conjunction with Article 40(3) of the UVPG, the competent authority shall provisionally assess the environmental impacts of the specifications in the environmental report with a view to effective environmental precautions in accordance with the applicable laws. Criteria for the assessment are to be found, inter alia, in Annex 2 of the Federal Regional Planning Act.

The purpose of the environmental report is to describe and assess the likely significant effects of the implementation of the ROP-E on the marine environment for provisions on the use and protection of the EEZ. The examination is carried out in each case on the basis of the protected resources.

According to Article 7(1) of the ROG, spatial plans must contain provisions as spatial planning **objectives and principles** for the development, organisation and safeguarding of areas, in particular on the uses and functions of areas. In accordance with Article 7(3) of the ROG, these provisions may also designate areas.

Specifications on the following uses are the subject of the environmental report, in particular

- Shipping
- Wind energy at sea
- Cables
- Raw material extraction
- Fisheries and marine aquaculture
- Marine Research
- Nature conservation/marine landscape/open space

In accordance with Article 17(1) No. 4 of the ROG, provisions for the protection and improvement of the marine environment also play a role.

### 2.20.1 Examination area

The description and assessment of the state of the environment refers to the North Sea EEZ, for which the spatial plan stipulates conditions. The SEA examination area covers the German North Sea EEZ (Figure 7). It should be noted that the data situation within the North Sea EEZ is significantly better for the area up to shipping route 10 than for the area northwest of shipping route 10. This is due to the project-related monitoring data available.

For the area north-west of shipping route 10, the spatial plan also defines the area. Based on the available sediment data and findings from monitoring for the "Doggerbank" protected area, it is also possible to describe and assess the environmental status of this area and evaluate potential environmental impacts.

The adjoining territorial sea and the adjacent areas of the riparian states are not the subject

of this plan, but they are included in the cumulative and transboundary consideration in the context of this SEA.

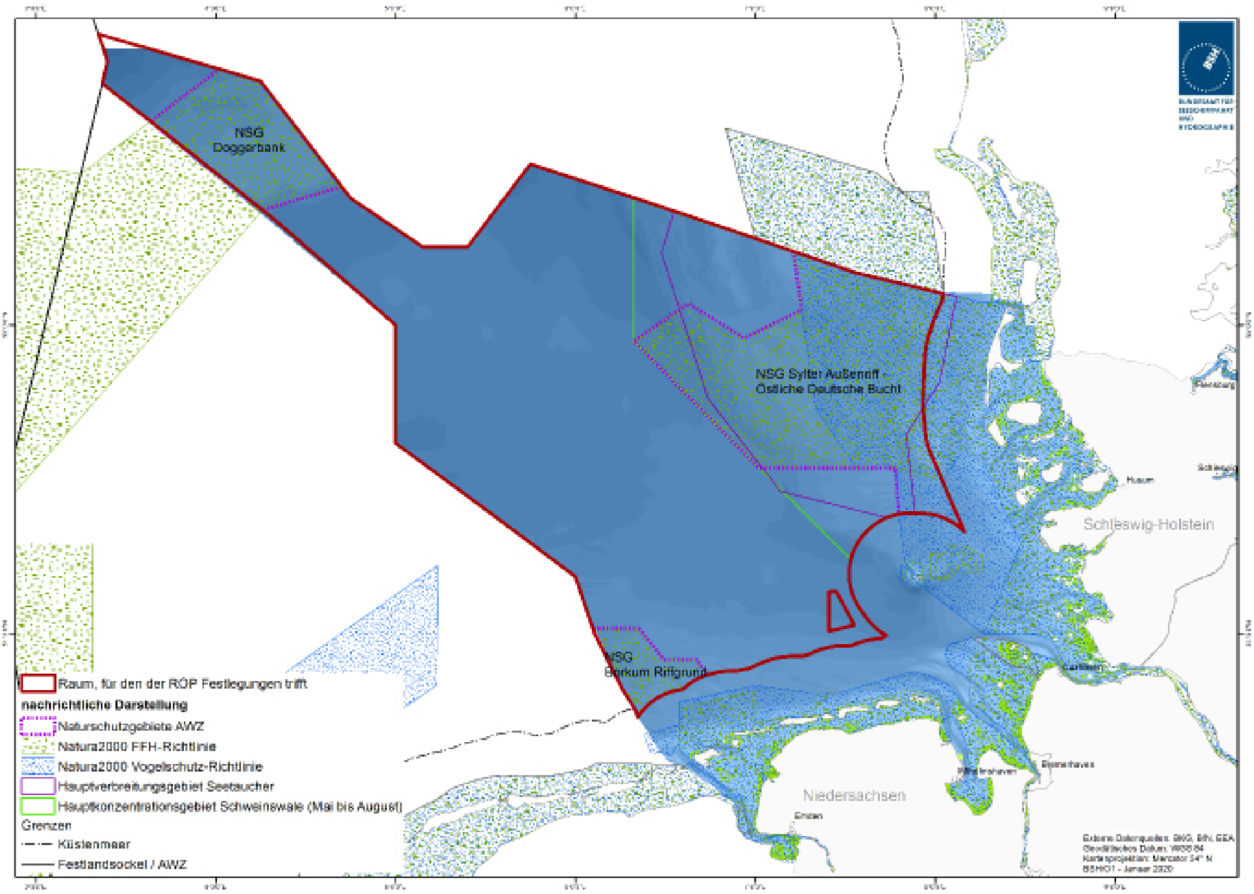



Figure 6: Boundary of the SEA investigation area (Environmental Report ROP-E EEZ North Sea).

### 2.20.2 Implementation of the environmental assessment

The assessment of the likely significant environmental effects of the implementation of the spatial plan shall include secondary, cumulative, synergistic, short-, medium- and long-term, permanent and temporary, positive and negative effects in terms of the resources to be protected. Secondary or indirect effects are those which are not immediate and therefore, may take effect after some time and/or in other places. Occasionally we also speak of consequential effects or interactions.

Possible impacts of the plan implementation are described and evaluated in relation to the protected areas. A uniform definition of the term "significance" does not exist, since it is an "individually determined significance" which cannot be considered independently of the "specific characteristics of plans or programmes" (SOMMER, 2005, 25f.). In general, significant effects can be understood to be effects that are serious and significant in the context under consideration.

According to the criteria of Annex 2 of the ROG, which are decisive for the assessment of the likely significant environmental effects, the significance is determined by

- "the probability, duration, frequency and irreversibility of the effects
- the cumulative nature of the effects
- the cross-border nature of the effects
- the risks to human health or the environment (e.g. in the event of accidents)
- the scale and spatial extent of the effect

- the importance and sensitivity of the area likely to be affected, due to its specific natural characteristics or cultural heritage, the exceeding of environmental quality standards or limit values and intensive land use
- the impact on sites or landscapes whose status is recognised as protected at national, Community or international level"

Also relevant are the characteristics of the plan, in particular

- the extent to which the plan sets a framework for projects and other activities in terms of location, type, size and operating conditions, or through the use of resources
- the extent to which the plan influences other plans and programmes, including those in a planning hierarchy
- the importance of the plan for the integration of environmental considerations, in particular with a view to promoting sustainable development
- the environmental issues relevant to the plan
- the relevance of the plan for the implementation of Community environmental legislation (e.g. plans and programmes relating to waste management or water protection) (Annex II of the SEA Directive)

In some cases, further details on when an effect reaches the significance threshold can be derived from sectoral legislation. Thresholds were developed under the law in order to be able to make a delimitation.

The description and assessment of potential environmental impacts is carried out for the individual spatial and textual specifications on the use and protection of the EEZ in relation to the protected property, including the status assessment.

Furthermore, where necessary, a differentiation is made according to different technical designs. The description and assessment of the likely significant effects of the implementation of the plan on the marine environment also relate to the protected resources presented. All contents of the plan that could potentially have significant environmental effects are examined.

Both permanent and temporary—e.g. construction-related—effects are considered. This is followed by a presentation of possible interactions, a consideration of possible cumulative effects and potential cross-border impacts.

The following protected resources are considered when assessing the state of the environment:

- Site
- Soil
- Water
- Plankton
- Biotope types
- Benthos
- Fish
- Marine mammals
- Avifauna
- Bats
- Biodiversity
- Air
- Climate
- Landscape
- Cultural and other material resources (underwater cultural heritage)
- People, in particular human health
- Interactions between protected resources

In general, the following methodological approaches are used in environmental assessment:

- Qualitative descriptions and assessments
- Quantitative descriptions and assessments
- Evaluation of studies and technical literature, expert opinions
- Visualisations
- Worst-case scenarios
- Trend assessments (e.g. on the state of the art of installations and the possible development of shipping traffic)
- Assessments by experts/the professional public

An assessment of the impacts resulting from the provisions of the plan is made on the basis of the status description and status assessment, and the function and significance of the individual areas for the individual protected resources on the one hand, and the impacts emanating from these provisions and the resulting potential impacts on the other. A forecast of the project-related impacts when the ROP-E is implemented is based on the criteria of intensity, range and duration or frequency of the effects (cf. Figure 7). Further assessment criteria are the probability and reversibility of the impacts, as specified in Annex 2 of Article 8(2) ROG.

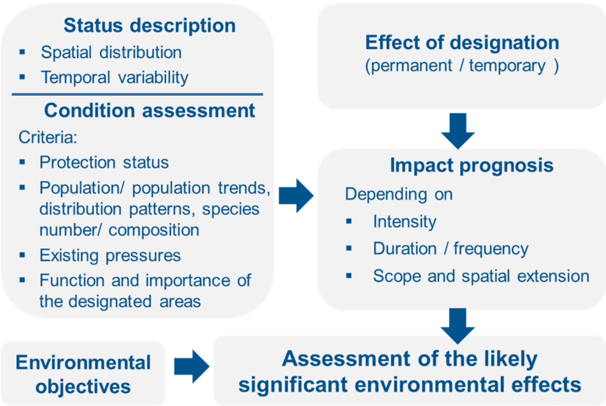



Figure 7: General methodology for assessing likely significant environmental effects.

### 2.20.3 Criteria for the description and assessment of the condition

The condition of the individual protected resources is assessed on the basis of various criteria. For the protected resources of site/soil, benthos and fish, the assessment is based on the aspects of rarity and vulnerability, diversity and peculiarity, and existing impacts. The description and assessment of marine mammals and marine and resting birds is based on the aspects listed in the figure. Since these are highly mobile species, a similar approach to that for the protected resources of site/soil, benthos and fish is not appropriate. For seabirds, resting birds and marine mammals, the criteria used are protection status, assessment of occurrence, assessment of spatial units and prior contamination. For migratory birds, the aspects of rarity, endangerment and existing pressures are taken into account, as are the aspects of occurrence assessment and the area's significance for bird migration over a large area. There is currently no reliable data source for a criteria-based assessment of bats as a protected species. The biodiversity protected resource is evaluated in text form.

The following is a summary of the criteria used for the status assessment of the respective protected resource. This overview deals with the protected resources which can be meaningfully delimited on the basis of criteria and which are considered in the focus area.

**Site/Soil**

| |
|---|
| **Aspect: Rarity and endangerment** |
| Criterion: Percentage of sediment on the seabed and distribution of the morphological inventory of forms. |
| **Aspect: Diversity and individuality** |
| Criterion: Heterogeneity of the sediment on the sea floor and formation of the morphological inventory of forms. |
| **Aspect: Prior contamination** |
| Criterion: Extent of the anthropogenic prior contamination of the sediment on the sea floor and the morphological inventory of forms. |

### Benthos

| Aspect: Rarity and endangerment |
|---|
| Criterion: Number of rare or endangered species based on the Red List species identified (Red List by RACHOR et al. 2013). |
| **Aspect: Diversity and individuality** |
| Criterion: Number of species and composition of the species communities. The extent to which species or communities that are characteristic of the habitat occur and how regularly they occur is assessed. |
| **Aspect: Prior contamination** |
| For this criterion, the intensity of fishing exploitation, which is the most effective disturbance variable, will be used as a benchmark. Eutrophication can also affect benthic communities. For other disturbance variables, such as vessel traffic, pollutants, etc., there is currently a lack of suitable measurement and detection methods to be able to include them in the assessment. |

### Biotope types

| Aspect: Rarity and endangerment |
|---|
| Criterion: national conservation status and endangerment of biotope types according to the Red List of Endangered Biotope Types in Germany (FINCK et al., 2017) |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences. |

### Fish

| Aspect: Rarity and endangerment |
|---|
| Criterion: Proportion of species considered endangered according to the current Red List of Marine Fish (THIEL et al. 2013) and for the diadromous species on the Red List of Freshwater Fish (FREYHOF 2009) and assigned to Red List categories. |
| **Aspect: Diversity and individuality** |
| Criterion: The diversity of a fish community can be described by the number of species (α-Diversity, 'Species richness'). The species composition can be used to assess the specific nature of a fish community, i.e. how regularly habitat-typical species occur. Diversity and specificity are compared and assessed between the North Sea and the German EEZ as a whole, and between the EEZ and individual areas. |
| **Aspect: Prior contamination** |
| Criterion: Through the removal of target species and bycatch, as well as the impact on the seabed in the case of bottom-dwelling fishing methods, fisheries are considered to be the most effective disturbance to the fish community and therefore, serve as a measure of the pressure on fish communities in the North Sea. There is no assessment of stocks on a smaller spatial scale such as the German Bight. The input of nutrients into natural waters is another pathway through which human activities can affect fish communities. For this reason, eutrophication is used to assess the existing pollution. |

### Marine mammals

| Aspect: Protection status |
| --- |
| Criterion: Status under Annex II and Annex IV of the Habitats Directive and the following international protection agreements: Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, CMS), ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas), Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) |
| **Aspect: Assessment of the occurrence** |
| Criteria: Population, population changes/trends based on large-scale surveys, distribution patterns and density distributions |
| **Aspect: Evaluation of spatial units** |
| Criteria: Function and importance of the German EEZ and the areas defined in the FEP for marine mammals as transit areas, feeding grounds or breeding grounds |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences and climate change. |

### Seabirds and resting birds

| Aspect: Protection status |
| --- |
| Criterion: Status under Annex 1 Species of the Birds Directive, European Red List by BirdLife International |
| **Aspect: Assessment of the occurrence** |
| Criteria: Population in the German North Sea and EEZ, large-scale distribution patterns, abundances, variability |
| **Aspect: Evaluation of spatial units** |
| Criteria: Function of the areas defined in the FEP for relevant breeding and migratory birds as resting areas, location of protected areas |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences and climate change. |

### Migratory birds

| Aspect: The importance of bird migration over a large area |
| --- |
| Criterion: Guidelines and areas of concentration |
| **Aspect: Assessment of the occurrence** |
| Criterion: migration and its intensity |
| **Aspect: Rarity and endangerment** |

| |
|---|
| Criterion: Number of species and endangered status of the species involved according to Annex I of the Birds Directive, the Bern Convention of 1979 on the Conservation of European Wildlife and Natural Habitats, the Bonn Convention of 1979 on the Conservation of Migratory Species of Wild Animals, the AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds) and SPEC (Species of European Conservation Concern). |
| **Aspect: Prior contamination** |
| Criterion: Prior contamination/endangerment due to anthropogenic influences and climate change. |

### 2.20.4 Assumptions used to describe and assess the likely significant effects

The description and assessment of the likely significant effects of the implementation of the ROP-E on the marine environment is carried out for the individual provisions on the use and protection of the EEZ on a protected resource basis, taking into account the status assessment described above. The following table lists, on the basis of the main impact factors, the potential environmental impacts which arise from the respective use and which are to be examined both as a prior impact, in the event the plan is not implemented, or as a likely significant environmental effect resulting from the provisions in the ROP. The effects are differentiated according to whether they are permanent or temporary.

Table 1: Overview of potentially significant effects of the uses identified in the spatial plan.

| Use | Effect | Potential effect | Protected Assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Sea birds and resting birds | Migratory birds | Marine mammals | Bats | Plancton | Biotope types | Biodiversity | Soil | Surface | Water | Air | Climate | Humans/ health | Cultural and material goods | Landscape |
| **Maritime uses with designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **Areas for offshore wind energy** | Placement of hard substrate (foundations) | Habitat change | x | | | | | | | x | x | x | | | | | | x | |
| | | Loss of habitat and land | x | x | | | | | | x | x | x | x | | | | | x | |
| | | Attraction effects, increase in species diversity, change in species composition | | x | | | | | | | x | | | | | | | | |
| | | Change in hydrological conditions | | x | | | | | | | | | | x | | | | | |
| | Scouring/sediment relocation | Habitat change | | | | | | | | x | | x | x | | | | | | |
| | Sediment swirls and turbidity plumes (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| | Resuspension of sediment and sedimentation (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | Noise emissions during pile driving (construction phase) | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| | | potential disruption/damage | | x t | | | x t | | | | | | | | | | | | |
| | Visual disturbance due to construction work | Local scaring and barrier effects | | | x t | | | | | | | | | | | | | | |
| | Obstacle in airspace | Scaring effects, loss of habitat | | | x | | | | | | | | | | | | | | |
| | | Barrier effect, collision | | | x | x | | x | | | | | | | | | | | x |
| | Light emissions (construction and operation) | Attraction effects, collision | | | x | x | | x | | | | | | | | | | | x |
| | wind farm related shipping traffic (maintenance, construction traffic) | see shipping | x | x | x | x | x | x | x | x | x | x | x t | x | x | x | x | x | |
| **Cables Routes for submarine cable systems and pipelines** | Introduction of hard substrate (stone fill) | Habitat change | x | | | | | | | x | | x | | | | | | x | |
| | | Loss of habitat and space | x | | | | | | | x | | x | x | | | | | x | |
| | Heat emissions (current-carrying cables) | Impairment/displacement of cold water-loving species | x | | | | | | | | x | | | | | | | | |
| | Magnetic fields (current-carrying cables) | Impairment | x | | | | | | | | | | | | | | | | |
| | | Impairment of the orientation behaviour of individual migratory species | | x | | | | | | | | | | | | | | | |
| | Turbidity plume (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| **Shipping** | Underwater Sound | Impairment / scaring effect | | x | | | x | | | | | | | | | | | | |
| | Emissions and discharges of hazardous substances (accidents) | Impairment/ damage | x | x | x | | x | | x | x | x | x | | x | | | x | | |
| | Physical disturbance during anchoring | Impact on the seabed | x t | | | | | | | x t | | x t | x t | | | | | x | |
| | Emission of air pollutants | Impairment of air quality | | | x | x | | x | | | | | | | x | x | x | | |
| | Introduction and spread of invasive species | Change in species composition | x | x | | | | | | | x | | | | | | | | |
| | Bringing in waste | Impairment/ damage | x | x | x | | x | | | | | | | x | | | x | | |
| | Risk of collision | Collision | | | | x | x | | | | | | | | | | | | |
| | Visual agitation | Impairment / scaring effect | | | x | | | | | | | | | | | | | | |

| Use | Effect | Potential effect | Protected Assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Sea birds and resting birds | Migratory birds | Marine mammals | Bats | Plancton | Biotoptype types | Biodiversity | Soil | Surface | Water | Air | Climate | Humans/ health | Cultural and material goods | Landscape |
| **Maritime uses with designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **Raw materials Sand and gravel mining / Seismic investigations** | Removal of substrates | Veränderung von Habitaten | x | x | | | | | | x | x | x | | | | | | x | |
| | | Lebensraum- und Flächenverlust | x | x | | | | | | x | x | x | x | | | | | x | |
| | Turbidity plumes | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| | Physical disturbance | Impact on the seabed | x | | | | | | | x | | x | x | | | | | | |
| | Underwater sound during seismic surveys | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| **Marine Research** | Sampling of selected species | Reduction of stocks | | x | | | | | | | | | | | | | | | |
| | | Deterioration of the food base | | | | | | | | | | | | | | | | | |
| | Physical disturbance by trawls | Impairment/ damage | x | | | | | | | x | | x | | | | | | | |
| **Maritime uses without designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **National defense** | Underwater sound | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| | Introduction of hazardous substances | Impairment | x | x | x | | x | | | x | x | x | | x | | | x | | |
| | Risk of collision | Collision | | | | | x | | | | | | | | | | | | |
| | Surface sound | Impairment / scaring effect | | | x | x | | x | | | | | | | | | x | | |
| **Recreation (-traffic)** | Taking of species (fishing) | Reduction of stocks | | x | | | | | | | | | | | | | | | |
| | Underwater Sound | Impairment / scaring effect | | x | | | x | | | | | | | | | | | | |
| | Emission of air pollutants | Impairment of air quality | | | x | x | | x | | | | | | | x | x | x | | |
| | Bringing in waste | Impairment | x | x | x | | x | | | | | | | x | | | x | | |
| | Visual agitation | Impairment / scaring effect | | | x | | | | | | | | | | | | | | |
| **Aquakultur** | Introduction of nutrients | Impairment | x | x | | | | | x | | | | | x | | | | | |
| | Installation of fixed installations | Habitat change | x | x | | | | | | x | | | | | | | | | x |
| | | Loss of habitat and land | x | x | | | | | | | | | x | | | | | | x |
| **Fischerei** | Sampling of selected species | Reduction of stocks | | x | | | | | | | x | | | | | | | | |
| | | Deterioration of the food base | | | x | | x | | | | | | | | | | | | |
| | Bycatch | Reduction of stocks | | x | | | x | | | | | | | | | | | | |
| | Physical disturbance by trawls | Impairment / damage | x | | | | | | | x | | x | | | | | | | |

x potential effect on the protected resource

x potential temporary effect on the protected resource

In addition to the impacts on the individual protected resources, cumulative effects and interactions between protected resources are also examined.

### 2.20.4.1 Cumulative consideration

In accordance with Article 5(1) of the SEA Directive, the environmental report also includes an assessment of cumulative effects. Cumulative effects arise from the interaction of various independent individual effects which either add up as a result of their interaction (cumulative effects) or reinforce each other and thus generate more than the sum of their individual effects (synergistic effects) (e.g. SCHOMERUS et al., 2006). Both cumulative and synergetic effects can be caused by the coincidence of effects in time and space. The effect can be reinforced by similar uses or different uses with the same effect, thereby increasing the effect on one or more protected resources.

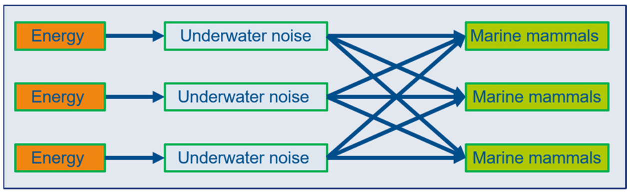



Figure 8: Exemplary cumulative effect of similar uses.

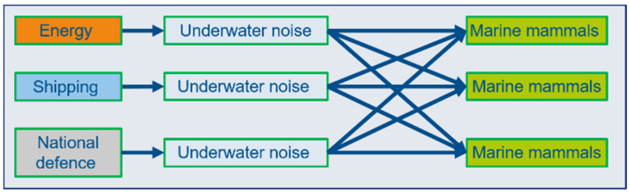



Figure 9: Exemplary cumulative effect of different uses.

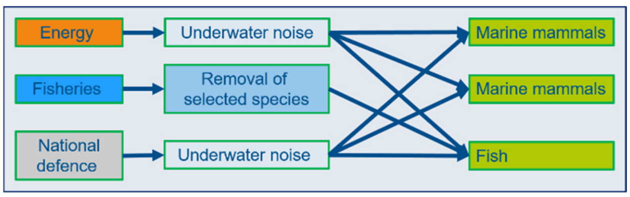



Figure 10: Exemplary cumulative effect of different uses with different effects.

In order to examine the cumulative effects, it is necessary to assess the extent to which the provisions of the plan, when taken together, can be expected to have a significant adverse effect. An examination of the provisions is performed on the basis of the current state of knowledge within the meaning of Article 5(2) of the SEA Directive. The position paper on the cumulative assessment of loons habitat loss in the German North Sea (BMU, 2009) and the BMUB's noise abatement concept (2013) form an important basis for assessing the effects of habitat loss and underwater noise.

### 2.20.4.2 Interactions

In general, effects on a protected resource lead to various consequences and interactions between the protected resources. The essential interdependence of the biotic protected resources exists via the food chains. Due to the variability of the habitat, interactions can only be described in very imprecise terms overall.

### 2.20.4.3 Specific assumptions for the assessment of the likely significant environmental effects

In detail, the analysis and examination of the respective provisions is as follows:

**Offshore wind energy**

With regard to the priority and reserved areas for offshore wind energy, a worst-case scenario is generally assumed. For the consideration of protected resources, certain parameters are assumed in this SEA in the form of ranges spatially separated into zones 1 and 2 and zones 3 to 5. In detail, these are, for example, the power output per installation [MW], hub height [m], rotor diameter [m] and total height [m] of the installations.

As input parameters, the SEA takes particular account of:

- installations already in operation or undergoing the licensing procedure (as reference and existing load)

- Transfer of the average parameters of the plants commissioned in the last 5 years on the sites defined in the FEP 2019
- Forecast of certain technical developments for the offshore wind energy priority and reserved areas, which are also defined in the ROP on the basis of the parameters presented. It should be noted here that these are only partly estimation-based assumptions, as project-specific parameters are not or cannot be checked at the SEA level.

Table 2: Parameters for the consideration of areas for offshore wind energy

| **WTG Parameters** | **Range** *Zones 1 and 2* | | **Range** *Zones 3-5* | |
|---|---|---|---|---|
| | from | to | from | to |
| Output per plant [MW] | 5 | 12 | 12 | 20 |
| Hub height [m] | 100 | 160 | 160 | 200 |
| Rotor diameter [m] | 140 | 220 | 220 | 300 |
| Total height [m] | 170 | 270 | 270 | 350 |

For the connecting cables of the priority areas for offshore wind energy, the route length (EEZ) varies between about 10 km and 160 km. For the priority areas in Zones 4 and 5, an average route length of about 250 km is assumed. For the assessment of the construction and operational environmental effects, certain widths of the cable trench [m] and a certain site of the intersection structures [$^{m2}$] are assumed for submarine cable system rout corridors. Above all, the environmental effects due to construction, operation and repair are considered.

For the route corridors for pipelines, cross-border submarine cable systems or data cables, the cable lengths result from the specifications. For pipelines, a width of 1.5 m is assumed for the assessment of environmental effects for the overlying pipeline plus 10 m each for impairments due to "reef effect" and sediment dynamics.

For other uses, evaluation criteria or parameters for the environmental assessment have to be developed or specified in the later procedure.

**Shipping**

In order to assess the environmental effect of shipping, there must be an examination of which additional effects can be attributed to the provisions of the ROP-E.

The priority areas identified must be kept free of building use. This control in the ROP-E should prevent or at least reduce collisions and accidents. Based on the provisions in the ROP, the frequency of traffic in the priority areas is expected to increase, in particular due to the increase in offshore wind farms along the shipping routes. Vessel movements on the shipping routes SN1 to SN17 and SO1 to SO5 vary considerably, with the most heavily used route, SN1, sometimes carrying more than 15 vessels per km² per day, while on the other, narrower routes there are usually about 1-2 vessels per km² per day.

The BSH has commissioned an expert report on the traffic analysis of shipping traffic, which is expected to include current evaluations.

The designation of priority areas for shipping only is not an expression of increased use, but rather serves to minimise risk.

The general effects of shipping are presented in Chapter 2 as prior contamination, especially for

birds and marine mammals. The effects of service traffic to the wind farms are dealt with in the chapter on wind energy.

**Raw material extraction**

When assessing the potential environmental effect of raw material extraction, a distinction must be made between sand and gravel extraction and hydrocarbon extraction.

Sand and gravel extraction:

Sand and gravel are extracted by means of floating suction dredgers. The extraction field is driven over in strips of approximately 2 m width and the subsoil is extracted to a depth of approximately 2 m. The seabed remains unstressed between the excavation strips. During mining, a sediment-water mixture is pumped on board the suction dredger. The sediment in the desired grain size is screened out and the unused portion is returned to the sea on site. Turbidity plumes result from the mining and discharge. Potential temporary effects result from the turbidity plumes, which can frighten and result in adverse effects for the marine fauna. Potential permanent effects arise from the removal of substrates and physical disturbance causes habitat and area loss, habitat alteration and seabed degradation.

Sand and gravel extraction is carried out on the basis of operational plans on portions of the authorised approval fields.

Gas production:

Exploratory and production wells are drilled for the exploration and exploitation of gas deposits. Drilling through the rock lying above the deposit results in drilling abrasion. This is brought to the surface by means of drilling fluids. The drilling fluids have either a water or oil base. If a water-based drilling fluid is used, it is discharged into the sea together with the cuttings. If oil-based drilling fluids are used, they are disposed of on land together with the cuttings.

Seismic methods are used in the exploration of hydrocarbon reservoirs, which lead to chase effects in marine mammals.

Operationally discharges of material into the sea result from the discharge of production and spray water, wastewater from the sewage treatment plant, and the shipping traffic caused. Production water is essentially reservoir water that may contain components from underground, such as salts, hydrocarbons and metals. As the deposit ages, the amount of gas in production water increases. Production water can also contain chemicals that are used in mining to improve extraction or to prevent corrosion of production equipment. The production water is discharged into the sea after treatment in accordance with the state of the art and compliance with national and international standards.

**Fisheries and marine aquaculture**

In the area of the southern silt floor, the sediment provides a particularly suitable habitat for this species, which can be quite clearly defined spatially. The nephrops population in the North Sea is considered stable and is classified as "least concern" in the IUCN Red List . For the German fishing fleet, the nephrops fishery represents a valuable and reliable source of income. Adverse effects of fishing in this area mainly affect the seabed, sediment and the habitats affected by it, which can be affected by the trawls used.

Table 3: Parameters for the consideration of fisheries.

| | |
|---|---|
| **Fishing effort (German fleet)** | Approximately 8,000 hrs/year (2013) to 14,000 hrs/year (2018)<br>12 (2014) - 18 (2015) vehicles |
| **Fishing gear used** | Bottom trawls |
| **Catches** | 200 - 350 t / year (plus non-German fisheries) |

**Marine Research**

The designated areas for scientific marine research (3 in the North Sea, 4 in the Baltic Sea) correspond to standard investigation areas ("boxes") of the Thuenen Institute in the North Sea and the Baltic Sea. In the North Sea, the German Small-Scale Bottom Trawl Survey (GSBTS), which has been carried out since 1987, has been collecting data on the development of fish populations over many years. The data sets form an important basis for assessing long-term changes in the bottom fish fauna (commercial and non-commercial species) of the North Sea and the Baltic Sea caused by natural (e.g. climatic) influences or anthropogenic factors (e.g. fisheries).

The GSBTS uses a standardised bottom trawl net or a high-density GOV otter trawl to sample small-scale bottom fish communities to determine abundances and distribution patterns. In parallel, epibenthos (using a 2 m beam trawl), infauna (using a Van Veen grab) and sediments will be studied, and hydrographic and marine chemical parameters in habitats typical of the region will be recorded.

Effects are to be expected from the equipment used, in particular on the soil/sediment and the habitats affected by it. To this end, fish of various ages and sizes are taken (cf. also Chapter 5.5.3).

Table 4: Parameters for the consideration of marine research

| | |
|---|---|
| **Frequency of surveys per year/number of hauls/duration per haul (approximate values, vary from trip to trip)** | 2 / in the range of approx. 40 - 50 (only GSBTS) / 30 min. |
| **Gear used (target species)** | Standardised bottom trawlers, using high-density otter trawls (bottom fishing communities)<br>2-metre beam trawl (epibenthos)<br>Van Veen grab (Infauna) |
| **Catches** | Total quantities for all (sampled) boxes (partly with other research activities) in double-digit tonnes |

**Nature conservation / marine landscape / open space**

The nature conservation rules in the spatial plan are not expected to have any significant adverse environmental effects.

The rules contribute to the long-term preservation and development of the marine environment in the EEZ as an ecologically intact open space over a large area. The scope of the rules is of particular importance in this context, with the EEZ accounting for 37.92% of the area of the North Sea. The nature conservation priority areas contribute to securing open spaces by excluding uses which are incompatible with nature conservation. This helps to avoid possible disturbances caused by the conversion of wind energy and to ensure the protection of the marine environment. Keeping the protected areas free of building structures also contributes to the protection of open spaces and the marine landscape on a large scale.

The designation of the main distribution area of harbour porpoises and the main concentration area of loons as reserved areas is of outstanding conservation importance for the protection of the disturbance-sensitive group of loons and harbour porpoise species.

The guiding principles of the careful and economical use of natural resources in the EEZ, as well as the application of the precautionary principle and the ecosystem approach, are intended to avoid or reduce damage to the balance of nature.

The spatial plan thus contributes to achieving the objectives of the MSFD. However, the ability of

spatial planning to influence this is limited and cannot affect all objectives.

**National and alliance defence**

The ROP-E contains textual provisions on national and alliance defence.

## 2.21 Data sources

The basis for the SEA is a description and assessment of the environmental status in the study area. All protected resources must be included. The data source is the basis for the assessment of the likely significant environmental effects, the site and species protection assessment and the assessment of alternatives.

According to Article 8(1) Sentence 3 of the ROG, the environmental assessment refers to what can reasonably be required on the basis of the current knowledge and generally accepted assessment methods, and the content and level of detail of the spatial plan.

On the one hand, the environmental report will describe and assess the current state of the environment, and describe the likely development if the plan is not implemented. It will also forecast and assess the likely significant environmental effects of implementing the plan.

The basis for the assessment of potential effects is a detailed description and assessment of the state of the environment. The description and assessment of the current state of the environment and the likely development in the event the plan is not implemented will be carried out with regard to the following protected resources

- Site/Soil
- Water
- Plankton
- Biotope types
- Benthos
- Fish
- Bats
- Biodiversity
- Air
- Climate
- Landscape
- Cultural and other material resources
- Marine mammals
- Avifauna
- People, especially human health
- Interactions between protected resources.

### 2.21.1 Overview data source

The data and knowledge has improved significantly in recent years, in particular as a result of the extensive data collection in the context of environmental impact studies, the construction and operational monitoring for the offshore wind farm projects, and the accompanying ecological research.

This information also forms an essential basis for monitoring the 2009 spatial plans under Article 45(4) of the UVPG. Accordingly, the results of the monitoring are to be made available to the public and taken into account when the plan is reinstated. The results of the accompanying plan for monitoring the current plans are summarised in the status report on the updating of spatial planning in the German North Sea and Baltic Sea EEZ, which is published in parallel (Chapter 2.5).

In general terms, the following data sources are used for the environmental report:

- Data and findings from the operation of offshore wind farms
- Data and findings from approval procedures for offshore wind farms, submarine cable systems and pipelines
- Results of the preliminary site investigations
- Results from the monitoring of Natura 2000 areas
- Mapping instructions for Article 30 biotope types
- MSRL initial and progress assessment
- Findings and results from R&D projects commissioned by the BfN

and/or the BSH and from accompanying ecological research
- Results from EU cooperation projects, such as Pan Baltic Scope and SEANSE
- Studies/Technical literature
- Current red lists
- Comments from the technical authorities
- Comments from the (specialist) public

A detailed overview of the individual data and knowledge sources is included in the annex to the framework of the study.

### 2.21.2 Indications of difficulties in compiling the documents

In accordance with No. 3a of Annex 1 to Article 8(1) of the ROG, indications of difficulties encountered in compiling the information, such as technical gaps or lack of knowledge, must be presented. There are still gaps in knowledge in some places, particularly with regard to the following points:

- Long-term effects from the operation of offshore wind farms
- Effects of shipping on individual protected resources
- Effects of research activities
- Data for assessing the environmental status of the various protected resources in the outer EEZ.

In principle, forecasts on the development of the living marine environment after the ROP has been carried out remain subject to certain uncertainties. There is often a lack of long-term data series or analytical methods, e.g. for combining extensive information on biotic and abiotic factors, in order to better understand the complex interrelationships of the marine ecosystem.

In particular, there is a lack of detailed area-wide sediment and biotope mapping outside the nature reserves of the EEZ. As a result, there is a lack of a scientific basis on which to assess the effects of the possible use of strictly protected biotope structures. At present, sediment and biotope mapping is being carried out on behalf of the BfN and in cooperation with the BSH, research and higher education institutions and an environmental office, with a focus on the nature conservation areas.

In addition, there is a lack of scientific assessment criteria for protected resources, both with regard to the assessment of their status and with regard to the effects of anthropogenic activities on the development of the living marine environment, in order to fundamentally consider cumulative effects over time and space.

Various R&D studies on assessment approaches, including those for underwater noise, are currently being carried out on behalf of the BSH. The projects serve the continuous further development of a uniform, quality-assured basis of marine environmental information for assessing the potential impacts of offshore installations.

The environmental report will also list specific information gaps or difficulties in compiling the documents for the individual protected resources.

## 2.22 Application of the ecosystem approach

The application of the ecosystem approach contributes to the achievement of "sustainable spatial planning that reconciles the social and economic demands on the spatial environment with its ecological functions and leads to a sustainable, balanced order over a large area" (Article 1(2) of the ROG). The application of the ecosystem approach is a requirement under Article 2(3) No. 6 p. 9 of the ROG with the aim of controlling human activities, sustainable development and supporting sustainable growth (cf. Art. 5(1) of the

Maritime Spatial Planning Directive (MSPD) in conjunction with Art. 1(3) of the MSFD).

Recital 14 of the MSPD specifies that spatial planning should be based on an ecosystem approach in accordance with the MSFD. It is also clear here—as in Preamble 8 of the MSFD—that sustainable development and use of the seas should be compatible with good environmental status.

In accordance with Article 5(1) of the MSPD: "When establishing and implementing maritime spatial planning, Member States shall consider economic, social and environmental aspects to support sustainable development and growth in the maritime sector, applying an ecosystem-based approach, and to promote the coexistence of relevant activities and uses."

Article 1(3) of the MSFD specifies that "Marine strategies shall apply an ecosystem-based approach to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of good environmental status and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while enabling the sustainable use of marine goods and services by present and future generations."

The ecosystem approach allows a holistic view of the marine environment, recognising that humans are an integral part of the natural system. Natural ecosystems and their services are considered together with the interactions resulting from their use. The approach is to manage ecosystems within the "limits of their functional capacity" in order to safeguard them for use by future generations. In addition, understanding ecosystems enables effective and sustainable use of resources.

A comprehensive understanding, protection and improvement of the marine environment and an effective and sustainable use of resources within the bearing capacity limit will safeguard marine ecosystems for future generations. The ecosystem approach can therefore contribute—at least in part —to good status in the marine environment.

Based on the so-called 12 Malawi Principles of the Biodiversity Convention, the ecosystem approach has also been substantiated by the HELCOM-VASAB working group on maritime spatial planning and specified for maritime spatial planning. The key elements formulated there represent a suitable approach for structuring the application of the ecosystem approach in the spatial plan for the German EEZ.

The combination of content-related and process-oriented key elements is intended to promote an overall picture that is as comprehensive as possible:

- Best available knowledge and practice;
- Precautions;
- Alternative development;
- Identification of ecosystem services;
- Prevention and mitigation;
- Relational understanding;
- Participation and communication;
- Subsidiarity and coherence;
- Adaptation.

The application of the ecosystem approach aims at a holistic perspective, the continuous development of knowledge about the oceans and their use, the application of the precautionary principle and flexible, adaptive management or planning. One of the greatest challenges is dealing with gaps in knowledge. Understanding the cumulative effects that the combination of different activities can have on species and habitats is of great importance for sustainable use. It is important for the planning process to promote communication and participation processes in order to use the broadest possible knowledge base of all stakeholders and to achieve the greatest possible acceptance of the plan.

Figure 11 shows the understanding of the application of the ecosystem approach. This takes place equally in the planning process, the ROP and in the Strategic Environmental Assessment (SEA). The SEA has proven to be the central instrument for applying the ecosystem approach and offers versatile points of contact in the content- and process-oriented key elements (see below).

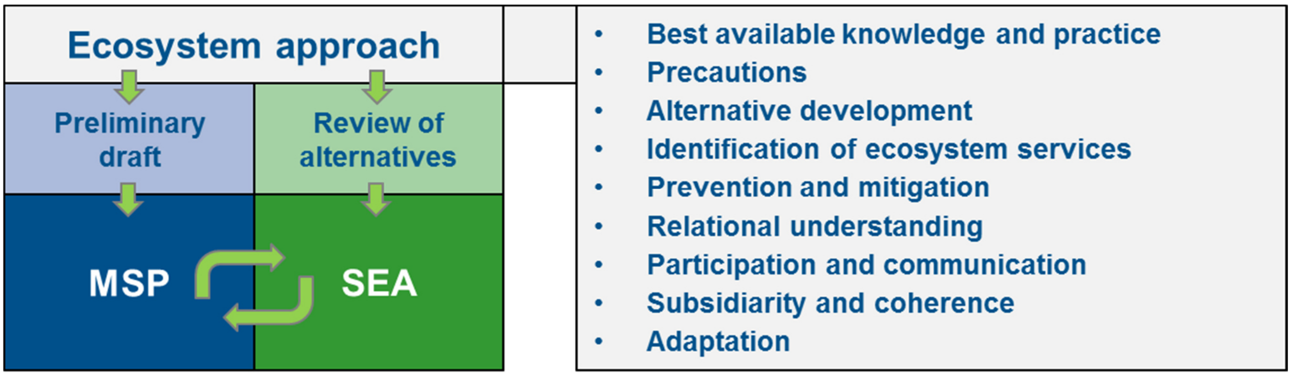



Figure 11: The ecosystem approach as a structuring concept in the planning process, the ROP and the Strategic Environmental Assessment

The ecosystem approach is anchored in the mission statement as the basis of the spatial plan. Its importance is also explicitly emphasised in the following principles:

- General requirements for economic uses: Principle of Best Environmental Practice (8.1) and Monitoring (8.2)
- Principle of nature conservation Preservation of the EEZ as a natural area (5)

The graphic and textual rules on marine nature conservation make a fundamental contribution to the protection and improvement of the state of the marine environment (see ROP model). In addition, the ROP's rules promote the resilience of the marine environment to the effects of economic uses and to the changes caused by climate change.

Due to a lack of data and knowledge, it is not possible to conclusively quantify the bearing capacity of the ecosystem. This represents a task for the future development of the ecosystem approach. Even if quantification is not possible at present, SEA and cumulative consideration must ensure that the ROP and the definitions of economic uses contained therein do not exceed the limits of ecosystem functioning.

The assessment of the likely significant environmental effects of the implementation of the spatial plan is methodologically described in Chapter 1.5.2The ecosystem approach does not itself constitute an assessment but does encompass a large number of important aspects and instruments for sustainable spatial planning. Of these, the SEA serves comprehensively to identify, describe and assess the impacts on the marine environment.

**Application of the key elements**

The ecosystem approach is highly complex due to its diversity and the comprehensive view of the relationship between the marine environment and economic uses. The key elements also interact with each other, underlining the interconnectedness and holistic perspective. Figure 12 portrays the relationships between the key elements. This approach becomes tangible and applicable when viewed at the level of the individual key elements, in particular those of the HELCOM/VASAB Directive (2016).

The application in the spatial plan for the German EEZ is based on the understanding that this approach needs to be continuously developed. Existing gaps in knowledge and the need for conceptual broadening result in the need to

consider the ecosystem approach as a permanent task of further development.

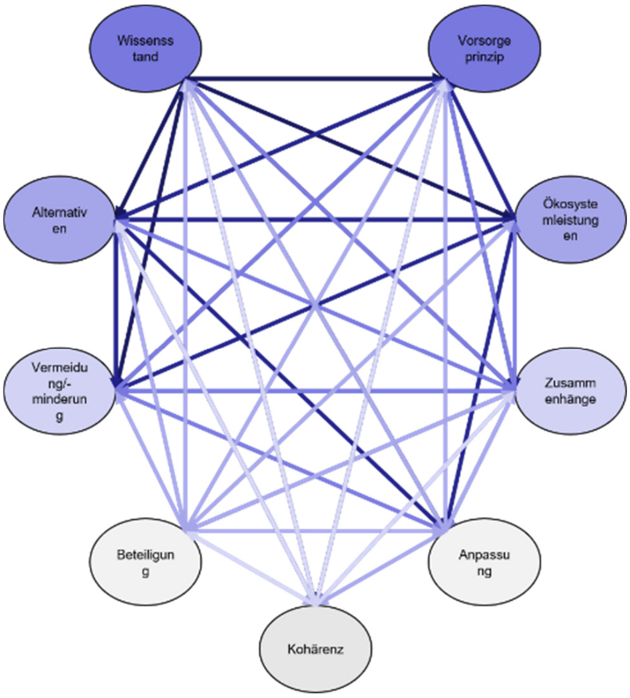



Figure 12: Networking between the key elements

**Best available knowledge and practice**

"The allocation and development of human uses shall be based on the latest state of knowledge of the ecosystems as such and the practice of safeguarding the components of the marine ecosystem in the best possible way." .

The use of the current (sound) level of knowledge is fundamentally indispensable for planning processes and forms the basis of the planning understanding for updating the spatial plan. This key element thus also affects the other elements mentioned, such as the precautionary principle, the avoidance and reduction of impacts and the understanding of interrelationships.

As part of the updating process, the knowledge base is supplemented by the sector-specific expertise of the stakeholders through an early and comprehensive participation process. Thematic workshops and technical discussions with various stakeholders were held even before the concept for the update was developed.

The Scientific Advisory Board (WiBeK) for the continuation of maritime spatial planning in the North Sea and Baltic Sea EEZ advises, from a scientific perspective, on questions of content, the procedure and the participation process.

Results from projects and findings on procedures for plan preparation in neighbouring countries within the framework of international cooperation are taken into account for the process of plan preparation. In addition to improving the level of knowledge, this contributes to the key element of "subsidiarity and coherence".

In-house research and development, such as databases and other tools, are developed, validated and applied at the BSH for a wide range of uses: e.g. MARLIN and MarineEARS. These can support the planning process and the subsequent plan monitoring with well-founded information and make an important contribution to the continuous improvement of the level of knowledge.

The following stipulations of the spatial plan promote the use of the current level of knowledge in economic uses as a basic guideline:

- General requirements for economic uses: Principle of Best Environmental Practice (8.1)
- Shipping: Principle of Protection of the Marine Environment (3)
- Offshore wind energy: Protection of the Marine Environment (6.1)
- Marine research: Principle of Protection of the Marine Environment (5).

The SEA is based on very detailed and comprehensive data on all relevant biological and physical aspects and conditions of the marine environment—in particular from EIA studies and monitoring of offshore wind farm projects according to StUK—scientific research activities, and from national and international monitoring programmes.

**Precautions**

"A far-sighted, anticipatory and preventive planning shall promote sustainable use in marine areas and shall exclude risks and hazards of human activities on the marine ecosystem. Those activities that according to current scientific knowledge may lead to significant or irreversible impacts on the marine ecosystem and whose impacts may not be in total or in parts sufficiently predictable at present require a specific careful survey and weighting of the risks." .

The precautionary principle has a high priority in spatial planning, particularly because of the complexity of marine ecosystems, far-reaching chains of effects and existing gaps in knowledge. This is already emphasised in the ROP's mission statement.

The provisions of the spatial plan make it clear that the precautionary principle is taken into account as a fundamental requirement in the case of economic uses (Principle 5 Nature conservation/marine landscape/open space) and in the case of subsequent uses:

- Maritime transport: Objective Priority areas Maritime transport (1)
- General requirements for economic uses: Objective Decommissioning (3) Principle of Site Conservation (2) and Best Environmental Practice (8.1)
- Lines Marine environment Principle (8)
- Fisheries and Marine Aquaculture: Sustainable Management Principle (2)
- Nature Conservation: Principle Preservation of the EEZ as a Natural Area (5).

The SEA examines the significance of the effects of the ROP's provisions on uses on the protected resources (Chapter 3).

**Alternative development**

"Reasonable alternatives should be developed to find solutions to avoid or mitigate adverse effects on the environment and other areas, as well as on ecosystem goods and services." .

The consideration of alternatives was given a high priority in the process of updating the spatial plans and was integrated into the contribution at an early stage.

In the conception for the further development of the spatial plans three planning options were developed as overall spatial planning alternatives, which represent the utilisation requirements of the different sectors from different perspectives:

- Planning option A: Perspective on traditional uses
- Planning option B: Climate protection perspective
- Planning option C: Marine nature conservation perspective

The alternatives presented as planning options are integrated approaches which take into account spatial and content-related dependencies and interactions over a large area.

The early and comprehensive consideration of several planning options represents an essential planning and review step in the updating of the spatial plans.

A preliminary assessment of selected environmental aspects was carried out before this environmental report was prepared. The preliminary assessment of selected environmental aspects in the sense of an early examination of variants and alternatives should support the comparison of the three planning options from an environmental point of view.

The design and preliminary assessment of selected environmental aspects were consulted, so that the knowledge and assessments of the stakeholders involved were contributed to the planning process.

An alternative assessment is carried out in the SEA (cf. Chapter 8), where the focus is on the conceptual/strategic design of the plan, and in particular on spatial alternatives.

**Identification of ecosystem services**

"In order to ensure a socio-economic evaluation of effects and potentials, the ecosystem services provided need to be identified." .

The identification of ecosystem services is an important step for the further development of the spatial plan and the ecosystem approach in maritime spatial planning. Ecosystem services can contribute to a broader understanding and illustrate the multiple functions that ecosystems can provide. Particularly noteworthy are their function as natural carbon sinks and other contributions to climate protection and adaptation. This need should be taken into account in future updates of the spatial plan and the development of the necessary tools should be continued.

With the specialist application MARLIN (Marine Life Investigator), BSH is currently developing a large-scale, high-resolution information network on marine ecological data from environmental investigations within the framework of environmental impact studies, preliminary site investigations and monitoring of offshore wind farm projects. Various data analyses at different spatial and temporal levels are possible in order to support the tasks of the BSH in line with requirements. MARLIN also combines the integrated marine ecological data with various environmental data to support the understanding of the effects and interrelationships of marine ecosystem services.

In the future, MARLIN will serve as a validated basis for ecosystem modelling to better assess the impact of cumulative effects. For example, in future it will be possible to consider all offshore wind farm processes and to carry out large-scale studies. Building on this, it may then be possible to identify ecosystem services. MARLIN's holistic approach enables new approaches to the analysis and modelling of ecological patterns and processes and creates a platform for the development and application of advanced tools for marine management and regulation.

**Prevention and mitigation**

“The measures are envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan.” .

The ROP's mission statement defines the contribution to the protection and improvement of the state of the marine environment, also by specifying how to avoid or reduce disturbances and pollution from uses.

The provisions of the spatial plan illustrate this consideration with measures to avoid and mitigate adverse effects of individual uses:

- Shipping: Principle of Protection of the Marine Environment (3)
- General requirements for economic uses: Principle of Best Environmental Practice (8.1)
- Offshore wind energy: Protection of the Marine Environment (6.1)
- Management: Principles Avoidance of Crossings (5) and Marine Environment (8)
- Raw material extraction: Principle of the Loon (3)
- Nature conservation: Principles Reserved Area for Loons (2) and Reserved Area for Harbour Porpoise (3)

In the SEA, measures to avoid, reduce and offset significant adverse effects of the implementation of the spatial plan are presented in detail in Chapter 7.

**Relational understanding**

"It is necessary to consider various effects on the ecosystem caused by human activities and interactions between human activities and the ecosystem, as well as among various human activities. This includes direct/indirect, cumulative, short/long-term, permanent/temporary and positive/negative effects, as well as interrelations including sealand interaction." .

The understanding of interrelations and interdependencies is of great importance for the tasks of spatial planning and the planning process. In this sense, the mission statement of the ROP-E emphasises the holistic approach and includes the consideration of land-sea relations.

In the Strategic Environmental Assessment, this is taken up and examined in Chapters 4.9Interactions and 0Cumulative consideration.

For technical support, the BSH is currently developing the specialist application MARLIN (Marine Life Investigator) as a large-scale, high-resolution information network for marine ecological data from environmental investigations within the framework of environmental impact studies, preliminary site investigations and monitoring of offshore wind farm projects. Various data analyses at different spatial and temporal levels are possible in order to support the tasks of the BSH as required. MARLIN also combines integrated marine ecological data with various environmental data. MARLIN's holistic approach enables new directions for the analysis and modelling of ecological patterns and processes and creates a platform for the development and application of advanced tools for marine management and regulation. This will support the understanding of impacts and interrelationships.

Further experience, e.g. on cumulative consideration, has been gained in European cooperation projects (Pan Baltic Scope, SEANSE) and will be incorporated into the further conceptual development, as will findings from the participation process.

An overview of the project results can be found on the respective pages:

- http://www.panbalticscope.eu/results/reports/
- https://northseaportal.eu/downloads/

**Participation and communication**

“All relevant authorities and stakeholders as well as a wider public shall be involved in the planning process at an early stage. The results shall be communicated.” .

This key element is an example of the networking and relationships between the key elements. The knowledge gained can contribute to all other key elements.

As part of the updating process, participation and communication have been carried out intensively right from the start. Early and comprehensive participation therefore contributes significantly to broadening the knowledge base through the sector-specific expertise of stakeholders and evaluations received.

The basis for this was the development of a participation and communication concept. In the course of the update, topic-specific workshops and technical discussions were held with representatives at sectoral level. On 18 and 19 March 2020, the concept and draft of the study framework were consulted in the participation meeting (scoping).

Interim results and information on stakeholder meetings are communicated on the BSH's blog "Offshore aktuell" (wp.bsh.de).

Additional support for the process is provided by the Wissenschaftlicher Begleitkreis (WiBeK). Since 2018, for the continuation of maritime spatial planning in the Exclusive Economic Zone in the North and Baltic Seas, the WiBeK has been advising from a scientific perspective on questions of content, the course of the procedure and the participation process, among other things.

**Subsidiarity and coherence**

“Maritime spatial planning with an ecosystem-based approach as an overarching principle shall be carried out at the most appropriate level and shall seek coherence between the different levels.” .

Spatial planning aims to produce coherent plans in the North and Baltic Seas through coordination with coastal countries and partners from neighbouring countries. Many years of bilateral exchange, participation in the HELCOM and VASAB working group on maritime spatial planning and cooperation in international projects on maritime spatial planning contribute to this.

Project results and findings on procedures for plan preparation in neighbouring countries within the framework of international cooperation are taken into account for the process of plan preparation. The international consultation procedures represent a further contribution.

The ROP-E's mission statement sets out this cooperation as a contribution to coherent international maritime spatial planning and coordinated planning with coastal countries.

At the level of definitions, Principles 3 and 4 for pipelines emphasise this sectoral coordination requirement for the planning of cross-border linear structures.

In the context of SEA, the cross-border impacts on the neighbouring areas of the neighbouring states are considered (Section 4.11).

**Adaptation**

"The sustainable use of the ecosystem should apply an iterative process including monitoring, reviewing and evaluation of both the process and the outcome." .

Monitoring and evaluation within the framework of spatial planning for the German EEZ take place at various levels.

The first step will be to evaluate the plan and its implementation. A monitoring and evaluation concept will be developed for this purpose.

In addition, in Chapter 10 the SEA lists the planned measures for monitoring the effects of the implementation of the spatial plan on the environment.

The effects of economic uses on the marine environment are to be investigated and evaluated at project level by means of effect monitoring. This is laid down in Principle 8.2 of the General Requirements for Economic Uses in the ROP.

**Summary**

In summary, and beyond this, the key elements and their implementation in the planning process, the ROP, and the SEA all show how the ecosystem approach as an overall concept supports the holistic perspective of spatial planning and thus contributes to the protection and improvement of the state of the marine environment.

## 2.23 Taking climate change into account

Anthropogenic climate change is one of the greatest challenges facing society and is of particular importance for changes in the oceans and their use. Figure 13 shows the links between climate change, the marine ecosystem, uses and maritime spatial planning, and also how they are a tool for achieving sustainable development goals.

In changing seas, the consideration and integration of climate impacts in MSP is of great importance in order to do justice to the precautionary and forward-looking nature of MSP and to develop long-term sustainable plans.

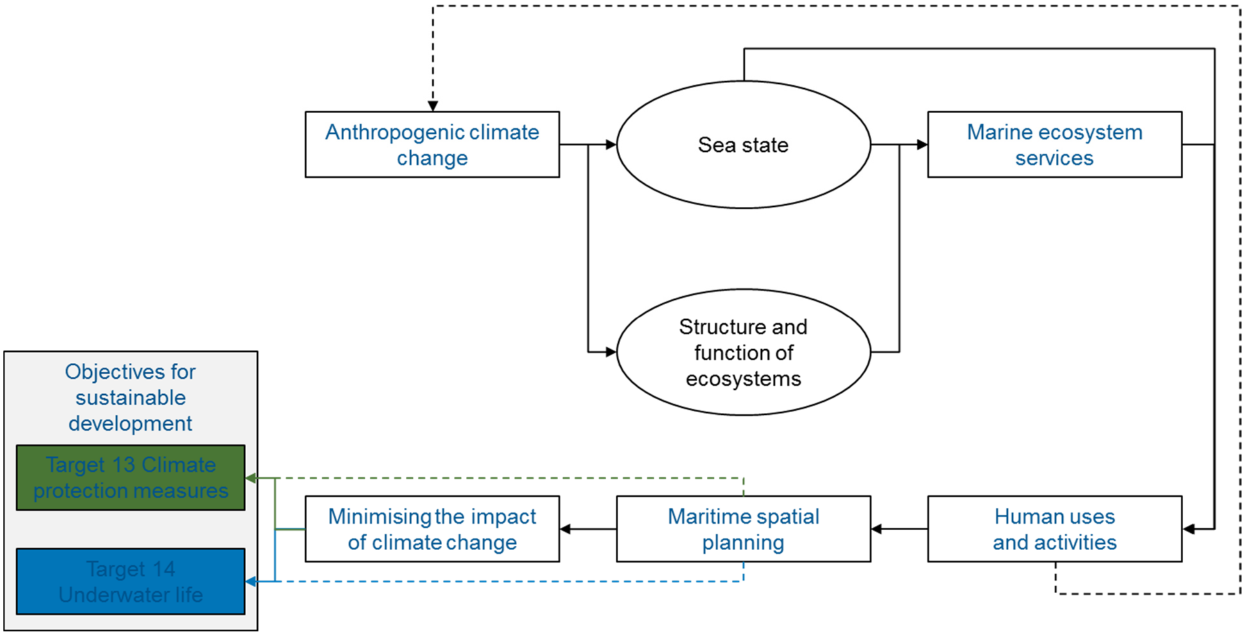



Figure 13: Representation of the interrelationships between climate change, marine ecosystems and maritime spatial planning, according to

Climate change will alter the physical, chemical and biological conditions in the North and Baltic Seas. This will inevitably have an impact on marine ecosystems, their structure and functions, which may also change ecosystem services. The changes may also have a direct impact on the uses to which they are put, e.g. shipping, renewable energy or extraction of raw materials.

The following table shows projections for some relevant parameters.

Table 5: Climate projections for selected parameters [1], [2], [3]

| | North Sea | Baltic Sea |
|---|---|---|
| Increase in mean sea surface temperature for 2031-2060 (in the 50th percentile of the RCP8.5 scenario compared to 1971-2000)[1] | 1 – 1.5 °C | 1.5 – 2 °C |
| Increase in mean sea surface temperature for 2071-2100 (in the 50th percentile of the RCP8.5 scenario compared to 1971-2000)[1] | 2.5 – 3 °C | 2.5 – 3.5 °C |
| Global sea level rise 2100 (RCP8.5 scenario vs. 1986-2005)[2] | 61 - 110cm | 61 - 110cm |
| Increase in extreme wind speeds (RCP8.5 scenario compared to 1971-2000)[3] | 0 - 0.5 m/s | No majority significant increases |

As a contribution to climate protection, the offshore wind energy provisions should be mentioned at the outset. Assuming that the current $CO_2$ factor of electricity from offshore wind energy is continued , by 2040, this results in an average annual $CO_2$ avoidance potential of 62.9 Mt $CO_2$ equivalents per year for the period between 2020 and 2040. By way of comparison, the annual emissions from power plants in the energy industry in 2016 were 294.5 Mt $CO_2$ equivalents per year.

Table 6 shows the abatement potential for the years 2020 and 2040 and the annual average for the entire period.

Table 6: Calculation of the $CO_2$ avoidance potential of the offshore wind energy provisions

| | Installed capacity | Full load hours | Annual electricity production | $CO_2$ avoidance factor | $CO_2$ avoidance |
|---|---|---|---|---|---|
| | GW | h/a | GWh/a | g CO2eq/kWh | Mt CO2eq/a |
| 2020 | 7.2 | 3800 | 27360 | 701 | 19.2 |
| 2040 | 40 | 3800 | 152000 | 701 | 106.6 |
| Average $CO_2$ avoidance per year | | | | | 62.9 |

Furthermore, keeping the priority areas of nature conservation free and the potential of ecosystems as natural carbon sinks contributes to climate protection. The designation of priority and reserved areas of nature conservation can also serve to strengthen the resilience of ecosystems and thus support the precautionary principle.

The mission statement shows that the use of climate-friendly technologies in the ocean supports energy security and the achievement of national and international climate targets.

The development of risk and vulnerability analyses to climate change and adaptation measures in the relevant sectors should be communicated to spatial planning. The holistic perspective of spatial planning can help to coordinate the compatibility of measures with other uses and marine nature conservation and to avoid conflicts. To promote this, a dialogue could be initiated to ensure that a joint discussion takes place in a spatial planning forum with stakeholders from the sectors.

For climate change to be fully integrated into MSP, institutional strengthening, including international cooperation in the North and Baltic Seas, is necessary. Projects in particular offer the opportunity to develop coherent approaches with neighbouring countries or to use joint data pools, for example.

One focus should be on the conceptual development of marine ecosystem services and, above all, the potential of natural carbon sinks.

are interdependent within the marine food chains.

The phytoplankton serves as a food source for organisms that specialise in filtering the water for food intake. The main primary consumers of phytoplankton include zooplanktonic organisms such as copepods and water fleas. Zooplankton has a central role in the marine ecosystem as a primary consumer of phytoplankton on the one hand and as the lowest secondary producer within the marine food chains on the other. Zooplankton serves as food for the secondary consumers of the marine food chains, from carnivorous zooplankton species to benthos, fish, marine mammals and seabirds. Among the uppermost components of the marine food chains are the so-called predators. The upper predators within the marine food chains include water and sea birds and marine mammals. In the food chains, producers and consumers are interdependent and influence each other in many ways.

In general, food availability regulates the growth and distribution of species. Exhaustion of the producer results in the decline of the consumer. Consumers in turn control the growth of producers by eating away. Food limitation affects the individual level by impairing the physical condition of each individual. At the population level, food restriction leads to changes in the abundance and distribution of species. Food competition within a species or between species has similar effects.

The time-adjusted succession or sequence of growth between the different components of the marine food chains is of critical significance. For example, the growth of fish larvae is directly dependent on the available biomass of plankton. For seabirds, breeding success is also directly related to the availability of suitable fish (species, length, biomass, energy value). Temporally or spatially staggered occurrence of succession and abundance of species from different trophic levels leads to the interruption of food chains. Temporal offset, the so-called trophic "mismatch", causes malnutrition or even starvation, particularly in early developmental stages of organisms. Disruptions in marine food chains can have an effect not only on individuals but also on populations. Predator-prey relationships or trophic relationships between size or age groups of a species or between species also regulate the balance of the marine ecosystem. For example, the decline of cod stocks in the Baltic Sea has had a positive effect on the development of sprat stocks (ÖSTERBLOM et al. 2006).

Trophic relationships and interrelationships between plankton, benthos, fish, marine mammals and seabirds are controlled by a variety of control mechanisms. Such mechanisms operate from the lower part of the food chains, starting with nutrient, oxygen or light availability and moving upwards to the upper predators. Such bottom-up control mechanisms can act by increasing or decreasing primary production. Effects starting from the upper predators downwards, via so-called "top-down" mechanisms, can also control food availability.

The interrelationship within the components of the marine food chains are influenced by abiotic and biotic factors. For example, dynamic hydrographic structures, frontal formation, water stratification and currents play a decisive role in food availability (increase in primary production) and use by upper predators. Exceptional events such as storms and ice winters also influence trophic relationships within marine food chains. Biotic factors such as toxic algal blooms, parasite infestation and epidemics also affect the entire food chain.

Anthropogenic activities also have a decisive influence on the interrelationship within the components of the marine ecosystem. Humans affect the marine food chain both directly through the capture of marine animals and indirectly through activities that can influence components of the food chain.

Overfishing of fish stocks, for example, confronts upper predators such as seabirds and marine mammals with food limitations or forces them to develop new food resources. Overfishing can also bring about changes at the lower end of the food chain. For example, jellyfish can spread extremely far when their fish predators have been fished out. Moreover, shipping and mariculture represent an additional factor that can lead to positive or negative changes in marine food chains through the introduction of non-native species. Discharges of nutrients and pollutants via rivers and the atmosphere also affect marine organisms and can lead to changes in trophic conditions.

Natural or anthropogenic impacts on one of the components of the marine food chains, e.g. the species spectrum or the biomass of the plankton, can affect the entire food chain and shift the balance of the marine ecosystem and, if necessary, endanger it. Examples of the very complex interrelationship and control mechanisms within the marine food chains were presented in detail in the description of the individual protected assets.

The complex interrelationships of the various components to each other ultimately lead to changes in the entire marine ecosystem of the North Sea. From thehe changes with regard to protected assets already described in Chapter Introduction

Legal bases and environmental assessment tasks

Maritime spatial planning in the German Exclusive Economic Zone (EEZ) is the responsibility of the Federal Government under the Regional Planning Act (Raumordnungsgesetz, ROG). In accordance with Article 17(1) of the ROG, the competent Federal Ministry, the Federal Ministry of the Interior, Building and Community (BMI), in agreement with the federal ministries concerned, draws up a spatial plan for the German EEZ as a statutory instrument. In accordance with Article 17(1) Sentence 3 of the ROG, the BSH carries out the preliminary procedural steps for drawing up the spatial plans (Raumordnungsplans, ROP) with the consent of the BMI. When drawing up the ROP, an environmental assessment is carried out in accordance with the provisions of the ROG and, where applicable, those of the Environmental Impacts Assessment Act (Gesetz über die Umweltverträglichkeitsprüfung, UVPG), the so-called Strategic Environmental Assessment (SEA).

The obligation to carry out a strategic environmental assessment, including the preparation of an environmental report, is a result of the updating, amendment and cancellation of the existing spatial plans from 2009, from Articles 7(7) and (8) of the ROG, in conjunction with Article 35(1) No. 1 of the UVPG and No. 1.6 of Annex 5.

According to Article 1 of the SEA Directive 2001/42/EC, the aim of the Strategic Environmental Assessment is to ensure a high level of environmental protection in order to promote sustainable development and to contribute to ensuring that environmental considerations are adequately taken into account during the preparation and adoption of plans well in advance of the actual project planning. According to Article 8 of the ROG, the Strategic Environmental Assessment has the task of determining the likely significant impacts of implementing the plan and to describe and evaluate them in an environmental report at an early stage. It serves to ensure effective environmental precautions in accordance with the applicable laws and is performed according to uniform principles and with public participation. All protected resources under Article 8(1) of ROG are to be considered:

- people, including human health
- fauna, flora, and biodiversity
- site, soil, water, air, climate and landscape
- cultural and other material resources
- the interactions between the above-mentioned protected resources.

In the context of spatial planning, definitions are mainly made in the form of priority and reserved areas and other objectives and principles.

The requirements and content of the environmental report to be prepared are specified in Annex 1 of Article 8(1) of the ROG.

Accordingly, the environmental report consists of an introduction, a description and assessment of the environmental impacts identified in the environmental review, in accordance with Article 8(1) of the ROG, and additional information.

According to No. 2d) of Annex 1 of Article 8 of the ROG, other planning options that may be expressly considered should also be named, taking into account the objectives and the geographical scope of the ROP.

## 2.24 Outline of the content and main objectives of the spatial plan

According to Article 17(1) of the ROG, the spatial plan for the German EEZ must take into account any interaction between land and sea, as well as safety aspects

9. to ensure safety and ease of navigation,
10. for further economic uses,
11. for scientific uses and
12. to protect and improve the marine environment.

According to Article 7(1) of the ROG, spatial plans for a specific planning area and a regular medium-term period must contain specifications as **objectives and principles** of spatial planning for the development, order and safeguarding of the area, in particular for the uses and functions of the area.

Under Article 7(3) of the ROG, these provisions may also designate areas. For the EEZ, these may be the following areas:

**Priority areas** intended for certain spatially significant functions or uses and excluding other spatially significant functions or uses in the area, where these are incompatible with the priority functions or uses.

**Reserved areas,** which are to be reserved for certain spatially significant functions or uses, to which particular weight is to be attached when comparing them to competing spatially significant functions or uses.

**Suitability areas for the marine area** in which certain spatially significant functions or uses do not conflict with other spatially significant interests, whereby these functions or uses are excluded elsewhere in the planning area.

In the case of priority areas, it may be stipulated that they also have the effect of suitability areas under Article 7(3) Sentence 2 No. 4 of the ROG.

According to Article 7(4) of the ROG, the spatial plans should also contain spatially significant planning provisions and measures by public bodies and entities under private law according to Article 4(1) Sentence 2 of the ROG which are suitable for inclusion in spatial plans, are necessary for the coordination of spatial claims, and can be secured by objectives or principles of spatial planning.

## 2.25 Relationship to other relevant plans, programmes and projects

In Germany, there is a tiered planning system for the coordination of all spatial requirements and concerns arising in a given area, consisting of Federal, State and Regional planning authorities. According to Article 1(1) Sentence 2 of the ROG, this system is used to coordinate different spatial requirements in order to balance out conflicts arising at the respective planning level and to make provisions for individual uses and functions of the space.

The tiered system allows the planning to be further specified by the subsequent planning levels. According to Article 1(3) of the ROG, the development, organisation and safeguarding of the subspaces should be integrated into the conditions and requirements of the overall area, and the development, organisation and safeguarding of the overall area should take into account the conditions and requirements of its subspaces.

The Federal Ministry of the Interior, Building and Community (BMI) is responsible for spatial planning at federal level in the EEZ. In contrast, the respective federal state is responsible for state planning for the entire area of the state, including the respective coastal waters.

In addition to spatial planning for the respective areas of responsibility, there are sectoral plans based on sectoral laws for certain planning areas. Sectoral plans serve to define details for the respective sector, taking into account the requirements of spatial planning.

### 2.25.1 Spatial plans in adjacent areas

In the interests of coherent planning, coordination processes with the plans of the coastal federal states and neighbouring states are advisable and must be taken into account in the cumulative assessment of impacts on the marine environment. At present, the spatial planning of both Lower Saxony and Schleswig-Holstein is being updated. Regional spatial planning programmes of the coastal regions will be taken into account, provided that significant definitions are made for the coastal waters.

#### 2.25.1.1 Lower Saxony

The spatial plan for the state of Lower Saxony, including the coastal sea of Lower Saxony, is the State Spatial Planning Programme (Landesraumordnungsprogramm, LROP). The Ministry of Food, Agriculture and Consumer Protection of Lower Saxony, as the highest state planning authority, is responsible for drawing up and amending it; the final decision on the LROP is the responsibility of the state government. The LROP is based on a directive from 1994 and has been updated several times since then, most recently in 2017. At the end of 2019, the procedure for a new update was initiated.

#### 2.25.1.2 Schleswig-Holstein

In Schleswig-Holstein, the State Development Plan (Landesentwicklungsplan, LEP S-H) is the basis for the state's spatial planning. The Ministry of the Interior, Rural Areas, Integration and Equality of Schleswig-Holstein (MILIG) is responsible for drafting it and amending it. The current LEP S-H, from 2010, forms the basis for the spatial planning of the state until 2025. The state of Schleswig-Holstein has initiated the procedure for updating the LEP S-H 2010 and carried out a participation procedure in 2019.

#### 2.25.1.3 Netherlands

The Netherlands is in the fourth revision cycle and is currently preparing the planning phase. The plan is binding and covers a planning area.

#### 2.25.1.4 United Kingdom

England consists of 11 planning areas and each area is to receive its own plan. These are to be designed for a long-term period of about 20 years and updated every three years. It is envisaged that all plans will be in place by 2021.

The Scottish Plan is currently being revised and is in its second cycle. The consultation on the revision of the first plan has just been completed. Scotland has one national maritime spatial plan and 11 spatial planning areas. The spatial plans are also binding in Scotland.

#### 2.25.1.5 Denmark

Denmark is at an advanced stage of the spatial planning process. Denmark is currently drafting the first spatial plan as a comprehensive plan for the North Sea and the Baltic Sea, which will be binding and last until 2050.

### 2.25.2 MSFD programme of measures

Each Member State must develop a marine strategy to achieve good status for its marine waters, which for Germany is the North Sea and the Baltic Sea. The key to this is the establishment of a programme of measures to achieve or maintain good environmental status and the practical implementation of this programme of measures. The establishment of the programme of measures is regulated in Germany by Article 45h of the Federal Water Act (Wasserhaushaltsgesetz, WHG). Under Objective 2.4 "Oceans with sustainably and carefully used resources", the current MSFD programme of measures mentions maritime spatial planning as a contribution of existing measures to achieving the operational objectives of the MSFD. In addition, the catalogue of measures also formulates a concrete review mandate for updating the spatial plans with regard to measures for the protection of migratory species in the marine area. Both the environmental objectives of the MSFD and the MSFD programme of measures are taken into account in the SEA.

### 2.25.3 Management plans for the North Sea EEZ nature reserves

On 17 November 2017, the Federal Agency for Nature Conservation (Bundesamt für Naturschutz, BfN) initiated the participation procedure under Article 7(3) of the Regulation on the Establishment of the "Borkum Riffgrund" Nature Conservation Area (NSGBRgV), Article 7(3) of the Regulation on the Establishment of the Doggerbank Nature Conservation Area (NSGDgbV) and Article 9(3) of the Regulation on the Establishment of the "Sylt Outer Reef - Eastern German Bight" Nature Conservation Area (NSGSylV) on the management plans for the nature conservation areas in the German North Sea EEZ. On 13 May 2020, the management plans "Borkum Riffgrund", "Doggerbank" and "Sylt Outer Reef - Eastern German Bight" were published in the Federal Gazette.

### 2.25.4 Tiered planning procedure for offshore wind energy and power lines (central model)

For some uses in the German EEZ, such as offshore wind energy and power cables, a multi-stage planning and approval process—i.e. a subdivision into several stages—is envisaged. In this context, the instrument of maritime spatial planning is at the highest and superordinate level. The spatial plan is the forward-looking planning instrument which coordinates the most diverse interests of users in the fields of industry, science and research as well as protection claims. A strategic environmental assessment must be carried out when the spatial plan is drafted. The SEA for the ROP is related to various downstream environmental assessments, in particular the directly downstream SEA for the site development plan (FEP).

The next level is the FEP. Within the framework of the so-called central model, the FEP is the control instrument for the orderly expansion of offshore wind energy and electricity grids in a tiered planning process. The FEP has the character of a sectoral plan. The sectoral plan is designed to plan the use of offshore wind energy and the electricity grids in a targeted manner and as optimally as possible under the given framework conditions—in particular the requirements of spatial planning—by defining areas and sites as well as locations, routes and route corridors for grid connections or for cross-border submarine cable systems. In principle, a SEA is carried out to accompany the establishment, updating and modification of the FEP.

In the next step, the sites for offshore wind turbines defined in the FEP will undergo a preliminary examination. If the requirements of Article 12(2) of the Wind Energy At Sea Act (WindSeeG) are met, the preliminary examination is followed by the determination of the suitability of the site for the construction and operation of offshore wind energy installations. The preliminary investigation is also accompanied by a SEA.

If the suitability of a site for the use of offshore wind energy is established, the site is put out to tender and the winning bidder or corresponding entitled entity can submit an application for approval (planning approval or planning permission) for the erection and operation of wind turbines on the area specified in the FEP. As part of the planning approval procedure, an environmental impact assessment is carried out if the prerequisites are met.

While the sites defined in the FEP for the use of offshore wind energy are pre-examined and tendered, this is not the case for defined sites, routes and route corridors for grid connections or cross-border submarine cable systems. Upon application, a planning approval procedure including an environmental assessment is usually carried out for the construction and operation of grid connection lines. The same applies to cross-border submarine cable systems.

Under Article 1(4) of the UVPG, the UVPG also applies where federal or state legislation does not specify the environmental impact assessment in more detail or does not comply with the essential requirements of the UVPG.

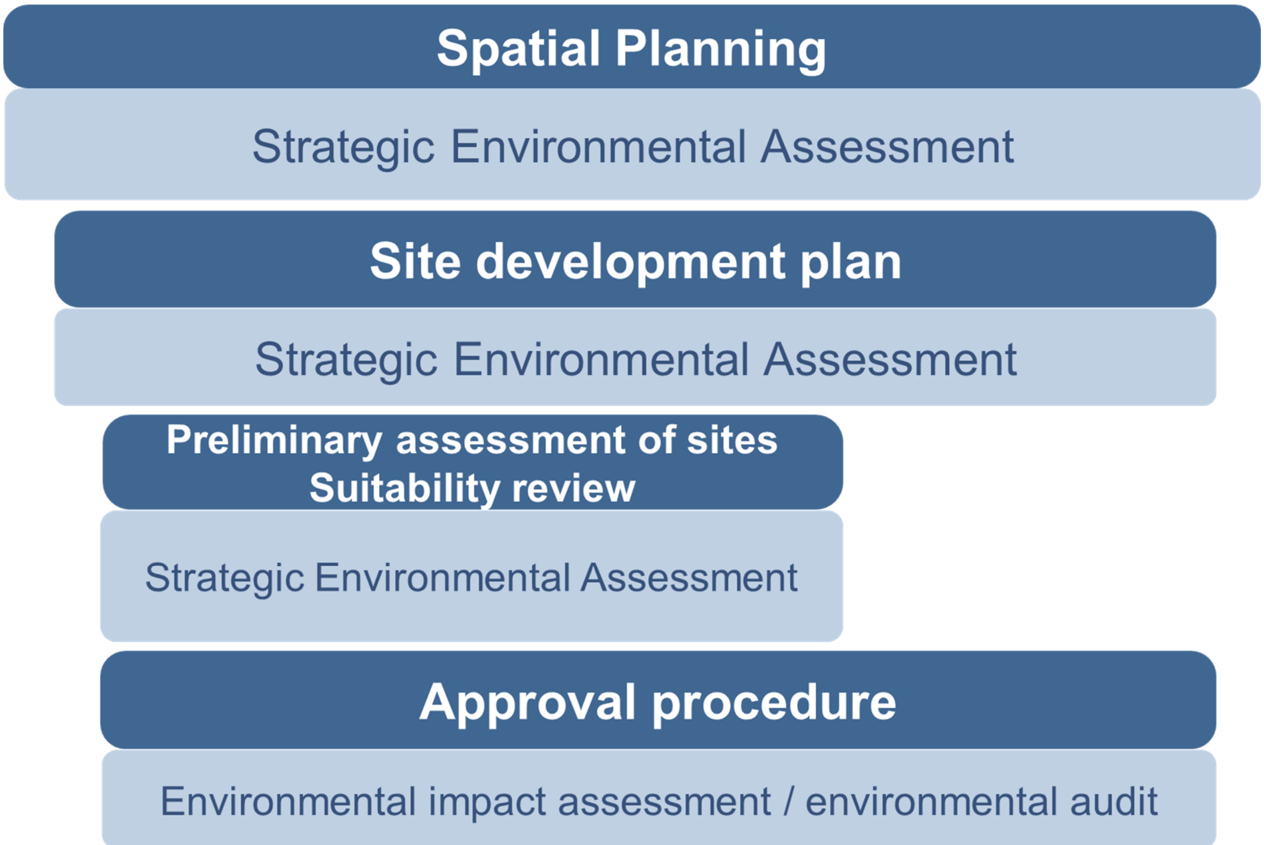



Figure 1: Overview of the tiered planning and approval process in the EEZ.

In the case of multi-stage planning and approval processes, it follows from the relevant legislation (e.g. Federal Regional Planning Act, WindSeeG and BBergG) or, more generally, from Article 39(3) of the UVPG that, in the case of plans, when defining the scope of the investigation, it should be determined at which of the process stages certain environmental impacts are to be assessed. In this way, multiple assessments are to be avoided. The nature and extent of the environmental impacts, technical requirements, and the content and subject matter of the plan must be taken into account.

In the case of subsequent plans and subsequent approvals of projects for which the plan sets a framework, the environmental assessment pursuant to Article 39(3) Sentence 3 of the UVPG shall be limited to additional or other significant environmental impacts as well as to necessary updates and more detailed investigations.

As part of the tiered planning and approval process, a common feature of all reviews is that environmental impacts on the protected resources specified in Article 8(1) of the ROG and Article 2(1) of the UVPG are considered, including their interactions.

According to the definition in Article 2(2) of the UVPG, environmental impacts within the meaning of the UVPG are direct and indirect impacts of a project or the implementation of a plan or programme on the protected resources.

According to Article 3 of the UVPG, environmental assessments comprise the identification, description and assessment of the significant impacts of a project or a plan or programme on the protected resources. They serve to ensure effective environmental protection in accordance with the applicable laws and are carried out according to uniform principles and with public participation.

In the offshore sector, avifauna has become established as a sub-category of the objects of protection of animals, plants and biological diversity: seabirds/resting and migratory birds, benthos, biotope types, plankton, marine mammals, fish and bats.

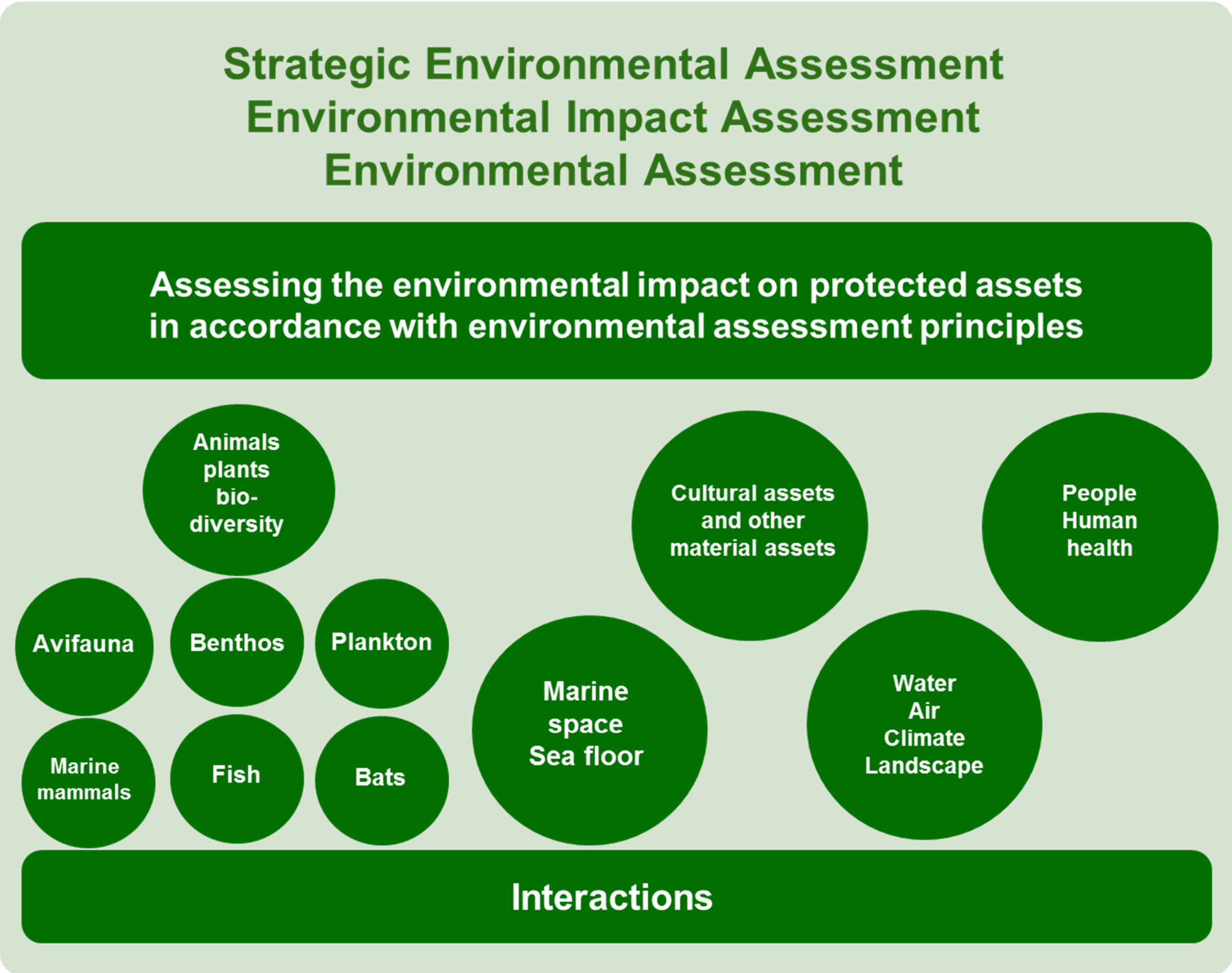


Figure 2: Overview of the protected resources in the environmental assessments.

The detail of the tiered planning process is as follows:

#### 2.25.4.1 Maritime spatial planning (EEZ)

At the highest and superordinate level is the instrument of maritime spatial planning. For sustainable spatial planning in the EEZ, the BSH prepares a spatial plan on behalf of the competent Federal Ministry, which comes into force in the form of statutory orders.

The spatial plans should **define**, taking into account possible interactions between land and sea, and safety aspects

- to ensure the safety and ease of navigation,
- for further economic uses,
- for scientific uses and
- to protect and improve the marine environment.

In the context of spatial planning, specifications are mainly made in the form of priority and reserved areas and other objectives and principles. According to Article 8(1) of the ROG, when drafting spatial plans, the body responsible for the spatial plan must carry out a strategic environmental assessment in which the likely significant impacts of the respective spatial plan on the resources to be protected, including interactions, must be identified, described and evaluated.

The **aim** of the instrument of spatial planning is to optimise overall planning solutions. A wider spectrum of uses and functions is considered. Fundamental strategic questions should be clarified at the beginning of a planning process. In this way, the instrument primarily functions, within the framework of the legal provisions, as a controlling planning instrument for the planning administrative bodies in order to create a framework for all uses which is compatible with the spatial and natural environment as far as possible.

In spatial planning, the **depth of examination** is generally characterised by a greater scope of investigation, i.e. a fundamentally greater number of planning options, and a lesser depth of investigation in terms of detailed analyses. Above all, regional, national and global impacts as well as secondary, cumulative and synergetic effects are taken into account.

The **focus** is therefore on possible cumulative effects, strategic and large-scale planning options and possible transboundary impacts.

#### 2.25.4.2 Site development plan

The next level is the FEP.

The **specifications** to be made by the FEP and to be examined within the framework of the SEA result from Article 5(1) of the WindSeeG. The plan mainly specifies areas and sites for wind energy plants as well as the expected capacity to be installed on these sites. In addition, the FEP also specifies routes, route corridors and sites. Planning and technical principles are also laid down. Although these also serve, among other things, to reduce environmental impacts, they may in turn lead to impacts, so that an assessment is required as part of the SEA.

With regard to the FEP's **objectives,** it deals with the fundamental questions of the use of offshore wind energy and grid connections on the basis of the legal requirements, especially with the need, purpose, technology and the identification of sites and routes or route corridors. Therefore, the primary function of the plan is as a steering planning instrument in order to create a spatially and, as far as possible, nature-compatible framework for the implementation of individual projects, i.e. the construction and operation of offshore wind energy plants, their grid connections, cross-border submarine cable systems and interconnections.

The **depth of the assessment** of the likely significant environmental effects is characterised by a wider scope of investigation, i.e. a larger number of alternatives and, in principle, a lower depth of investigation. At the level of sectoral planning, detailed analyses are generally not yet performed. Above all, local, national and global impacts, as well as secondary, cumulative and synergistic impacts in the sense of an overall view, are taken into account.

As with the instrument of maritime spatial planning, the **focus** of the audit is on possible cumulative effects as well as possible cross-border impacts. In addition, the FEP focuses on strategic, technical and spatial alternatives, especially for the use of wind energy and power lines.

#### 2.25.4.3 Suitability test as part of the preliminary examination

The next step in the tiered planning process is the suitability testing of sites for offshore wind turbines.

In addition, the power to be installed is determined on the site in question.

In accordance with Article 10(2) of the WindSeeG, the suitability test assesses whether the construction and operation of offshore wind energy installations on the site conflicts with the criteria for the inadmissibility of defining a site in the site development plan, in accordance with Article 5(3) of the WindSeeG or, insofar as they can be assessed independently of the later design of the project, with the interests relevant for the plan approval in accordance with Article 48(4) Sentence 1 of the WindSeeG.

Both the criteria of Article 5(3) of the WindSeeG and the matters of Article 48(4) Sentence 1 of the WindSeeG require an assessment of whether the marine environment is endangered. With regard to the latter concerns, there must be an assessment of whether pollution of the marine environment within the meaning of Article 1(1) No. 4 of the United Nations Convention on the Law of the Sea is at risk and whether bird migration is endangered.

Therefore, the preliminary examination with the suitability assessment or determination is the instrument connected between the FEP and the individual approval procedure for offshore wind energy plants. It refers to a specific site designated in the FEP and is thus much smaller than the FEP. It is distinguished from the plan approval procedure by the fact that an inspection approach which is independent of the later specific type of plant and layout is to be applied. So, the impact prognosis is based on model parameters, e.g. in two scenarios or ranges of scenarios which are intended to represent possible realistic developments.

Compared to the FEP, the SEA of the proficiency test is characterised by a smaller examination area and a greater **depth of examination**. In principle, fewer and spatially limited alternatives are seriously considered. The two primary alternatives are the determination of the suitability of a site on the one hand and the determination of its (possibly partial) unsuitability (see Article 12(6) of the WindSeeG) on the other. Restrictions on the type and extent of development, which are included as specifications in the determination of suitability, are not alternatives in this sense.

The **focus** of the environmental assessment within the framework of the suitability test is on considering the local impacts of a development with wind energy plants in relation to the site and the location of the development on the site.

#### 2.25.4.4 Approval procedure (planning approval and planning licensing procedure) for offshore wind turbines

The next step after the preliminary examination is the approval procedure for the installation and operation of offshore wind turbines. After the site under examination has been put out to

tender by the BNetzA, the winning bidder can, once BNetzA has accepted the bid, submit an application for planning approval or—if the prerequisites are met—for planning permission for the construction and operation of offshore wind energy plants, including the necessary ancillary plants on the site under examination.

In addition to the legal requirements of Article 73(1) Sentence 2 of the VwVfG, the plan must include the information contained in Article 47(1) of the WindSeeG. The plan may only be established under certain conditions listed in Article 48(4) of the WindSeeG, and only if, inter alia, the marine environment is not endangered, in particular if there is no cause for concern about pollution of the marine environment within the meaning of Article 1(1) No.4 of the Convention on the Law of the Sea, and if bird migration is not endangered.

Under Article 24 of the UVPG, the competent authority prepares a summary of

- the environmental impact of the project
- the characteristics of the project and the site, which are intended to prevent, reduce or offset significant adverse environmental effects
- measures to prevent, reduce or offset significant adverse environmental impacts
- the replacement measures in case of interventions in nature and landscape.

Under Article 16(1) of the UVPG, the project developer must submit a report to the competent authority on the expected environmental impacts of the project (EIA report), which must contain at least the following information:

- a description of the project, including information on the location, nature, scale and design, size and other essential characteristics of the project
- a description of the environment and its components within the project's sphere of influence
- a description of the characteristics of the project and of the location of the project to exclude, reduce or offset the occurrence of significant adverse environmental effects of the project
- a description of the measures planned to prevent, reduce or offset any significant adverse effects of the project on the environment and a description of planned replacement measures
- a description of the expected significant environmental effects of the project
- a description of the reasonable alternatives, relevant to the project and its specific characteristics, that have been considered by the developer and the main reasons for the choice made, taking into account the specific environmental effects of the project
- a generally understandable, non-technical summary of the EIA report.

Pilot wind energy plants are only dealt with in the context of the environmental assessment in the approval procedure and not at upstream stages.

#### 2.25.4.5 Approval procedure for grid connections (converter platforms and submarine cable systems)

In the tiered planning process, the establishment and operation of grid connections for offshore wind energy plants (converter platform and submarine cable systems, if applicable) is examined at the level of the approval procedures (planning approval and planning permission procedures) when implementing the spatial planning requirements and the specifications of the FEP at the request of the respective project executing agency—the responsible TSO.

According to Article 44(1) in conjunction with Article 45(1) of the WindSeeG, the construction and operation of facilities for the transmission of electricity require planning approval. In addition to the legal requirements of Article 73(1) Sentence 2 of the VwVfG, the plan must include the information contained in Article 47(1) of the WindSeeG. The plan may only be approved under certain conditions listed in Article 48(4) of the WindSeeG and only if, inter alia, the marine environment is not endangered, in particular if there is no cause for concern about pollution of the marine environment within the meaning of Article 1(1) No.4 of the Convention on the Law of the Sea, and no threat to bird migration.

Moreover, according to Article 1(4) of the UVPG, the requirements for the environmental impact assessment of offshore wind energy installations, including ancillary installations, apply accordingly to the performance of the environmental assessment.

#### 2.25.4.6 Cross-border submarine cable systems

According to Article 133(1) in conjunction with Article 133(4) of the BBergG (Federal Mining Act), the construction and operation of an underwater cable in or on the continental shelf requires a permit

- from a mining point of view (through the competent state mining authority)
- concerning the organisation of the use and exploitation of waters above the continental shelf and the airspace above these waters (through the BSH).

In accordance with Article 133(2) of the BBergG, the above-mentioned permits may only be refused if there is a risk to the life or health of persons or material resources or an impairment of overriding public interests which cannot be prevented or compensated for by a time limit, conditions or requirements. An impairment of overriding public interests exists in particular in the cases specified in Article 132(2) No. 3 of the BBergG. In accordance with Article 132(2) No. 3 b) and d) of the BBergG, an impairment of overriding public interests with regard to the marine environment exists in particular if the flora and fauna would be impaired in an unacceptable manner or if there is reason to believe that the sea will be polluted.

In accordance with Article 1(4) of the UVPG, the essential requirements of the UVPG must be observed for the construction and operation of transboundary submarine cable systems.

## Tabular overview of environmental audits: Focus of the investigations

| Maritime spatial planning<br>SEA | FEP<br>SEA | Preliminary study<br>SEA suitability test | Approval procedure<br>(planning approval or planning permission) grid connections<br>EA | Approval procedure<br>Transboundary submarine cable systems<br>EA |
|---|---|---|---|---|
| **Strategic planning for designations** | **Strategic planning for designations** | **Strategic decision on suitability of sites for OWF** | **Request for environmental assessment** | **Request for environmental assessment** |
| **Specifications and subject matter** | | | | |
| Priority and reservation areas<br>• To ensure the safety and efficiency of navigation,<br>• To further economic uses. especially offshore wind energy and pipelines<br>• To enable scientific uses and to protect and improve the marine environment<br>Objectives and principles<br>Application of the ecosystem approach | • Areas for offshore wind turbines<br>• Areas for offshore wind turbines, including the expected capacity to be installed | • Verification of the suitability of the site for the construction and operation of wind turbines, including the capacity to be installed<br>• On the basis of the available and collected data (STUK) as well as other information that can be determined with reasonable effort<br>• Specifications in particular on the type, extent and location of the development | • The construction and operation of platforms and interconnectors<br>• In accordance with the requirements of maritime spatial planning and the site development plan | • The construction and operation of transboundary submarine cable systems<br>• According to the requirements of regional planning and the FEP |
| **Environmental impact analysis** | | | | |
| Analyses (identifies, describes and assesses) the likely significant effects of the plan on the marine environment | Analyses (identifies, describes and assesses) the likely significant environmental effects of the plan on the marine environment | Analyses (determines, describes and evaluates) the likely significant environmental impacts of the construction and operation of wind turbines, which can be assessed independently of the later design of the project, on the basis of model assumptions | Analyses (determines, describes and evaluates) the environmental impacts of the specific project (platform and connecting undersea cable, if applicable). | Analyses (identifies, describes and evaluates) the environmental impacts of the specific project. |
| **Objective** | | | | |
| Aims at the optimisation of overall planning solutions, i.e. comprehensive packages of measures.<br>Consideration of a wider range of uses.<br>Begins at the beginning of the planning process to clarify strategic issues of principle, i.e. at an early stage when there is even greater scope for action. | For the use of offshore wind energy, addresses the fundamental questions of<br>• Needs or statutory objectives<br>• Purpose<br>• Technology<br>• Capacities<br>• Finding locations for platforms and tracks. | For the use of wind turbines, deals with the fundamental questions of<br>• Capacity<br>• Suitability of the area<br>Provides information on the site required by law for the submission of bids. | Deals with questions regarding the concrete design ("how") of a project (technical equipment, construction - building permits).<br>Assesses the environmental compatibility of the project and formulates conditions for this. | Deals with questions regarding the concrete design ("how") of a project (technical equipment, construction - building permits).<br>Assesses the environmental impact of the project and also formulates conditions. |

| | | | | |
|---|---|---|---|---|
| Essentially functions as a controlling planning instrument of the planning administrative bodies to create an environmentally compatible framework for all uses. | Searches for environmentally sound packages of measures without absolutely assessing the environmental compatibility of the planning.<br><br>Acts mainly as a steering planning instrument to create an environmentally sound framework for the realisation of individual projects (wind turbines and grid connections, transboundary submarine cables) | Searches for environmentally sound packages of measures without assessing the environmental compatibility of the specific project.<br>Acts as an instrument between the FEP and the approval procedure for wind turbines on a specific site. | Serves primarily as a passive assessment instrument that reacts to requests from the project developer. | Serves primarily as a passive assessment instrument that reacts to requests from the project developer. |
| **Assessment depth** | | | | |
| Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses)<br><br>Considers spatial, national and global impacts as well as secondary, cumulative and synergistic impacts in the sense of a comprehensive perspective . | Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses)<br><br>Takes into account local, national and global impacts as well as secondary, cumulative and synergistic impacts in the sense of an overall view. | Characterised by a smaller assessment area, greater depth of study (detailed analyses).<br><br>The determination of suitability may include specifications for the subsequent project, in particular with regard to the type and extent of the development of the site and its location. | Characterised by a narrower scope of study (limited number of alternatives) and greater depth of study (detailed analyses).<br><br>Assesses the environmental compatibility of the project and formulates conditions for this.<br><br>Considers primarily local impacts in the vicinity of the project. | Characterised by a narrower scope of study (limited number of alternatives) and greater depth of study (detailed analyses).<br><br>Considers primarily local impacts in the vicinity of the project. |
| **Focus of the assessment** | | | | |
| **Cumulative effects**<br>Overall perspective<br>Strategic and large-scale alternatives<br>Possible transboundary effects | **Cumulative effects**<br>Overall perspective<br>Strategic, technical and spatial alternatives<br>Possible transboundary effects | **Local effects in** relation to the site and its location. | Environmental impacts of turbines, construction and operation<br><br>Turbine dismantling<br><br>Study in relation to the specific installation design.<br><br>Intervention, compensation and replacement measures. | Environmental impacts of turbines, construction and operation<br><br>Study in relation to the specific installation design.<br><br>Intervention, compensation and replacement measures. |

**Approval procedure (plan approval or plan permit) for wind turbinesEIA**

## Assessment subject

**Environmental impact assessment on request for**

- The installation and operation of wind turbines
- The site defined and pre-examined in the FEP
- According to the designations of the FEP and the specifications of the preliminary study.

## Environmental impact assessment

Analyses (determines, describes and evaluates) the environmental impacts of the specific project (wind turbines, platforms and internal cabling of the wind farm, if applicable)

Under Section 24 UVPG, the competent authority prepares a summary
- Of the environmental impacts of the project,
- Of the characteristics of the project and of the site, which are intended to prevent, reduce or offset **significant adverse environmental effects,**
- Of the measures to prevent, reduce or offset **significant negative environmental impacts**, and
- Of the replacement measures in the event of interference with nature and landscape (note: exception under Section 56 subsection 3 BNatSchG

## Objective

Addresses the questions of the specific design ("how") of a project (technical equipment, construction).

Serves primarily as a passive assessment instrument that reacts to requests from the tender winner/project developer.

## Assessment depth

Characterised by a narrower scope of study, i.e. a limited number of alternatives, and greater depth of study (detailed analyses).

Assesses the environmental compatibility of the project on the site under study and formulates conditions for this.

Considers mainly local effects in the vicinity of the project.

## Focus of the assessment

The main focus of the assessment is formed by:
- Environmental impacts from construction and operation.
- Assessment in relation to the specific installation design.
- Installation dismantling.

Figure 3: Overview of key aspects of environmental assessments in planning and approval procedures.

### 2.25.5 Cables

On the upper level is the instrument of spatial planning. In this framework, areas or corridors for pipelines and data cables are defined.

According to Article 8(1) of the ROG, the likely significant effects of the pipeline provisions on the protected resources must be identified, described and assessed.

According to Article 133(1) in conjunction with Article 133(4) of the BBergG, the construction and operation of a transit pipeline or underwater cable (data cable) in or on the continental shelf requires a permit

- from a mining point of view (through the competent state mining authority) and
- concerning the organisation of the use and exploitation of waters above the continental shelf and the airspace above these waters (through the BSH).

According to Article 133(2) of the BBergG, the above-mentioned permits may only be refused if there is a risk to the life or health of persons or material resources or an impairment of overriding public interests which cannot be prevented or compensated for by a time limit, conditions or requirements. An impairment of overriding public interests exists in particular in the cases specified in Article 132(2) No. 3 of the BBergG. In accordance with Article 132(2) No. 3 b) and d) of the BBergG, an impairment of overriding public interests with regard to the marine environment exists in particular if the flora and fauna are impaired in an unacceptable manner or if there is reason to believe that the sea will be polluted.

In accordance with Article 133(2a) of the BBergG, the construction and operation of a transit pipeline, which is also a project within the meaning of Article 1(1) No.1 of the UVPG, is subject to an environmental impact assessment in the licensing procedure with regard to the organisation of the use and exploitation of the waters above the continental shelf and the airspace above these waters, as stipulated in the UVPG.

In accordance with Article 1(4) of the UVPG, the essential requirements of the UVPG must be observed for the construction and operation of data cables.

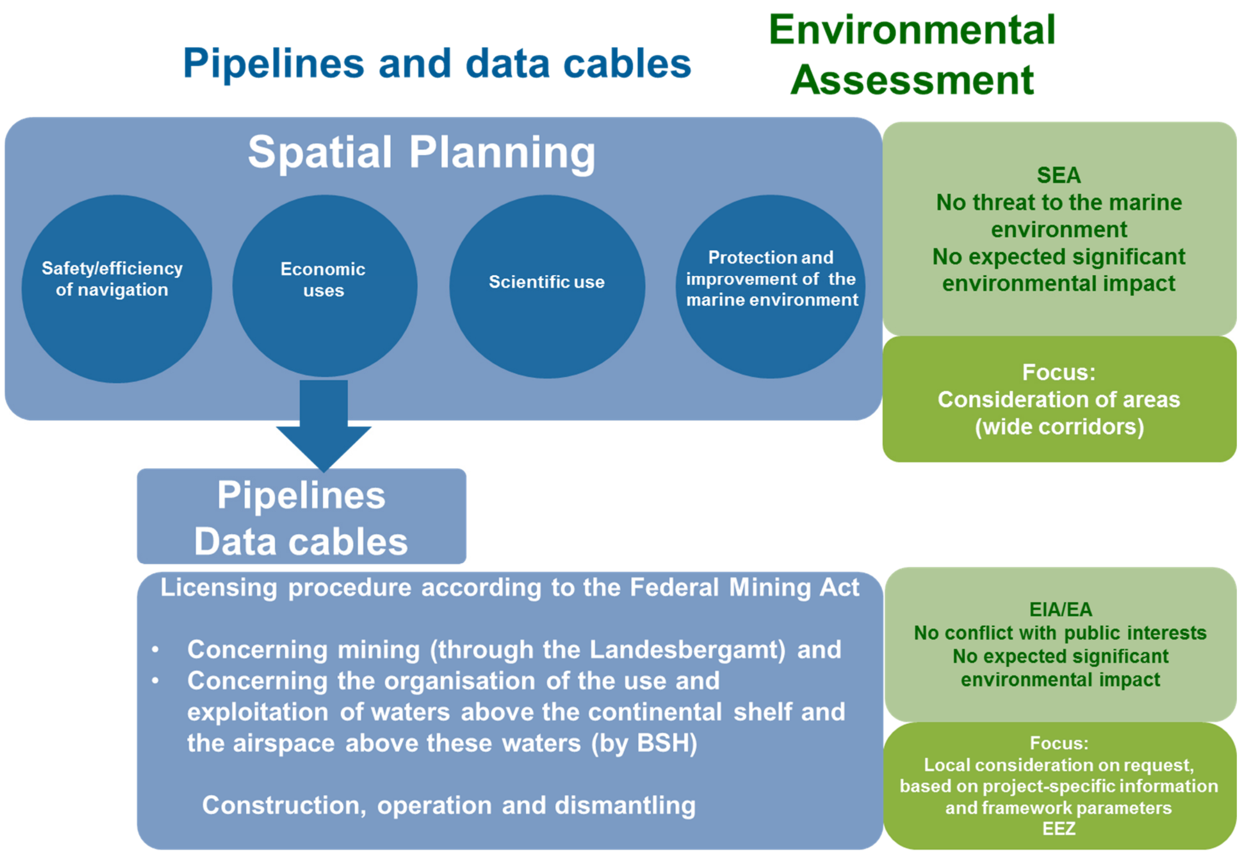



Figure 4: Overview of the focal points of the environmental assessment for pipelines and data cables.

### 2.25.6 Raw material extraction

In the German North and Baltic Seas, various mineral resources are sought and extracted, e.g. sand, gravel and hydrocarbons. As a superordinate instrument, spatial planning addresses possible large-scale spatial definitions, possibly including other uses. The anticipated significant environmental effects are reviewed (cf. also Chapter 1.5.4).

During implementation, the extraction of raw materials is regularly divided into different phases: exploration, development, operation and aftercare phase.

The exploration serves the purpose of exploring raw material deposits in accordance with Article 4(1) of the BBergG. In the marine area, it is regularly carried out by means of geophysical surveys, including seismic surveys and exploration drilling. In the EEZ, the extraction of raw materials includes the extraction (loosening, release), processing, storage and transport of raw materials.

In accordance with the Federal Mining Act, mining permits (permission, licence) must be obtained for exploration in the area of the continental shelf. These grant the right to explore for and/or extract mineral resources in a specified field for a specified period. Additional permits in the form of operating plans are required for development (extraction and exploration activities) (cf. Article 51 of the BBergG). For the establishment and management of an operation, main operating plans must be drawn up for a period not normally exceeding two years, which must be continuously updated as required (Article 52(1) Sentence 1 of the BBergG).

In the case of mining projects requiring an EIA Act, the preparation of a general operating plan is mandatory, and a planning approval procedure must be carried out for its approval (Article 52(2a) of the BBergG). Framework operation plans are generally valid for a period of 10 to 30 years.

In accordance with Article 57c of the BBergG in conjunction with the Regulation on the Environmental Impact Assessment of Mining Projects (UVP-V Bergbau), the construction and operation of production platforms for the extraction of oil and gas in the area of the continental shelf requires an EIA. The same applies to marine sand and gravel extraction on mining sites of more than 25 ha or in a designated nature reserve or Natura 2000 area.

The licensing authorities for the German North Sea and Baltic Sea EEZ are the state mining authorities.

#### 2.25.7 Shipping

In the context of spatial planning, the shipping sector is regularly defined in terms of areas (priority and/or reserved areas), objectives and principles. There is no tiered planning and approval process for the shipping sector, as is the case for the offshore wind energy sector, grid connections, cross-border submarine cables, pipelines and data cables.

With regard to the consideration of the likely significant effects of the provisions on the shipping sector, reference is made to Chapter 1.5.4.3

#### 2.25.8 Fisheries and marine aquaculture

Fisheries and aquaculture are considered as concerns in the context of spatial planning. There is no tiered planning and approval process. The framework for authorised catches, fishing techniques and gear is set within the framework of the EU's Common Fisheries Policy (CFP).

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

#### 2.25.9 Marine scientific research

Marine scientific research projects can have an adverse effect on the marine environment, e.g. through underwater noise generated during seismic surveys. On its website, the BfN mentions, among other things, the construction of artificial islands, installations or structures, the use of explosives, or measures of direct relevance to the exploration and exploitation of resources, which are in principle likely to have a significant effect on the area and must be assessed for their compatibility with the purpose of protecting potentially affected Natura 2000 protected areas before they are approved.

In this case, a nature conservation examination and approval are also required as part of the approval procedure. Notification is required for projects which do not require authorisation, and which may significantly affect Natura 2000 sites.

In the reserved areas, research is predominantly carried out by the Thuenen Institute under the technical supervision of the BMEL, especially within the framework of the CFP and reporting obligations within ICES. This takes place within the framework of long-term regular sampling and is not subject to authorisation in the EEZ.

#### 2.25.10 National and alliance defence

National and alliance defence is considered a concern in the context of spatial planning. There is no tiered planning and approval process.

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

#### 2.25.11 Leisure

The issue of leisure is also considered. There is no tiered planning and approval process.

With regard to the consideration of the likely significant effects, reference is made to Chapter 1.5.4.3

## 2.26 Presentation and consideration of environmental protection objectives

The ROP and the SEA will be drafted and implemented with due regard for the objectives of environmental protection. These provide information on the environmental status that is to be achieved in the future (environmental quality objectives). The objectives of environmental protection can be found in an overview of the international, EU and national conventions and regulations dealing with marine environmental protection, on the basis of which the Federal Republic of Germany has committed itself to certain principles and objectives. The environmental report will contain a description of how compliance with the requirements is checked and what specifications or measures are taken.

### 2.26.1 International conventions on the protection of the marine environment

The Federal Republic of Germany is party to all relevant international conventions on marine environmental protection.

#### 2.26.1.1 Globally applicable conventions that are wholly or partly aimed at protecting the marine environment

- the 1973 Convention for the Prevention of Pollution from Ships, as amended by the 1978 Protocol (MARPOL 73/78)
- 1982 United Nations Convention on the Law of the Sea
- Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (London, 1972) and the 1996 Protocol

#### 2.26.1.2 Regional agreements on marine environmental protection

- Trilateral Wadden Sea Cooperation (1978) and Trilateral Monitoring and Assessment Programme of 1997 (TMAP)
- 1983 Agreement for Co-operation in Dealing with Pollution of the North Sea by Oil and Other Harmful Substances (Bonn Agreement)
- 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)

#### 2.26.1.3 Agreements specific to protected resources

- 1979 Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
- 1979 Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

Under the Bonn Convention, regional agreements for the conservation of the species listed in Appendix II were concluded in accordance with Article 4 No. 3 of the Bonn Convention:

- 1995 Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)
- 1991 Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)
- 1991 Agreement on the Conservation of Seals in the Wadden Sea
- 1991 Agreement on the Conservation of Populations of European Bats (EUROBATS)
- 1993 Convention on Biological Diversity

### 2.26.2 Environmental and nature protection requirements at EU level

The relevant EU legislation must be taken into account:

- Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning (MSP Directive)
- Council Directive 337/85/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (Environmental Impact Assessment Directive, EIA Directive)
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD)
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (Strategic Environmental Assessment Directive, SEA Directive)
- 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 (Marine Strategy Framework Directive, MSFD),
- Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (Birds Directive).

#### 2.26.3 Environmental and nature conservation requirements at national level

There are also various legal provisions at national level, the requirements of which must be taken into account in the environmental report:

- Law on nature conservation and landscape management (Federal Nature Conservation Act - BNatSchG)
- Water Resources Act (WHG)
- Law on Environmental Impact Assessment (UVPG)
- Regulation on the establishment of the nature reserve "Sylt Outer Reef - Eastern German Bight", the regulation on the establishment of the nature reserve "Borkum Riffgrund", and the regulation on the establishment of the nature reserve "Doggerbank" in the North Sea EEZ
- Management plans for nature conservation areas in the German North Sea EEZ
- Energy and climate protection targets of the Federal Government

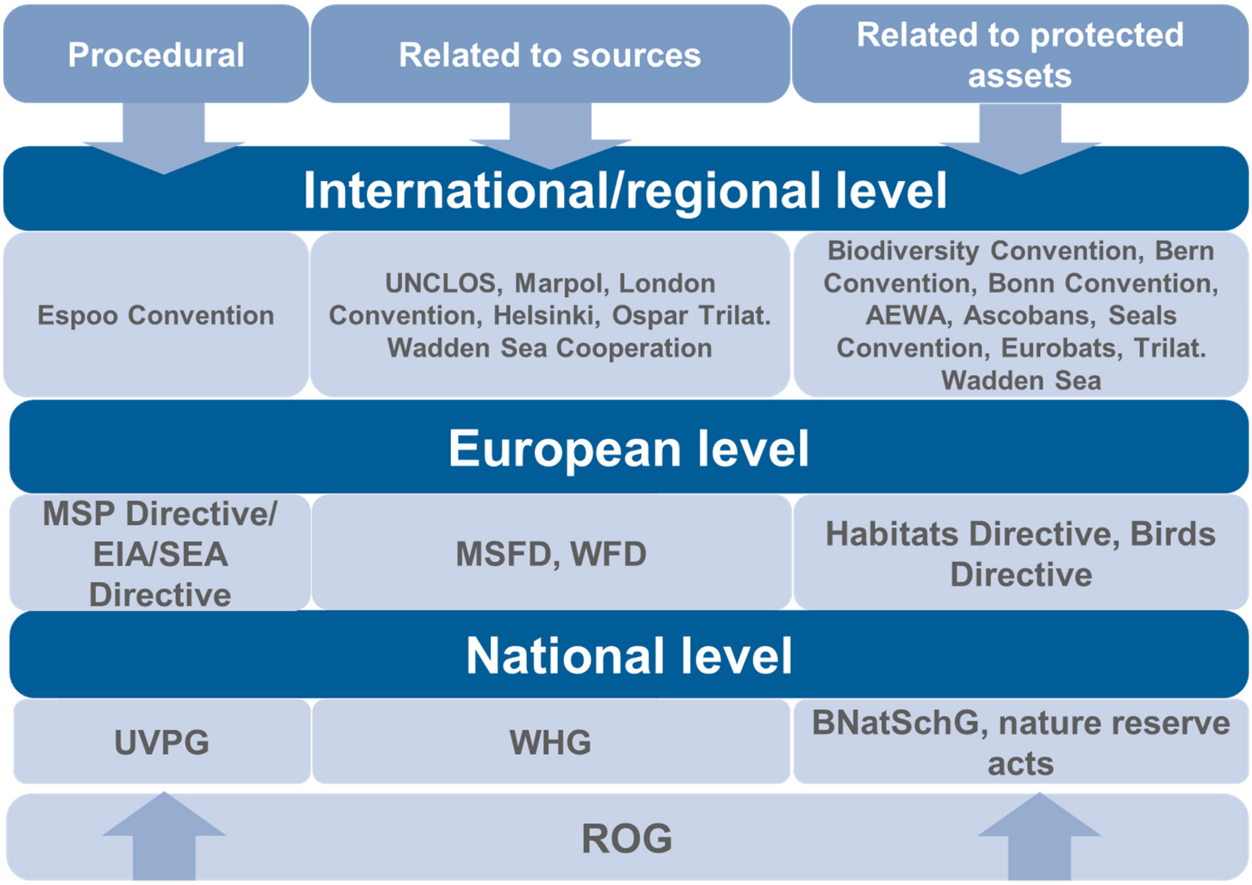



Figure 5: Overview of the levels of standardisation of the relevant legal acts for SEA.

### 2.26.4 Support for the objectives of the Marine Strategy Framework Directive

Spatial planning can support the implementation of individual objectives of the MSFD and thus contribute to good environmental status in the North Sea and Baltic Sea.

The following environmental goals (BMUB 2016) are taken into account when defining goals and principles:

- Environmental objective 1: Oceans unaffected by anthropogenic eutrophication—consideration in the objectives and principles for ensuring the safety and ease of navigation.
- Environmental objective 3: Oceans without deterioration of marine species and habitats due to the impact of human activities—consideration in the objectives and principles for offshore wind energy and nature conservation
- Environmental objective 6: Oceans without adverse impacts from anthropogenic energy inputs—consideration in the objectives and principles for offshore wind energy and pipelines

In the environmental assessment, avoidance and mitigation measures are formulated to support objectives 1, 3 and 6.

In addition, the spatial plan counteracts the deterioration of the environment by making certain uses possible only in geographically defined areas and for a limited period of time. The principles of environmental protection must be taken into account. At the permit level, the design of the use is specified in detail, with conditions if required, in order to prevent adverse effects on the marine environment.

An essential basis of the MSFD is the ecosystem approach regulated in Article 1(3) of the MSFD, which ensures the sustainable use of marine ecosystems by managing the overall

burden of human activities in a way that is compatible with the achievement of good environmental status. The application of the ecosystem approach is outlined in Chapter 4.3.

## 2.27 Strategic Environmental Assessment methodology

In principle, different methodological approaches can be considered when conducting the Strategic Environmental Assessment. The present environmental report builds on the methodology already applied in the Strategic Environmental Assessment of the federal sectoral plans and the site development plan with regard to the use of offshore wind energy and electricity grid connections.

For all other uses for which specifications are made in the ROP-E, such as shipping, extraction of raw materials and marine research, sector-specific criteria for an assessment of possible impacts are used.

The methodology is based primarily on the provisions of the plan to be examined. Within the framework of this SEA, each of the specifications is identified, described and assessed to see whether the specifications are likely to have significant effects on the protected resources concerned. According to Article 1(4) of the UVPG in conjunction with Article 40(3) of the UVPG, the competent authority shall provisionally assess the environmental impacts of the specifications in the environmental report with a view to effective environmental precautions in accordance with the applicable laws. Criteria for the assessment are to be found, inter alia, in Annex 2 of the Federal Regional Planning Act.

The purpose of the environmental report is to describe and assess the likely significant effects of the implementation of the ROP-E on the marine environment for provisions on the use and protection of the EEZ. The examination is carried out in each case on the basis of the protected resources.

According to Article 7(1) of the ROG, spatial plans must contain provisions as spatial planning **objectives and principles** for the development, organisation and safeguarding of areas, in particular on the uses and functions of areas. In accordance with Article 7(3) of the ROG, these provisions may also designate areas.

Specifications on the following uses are the subject of the environmental report, in particular

- Shipping
- Wind energy at sea
- Cables
- Raw material extraction
- Fisheries and marine aquaculture
- Marine Research
- Nature conservation/marine landscape/open space

In accordance with Article 17(1) No. 4 of the ROG, provisions for the protection and improvement of the marine environment also play a role.

### 2.27.1 Examination area

The description and assessment of the state of the environment refers to the North Sea EEZ, for which the spatial plan stipulates conditions. The SEA examination area covers the German North Sea EEZ (Figure 7). It should be noted that the data situation within the North Sea EEZ is significantly better for the area up to shipping route 10 than for the area northwest of shipping route 10. This is due to the project-related monitoring data available.

For the area north-west of shipping route 10, the spatial plan also defines the area. Based on the available sediment data and findings from monitoring for the "Doggerbank" protected area, it is also possible to describe and assess the environmental status of this area and evaluate potential environmental impacts.

The adjoining territorial sea and the adjacent areas of the riparian states are not the subject

of this plan, but they are included in the cumulative and transboundary consideration in the context of this SEA.

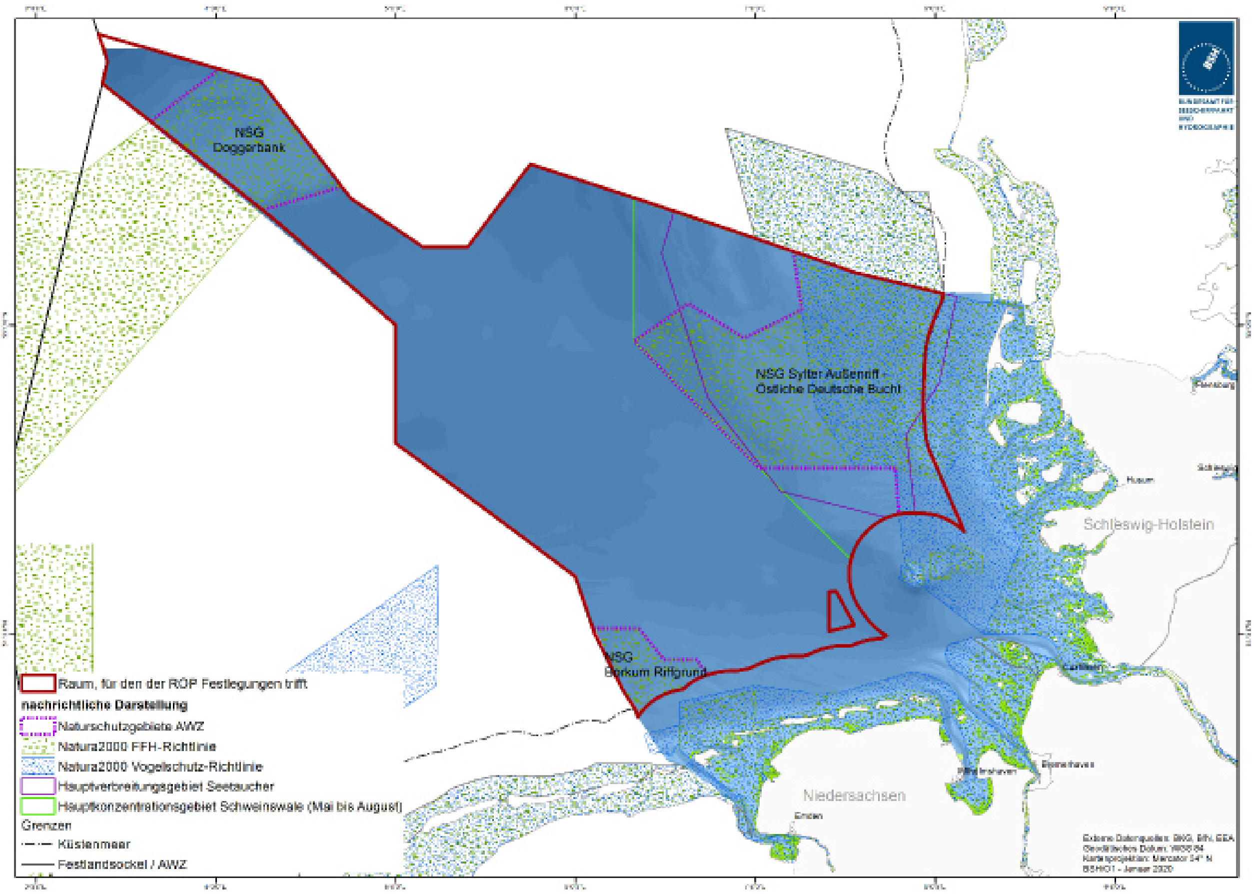



Figure 6: Boundary of the SEA investigation area (Environmental Report ROP-E EEZ North Sea).

### 2.27.2 Implementation of the environmental assessment

The assessment of the likely significant environmental effects of the implementation of the spatial plan shall include secondary, cumulative, synergistic, short-, medium- and long-term, permanent and temporary, positive and negative effects in terms of the resources to be protected. Secondary or indirect effects are those which are not immediate and therefore, may take effect after some time and/or in other places. Occasionally we also speak of consequential effects or interactions.

Possible impacts of the plan implementation are described and evaluated in relation to the protected areas. A uniform definition of the term "significance" does not exist, since it is an "individually determined significance" which cannot be considered independently of the "specific characteristics of plans or programmes" (SOMMER, 2005, 25f.). In general, significant effects can be understood to be effects that are serious and significant in the context under consideration.

According to the criteria of Annex 2 of the ROG, which are decisive for the assessment of the likely significant environmental effects, the significance is determined by

- "the probability, duration, frequency and irreversibility of the effects
- the cumulative nature of the effects
- the cross-border nature of the effects
- the risks to human health or the environment (e.g. in the event of accidents)
- the scale and spatial extent of the effect

- the importance and sensitivity of the area likely to be affected, due to its specific natural characteristics or cultural heritage, the exceeding of environmental quality standards or limit values and intensive land use
- the impact on sites or landscapes whose status is recognised as protected at national, Community or international level"

Also relevant are the characteristics of the plan, in particular

- the extent to which the plan sets a framework for projects and other activities in terms of location, type, size and operating conditions, or through the use of resources
- the extent to which the plan influences other plans and programmes, including those in a planning hierarchy
- the importance of the plan for the integration of environmental considerations, in particular with a view to promoting sustainable development
- the environmental issues relevant to the plan
- the relevance of the plan for the implementation of Community environmental legislation (e.g. plans and programmes relating to waste management or water protection) (Annex II of the SEA Directive)

In some cases, further details on when an effect reaches the significance threshold can be derived from sectoral legislation. Thresholds were developed under the law in order to be able to make a delimitation.

The description and assessment of potential environmental impacts is carried out for the individual spatial and textual specifications on the use and protection of the EEZ in relation to the protected property, including the status assessment.

Furthermore, where necessary, a differentiation is made according to different technical designs. The description and assessment of the likely significant effects of the implementation of the plan on the marine environment also relate to the protected resources presented. All contents of the plan that could potentially have significant environmental effects are examined.

Both permanent and temporary—e.g. construction-related—effects are considered. This is followed by a presentation of possible interactions, a consideration of possible cumulative effects and potential cross-border impacts.

The following protected resources are considered when assessing the state of the environment:

- Site
- Soil
- Water
- Plankton
- Biotope types
- Benthos
- Fish
- Marine mammals
- Avifauna
- Bats
- Biodiversity
- Air
- Climate
- Landscape
- Cultural and other material resources (underwater cultural heritage)
- People, in particular human health
- Interactions between protected resources

In general, the following methodological approaches are used in environmental assessment:

- Qualitative descriptions and assessments
- Quantitative descriptions and assessments
- Evaluation of studies and technical literature, expert opinions
- Visualisations
- Worst-case scenarios
- Trend assessments (e.g. on the state of the art of installations and the possible development of shipping traffic)
- Assessments by experts/the professional public

An assessment of the impacts resulting from the provisions of the plan is made on the basis of the status description and status assessment, and the function and significance of the individual areas for the individual protected resources on the one hand, and the impacts emanating from these provisions and the resulting potential impacts on the other. A forecast of the project-related impacts when the ROP-E is implemented is based on the criteria of intensity, range and duration or frequency of the effects (cf. Figure 7). Further assessment criteria are the probability and reversibility of the impacts, as specified in Annex 2 of Article 8(2) ROG.

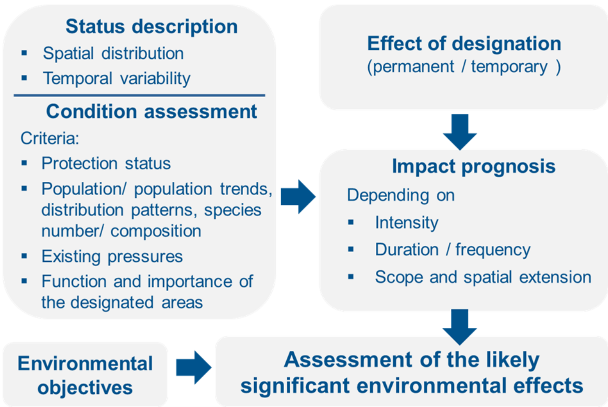



Figure 7: General methodology for assessing likely significant environmental effects.

### 2.27.3 Criteria for the description and assessment of the condition

The condition of the individual protected resources is assessed on the basis of various criteria. For the protected resources of site/soil, benthos and fish, the assessment is based on the aspects of rarity and vulnerability, diversity and peculiarity, and existing impacts. The description and assessment of marine mammals and marine and resting birds is based on the aspects listed in the figure. Since these are highly mobile species, a similar approach to that for the protected resources of site/soil, benthos and fish is not appropriate. For seabirds, resting birds and marine mammals, the criteria used are protection status, assessment of occurrence, assessment of spatial units and prior contamination. For migratory birds, the aspects of rarity, endangerment and existing pressures are taken into account, as are the aspects of occurrence assessment and the area's significance for bird migration over a large area. There is currently no reliable data source for a criteria-based assessment of bats as a protected species. The biodiversity protected resource is evaluated in text form.

The following is a summary of the criteria used for the status assessment of the respective protected resource. This overview deals with the protected resources which can be meaningfully delimited on the basis of criteria and which are considered in the focus area.

**Site/Soil**

| **Aspect: Rarity and endangerment** |
|---|
| Criterion: Percentage of sediment on the seabed and distribution of the morphological inventory of forms. |
| **Aspect: Diversity and individuality** |
| Criterion: Heterogeneity of the sediment on the sea floor and formation of the morphological inventory of forms. |
| **Aspect: Prior contamination** |
| Criterion: Extent of the anthropogenic prior contamination of the sediment on the sea floor and the morphological inventory of forms. |

### Benthos

| Aspect: Rarity and endangerment |
|---|
| Criterion: Number of rare or endangered species based on the Red List species identified (Red List by RACHOR et al. 2013). |
| **Aspect: Diversity and individuality** |
| Criterion: Number of species and composition of the species communities. The extent to which species or communities that are characteristic of the habitat occur and how regularly they occur is assessed. |
| **Aspect: Prior contamination** |
| For this criterion, the intensity of fishing exploitation, which is the most effective disturbance variable, will be used as a benchmark. Eutrophication can also affect benthic communities. For other disturbance variables, such as vessel traffic, pollutants, etc., there is currently a lack of suitable measurement and detection methods to be able to include them in the assessment. |

### Biotope types

| Aspect: Rarity and endangerment |
|---|
| Criterion: national conservation status and endangerment of biotope types according to the Red List of Endangered Biotope Types in Germany (FINCK et al., 2017) |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences. |

### Fish

| Aspect: Rarity and endangerment |
|---|
| Criterion: Proportion of species considered endangered according to the current Red List of Marine Fish (THIEL et al. 2013) and for the diadromous species on the Red List of Freshwater Fish (FREYHOF 2009) and assigned to Red List categories. |
| **Aspect: Diversity and individuality** |
| Criterion: The diversity of a fish community can be described by the number of species (α-Diversity, 'Species richness'). The species composition can be used to assess the specific nature of a fish community, i.e. how regularly habitat-typical species occur. Diversity and specificity are compared and assessed between the North Sea and the German EEZ as a whole, and between the EEZ and individual areas. |
| **Aspect: Prior contamination** |
| Criterion: Through the removal of target species and bycatch, as well as the impact on the seabed in the case of bottom-dwelling fishing methods, fisheries are considered to be the most effective disturbance to the fish community and therefore, serve as a measure of the pressure on fish communities in the North Sea. There is no assessment of stocks on a smaller spatial scale such as the German Bight. The input of nutrients into natural waters is another pathway through which human activities can affect fish communities. For this reason, eutrophication is used to assess the existing pollution. |

### Marine mammals

| Aspect: Protection status |
|---|
| Criterion: Status under Annex II and Annex IV of the Habitats Directive and the following international protection agreements: Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, CMS), ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas), Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) |
| **Aspect: Assessment of the occurrence** |
| Criteria: Population, population changes/trends based on large-scale surveys, distribution patterns and density distributions |
| **Aspect: Evaluation of spatial units** |
| Criteria: Function and importance of the German EEZ and the areas defined in the FEP for marine mammals as transit areas, feeding grounds or breeding grounds |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences and climate change. |

### Seabirds and resting birds

| Aspect: Protection status |
|---|
| Criterion: Status under Annex 1 Species of the Birds Directive, European Red List by BirdLife International |
| **Aspect: Assessment of the occurrence** |
| Criteria: Population in the German North Sea and EEZ, large-scale distribution patterns, abundances, variability |
| **Aspect: Evaluation of spatial units** |
| Criteria: Function of the areas defined in the FEP for relevant breeding and migratory birds as resting areas, location of protected areas |
| **Aspect: Prior contamination** |
| Criterion: Endangerment due to anthropogenic influences and climate change. |

### Migratory birds

| Aspect: The importance of bird migration over a large area |
|---|
| Criterion: Guidelines and areas of concentration |
| **Aspect: Assessment of the occurrence** |
| Criterion: migration and its intensity |
| **Aspect: Rarity and endangerment** |

| |
|---|
| Criterion: Number of species and endangered status of the species involved according to Annex I of the Birds Directive, the Bern Convention of 1979 on the Conservation of European Wildlife and Natural Habitats, the Bonn Convention of 1979 on the Conservation of Migratory Species of Wild Animals, the AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds) and SPEC (Species of European Conservation Concern). |
| **Aspect: Prior contamination** |
| Criterion: Prior contamination/endangerment due to anthropogenic influences and climate change. |

### 2.27.4 Assumptions used to describe and assess the likely significant effects

The description and assessment of the likely significant effects of the implementation of the ROP-E on the marine environment is carried out for the individual provisions on the use and protection of the EEZ on a protected resource basis, taking into account the status assessment described above. The following table lists, on the basis of the main impact factors, the potential environmental impacts which arise from the respective use and which are to be examined both as a prior impact, in the event the plan is not implemented, or as a likely significant environmental effect resulting from the provisions in the ROP. The effects are differentiated according to whether they are permanent or temporary.

Table 1: Overview of potentially significant effects of the uses identified in the spatial plan.

| Use | Effect | Potential effect | Protected Assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Sea birds and resting birds | Migratory birds | Marine mammals | Bats | Plancton | Biotope types | Biodiversity | Soil | Surface | Water | Air | Climate | Humans/ health | Cultural and material goods | Landscape |
| **Maritime uses with designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **Areas for offshore wind energy** | Placement of hard substrate (foundations) | Habitat change | x | | | | | | | x | x | x | | | | | | x | |
| | | Loss of habitat and land | x | x | | | | | | x | x | x | x | | | | | x | |
| | | Attraction effects, increase in species diversity, change in species composition | | x | | | | | | | x | | | | | | | | |
| | | Change in hydrological conditions | | x | | | | | | | | | | x | | | | | |
| | Scouring/sediment relocation | Habitat change | | | | | | | | x | | x | x | | | | | | |
| | Sediment swirls and turbidity plumes (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| | Resuspension of sediment and sedimentation (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | Noise emissions during pile driving (construction phase) | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| | | potential disruption/damage | | x t | | | x t | | | | | | | | | | | | |
| | Visual disturbance due to construction work | Local scaring and barrier effects | | | x t | | | | | | | | | | | | | | |
| | Obstacle in airspace | Scaring effects, loss of habitat | | | x | | | | | | | | | | | | | | |
| | | Barrier effect, collision | | | x | x | | x | | | | | | | | | | | x |
| | Light emissions (construction and operation) | Attraction effects, collision | | | x | x | | x | | | | | | | | | | | x |
| | wind farm related shipping traffic (maintenance, construction traffic) | see shipping | x | x | x | x | x | x | x | x | x | x | x t | x | x | x | x | x | |
| **Cables Routes for submarine cable systems and pipelines** | Introduction of hard substrate (stone fill) | Habitat change | x | | | | | | | x | | x | | | | | | x | |
| | | Loss of habitat and space | x | | | | | | | x | | x | x | | | | | x | |
| | Heat emissions (current-carrying cables) | Impairment/displacement of cold water-loving species | x | | | | | | | | x | | | | | | | | |
| | Magnetic fields (current-carrying cables) | Impairment | x | | | | | | | | | | | | | | | | |
| | | Impairment of the orientation behaviour of individual migratory species | | x | | | | | | | | | | | | | | | |
| | Turbidity plume (construction phase) | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| **Shipping** | Underwater Sound | Impairment / scaring effect | | x | | | x | | | | | | | | | | | | |
| | Emissions and discharges of hazardous substances (accidents) | Impairment/ damage | x | x | x | | x | | x | x | x | x | | x | | | x | | |
| | Physical disturbance during anchoring | Impact on the seabed | x t | | | | | | | x t | | x t | x t | | | | | x | |
| | Emission of air pollutants | Impairment of air quality | | | x | x | | x | | | | | | | x | x | x | | |
| | Introduction and spread of invasive species | Change in species composition | x | x | | | | | | | x | | | | | | | | |
| | Bringing in waste | Impairment/ damage | x | x | x | | x | | | | | | | x | | | x | | |
| | Risk of collision | Collision | | | | x | x | | | | | | | | | | | | |
| | Visual agitation | Impairment / scaring effect | | | x | | | | | | | | | | | | | | |

| Use | Effect | Potential effect | Benthos | Fish | Sea birds and resting birds | Migratory birds | Marine mammals | Bats | Plancton | Biotoptype types | Biodiversity | Soil | Surface | Water | Air | Climate | Humans/ health | Cultural and material goods | Landscape |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Protected Assets | | | | | | | | | | | | | | | | |
| **Maritime uses with designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **Raw materials Sand and gravel mining / Seismic investigations** | Removal of substrates | Veränderung von Habitaten | x | x | | | | | | x | x | x | | | | | | x | |
| | | Lebensraum- und Flächenverlust | x | x | | | | | | x | x | x | x | | | | | x | |
| | Turbidity plumes | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| | Physical disturbance | Impact on the seabed | x | | | | | | | x | | x | x | | | | | | |
| | Underwater sound during seismic surveys | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| **Marine Research** | Sampling of selected species | Reduction of stocks | | x | | | | | | | | | | | | | | | |
| | | Deterioration of the food base | | | | | | | | | | | | | | | | | |
| | Physical disturbance by trawls | Impairment/ damage | x | | | | | | | x | | x | | | | | | | |
| **Maritime uses without designations in the maritime spatial plan** | | | | | | | | | | | | | | | | | | | |
| **National defense** | Underwater sound | Impairment / scaring effect | | x t | | | x t | | | | | | | | | | | | |
| | Introduction of hazardous substances | Impairment | x | x | x | | x | | | x | x | x | | x | | | x | | |
| | Risk of collision | Collision | | | | | x | | | | | | | | | | | | |
| | Surface sound | Impairment / scaring effect | | | x | x | | x | | | | | | | | | x | | |
| **Recreation (-traffic)** | Taking of species (fishing) | Reduction of stocks | | x | | | | | | | | | | | | | | | |
| | Underwater Sound | Impairment / scaring effect | | x | | | x | | | | | | | | | | | | |
| | Emission of air pollutants | Impairment of air quality | | | x | x | | x | | | | | | | x | x | x | | |
| | Bringing in waste | Impairment | x | x | x | | x | | | | | | | x | | | x | | |
| | Visual agitation | Impairment / scaring effect | | | x | | | | | | | | | | | | | | |
| **Aquakultur** | Introduction of nutrients | Impairment | x | x | | | | | x | | | | | x | | | | | |
| | Installation of fixed installations | Habitat change | x | x | | | | | | x | | | | | | | | | x |
| | | Loss of habitat and land | x | x | | | | | | | | | x | | | | | | x |
| **Fischerei** | Sampling of selected species | Reduction of stocks | | x | | | | | | | x | | | | | | | | |
| | | Deterioration of the food base | | | x | | x | | | | | | | | | | | | |
| | Bycatch | Reduction of stocks | | x | | | x | | | | | | | | | | | | |
| | Physical disturbance by trawls | Impairment / damage | x | | | | | | | x | | x | | | | | | | |

x potential effect on the protected resource

x potential temporary effect on the protected resource

In addition to the impacts on the individual protected resources, cumulative effects and interactions between protected resources are also examined.

### 2.27.4.1 Cumulative consideration

In accordance with Article 5(1) of the SEA Directive, the environmental report also includes an assessment of cumulative effects. Cumulative effects arise from the interaction of various independent individual effects which either add up as a result of their interaction (cumulative effects) or reinforce each other and thus generate more than the sum of their individual effects (synergistic effects) (e.g. SCHOMERUS et al., 2006). Both cumulative and synergetic effects can be caused by the coincidence of effects in time and space. The effect can be reinforced by similar uses or different uses with the same effect, thereby increasing the effect on one or more protected resources.

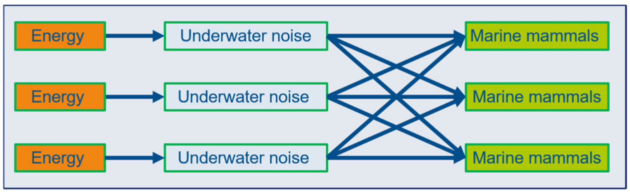



Figure 8: Exemplary cumulative effect of similar uses.

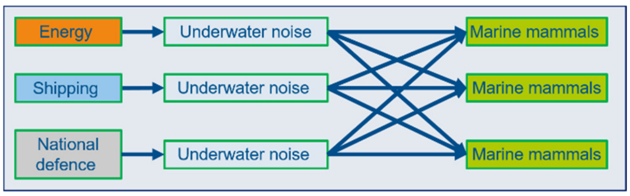



Figure 9: Exemplary cumulative effect of different uses.

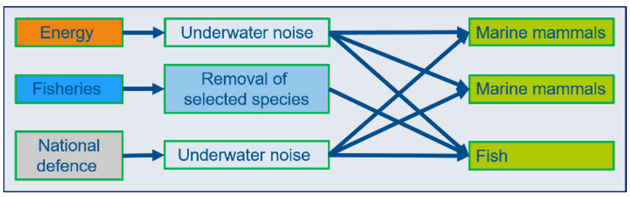



Figure 10: Exemplary cumulative effect of different uses with different effects.

In order to examine the cumulative effects, it is necessary to assess the extent to which the provisions of the plan, when taken together, can be expected to have a significant adverse effect. An examination of the provisions is performed on the basis of the current state of knowledge within the meaning of Article 5(2) of the SEA Directive. The position paper on the cumulative assessment of loons habitat loss in the German North Sea (BMU, 2009) and the BMUB's noise abatement concept (2013) form an important basis for assessing the effects of habitat loss and underwater noise.

### 2.27.4.2 Interactions

In general, effects on a protected resource lead to various consequences and interactions between the protected resources. The essential interdependence of the biotic protected resources exists via the food chains. Due to the variability of the habitat, interactions can only be described in very imprecise terms overall.

### 2.27.4.3 Specific assumptions for the assessment of the likely significant environmental effects

In detail, the analysis and examination of the respective provisions is as follows:

**Offshore wind energy**

With regard to the priority and reserved areas for offshore wind energy, a worst-case scenario is generally assumed. For the consideration of protected resources, certain parameters are assumed in this SEA in the form of ranges spatially separated into zones 1 and 2 and zones 3 to 5. In detail, these are, for example, the power output per installation [MW], hub height [m], rotor diameter [m] and total height [m] of the installations.

As input parameters, the SEA takes particular account of:

- installations already in operation or undergoing the licensing procedure (as reference and existing load)

- Transfer of the average parameters of the plants commissioned in the last 5 years on the sites defined in the FEP 2019
- Forecast of certain technical developments for the offshore wind energy priority and reserved areas, which are also defined in the ROP on the basis of the parameters presented. It should be noted here that these are only partly estimation-based assumptions, as project-specific parameters are not or cannot be checked at the SEA level.

Table 2: Parameters for the consideration of areas for offshore wind energy

| **WTG Parameters** | **Range** *Zones 1 and 2* from | to | **Range** *Zones 3-5* from | to |
|---|---|---|---|---|
| Output per plant [MW] | 5 | 12 | 12 | 20 |
| Hub height [m] | 100 | 160 | 160 | 200 |
| Rotor diameter [m] | 140 | 220 | 220 | 300 |
| Total height [m] | 170 | 270 | 270 | 350 |

For the connecting cables of the priority areas for offshore wind energy, the route length (EEZ) varies between about 10 km and 160 km. For the priority areas in Zones 4 and 5, an average route length of about 250 km is assumed. For the assessment of the construction and operational environmental effects, certain widths of the cable trench [m] and a certain site of the intersection structures [$^{m2}$] are assumed for submarine cable system rout corridors. Above all, the environmental effects due to construction, operation and repair are considered.

For the route corridors for pipelines, cross-border submarine cable systems or data cables, the cable lengths result from the specifications. For pipelines, a width of 1.5 m is assumed for the assessment of environmental effects for the overlying pipeline plus 10 m each for impairments due to "reef effect" and sediment dynamics.

For other uses, evaluation criteria or parameters for the environmental assessment have to be developed or specified in the later procedure.

**Shipping**

In order to assess the environmental effect of shipping, there must be an examination of which additional effects can be attributed to the provisions of the ROP-E.

The priority areas identified must be kept free of building use. This control in the ROP-E should prevent or at least reduce collisions and accidents. Based on the provisions in the ROP, the frequency of traffic in the priority areas is expected to increase, in particular due to the increase in offshore wind farms along the shipping routes. Vessel movements on the shipping routes SN1 to SN17 and SO1 to SO5 vary considerably, with the most heavily used route, SN1, sometimes carrying more than 15 vessels per km² per day, while on the other, narrower routes there are usually about 1-2 vessels per km² per day.

The BSH has commissioned an expert report on the traffic analysis of shipping traffic, which is expected to include current evaluations.

The designation of priority areas for shipping only is not an expression of increased use, but rather serves to minimise risk.

The general effects of shipping are presented in Chapter 2 as prior contamination, especially for

birds and marine mammals. The effects of service traffic to the wind farms are dealt with in the chapter on wind energy.

**Raw material extraction**
When assessing the potential environmental effect of raw material extraction, a distinction must be made between sand and gravel extraction and hydrocarbon extraction.

Sand and gravel extraction:

Sand and gravel are extracted by means of floating suction dredgers. The extraction field is driven over in strips of approximately 2 m width and the subsoil is extracted to a depth of approximately 2 m. The seabed remains unstressed between the excavation strips. During mining, a sediment-water mixture is pumped on board the suction dredger. The sediment in the desired grain size is screened out and the unused portion is returned to the sea on site. Turbidity plumes result from the mining and discharge. Potential temporary effects result from the turbidity plumes, which can frighten and result in adverse effects for the marine fauna. Potential permanent effects arise from the removal of substrates and physical disturbance causes habitat and area loss, habitat alteration and seabed degradation.

Sand and gravel extraction is carried out on the basis of operational plans on portions of the authorised approval fields.

Gas production:

Exploratory and production wells are drilled for the exploration and exploitation of gas deposits. Drilling through the rock lying above the deposit results in drilling abrasion. This is brought to the surface by means of drilling fluids. The drilling fluids have either a water or oil base. If a water-based drilling fluid is used, it is discharged into the sea together with the cuttings. If oil-based drilling fluids are used, they are disposed of on land together with the cuttings.

Seismic methods are used in the exploration of hydrocarbon reservoirs, which lead to chase effects in marine mammals.

Operationally discharges of material into the sea result from the discharge of production and spray water, wastewater from the sewage treatment plant, and the shipping traffic caused. Production water is essentially reservoir water that may contain components from underground, such as salts, hydrocarbons and metals. As the deposit ages, the amount of gas in production water increases. Production water can also contain chemicals that are used in mining to improve extraction or to prevent corrosion of production equipment. The production water is discharged into the sea after treatment in accordance with the state of the art and compliance with national and international standards.

**Fisheries and marine aquaculture**

In the area of the southern silt floor, the sediment provides a particularly suitable habitat for this species, which can be quite clearly defined spatially. The nephrops population in the North Sea is considered stable and is classified as "least concern" in the IUCN Red List . For the German fishing fleet, the nephrops fishery represents a valuable and reliable source of income. Adverse effects of fishing in this area mainly affect the seabed, sediment and the habitats affected by it, which can be affected by the trawls used.

Table 3: Parameters for the consideration of fisheries.

| | |
|---|---|
| **Fishing effort (German fleet)** | Approximately 8,000 hrs/year (2013) to 14,000 hrs/year (2018)<br>12 (2014) - 18 (2015) vehicles |
| **Fishing gear used** | Bottom trawls |
| **Catches** | 200 - 350 t / year (plus non-German fisheries) |

### Marine Research

The designated areas for scientific marine research (3 in the North Sea, 4 in the Baltic Sea) correspond to standard investigation areas ("boxes") of the Thuenen Institute in the North Sea and the Baltic Sea. In the North Sea, the German Small-Scale Bottom Trawl Survey (GSBTS), which has been carried out since 1987, has been collecting data on the development of fish populations over many years. The data sets form an important basis for assessing long-term changes in the bottom fish fauna (commercial and non-commercial species) of the North Sea and the Baltic Sea caused by natural (e.g. climatic) influences or anthropogenic factors (e.g. fisheries).

The GSBTS uses a standardised bottom trawl net or a high-density GOV otter trawl to sample small-scale bottom fish communities to determine abundances and distribution patterns. In parallel, epibenthos (using a 2 m beam trawl), infauna (using a Van Veen grab) and sediments will be studied, and hydrographic and marine chemical parameters in habitats typical of the region will be recorded.

Effects are to be expected from the equipment used, in particular on the soil/sediment and the habitats affected by it. To this end, fish of various ages and sizes are taken (cf. also Chapter 5.5.3).

Table 4: Parameters for the consideration of marine research

| | |
|---|---|
| **Frequency of surveys per year/number of hauls/duration per haul (approximate values, vary from trip to trip)** | 2 / in the range of approx. 40 - 50 (only GSBTS) / 30 min. |
| **Gear used (target species)** | Standardised bottom trawlers, using high-density otter trawls (bottom fishing communities)<br>2-metre beam trawl (epibenthos)<br>Van Veen grab (Infauna) |
| **Catches** | Total quantities for all (sampled) boxes (partly with other research activities) in double-digit tonnes |

### Nature conservation / marine landscape / open space

The nature conservation rules in the spatial plan are not expected to have any significant adverse environmental effects.

The rules contribute to the long-term preservation and development of the marine environment in the EEZ as an ecologically intact open space over a large area. The scope of the rules is of particular importance in this context, with the EEZ accounting for 37.92% of the area of the North Sea. The nature conservation priority areas contribute to securing open spaces by excluding uses which are incompatible with nature conservation. This helps to avoid possible disturbances caused by the conversion of wind energy and to ensure the protection of the marine environment. Keeping the protected areas free of building structures also contributes to the protection of open spaces and the marine landscape on a large scale.

The designation of the main distribution area of harbour porpoises and the main concentration area of loons as reserved areas is of outstanding conservation importance for the protection of the disturbance-sensitive group of loons and harbour porpoise species.

The guiding principles of the careful and economical use of natural resources in the EEZ, as well as the application of the precautionary principle and the ecosystem approach, are intended to avoid or reduce damage to the balance of nature.

The spatial plan thus contributes to achieving the objectives of the MSFD. However, the ability of

spatial planning to influence this is limited and cannot affect all objectives.

**National and alliance defence**

The ROP-E contains textual provisions on national and alliance defence.

## 2.28 Data sources

The basis for the SEA is a description and assessment of the environmental status in the study area. All protected resources must be included. The data source is the basis for the assessment of the likely significant environmental effects, the site and species protection assessment and the assessment of alternatives.

According to Article 8(1) Sentence 3 of the ROG, the environmental assessment refers to what can reasonably be required on the basis of the current knowledge and generally accepted assessment methods, and the content and level of detail of the spatial plan.

On the one hand, the environmental report will describe and assess the current state of the environment, and describe the likely development if the plan is not implemented. It will also forecast and assess the likely significant environmental effects of implementing the plan.

The basis for the assessment of potential effects is a detailed description and assessment of the state of the environment. The description and assessment of the current state of the environment and the likely development in the event the plan is not implemented will be carried out with regard to the following protected resources

- Site/Soil
- Water
- Plankton
- Biotope types
- Benthos
- Fish
- Bats
- Biodiversity
- Air
- Climate
- Landscape
- Cultural and other material resources
- Marine mammals
- Avifauna
- People, especially human health
- Interactions between protected resources.

### 2.28.1 Overview data source

The data and knowledge has improved significantly in recent years, in particular as a result of the extensive data collection in the context of environmental impact studies, the construction and operational monitoring for the offshore wind farm projects, and the accompanying ecological research.

This information also forms an essential basis for monitoring the 2009 spatial plans under Article 45(4) of the UVPG. Accordingly, the results of the monitoring are to be made available to the public and taken into account when the plan is reinstated. The results of the accompanying plan for monitoring the current plans are summarised in the status report on the updating of spatial planning in the German North Sea and Baltic Sea EEZ, which is published in parallel (Chapter 2.5).

In general terms, the following data sources are used for the environmental report:

- Data and findings from the operation of offshore wind farms
- Data and findings from approval procedures for offshore wind farms, submarine cable systems and pipelines
- Results of the preliminary site investigations
- Results from the monitoring of Natura 2000 areas
- Mapping instructions for Article 30 biotope types
- MSRL initial and progress assessment
- Findings and results from R&D projects commissioned by the BfN

and/or the BSH and from accompanying ecological research

- Results from EU cooperation projects, such as Pan Baltic Scope and SEANSE
- Studies/Technical literature
- Current red lists
- Comments from the technical authorities
- Comments from the (specialist) public

A detailed overview of the individual data and knowledge sources is included in the annex to the framework of the study.

#### 2.28.2 Indications of difficulties in compiling the documents

In accordance with No. 3a of Annex 1 to Article 8(1) of the ROG, indications of difficulties encountered in compiling the information, such as technical gaps or lack of knowledge, must be presented. There are still gaps in knowledge in some places, particularly with regard to the following points:

- Long-term effects from the operation of offshore wind farms
- Effects of shipping on individual protected resources
- Effects of research activities
- Data for assessing the environmental status of the various protected resources in the outer EEZ.

In principle, forecasts on the development of the living marine environment after the ROP has been carried out remain subject to certain uncertainties. There is often a lack of long-term data series or analytical methods, e.g. for combining extensive information on biotic and abiotic factors, in order to better understand the complex interrelationships of the marine ecosystem.

In particular, there is a lack of detailed area-wide sediment and biotope mapping outside the nature reserves of the EEZ. As a result, there is a lack of a scientific basis on which to assess the effects of the possible use of strictly protected biotope structures. At present, sediment and biotope mapping is being carried out on behalf of the BfN and in cooperation with the BSH, research and higher education institutions and an environmental office, with a focus on the nature conservation areas.

In addition, there is a lack of scientific assessment criteria for protected resources, both with regard to the assessment of their status and with regard to the effects of anthropogenic activities on the development of the living marine environment, in order to fundamentally consider cumulative effects over time and space.

Various R&D studies on assessment approaches, including those for underwater noise, are currently being carried out on behalf of the BSH. The projects serve the continuous further development of a uniform, quality-assured basis of marine environmental information for assessing the potential impacts of offshore installations.

The environmental report will also list specific information gaps or difficulties in compiling the documents for the individual protected resources.

### 2.29 Application of the ecosystem approach

The application of the ecosystem approach contributes to the achievement of "sustainable spatial planning that reconciles the social and economic demands on the spatial environment with its ecological functions and leads to a sustainable, balanced order over a large area" (Article 1(2) of the ROG). The application of the ecosystem approach is a requirement under Article 2(3) No. 6 p. 9 of the ROG with the aim of controlling human activities, sustainable development and supporting sustainable growth (cf. Art. 5(1) of the

Maritime Spatial Planning Directive (MSPD) in conjunction with Art. 1(3) of the MSFD).

Recital 14 of the MSPD specifies that spatial planning should be based on an ecosystem approach in accordance with the MSFD. It is also clear here—as in Preamble 8 of the MSFD—that sustainable development and use of the seas should be compatible with good environmental status.

In accordance with Article 5(1) of the MSPD: “When establishing and implementing maritime spatial planning, Member States shall consider economic, social and environmental aspects to support sustainable development and growth in the maritime sector, applying an ecosystem-based approach, and to promote the coexistence of relevant activities and uses.”

Article 1(3) of the MSFD specifies that “Marine strategies shall apply an ecosystem-based approach to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of good environmental status and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while enabling the sustainable use of marine goods and services by present and future generations.”

The ecosystem approach allows a holistic view of the marine environment, recognising that humans are an integral part of the natural system. Natural ecosystems and their services are considered together with the interactions resulting from their use. The approach is to manage ecosystems within the "limits of their functional capacity" in order to safeguard them for use by future generations. In addition, understanding ecosystems enables effective and sustainable use of resources.

A comprehensive understanding, protection and improvement of the marine environment and an effective and sustainable use of resources within the bearing capacity limit will safeguard marine ecosystems for future generations. The ecosystem approach can therefore contribute—at least in part —to good status in the marine environment.

Based on the so-called 12 Malawi Principles of the Biodiversity Convention, the ecosystem approach has also been substantiated by the HELCOM-VASAB working group on maritime spatial planning and specified for maritime spatial planning. The key elements formulated there represent a suitable approach for structuring the application of the ecosystem approach in the spatial plan for the German EEZ.

The combination of content-related and process-oriented key elements is intended to promote an overall picture that is as comprehensive as possible:

- Best available knowledge and practice;
- Precautions;
- Alternative development;
- Identification of ecosystem services;
- Prevention and mitigation;
- Relational understanding;
- Participation and communication;
- Subsidiarity and coherence;
- Adaptation.

The application of the ecosystem approach aims at a holistic perspective, the continuous development of knowledge about the oceans and their use, the application of the precautionary principle and flexible, adaptive management or planning. One of the greatest challenges is dealing with gaps in knowledge. Understanding the cumulative effects that the combination of different activities can have on species and habitats is of great importance for sustainable use. It is important for the planning process to promote communication and participation processes in order to use the broadest possible knowledge base of all stakeholders and to achieve the greatest possible acceptance of the plan.

Figure 11 shows the understanding of the application of the ecosystem approach. This takes place equally in the planning process, the ROP and in the Strategic Environmental Assessment (SEA). The SEA has proven to be the central instrument for applying the ecosystem approach and offers versatile points of contact in the content- and process-oriented key elements (see below).

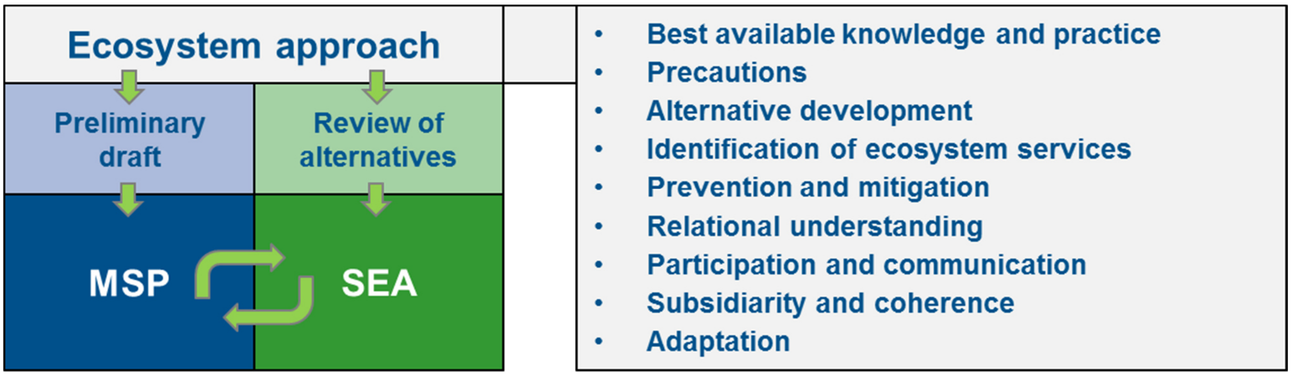



Figure 11: The ecosystem approach as a structuring concept in the planning process, the ROP and the Strategic Environmental Assessment

The ecosystem approach is anchored in the mission statement as the basis of the spatial plan. Its importance is also explicitly emphasised in the following principles:

- General requirements for economic uses: Principle of Best Environmental Practice (8.1) and Monitoring (8.2)
- Principle of nature conservation Preservation of the EEZ as a natural area (5)

The graphic and textual rules on marine nature conservation make a fundamental contribution to the protection and improvement of the state of the marine environment (see ROP model). In addition, the ROP's rules promote the resilience of the marine environment to the effects of economic uses and to the changes caused by climate change.

Due to a lack of data and knowledge, it is not possible to conclusively quantify the bearing capacity of the ecosystem. This represents a task for the future development of the ecosystem approach. Even if quantification is not possible at present, SEA and cumulative consideration must ensure that the ROP and the definitions of economic uses contained therein do not exceed the limits of ecosystem functioning.

The assessment of the likely significant environmental effects of the implementation of the spatial plan is methodologically described in Chapter 1.5.2The ecosystem approach does not itself constitute an assessment but does encompass a large number of important aspects and instruments for sustainable spatial planning. Of these, the SEA serves comprehensively to identify, describe and assess the impacts on the marine environment.

**Application of the key elements**

The ecosystem approach is highly complex due to its diversity and the comprehensive view of the relationship between the marine environment and economic uses. The key elements also interact with each other, underlining the interconnectedness and holistic perspective. Figure 12 portrays the relationships between the key elements. This approach becomes tangible and applicable when viewed at the level of the individual key elements, in particular those of the HELCOM/VASAB Directive (2016).

The application in the spatial plan for the German EEZ is based on the understanding that this approach needs to be continuously developed. Existing gaps in knowledge and the need for conceptual broadening result in the need to

consider the ecosystem approach as a permanent task of further development.

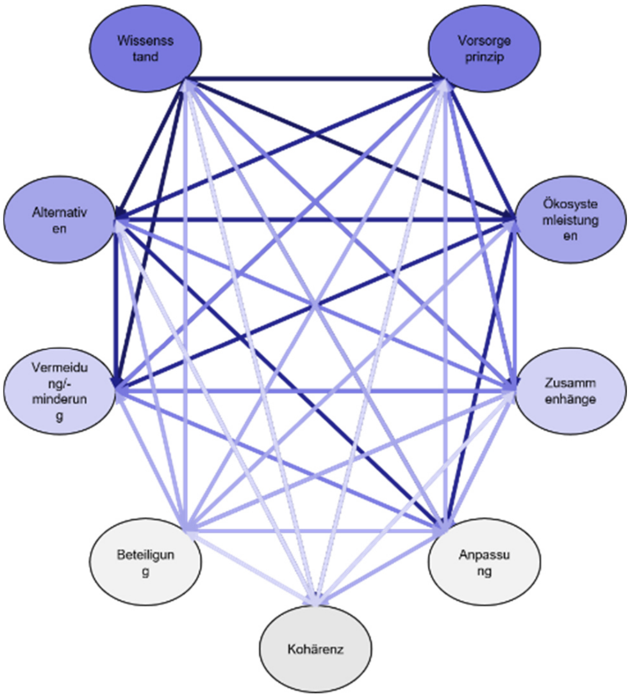



Figure 12: Networking between the key elements

**Best available knowledge and practice**

"The allocation and development of human uses shall be based on the latest state of knowledge of the ecosystems as such and the practice of safeguarding the components of the marine ecosystem in the best possible way." .

The use of the current (sound) level of knowledge is fundamentally indispensable for planning processes and forms the basis of the planning understanding for updating the spatial plan. This key element thus also affects the other elements mentioned, such as the precautionary principle, the avoidance and reduction of impacts and the understanding of interrelationships.

As part of the updating process, the knowledge base is supplemented by the sector-specific expertise of the stakeholders through an early and comprehensive participation process. Thematic workshops and technical discussions with various stakeholders were held even before the concept for the update was developed.

The Scientific Advisory Board (WiBeK) for the continuation of maritime spatial planning in the North Sea and Baltic Sea EEZ advises, from a scientific perspective, on questions of content, the procedure and the participation process.

Results from projects and findings on procedures for plan preparation in neighbouring countries within the framework of international cooperation are taken into account for the process of plan preparation. In addition to improving the level of knowledge, this contributes to the key element of "subsidiarity and coherence".

In-house research and development, such as databases and other tools, are developed, validated and applied at the BSH for a wide range of uses: e.g. MARLIN and MarineEARS. These can support the planning process and the subsequent plan monitoring with well-founded information and make an important contribution to the continuous improvement of the level of knowledge.

The following stipulations of the spatial plan promote the use of the current level of knowledge in economic uses as a basic guideline:

- General requirements for economic uses: Principle of Best Environmental Practice (8.1)
- Shipping: Principle of Protection of the Marine Environment (3)
- Offshore wind energy: Protection of the Marine Environment (6.1)
- Marine research: Principle of Protection of the Marine Environment (5).

The SEA is based on very detailed and comprehensive data on all relevant biological and physical aspects and conditions of the marine environment—in particular from EIA studies and monitoring of offshore wind farm projects according to StUK—scientific research activities, and from national and international monitoring programmes.

**Precautions**

"A far-sighted, anticipatory and preventive planning shall promote sustainable use in marine areas and shall exclude risks and hazards of human activities on the marine ecosystem. Those activities that according to current scientific knowledge may lead to significant or irreversible impacts on the marine ecosystem and whose impacts may not be in total or in parts sufficiently predictable at present require a specific careful survey and weighting of the risks." .

The precautionary principle has a high priority in spatial planning, particularly because of the complexity of marine ecosystems, far-reaching chains of effects and existing gaps in knowledge. This is already emphasised in the ROP's mission statement.

The provisions of the spatial plan make it clear that the precautionary principle is taken into account as a fundamental requirement in the case of economic uses (Principle 5 Nature conservation/marine landscape/open space) and in the case of subsequent uses:

- Maritime transport: Objective Priority areas Maritime transport (1)
- General requirements for economic uses: Objective Decommissioning (3) Principle of Site Conservation (2) and Best Environmental Practice (8.1)
- Lines Marine environment Principle (8)
- Fisheries and Marine Aquaculture: Sustainable Management Principle (2)
- Nature Conservation: Principle Preservation of the EEZ as a Natural Area (5).

The SEA examines the significance of the effects of the ROP's provisions on uses on the protected resources (Chapter 3).

**Alternative development**

"Reasonable alternatives should be developed to find solutions to avoid or mitigate adverse effects on the environment and other areas, as well as on ecosystem goods and services." .

The consideration of alternatives was given a high priority in the process of updating the spatial plans and was integrated into the contribution at an early stage.

In the conception for the further development of the spatial plans three planning options were developed as overall spatial planning alternatives, which represent the utilisation requirements of the different sectors from different perspectives:

- Planning option A: Perspective on traditional uses
- Planning option B: Climate protection perspective
- Planning option C: Marine nature conservation perspective

The alternatives presented as planning options are integrated approaches which take into account spatial and content-related dependencies and interactions over a large area.

The early and comprehensive consideration of several planning options represents an essential planning and review step in the updating of the spatial plans.

A preliminary assessment of selected environmental aspects was carried out before this environmental report was prepared. The preliminary assessment of selected environmental aspects in the sense of an early examination of variants and alternatives should support the comparison of the three planning options from an environmental point of view.

The design and preliminary assessment of selected environmental aspects were consulted, so that the knowledge and assessments of the stakeholders involved were contributed to the planning process.

An alternative assessment is carried out in the SEA (cf. Chapter 8), where the focus is on the conceptual/strategic design of the plan, and in particular on spatial alternatives.

**Identification of ecosystem services**

"In order to ensure a socio-economic evaluation of effects and potentials, the ecosystem services provided need to be identified." .

The identification of ecosystem services is an important step for the further development of the spatial plan and the ecosystem approach in maritime spatial planning. Ecosystem services can contribute to a broader understanding and illustrate the multiple functions that ecosystems can provide. Particularly noteworthy are their function as natural carbon sinks and other contributions to climate protection and adaptation. This need should be taken into account in future updates of the spatial plan and the development of the necessary tools should be continued.

With the specialist application MARLIN (Marine Life Investigator), BSH is currently developing a large-scale, high-resolution information network on marine ecological data from environmental investigations within the framework of environmental impact studies, preliminary site investigations and monitoring of offshore wind farm projects. Various data analyses at different spatial and temporal levels are possible in order to support the tasks of the BSH in line with requirements. MARLIN also combines the integrated marine ecological data with various environmental data to support the understanding of the effects and interrelationships of marine ecosystem services.

In the future, MARLIN will serve as a validated basis for ecosystem modelling to better assess the impact of cumulative effects. For example, in future it will be possible to consider all offshore wind farm processes and to carry out large-scale studies. Building on this, it may then be possible to identify ecosystem services. MARLIN's holistic approach enables new approaches to the analysis and modelling of ecological patterns and processes and creates a platform for the development and application of advanced tools for marine management and regulation.

**Prevention and mitigation**

“The measures are envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan.” .

The ROP's mission statement defines the contribution to the protection and improvement of the state of the marine environment, also by specifying how to avoid or reduce disturbances and pollution from uses.

The provisions of the spatial plan illustrate this consideration with measures to avoid and mitigate adverse effects of individual uses:

- Shipping: Principle of Protection of the Marine Environment (3)
- General requirements for economic uses: Principle of Best Environmental Practice (8.1)
- Offshore wind energy: Protection of the Marine Environment (6.1)
- Management: Principles Avoidance of Crossings (5) and Marine Environment (8)
- Raw material extraction: Principle of the Loon (3)
- Nature conservation: Principles Reserved Area for Loons (2) and Reserved Area for Harbour Porpoise (3)

In the SEA, measures to avoid, reduce and offset significant adverse effects of the implementation of the spatial plan are presented in detail in Chapter 7.

**Relational understanding**

"It is necessary to consider various effects on the ecosystem caused by human activities and interactions between human activities and the ecosystem, as well as among various human activities. This includes direct/indirect, cumulative, short/long-term, permanent/temporary and positive/negative effects, as well as interrelations including sealand interaction." .

The understanding of interrelations and interdependencies is of great importance for the tasks of spatial planning and the planning process. In this sense, the mission statement of the ROP-E emphasises the holistic approach and includes the consideration of land-sea relations.

In the Strategic Environmental Assessment, this is taken up and examined in Chapters 4.9Interactions and 0Cumulative consideration.

For technical support, the BSH is currently developing the specialist application MARLIN (Marine Life Investigator) as a large-scale, high-resolution information network for marine ecological data from environmental investigations within the framework of environmental impact studies, preliminary site investigations and monitoring of offshore wind farm projects. Various data analyses at different spatial and temporal levels are possible in order to support the tasks of the BSH as required. MARLIN also combines integrated marine ecological data with various environmental data. MARLIN's holistic approach enables new directions for the analysis and modelling of ecological patterns and processes and creates a platform for the development and application of advanced tools for marine management and regulation. This will support the understanding of impacts and interrelationships.

Further experience, e.g. on cumulative consideration, has been gained in European cooperation projects (Pan Baltic Scope, SEANSE) and will be incorporated into the further conceptual development, as will findings from the participation process.

An overview of the project results can be found on the respective pages:

- http://www.panbalticscope.eu/results/reports/
- https://northseaportal.eu/downloads/

**Participation and communication**

“All relevant authorities and stakeholders as well as a wider public shall be involved in the planning process at an early stage. The results shall be communicated.” .

This key element is an example of the networking and relationships between the key elements. The knowledge gained can contribute to all other key elements.

As part of the updating process, participation and communication have been carried out intensively right from the start. Early and comprehensive participation therefore contributes significantly to broadening the knowledge base through the sector-specific expertise of stakeholders and evaluations received.

The basis for this was the development of a participation and communication concept. In the course of the update, topic-specific workshops and technical discussions were held with representatives at sectoral level. On 18 and 19 March 2020, the concept and draft of the study framework were consulted in the participation meeting (scoping).

Interim results and information on stakeholder meetings are communicated on the BSH's blog "Offshore aktuell" (wp.bsh.de).

Additional support for the process is provided by the Wissenschaftlicher Begleitkreis (WiBeK). Since 2018, for the continuation of maritime spatial planning in the Exclusive Economic Zone in the North and Baltic Seas, the WiBeK has been advising from a scientific perspective on questions of content, the course of the procedure and the participation process, among other things.

**Subsidiarity and coherence**

“Maritime spatial planning with an ecosystem-based approach as an overarching principle shall be carried out at the most appropriate level and shall seek coherence between the different levels.” .

Spatial planning aims to produce coherent plans in the North and Baltic Seas through coordination with coastal countries and partners from neighbouring countries. Many years of bilateral exchange, participation in the HELCOM and VASAB working group on maritime spatial planning and cooperation in international projects on maritime spatial planning contribute to this.

Project results and findings on procedures for plan preparation in neighbouring countries within the framework of international cooperation are taken into account for the process of plan preparation. The international consultation procedures represent a further contribution.

The ROP-E's mission statement sets out this cooperation as a contribution to coherent international maritime spatial planning and coordinated planning with coastal countries.

At the level of definitions, Principles 3 and 4 for pipelines emphasise this sectoral coordination requirement for the planning of cross-border linear structures.

In the context of SEA, the cross-border impacts on the neighbouring areas of the neighbouring states are considered (Section 4.11).

**Adaptation**

“The sustainable use of the ecosystem should apply an iterative process including monitoring, reviewing and evaluation of both the process and the outcome.” .

Monitoring and evaluation within the framework of spatial planning for the German EEZ take place at various levels.

The first step will be to evaluate the plan and its implementation. A monitoring and evaluation concept will be developed for this purpose.

In addition, in Chapter 10 the SEA lists the planned measures for monitoring the effects of the implementation of the spatial plan on the environment.

The effects of economic uses on the marine environment are to be investigated and evaluated at project level by means of effect monitoring. This is laid down in Principle 8.2 of the General Requirements for Economic Uses in the ROP.

**Summary**

In summary, and beyond this, the key elements and their implementation in the planning process, the ROP, and the SEA all show how the ecosystem approach as an overall concept supports the holistic perspective of spatial planning and thus contributes to the protection and improvement of the state of the marine environment.

## 2.30 Taking climate change into account

Anthropogenic climate change is one of the greatest challenges facing society and is of particular importance for changes in the oceans and their use. Figure 13 shows the links between climate change, the marine ecosystem, uses and maritime spatial planning, and also how they are a tool for achieving sustainable development goals.

In changing seas, the consideration and integration of climate impacts in MSP is of great importance in order to do justice to the precautionary and forward-looking nature of MSP and to develop long-term sustainable plans.

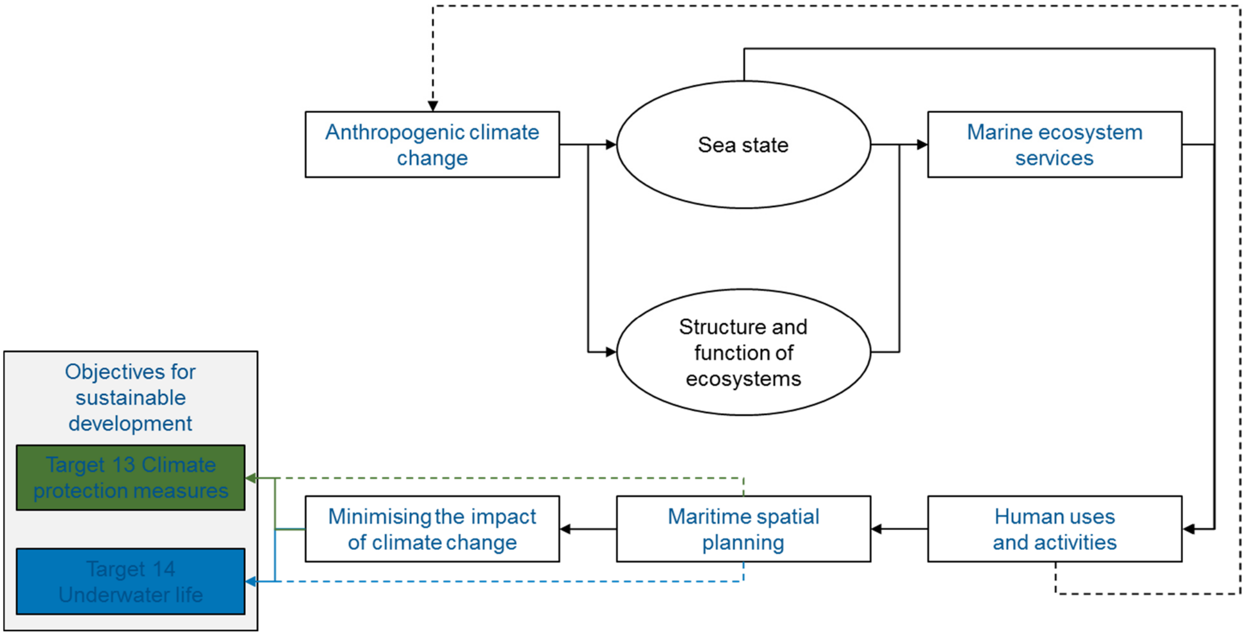



Figure 13: Representation of the interrelationships between climate change, marine ecosystems and maritime spatial planning, according to

Climate change will alter the physical, chemical and biological conditions in the North and Baltic Seas. This will inevitably have an impact on marine ecosystems, their structure and functions, which may also change ecosystem services. The changes may also have a direct impact on the uses to which they are put, e.g. shipping, renewable energy or extraction of raw materials.

The following table shows projections for some relevant parameters.

Table 5: Climate projections for selected parameters [1], [2], [3]

| | North Sea | Baltic Sea |
|---|---|---|
| Increase in mean sea surface temperature for 2031-2060 (in the 50th percentile of the RCP8.5 scenario compared to 1971-2000)[1] | 1 – 1.5 °C | 1.5 – 2 °C |
| Increase in mean sea surface temperature for 2071-2100 (in the 50th percentile of the RCP8.5 scenario compared to 1971-2000)[1] | 2.5 – 3 °C | 2.5 – 3.5 °C |
| Global sea level rise 2100 (RCP8.5 scenario vs. 1986-2005)[2] | 61 - 110cm | 61 - 110cm |
| Increase in extreme wind speeds (RCP8.5 scenario compared to 1971-2000)[3] | 0 - 0.5 m/s | No majority significant increases |

As a contribution to climate protection, the offshore wind energy provisions should be mentioned at the outset. Assuming that the current $CO_2$ factor of electricity from offshore wind energy is continued , by 2040, this results in an average annual $CO_2$ avoidance potential of 62.9 Mt $CO_2$ equivalents per year for the period between 2020 and 2040. By way of comparison, the annual emissions from power plants in the energy industry in 2016 were 294.5 Mt $CO_2$ equivalents per year.

Table 6 shows the abatement potential for the years 2020 and 2040 and the annual average for the entire period.

Table 6: Calculation of the $CO_2$ avoidance potential of the offshore wind energy provisions

| | Installed capacity | Full load hours | Annual electricity production | $CO_2$ avoidance factor | $CO_2$ avoidance |
|---|---|---|---|---|---|
| | GW | h/a | GWh/a | g CO2eq/kWh | Mt CO2eq/a |
| 2020 | 7.2 | 3800 | 27360 | 701 | 19.2 |
| 2040 | 40 | 3800 | 152000 | 701 | 106.6 |
| Average $CO_2$ avoidance per year | | | | | 62.9 |

Furthermore, keeping the priority areas of nature conservation free and the potential of ecosystems as natural carbon sinks contributes to climate protection. The designation of priority and reserved areas of nature conservation can also serve to strengthen the resilience of ecosystems and thus support the precautionary principle.

The mission statement shows that the use of climate-friendly technologies in the ocean supports energy security and the achievement of national and international climate targets.

The development of risk and vulnerability analyses to climate change and adaptation measures in the relevant sectors should be communicated to spatial planning. The holistic perspective of spatial planning can help to coordinate the compatibility of measures with other uses and marine nature conservation and to avoid conflicts. To promote this, a dialogue could be initiated to ensure that a joint discussion takes place in a spatial planning forum with stakeholders from the sectors.

For climate change to be fully integrated into MSP, institutional strengthening, including international cooperation in the North and Baltic Seas, is necessary. Projects in particular offer the opportunity to develop coherent approaches with neighbouring countries or to use joint data pools, for example.

One focus should be on the conceptual development of marine ecosystem services and, above all, the potential of natural carbon sinks.

, following can be summarised for the North Sea marine ecosystem:

- Since the early 1980s, there have been slow changes in the biotic marine environment.
- Since 1987/88, sudden changes in the biotic marine environment have been observed.

The following aspects or changes can influence the interrelationship of the various components in the biotic marine environment: Changes in species composition (phyto- and zooplankton, benthos, fish), introduction and partial establishment of non-native species (phyto- and zooplankton, benthos, fish), changes in abundance and dominance ratios (phyto- and zooplankton), changes in available biomass (phytoplankton), extension of the growth phase (phytoplankton, copepods), Delay in the growth phase after a warm winter (spring diatom bloom), food organisms of fish larvae have brought forward the start of growth (copepods), decline of many species typical of the area (plankton, benthos, fish), decline in the food base for upper predators (seabirds), shift of stocks from southern to northern latitudes (cod), shift of stocks from northern to southern latitudes (porpoises).

# 3 Anticipated development if the plan is not implemented

According to Annex 1 No. 2b) to Article 8 ROG, a forecast of the development of the condition of the environment must be included in the environmental report even if the plan is not implemented.

## 3.1 Shipping

Shipping is one of the traditional uses at sea, alongside fishing. Several shipping routes run through the coastal sea and the EEZ, and are extremely important for German foreign trade and international transit traffic due to their central location in the North Sea and the Baltic Sea.

Prior to the adoption of the spatial development plans in 2009 and the associated definition of priority and reserved areas for shipping, only traffic separation areas (VTG) were established in the North Sea by the International Maritime Organisation (IMO) to protect ships and minimise the risk of collision.

Particularly with the emergence of the first offshore wind turbines and the increasing number of applications from the wind energy industry, the need to safeguard clear shipping routes and therefore the added value of the provisions in maritime spatial planning became clear.

The legal situation of shipping is strongly influenced by international regulations, particularly the law on the United Nations Convention on the Law of the Sea of 10 December 1982 (Treaty Law Convention on the Law of the Sea), in which freedom of navigation is guaranteed under Article 58. Internationally applicable rules and standards are also laid down by the IMO. The definition of traffic separation areas is particularly important for spatial planning. These lay down mandatory lane routing in one-way traffic with separate lanes at potential danger points.

The law concerning the duties of the Federal Government in the Field of Maritime Navigation (Seeaufgabengesetz - SeeAufgG) and particularly the various ordinances issued on the basis of this law form the legal basis of measures for averting dangers to the safety and ease of transport, and preventing dangers arising from maritime navigation, including harmful effects on the environment.

Important international conventions concerning environmental protection in maritime transport can be found in the Convention for the Prevention of Pollution from Ships, as amended by the 1978 Protocol (MARPOL 73/78), which contains regulations concerning the discharge of waste water and ship's waste and the gradual reduction of air pollutant emissions.

Since the North Sea and the Baltic Sea are SOx emission control areas (SECA), the sulphur emission limits are very low. From 2021, the North Sea and the Baltic Sea will also become NOx emission control areas (NECA).

The International Convention for the Control and Management of Ships' Ballast Water and Sediments is an international agreement that was adopted in 2004 within the International Maritime Organisation. The aim of the Convention is to mitigate damage to the marine environment caused by ballast water, particularly in order to prevent the introduction of non-native species.

The OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic (1992) and the North East Atlantic Environmental Strategy (2010) include measures concerning the 'clean ship approach', air pollution (e.g. NOx, SOx), ship noise, the introduction and spreading of non-native species and other measures for preventing, preparing for and combating pollution from ships.

**Development of shipping**

The average traffic density resulting from the analysis of AIS data shows that there is an increasing need for space, not least driven by construction site, maintenance and supply trips for the expanding offshore wind industry, the increasing number of cruise ships and increased demand for anchorage and shipping space.

In its maritime traffic forecast for 2030, the BMVI published the predicted development of the turnover volume of German seaports (BMVI, 2014). The turnover volume is predicted to increase from 438 million tonnes to 712 million tonnes between 2010 and 2030. This refers to the turnover of German and foreign ports and their hinterland traffic which uses the German transport infrastructure. The main drivers for the predicted turnover increase are the overall continuing trend towards globalisation and the strong export orientation of the German economy. However, this assumed increase in turnover and shipping traffic on the whole is subject to uncertainty, and may be significantly lower due to changes to the economic situation and crises.

With regard to the technical development of ships, particularly the IMO regulations are strong drivers. For example, various purification plants or alternative fuels are used to comply with the NOx and SOx emission limits. The IMO strategy for reducing $CO_2$ emissions which was adopted in April 2018 will also require alternative fuels and greater energy efficiency (DNV GL 2019).

**Effects of shipping on the marine environment**

Shipping has different effects on the marine environment. These include illegal disposal of oil at sea, propulsion-related emissions, waste disposal, noise emissions, the consequences of shipwrecks, discharges of toxic substances such as TBT and the introduction of exotic species. The effects can be of a supra-regional, temporary or permanent nature, and can be summarised as follows:

- supra-regional, temporary effect due to oil input, emissions and introduction of toxic substances;
- supra-regional, permanent effect due to the introduction of exotic species.

The following table provides an overview of the effects of shipping and their potential consequences on the protected assets. The effects must mainly be classified as prior effects (Chapter 2) and as effects that will still occur if the plan is not implemented.

Table 15: Potential effects of shipping

| Use | Effect | Potential impact | Protected assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Seabirds and resting birds | Migratory birds | Marine Mammals | Bats | Plankton | Biotopes | Biological diversity | Floor | Area | Water | Air | Climate | Human/ Health | Cultural and material assets | Landscape |
| **Shipping** | Underwater Sound | Impairment/ scaring effect | | x | | | x | | | | | | | | | | | | |
| | Emissions and discharges of hazardous substances (ac-cidents) | Impairment/ damage | x | x | x | | x | | x | x | x | x | | x | | | x | | |
| | Physical distur-bance during anchoring | Impact on the seabed | xt | | | | | | | x t | | x t | x t | | | | | x | |
| | Emission of air pollutants | Impairment of air quality | | | x | x | | | | | | | | | x | x | x | | |
| | Introduction and spread of invasive spe-cies | Change in species composition | x | x | x | | | | x | | x | | | | | | | | |
| | Dumping of waste/ discharges | Impairment/ damage | x | x | x | | x | | x | x | | | | x | | | x | | |
| | Risk of collision | Collision | | | x | x | x | | | | | | | | | | | | |
| | Visual agitation | Impairment/ chickening out effect | | x | x | | | | | | | | | | | | | | |

### 3.1.1 Seabed/ Area

The seabed is influenced by the following effects of shipping:

*Introduction of pollutants:*

For operational reasons, shipping generates pollutants that contribute to sediment and water pollution. The introduction of oil causes pollution in water and sediment to varying degrees with pollutants which are partially toxic. Depending on the quantity, type and composition, oil slicks of varying sizes can form which are spread over large areas depending on the weather conditions, and can sink to the sea bed.

*Physical disturbance during anchoring:*

When ships anchor, the anchors penetrate the seabed and mix the sediments, which has a local and temporary influence on the structure of the sediment.

The above-mentioned effects are independent of the non-implementation or implementation of the plan.

### 3.1.2 Benthos and biotope types

The following explanations are limited to the effects of shipping on benthic communities. Since biotopes are the habitats of a regularly recurring community of species, impairments to biotopes have a direct effect on the biotic communities.

The effects of shipping on benthos are due to the following factors.

- Introduction of oil. Even the smallest amount of oil pollution represents a risk to living organisms, and the effects of chronic oil pollution on birds are well documented. On the other hand, there are only a few studies which examine the effects of chronic oil pollution on other organisms. Among other things, the few studies show reduced species diversity and number of individuals in molluscs. Bernem (2003) mainly examines the effects on coastal areas, and identifies salt marshes as particularly endangered habitats. Studies of the effects on the benthos of deeper marine areas such as the EEZs are not known, although oil can drift below the surface of the water and sink to the sea bed.
- Introduction of toxic substances. The effects of TBT on aquatic organisms, primarily in coastal waters, have been known since the beginning of the 1970s, and should not really be affected by the biocidal action of the chemical. TBT has been shown to have an endocrine effect, i.e. it interferes with the endocrine system of organisms.
  TBT is capable of causing a pathomorphosis known as imposex, not only in bivalve molluscs but also in diescious gastropods. Imposex describes the masculinisation of females in snail populations. In the female whelk (Buccinum undatum) it also leads to the development of male reproductive organs. In the final stage of imposex development, rapidly growing male genitals lead to sterilisation in the majority of species, and often the death of the affected females (Watermann et al., 2003), and entire populations can eventually become extinct (Weigel, 2003). This ultimately led to an extensive international ban on organotin anti-fouling agents in 2008.
- Physical disturbances during anchoring. When ships are anchoring, local and temporary disturbance of the seabed takes place, and therefore a small-scale impact on benthic communities.
- Introduction of non-native species. An increasing tendency toward first-time introductions of non-native species has been observed since 1970. In addition to aquaculture, which makes targeted use of alien species in some cases, the main contributors have been shipping traffic via ballast water, via sediment from ballast

tanks and via the hulls of ships (Gollasch, 2003). The range of introduced species extends from macro-algae to invertebrates. If the alien species find optimal living conditions, mass reproduction can occur, which can cause a considerable amount of ecological and economic damage. However, none of the newly introduced species have led to drastic negative impacts in recent years. The species that lead to the greatest negative economic impacts, such as the Chinese woolly hand crab (Eriocheir sinensis) and the shipworm (Teredo navalis), which has now caused considerable damage since it became firmly established, or various species of phytoplankton, have already been resident here for a long time (Gollasch, 2003) The Ballast Water Convention has been in force since 2017, and regulates the introduction and spread of organisms with the ballast water of ocean-going vessels. The current ballast water exchange in the North Sea is only possible under certain conditions. Species are released with bio-accumulation, but these are sessile species that require suitable environmental conditions (solid substrates) to settle and establish themselves when released. The introduction of alien species via fouling from ships is also becoming more of an issue, including smaller pleasure vessels.

By way of a summary, the main impacts of shipping on marine benthos are as follows:

- supra-regional, temporary effects due to oil introduction, emissions and the introduction of toxic substances, anchoring
- supra-regional, permanent effect due to the introduction of non-native species.

The above-mentioned effects on benthic communities and biotopes arise independently of the non-implementation or implementation of the plan.

### 3.1.3 Fish

The effects of shipping on fish include underwater noise, the introduction of hazardous substances, the dumping of waste and the introduction and propagation of invasive species.

The majority of ships, particularly the bigger ships, emit mostly low-frequency **underwater sound**, which depends on the type of ship, the ship's propeller and the hull design, among other things (POPPER & HAWKINS 2019). The sound emitted by ships could have an impact on fish fauna. The hearing ability of fish differs considerably. Some species, such as clupeiforms, have very good hearing because their inner ear is connected to the swimming bladder. When sound hits the swimming bladder, the vibration which is generated is mechanically transmitted to the ear. Clupeiforms are therefore probably more sensitive to underwater sound than fish species without a swimming bladder, such as flatfish and sand eels. For example, hearing allows fish to locate prey, escape predators or find a reproductive partner (POPPER & HAWKINS 2019). The noise could particularly affect fish that communicate using self-produced sounds (LADICH 2013, POPPER & HAWKINS 2019). Continuous underwater noise could particularly mask communication, especially during spawning (DE JONG et al. 2020). Some fish species, such as herring and cod, also showed typical avoidance reactions to shipping traffic, such as changing swimming direction, increased diving or horizontal movements (MITSON 1995, SIMMONDS & MACLENNAN 2005). The responses of fish to the direct and indirect effects of shipping are generally inconsistent (POPPER AND HASTINGS 2009) and can differ between species. Even the response of a single species to shipping noise can change depending on its stage of life (DE ROBERTIS & HANDEGARD 2013). The literature contains references to possible behavioural changes caused by ship noise, but the findings are not conclusive enough to draw conclusions about their relevance. Scientific reviews of the existing literature about the possible effects of ship noise on fish clearly indicate the lack of comparability, transferability and reproducibility of the results (Popper & Hawkins 2019). Long-term studies of the effects of continuous noise emissions on fish in their natural habitat are also needed in order to draw conclusions at population level (Weilgart 2018, de Jong et al. 2020).

As well as acoustic stimuli, the introduction of pollutants is also worth mentioning as an effect of shipping traffic. Shipping can have a severe impact on the marine environment as a result of accidents and the potential release of pollutants, particularly **heavy oil.** Several factors such as the type, condition and quantity of oil determine the degree of impairment (van Bernem 2003).

Pelagic species may be able to avoid oil-contaminated areas, as observed in laboratory tests on salmon (van Bernem 2003), and bottom-dwelling fish species may be damaged by prolonged contact with oily sediments. Potential consequences include the intake of hydrocarbons from sediment, the occurrence of certain diseases (including fin rot) and the decline of stocks. There is no known scientific evidence from the natural habitat that could be used to assess the relevance of these effects.

Fish eggs and juveniles are generally more vulnerable than adults, because their sensory skills are not yet developed or not fully developed, and they are also less mobile.

Another effect of shipping is the **introduction of non-native species**. An increasing tendency toward first introductions of alien species has been observed since 1970. Vessel traffic via ballast water and via the outer hulls of ships has also contributed to this (Gollasch 2003). In principle, non-native fish species can be introduced into the North Sea and potentially establish themselves (Gollasch 2002). If the alien species find suitable living conditions, mass reproduction can occur, which in turn can lead to the displacement of native species due to competition for food and habitats. Studies of alien species primarily concentrate on benthic invertebrates (see BMU 2018). Fish could particularly propagate by means of the transportation of eggs and larvae in ballast water (LLUR 2014). The introduction of alien fish species with invasive potential by shipping is not known in the German North Sea EEZ.

Marine pollution is a global threat to the marine ecosystem, and can also have negative effects in the North Sea. With 85%, plastic is the dominant category of waste on the seabed of the North Sea (Thünen 2020). An estimated 600,000 m³ of plastic waste is found in the North Sea (Bundesregierung 2020), of which about one third is attributable to shipping and fisheries (BfN 2017). The fish also ingest plastic with food and spread it via the food web. At present, there are no systematic studies on the effects of plastics on fish fauna that would make a differentiated assessment possible. The Thünen Institute of Fishery Ecology is examining the risk posed by plastics in the marine environment in the PlasM project, probably until 2021. The results are not yet available.

### 3.1.4 Marine mammals

The effects of shipping on marine mammals can be caused by noise emissions, pollution during normal operation or accidents involving ships, among other things. During normal operation, shipping represents a potential hazard to marine mammals. The effects are area-specific and of low, medium or even high intensity. The effects are also temporary or recurrent in an area-specific way, such as along busy shipping routes.

Direct disturbance of marine mammals by sound emissions is more likely to occur, especially along busy traffic separation areas, such as north of the East Frisian Islands. Unlike other cetacean species, harbour porpoises are not known to be attracted by ships. Harbour porpoises generally tend to be shy. Harbour porpoises and seals are also not known to collide with ships. It is assumed that interference may occur by masking communication, particularly in the case of bearded whales, which echolocate and communicate at low frequency ranges which overlap with ship sounds. Information can be found in numerous studies, but the results thereof are often not comparable, transferable and reproducible (Erbe et al., 2019). Furthermore, the possible effects of disturbance from ship noise are difficult to quantify, and differentiate from other sources of disturbance. Marine mammals have also developed adaptation mechanisms to maintain communication in noisy areas. The known adaptations of cetaceans to the acoustic environment in the oceans include the so-called Lombard Effect. The Lombard Effect is described as the ability to maintain communication between members of the same species by changing the volume, vocalisation rate and frequency of sounds, even in noisy environments, and has been verified in various groups of animals. Cetaceans such as the harbour porpoise are also able to increase the volume and frequency of vocalisation and change the frequency range. This adaptation is a vital survival strategy which allows them to search for food effectively and efficiently, escape predators, maintain contact between a mother and a calf, and also seek out members of the same species (Erbe et al., 2019).

In the event of shipwrecks, environmentally hazardous substances such as oil and chemicals can be released. Direct mortality as a result of oil pollution is only expected in major oil disasters (Geraci and St Aubin 1990; Frost and Lowry, 1993). Oil spills can cause lung and brain damage in marine mammals. The long-term effects of oil spills which have been observed have included increased juvenile mortality in seals.

The loss of cargo can also lead to contamination with toxic substances. Even during normal ship operation, oil and oil residues, lipophilic cleaning agents from tank cleaning, ballast water containing non-indigenous organisms and solid waste are released into the marine environment (OSPAR, 2000). Pollutants discharged into the sea by ships can accumulate in the food chains and therefore contribute to pollution and contamination. Effects on marine mammals from the accumulation of pollutants in the food chains are also possible.

According to the current state of knowledge, the effects at population level are difficult to assess. It is therefore advisable to always act in accordance with the precautionary principle in the event of any use (Evans, 2020).

The non-implementation of the plan would not affect the existing or described impacts of shipping on harbour porpoises, harbour seals and grey seals.

### 3.1.5 Seabirds and resting birds

The effects of shipping on seabirds and resting birds include visual disturbance, attracting effects and collisions, pollution and the introduction of invasive species.

Visual agitation can cause scaring or avoidance reactions in species that are sensitive to disturbance. According to a recent study by Fließbach et al (2019), red-throated divers, black guillemots, black-throated divers, velvet scoters and red-breasted mergansers are among the most sensitive species to shipping traffic. The most common reaction is to take flight. The escape distances vary depend on the species and the individual, and may be associated with various individual and ecological factors (Fließbach et al. 2019). The sensitivity of black throated divers to ships is also known from other studies (Garthe & Hüppop 2004, Schwemmer et al. 2011, Mendel et al. 2019, Burger et al. 2019).

Direct effects on seabirds caused by visual disturbance are to be expected, particularly along busy traffic routes or traffic separation areas.

The effects of visual disturbance caused by shipping on seabirds and resting birds depend on the regional and temporal occurrence of shipping. Findings on the reactions of divers to ships indicate that the duration and intensity of the scaring reaction may depend on the type of ship and related factors such as the ship speed (BURGER et al. 2019).

Shipping can release oil and oil residue, lipophilic detergents from tank cleaning, ballast water containing non-native organisms and solid waste into the marine environment (OSPAR 2000).

WIESE AND RYAN (2003) found signs of chronic oil pollution in seabirds. Almost 62% of all dead seabirds found along the south-eastern coasts of Newfoundland between 1984 and 1999 were contaminated with oil from ship operations. Auks were the birds that were most frequently contaminated with oil.

The loss of cargo can also lead to contamination with toxic substances. Pollutants that are discharged into the sea from ships can accumulate in the food chain and therefore contribute to pollution and contamination. Shipwrecks can also cause massive discharges of environmentally hazardous substances such as oil and chemicals.

Various effects are known to be caused by oil spills. After the accident of the "Prestige" in 2003, for example, the breeding success of cormorants was discovered to be reduced by up to 50% in breeding colonies affected by oil pollution in comparison to undisturbed breeding colonies (VELANDO et al. 2005a). Indirect effects of the "Prestige" accident on the breeding success of the Cormorant were also observed: high levels of contamination in sediment, plankton and benthos reduced the sand eel population. The reduction in the number of sand eels has in turn affected the breeding success of the cormorant. In 2003, for example, the long-term data revealed that fewer breeding pairs than expected bred successfully. The chicks were also extremely weak due to lack of food or reduced food quality (VELANDO et al. 2005b).

The above-mentioned effects on seabirds and resting birds are independent of the non-implementation or implementation of the plan.

### 3.1.6 Migratory birds

For migratory birds, the effects of shipping may be caused by visual stimuli and the introduction of pollutants. Migratory birds can be attracted at night by ships' lighting. This particularly applies to nights with poor visibility conditions caused by clouds, fog and rain, among other things, possibly resulting in collisions.

Migratory birds are not very likely to be endangered by oil or pollutants. Only migratory birds such as seabirds which interrupt their migration by landing on the water to feed or to wait out bad weather conditions (such as headwinds and poor visibility) would be affected. As a result, the birds would die from oily plumage and the intake of oil into the gastro-intestinal tract due to their cleaning behaviour or the consumption of oily food.

The above effects on migratory birds are independent of the non-implementation or implementation of the plan.

### 3.1.7 Bats and bat migration

The effects of shipping on bats are largely unknown. There are only isolated reports of bats found on ships. WALTER et al (2005) have summarised these observations/findings on ships as part of the investigations for offshore wind energy projects. According to these, it is assumed can have ships can have an attracting effect on bats.

Insects can be attracted to ships by lighting and heat generation, as a result of which bats searching for food can be attracted by the insects. It is also assumed that migrating bats also land on ships to rest. However, this does not necessarily mean that there is a risk of collision.

No other direct or indirect effects of shipping on bats are known. At most, the above-mentioned attraction effects can be regional and temporary.

The above-mentioned effects on bats are independent of the non-implementation or implementation of the plan.

#### 3.1.8 Air

Shipping causes pollutant emissions, particularly nitrous oxides, sulphur dioxides, carbon dioxide and soot particles. These can have a negative impact on air quality. However, this is independent of the non-implementation or implementation of the ROP.

#### 3.1.9 Climate

The pollutant emissions from shipping described in chapter 3.1.8contribute to climate change. The global proportion of greenhouse gas emissions caused by shipping is 2.2%. (BMU, 2020).

However, this is independent of the non-implementation or implementation of the ROP.

#### 3.1.10 Cultural and other material assets

In the context of navigation, measures for deepening, relocating or widening fairways by means of dredging, for example, can lead to the destruction of the neighbouring underwater cultural heritage. Furthermore, the underwater cultural heritage site is threatened, particularly in shallow waters, because ship propellers can cause turbulence in the sediment, which has an erosive effect on archeological layers. Destruction can also be caused by anchoring, particularly in the case of structural measures involving anchored construction vessels.

Indirectly, the increasing tendency since 1970 of the introduction of non-native species via ballast water and on the hulls of ships (Gollasch 2003) represents the biggest threat to underwater cultural heritage. Three species of shipworm are active in native waters, including the most well-known species the common shipworm, which was detected in the Baltic Sea as early as 1872 and has since caused major damage to wooden harbour structures, shipwalls and piles. The spread of this species is limited by tolerance ranges with regard to salinity, water temperature and oxygen (cf. Björdal et al. 2012, 208; Lippert et al. 2013, 47). However, shipping can cause the introduction of other destructive organisms that have adapted to a different tolerance range and can advance into previously unaffected areas.

Recreational diving in the EEZ as an indirect consequence of recreational boating is also worth mentioning. In the past, objects were removed from historical wrecks or even deliberately dismantled, as was the case in the example of the wreck of the SMS Mainz, which was looted by Dutch divers in 2011 (Huber & Knepel 2015).

In the past, wrecks from the first and second world war periods was carried out by the Explosive Ordnance Disposal Service on the suspicion that ammunition might still be on board. In this case, a balance must be struck between safety aspects and protecting cultural heritage.

### 3.2 Wind energy at sea

The increasing demand for space due to offshore wind energy and the ambitious targets of the German government for the utilisation of offshore wind energy have been the main reasons for drawing up the 2009 spatial development plans for the German North Sea and Baltic Sea EEZ. The preparation of the regional development plans was an explicitly mentioned means of promoting the expansion of renewable energy sources.

When the 2009 regional development plans were adopted, an initial offshore wind farm, the alpha ventus test field, with 12 individual turbines, was nearing completion. In the meantime, 21 wind farms with a total of 1,399 turbines and an installed capacity of around 7.2 GW are in (trial) operation.

The first offshore wind turbines had a nominal capacity of 2.3 to 5 MW. Bigger rotors and substructures which can support heavier loads have led to a significant increase in nominal capacity over the course of time.

Specialist planning:

The 2019 FEP (which is currently being updated and amended) includes a current sectoral plan for controlling the planning of the expansion of offshore wind energy and the electricity grid connections.

The current draft FEP defines areas N-1 to N-13 for offshore wind energy in the North Sea EEZ in order to achieve the expansion target of 20 GW by 2030. The increased expansion path for offshore wind energy results from the draft law amending the Offshore Wind Energy Act and other regulations adopted by the Federal Cabinet on 3 June 2020. Various impacts on the marine environment may occur in connection with the construction and operation of wind energy installations, including loss of local habitat due to permanent land sealing, scaring and barrier effects and a resulting loss of habitat for birdlife. The potential impacts of maintenance and service traffic must also be taken into consideration.

In order to assess the requirements for offshore wind energy, the following possible impacts will be examined:

Table 16 Potential effects of offshore wind energy (t = temporary).

| Nutzung | Wirkung | Potenzielle Auswirkung | Schutzgüter | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fische | See- und Rastvögel | Zugvögel | Meeressäuger | Fledermäuse | Plankton | Biotoptypen | Biologische Vielfalt | Boden | Fläche | Wasser | Luft | Klima | Mensch/ Gesundheit | Kultur- und Sachgüter | Landschaftsbild |
| Gebiete für Windenergie auf See | Einbringen von Hartsubstrat (Fundamente) | Veränderung von Habitaten | x | x | | | x | | x | x | x | x | | | | | | | |
| | | Lebensraum- und Flächenverlust | x | x | | | x | | | x | x | x | x | | | | | x | |
| | | Anlockeffekte, Erhöhung der Artenvielfalt, Veränderung der Artenzusammensetzung | x | x | x | | x | | x | | x | | | | | | | | |
| | | Veränderung der hydrographischen Bedingungen | x | x | | | x | | x | | | | | x | | | | | |
| | Auskolkung/Sediment-umlagerung | Veränderung von Habitaten | x | x | | | | | x | x | | x | x | | | | | | |
| | Sediment-aufwirbelungen und Trübungsfahnen (Bauphase) | Beeinträchtigung | x t | x t | x t | | | | x t | | | | | x t | | | | | |
| | | Physiologische Effekte und Scheucheffekte | | x t | | | x | | | | | | | | | | | | |
| | Resuspension von Sediment und Sedimentation (Bauphase) | Beeinträchtigung | x t | x t | | | | | x t | | | | | x t | | | | | |
| | Schallemissionen während der Rammung (Bauphase) | Beeinträchtigung/ Scheucheffekt | | x t | | | x | | | | | | | | | | | | |
| | | potenzielle Störung/ Schädigung | | x t | | | x | | | | | | | | | | | | |
| | Visuelle Unruhe durch Baubetrieb | Lokale Scheuch- und Barriereeffekte | | x t | x t | | | | | | | | | | | | | | |
| | Hindernis im Luftraum | Scheucheffekte, Habitatverlust | | | x | | | | | | | | | | | | | | |
| | | Barrierewirkung, Kollision | | | x | x | | x | | | | | | | | | | | x |
| | Lichtemissionen (Bau und Betrieb) | Anlockeffekte, Kollision | | | x | x | | x | | | | | | | | | | | x |
| | windparkbezogener Schiffsverkehr (Wartungs-, Bauverkehr) | siehe Schifffahrt | x | x | x | x | x | x | x | x | x | x | x t | x | x | x | x | x | |

### 3.2.2 Seabed/ Area

The use of "wind energy at sea" has the following effects on the seabed:

**Wind turbines**

The wind turbines and platforms have a locally limited environmental impact with regard to the seabed, which is the subject of the protection. The sediment is only permanently affected in the immediate vicinity by the introduction of the foundation elements (including scouring protection, if necessary) and the resulting land use. To protect against scouring, either scour protection in the form of so-called mudmats or stone packing is deployed around the foundation elements, or the foundation piles of deep foundations are embedded deeper into the seabed accordingly. Wind turbines and platforms are currently installed almost exclusively as deep foundations. However, the use of other foundation structures such as gravity foundations or suction bucket foundations can also be taken into consideration. In deep foundations, the foundation of a wind turbine or platform is anchored to the seabed using one or more steel piles, which are generally driven into the ground. Suction bucket foundations obtain their stability by creating a negative pressure in the cylindrical foundation structure, which does not need to be driven. Above the seabed a lattice-shaped frame structure consisting of steel tubes and struts, the so-called jacket structure, is usually used as a stiffening structure for both deep foundations and for suction bucket foundations.

*Construction-related effects:* When the foundations of the wind turbines and platforms are being installed, sediment is briefly churned up and turbidity plumes are formed. The extent of resuspension mainly depends on the fine-grain content of the seabed. Since the surface sediment of the North Sea EEZ within the priority and reserved areas mainly consists of fine and medium grain sand and coarse sand in some locations, the sediment that is released will quickly settle directly at the construction site or in its immediate vicinity. The anticipated impairments caused by increased turbidity will be limited to a small area. Pollutants and nutrients from the sediment may be released into the soil water for a short time. The potential introduction of pollutants into the water column by churned up sediment is negligible due to the relatively low fine-grain content (silt and clay) and the low pollutant load, and also the relatively rapid resedimentation of the sand. This also applies against the background that the sandy sediments are naturally (e.g. during storms) churned up and moved by sea waves touching the ground and appropriate currents. Effects in the form of mechanical stress on the seabed caused by displacement, compaction and vibration that are anticipated during the construction phase are estimated to be minor because of their small scale.

*Due to the type of installation,* the seabed is only permanently sealed locally to a very limited extent by the insertion of the foundation elements of deep-foundation wind turbines or platforms. The areas that are affected essentially consist of the diameter of the foundation piles, plus any scour protection that may be required. In the case of transformer and converter platforms, which are almost exclusively supported on jacket structures (without scour protection), the area that is required (sealing) is approx. 600 $^{m2}$ to 900 m², depending on the size of the platform. Wind turbines are also almost exclusively deep foundation installations. By far the most common type of foundation in this case is the monopile. With a monopile diameter of 8.5 m, including scour protection, a surface area of approx. 1400 $^{m2}$ is required. The area that is required for suction bucket foundations is approximately the same of that of a monopile.

In the case of a gravity-based platform, the area that is sealed because of the installation is significantly greater than in the case of deep foundations. Including scour protection measures, the area that is required is probably ten to twenty times that of a deep-foundation platform.

*Due to operational conditions,* the interaction of the foundation and the hydrodynamics in the immediate vicinity of the installation may lead to permanent turbulence and rearrangement of the sandy sediments. Scouring may also occur in the immediate vicinity of the installations. According to previous experience, flow-induced permanent sediment rearrangement can only be expected in the immediate vicinity of the platform. According to the findings of the accompanying geological investigations in the "alpha ventus" offshore test field (LAMBERS-HUESMANN & ZEILER 2011) and on the FINO1 and FINO3 research platforms, this will occur locally around the individual foundation piles (local scour). Because of the prevailing properties of the seabed and the predicted small extent of the scouring, no significant changes to the substrate are anticipated.

**Undersea cable systems**

For construction reasons, the turbidity of the water column increases because of sediment uplift during cable-laying work, and is distributed over a bigger area because of the influence of tidal currents. The extent of the resuspension mainly depends on the laying method and the consistency of the seabed. Due to the prevailing sediment composition in the North Sea EEZ, most of the sediment that is released will settle directly at the construction site or in the immediate vicinity thereof, during which the suspension content will decrease back to the natural background values due to dilution effects and sedimentation of the churned-up sediment particles. The impairment that is anticipated because of increased turbidity remains locally limited. The results of investigations of different methods in the North Sea reveal that the seabed levels off relatively quickly in some cases due to the natural sediment dynamics along the affected routes. In the short term, pollutants and nutrients can be released from the sediment into the subsurface water. The possible release of pollutants from the sandy sediment is negligible due to the low proportion of fine grains and the low concentrations of heavy metals in the sediment. The anticipated effects in the form of mechanical disturbance of the seabed due to displacement, compaction and vibration during the construction phase are estimated to be minor because of the small scale thereof.

For operational reasons, energy losses may occur in the form of heat given off into the surrounding sediment. The heat emission results from the thermal losses of the cable system during energy transfer.

By way of a summary, the potential impacts of the currently planned wind energy installations, platforms and undersea cable systems on the protected seabed are local and independent of regional planning.

**ROP and FEP - Priority and reserved areas**

The current planning status for the expansion of offshore wind energy is set out in the FEP 2019, which - from a geographical point of view - covers the *priority areas of* wind energy of the ROP-E. For this study area, the impacts described above were therefore examined during the course of preparing the FEP 2019. As a result, no significant impacts on the seabed as a protected resource were found, particularly since the affected areas mainly consist of poorly structured seabed with a homogeneous sediment distribution consisting of fine and medium grain sand.

If the FEP is not implemented, the result would probably be an installation that was less coordinated and possibly a greater number of cable systems or longer undersea submarine cable systems. This could lead to the use of a bigger area and therefore an increase in the possible effects on the protected seabed or surface area in comparison to the implementation of the FEP. If the FEP is not implemented, there would probably also be a greater number of cable crossings with undersea cables that are already in operation. This would require an increased amount of rock filling, even in areas with a predominantly homogeneous sandy seabed. In the case of the crossing disused telecommunication cables, these are usually cut, meaning that the cut cable ends have to be prevented from floating by attaching concrete weights. This would result in additional seabed sealing and the introduction of artificial hard substrate.

In addition to priority areas, the ROP-E also provides for *reserved areas* for the North Sea EEZ. If the plan is not implemented, the development of offshore wind energy in these areas is likely to be less coordinated.

### 3.2.3 Benthos and biotope types

Benthic communities and biotopes would also be partially affected by the impacts of different uses if the plan is not implemented. It can also be expected that the warming of the water which has already been triggered by climate change will continue in the future. This also has an impact on benthic biotic communities. This may lead to the colonisation of new species or an overall shift in the range of species. However, this development is independent of whether or not the plan is implemented.

If the plan is not implemented, wind farm planning that was less geographically coordinated would be expected. As a result of non-implementation of the plan, a comparatively greater amount of land use could be expected, and therefore a greater potential impact on the benthos and biotopes compared with implementation of the plan. Possible impacts result from the installation of the foundations for the wind turbines and platforms. During the construction phase, impacts on benthic communities could occur through direct disturbance of near-surface sediments, the introduction of pollutants, sediment resuspension, the formation of turbidity plumes and an increase in the amount of sedimentation.

Changes could occur to the composition of the existing species in the vicinity of the foundations of the installations and platforms due to the artificial hard substrate that is introduced.

Since the provisions of the plan are aimed at minimising the use of the seabed, it would probably be more difficult to ensure that the benthos and biotopes were protected if the plan were not implemented than if it were.

### 3.2.4 Fish

The impact of OWPs on the fish population due to construction, installation and operation is geographically and also partially temporally limited, and mainly concentrates on the area of the planned project. The effects of the different wind farm phases are described in detail in the following.

Construction-related effects

- Noise emissions due to the ramming of the foundations
- Sedimentation and turbidity plumes

Construction-related **noise emissions are expected to be caused** in the vicinity of the project by the use of ships, cranes and construction platforms and by the installation of the foundations and the scour protection (if required). It is known from the literature that underwater ramming impacts produce a high level of sound pressure in the low-frequency range. All of the fish species which have been investigated so far and their stages of life can perceive sound as particle movement and pressure changes (KNUST et al. 2003, KUNC et al. 2016, WEILGART 2018, POPPER & HAWKINS 2019). Depending on the intensity, frequency and duration of acoustic events, sound could have a direct negative effect on the development, growth and behaviour of fish or be superimposed onto environmental acoustic signals, which are sometimes crucial for fish survival (KUNC et al. 2016, WEILGART 2018, JONG et al. 2020). However, most of the evidence to date on the effects of sound on fish comes from laboratory studies (WEILGART 2018). There have been few studies of the range of perception and possible species-specific behavioural reactions in the marine habitat to date. The construction-related effects of wind farms on the fish population are limited in terms of geography and time. Short, intensive sound events during the construction phase - particularly during the installation of the foundations – will probably cause fish to be scared away. In the Belgian EEZ, DE BACKER et al (2017) showed that the sound pressure generated during pile-driving was sufficient to cause internal bleeding and barotrauma of the swimming bladder in cod *Gadus morhua.* This effect was observed at a distance of 1,400 m or closer to a pile-driving source without any sound insulation (DE BACKER et al. 2017). Investigations such as this indicate that significant disturbances or even the killing of individual fish in the vicinity of the ramming points are possible. Hydroacoustic measurements have shown that construction measures (pile-driving and other construction activities) in the "alpha ventus" test area resulted in a considerably reduced population of pelagic fish in relation to the surrounding area (KRÄGEFSKY 2014). However, the fish are likely to return once the noise-intensive construction measures are completed after the temporary displacement. Studies on the effects of sound effect on fish by NEO et al. (2016) showed that most of them returned to their normal behaviour 30 minutes after the auditory stimuli.

The construction work on the foundations of wind turbines, the transformer platform and the internal cabling of the wind farm causes **sediment turbulence and turbidity plumes**, which can cause physiological disturbances to the fish fauna, especially the fish spawn, even though they are temporary and species-specific. However, sediment upheavals, turbidity plumes and sedimentation are not expected to have significant effects on the fish population. Detailed information on this topic can be found in Section 3.4.3

Installation-related effects

- Land use
- Introduction of hard substrate
- Fishing ban
- Operating noise

The construction of the foundations of the WTGs and technical platforms, plus the scour protection, means that habitats are being built over and will no longer be available for fish. This results in permanent **habitat loss** for demersal fish species and their food source, macrozoobenthos, due to local overbuilding. However, this loss of habitat loss is limited to the immediate, small-scale location of the individual WTGs and platforms.

The construction of wind farms changes the structure of the seabed of the North Sea, which is often uniformly sandy, by newly introduced hard substrate (foundations, scour protection). The majority of observations have shown that **artificial reefs attract** fish (METHRATTA & DARDICK 2019). However, it has not yet been conclusively clarified whether this is the result of a concentration effect on fish that would otherwise be found elsewhere, or the result of increased productivity (GLAROU et al. 2020). Bigger catches of cod and pollock have been made near Norwegian oil platforms than before they were built (VALDEMARSEN 1979, SOLDAL et al. 2002). In the North Sea, increasing numbers of large adult predators such as cod *Gadus morhua* and pollock *Pollachius virens* are being observed above wrecks and stone fields (EHRICH 2003). Increased densities of flatfish have been found in the vicinity of artificial reefs (POLOVINA & SAKI 1989). According to expert reports and video recordings of the accompanying monitoring, many fish species using the artificial hard substrate are found at the monopiles of the existing "Horns Rev I" wind farm (LEONHARD et al. 2011). As well as this positive effect, changes to the dominance relationships and size structure within the fish community as a result of the increase in the number of large predatory fish could lead to increased feeding pressure on one or more species of prey fish.

The attractiveness of artificial substrates for fish is dependent upon the size of the hard substrate that is introduced (OGAWA et al. 1977). The effective radius is assumed to be 200 to 300 m for pelagic fish and up to 100 m for benthic fish (GROVE et al. 1989). STANLEY & WILSON (1997) found increased fish densities within a 16 m radius of an oil rig in the Gulf of Mexico. When this is transferred to the foundations of the wind turbines, due to the distance between the individual turbines it can be assumed that each individual foundation, regardless of the type of foundation, acts as a separate, relatively unstructured substrate and the effect does not cover the entire area of the wind farm.

COUPERUS et al. (2010) found a concentration of pelagic fish that was up to 37 times greater in the vicinity (0-20 m) of wind turbine foundations using hydroacoustic methods in comparison to the areas between the individual wind turbines. REUBENS et al. (2013) found significantly higher concentrations of pouting *Trisopterus luscus* at the foundations than above the surrounding soft substrate, which mainly fed on the vegetation on the foundations. GLAROU et al (2020) evaluated 89 scientific studies on artificial reefs, 94% of which showed that artificial reefs have positive or no effect on the abundance and biodiversity of the fish population. In 49% of the studies, a local increase in the abundance of fish was recorded after the construction of artificial reefs. The reasons for an increased abundance of fish on artificial reefs and in OWPs could be the fact that more food is available locally and protection from currents and predators is provided (GLAROU et al. 2020).

The **elimination of fishing** due to the anticipated traffic ban in the wind farms could have a further positive effect on the fish community. This would eliminate the associated negative effects of fishing, such as disturbance or destruction of the seabed and the catching and by-catching of many species. Because of the absence of fishing pressure, the age structure of the fish population within the project area could revert to a more natural distribution, so that the number of older individuals increases. In addition to the absence of fishing, an improved food basis for fish species with a wide variety of diets would also be conceivable. The growth of sessile invertebrates on wind turbines could favour benthos-eating species and provide fish with a bigger and more varied food source (LINDEBOOM et al. 2011). This could improve the condition of the fish, which in turn would have a positive effect on their fitness. Research is currently needed to transfer cumulative effects of this nature to the population level of the fish. To date, the effects on the fish population which could result from the discontinuation of fishing in the vicinity of offshore wind farms have not been directly investigated, or results are still outstanding for some fish species (GIMPEL 2020).

For the operational phase of the OWPs, it can be assumed that the prevailing meteorological conditions in the North Sea will basically allow the WTGs to be operated almost permanently. The noise emitted by the WTGs will therefore probably be permanent. Studies by MATUSCHEK et al (2018) on the **operational noise** of wind farms showed that low-frequency noise can be measured at a distance of 100 m from the respective turbine. As the distance from the turbine increases, the noise levels towards the centre of the wind farm decreased in all wind farms. However, outside the wind farms, at a distance of 1 km, higher levels were measured than in the centre of the wind farm. In general, the investigations revealed that the underwater sound emitted by the turbines cannot be clearly distinguished from other sound sources, such as waves or noise from ships (MATUSCHEK et al. 2018). Previous studies on the effects of continuous noise emissions on fish have not been able to provide clear evidence of negative effects such as persistent stress reactions (WEILGART 2018).

### 3.2.5 Marine mammals

Construction-related: Harbour porpoises, grey seals and seals can be at risk from noise emissions during the construction of offshore wind turbines and the transformer station unless avoidance and reduction measures are taken. Impulse sound or continuous sound can be entered depending on the type of foundation. The introduction of impulse noise, which is generated when piles are being driven with hydraulic hammers, for example, has been thoroughly investigated. The current state of knowledge about impulse noise makes a significant contribution to the development of technical noise reduction systems. On the other hand, little knowledge is available about the introduction of continuous sound resulting from the driving of foundation piles using alternative methods.

The Federal Environment Agency (UBA) recommends compliance with noise protection values during the installation of foundations for offshore wind turbines. The sound event level (SEL) outside of a circle with a radius of 750 m around the pile-driving or insertion point must not exceed 160 dB (re 1 µPa). The maximum peak sound pressure level must not exceed 190 dB if possible. The UBA recommendation does not include any further concretisation of the SEL noise protection value (http://www.umweltdaten.de/publikationen/fpdf-l/4118.pdf, as of May 2011).

The noise protection value recommended by UBA has already been worked out by means of preliminary work in various projects (UNIVERSITY OF HANNOVER, ITAP, FTZ 2003). For precautionary reasons, "safety margins" have been taken into consideration, e.g. for the inter-individual distribution of hearing sensitivity which has been documented to date, and particularly because of the problem of repeated exposure to loud sound impulses such as the ones that will occur when foundations are being rammed (ELMER et al., 2007). At present, only a small amount of reliable data is available for evaluating the effect duration of exposure to pile-driving sounds. However, pile-driving operations, which can last several hours, are much more potentially damaging than a single pile-driving operation. It currently remains unclear what kind of deduction should be applied to the above-mentioned limit value should be applied to a series of individual events. A deduction of 3 dB to 5 dB for each tenfold increase in the number of pile-driving impulses is being discussed among experts. Because of the uncertainties shown here in the evaluation of the effect duration, the limit value that is used in licensing practice is less than the limit value proposed by SOUTHALL et al (2007).

As part of the development of a measurement specification for recording and evaluating underwater noise from offshore wind farms, the BSH has concretised the specifications from the UBA recommendation (UBA 2011) and the findings of

the research projects with regard to noise protection values and standardised them as much as possible. In the measurement regulations for underwater sound measurements from the BSH, the $SEL_5$ value is defined as the assessment level,
i.e. 95% of the measured individual sound event levels must be less than the statistically determined $SEL_5$ value (BSH 2011). The comprehensive measurements carried out as part of the efficiency check show that the $SEL_5$ value is up to 3 dB higher than the $SEL_{50}$ value. Therefore, by defining the SEL5 value as an assessment level, a further tightening of the noise protection value was made in order to take the precautionary principle into consideration.

In its overall assessment of the available expert information, the BSH therefore assumes that the sound event level ($SEL_5$) outside of a circle with a radius of 750 m around the pile-driving or introduction site must not exceed 160 dB (re 1 µPa) in order to be able to rule out adverse effects on harbour porpoises with the required certainty.

Initial results concerning the acoustic resilience of harbour porpoises have been obtained as part of the MINOSplus project. After sonication with a maximum reception level of 200 pk-pk dB re 1 µPa and an energy flux density of 164 dB re 1 µPa2/Hz, a temporary hearing threshold shift (so-called TTS) was detected for the first time in a captive animal at 4 kHz. It was also shown that the hearing threshold shift lasted for more than 24 hours. Behavioural changes were already registered in the animal from a reception level of 174 pk-pk dB re 1 µPa (LUCKE et al. 2009). However, in addition to the absolute volume, the duration of the signal also determines the effects on the exposure limit. The exposure limit decreases as the duration of the signal increases, i.e. damage to the hearing of the animals can occur in the event of prolonged exposure, even at lower volumes. Based on these latest findings, it is clear that harbour porpoises suffer a hearing threshold shift above 200 decibels (dB) at the latest, which may also lead to damage to vital sensory organs.

The scientific findings that have led to the recommendation or setting of so-called noise limits are mainly based on observations of other cetacean species (SOUTHALL et al. 2007) or on experiments on harbour porpoises in captivity using so-called airguns or air pulsers (LUCKE et al. 2009).

Without the use of noise-reducing measures, considerable impairment to marine mammals during the pile-driving of the foundations cannot be ruled out. The driving of the piles of the wind turbines and the transformer station will therefore only be permitted in the specific approval procedure if effective noise reduction measures are used. Principles will be included for this purpose. These principles state that the piledriving work when installing the foundations of offshore wind energy plants and platforms may only be carried out if strict noise reduction measures are complied with. In the specific approval procedure, extensive noise reduction measures and monitoring measures will be arranged in order to ensure that the applicable noise protection values (noise event level (SEL) of 160 dB re 1µPa and maximum peak level of 190 dB re 1µPa at a distance of 750 m around the pile-driving or introduction point) are complied with. Suitable measures must be taken to ensure that no marine mammals are present in the vicinity of the piledriving site.

Current technical developments in the field of reducing underwater noise show that the use of suitable systems can significantly reduce or even completely prevent the effects of noise input on marine mammals (Bellmann, 2020).

Taking the current state of knowledge into consideration, the licensing procedure will contain conditions as part of the specification of the types of foundation to be constructed with the goal of avoiding effects on harbour porpoises caused by noise to as great an extent as possible. The extent of the necessary conditions will result from the checking of the structural design in a location and project-specific way at approval level on the basis of the species protection law and territorial protection law requirements.

The noise abatement concept of BMU has also been in force since 2013. The approach of the BMU noise abatement concept is habitat-related. According to the noise abatement concept, pile-driving work must be temporally coordinated in such a way that sufficiently large areas, especially within the German EEZ in the North Sea and especially within the protected areas and the main concentration area of the harbour porpoise during the summer months are kept free from effects caused by impact noise.

The approval notices of the BSH include two orders for the protection of the marine environment from noise emissions caused by piledriving work:

a) Noise reduction at source: Mandatory use of low-noise working methods in accordance with the state of the art for driving foundation piles, and mandatory limitation of noise emissions during piledriving. The ordinance is primarily intended to protect marine species from pulsating noise input by avoiding deaths and injuries.
b) Avoidance of significant cumulative effects: The spread of noise emissions must not exceed a defined area percentage of the German EEZ and the nature conservation areas. This ensures that habitats of a sufficiently high quality are available to the animals at all times for evasion purposes. The primary purpose of the order is to protect marine habitats by avoiding and minimising disturbances caused by pulsating noise input.

The order under a) specifies the noise protection values to be complied with and the maximum duration of the pulsating sound input, the use of technical noise reduction systems and deterrence and the extent of the monitoring of the protective measures.

Under order b), provisions are made for avoiding and reducing significant cumulative effects or disturbances to the harbour porpoise population which may be caused by pulsating sound impacts, among other things. The provisions are derived from the BMU concept for the protection of harbour porpoises in the German North Sea EEZ (BMU, 2013).

- It must be ensured with the necessary certainty that at any given time, no more than 10% of the area of the German North Sea EEZ and no more than 10% of a nature conservation area adjacent to sound-intensive pile-driving for the foundation of the piles are affected by disturbance-inducing sound impacts.
- During the sensitive period of the harbour porpoise from 1 May to 31 August, it must be ensured with the necessary certainty that no more than 1% of sub-area I of the nature reserve "Sylt Outer Reef - Eastern German Bight" with its special function as a breeding area is affected by disturbance-inducing noise from noise-intensive pile-driving for the foundation of the piles.

In order to ensure that marine habitats are protected, the BMU noise abatement concept of (2013) states that, depending on the location of a project in the German EEZ or its proximity to nature conservation areas, additional measures are required during foundation work. Additional measures will be issued by the BSH within the scope of the third construction approval, taking the site-specific and project-specific characteristics into consideration.

In general, the noise pollution considerations made for harbour porpoises from the construction and operation of wind turbines and platforms also apply to all other marine mammals that are present in the immediate vicinity of the structures.

Particularly during piledriving, direct disturbances of marine mammals at individual level are expected locally around the pile-driving site and for a limited period of time, whereby (as explained above) the duration of the work also has an impact on the exposure limit. In order to prevent any resulting hazard to the marine environment, the specific approval procedure must include an order to limit the effective pile-driving time (including evasive measures) to a minimum. The effective pile-driving time (including evasive measures) to be adhered to in each case will be specified later in the licensing procedure on a site-specific and installation-specific basis. Within the framework of the enforcement procedure, the right to coordinate noise-intensive work with other construction projects is also reserved in order to prevent or reduce cumulative effects.

On the basis of the function-dependent importance of the areas for harbour porpoises and taking the noise abatement concept of the BMU (2013) into consideration for avoiding disturbances and cumulative effects, the provisions made in the regional development plan (FEP, 2019), the specifications within the scope of the suitability check and the conditions imposed within the scope of individual approval procedures for reducing noise input, the potential effects of noise-intensive construction work on harbour porpoises are not considered to be significant. By protecting open space in nature conservation areas, defining the reserve area and implementing the specifications of the BMUB's noise abatement concept, the impairment of important feeding and breeding grounds for harbour porpoises is ruled out.

According to the current state of knowledge, the operational noise from the wind turbines and the transformer platform has no effect on highly mobile animals such as marine mammals. Investigations within the scope of the operational monitoring for offshore wind farms have not yet provided any indications that avoidance has been caused by wind farm related shipping traffic. To date, avoidance has only been detected during the installation of the foundations, which may possibly because of the large number of vehicles on the construction site and their different operating conditions.

The standardised measurements of the continuous sound input caused by wind farm operation, including the wind farm-related shipping traffic, have shown that low frequency noise can be measured at a distance of 100 m from the respective wind turbine. However, as the distance from the wind turbine increases, the noise of the turbine only differs slightly from the ambient noise. At a distance of 1 km from the wind farm, noise levels that are higher than those in the middle of the wind farm are always measured. The investigations have clearly shown that the underwater sound emitted by the turbines cannot be clearly identified from other sound sources, such as waves or ship noise, even at short distances. It was also hardly possible to distinguish between the wind farm-related shipping traffic and the general ambient noise which is introduced by various sound sources such as other shipping traffic, wind and waves, rain and other uses (MATUSCHEK et al. 2018).

All of the measurements showed that not only the offshore wind turbines emit sound into the water, but also various natural sound sources such as wind and waves (permanent background sound) can be detected in the water in a broadband manner and contribute to the broadband permanent background sound.

In the measurement regulation for the recording and evaluation of underwater noise (BSH, 2011), a level difference of at least 10 dB is required between pulsating and background noise for a technically unambiguous calculation of impulse noise during pile-driving. On the other hand, for the calculation or evaluation of continuous sound measurements there is no minimum requirement in this respect due to a lack of experience and data. Within the airborne sound range, a level difference of at least 6 dB is required between plant and background noise in order to achieve an unambiguous assessment of installation noise and operating noise. If this level difference is not achieved, a technically unambiguous assessment of the installation noise is not possible, or the installation noise is not clearly distinguishable from the background noise level.

The results from the measurements of underwater sound that are available show that a 6 dB criterion such as this based on airborne sound can only be fulfilled in the close proximity to one of the installations at most. However, this criterion is no longer fulfilled even a short distance from the edge of the wind farm. As a result, from an acoustic point of view, the sound emitted by the operation of the wind turbines outside the project areas does not clearly differ from the existing ambient noise.

The biological relevance of continuous sound on marine species, particularly harbour porpoises, has not yet been conclusively clarified. Continuous noise is the result of emissions from various anthropogenic uses, but also from natural sources. Reactions by animals in close proximity to a source such as a moving ship are to be expected, and can occasionally be observed. Such reactions are even essential for survival to avoid collisions, for example. On the other hand, reactions that have not been observed in close proximity to sound sources can no longer be assigned to a specific source.

The vast majority of behavioural changes are the result of a wide range of effects. Noise can certainly be a possible cause of behavioural changes. However, behavioural changes are primarily controlled by the survival strategy of the animals, for preying on food, for escaping from predators and for communicating with members of the same species. For this reason, behavioural changes always occur in a situational way and in a different form.

The literature contains references to possible behavioural changes caused by ship noise, but the results are not valid for drawing conclusions about the significance of behavioural changes or even for developing and implementing suitable mitigation measures.

However, scientific reviews of the existing literature on the possible effects of ship noise on cetaceans but also on fish clearly point to the lack of comparability, transferability and reproducibility of the results (Popper & Hawkins, 2019, Erbe et la. 2019).

It is known from oil and gas platforms that the attraction of different fish species leads to an enrichment of the food supply (Fabi et al., 2004; Lokkeborg et al., 2002). The recording of harbour porpoise activity in close proximity to platforms has also shown an increase in harbour porpoise activity associated with foraging during the night (TODD et al., 2009). It can therefore be assumed that the possible increase in food supply in the vicinity of wind turbines and the transformer platform is very likely to have an attractive effect on marine mammals.

As a result of the SEA, it can be concluded that, according to the current state of knowledge, no significant impacts on the protected marine mammal species must be expected from the construction and operation of wind turbines and the transformer platform.

Non-implementation of the plan would have had an influence on the existing or described effects of wind energy production on harbour porpoises, harbour seals and grey seals to the extent that it would not have been possible to plan the expansion in an orderly manner, taking specific objectives and principles into consideration.

### 3.2.6 Seabirds and resting birds

Construction-related: During the construction of offshore wind energy plants, effects on seabirds and resting birds must be assumed, although the nature and extent of these effects are limited in terms of time and geography.

In the case of species which are sensitive to disturbance, avoidance of the construction site can be expected, the intensity of which varies according to the species, and can very probably be attributed to the construction-related shipping traffic.

Construction-related turbidity plumes occur locally and for a limited time. Attracting effects caused by the illumination of the construction site and the construction site vehicles cannot be ruled out.

Operational and system-related: wind energy installations which have been constructed may constitute an obstacle in the airspace and may also cause collisions between the vertical structures and sea birds and resting birds (GARTHE 2000). It is difficult to estimate the extent of such incidents to date, since it is assumed that a large proportion of the colliding birds do not collide with a fixed structure (HÜPPOP et al. 2006). However, the risk of collision is estimated to be very low for disturbance-sensitive species such as red-throated and black-throated divers, since they do not fly directly into or near the wind farms due to their avoidance behaviour. Furthermore, factors such as manoeuvrability, flight altitude and the proportion of time spent flying determine the collision risk of a species (GARTHE & HÜPPOP 2004). The collision risk for seabirds and resting birds must therefore be assessed differently for each species.

The relevant height parameters of the turbines are an important key figure for assessing the possible risk of collision for sea birds and resting birds with wind turbines at sea. Bandwidths for the height parameters of the turbine types which are currently installed or potential types of turbine were included in the ROP in accordance with the current technical developments of wind energy installations (cf. Chapter 4.2). This takes wind farm projects into consideration which are already in operation, as well as those which will be going into operation in zones 1 and 2 within the scope of the transitional system and the initial commissioning years of the central system. Installations which could potentially be installed in future wind farm projects in zones 3 to 5 represent another range of turbines. For wind farm projects in zones 1 and 2 which have already been implemented or will be implemented in the future, data or assumptions are available for 5 to 12 MW turbines with a hub height of 100 to 160 m and, based on rotor diameters of 140 m to 220 m, a total height of 170 m to 270 m. For wind farm projects in zones 3 to 5, assumptions are made for 12 to 20 MW turbines, which have a hub height of 160 to 200 m and, based on rotor diameters of 220 m to 300 m, a total height of 270 m to 350 m. This means that the lower rotor-free area from the surface of the water to the lower blade tip would be between 30 m to 50 m for wind farms in zones 1 and 2 and between 30 m to 50 m for wind farms in zones 3 to 5.

As part of StUKplus, the "TESTBIRD" project used rangefinders to determine the flight altitude distribution of a total of seven species of sea birds and resting birds. In the majority of the flights that were recorded, the European herring gulls, herring gulls and great black-backed gulls flew at altitudes of 30 - 150 m. On the other hand, species such as the black-legged kittiwake, the common gull, the little gull and the gannet were mainly observed at low altitudes up to 30 m (MENDEL et al. 2015). A recent study at the Thanet Offshore wind farm in England also examined the flight altitude distribution of the gannet, the black-legged kittiwake and the European herring gull, the great black-backed gull and the herring gull using the rangefinder (SKOV et al. 2018). The flight level measurements of great black-backed gulls and gannets revealed heights comparable to those determined by Mendel et al. (2015). Black-legged kittiwakes, on the other hand, were mostly observed at an altitude of about 33 m.

Large and small gulls are generally very manoeuverable, and can react to wind turbines with appropriate evasive manoeuvres (GARTHE & HÜPPOP 2004). This was also shown in the study by SKOV et al. (2018), which examined not only the flight altitude but also the immediate, small-scale and large-scale avoidance behaviour of the species under consideration. The investigations using radar and thermal imaging cameras also revealed low nocturnal activity, which means that there is only a low risk of collision for the species in question at night.

The terns listed in Annex I of the V-RL are extremely agile flyers and prefer low flying altitudes (GARTHE & HÜPPOP 2004). Only low collision risks can therefore generally be assumed for these species.

For species susceptible to disturbance, it can be assumed that wind farm areas will be avoided during the operating phase of the wind farms to a species-specific and area-specific extent.

Red-throated divers and black-throated divers show very pronounced avoidance behaviour towards offshore wind farms. Current results from the wind farm projects in the EN5 area show significant mean avoidance distances of at least 10 km (BIOCONSULT SH 2017, BIOCONSULT SH 2018, BIOCONSULT SH 2019, BIOCONSULT SH 2020) and approx. 15 km (IFAÖ 2018) from the wind farm projects in the EN5 area. Effects on the distribution of divers up to a distance of 10 km from the wind farm could be demonstrated for the wind farm projects in the EN4 area (IBL UMWELTPLANUNG et al. 2017a, IBL UMWELTPLANUNG et al. 2018, IBL UMWELTPLANUNG et al. 2019). Effects up to 2 - 4 km were determined for the EN1 to EN3 areas (IFAÖ et al. 2017). In a current study conducted by the FTZ on behalf of the BSH and the BfN, which took into account data from wind farm monitoring in the EEZ as well as research data and data from Natura 2000 monitoring, a statistically significant decrease in the abundance of divers up to 10 km from the periphery of a wind farm was determined for all built-up areas in the EEZ (GARTHE et al. 2018). This was also the result of a study commissioned by the BWO, which used a modified data basis and other statistical analysis methods compared to the FTZ study (BIOCONSULT SH et al. 2020). The DIVER research project used an independent method to determine avoidance effects with the telemetry of divers in the German EEZ, in addition to the usual digital aircraft-based recording of sea birds and resting birds. The telemetric investigations of the DIVER research project also show significant avoidance effects up to a distance class of 10 - 15 km for wind farms in the EN4 and EN5 areas (BURGER et al. 2018). The large-scale digital aerial surveys carried out west of Sylt as part of the HELBIRD research project showed statistically significant avoidance effects up to a distance of 16.5 km from a wind farm, with the biggest increase in diver density was found within 10 km of the wind farm (MENDEL et al. 2019). With all of the above-mentioned parameters, it should be noted that these distances do not represent total avoidance, but partial avoidance with increasing diver densities up to the relevant distances from a wind farm. One thing that all of the studies have in common is the observation that divers avoid the actual wind farm area (footprint).

In order to quantify the loss of habitat, early decisions concerning individual approval procedures were based on a scaring distance of 2 km (defined as complete avoidance of the wind farm area including a 2 km buffer zone) for divers. The assumption of a habitat loss of 2 km was based on data from the monitoring of the Danish wind farm "Horns Rev" (PETERSEN et al. 2006). The current study by GARTHE et al. (2018) shows the distance more than doubling to an average of 5.5 km. This scaring distance, which is also known as calculated total habitat loss, is based on the purely statistical assumption that there are no divers within 5.5 km of an offshore wind farm. The study commissioned by the BWO showed a calculated total habitat loss ('theoretical habitat loss') of 5 km for wind farm projects in the entire study area under consideration and therefore provided a comparable result. In the individual consideration of a northern and a southern sub-area, a calculated total habitat loss of 2 km in the southern sub-area indicated that there were regional differences. However, for wind farm projects in the northern sub-area, which includes the main concentration area, the calculated overall value of 5 km was confirmed (BioConsult SH et al. 2020).

All available results from research and monitoring show unanimously that the avoidance behaviour of divers towards wind farms is much more pronounced than was previously assumed.

For other species such as gannets, razorbills, little gulls and fulmars, findings are available regarding small-scale or partial avoidance behaviour towards wind farms (e.g. Dierschke et al. 2016, Skov et al. 2018, IfAÖ et al. 2017, IBL Umweltplanung et al. 2017a, IBL Umweltplanung et al. 2018).

For the Common Guillemot, which is widespread in the German North Sea, previous findings indicate that reactions to offshore wind farms depend on a number of factors. Dierschke et al. (2016) compiled findings on the behaviour of seabirds from 20 European wind farms. From the studies that were taken into consideration, it was found that Common Guillemots appear to react differently depending on the location of an offshore wind farm. In the wind farms that were examined, complete avoidance of the OWP area, partial avoidance behaviour into adjacent areas or no avoidance behaviour at all was observed (Dierschke et al. 2016), differences that the authors attribute to the availability of food at the respective site. Mendel et al. (2018) add a seasonal aspect to the avoidance behaviour of guillemots. Using digital flight transect studies in the area north of Helgoland, the authors found differences in the avoidance behaviour before and during the breeding season. In spring, for example, a significant reduction in density up to 9 km from the wind farm projects north of Helgoland was observed, while no effect radius was found during the breeding season. Mendel et al. (2018) relate these differences to the reduced action radius and the attachment to the breeding colony on Helgoland during the breeding season. In spring, however, Common Guillemots are independent of a specific action radius and generally have a more westerly oriented distribution (Mendel et al. 2018). In a recent study, Peschko et al. (2020) confirm the breeding season behaviour observed by Mendel et al. (2018) using tagged Guillemots in the same study area. From the monitoring of wind farm projects in the German EEZ, there are currently indications of partial avoidance effects up to 6 km in the EN8 area (IBL et al. 2018). However, these results take into account studies from a complete annual cycle and are not seasonally broken down. Scientific findings on seasonal and site-related avoidance behaviour during the high season of winter and autumn are not currently available.

It is also expected that fish stocks will recover during the operational phase by means of a regular ban on fishing within the wind farms accompanied by a ban on vessels. In addition to the introduction of hard substrate, this could therefore increase the range of fish species present and provide an attractive food supply for foraging seabirds.

If the ROP is not carried out, there would be less spatially coordinated planning of wind farm projects. This would probably increase land use, which in turn could have an effect on disturbance-sensitive species. Furthermore, the ROP is based on planning principles which provide for the spatial and temporal coordination of construction projects in order to be able to reduce temporary factors affecting seabirds and resting birds, such as construction-related additional shipping traffic.

Even if similar factors would basically have an effect on the protection of seabirds and resting birds whether or not the ROP is carried out, the protection of seabirds and resting birds would be more difficult to ensure in the absence of planning principles and their coordinating specifications.

### 3.2.7 Migratory birds

Construction-related: The main effects during the construction phase are light emissions and visual disturbance. These can have different, species-specific scaring and barrier effects on migrating birds. However, lighting for construction equipment can also have the effect of attracting migrating birds and increase the risk of collision.

Installation and operation-related: The potential impact of offshore wind farms during the operational phase may be that they represent a barrier to migrating birds or a risk of collision. Flying around or other disturbances to flight behaviour can lead to higher energy consumption, which can affect the birds' fitness and consequently their survival rate or breeding success. Bird strike events may occur on vertical structures (such as rotors and supporting structures of wind turbines, substations and converter platforms). Poor weather conditions - especially at night and in strong winds - and high levels of migration increase the risk of bird strikes. There are also possible glare or attracting effects caused by the safety lighting of the installations, which can lead to birds becoming disoriented. Furthermore, the manoeuvrability of birds caught in wake currents and air turbulence at the rotors could be impaired. For the factors mentioned above, however, as with the scaring and barrier effects, it must be assumed that sensitivities and risks vary from species to species.

In general, a threat to bird migration does not already exist if there is an abstract danger that individual birds may be harmed when passing through an offshore wind farm. A threat to bird migration only exists if there is sufficient evidence to justify the prediction that the number of potentially affected birds is such that, taking into account their respective population sizes, it can be assumed with sufficient probability that individual or several different populations will be significantly impaired. The biogeographic population of the migratory bird species in question is the reference point for the quantitative assessment.

It has been agreed that according to the current legal situation, individual losses of individuals during bird migration must be accepted. In particular, it must be taken into consideration that bird migration in itself involves many dangers, and subjects populations to a harsh selection process. The mortality rate can be around 60-80% for small birds, while the natural mortality rate is lower for bigger species. Also, different species have different reproduction rates, meaning that the loss of individuals may be of differing importance for each species.

Due to a lack of sufficient knowledge, it has not yet been possible to determine a generally valid acceptance threshold.

For the assessment of a possible collision risk for migratory birds with wind turbines at sea, the relevant height parameters of the turbines are an important key figure. Bandwidths for the height parameters of currently installed or potential turbine types were included the ROP-E in accordance with the latest technical developments in wind energy installations (cf. Chapter 4.2). On the one hand wind farm projects which are already operation are taken into consideration, plus the ones that will go into operation in zones 1 and 2 within the scope of the transitional system and the initial years of commissioning of the central system. Another range of turbines represents systems which could potentially be installed in future wind farm projects in zones 3 to 5. For wind farm projects which have already been realised or future wind farm projects in zones 1 and 2, information or assumptions are available for 5 to 12 MW turbines which have a hub height of 100 to 160 m and, based on rotor diameters of 140 m to 220 m, a total height of

170 m to 270 m. For wind farm projects in zones 3 to 5, assumptions are made for 12 to 20 MW turbines which have a hub height of 160 to 200 m and, based on rotor diameters of 220 m to 300 m, a total height of 270 m to 350 m. This means that the lower rotor-free area from the water surface to the lower blade tip would be between 30 m to 50 m for wind farms in zones 1 and 2 and between 30 m to 50 m for wind farms in zones 3 to 5.

*Elevation profiles obtained from migration plan observations in areas EN1 to EN3 show a strong concentration at elevation areas up to 20 m and therefore below the rotor area of the turbines shown above. Whereas 85% of the birds observed migrated within this height range in spring, this figure was almost three-quarters in autumn (AVITEC RESEARCH 2017). In the EN5 area, the visible daytime migration occurred mainly (92 %) at flight altitudes of below 20 m. Overall, the proportion of flying movements in the potential risk area of the rotors (20 - 200 m) was 8.0 %. In the case of divers, geese and songbirds, more than one third of the individuals were registered in the potential risk area of the rotors (BIOCONSULT SH 2017).*

*Previous investigations of bird migration using vertical radar in the North Sea EEZ have shown that the height distribution depends on the time of day. During the day, bird migration in spring was concentrated in lower altitudes, since more than half of all radar echoes recorded during daylight were at altitudes of up to 300 m. Whereas the number of bird echoes recorded during the day continuously decreased as the altitude increased, a bimodal distribution pattern was observed in the recorded bird movements in darkness. On the one hand, the majority of night flying took place at the lowest altitudes of up to 100 m (35,018 flight movements; 13.2%) and on the other hand the highest altitudes between 900-1,000 m (30,295 flight movements; 11.4%). About one third of the echoes were recorded at altitudes of up to 300 m, above 300 m to 700 m and above 700 m to 1,000 m (AVITEC RESEARCH 2017). However, corresponding to the conditions in the spring, night-time bird migration was also recorded in the autumn with height profiles that deviated from the basic pattern. During the intense bird migration night of 25/26 October, the majority of flying took place at the altitude range above 900 m to 1,000 m, which suggests that bird migration was underestimated during this night and a considerable (but unknown) proportion of migrating birds flew over the area covered by radar measurements. Even during the very intense bird migration night of 09./10.11., there was a relatively strong upwards shift in bird migration. Avitec Research (2017) therefore assumes that its vertical radar system, with its data basis up to 1,000 m altitude, registers at least 2/3 of all bird migration on average. In individual cases, depending on the vertical wind profile, the recorded proportion can be significantly higher during intense bird migration. On the other hand, more than half of all migratory birds will also be missed on nights with an altitude distribution that only slowly decreases or even increases with the altitude. However, this is usually only the case on a small number of nights.*

Migrating birds generally fly higher in good weather than they do in bad weather. The majority of birds also usually start their migration in good weather, and are able to choose their departure conditions so that they are likely to reach their destination in the best possible weather. In the clear weather conditions preferred by birds for their migration, the probability of collision with WTGs is therefore low, as most birds will fly above the range of the rotor blades and the turbines will be clearly visible. On the other hand, unexpected fog and rain, which lead to poor visibility and low flight altitudes, represent a potential risk situation. The coincidence of bad weather conditions and so-called mass migration events is particularly problematic. According to information from various environmental impact studies, mass migration events in which birds of different species fly over the North Sea simultaneously occur about 5 to 10 times per year. An analysis of all existing bird migration studies from the mandatory monitoring of offshore wind farms in the North Sea and Baltic Sea EEZ (observation period 2008 - 2016) confirms that particularly intensive bird migration coincides with extremely bad weather conditions for less than 1% of the migration periods (WELCKER 2019b).

As well as the risk of bird strikes, another risk for migrating birds may be that the presence of wind turbines could divert the migration route and therefore extend it. However, this does not affect bird migration in its entirety, since much of the migration takes place at altitudes that are beyond the influence of wind turbines. Many songbirds migrate at altitudes between 1,000 and 2,000 m. Waders are also known to migrate at very high altitudes (JELLMANN 1989). However, significant numbers migrate at altitudes of <200 m and are therefore within the sphere of influence of wind turbines. Many of the species which migrate at low altitudes belong to the group of waterfowl and seabirds, which are able to land on the water to rest and possibly eat. Any detours will therefore have little impact on species such as these. Migrating land birds that are not capable of landing on water may have problems. It should be kept in mind that migratory birds are capable of impressive non-stop flights, particularly when species that do not land on water are migrating across seas. For example, the non-stop flight performance of many species, including small birds, is more than 1,000 km (TULP et al. 1994). It is therefore unlikely that the additional energy requirement that may be required would jeopardize bird migration if a diversion was necessary in the North Sea EEZ, provided that no continuous barriers are created in the main direction of migration.

If the ROP is not carried out, there would be less geographically coordinated planning of wind farm projects. This would probably increase land consumption. Furthermore, the ROP-E is based on planning principles which provide for geographical and temporal coordination of construction projects.

Although similar factors would basically affect migratory birds regardless of whether the ROP is carried out, the protection of migratory birds would be more difficult to ensure in the absence of planning principles and their coordinating requirements.

### 3.2.8 Bats and bat migration

No reliable information is currently available about possible migration corridors and migration behaviour of bats over the North Sea. In general, the following effects of the use of offshore wind energy can affect bats:

<u>Construction-related</u>: The construction work during the construction of WTGs involves an increased volume of shipping. The lighting of the ships and the construction site can have an attracting effect on bats migrating across the sea. There would then be a risk of collision with the ships and the construction site.

<u>Plant and operation-related:</u> During the operational phase, the lighting of the installations may cause attracting effects that could lead to collisions.

The same effects may occur on bats regardless of whether or not the plan is implemented.

### 3.2.9 Air

The construction and operation of the wind turbines and platforms and the laying of undersea cable systems will increase the amount of shipping traffic. However, there are no measurable effects on air quality. The air to be protected will therefore develop in the same way regardless of whether or not the plan is implemented.

### 3.2.10 Climate

Negative impacts on the climate from offshore wind energy are not expected, since there are no measurable climate-related emissions during construction or operation. The $CO_2$ reductions associated with the development of offshore wind energy (cf. Chapter 1.8) are expected to have positive effects on the climate in the long term.

### 3.2.11 Landscape

The implementation of offshore wind farms has an impact on the landscape, since it is changed by the construction of vertical structures. The plants must also be illuminated at night or in poor visibility conditions for safety reasons. This can also lead to visual impairments of the landscape. The construction of platforms can also lead to visual changes in the landscape. The extent to which the landscape is impaired by offshore installations depends on the respective visibility conditions to a considerable extent, but also on subjective perceptions and the basic attitude of the observer towards offshore wind energy. The vertical structures, which are untypical for the usual picture of a marine landscape, can be perceived as interfering in some cases, but also as technically interesting in others. In any case they change the landscape and modify the character of the area. The actual visibility of the offshore wind farms is determined by the distance thereof from the coast or islands, the size of the wind farm in terms of area, the height of the wind turbines, the visibility range based on the specific weather conditions, the height of the observer's location (e.g. beach, viewing platform, lighthouse) and the performance of the human eye. Due to the considerable distance (more than 30 km) between the WTGs and platforms which are planned and have already been installed and the coast, the turbines will only be visible from land to a very limited extent and only in good visibility conditions. This also applies to night-time safety lighting.

To minimise visibility, a glare-free and low-reflection coating is a standard requirement for the approval of individual projects. It must also be taken into consideration that the platforms are always in close proximity to the offshore wind farms, so that the change in the landscape appearance is only slightly increased by these individual structures in the immediate vicinity of the offshore wind farms.

Overall, the impairment of the landscape by offshore installations from the coast can be classified as quite low.

The development of the landscape if the ROP is not carried out is not expected to differ significantly from the development if the ROP is carried out. However, it should be noted that the required land requirements can be minimized by the provisions of the ROP (and the land development plan). The potential impacts on the landscape as a protected asset can therefore be reduced to a minimum by means of geographically coordinated, anticipatory and coordinated overall planning of the ROP and the FEP. Insufficient geographic coordination in the event of non-implementation of the plan could lead to more fragmented wind farm areas, the use of more land and a slight increase in visibility from the coast.

The undersea cable systems will not have negative impacts on the landscape during the operating phase due to being installed as undersea cables.

### 3.2.12 Cultural and other material assets

The deep foundations of wind turbines result in disturbances to the seabed due to construction, which can affect discovered and undiscovered cultural heritage. The cultural heritage is completely or partially destroyed during excavation or pile-driving, or the context thereof is affected. Extensive secondary impacts on the protected assets of underwater cultural heritage from the construction vehicles can also be expected during construction work.

The foundation can also be expected to obstruct flow and cause long-term formation of scour funnels, especially on fine sandy seabeds, which means that cultural traces that remained undiscovered during the construction work can freely erode.

## 3.3 Lines

Lines within the meaning of the spatial development plan include pipelines and undersea cables. Undersea cables include cross-border power lines and connecting lines for offshore wind farms as well as data cables. So-called undersea wind farm-internal cables are not covered by this definition. Reference is made in this respect to specifications within the scope of the technical planning (FEP).

The North Sea EEZs are crossed by pipelines which only cross the German continental shelf (so-called transit pipelines) and those which also go ashore on the German coast. The Norpipe, Eu-ropipe 1 and Europipe 2 pipelines transport gas from the Norwegian gas fields to Germany. These pipelines go ashore on the coast of Lower Saxony. Since 2009, a gas pipeline between the Danish Ravn oil field and the German production platform A6-A has been added in the Duck's Bill area. No further pipelines are currently planned.

The reserved pipeline areas safeguard routes for existing and future pipelines and undersea cables. Current-carrying cables are the subject of specialist planning.

Nine undersea cable systems are currently in operation in the North Sea EEZ for connecting offshore wind farms. Five more systems are currently under construction.

In the North Sea, grid connection systems are operated with direct and alternating current. The wind turbines produce alternating current, which is collected on the wind farm's own transformer platforms and transformed up to a voltage level of 155 kV. The electricity is then transferred from the transformer platform via an AC cable (alternating current) to the transmission system operator's converter platform. Alternatively, in the future the wind turbines will have a direct connection to the converter platform by means of a 66 kV undersea cable system. The 66 kV direct connection was defined as a standard connection concept in the FEP 2019.

In comparison, the DC transmission technology is more area-efficient due to the significantly higher transmission capacity compared to AC technology, combined with fewer environmental impacts caused by cable laying.

Three transnational power cables, NorNed, Nord.Link and COBRAcable, are currently also operating in the North Sea EEZ. Large numbers of transnational data cables - usually fibre optic cables for telecommunications - cross the German North Sea. There are also a number of cables in the seabed which have been taken out of service and were not removed after being abandoned.

Pipelines have different impacts on the marine environment. Pipelines primarily affect the protected resources of soil, benthos and fish, where the potential effects of introducing hard substrate, turbidity plumes and, for live cables, operational heat emissions and possibly magnetic fields are evaluated.

In order to evaluate the specifications for pipelines, the following possible impacts are examined:

Table 17: Potential impacts of pipelines on the marine environment (t = temporary).

| Nutzung | Wirkung | Potenzielle Auswirkung | Schutzgüter | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fische | See- und Rastvögel | Zugvögel | Meeressäuger | Fledermäuse | Plankton | Biotoptypen | Biologische Vielfalt | Boden | Fläche | Wasser | Luft | Klima | Mensch/ Gesundheit | Kultur- und Sachgüter | Landschaftsbild |
| **Leitungen** Trassen für Seekabel-systeme und Rohrleitungen | Einbringen von Hartsubstrat (Steinschüttung) | Veränderung von Habitaten | x | x | | | | | x | x | | x | | | | | | x | |
| | | Lebensraum- und Flächenverlust | x | x | | | | | | x | | x | x | | | | | x | |
| | Wärmeemissionen (stromführende Kabel) | Beeinträchtigung/ Verdrängung kaltwasserliebender Art | x | | | | | | | | x | x | | | | | | | |
| | Magnetfelder (stromführende Kabel) | Beeinträchtigung | x | | | | | | | | | | | | | | | | |
| | | Beeinträchtigung des Orientierungsverhaltens einzelner wandernder Arten | | x | | | | | | | | | | | | | | | |
| | Trübungsfahnen (Bauphase) | Beeinträchtigung | x t | x t | x t | | | | x t | | | | | x t | | | | | |
| | | Physiologische Effekte und Scheucheffekte | | x t | | | | | | | | | | | | | | | |

### 3.3.1 Floor/ Area

#### *Pipelines*

The formation of a turbidity plume near the seabed and minor changes to the morphology and sedimentary composition are likely during laying in the seabed. The resuspended sediments are transported and deposited by different distances in the vicinity of the pipeline depending on the grain size: The distances are significantly less than those determined for the sedimentation of turbidity plumes during the course of sand and gravel extraction. The concentrations of resuspended particulate material are of a comparable order of magnitude to those found in natural resuspensions of sediments caused by storms.

The formation of undercuts ("freespans") can lead to a change in the sedimentary composition or grain composition. However, this is geographically limited. Depending on the type of sand and the geological structure of the subsoil, these undercuts may stabilise or only be temporary. In the case of sand deficits, the substrate may change, e.g. due to the temporary presence of till, clay or the like on the seabed.

To protect the pipeline from external corrosion, sacrificial anodes made from zinc and aluminium are attached at regular intervals, small quantities of which are dissolved and released into the water column. Because they are very diluted, only trace concentrations thereof are present; these are adsorbed by sinking or resuspended sediment particles in the water, and settle on the seabed.

#### *Undersea cables*

When undersea cables are being laid, changes to the soil morphology and the original sediment structure generally occur in the route area as a result of the cable laying. However the seabed along the affected routes can regenerate because of the natural sediment dynamics in the North Sea.

In addition to the formation of a ground-level turbidity plume, the re-suspension of sediment-bound pollutants and increased pollutant introduction by construction site traffic can occur.

Magnetic effects during the operation of current-carrying cables can be neglected or ruled out because the magnetic fields in alternating current cables (three-wire three-phase cables) and bipolar direct current cables almost cancel each other out. Depending on the duration and strength of the wind speed, energy is lost during the transfer of power to the land-based grid, which leads to heating of the sediment around the cable. In accordance with the state of the art, no oil-insulated cables are used. Lead cannot escape through the insulation.

Operation-related Both direct current and three-phase undersea cable systems heat up the surrounding sediment radially around the cable systems. The heat emission results from the thermal losses of the cable system during power transmission.

These energy losses depend on a number of factors. The following output parameters have a significant influence:

- Transmission technology: Basically, greater heat emission due to thermal losses can be assumed with three-phase submarine cable systems than with direct current submarine cable systems with the same transmission capacity (OSPAR Commission 2010).
- Ambient temperature in the vicinity of the cable systems: Depending on the water depth and the time of year, fluctuation of the natural sediment temperature can be assumed, which influences heat dissipation.
- Thermal resistance of the sediment: Mainly water-saturated sands occur in the EEZ, for whose specific thermal resistance a size range of 0.4 to 0.7 KmW-1 is valid, taking into account various sources (Smolczyk 2001, Bartnikas & Srivastava 1999, VDI 1991, Barnes 1977). According to this, more efficient heat removal can be assumed for water-saturated coarse sands than for finer-grained sands.

The depth at which the cable systems are laid is also decisive for temperature development in the sediment layer close to the surface. According to the current state of knowledge, no significant effects from cable-induced sediment heating can be expected if a sufficient installation depth is maintained and if state-of-the-art cable configurations are used. Various calculations relating to sediment heating caused by the operation of undersea cable systems were presented within the scope of environmental technical papers on the subject of the current-carrying cable systems of offshore wind farms. According to the applicant, the cable-induced sediment heating in the "BorWin 3 and BorWin gamma" project will amount to approx. 1.3 K at a sediment depth of 20 cm for the direct current cables, provided that the cables are jetted in at least 1.50 m deep as specified in the FEP (PRYSMIAN, 2016). Temperature measurements on a wind farm-internal three-phase cable system at the Danish offshore wind farm "Nysted" revealed sediment heating of max. 1.4 K directly above the cable (transmission power of 166 MW) 20 cm below the seabed (MEISSNER et al. 2007). The intensive water movement near the bottom of the North Sea also leads to the rapid removal of local heat.

Taking the above-mentioned results and predictions into consideration, it can be assumed that at a laying depth of at least 1.50 m, compliance with the so-called "2 K criterion"[10] can be assumed, which has established itself as a precautionary value in current official approval practice. In order to ensure compliance with the "2 K criterion", i.e. a maximum temperature increase of 2 degrees at 20 cm below the surface of the sea bed, an appropriate principle for sediment warming has already been included in the BFO-N and continued in the FEP (cf. e.g. planning principles 5.3.2.9, 5.4.2.9, 5.5.2.13 BFO-N and planning principle 4.4.4.8).

This principle defines the compliance with the 2 K criterion in order to reduce potential adverse

[10] "The so-called 2 C criterion represents a precautionary value which, according to the BfN, ensures with sufficient probability on the basis of the current state of knowledge that significant negative impacts of cable heating on nature or the benthic biocoenosis will be avoided. (http://www.stromeffizienz.de/page/fileadmin/offshore/documents/StAOWind_Workshops/Kabel_in_Schutzgebieten/Kabel_in_Schutzgebieten_Vortrag_Merck.pdf)

effects on the marine environment from cable-induced sediment warming as far as possible. If the 2C criterion is adhered to in accordance with the planning principle, as things stand it can be assumed that no significant impacts, such as structural and functional changes, can be expected from cable-induced sediment heating on the seabed as a protected resource. Due to the low proportion of organic material in the sediment, no significant release of pollutants is expected from sediment heating.

The above-mentioned impacts on the soil as a protected resource occur independently of the stipulations of the ROP. If the plan is not implemented, however, geographically less coordinated planning of the pipe systems would have to be expected. This would result in an increased number of line crossings or crossing structures, which would require the introduction of hard substrate.

Since the provisions of the plan are aimed at minimising the use of the seabed/ sensitive areas due to the predominant location outside of sensitive areas and the reduction of pipeline routes, it is likely to be more difficult to ensure soil protection if the plan is not implemented than if the plan is implemented.

### 3.3.2 Benthos and biotope types

With regard to benthos and biotopes, the comments in Chapter 3.2.3 apply analogously. If the plan is not implemented, pipeline planning that is less geographically coordinated would have to be expected. The pipelines mainly run outside sensitive protected areas. An increased number of line crossings or crossing structures would also have to be expected, which would also require the introduction of hard substrate. Here, too, the habitat structures would change on a small scale, which in turn could lead to a shift or change in the species spectrum of the benthos.

Since the provisions of the plan are aimed at minimising the use of the seabed/ sensitive areas due to the predominant location outside sensitive areas and the reduction of pipeline routes, the protection of benthos and biotopes would probably be more difficult to ensure than if the plan were not implemented.

### 3.3.3 Fish

***Pipelines***

The fish population may be temporarily disturbed by **noise and vibration due** to the use of both ships and cranes and due to the installation of pipeline systems (see also Chapter 3.2.4) during the construction phase of pipelines. Construction-related **turbidity plumes** may also occur near the sea bed, and local sediment shifts may take place which may damage fish, especially spawn and larvae. The ecological effects of the turbidity plumes on the fish are described in detail in Section 3.4.3. The effects on fish in areas with sediment redistribution are short-term and geographically limited.

***Undersea cables***

Construction-related impairments of the fish fauna by underwater cables and pipelines are to be expected via **noise emissions and turbidity plumes.** Detailed information is provided in Sections 3.2.4 and 3.4.3.

The rock fills in the vicinity of the planned pipeline crossings are expected to cause a **local change in the fish community.** A change in the fish community can lead to a change in the dominance relationships and the food network. However, these effects are to be regarded as minor due to the small-scale nature of the planned cable crossings.

With regard to the possible operational impacts of underwater cable systems of OWPs, such as **sediment heating and electromagnetic fields,** no significant effects on the fish population are expected either. Experience shows that sediment heating in the immediate vicinity of the cables will not exceed the precautionary value of 2K at a sediment depth of 20 cm. Direct electric fields do not occur with the planned type of cable due to the shielding. Induced magnetic fields of the individual conductors largely cancel each other out in the planned bundled installation with one outgoing conductor and one return conductor, and are significantly less than the strength of the Earth's natural magnetic field. According to the TdV, the magnetic field generated during operation of the Ostwind 2 cable system amounts to a maximum of 20 µT at the surface of the sea bed. In comparison, the natural geomagnetic field of the earth is 30 to 60 µT depending on the location. The field strength decreases rapidly as the distance from the cable increases. Particularly diadromous species such as salmon and European eel could react sensitively to electromagnetic fields. However, various studies on the effects of electromagnetic fields on the European eel did not show clear results. In the Danish wind farm "Nysted" no behavioural changes of the eel could be recorded (BIO/CONSULT AS 2004). However, both WESTERBERG AND LAGENFELT (2008) and GILL AND BARTLETT (2010) recorded short-term changes in their swimming activity. Overall, the expected moderate and small-scale changes in the magnetic field in the area of the cable make it unlikely that the migratory movements of marine fish will be blocked. However, magnetosensitive fish species could avoid the immediate vicinity of the cable.

In the case of the three-wire three-current cables and bipolar direct current cables provided for in the German EEZ, magnetic effects during operation can be neglected or excluded, since the magnetic fields almost cancel each other out. No significant effects on sensitive fish species are therefore to be expected.

### 3.3.4 Marine mammals

**Pipelines**

The laying, operation, maintenance and dismantling of pipelines in the sea can have an impact on marine mammals. The following should be mentioned: shipping traffic, noise emissions, sediment plumes and pollution. Effects on marine mammals can be ruled out with reasonable certainty during normal operation. During maintenance work, increased shipping traffic with noise emissions and pollution is possible.

*Construction-related:* During the laying of pipelines, temporary noise interference and sediment cloudiness plumes occur. The intensity and duration of the sound emissions mainly depend on the laying method. On the whole, however, disturbances for marine mammals caused by pipe-laying operations are small-scale, local and short-lived.

The effects due to changes in sediment structure and damage to benthos during laying are negligible for marine mammals in any case. These changes take place on a small scale along the pipeline. Effects caused by long-term changes to the sediment structure and benthos are insignificant for marine mammals, since they mainly search for their prey organisms in the water column in widespread areas.

Direct disturbance of marine mammals at individual level can occur during the laying and dismantling of pipelines. Effects from shipping traffic and particularly noise emissions during laying work are only expected to be regional and temporary. The formation of sediment plumes is largely expected to be local and temporary. Habitat loss for marine mammals at individual level could therefore only occur locally and for a limited period of time.

*Operational:* The pipelines laid on the seabed can have attracting effects on marine mammals, triggered by increased fish populations in the vicinity of the pipelines (these can in turn be attracted by the colonisation of benthic organisms on the pipelines).

During normal operation, pipelines do not have a significant impact on marine mammals. In the event of damage to the pipeline or inspection and maintenance work being carried out, regional and temporary disruptions due to shipping traffic with noise emissions and pollutant leakage are possible.

The effects of sediment and benthic changes are insignificant for marine mammals, since they mainly search for their prey organisms in the water column in widespread areas. If the benthic species spectrum were to change along pipelines laid on the sea floor, the change would possibly attract more fish. Increased fish occurrence could in turn attract marine mammals.

During normal operation, the effects on the population level are not known. Due to the narrow, linear shape of pipelines, negative effects on the population level can be excluded with certainty.

The non-implementation of the plan would not affect the existing or described effects of pipelines on harbour porpoises, harbour seals and grey seals.

***Underwater cables***

Potential impacts during the laying and, in some cases, the dismantling of underwater cables for marine mammals are: shipping traffic, noise emissions and turbidity plumes. The potential operational effects on marine mammals from the generation of electric and magnetic fields in the immediate vicinity of underwater cables depend on the type of cable.

*Construction-related*: The laying of cables causes temporary noise emissions that may cause disturbance to marine mammals. The duration and intensity of the sound emissions vary depending on the installation method. However, the effects of noise emissions during installation are local and temporary. The intensity of the effects may vary between medium and high, depending on the method of installation. This also applies to effects due to the formation of turbidity plumes. Changes to sediment structure and associated temporary changes in benthos have no effect on marine mammals, since they search for their prey in widespread areas in the water column.

*Operational:* During operation, power cables can lead to heating of the surrounding sediments. However, this has no direct effect on highly mobile animals such as marine mammals.

On the whole, no significant effects are expected on marine mammals from cables used to dissipate energy or by bundling cables in a shared cable route, either at individual or population level.

The non-implementation of the plan would not affect the existing or described effects of undersea cables on harbour porpoises, seals and grey seals.

### 3.3.5 Seabirds and resting birds

***Pipelines***

Construction-related*:* When pipelines are laid, cloudy sediment plumes and local sediment and benthic changes occur temporarily. During the laying work, construction-related shipping traffic can lead to visual disturbance and can trigger scaring or avoidance reactions in the case of species that are sensitive to disturbance.

Potential construction-related effects are only temporary and local for the duration and the immediate proximity of the relocation.

Operational: The effects of sediment and benthic changes are of little importance for seabirds and resting birds, since they mainly search for their prey organisms in the water column in widespread areas. If the benthic species spectrum changes along pipelines laid on the seabed, the change would possibly attract more fish. Increased fish occurrence could in turn also attract seabirds. During the operational phase, maintenance-related shipping traffic can lead to visual disturbance and trigger temporary scaring or avoidance reactions in the case of species that are sensitive to disturbance.

***Submarine cable***

Construction-related*:* During the laying of submarine cables, cloudy sediment plumes and local sediment and benthic changes occur temporarily. During the laying work, construction-related shipping traffic can lead to visual disturbance and trigger scaring or avoidance reactions in the case of species that are sensitive to disturbance.

Potential construction-related effects are only temporary and local for the duration and the immediate proximity of the laying.

Operational: Effects due to sediment and benthic changes are of little importance for seabirds and resting birds, since they mainly search for their prey organisms in the water column in widespread areas. During the operational phase, maintenance-related shipping traffic can cause visual disturbance and trigger temporary scaring or avoidance reactions in the case of species that are sensitive to disturbance.

***Non-implementation of the plan***

Non-implementation of the plan would result in less geographically coordinated planning of lines and border corridors. The ROP is based on planning principles which provide for the geographical and temporal coordination of construction projects in order to minimise impacts on, among other things, the marine environment and therefore also sea birds and resting birds.

Even if similar factors would basically have an effect on the protection of sea birds and resting birds during the implementation and the non-implementation of the ROP, the protection of the marine environment and therefore of sea birds and resting birds would be more difficult to ensure in the absence of planning principles and their coordinating requirements.

### 3.3.6 Migratory birds

***Pipelines***

The potential effects of pipelines on migratory birds are mainly limited to the construction phase. Illuminated construction vehicles can cause attracting effects, which can lead to collisions.

***Underwater cables***

The potential effects of pipelines on migratory birds are mainly limited to the construction phase. Illuminated construction vehicles can cause attracting effects, which can lead to collisions.

The potential impact on bats is independent of the non-implementation or implementation of the plan.

### 3.3.7 Bats and migrating bats

The potential effects of pipelines on bats are mainly limited to the construction phase. Illuminated construction vehicles can cause attracting effects, which can lead to collisions.

The potential impact on bats is independent of the non-implementation or implementation of the plan.

### 3.3.8 Air

***Pipelines***

The laying, maintenance and dismantling of pipelines involves shipping traffic. This in turn leads to pollutant emissions which can affect air quality.

No significant adverse effects on air quality are expected.

***Underwater cables***

The laying, maintenance and dismantling of underwater cables involves shipping traffic. This in turn leads to pollutant emissions which can affect air quality. Significant adverse effects on air quality are not expected.

### 3.3.9 Cultural and other material assets

Construction-related effects of pipelines and underwater cables on the underwater cultural heritage depend on the installation methods used. Both flushing and dredging operations can lead to the destruction of underwater cultural heritage on the seabed. As well as the direct effects of the installation methods that are used, indirect effects such as those caused by anchoring work or propeller wash must also be taken into consideration.

In the case of pipelines that are laid directly on the seabed and sink into the sediment over time, the direct impact can be regarded as low. Installation and operational impacts are not to be expected.

## 3.4 Raw material extraction

Raw materials are extracted from the sea for both commercial purposes and also for coastal protection (particularly stone, gravel and sand extraction). Large areas have also already been covered by hydrocarbon exploration licenses, particularly in the North Sea. In the German EEZ, these are mainly natural gas deposits. The importance thereof is particularly evident as far as the North Sea is concerned, where production at sea clearly exceeds that on land.

The Federal Mining Act (BBergG) is the federal law for regulating mining law issues and includes, among other things, the exploration and extraction of raw materials. The purpose of the raw materials safeguarding clause in Section 48 (1) sentence 2 BBergG is to apply non-mining regulations from other competent authorities in such a way that the exploration and extraction of raw materials is impaired as little as possible. Furthermore, §§ 48 ff. 48 et seq. of the BBergG also contains provisions for in favour of shipping, fisheries, the laying and operation of cables and pipelines and the marine environment which must be observed when exploring for or approving operating plans for operating in the area of the continental shelf.

According to § 7 BBergG, permits grant the authorised permit holder the exclusive right to search for mineral resources in a specific field. Pursuant to § 8 BBergG, permits particularly grant the exclusive right to extract a raw material. The refusal of a permit or authorisation is based on the existence of the reasons stated in § 11 or § 12 BBergG.

During implementation, the extraction of raw materials is regularly divided into different phases – the exploration, development, operation and aftercare phases.

Exploration serves the purpose of searching for raw material deposits in accordance with § 4 para. 1 BBergG. In the marine area it is regularly carried out by means of geophysical surveys, including seismic surveys and exploration drilling. In the EEZ, the extraction of raw materials includes the extraction (loosening, release), processing, storage and transport of raw materials.

In accordance with the Federal Mining Act, mining permits (permission, licence) must be obtained for exploration in the area of the continental shelf. These grant the right to explore for and/or extract mineral resources in a specified field for a specified period. Additional permits in the form of operating plans are required for development (extraction and exploration activities) (cf. Section 51 BBergG). For the establishment and management of an operation, main operating plans must be drawn up for a period not normally exceeding 2 years, which must be continuously updated as required (Section 52 (1) sentence 1 BBergG).

In the case of mining projects requiring an EIA Act, the preparation of a general operating plan is mandatory, and a planning approval procedure must be carried out for its approval (§ 52 (2a) BBergG). Framework operation plans are usually valid for a period of 10 to 30 years.

Pursuant to § 57c BBergG in conjunction with the Ordinance on the Environmental Impact Assessment of Mining Projects (UVP-V Bergbau), the construction and operation of production platforms for the extraction of oil and gas in the area of the continental shelf require an EIA. The same applies to marine sand and gravel extraction on mining areas of more than 25 ha or in a designated nature reserve or Natura 2000 area.

In the planning period from 2004 to 2009, mining permits for sand and gravel extraction in the Sylt outer reef area were available for the North Sea as follows:

| | | |
|---|---|---|
| Authorisation field | Weisse Bank | until 2039 |
| Authorisation field | BSK 1 | until 2033 |
| Authorisation field | OAM III | until 2051 |

In these areas, between 0.8 and 2.4 million tonnes of sand and gravel were mined each year from 1997 to 2006 using valid framework operating plans.

Hydrocarbon exploration licences have been granted (NE3-0001-01, until the end of May 2020; B 20 008/71, until the end of May 2021) in the south-western EEZ and in the western EEZ (NE3-0002-01, until the end of December 2021).

For the extraction of natural gas in the "Duck's Bill" at the border with the Danish EEZ, a German North Sea A6/B4 permit (until 2028) is available. At the time of planning, a production platform was in operation there which ceased production in the second half of 2020.

**Development of raw material extraction**

During the period from 2009 to 2019, no new permit or authorisation fields for sand and gravel extraction or hydrocarbons have been authorised in the German North Sea EEZ.

For the German EEZ in the North Sea, a decrease in the area of hydrocarbon permit areas has been observed since the adoption of the 2009 spatial development plans.

All the fields of approval for hydrocarbons in the Duck's Bill have expired, with the exception of the German North Sea A6/B4 permit with the A6-A production platform. The permit for mining in the Weisse Bank field has expired (ruling of the Schleswig Higher Administrative Court, legally effective since 12 February 2019). Since 2009 there has been no general operating plan for the BSK1 field.

The following table shows the effects of raw material extraction and potential impacts on the protected assets.

Table 18: Effects and potential impacts of raw material extraction

| Use | Effect | Potential impact | Protected assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Seabirds and resting birds | Migratory birds | Marine Mammals | Bats | Plankton | Biotopes | Biological diversity | Floor | Area | Water | Air | Climate | Human/ Health | Cultural and material assets | Landscape |
| **Raw materials** Sand and gravel mining/ Seismic investigations | Removal of substrates | Habitat change | x | x | | | | | | x | x | x | | | | | | x | |
| | | Loss of habitat and land | x | x | | | | | | x | x | x | x | | | | | x | |
| | Turbidity flags | Impairment | x t | | | | | | | | | | | | | | | | |
| | | Physiological effects and scaring effects | | x t | | | | | | | | | | | | | | | |
| | Physical disturbance | Impact on the seabed | x | | | | | | | x | | x | x | | | | | | |
| | Underwater sound during seismic surveys | Impairment scaring effect | | x t | | | x t | | | | | | | | | | | | |

Potential temporary effects result from underwater noise during seismic investigations and turbidity plumes during raw material extraction, and can lead to impairments and scaring effects. Potential permanent effects due to substrate extraction and physical disturbance result in habitat and area loss, habitat changes and seabed extraction.

### 3.4.1 Seabed/ Area

***Sand and gravel extraction***

In the North Sea EEZ, the extraction of gravel and sand is carried out over a large area with a suction trailer hopper dredger. For technical and navigational reasons, a suction trailer hopper dredger with a towing head which is usually 2 m wide passes over the extraction field several times until the maximum permissible extraction depth of 2 m is reached with an additional dredging tolerance of approx. half a metre. As a rule, approximately 2 to 4 m wide furrows with a maximum depth of 2.6 m are created, between which unaffected seabed remains. A residual thickness of the pumpable sediment must be maintained in order to preserve the original substrate for repopulation.

Stone fields are excluded from extraction at a distance of 500 m. In case of selective sediment extraction, the gravel sands are sieved on board and the unused fraction (sand or gravel) is returned to the site.

During these sediment dredging operations, the seabed as a protected resource is affected in many ways:

- Substrate removal and change of seabed topography
- Change in hydrographic conditions
- formation of turbidity plumes & sedimentation of suspended material
- Remobilisation of pollutants

*Substrate removal and alteration as well as alteration of the seabed topography:* Due to the mining technique described above, the seabed is not evenly deepened by 2.6 m over the entire area, but a relief consisting of multiple crossing furrows and original seabed is created. This topographical and morphological change is accompanied by an influence on the seabed current pattern. Basically, extensive extraction is intended to ensure that the original substrate is retained, provided that the sands, gravel sands and gravel that are suitable for extraction are of a sufficient thickness. Selective extraction ("screening") results in a change to the substrate; depending on the returned fraction, the original sediment type is refined or coarsened. Whereas the gravel fraction is locally stable and does not undergo any significant rearrangement, the returned sand is mobilised by the natural sediment dynamics. Due to the changed topography, this results in a trapping effect of the furrows in which relocated, generally finer-grained sand accumulates and permanently alters the substrate (BOYD et al., 2004; ZEILER et al., 2004).

*Formation of turbidity plumes and sedimentation of suspended material*: Turbidity plumes occur at several points in the extraction process (HERRMANN and KRAUSE, 2000):

- Due to the mechanical disturbance of the sediment in the seabed by the dredger head
- The overflow water flowing back into the sea from the dredger
- The dumping of unwanted sediment fractions (screening).

The concentration of suspended material normally decreases very rapidly as the distance increases (HERRMANN AND KRAUSE, 2000). However, increased turbidity is observed up to a distance of few hundred metres from the excavator, and in some cases can even be detected several kilometres away. The extent of the turbidity plume depends on the grain size and quantity of the returned material as well as the flow and its directional stability. Depending on the grain size and water depth, sorting of the returned grain mixture takes place: the coarse particles are deposited first, most of which are covered by the finer particles. During the further course of the process, progressive sorting takes place as the finer sands are increasingly rearranged by the natural sediment dynamics; the coarser proportion of the sand remains in the vicinity of the return line and undergoes less rearrangement (ZEILER et al. 2004, DIESING, 2003).

*Remobilisation of pollutants:* The resuspension of sediment particles can lead to the release of chemical compounds such as nutrients and heavy metals. This potential pollutant introduction is negligible, since commercially used sands and gravels generally have a low content of organic and clayey components and therefore hardly any chemical interaction with the water column. The extraction activities are also temporally and geographically limited. At present, sand and gravel extraction takes place exclusively in extraction area OAMIII over a currently applied for extraction area of 17.5 km² (actual area requirement 5.3 km²). With regard to the biotope of the species-rich gravel, coarse sand and sediment beds occurring in this area, monitoring has shown that the mining activities have not led to any fundamental change to the sediment structure or composition in the extraction area so far. The original substrate in the area has been preserved, and the results show that this protected biotope is present in the same position within the extraction area (IFAÖ 2019). In the collateral clauses of the main operating plan OAM III (2019-2023), it was stipulated that the reef types "Steinfeld/Blockfeld North

Sea" and "Marine erratic blocks" (radius 75 m) must be excluded from extraction and impairment by screening (reef types according to the Reef Mapping Instructions BFN, 2018).

If this practice is adhered to, the current state of knowledge indicates that, given a constant level of extraction activity, no destruction or significant impairment of the species-rich gravel, coarse sand and sediment soils biotope in the marine area is to be expected. In order to ensure this even in the event of an increase in mining intensity and before the approval of a subsequent main operating plan, the following must be demonstrated within the framework of appropriate monitoring:

- There are still a sufficient number of intact areas between the excavation tracks, so that the potential for re-colonisation with typical species-rich gravel, coarse sand and sediments is still demonstrably present,
- The maximum permitted extraction depth is demonstrably not exceeded
- The original substrate, in this case coarse sand and gravel for species-rich gravel, coarse sand and sediments, is demonstrably retained

Since the occurrence of KGS soils in the SAR area is very variable on a small scale (see Figure 15 b) verification using hydroacoustic methods within the scope of monitoring appears to be meaningful in order to obtain a detailed picture of the potential changes.

**Extraction of hydrocarbons**

In the German EEZ, the "A6-A" production platform for the production of natural gas has been in operation since September 2000. The platform is located at a water depth of 48 m. It is a six-legged, lattice-shaped steel construction with pile foundations (jacket construction).

According to the planning approval decision of the Clausthal-Zellerfeld Upper Mining Authority (now: LBEG - State Office for Mining, Energy and Geology) for the construction and operation of the A6-A drilling and production platform[11], the following effects on the seabed protected resource are to be expected

*Construction-related:* Effects can occur due to load-induced compaction and material changes in the sediments during the . During the introduction of cuttings/drilling fluid, temporary turbidity can occur.

*System-related*: Effects may occur in the form of foundation-related compaction of the seabed, pollution caused by coatings and changes to the flow conditions via the platform.

*Operational*: Corrosion coatings, sheathing materials and sacrificial anodes used for corrosion protection may release harmful substances. The discharge of production water and waste water from the sewage treatment plant can have effects on the water and sediment.

As a result of the extraction of natural gas deposits, long-term seabed subsidence of the order of several metres can also be expected, which has been described or predicted for Norwegian and Dutch oil and gas fields (FLUIT AND HULSCHER, 2002; MES, 1990; SULAK AND DANIELSEN, 1989).

As well as the current production in the KWN1 area, there are also the permit fields NE3-0002-01 at the border to the Dutch EEZ and fields NE3-0001-01 and B 20 008/71 north of the Borkum Reef Ground. Within the licence fields, new licences for gas production are expected to be issued in the future. By defining the KWN2-5 reserved areas, areas for the construction of an infrastructure associated with the production area specified within the large-scale approval fields. This will allow, for example, better spatial

[11] Plan-approval decision of the Oberbergamt for the Land of Schleswig-Holstein in Clausthal-Zellerfeld on the approval of the general operating plan for the construction and operation of a drilling and production platform in blocks A6/B4 in the German North Sea of 22 March 1999 - 21 - 23/98 VI- W 60004 Bh. 29 - III - -

control of the locations of production platforms. Impacts on the seabed protected resource - as described above for the example of the A6-A production platform - can therefore be controlled and minimised.

The current sand, gravel and hydrocarbon extraction in the German North Sea is already technically secured by the competent authority. The effects described above would therefore still exist even if the plan were not implemented. However, the establishment of reserved areas will result in a greater geographical concentration of the use of raw material extraction and will be given greater importance in regional planning considerations in the future. The seabed protected resource is therefore more likely to be affected in the reserved areas if the plan is implemented than if it is not.

### 3.4.2 Benthos and biotope types

The following comments are limited to the effects of the uses on benthic communities. Since biotopes are the habitats of a regularly recurring community of species, impairments to biotopes have direct impacts on the biotic communities.

**Sand and gravel extraction**

A number of physical and chemical effects of sediment dredging (HERMANN and KRAUSE, 2000) are possible, which are also relevant for the marine benthos:

(a) Substrate removal and changes to soil topography. The most serious ecological impact of sand and gravel extraction is the reduction of the infauna or epifauna. The aspects of settlement density and biomass of benthic organisms are normally more seriously affected than of the number of species. In Dutch studies by MOORSEL AND WAARDENBURG (1990, 1991, at ICES WGEXT 1998), immediately after extraction, settlement density was reduced by 70% and biomass by 80%, whereas species numbers were reduced by only 30%. Depending on the intensity and duration of the change in environmental conditions and sediment character, and the geographical distance for immigrant species, the regeneration of benthic fauna can take periods of between one month and 15 years or more (HERRMANN and KRAUSE, 2000). Repopulation depends not only on physical factors such as water depth, currents and swell as well as sedimentological parameters, but also on the species composition. It is particularly important that the sediment character has not been changed by dredging. In general, the repopulation process can be divided into three phases (HERRMANN and KRAUSE, 2000):

- *Phase I*: Rapid re-colonisation by species that were dominant even before extraction (predominantly opportunistic species); species and individual numbers increase rapidly and may sometimes reach the initial level after a short time; however, the biomass remains low
- *Phase II*: The biomass remains significantly reduced over a longer period (several months to years). This may be due to the loss of older vintages of long-lived species (e.g. bivalve molluscs such as *Mya arenaria, Cerastoderma* spp. and *Macoma balthica*) or to the fact that repopulation is hindered by the continued relocation of sediments disturbed by extraction.
- *Phase III*: The biomass increases significantly, and the cenoses regenerate completely.

  Very long-lasting changes in benthic communities are observed in mining areas where another sediment remains after dredging. The result is a permanent change in soil fauna, often towards soft soil communities (HYGUM, 1993, currently in HERRMANN and KRAUSE, 2000). In certain cases, there may also be a permanent change from soft bottom to hard bottom with a corresponding change in fauna (HERRMANN and KRAUSE, 2000). According to ICES (2016), the repopulation process is supported if the post-extraction substrate has comparable properties to the pre-extraction substrate.

Based on the benthic-ecological monitoring in 2010, 2013 and 2018 of the "OAM III" gravel-sand storage area in the vicinity of the "Sylt Outer Reef - Eastern German Bight" nature reserve (IFAÖ 2019), it was shown that if the previous extraction intensities within the extraction area are maintained, the original biotopes and particularly species-rich gravel, coarse sand and sediment beds will continue to occur in the same location. At present, there is no evidence that the previous extraction activities have led to a fundamental change in the sediment structure or composition in the extraction area. There are no statistically significant differences to the abundance and species composition of macrozoobenthos in the extraction and reference areas. As expected, only the total biomass in the extraction area is statistically significantly lower than in the reference area (IFAÖ 2019). On the whole, the investigations show that the original substrate has been preserved in the area and that regeneration capacity exists, particularly for species-rich gravel, coarse sand and sediments. A change to the geographical expansion of the species-rich gravel, coarse sand and sediments due to previous mining activities is not to be expected, since there has been no loss of coarse sand areas and character species. The temporary losses of benthos in the extraction area will be compensated for within a relatively short period of time as a result of re-colonisation of the area with a comparable species community, so that no permanent impairment of the extraction areas will be caused (IFAÖ 2019).

In the incidental provisions of the main operating plan OAM III of 3 December 2019, it was also stipulated that a "Steinfeld/Blockfeld North Sea" defined by the Federal Agency for Nature Conservation (BfN, 2018) in accordance with the Reef Mapping Instructions (BfN, 2018) is excluded from extraction and that "marine boulders" within a radius of 75 m are not affected. It was also determined that sufficient areas that have not yet been excavated remain between the excavation tracks so that the potential for recolonisation with typical species-rich gravel, coarse sand and sediments continues to exist and the original substrate is preserved. Appropriate measures must also be taken for future main operating plans in the SKN1 and SKN2 areas.

(b) changes to hydrographic conditions. Changes to soil topography can cause changes to hydrographic conditions and therefore also to water exchange and sediment transport. As a result of bathymetry changes, a local decrease in flow velocity may occur, leading to the deposition of fine sediments and local oxygen deficiency phenomena (NORDEN ANDERSEN et al., 1992). This may have consequences for seabed fauna. According to GOSSELCK et al. (1996), no effects on large-scale flow conditions are to be expected from sand and gravel mining, but small and mesoscale changes must be taken into consideration.

(c) turbidity plumes. *Turbidity* plumes can essentially occur at three points in the extraction process (HERRMANN and KRAUSE, 2000):

- Due to mechanical disturbance of the sediment in the seabed by the dredger head
- The overflow water flowing back into the sea from the dredger
- The dumping of unwanted sediment fractions (screening).

Although increased turbidity can be observed up to a few hundred metres away from the excavator, and in some cases even several kilometres away, the concentration of suspended material usually decreases very quickly with distance (HERRMANN AND KRAUSE, 2000). A short-term occurrence of increased concentrations of suspended material does not appear to be harmful to adult bivalve molluscs. The growth of filtering bivalve molluscs can even be encouraged. However, the eggs and larvae of a species generally react more sensitively than the adults.

Although the concentration of suspended particles can reach levels that are harmful to certain organisms, the impact on marine organisms must be regarded as relatively low, since such concentrations are limited in terms of duration and geography, and are rapidly reduced again by dilution and distribution effects (HERRMANN and KRAUSE, 2000).

(d) Remobilisation of chemical substances. The resuspension of sediment particles can lead to the release of chemical compounds such as nutrients and heavy metals. The oxygen content may decrease when organic substances are brought into solution (HERRMANN and KRAUSE, 2000).

According to measurements during dredging in the Belt Sea, the concentration of inorganic nitrogen and phosphorus in the overflow water can be 3 to 100 times higher (HYGUM, 1993). With regard to nutrient levels, increases have been measured up to a distance of 180 m behind the dredger, with the highest concentrations recorded within the first 50 m (HERRMANN and KRAUSE, 2000). An increase in heavy metal concentrations (manganese and copper) was detected up to a distance of 12 m.

The chemical effects are generally considered to be relatively low, as the commercially used sands and gravels generally have a low content of organic and clayey components and therefore show little chemical interaction with the water column. Furthermore, the mining activities are temporally and geographically limited. Waves and currents also cause rapid dilution of any increases in the concentration of nutrients and pollutants that may occur (ICES, 1992; ICES WGEXT, 1998).

(e) sedimentation and sanding: The dispersion of sediment particles depends to a large extent on the fine particle content and the hydrographic situation (particularly swell, currents) (HERRMANN and KRAUSE, 2000). Drifting of suspended particles has been demonstrated up to 1,000 m from the dredging site in some cases. Most of the material, however, sediments at the extraction site or in the immediate vicinity thereof. Furthermore, studies by KENNY and REES (1996) showed that sediments that have been disturbed by dredging can remain more easily mobile for longer periods of time due to tides and waves. An extraction-induced increase in sediment mobility such as this can also lead to sedimentation phenomena and impair the development of benthic organisms.

The practice of "screening" (dumping of unwanted sediment fractions) can also lead to a change in the soil substrate towards mobile sandy areas. The effects of sediment fallout from the overflow of ships on the benthic communities of areas not directly affected by dredging can vary greatly. The following possibilities have been observed in previous studies (ICES 1992):

- Initially, as in the dredging area, almost complete death of the benthic fauna, but subsequent re-colonisation is faster.
- The benthic fauna is damaged, but less severely than in the extraction area, and subsequent repopulation is faster.
- The biodiversity and abundance are enhanced in the sedimentation area.
- The impact is insignificant.

The main risk of sedimentation is the burial of sessile benthic organisms such as bivalves and polychaetes. Crustaceans such as lobsters can also lose their habitat if the caves and crevices they inhabit are buried. Edible crabs, which are immobile during reproduction, are also at risk of burial and suffocation (ICES, 1992).

In summary, the main effects of sand and gravel extraction on marine benthos are as follows:

<u>Direct effects:</u>

- Temporary (short-term for opportunistic species; medium-term for long-lived species), regional (small-scale) loss of individuals of the benthic infauna and epifauna due to substrate removal.
- Temporary (short-term), regional (small-scale) damage to individuals, eggs and larvae of benthic organisms due to turbidity plumes.
- Temporary (short-term) and regional (small-scale) impairment of benthic organisms due to the remobilisation of chemical substances.
- Temporary (short-term) and regional (small-scale) impairments of development, possibly also loss of individuals of benthic organisms due to sedimentation and overlying sand.

Indirect effects:

- Temporary (short-term) and regional (small-scale) habitat loss for benthic organisms due to substrate removal if the sediment character is not changed by dredging.
- Permanent and regional (local) habitat loss due to possible changes in hydrographic conditions.
- Temporary (short-term) and regional (small-scale) impact on the food supply for benthic organisms by impairing primary production (phyto- and zooplankton) due to the remobilisation of chemical substances.

**Extraction of hydrocarbons**

The conceivable impairments to benthic communities by offshore platforms for the production of natural gas can be divided into three areas. These include the construction- and plant-related and the operation-related effects.

The majority of construction and plant-related effects can be found in Chapter 3.2.3 on offshore wind energy.

By way of a summary, the main impacts of natural gas production on marine benthos are as follows:

Direct effects:

- Small-scale and short-term habitat loss for the duration of the installation of the foundations due to sediment turbulence and turbidity plumes.
- Short-term and small-scale damage to individuals, eggs and larvae of benthic organisms due to turbidity plumes
- Short-term and small-scale impairment of benthic organisms due to possible remobilisation of chemical substances.
- Small-scale and permanent habitat lost due to the pillars of the platform because of land use.

- Small-scale and permanent supply of artificial hard substrate due to the construction of the platform.
- Small-scale and permanent changes to sediment parameters due to the design of the platform.

Indirect effects:

Short-term and small-scale impact on the food supply for benthic organisms by impairing primary production (phyto- and zooplankton) due to possible remobilisation of chemical substances.

### 3.4.3 Fish

**Sand and gravel extraction**

The extraction of sand and gravel in the North Sea can change habitats and mean a loss of habitat for the fish population. Substrate extraction also leads to turbidity plumes with consequent sedimentation and resuspension of sediment particles, which can affect the fish population.

During the removal of substrates, the fish are usually scared away from their habitat. A **loss of area** depends on the geological condition of the removed material. A change to the sediment type after removal can make it difficult for some species to recolonise. Fish are significantly affected by the effects of sand and gravel extraction, especially when the extraction areas overlap with the spawning grounds, which is only the case for a few species in the North Sea EEZ, such as the sand eel (HERRMANN & Krause 2000). Sand eels burrow into sediments and lay their eggs there. As a main food source for harbour porpoises, grey seals and various species of sea birds, habitat loss for sand eels through the food web could also affect other protected species. Connections between the abundance of sand eels and the breeding success of birds have been demonstrated for kittiwakes, for example (MACDONALD et al. 2019). Fish themselves are also indirectly affected by the loss of food resources, since the extraction of sand and gravel is accompanied by a reduction in the invertebrate infauna and epifauna in the area.

Sand and gravel extraction also causes **sediment upheavals and turbidity plumes**, which - although temporary and species-specific - can cause physiological impairments and scaring. Predators such as mackerel and horse mackerel hunting in open water avoid areas with high sediment loads and thus avoid the danger of agglutination of the gill apparatus (EHRICH & STRANSKY 1999). A threat to these species as a result of sediment upheavals does not appear likely due to their high mobility. Neither is any impairment of bottom-dwelling fish to be expected due to their good swimming properties and the associated evasion possibilities. In the case of plaice and sole, even increased foraging activity was observed after storm-induced sediment disturbance (EHRICH et al. 1998). In principle, however, fish are able to avoid disturbances due to their pronounced sensory abilities (lateral line organ) and their high mobility, so that impairments are unlikely for adult fish. Eggs and larvae whose reception, processing and implementation of sensory stimuli are not yet or only slightly developed are generally more sensitive than adults of the same species. After fertilisation, fish eggs form a dermis which makes them robust against mechanical stimuli, e.g. sediments that have been churned up. Although the concentration of suspended particles can reach levels that are harmful to certain organisms, the effects on fish must be regarded as relatively low, since concentrations such as these are temporally and geographically limited, and are quickly reduced again by dilution and distribution effects (HERRMANN & KRAUSE 2000).

This also applies to possible increases in concentrations of nutrients and pollutants due to the **resuspension** of sediment particles (ICES 1992; ICES WGEXT 1998). The resuspension of sediment particles can lead to the release of chemical compounds such as nutrients and

heavy metals. The oxygen content may decrease when organic substances are brought into solution (HERRMANN & Krause 2000). The chemical impact is generally considered to be relatively low for the North Sea, since the commercially used sands and gravels generally have a low content of organic and clayey components and therefore have little chemical interaction with the water column.
With regard to the **sedimentation of** the released substrate, the main risk is covering fish spawn deposited on the seabed. This can result in a lack of oxygen supply to the eggs and, depending on the efficiency and duration of the sedimentation process, can lead to damage or even death of the spawn. For most fish species present in the EEZ, no damage to the spawning stock is expected, since they either have pelagic eggs and/or their spawning grounds are in shallow water outside the EEZ. The early life stages may also be adapted to turbulence, which regularly occurs in the North Sea due to natural phenomena such as storms or currents.

### 3.4.4 Marine mammals

***Sand and gravel extraction***

Sand and gravel extraction can cause sediment plumes as well as sedimentary changes and the associated damage to or alteration of benthic communities. Temporary effects on marine mammals due to noise emissions from vehicles involved in extraction would also be expected. Particularly turbidity plumes and changes in sediment structure and benthos can affect the quality of the habitat for marine mammals. However, these are local and temporary and any disturbance would therefore be negligible.

The non-implementation of the plan would not affect the existing or described effects of sand and gravel extraction on harbour porpoises, harbour seals and grey seals.

***Extraction of hydrocarbons***

Possible impacts on marine mammals from the construction and operation of offshore platforms for the production of natural gas can be caused by shipping traffic, noise emissions, pollution through leakage and sediment plumes. During normal operation, platforms are expected to cause sediment and benthic changes. Attraction effects on fish caused by changes to the composition of benthos can in turn lead to attraction effects for marine mammals (consumers). Harbour porpoises are not known to collide with platforms. In the event of accidents, pollutants can enter the marine environment, which can lead to contamination of marine mammals.

Direct disturbance to marine mammals at individual level can only occur during the construction phase of gas production platforms. However, effects from shipping traffic and, above all, noise emissions during the construction phase are only expected to be regional and temporary. The formation of sediment plumes can largely only be expected locally and also for a limited period of time. A loss of habitat for marine mammals could therefore occur locally and for a limited period of time.

Indirect effects due to pollutant introduction during normal operation and accumulation in the food chains should be prevented by appropriate measures according to the state of the art. Effects due to the release of pollutants in the event of an incident or accident cannot be excluded. These would mainly occur at specific points.

The non-implementation of the plan would not affect the existing or described effects of carbon capture on harbour porpoises, harbour seals and grey seals.

### 3.4.5 Seabirds and resting birds

***Sand and gravel extraction***

For seabirds, the extraction of sand and gravel may be affected mainly by turbidity plumes and visual disturbance caused by shipping traffic. Indirectly, sedimentary changes and associated changes in benthic communities may affect seabirds and resting birds via the food chain. These effects are generally minor for seabirds and resting birds, since the birds search for their prey organisms mainly in the water column in widespread areas.

Direct effects of turbidity plumes vary for seabirds depending on their feeding strategy. Moreover, the turbidity plumes only cause local turbidity.

Shipping traffic during excavation work can lead to avoidance behaviour for disturbance-sensitive species and therefore a temporary loss of habitat.

On the whole, the impact on seabirds and migratory birds from shipping traffic and the formation of turbidity plumes as a result of dredging is limited regionally and to the duration of the extraction work.

The above-mentioned effects on seabirds and resting birds are independent of the non-implementation or implementation of the plan.

***Extraction of hydrocarbons***

For seabirds and resting birds, the construction and operation of hydrocarbon extraction installations can cause potential effects from the use-related shipping traffic in the form of visual disturbance and sediment plumes. Sediment and benthic changes may also occur. Attraction effects on fish due to changes in the composition of the benthos can in turn lead to attraction effects for their consumers, in this case seabirds (LOKKEBORG et al. 2002, FABI et al. 2004). Accidents can release pollutants and oil into the marine environment, which can also result in contamination of seabirds. Depending on the technical implementation of hydrocarbon extraction, the effects on seabirds and resting birds may be comparable to those of offshore wind energy (see Chapter 3.2.6).

The effects of usage-associated shipping traffic are to be expected above all for disturbance-sensitive species such as divers, but are only regional and temporary.

The formation of sediment plumes can largely be expected to be local and also temporary.

Effects of sediment and benthic changes are generally not very pronounced for seabirds, since they search for their prey organisms predominantly in the water column in widespread areas.

According to current knowledge, the effects of hydrocarbon extraction on seabirds and resting birds are mainly temporary and geographically limited. For further potential impacts comparable to the impacts of offshore wind energy, please refer to Chapter 3.2.6

The above-mentioned effects on seabirds and resting birds are independent of the non-implementation or implementation of the plan.

### 3.4.6 Migratory birds

***Sand and gravel extraction***

The impact of sand and gravel extraction on migratory birds may be mainly due to the attracting effect of illuminated extraction vehicles. These effects can occur mainly at night in poor visibility and weather conditions, which can lead to collisions.

The above effects on migratory birds are independent of the non-implementation or implementation of the plan.

***Extraction of hydrocarbons***

With the extraction of hydrocarbons, illuminated structures can have an attracting effect. Depending on the technical implementation of hydrocarbon extraction, system-related effects comparable to those of offshore wind energy may occur (see section 3.2.7).

The above effects on migratory birds are independent of the non-implementation or implementation of the plan.

### 3.4.7 Air

***Sand and gravel extraction***

The shipping traffic associated with sand and gravel extraction will cause emissions of pollutants that may affect air quality. Significant adverse effects on air quality are not expected.

***Extraction of hydrocarbons***

The extraction of hydrocarbons is associated with emissions that can affect air quality. The emissions come in particular from shipping traffic (e.g. utilities) associated with offshore activities, drilling activities, construction activities (e.g. driving foundation piles) and from the operation of production platforms. For example, carbon dioxide, nitrogen oxides and volatile organic compounds including methane are emitted during platform operation. Significant adverse effects on air quality are not expected.

### 3.4.8 Cultural and other assets

Basically, large-scale interventions in the seabed, such as dredging for sand and gravel extraction, increase the probability of finding archaeological traces. The primary risks are fully covered, previously unknown wrecks and prehistoric sites. Dredging can also influence current conditions and thus lead to local erosion, which gradually covers and eventually destroys new archaeological sites
(cf. Gosselck et al. 1996).

The same applies to the extraction of stone material, which was already practised as offshore stone fishing from 1840-1930 and down to depths of 6-12 m from 1930-1976 (Bock et al. 2003). As well as changes to current and erosion conditions, wrecks can also be directly affected when the ballast stones above a wreck find are removed.

## 3.5 Fisheries

Traditionally, the entire North Sea and Baltic Sea EEZ has been used for fishing. In the North Sea EEZ, a distinction must be made between coastal and cutter fisheries and small-scale deep-sea fisheries. These differ mainly in the size of vessels and motorisation. Large industrial deep-sea fisheries, which land roughly half of the German catch with just a few vessels, do not take place in the German EEZ.

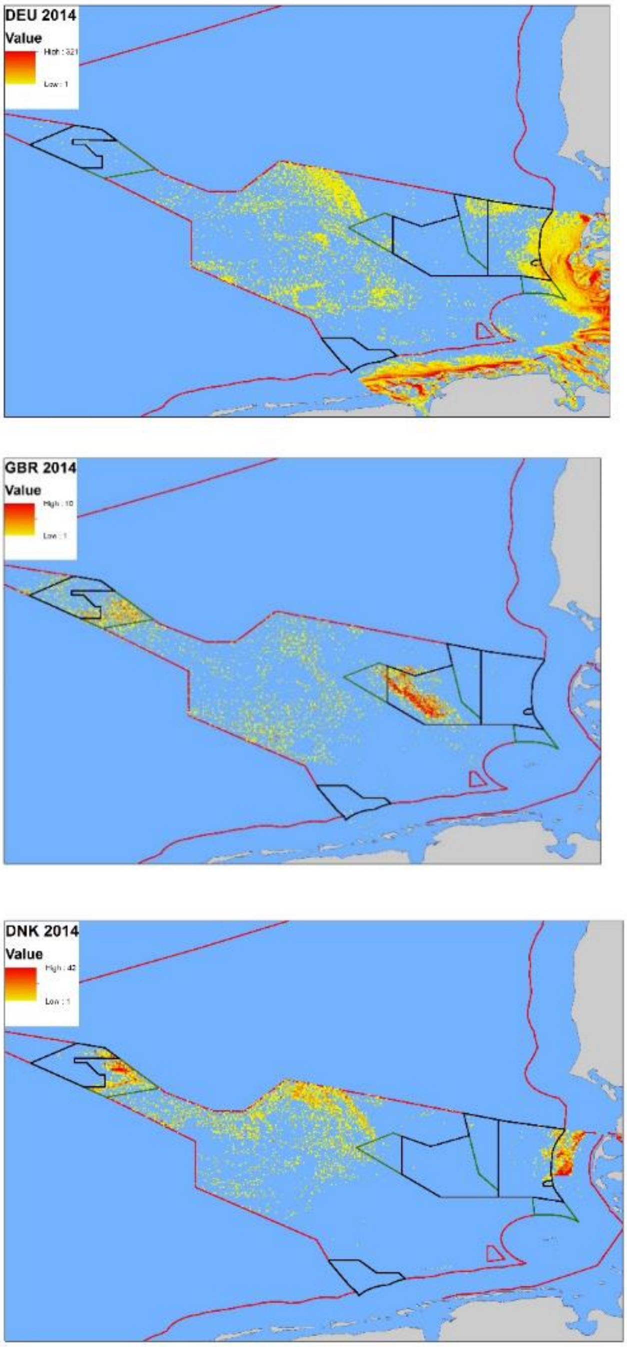
In the North Sea, cutter fishing, mostly with vessels of 18-24 metres in length, accounts for the majority of fishing. Small-scale deep-sea fishing, which only accounts for a small proportion of the German fishing fleet, is carried out deep-sea cutters up to 32 metres in length, which are often more powerful.

Fishing is mainly demersal (on the seabed) with beam trawls or bottom trawl nets, or pelagic with drag nets.

Shrimp fishing (North Sea shrimp, *crangon crangon*) accounts for the biggest proportion of fishing operations and also the biggest catches in the North Sea, as well as flatfish such as plaice or sole. Smaller cutters are allowed to operate in the so-called "plaice box", in the eastern part of the EEZ and the coastal sea, but more powerful motorised vessels may only fish flatfish outside this area. Other target species for pelagic fisheries are herring, mackerel, pollock and cod.

Operations from neighbouring countries, particularly the Netherlands, Denmark and the United Kingdom, account for a large share of the catches, especially of shrimp, but also bigger catches of sprat or sand eel. The latter, on the other hand, are of no significance for German fisheries.

Geographically, several priority areas can be identified on the basis of VMS data, here from 2014 (Thuenen, 2017): the shrimp fishery on the eastern edge of the EEZ, plus the northern edge of the Sylt Outer Reef Conservation Area, as well as in the western half up to the Duck's Bill with a focus on the Southern Silt Bottom, which is a main fishing area for Norway lobster.



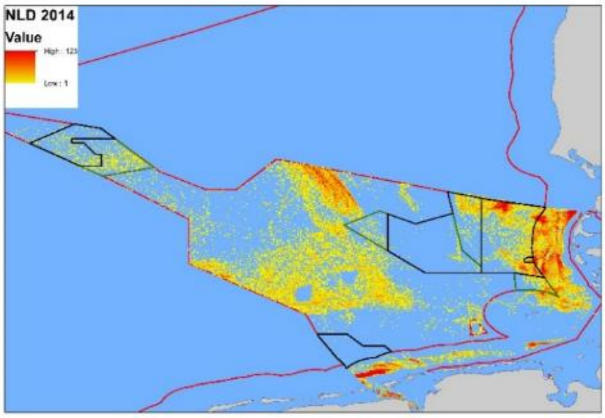




Figure 41: Fishing effort in the territorial sea and EEZ based on VMS data 2014 for individual national fleets (DEU: Germany; NLD: Netherlands; DNK: Denmark; GBR: United Kingdom). (Thuenen, 2016)

**The development of fishing**

On the whole, fishing in the North Sea has been on the decline, with large reductions in yields, particularly with regard to fishing close to the bottom and on the bottom of the seabed. The number of vessels in the German fishing fleet as a whole has fallen from 2315 (2000) to 1329, mainly due to the reduction in the number of vessels in the Baltic Sea.

Just a few (currently 7) globally operating deep-sea trawlers land about half of the German catches. The majority of the remaining vessels, around 1,110, are small gillnet cutters (4 - 10 m long) operating near the coast of the Baltic Sea. These only account for about 4% of the catches. Around 200 shrimp cutters (9 - 27 m long) operate in the North Sea. Bottom trawling, especially for cod and pollock, is carried out by around 70 cutters in the North Sea and the Baltic (Thünen Institute for Sea Fisheries 2018).

Restrictions on fishing take place at the level of the EU's Common Fisheries Policy in terms of catches, fishing gear and fishing areas. Particularly the annual fixing of quotas has a major impact on the economic framework conditions of fishing enterprises. For example, the major reductions in the herring and cod quotas in the Baltic Sea for 2020, currently set on the basis of scientific advice, are considered by many businesses to threaten their survival. The economic situation of fishing enterprises is expected to become worse in the coming years.

Spatial restrictions with regard to target species, use of fishing gear or time limits, with proportions in the German EEZ in each case, have been adopted under EU law in the North Sea ("Schollenbox") and the Baltic Sea ("Oderbank"). Fisheries management measures in the nature reserves based on joint recommendations by the states of the Scheveningen Group (North Sea) and the BaltFish Group (Baltic Sea) will be introduced as part of the respective management plans for the NSG. For the North Sea, the draft Joint Recommendation for decision lies with the EU, and only a few proposals have been prepared for the Baltic Sea.

As well as the impact of the EU's Common Fisheries Policy on the fishing sector in the EEZ, the construction of offshore wind farms particularly has geographical implications for fishing. The establishment of safety zones for fixed infrastructures (wind turbines, transformers and converter platforms) has led to a widespread ban on traffic in and around the wind farms. The use of fishing gear such as bottom gears, trawls and driftnets is also generally prohibited in the safety zones. By 2019, large areas in the North Sea and Baltic Sea EEZs will already be closed to fishing. From a fishing point of view there will also be further restrictions on cable connections outside wind farms, which must not be fished over in certain areas for safety reasons.

The following potential impacts may result from the use of the EEZ for fishing:

Table 19: Effects and potential impacts of fishing (t= temporary).

| Use | Effect | Potential impact | Protected assets | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Seabirds and resting birds | Migratory birds | Marine Mammals | Bats | Plankton | Biotopes | Biological diversity | Floor | Area | Water | Air | Climate | Human/ Health |
| **Fisheries** | Sampling of selected species | Reduction of stocks | x | x | | | | | | | x | | | | | | |
| | | Deterioration of the food base | | | x | | | | | | | | | | | | |
| | Bycatch | Reduction of stocks | x | x | x | | x | | | | x | | | | | | |
| | Physical disturbance by trawls | Impairment/ damage | x | x | | | x | | | x | | x | | | | | |

### 3.5.1 Seabed

The fishing gear used in *bottom-contacting fishing* (e.g. otter trawls, dredges and beam trawls) have an impact on the seabed as a protected resource. Beam trawl fishing is predominant in the German North Sea EEZ, with the greatest intensity being in the southern North Sea. Often several times a year, the seabed is churned up to an average depth of 10 cm, depending on the seabed conditions (ICES, 2000). This intervention, which varies in terms of time and location, is subject to relatively rapid regeneration during the course of natural sediment dynamics, meaning that the drag marks usually disappear within a few days or weeks. Nevertheless, the use of bottom trawls does result in some smoothing of the seabed by levelling ripple structures or small elevations. The movement of rocks can lead to changes in sediment structure and habitat levelling.

The formation of turbidity plumes near the seabed and the potential release of pollutants from the sediment are generally negligible due to the generally low silt and clay content, low heavy metal concentrations and the prevailing flow conditions. In intensively fished areas such as the Outer Silver Pit, grain refinement on the seabed has been observed, which can be attributed not only to natural causes but also sediment resuspension by bottom trawls and subsequent resedimentation (TRIMMER et al., 2005).

The effects on the seabed as a protected resource occur independently of the non-implementation or implementation of the plan.

### 3.5.2 Benthos and biotope types

Fishing for demersal fish species is important for benthos and biotopes. In order to catch fish living on the seabed, equipment is used which penetrates the seabed in some cases, and changes the animal community living there. The fishing gear that is used is the otter trawl, which is used to catch cod and shellfish, the beam trawl for catching flatfish (sole, plaice) and the dredge, which is used to catch mussels (WEBER et al., 1990). Beam trawl fishing for catching flatfish and prawns is the main activity in the German North Sea EEZ. The seabed is churned up to a depth of 10 cm by the skids of the beam trawls and by the front gear (chains or chain mats) (LINDEBOOM et al., 1998). The otter boards of the otter trawl net have the same effect. They usually slide across the ground at an angle and leave furrows which can be up to 10 cm deep (ICES, 2000) depending on the soil conditions. The intensity of bottom fishing varies considerably, with the southern North Sea being the most intensively targeted within the German EEZ. Depending on the behaviour of fishermen, it is not unusual for the seabed in this area to be fished up to ten or more times a year with beam trawls or similar gear (EHRICH, 1998).

Fishing activities may kill epibenthos and endobenthos organisms because of the mechanical stress, or they may be removed from the system and returned overboard, usually damaged. The severity of the damage depends not only on the sediment type and the penetration depth of the fishing gear, but also on the species composition of the benthos and, of course, on the frequency with which an area is fished. During the fishing process, the majority of epibenthos and endobenthos organisms (about 90 per cent) pass through the mesh of the net and are therefore not landed on the deck of the vessels. An unknown proportion of the organisms are killed directly by the fishing gear. The survival rate of invertebrates returned overboard depends on the species, and varies from < 10% (starfish) to 90% (Iceland cyprina). Creatures buried in silt rich soils are generally more sensitive to the shoals of beam trawls than creatures living in sand (SCHOMERUS et al., 2006). Otter trawls generally have less impact on creatures buried in the seabed, since the otter trawls affect a smaller area than beam trawls. The sedentary epibenthos is affected by otter board fishing to a similar extent to which they are by beam trawls if the otter trawls are equipped with chains instead of a lightweight roller harness as the basic harness.

The effects of fishing gear on benthic communities can be divided into short-term and long-term effects (Weber et al., 1990):

- Short-term consequences. Some of the creatures released from the fishing gear are injured or killed. The bigger and hard-shelled representatives, such as sea urchins and swimming crabs, are particularly susceptible to this. Smaller benthic creatures such as brittle stars and thin-shelled small mussels are hardly damaged at all (Graham, 1955). The exposed and damaged creatures are a welcome food for fish from the surrounding area. Margetts and Bridger (1971) made the observation that dabs seemed to be more numerous and feeding more actively in the dragline than in the surrounding area.
- Long-term consequences. Fishing activities increase the mortality of sensitive species until only the opportunists can survive. The diversity decreases at the same time. The abundance increases for species which are not damaged by fishing activities to the extent that sensitive species disappear from the biotope. The production of organic matter could increase to begin with, since the older, slow-growing specimens are replaced by fast-growing, young ones. As trawl activity increases, the younger animals will then also die, meaning that production will decline.

In summarising, the main impacts of fishing on marine macrozoobenthos are as follows:

- Loss of individuals, particularly long-lived and vulnerable species, caused by fishing gear
- Reduction of sedentary epifauna
- Decline in biodiversity
- Shift in the size spectrum of the soil fauna
- Habitat levelling by moving rocks.

The above-mentioned impacts on benthic communities and biotopes occur independently of the non-implementation or implementation of the plan.

### 3.5.3 Fish

***Fishing***

Fishing throughout the North Sea involves some 6600 vessels and is concentrated on more than 100 fish populations (ICES 2018a). Some areas of the southern North Sea are fished up to ten times a year with fishing gear towed to the bottom (Zidowitz et al. 2017). In the southern North Sea, the main traditional fishing is for North Sea prawns in territorial waters. Flatfish fishing in the German EEZ targets pollock, cod, plaice and sole (ICES 2018a). In addition to the use of heavy seabed tackle, relatively small meshes are often used in these fisheries, which can result in very high by-catch rates of small fish and other marine organisms.

The environmental impacts resulting from fishing are manifold and in some cases considerable. The basic problem is excessive fishing and overfishing of some populations (see also Chapter 2.6.3 Pre-pollution). Population developments which are negative to critical are a major problem in the North Sea, as is the by-catch of young stocks, since this deprives the stocks of their future reproductive potential. As a result, the full reproductive potential of North Sea commercial fish populations is often not available. As well as the direct mortality of target species, non-targeted by-catch species are potentially threatened by fishing. Sharks and rays are particularly sensitive to fishing pressure due to their very slow growth, late maturity and low fertility, with the potential consequence of population decline in the North Sea (Zidowitz et al. 2017). Demersal fishing also has a negative impact on invertebrates, which are an important food source for many bony and cartilaginous fishes.

Another effect of intensive fishing is the change in the age and length structure of the fish due to size-selective fishing methods. It is mainly bigger older individuals which are caught, meaning that the proportion of smaller younger individuals in the fish community is increasingly predominant. This change to the fish community will probably have particular consequences for the reproduction of fish populations. In general, small fish produce fewer and smaller eggs than bigger fish of the same species. Their fry are also more sensitive to a variable environment, and may therefore be subject to increased mortality (TRIPPEL et al. 1997). This impact of fishing can lead to population decline and changes within the community (such as dominance relationships).

As well as the direct effects of fishing, the discharge of marine waste, particularly plastic waste, can have indirect negative effects on fish populations. Particularly abandoned fishing nets, which drift around for decades and continue to catch fish, represent a problem for fish populations. Mortality from abandoned fishing nets could contribute to population decline and represent a particular problem for endangered fish species.

### 3.5.4 Marine mammals

***Fishing***

The majority of fishing in the North Sea is carried out using beam trawls and towed nets. The main threat to harbour porpoises in the North Sea is unwanted by-catch in nets (ASCOBANS, 2003, Evans 2020).

The non-implementation of the plan would not affect the existing or described impacts of fishing on harbour porpoises, seals and grey seals.

***Mariculture***

Marine mammals would be indirectly affected by the establishment of maricultures due to the deterioration of water quality and via the food chains: pollutants, particularly growth hormone supplements and antibiotics, could affect the immune system of marine mammals. Changes at the bottom of the food chains could affect the entire food chain and therefore the predators at the top of the food chain, such as marine mammals.

According to the current state of knowledge and due to a lack of concrete planning, it is not possible to assess the impact of maricultures in the EEZ.

The non-implementation of the plan would not affect the existing or described effects of mariculture on harbour porpoises, seals and grey seals.

### 3.5.5 Seabirds and resting birds

***Fishing***

Fishing influences the occurrence of seabirds. Discards of by-catch from fishing activities provide additional food sources for some seabird species. This creates concentrations around fishing vessels. Particularly fulmars, skuas, lesser black-backed gulls, herring gulls, European herring gulls and great black-backed gulls benefit from discards. In one study, a trend towards an increased number of birds (herring gulls, European herring gulls, common gulls and black-headed gulls) with an appropriately increased number of fishing vessels was clearly identified (GARTHE et al. 2006). Seabirds and resting birds can also perish as by-catch in fishing nets.

The overfishing of important stocks that provide the food base for various species of seabird also limits the food supply. The indirect effects of food limitation or the switch to other fish species as a food source are a reduction in the reproductive success and impairment of the survival chances of many bird species. Particularly the effects of overfishing and the decline in the sand eel population from the North Sea are well known (FREDERIKSEN et al. 2006). For example, there are observations of reduced reproductive success in kittiwakes and guillemots from British breeding colonies, which are linked to the decline of sand eels as the main food for chicks. The spread of the sand eel-like pipefish in the North Sea, which is often used by parent birds instead of the sand eel to feed the chicks, is not scientifically proven to provide an equivalent diet. Because of the hard consistency of the pipefish, the young birds are not able to use them as food. As a result, they remain undernourished or starve to death (WANLESS et al. 2006).

In summarising, the main impacts of fishing on seabirds are as follows:

The effects of fishing can thus be temporally and geographically limited by the actual fishing process, but can also be long-lasting and extensive due to changes in food availability and the range of prey.

***Aquaculture***

The management of aquaculture facilities involves the transport of vessels and various offshore activities in the facilities, which cause visual and acoustic disturbance and scaring effects in small areas.

The above-mentioned effects of fisheries and aquaculture on sea birds and resting birds are independent of the non-implementation or implementation of the plan.

#### 3.5.6 Migratory birds

***Fishing***

For migratory birds, fishing causes visual and acoustic disturbance and scaring effects that depend on the frequentation of marine areas. Migratory water birds that interrupt their migration to feed also run the risk of being caught in fishing nets and drowning.

***Aquaculture***

The management of aquaculture facilities is linked to the transport of vessels and various offshore activities in the facilities, which cause visual and acoustic disturbance and scaring in small areas.

The above-mentioned effects of fishing and aquaculture on migratory birds are independent of the non-implementation or implementation of the plan.

#### 3.5.7 Cultural and other material assets

Fishing with trawls can contribute to the destruction of archaeological layers and wreck finds. The trawls and their trawl boards penetrate the sediment of the seabed and can leave furrows up to 50 cm deep and 100 cm wide on a fine sandy bottom, which can even be seen in the side scan sonar image (Firth et al. 2013, 17). In individual cases, a targeted search is made for proximity to wrecks which, as hard substrate, form natural habitats and in the vicinity of which bigger fish populations can be expected. There are already many documented examples worldwide of the destruction of underwater cultural heritage caused by trawling (Atkinson 2012, 101). On the other hand, information on netted objects, if they are reported by fishermen, can also contribute to the discovery of underwater cultural heritage.

## 3.6 Marine Research

Extensive research and environmental monitoring activities take place in the German EEZ of the North Sea and the Baltic. According to Art. 56 para. 1 UNCLOS, the coastal nation has sovereign rights for the purpose of exploring and exploiting, conserving and managing the living and non-living natural resources of the waters above the sea-bed.

The BSH itself has been operating the MARNET monitoring network since 1989 - with the majority of monitoring stations in the German EEZ and a few more in the coastal seas of the North Sea and the Baltic. The systematic measurements are used for long-term marine environmental monitoring. Unmarked seabed frames with measuring instruments are installed around the stations at a distance of about 500 - 1000 m.

In the North Sea, these also include the first FINO measuring mast (research platform in the North and Baltic Seas - FINO 1) which was constructed in 2004 near the future offshore wind farm alpha ventus, as well as FINO 3 near Dan Tysk. The measuring masts are used to measure the environmental conditions before the wind farms are constructed - as well as for monitoring changes, disturbances, effects and interactions after the offshore wind farms are constructed. All measuring masts are now located in or near the wind farms mentioned above.

The Alfred Wegener Institute for Polar and Marine Research (AWI), the Thuenen Institutes, the Institute for Baltic Sea Research (IOW) and other research institutions operate measuring stations in the North Sea and the Baltic, conduct surveys on various research and monitoring issues and tasks. This is associated with different requirements regarding accessibility or avoidance of disturbances.

Within the framework of the German Small-scale Bottom Trawl Survey (GSBTS), several standard investigation areas ("boxes") in the North Sea and the Baltic have been sampled since 1987 by the Thuenen Institute of Sea Fisheries (with the vehicles SOLEA, Walter Herwig III).

The TI is investigating abundances and distribution patterns of bottom-dwelling fish in the North Sea on a small scale. To this end, annual fishing with a standardised bottom trawl net is carried out in 12 standard study areas ("boxes"), each measuring 10 x 10 nautical miles. The current data set forms an important basis for assessing long-term changes in the North Sea bottom fish population caused by natural (e.g. climatic) influences or anthropogenic factors (e.g. fishing).

The GSBTS uses a standardised bottom trawl with a high-density otter trawl of the type GOV to sample small-scale bottom-feeding fish communities. In parallel, epibenthos (by means of a 2 m beam trawl), infauna (by van Veen grab) and sediments will be studied, and hydrographic and marine chemical parameters of habitats typical for the region will be recorded.

The following impacts on the marine environment are possible through the use of marine scientific research.

Table 20: Effects and potential impacts of marine research (t= temporary).

| Use | Effect | Potential impact | Protected assets | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benthos | Fish | Seabirds and resting birds | Migratory birds | Marine Mammals | Bats | Plankton | Biotopes | Biological diversity | Floor | Area | Water | Air | Climate | Human/ Health | Cultural and material assets | Landscape |
| **Marine research** | Sampling of selected species | Reduction of stocks | | x | | | | | | | | | | | | | | | |
| | Physical disturbance by trawls | Impairment/ damage to bycatch | x | x | | | | | | x | | x | | | | | | x | |

### 3.6.1 Seabed

The various activities of marine research are associated with different environmental impacts depending on the type of methods and equipment used. Fishing research activities which may lead to physical disturbance of the surface of the seabed by trawls are particularly important for the seabed as a protected resource (see Fisheries Chapter 0). Bottom trawls on sandy soils generally penetrate the seabed to a depth of several millimetres to centimetres.

It cannot be ruled out that grain sorting may occur on the seabed as a result of the accumulation of previously churned up fine sandy sediment on the seabed surface due to regular fishing. The fact that the natural sediment dynamics, especially during intensive sand redistributions during storms, cause the upper decimetres to be mixed up completely, therefore restoring a largely natural sediment composition, speaks against this. One of the consequences of this is that drag lines are not usually permanently seen on the predominantly sandy seabeds of the EEZ.

The formation of turbidity plumes near the seabed and the possible release of pollutants from the sediment is negligible due to the generally relatively low proportion of silt and clay and the low concentrations of heavy metals.

The effects on the seabed as a protected resource will occur independently of the non-implementation or implementation of the plan.

### 3.6.2 Benthos and biotope types

The various activities of marine research are associated with different environmental impacts depending on the type of methods and equipment used. For example, sampling can lead to damage of varying degrees and even the death of individual benthic organisms. Similarly, the use of specific methods and equipment can result in a wide range of material emissions of various kinds to a small extent. In principle, it can be assumed that intensive research activities, especially on sensitive species or in sensitive habitats, can lead to considerable environmental impacts. Overall, however, it can be assumed that marine research is aimed at minimising environmental impacts and is adapted to the requirements for the protection of endangered species.

In summarising, the main impacts of research activities on marine macrozoobenthos are as follows:

- local, temporary damage or loss of individuals due to sampling
- local, temporary effect due to the increase in pollutant introduction.

The above-mentioned impacts on benthic communities and biotopes occur independently of the non-implementation or implementation of the plan.

### 3.6.3 Fish

The various marine research activities have different impacts on the fish population depending on the methods and the equipment that are used. For example, sampling can lead to varying degrees of damage and even the death of fish. Fish sampling could contribute to the decline of some species. Intensive research activities, particularly on sensitive species or in sensitive habitats, could have significant environmental impacts. However, marine research in the North Sea generally serves to identify negative developments in the ecosystem at an early stage and make targeted recommendations. In the long term, various marine research projects can therefore make an important contribution to preserving the marine environment.

### 3.6.4 Marine mammals

The following potential impacts of research on marine mammals are possible: small-scale and time-limited effects from by-catch in fisheries research, localised, time-limited impacts from fishing vessels and sub-regional, time-limited impacts from seismic and other noise-intensive research activities.

The non-implementation of the plan would not affect the existing or described impacts of marine research on harbour porpoises and on harbour seals and grey seals.

### 3.6.5 Seabirds and resting birds

Marine research can have different impacts on seabirds and resting birds, depending the objectives and design thereof. Fishing research focuses on by-catch and discard impacts. The use of vessels can lead to visual disturbance effects on disturbance-sensitive species, triggering avoidance behaviour. Fishing research can have indirect an impact on the marine food chain and influence the food supply for seabirds and resting birds.

On the whole, marine research impacts can be described as small-scale and limited to the duration of the research activity.

Due to the small-scale, time-limited activities of scientific research, significant impacts on seabirds can be reliably ruled out.

The above-mentioned effects on seabirds and resting birds are independent of the non-implementation or implementation of the plan.

### 3.6.6 Migratory birds

The various activities of marine research are associated with different environmental impacts depending on the type of methods and equipment used. For migratory birds, short-term and small-scale visual and acoustic disturbance effects may be relevant. However, these effects are small-scale and limited in time.

Research activities may also be linked to the installation of building structures. These could have an impact at night in bad weather conditions, when migratory birds are attracted by illuminated structures and could potentially collide.

The above-mentioned effects on seabirds and resting birds are independent of the non-implementation or implementation of the plan.

#### 3.6.7 Cultural and other material assets

When the impact of marine research or even archaeological research is assessed, a distinction must be made between intrusive and non-intrusive research methods. Non-intrusive research methods, such as geophysical or acoustic mapping of the seabed, are generally not expected to have negative effects. On the contrary, the results could also be used for research into the underwater cultural heritage.

During the taking of soil samples by drill cores, archaeologically relevant layers could be penetrated, but the disturbance of these layers is insignificant due to the small size of the area. Sampling using excavator grabs can have a bigger impact on the potential cultural asset, but the information that is acquired during the recording and reporting of archaeological finds is usually of considerable value if any destruction occurred.

## 3.7 Nature conservation

The German EEZ represents a special natural area with a wide diversity of species, biotic communities and habitat-typical processes.

Unlike the other types of use, marine nature conservation is not a use in the strictest sense, but rather an existing basic all-encompassing functional requirement, which must be taken into account when other uses take advantage of it. The international character of marine nature should also be emphasized. Marine nature and all related processes are part of a large-scale, dynamic system that is not restricted by political boundaries.

In accordance with Article 57 of the Federal Nature Conservation Act (BNatSchG), the ordinances of 22 September 2017 included the existing bird protection areas and FFH areas in the German EEZ in the national area categories and declared them nature conservation areas. Within this framework, they were partially regrouped. For example, the Regulation on the designation of the nature conservation area "Sylt Outer Reef - Eastern German Bight" (NSGSylV), the Regulation on the designation of the nature conservation area "Borkum Reef Ground" (NSGBRgV) and the Regulation on the designation of the nature conservation area "Dogger Bank" (NSGDgbV) now establish the nature conservation areas "Sylt Outer Reef - Eastern German Bight", "Borkum Reef Ground" and "Dogger Bank".

Article I 6 (1) of the Habitats Directive stipulates that Member States must establish the necessary conservation measures and, where appropriate, draw up management plans. On 17 November 2017, BfN initiated the participation procedure for the management plans for the nature conservation areas in the German North Sea EEZ. All three management plans came into force on 13.05.2020.

As well as the conservation areas that were defined by law on 22.09.2017, the planning also includes the nature conservation guidelines of the BMU, which is based on the position paper of the business unit of the Federal Environment Ministry on the cumulative assessment of the loss of diver habitat due to offshore wind farms in the German EEZ of the North and Baltic Seas in 2009 (main distribution area of divers) and the concept for the protection of harbour porpoises from noise pollution during the construction of offshore wind farms in the German North Sea, Noise Abatement Concept of 1 January 2009 December 2013 (main concentration area of harbour porpoises in the German EEZ from May to August). This is the basis upon which the assessment criteria under species protection law were adjusted.

#### 3.7.1 Seabed

National marine conservation areas and the associated management plans are intended to achieve or maintain the favourable conservation status of habitat types such as "reefs" and "sandbanks" and biotopes such as the "KGS beds", among other things. This can also reinforce the protection of the low occurrence of coarse sediments (gravel, coarse sand), residual sediments and boulders in the German EEZ. In addition to measures for reducing the negative impacts of trawling and the extraction of sand and gravel, other planned measures in the management plans are also associated with positive effects for the seabed as a protected resource, such as the reduction of adverse impacts from pollutant inputs.

Since the spatial development plan supports nature conservation by identifying priority areas, the protection of the seabed in national marine conservation areas would probably be less well ensured if the plan were not implemented.

### 3.7.2 Benthos and biotope types

The goal of designated nature reserves and conservation area measures is to safeguard the ecological functions of protected species and habitats. Among other things, this means that the desired target statuses for the "reefs" and "sandbanks" habitat types mentioned in the Habitats Directive and the corresponding benthic biotic communities are to be achieved by taking appropriate measures. If the plan were not implemented, the positive effects on benthic habitats of designating nature conservation areas as priority areas would probably be less likely to be achieved.

### 3.7.3 Fish

Marine protected areas of sufficient size could have a positive impact on the fish community and help to prevent overexploitation of fish populations.

The "Borkum Reef Ground" and "Sylt Outer Reef - Eastern German Bight" nature reserves are of particular importance for fish as a protected species. The FFH twaite shad species uses both marine conservation areas as a feeding habitat. The "Sylt Outer Reef - Eastern German Bight nature reserve is a feeding and migration area for the FFH river lamprey species. The availability of food in the "Sylt Outer Reef - Eastern German Bight" nature reserve is occasionally very good because of frontal and upwelling areas, and probably also attracts potential host fish for the parasitic river lamprey. Overall, various fish species, whether they are FFH, Red List (THIEL et al. 2013) or commercially exploited species, can occur in marine conservation areas and benefit from them. Previous studies have shown an increase in abundance, biomass and species diversity within marine conservation areas of sufficient size and protection status ("no-take areas"/"no-trawl areas") compared with unprotected areas (CARSTENSEN et al. 2014, MCCOOK et al. 2010, STOBART et al. 2009). In addition, the age-length structure could shift towards older, bigger individuals with better reproduction (CARSTENSEN et al. 2014). The result would be improved recruitment and therefore increased productivity of the fish population. However, there is a need for research on the impact of nature conservation areas on the fish community in the North Sea. A direct transfer of the available international findings is only possible to a limited extent, since important influencing variables such as other uses in the conservation area or climatic changes are generally ignored. In general, according to scientific findings, the benefits for the fish population are greater in nature reserves without any uses whatsoever compared to partially protected areas (LESTER & HALPERN

2008, Sciberas ET al. 2013). In German marine conservation areas, other uses such as fishing or raw material extraction are permitted in some cases. However, the impacts of these uses on the twaite shad and the river lamprey species which are protected under the Protected Areas Ordinance have been assessed as low to negligible (BFN 2017). Overall, according to current knowledge, the marine conservation areas in the North Sea can have a significant positive impact on the fish community.

#### 3.7.4 Marine mammals

The protection of endangered and characteristic species and habitats is extremely important for maintaining healthy marine ecosystems and marine biodiversity. The extension of the Natura 2000 network and the designation of the "Borkum Reef Ground", "Sylt Outer Reef - Eastern German Bight" and "Dogger Bank" nature reserves contributes to the conservation or restoration of populations of protected and characteristic species and their habitats.

#### 3.7.5 Seabirds and resting birds

The protection of nature and habitats contributes to maintaining or restoring populations and habitats. In this context, nature reserves and other areas of particular importance have an important function in maintaining ecological links between the different levels of the food web. Adequate protection of habitats also serves in particular to protect endangered species and to conserve species.

#### 3.7.6 Migratory birds

Many bird species migrating across the German North Sea rest on their way to their wintering or breeding grounds in the EEZ. The general impacts of nature conservation on seabirds and resting birds described in section 3.7.5 therefore also apply accordingly to many migratory bird species.

## 3.8 Other uses without spatial specifications

No spatial specifications are made for other uses.

### 3.8.1 Defence

#### 3.8.1.1 Fish

Particularly the fish population could be affected by underwater noise and the introduction of dangerous substances by military uses. Depending on the level, underwater noise can lead to scaring effects (shipping traffic) or even the death of individual fish (e.g. detonation). For detailed effects of underwater sound on the fish population, see Chapters 3.2.4and 3.1.3 In general, military activities, such as shooting exercises or submarine manoeuvres, are temporally and geographically limited.

Other adverse effects of military events could result from the release of toxins from the estimated 1.3 million tonnes of munitions and wrecks on the seabed of the North Sea. Little is known about the extent to which progressive corrosion promotes the release of toxic substances and how this affects the health status of fish. The initial results of the Thuenen Institute for Fishery Ecology showed no difference in the health status of cod from the main dumping area for chemical warfare agents east of Bornholm compared to an uncontaminated reference area (LANG et al. 2017). Nevertheless, an increased accumulation of pollutants in fish cannot be ruled out. There is a need for research on the effects on different species and life stages, the reproductive capacity or the spread of toxic substances via the food web.

#### 3.8.1.2 Avifauna

The general effects of national defence on birds may include, in particular, visual disturbance from shipping or low-flying air traffic. In general, military activities, such as shooting exercises or submarine manoeuvres, are geographically and temporally limited. Direct and indirect effects via the food chain, for example, are also possible via the introduction of dangerous substances, such as the release of toxic substances.

The general impact of national defence on birds does not distinguish between non-implementation or implementation of the plan.

### 3.8.2 Leisure

#### 3.8.2.1 Fish

Leisure activities can affect the fish fauna of the North Sea in a number of ways. Landings from recreational fishing do not generally have to be reported from the marine area to state institutions, meaning that there are no scientifically usable catch statistics for the North Sea (BFAFi 2007). According to HYDER et al. (2018), recreational fishing in the North Sea focus on cod, European eel, sea bass, salmon, pollock and shark and ray species. The removal of individual fish by anglers and recreational fishermen could contribute to the decline in the populations of the above species, with particularly negative effects on the populations of endangered species.

Further impairments due to recreational activities are caused by underwater noise (for details, see Chapter 3.1.3) and the dumping of rubbish (see Chapter 3.5.3).

#### 3.8.2.2 Avifauna

The general effects of recreation on birds can particularly be caused by visual disturbance from recreational traffic. There may also be direct and indirect effects via the food chain via the disposal and introduction of waste into the marine environment.

The general impact of recreation on birds does not distinguish between not implementing or implementing the plan.

## 3.9 Interactions

It is assumed that the interactions between the objects of protection will develop in the same way regardless of whether the plan is implemented or not. Reference is made here to Chapter 2.17.

# 4 Description and assessment of the likely significant effects of the implementation of the spatial development plan on the marine environment

In the following, the description and assessment of the environmental impacts of the plan focus on those protected assets, for which significant impacts cannot be excluded *a priori* by the implementation of the spatial development plan.

According to Section 8 ROG, the probable significant impacts of ROP-E on the protected assets must be described and evaluated. The spatial development plan establishes a framework for downstream planning levels.

Not taken into account are those protected assets, for which a significant impairment could already be excluded in the previous Chapter 2. This applies to plankton, air, cultural heritage and other material assets, as well as human beings, including human health.

Possible impacts on the biodiversity of the protected asset are dealt with for each individual biological protected asset. Overall, the protected assets listed in Article 8 (1) ROG are examined before the species conservation and site protection assessments are presented.

## 4.1 Shipping

The spatial development plan defines the priority areas for shipping SN1 to SN17 in the North Sea EEZ.

In order to assess the environmental impact of shipping, it is necessary to examine what additional effects can be attributed to the provisions of the spatial development plan.

The priority areas identified must be kept free of structural use. This control in the ROP will reduce collisions and accidents. Based on the provisions of the ROP, the frequency of traffic in the priority areas is expected to increase due to displacement and bundling effects. The vessel movements on the shipping routes SN1 to SN17 vary considerably, with the most heavily used route SN1 sometimes carrying more than 15 vessels per km² per day, while on the other, narrower, routes there are usually about 1-2 vessels per km² per day (BfN 2017).

The BSH has commissioned an expert report on the traffic analysis of shipping traffic, which is expected to include current evaluations.

The general effects of shipping are presented in Chapter 2 as a prior exposure, especially for birds and marine mammals.

As a precautionary measure, the definition of priority areas for shipping serves to minimise risk.

### 4.1.1 Seabed/Site

Since the impacts of shipping on the seabed occur independently of whether the plan is implemented, the provisions of the ROP-E do not have any impacts other than those described in Chapter 3.1.1. The principle of ROP-E, i.e. to reduce pressures on the marine environment by applying best environmental practice in accordance with international conventions, can help to prevent pollutant discharges.

In summary, significant negative impacts on the seabed can be excluded due to the ROP's provisions on shipping.

### 4.1.2 Water

The impacts of shipping on the protected water resource arise independently of the implementation of the ROP. In this respect, significant impacts on the protected asset can be excluded by the provisions for navigation.

### 4.1.3 Benthos and biotopes

With regard to the use of shipping, there are no further concrete effects from the ROP specifications on benthos or biotopes compared with the general effects of use described in Chapter 3.1.2Significant impacts on benthic biotic communities and biotopes as a result of the ROP-E provisions on shipping can, thus, be ruled out.

### 4.1.4 Fish

No significant impact at the fish population level is expected from the shipping regulations.

### 4.1.5 Marine mammals

The priority area definitions for shipping are based, in particular, on existing shipping routes identified in the procedure for updating the ROP-E. These definitions keep important shipping routes free of incompatible uses – in particular by structural facilities – which contributes to reducing impacts. The definition of priority areas for shipping does not have a direct concentration and steering effect on shipping traffic. Shipping can continue to use the entire maritime space in the future. In this respect, the establishment of shipping priority areas will have no additional impact on marine mammals as a whole compared to the current situation and the zero option.

The ROP-E makes further statements regarding the reduction of the burden on the marine environment by observing the IMO regulations and taking into account best environmental practice in accordance with the OSPAR and HELCOM Conventions and the current state of the art in shipping. In this way, negative impacts on the protected sassets are avoided.

Based on the above statements and the presentations in Chapter 3, it can be stated for the SEA that the provisions for shipping in the ROP are not expected to have any significant impacts on marine mammals, but rather, compared with not implementing the plan, adverse impacts are avoided, in particular by reducing conflicts of use.

### 4.1.6 Seabirds and resting birds

The general effects of shipping on seabirds and resting birds are described in Chapter 3.1.5

The spatial planning definitions of priority areas for shipping reflect the main traffic flows in the EEZ, where shipping is given priority over other uses of spatial importance. This objective of spatial planning, in particular, prevents conflicts (collisions) with offshore wind farms and subsequently prevents potential disasters affecting the marine environment and, thus, also sea birds and resting birds. The provisions for navigation do not automatically lead to an increase in the volume of traffic in the priority areas, since navigation enjoys special freedom under Art. 58 UNCLOS and is, therefore, not bound to specific routes. However, certain displacement and bundling effects can be expected.

Additional or significant effects from the provisions for navigation on sea birds and resting birds can, thus, be excluded with the necessary certainty.

### 4.1.7 Migratory birds

With regard to the use of shipping, there are no further concrete effects from the provisions of ROP-E compared to the general impacts described in Chapter 3.1.6. Significant impacts on migratory birds due to the provisions of ROP-E on shipping can be ruled out with the necessary degree of certainty.

### 4.1.8 Bats

With regard to the use of shipping, there are no further concrete effects from the provisions of ROP-E compared to the general impacts described in Chapter 3.1.7. Significant impacts on bats based on the provisions of ROP-E on shipping can be ruled out with the necessary degree of certainty.

#### 4.1.9 Air

Shipping generates pollutant emissions. These can have a negative impact on air quality. However, this is independent of the implementation of the ROP.

#### 4.1.10 Climate

The provisions on shipping are not expected to have a significant impact on the climate.

## 4.2 Wind energy at sea

The ROP-E contains provisions on priority and reserved areas for wind energy. In particular, the area definitions of the sectoral plan for wind energy – FEP 2019/Draft FEP 2020 – are taken into account. With the priority areas EN1 to EN3 and EN6 to EN8, the area definitions N-1 to N-3, N-6 to N-8 in FEP 2019 are adopted as priority areas. The areas N-9 to N-13 in FEP 2019 have been extended in a north-western direction and are defined in the extended form in ROP-E as priority areas EN9 to EN13. For areas EN4 and EN5, the areas shown in FEP 2019 under review are defined as priority areas. The areas EN14 to EN19 are defined as reserved areas. In the following, an assessment of the areas defined will only be carried out if they have additional effects and have not yet been fully dealt with in the Strategic Environmental Assessment (North Sea Environmental Report) for FEP 2019/Draft FEP 2020.

The construction and operation of wind turbines and ancillary installations in the areas can have a number of impacts on the marine environment, including local habitat loss due to permanent land sealing, chilling and barrier effects and a consequent loss of habitat for avifauna. Potential impacts of maintenance and service traffic must also be considered.

#### 4.2.1 Seabed/Site

The erection and operation of offshore wind energy plants has rather local impacts on the seabed as a protected asset (see Chapter 3.2.1), which arise independently of the implementation of the spatial development plan. However, by defining priority and reserved areas for the use of offshore wind energy, negative impacts on the seabed are reduced by coordinating the areas eligible for the erection of WTGs and thus reducing land use. No wind energy plants and platforms are planned in marine nature reserves, in particular due to the legal requirements of the WindSeeG. In addition, the ROP-E contains provisions for spatially coordinated installation and, if necessary, a smaller number of cable systems, the lowest possible number of cable crossings and gentle installation procedures.

The expansion of wind energy is already regulated in detail within the priority areas in FEP 2019. This also contains the spatially coordinating provisions that are positive for the marine environment.

The designation of the reserved areas is expected to lead to the installation of WTGs in these areas, which will result in an additional impact on the seabed, despite the positive coordinating effect of ROP-E. However, significant impacts in zones 4 and 5 should not be feared, as the effects will be temporary and mostly very small-scale. In these areas, the seabed site consists of fine sand with sometimes considerable silt and clay content. In areas with a higher proportion of fine sand, the impact will increase slightly during the construction phase of the facilities due to resuspension of sediment and turbidity plumes. Local sealing of the seabed will be very low, as in the existing wind farm areas.

In conclusion, it should be noted that the stipulations for wind energy in the spatial development plan are associated with an expansion of the usable area for wind energy. However, no significant negative impacts on soil as a protected good are to be expected. On the contrary, compared to the non-implementation of the plan, negative impacts can be avoided by the coordinating spatial provisions.

### 4.2.2 Benthos

The use of wind energy can have an impact on the macrozoobenthos. These impacts apply equally to all areas defined for wind energy use.

The EEZ of the North Sea is not of major importance in terms of the species inventory of benthic organisms.

Construction: Deep foundations for wind turbines and platforms cause disturbances to the seabed, sediment turbulence and the formation of turbidity plumes. This can lead to the impairment or damage of benthic organisms or communities in the immediate vicinity of the installations for the duration of construction activities. During the construction of the installations, it is mainly the resuspension of sediment that leads to direct impairments of the benthic community. Turbidity plumes are to be expected during the foundation work for the installations. However, the concentration of suspended material usually decreases very quickly with removal. Due to the predominant sedimentary composition, the sediment released will settle quickly.

Depending on the installation, changes in the benthic community may occur due to the sealing of the site, the introduction of hard substrates and changes in the flow conditions around the installations. In the area of the installations and the associated scour protection, there is a sealing of the site and site use and, thus, a complete loss of macrozoobenthos habitats in the soft seabed.

In addition to habitat losses or habitat changes, new hard substrate habitats are created that are alien to the site. This can have an impact on the soft seabed fauna in the immediate vicinity. According to KNUST et al (2003), the introduction of artificial hard substrate into sandy soils leads to the colonisation by additional species. These species will most likely be recruited from natural hard substrate habitats, such as superficial boulder clay and stones. This means that the risk of negative impacts on the benthic sandy seabed community by non-native species is low.

Based on current knowledge, operational impacts by wind turbines and platforms on macrozoobenthos are not expected.

On the basis of the statements and representations above, the result of the SEA is that, according to the current state of knowledge, no significant impacts on the protected resource benthos are to be expected as a result of the definition of the areas for wind energy in the ROP-E. Overall, the impacts on the benthic resource are assessed as being short-term and small-scale. Only small-scale areas outside protected areas are used and, due to the usually rapid regeneration capacity of the existing populations of benthic organisms with short generation cycles and their widespread distribution in the German Bight, rapid recolonisation is very likely.

### 4.2.3 Biotopes

Possible impacts from wind energy use on biotopes in the protected asset can result from direct use of protected biotopes, possible covering by sedimentation of construction-related material released during construction and potential habitat changes.

Considerable construction-related use of protected biotopes by the installations is not to be expected for areas EN1 to EN18, since protected biotope structures pursuant to Article 30 of the Federal Nature Conservation Act (BNatSchG) are to be avoided as far as possible within the framework of the specific approval procedure. Owing to the predominant sediment composition in the areas where the occurrence of protected biotopes is to be expected, impairments due to sedimentation are likely to be small-scale, as the sediment released will settle quickly.

For the EN19 site located on an occurrence of the "sublittoral sandbank" biotope protected under Article 30 (2) No. 6 BNatSchG, it must be ensured that the guidance values for the relative and absolute loss of area according to LAMBRECHT & TRAUTNER (2007) and Bernotat (2013) are not exceeded.

Due to the nature of the installations, permanent habitat changes will occur, but these are limited to the immediate vicinity of the installations. The artificial hard substrate provides new habitats for benthic organisms and can lead to changes in species composition (SCHOMERUS et al. 2006). These small-scale areas are not expected to have any significant impacts on biotopes as a protected asset. In addition, it is highly probable that species will be recruited from natural hard substrate habitats, such as superficial boulder clay and stones. This means that the risk of negative impacts on the benthic soft soil community by non-native species is low.

According to current knowledge, operational impacts from wind energy use on biotopes are not to be expected.

### 4.2.4 Fish

In the priority areas for wind energy use, the typical demersal fish community of sandy soils of the southern North Sea has been identified unanimously. It is equally true for all priority areas that the construction, foundations and operation of the wind turbines are not expected to have any significant impact at population level.

On the basis of the current state of knowledge, it can be stated for the SEA that the provisions for wind energy in the ROP-E are not expected to have any significant impacts on fish as a protected resource, but rather that negative impacts are avoided compared to non-implementation of the plan.

### 4.2.5 Marine mammals

The overall impact of WTGs on marine mammals through the identification of priority areas for wind energy is expected to be negligible. This is also true when considered cumulatively.

The function and importance of the priority areas in the German North Sea EEZ for harbour porpoises were assessed in Chapter 2.7according to the current state of knowledge.

By establishing priority and reserved areas for offshore wind energy production outside nature reserves, disturbances within valuable habitats of particular importance as feeding and rearing grounds are avoided. The designation of the porpoise reserve also allows for better protection during the sensitive period by strict measures ordered as part of the downstream authorisation procedures.

In addition, in order to protect the marine environment, provisions have been made to take account of best environmental practice under the OSPAR and Helsinki Conventions and the state of the art. In this context, regulations for the prevention and reduction of negative impacts from the construction and operation of wind turbines on marine mammals, in particular in the form of noise minimisation measures, which may also provide for the coordination of construction work for projects constructed at the same time, are to be adopted at permit level. This corresponds to current licensing practice. On the basis of the function-dependent significance of the priority areas for wind energy and the principles contained in the ROP-E and the measures ordered in the downstream licensing procedures and taking into account the current state of the art in science and technology in reducing impulse-bearing sound inputs, significant impacts on harbour porpoise, common seal and grey seal populations can be ruled out. Direct disturbance of marine mammals at the individual level by sound emissions during the construction phase, in particular during pile driving, is to be expected on a regional and temporal scale. However, due to the high level of mobility of the animals and the above-mentioned measures that are to be taken to avoid and reduce intensive sound emissions, significant effects can be ruled out with reasonable certainty. This also applies from the point of view that shipping could have an impact on disturbance-sensitive marine mammals, as these impacts are only very brief and local. Sediment plumes can be expected to occur largely at local and temporal levels. Habitat loss for marine mammals could, therefore, be local and temporary. The effects of sedimentary and benthic changes are insignificant for marine mammals, as they search for their prey organisms mainly in the water column over extensive areas. Effects at the population level are not known and are rather unlikely to result from the predominantly short-term and local effects in the construction phase.

Significant impacts from WTGs in the priority areas during the operational phase on marine mammals can also be excluded with certainty on the basis of the current state of knowledge. The investigations carried out as part of the operational monitoring of offshore wind farms have, so far, not provided any indications that avoidance effects on harbour porpoises due to wind farm related shipping traffic can be detected. Avoidance could so far only be detected during the installation of the foundations, which may possibly be related to the large number of vessels and the different operating conditions of the vessels on the construction site.

In summary, the establishment of priority areas outside the main feeding and rearing areas for harbour porpoises indirectly serves to protect the species. Priority areas for nature conservation help safeguard open space, as uses incompatible with nature conservation are excluded in them. This reduces threats to harbour porpoises in important feeding and breeding grounds. The establishment of these areas will not have any negative impact for harbour seals and grey seals, either. On the basis of the statements above and the presentations in Chapter 2the SEA concludes that the definition of priority areas for wind energy in the spatial development plan for the German North Sea EEZ is not expected to have a significant impact on marine mammals, even from a transboundary perspective, but rather that negative impacts are avoided compared to the non-implementation of the plan.

### 4.2.6 Seabirds and resting birds

The general effects of offshore wind series on sea and resting birds are described in Chapter 3.2.6

Priority areas are sometimes defined in locations where offshore wind farm projects have already been implemented or have a concrete implementation status (EN1 to EN3, EN6 to EN8). Other priority areas, in which no projects have yet been realized, are located in a spatial context with areas that have already been built on (EN9 to EN13), so that a comparable function as a resting and foraging habitat can be assumed for these areas, taking into account the respective species-specific habitat requirements, spatial and temporal distribution patterns and species-specific behaviour towards OWPs (cf. Chapters 2.8.2.5and 3.2.6). The designation of reserved areas for wind energy takes into account, among other things, areas for which conflicts of use were already identified in FEP 2019/Draft FEP 2020 and which were reviewed for subsequent use (BSH 2019). Areas EN4 and EN5 in the main concentration area for loons have been designated as wind energy reserve areas, since the planning, construction and operation of energy generation facilities in the loon reserve area should only take place if this does not lead to any significant impairment of the loon's habitat (cf. principle (2) under Nature Conservation).

The EN13 priority area also maintains a distance of 5.5 km from the main concentration area of loons, which is based on current knowledge on the avoidance behaviour of the species group tat is sensitive to disturbances (see Chapter 3.2.6). The spatial planning regulations thus also take into account the protection of the particularly important main concentration area for loons. In addition, the fact that the priority areas are kept free of any use incompatible with nature conservation (such as wind energy) reduces the negative impacts on sea birds and contributes to the protection of these important habitats.

The definition of areas EN14 to EN19 as reserved areas for wind energy takes into account, among other things, the lower level of knowledge about the species spectrum and distribution of seabirds in this area of the EEZ.

The provisions on wind energy may lead to a spatial concentration of shipping traffic in some parts of the EEZ due to the navigation regulations in force. However, it can be assumed that this congestion will take place in traffic areas which already have a higher level of shipping activity.

Current findings from studies confirm the shying effect on loons caused by wind farm-based shipping traffic (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019). According to FLIESSBACH et al. (2019), red-throated divers, black guillemots, black-throated divers, velvet scoters and red-breasted mergansers are among the species most sensitive to shipping traffic. The most common reaction is to take off, even if the flight distances vary considerably. According to the current state of knowledge, the provisions of the ROP-E for wind energy have no additional or significant impact on the protected species of sea and resting birds.

### 4.2.7 Migratory birds

The general effects of offshore wind energy on migratory birds were described in Chapter 3.2.7

By defining priority and reserved areas in a spatial context and securing open space in the nature reserves, barrier effects and collision risks in important food and resting habitats are reduced.

On the basis of the current state of knowledge, it is possible to rule out with the necessary certainty any significant effects of the provisions on migratory birds, particularly in comparison with the non-implementation of the spatial development plan.

### 4.2.8 Bats and bat migration

The general effects of offshore wind energy on bats and the current state of knowledge on bat migration over the North Sea are described in Chapter 3.2.8

There is currently no evidence that the spatial planning regulations have a significant impact on bats. By defining priority and reserved areas in a spatial context and securing open space in nature conservation areas, barrier effects are reduced and important habitats are protected.

### 4.2.9 Climate

The provisions on offshore wind energy are not expected to have a significant negative impact on the climate.

The CO2 savings associated with the expansion of offshore wind energy (cf. Chapter 1.8) can be expected to have positive effects on the climate in the long term.

### 4.2.10 Landscape

As explained in Chapter 3.2.11realisation of offshore wind farms in the priority and reserved areas defined by ROP-E will have an impact on the landscape as a protected asset, as it will be altered by the erection of vertical structures and safety lighting. The extent of these visual impairments to the landscape caused by the planned wind turbines and platforms will strongly depend on the respective visibility conditions. Due to the considerable distance of the planned areas from the North Sea coast of more than 30 km, the turbines will have very limited visibility from land (HASLØV & Kjærsgaard 2000) and only under good visibility conditions. This also applies to night-time safety lighting. Due to subjective perceptions, as well as the basic attitude of the observer towards offshore wind energy, the vertical structures – atypical for a marine and coastal landscape – can be perceived partly as disturbing, but partly also as technically interesting. in any case they cause a change in the landscape and the character of the area is modified.

Beyond the coast, the visual impairment of the landscape changes with greater proximity to the offshore areas. The type of use is decisive here. The value of the landscape in terms of industrial or transport use plays a subordinate role. For recreational uses, such as water sports and tourism, the landscape is of great importance. However, direct use for recreation and leisure by pleasure boats and tourist vessels is only sporadic in the priority and reserved areas for the use of offshore wind energy.

As a result, the impairment of the coastal landscape by the planned wind energy installations in the German EEZ on the coast can be classified as minor. The provisions of the ROP-E can minimise the land required for the expansion of offshore wind energy by means of coordinated and harmonised overall planning and thus – compared to non-implementation of the plan – also reduce the impacts on the landscape as a protected asset.

For the cables, negative impacts on the landscape can be ruled out due to their installation in or on the seabed.

## 4.3 Cables

The ROP-E defines the reserved areas for LN1 to LN15 lines. Cables as defined in the ROP-E include pipelines and submarine cables. Cross-border power lines and connecting lines for wind farms, as well as data cables, are summarised as submarine cables. So-called in-farm submarine cables are not covered by this definition. In addition, ROP-E- defines the objective of routing cables at the transition to the territorial sea through the border corridors GN1 to GN6.

### 4.3.1 Seabed/Site

The impacts of the construction and operation of pipelines and submarine cables on the seabed described in Section 3.3.1occur independently of the provisions of ROP-E.

The ROP-E makes statements on the reduction of pollution in the marine environment to be aimed at by taking into account best environmental practice in accordance with international conventions and the state of the art in science and technology. In this way, adverse impacts on the marine environment can be reduced. For example, when laying and operating cables, damage to or destruction of biotopes must be avoided in accordance with Article 30 BNatSchG.

In addition, the definition of reserved areas for cables in the spatial development plan means that interactions among uses and cumulative effects on protected assets can be better assessed and forecast in existing and, above all, future planning.

Thus, with regard to the seabed as a protected asset, no significant negative impacts are to be expected from the provisions for cables/submarine cables in ROP-E. On the contrary, negative impacts are avoided in comparison to the non-implementation of the plan, as the provisions of the plan aim at minimising the impact on the seabed by reducing the number of cable routes and minimising the number of crossings.

### 4.3.2 Benthos

Pipelines can have an impact on the macrozoobenthos. These effects apply equally to all the areas reserved for pipelines.

<u>Construction:</u> Possible effects on benthic organisms depend on the installation methods used. By careful laying of the submarine cable systems and pipelines by means of flushing procedures or laying pipelines, only small-scale, short-term and thus minor disturbances of the benthos are to be expected.

In the event of a population decline due to a natural or anthropogenic disturbance (e.g. cable intrusion), sufficient potential for repopulation by the organisms remains in the overall system (KNUST et al. 2003). The linear character of submarine cable systems and pipelines favours repopulation from undisturbed peripheral areas.

Turbidity plumes are caused by the disturbance of the sediment during the flushing of the cable system or the laying of pipes. The dispersion of sediment particles depends to a large extent on the content of fine components and the hydrographic situation (especially maritime conditions, currents) (HERRMANN & KRAUSE 2000). Due to the predominant sedimentary composition in the North Sea EEZ, most of the sediment released will settle directly at the construction site or in its immediate vicinity.

Thus, according to current knowledge, the impairments during the construction phase remain small-scale and usually short-term.

Benthic organisms may also be affected in the short term and on a small scale by the release of nutrients and pollutants associated with the resuspension of sediment particles. The oxygen content may decrease if organic substances are brought into solution (HERRMANN and KRAUSE 2000).

The impact is generally considered to be small, as the laying of cables is limited in time and space and pollution levels are relatively low in the EEZ area. In addition, waves and currents cause a rapid dilution of any increases in the concentration of nutrients and pollutants that may occur.

The potential effects of any repair work that may become necessary are comparable to the possible construction-related effects.

Depending on the system: In the area of overlying pipelines or possible crossings the disturbances are permanent, but also small-scale. Necessary crossings are secured with a stone fill, which permanently represents a hard substrate that is foreign to the location. The hard substrate that is foreign to the location provides new habitats for benthic organisms.

Due to operational conditions, heating of even the uppermost sediment layer of the seabed can occur directly above current-carrying cable systems, which can reduce the winter mortality of the infauna and lead to a change in species communities in the area of the cable routes. In particular, cold-water-loving species (e.g. *Arctica islandica*) may be displaced from the area of the cable routes. According to the current state of knowledge, no significant effects on the benthos from cable-induced sediment warming are to be expected, provided that a sufficient laying depth is maintained and state-of-the-art cable configurations are used. No significant effects on the macrozoobenthos are to be expected from electric and electromagnetic fields.

If the installation depth is sufficient and taking into account the fact that the effects will occur on a small scale, i.e. only a few metres on either side of the cable, no significant impacts on benthic communities are expected from the installation and operation of the submarine cable systems according to current knowledge. According to current knowledge, the ecological effects are small-scale and mostly short-term.

In the case of pipelines, the chemicals resulting from an imprint test can be introduced into the water body in high dilution. To protect the pipeline from external corrosion, sacrificial anodes made from zinc and aluminium are placed at regular intervals. Due to the very high level of dilution, these elements are only present in trace concentrations; in the water they are adsorbed on sinking or resuspended sediment particles and settle on the sea floor.

### 4.3.3 Biotopes

Pipelines can have an impact on biotopes. These effects apply equally to all the areas defined as reserved areas for pipelines.

Depending on the construction, possible effects from pipelines on the protected asset biotopes can arise through the direct use of protected biotopes, possible covering by sedimentation of released material and potential habitat changes. Direct use of protected biotopes is avoided as far as possible by planning the pipeline systems. In addition, protected biotopes under Article 30 BNatSchG must be given special consideration in the specific approval procedure and avoided as far as possible in the course of fine routing.

Due to the predominant sediment composition, impairments caused by overburdening are likely to be small-scale, as the released sediment will settle quickly.

System-related permanent habitat changes are limited to the area where pipelines rest on the seabed and the immediate area of rock fills that become necessary in case of crossings. The pipelines and the rock fills permanently represent a hard substrate that is not native to the site, even in areas with a predominantly homogeneous sandy seabed.

Known occurrences of protected biotopes under Article 30 BNatSchG are avoided as far as possible. Due to the lack of reliable data at the SEA level, it is not possible to check whether the marine biotopes considered under Article 30 BNatSchG (1) No. 6 actually occur in the area of the planned pipeline routes and whether they may be impaired, as there is currently no detailed, comprehensive biotope map for the North Sea EEZ.

It is generally assumed that biotopes protected under Article 30 of the Federal Nature Conservation Act which have a specific sensitivity to the laying of pipelines, especially reefs, occur only in small areas and at specific points and can be bypassed by fine routing. If it is not possible to bypass these strictly protected biotopes or FFH-LRT, e.g. because the occurrences are more extensive, significant impairment of these legally protected biotopes cannot be ruled out. In the specific individual procedure, it must be examined, on the basis of available data from the route surveys, whether the affected area is so large that significant impairment exists.

#### 4.3.4 Fish

The specifications for the pipelines in the spatial development plan do not have a significant impact on the protected asset fish.

#### 4.3.5 Marine mammals

The spatial development plan makes statements regarding the reduction of the burden on the marine environment by taking into account best environmental practice in accordance with the OSPAR and HELCOM Conventions and the current state of the art in laying, operating, maintaining and dismantling submarine pipelines. This can reduce adverse impacts on the marine environment.

The identification of areas for pipelines in the spatial development plan means that interactions between uses and cumulative effects on biological assets can be better assessed and forecast in existing and, above all, future planning.

#### 4.3.6 Avifauna

The general effects of pipelines on avifauna are described in sections 3.3.5and 3.3.6The effects are only temporary and local.

Significant effects of the spatial planning regulations on avifauna can be ruled out with the necessary certainty.

#### 4.3.7 Bats and bat migration

The general effects of cables on bats are described in Chapter 3.3.7The effects are only temporary and local.

Considerable effects of the spatial planning determinations can be ruled out with the necessary certainty.

#### 4.3.8 Cultural and other material goods

The regulations for the planning, construction and operation of wind energy plants and pipelines aim to avoid or reduce construction-related disturbances of the seabed affecting discovered and undiscovered cultural heritage by involving the technical authorities at an early stage. Synergy effects are to be promoted through cooperation in the evaluation of subsoil investigations and soil samples, which will be carried out as part of the large-scale development of marine areas for wind energy, and which may provide new insights into cultural traces such as lost landscapes.

## 4.4 Raw material extraction

As a principle of the spatial planning, the areas SKN1 and SKN2 are designated as reserved areas for sand and gravel extraction, while the areas KWN1 to KWN5 are designated as reserved areas for hydrocarbons.

### 4.4.1 Seabed/Site

The general provisions of the ROP regarding the extraction of raw materials, such as, for example, the use of the soil, have a fundamentally positive impact on the soil as a protected resource:

- Concerted extraction of raw material deposits using as little space as possible,
- Reduce the impact on the environment by taking into account the best environmental practice under the OSPAR and Helsinki Conventions in the exploration and extraction of raw materials,
- Project-related monitoring to ensure environmentally sound extraction of raw materials,
- Avoiding damage to sandbanks, reefs and submarine structures caused by gas leaks.

The spatial specifications in the ROP-E also allocate space for the use of raw material extraction in the long term (securing land with possible use), which exceeds, for example, the duration of the valid operating plan OAMIII.

There will be no additional impact on the definition of reserved areas for the extraction of hydrocarbons.

The location of the designated reservation areas SKN1 and SKN2 within the marine protection area "Sylt Outer Reef – Eastern German Bight" must be taken into account when planning the extraction of raw materials. As described in Chapter 3.4.1, the current extraction activities in the OAMIII permit area – according to monitoring data – do not cause any significant impairment of the legally protected biotopes "Reefs" and "Species-rich gravel, coarse sand and shell beds. Auxiliary provisions were drawn up in individual proceedings for their protection and conservation.

New findings show the very small-scale heterogeneity of coarse sediments in the marine protected area "Sylt Outer Reef – Eastern German Bight", which were recorded over a wide area using hydro-acoustic methods (see section 2.2). This must be taken into account within the OAMIII and BSK1 licence areas when drawing up and approving new operating plans and developing suitable monitoring concepts.

With reference to the spatial definitions of the ROP-E, it can be summarised that the seabed will be strained by the impacts of the current raw material extraction in the OAMIII permit area, but will not undergo any significant changes. Thus, while maintaining the previous extraction activities, including and complying with corresponding ancillary provisions in future main operating plans and carrying out appropriate monitoring, significant impairments of the protected property soil can currently be excluded by defining the SKN1 and SKN2 permit areas.

### 4.4.2 Benthos and biotopes

The general impacts of raw material use are described in Chapter 3.4.2. With regard to the designation of areas KWN1 to KWN5 for hydrocarbon extraction, there are no additional impacts.

With regard to the designation of the areas SKN1 and SKN2 as reserved areas for sand and gravel extraction, their location within the nature reserve "Sylt Outer Reef – Eastern German Bight" must be taken into account.

On the basis of the monitoring carried out so far (see Chapter 3.4.2) and in compliance with the secondary provision of the main operating plan, it can be assumed that significant impacts on benthic habitats and their communities can be excluded with the necessary certainty by defining the areas SKN1 and SKN2.

#### 4.4.3 Fish

The definition of the areas for the extraction of raw materials does not have a significant impact on the protected asset fish.

#### 4.4.4 Marine mammals

The basis for the definition of the reserved areas KWN2 and KWN3 and the priority area KWN1 for hydrocarbon extraction in zones 4 and 5 are corresponding permits under Section 7 BBergG and permits under Section 8 BbergG (cf. Section 3.4, Specifications on Raw Material Extraction in ROP-E 2021). The specifications are, therefore, records of already approved or existing activities. The incorporation of the raw material extraction areas into the spatial development plan means that, in existing and, above all, in future planning, the interactions between the uses and cumulative impacts on biological assets can be better assessed and forecast.

On the basis of the above statements and the presentations in Chapter 3.4.4the SEA concludes that no significant impact on marine mammals is expected, but that, compared to the non-implementation of the plan, adverse effects are avoided.

#### 4.4.5 Seabirds and resting birds

The basis for the definition of the reserved areas KWN2 and KWN3 and the priority area KWN1 for hydrocarbon extraction in zones 4 and 5 is the corresponding permits under Section 7 BBergG and permits under Section 8 BbergG (cf. Section 3.4, Specifications on Raw Material Extraction in ROP 2021). The specifications are based on already licensed or existing activities. The spatial planning provisions are, therefore, not expected to increase the intensity of use in the areas. Significant impacts from the specifications can be ruled out with the necessary certainty.

The areas SKN1 and SKN2 reserved for sand and gravel extraction (with the exception of a part of the reserved area SKN2) are located within the nature reserve " Sylt Outer Reef - Eastern German Bight ". The SKN1 reserved area is entirely within sub-area II of the nature reserve and thus within the "Eastern German Bight" bird sanctuary. Both reserve areas are also completely within the main concentration area of loons in spring.

In the status description and assessment of the nature conservation areas in the North Sea EEZ, the impacts of sand and gravel extraction in the OAM III permit area (SKN1) on seabird species or species groups protected in the bird reserve were predominantly rated as "negligible" (BfN 2017). The low level of sand and gravel extraction in previous years had only minor impacts on loons and aukes. This also corresponds to a current expert assessment within the framework of the FFH compatibility study of the OAM III permit area (IFAÖ 2019). Furthermore, there are no findings on fundamental changes in sediment structure caused by the mining of sand and gravel and thus potential changes in the food sources of seabirds (IFAÖ 2019). Other impacts resulting from sand and gravel extraction are mainly temporary and local (see Chapter 3.4.5). In addition, the spatial development plan contains the principle (cf. Principle (2) under raw materials extraction) that sand and gravel extraction in the loon reserve area in the period from 1 March to 15 May should be avoided as far as possible.

Considerable effects of the specifications can be excluded with the required degree of certainty.

#### 4.4.6 Migratory birds

Significant effects from the spatial planning definitions of reserved areas for sand and gravel extraction and hydrocarbon extraction and the priority area for hydrocarbon extraction can be excluded with the necessary certainty.

### 4.5 Fisheries

The ROP-E contains a provision for Norway lobster fisheries, with the FiN1 reservation.

#### 4.5.1 Seabed/Site

The impairment of the seabed in terms of fishing exploitation is presented in Chapter 0Since the proposed reserved area for Norway lobster fisheries (FiN1) has been considered the traditional main Nephrops fishery area for decades, no further significant impacts on the conservation value of the bottom are to be expected in terms of this ROP-E definition.

#### 4.5.2 Benthos and biotopes

With regard to fisheries use, there are no further concrete effects of the ROP-E provisions compared to the general effects of use described in Chapter 3.5.2.

No increases in fishing effort due to the designation of the reserved area are forecast. Thus, significant impacts on benthic communities and biotopes can be ruled out on the basis of the ROP-E's provisions on fisheries.

#### 4.5.3 Fish

As a result of the spatial planning regulations for fisheries, there are unlikely to be any significant changes in the impacts on fish fauna compared with those described in Chapter 3.5.3

#### 4.5.4 Marine mammals

The implementation of the plan will not lead to effects on marine mammals other than those already described in Chapter 3.5.4The designation of the FinN reserved area for Norway lobster fisheries will not lead to an increase in current fishing activity in this area of the EEZ.

#### 4.5.5 Avifauna

With regard to fisheries use, there are no further effects of the provisions of ROP-E compared to the general impacts of use described in Sections 3.5.5and 3.5.6. The designation of the FiN1 reserve area for Norway lobster fisheries is not expected to lead to an increase in fishing activity in this area.

### 4.6 Marine Research

For marine research, in particular the fisheries research activities of the Thuenen-Institute for Sea Fisheries, the GSBTS boxes of the Thuenen-Institute for Sea Fisheries have been designated as research reserve areas FoN1 to FoN3 in the North Sea.

The definition is made in order to safeguard existing long-term fisheries research programmes. The aim is to keep these areas free from uses, which could devalue the long-term research series.

The results of marine scientific research are to be continuously recorded in order to explain ecosystem interrelationships as comprehensively as possible and thus create an important basis for sustainable development in the EEZ.

Since the aim here is to safeguard the stock, the area definitions have no further impact on the protected species and the marine environment as a whole compared with the current status and the zero variant.

#### 4.6.1 Seabed/Site

The provisions of ROP-E do not result in any other concrete impacts on the seabed than those described in Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**Significant impacts on the soil as a protected resource as a result of the provisions of ROP-E for the use of marine research can thus be excluded.

### 4.6.2 Benthos and biotopes

With regard to the use of marine research, there are no further concrete effects of the ROP-E provisions compared with the general effects of use described in Section 3.6.2. Significant impacts on benthic communities and biotopes as a result of the ROP-E provisions on marine research can thus be ruled out.

### 4.6.3 Fish

The designation of the research reserve areas does not have a significant impact on the protected asset fish.

### 4.6.4 Marine mammals

The designation of reserved areas for scientific research means that interactions among uses and cumulative impacts on biological assets can be better assessed in existing and, above all, future planning.

On the basis of the above statements and the presentations in Chapter 3.6.4the SEA concludes that the provisions for scientific research in the spatial development plan are not expected to have a significant impact on marine mammals, but rather that adverse effects are avoided in comparison with not implementing the plan.

### 4.6.5 Avifauna

With regard to marine research, there are no further concrete effects of the ROP-E provisions compared with the general effects of use described in Chapter 3.6.5. Significant impacts on seabirds and resting and migratory birds due to the provisions of ROP-E on marine research can be ruled out with the necessary certainty.

## 4.7 Nature conservation

The National Marine Protected Areas Borkum Riffgrund, Doggerbank, Sylt Outer Reef – Eastern German Bight in the North Sea EEZ are designated as priority areas for nature conservation in accordance with their conservation objectives.

The "main concentration area of loons" defined in the BMU position paper of 2009 is designated as the reserved area for divers.

The main distribution area of harbour porpoises in summer (in accordance with BMU's 2013 noise abatement concept) is defined as the temporary reserve area "Harbour porpoises (May to August)".

The provisions contribute to the long-term preservation and development of the marine environment in the EEZ as an ecologically intact open space over a large area. The designation of areas which have an important ecological function for specific species – the main concentration area of loons and the main distribution area of harbour porpoises – as reserved areas provides special protection for the species group of loons and harbour porpoise, which are sensitive to disturbance. The spatial development plan thus contributes to achieving the objectives of the MSFD.

### 4.7.1 Seabed/Site

The spatial development plan reinforces nature conservation in the German EEZ by defining priority areas for nature conservation. This supports the expected positive effects of management measures for marine protected areas on the seabed protected asset.

### 4.7.2 Benthos and biotopes

The designation of the designated nature conservation areas of the North Sea EEZ as nature conservation priority areas supports the positive effects on benthic communities and biotopes that can be expected on the basis of appropriate management measures for the nature conservation areas.

The spatial planning designation as a priority area supports the maintenance or restoration of a favourable conservation status for the habitat types characteristic of the nature conservation areas as defined in Annex I of Directive

92/43/EEC (sandbanks with only weak permanent cover by seawater (EU code 1110) and reefs (EU code 1170)), as well as the natural or semi-natural character of species-rich gravel, coarse sand and sediment beds and the function of these habitats as regeneration areas for benthic biotic communities.

#### 4.7.3 Fish

The designation of nature reserves as priority areas in the EEZ could have a positive impact on the fish fauna. In particular, marine protected areas could increase the biodiversity and condition of the fish zone and counteract the overexploitation of fish stocks.

#### 4.7.4 Marine mammals

The harbour porpoise is one of the protected species in all three priority areas of nature conservation. In addition, the plan defines the main concentration area identified as part of BMU's noise abatement concept (2013) as the reserve area for harbour porpoises during the sensitive period from 1 May to 31 August inclusive. The designation of wind energy priority areas exclusively outside priority areas for nature conservation leads to the avoidance and mitigation of negative impacts on the population of harbour porpoise in the German North Sea EEZ. The designation of the porpoise priority area will also protect important habitats during the rearing season.

As a result, the nature conservation provisions have a positive impact on the conservation status of the harbour porpoise population.

#### 4.7.5 Avifauna

Among other things, the spatial development plan defines the nature reserve "Sylt Outer Reef – Eastern German Bight" with the bird sanctuary in sub-area II of the complex area as a nature conservation priority area. This provides special protection for the habitat of specially protected species and regularly occurring migratory bird species. By establishing priority and reserved areas for wind energy exclusively outside priority areas of nature conservation, the impact of offshore wind energy on protected and other bird species and their habitat, such as habitat loss and collision risks, will be reduced.

The main concentration area of loons is also designated as a nature conservation reserve (cf. ROP-E Principle (2) Ch. 2.4.1 Nature conservation). This states that the planning, construction and operation of energy generation facilities in the loon reserve should not take place if this leads to a significant impairment of the loon's habitat. This gives additional consideration to the protection of the species group of loons, which is sensitive to disturbance, and their particularly important habitat in the North Sea EEZ. In addition, the designation of the larger main concentration area of loons, which covers Part II of the nature conservation area "Sylt Outer Reef – Eastern German Bight" as a reserved area, may have a positive impact on other species protected in the nature conservation area or bird sanctuary and their feeding and resting grounds.

Many bird species migrating across the German North Sea rest on their migration to their wintering or breeding grounds in the EEZ.

All in all, the regional planning provisions on nature conservation in the EEZ have exclusively positive effects on sea and resting bird species and migratory birds.

### 4.8 Other uses without spatial specifications

#### 4.8.1 National and alliance defence

No spatial specifications are made for the defence of the country and the alliance and the military exercise areas are only presented for information purposes.

As the ROP-E only tracks the resources, there are no effects beyond the non-implementation of the plan.

### 4.8.2 Air transport

Air traffic above the EEZ takes place in the context of commercial flights at higher altitudes. No direct impact on the marine environment is expected from the provisions of the ROP-E.

### 4.8.3 Leisure

Recreational activities in the EEZ are mainly carried out through traffic involving private smaller motor and sailing boats. In contrast to areas near the coast, relatively low frequencies and environmental pollution are assumed. No direct pollution of the marine environment is to be expected as a result of the provisions of the ROP-E.

## 4.9 Interactions

In general, impacts on a protected asset lead to various consequences and interactions between the protected goods. For example, impacts on the seabed or the water body usually also have consequences for the biotic assets in these habitats. For example, pollutant discharges may reduce water and/or sediment quality and be absorbed by benthic and pelagic organisms from the surrounding medium. The biotic protection goods are essentially interlinked via the food chains. These interrelationships between the various objects of protection and possible impacts on biological diversity are described in detail for the respective objects of protection.

*Sediment shifting and turbidity plumes*

Sediment shifting and turbidity plumes occur during the construction phase for wind farms and platforms or the laying of a submarine cable system. Fish are temporarily driven away. The macrozoobenthos is covered locally. As a result, the feeding conditions for benthos-eating fish and for fish-eating seabirds and harbour porpoises also change temporarily and locally (decrease in the supply of available food). However, considerable impairments to the biotic assets to be protected, and thus to the existing interactions with one another, can be ruled out with the requisite degree of certainty due to the mobility of species and the temporal and spatial limitation of sediment relocation and turbidity plumes.

*Noise emissions*

The installation of facilities can lead to temporary escape reactions and avoidance of the area by marine mammals, some fish species and seabird species. Great seagulls, on the other hand, are attracted by the construction activities. On the other hand, avoidance by seabirds sensitive to disturbance would reduce the risk of bird strikes.

*Land use*

The laying of foundations results in a local deprivation of settlement area for the benthic zone, which can lead to a potential deterioration of the food base for the fish, birds and marine mammals following within the food pyramid. However, benthos-eating seabirds in deeper water areas are not affected by the loss of foraging area due to land sealing, as the water is too deep for effective food acquisition.

*Placement of artificial hard substrate*

The introduction of an artificial or off-site hard substrate (e.g. foundations, cable crossing structures) leads to a change in seabed and sediment conditions locally. As a consequence, the composition of the macrozoobenthos can change. According to KNUST et al (2003), the introduction of artificial hard substrate into sandy seabeds leads to the colonisation of additional species. These species will most likely be recruited from natural hard substrate habitats, such as superficial boulder clay and stones.

Thus, the risk of negative impacts on benthic sandy seabed communities by non-native species is low. However, settlement areas for sandy soil fauna are lost in these places. By changing the species composition of the macrozoobenthos community, the food base of the fish community at the site can be influenced (bottom-up regulation).

Certain fish species could be attracted, which in turn could increase the feeding pressure on the benthos by predation and thus shape the dominance relationships by selecting certain species (top-down regulation).

*Prohibition of use and visitation*

Within and around the wind farms and platforms there is a fishing ban. Restrictions on fishing can lead to an increase in the stock of both target and unused fish species, and a shift in the length spectrum of these fish species is also conceivable. In the event of an increase in fish stocks, an enrichment of the food supply for marine mammals can be expected. It is also expected that a macrozoobenthos community will develop that is undisturbed by fishing activity. This could mean that the diversity of the community of species will increase, giving sensitive and long-lived species of the current epifauna and infauna better chances of survival and developing stable stocks.

Due to the variability of the habitat, interactions can only be described in a very imprecise manner overall. In principle, it can be stated that, at present, no effects on existing interactions that could result in a threat to the marine environment are discernible as a result of the implementation of ROP-E. Therefore, it must be concluded for the SEA that, according to the current state of knowledge, no significant impacts due to interactions on the marine environment are to be expected from the provisions in the spatial development plan, but rather that, compared with non-implementation of the plan, adverse impacts can be avoided.

## 4.10 **Cumulative effects**

### 4.10.1 Seabed/site, benthos and biotopes

A substantial part of the environmental impacts caused by the areas for offshore wind energy and areas reserved for cables on the seabed, benthos and biotopes will only occur during the construction period (formation of turbidity plumes, sediment relocation etc.) and on a spatially narrowly defined area. Due to the gradual implementation of the construction projects, cumulative construction-related environmental impacts are unlikely. Possible cumulative impacts on the seabed, which could also have a direct impact on the benthic material to be protected and on specially protected biotopes, result from the permanent direct land use of the system foundations and from the cables laid. The individual impacts are generally small-scale and local.

In the area where cables are laid, the impairment of sediment and benthic organisms will be essentially temporary. In the case of crossing particularly sensitive biotopes, such as reefs or species-rich gravel, coarse sand and shell beds, permanent impairment would have to be assumed.

For a balance of site use, please refer to the environmental report on FEP 2019 or FEP draft 2020. There an estimation of the direct site use by wind energy and power cables is made using model assumptions.

No statement can be made on the use of specially protected biotopes under Article 30 of the Federal Nature Conservation Act (BNatSchG) due to the lack of a reliable scientific basis. A comprehensive sediment and biotope mapping of the EEZs currently being carried out will provide a more reliable basis for assessment in future.

In addition to the direct use of the seabed and thus of the habitat of the organisms settled there, system foundations, overlying cables and necessary crossing structures lead to an additional supply of hard substrate. As a result, alien hard substrate loving species can settle and change the species composition. This effect can lead to cumulative effects due to the erection of several offshore structures, pipelines or rock fills in crossing areas for pipelines. The benthic fauna adapted to soft seabeds also lose habitat due to the hard substrate introduced. However, since both the grid infrastructure and the wind farms will use the area ‰, no significant impacts are to be expected in the cumulative area, according to current knowledge, which would endanger the marine environment with regard to the seabed and benthos.

### 4.10.2 Fish

The impact on the fish fauna caused by the provisions is probably most strongly determined by the realisation of an initial 20 GW of wind energy in the reserved areas of the North and Baltic Seas. The impact of the OWPs will focus on the one hand on the regularly ordered closure of the area for fishing and, on the other hand, on habitat changes and their interaction.

The expected fishery-free zones within the wind farm areas could have a positive impact on the fish zone by eliminating the negative effects of fishing, such as disturbance or destruction of the seabed and catch and by-catch of many species. The lack of fishing pressure could lead to a more natural age distribution of the fish fauna, leading to an increase in the number of older individuals. The OWP could develop into an aggregation site for fish, although it is not yet clear whether wind farms attract fish.

In addition to the absence of fishing, an improved food base for fish species with a wide range of diets could be envisaged. The growth of sessile invertebrates on wind turbines could favour benthos-eating species and provide the fish with a larger and more diverse food source (LINDEBOOM et al. 2011). This could improve the condition of the fish, which in turn would have a positive effect on their fitness. Research is currently needed to transfer such cumulative effects to the fish population level.

Furthermore, wind farms in the southern North Sea could have an additive effect beyond their immediate location, by spreading the mass and measurable production of plankton by currents, which could influence the qualitative and quantitative composition of the zooplankton (FLOETER et al. 2017). This, in turn, could affect more planktonic fish species, including pelagic schooling fish such as herring and sprat, which are the target of one of the largest fisheries in the North Sea. The species composition could also change directly, as species with habitat preferences different from those of established species, e.g. reef dwellers, find more favourable living conditions and are more abundant. In the Danish wind farm Horns Rev, 7 years after construction, a horizontal gradient in the occurrence of hard-subrate-affected species was found between the surrounding sand areas and near the turbine foundations: cliff perch Ctenolabrus rupestris, eel mother Zoarces viviparous and lumpfish Cyclopterus lumpus were found much more frequently near the wind turbine foundations than on the surrounding sand areas (LEONHARD et al. 2011). Cumulative effects resulting from a major expansion of offshore wind energy could include

- an increase in the number of older individuals,
- better conditions for fish due to a larger and more diverse food base,
- the further establishment and distribution of fish species adapted to reef structures,
- the recolonisation of previously heavily fished areas and zones,
- better living conditions for territorial species such as cod-like fish.

The natural mechanism for limiting populations is, besides predation, intra- and interspecific competition, also called density limitation. It cannot be excluded that, within individual wind farms, local density limitation sets in before the favourable effects of the wind farms are spatially reproduced, e.g. through the migration of "surplus" individuals. In this case, the effects would be local and not cumulative. What effects changes in the fish fauna could have on other elements of the food web, both below and above their trophic level, cannot be predicted at this stage of knowledge.

Together with the designation of nature reserves, wind farms could contribute to positive stock development and thus to the recovery of fish stocks in the North Sea.

### 4.10.3 Marine mammals

Cumulative effects on marine mammals, in particular harbour porpoises, may occur mainly due to noise exposure during the installation of deep foundations. For example, marine mammals can be significantly affected by the fact that, if ramming is carried out simultaneously at different sites within the EEZ, there is not enough equivalent habitat available for evasion and retreat.

The implementation of offshore wind farms and platforms so far has been relatively slow and gradual. From 2009 to 2018, pile driving work was carried out on twenty wind farms and eight converter platforms in the German North Sea EEZ. Since 2011, all pile driving work has been carried out using technical noise reduction measures. Since 2014, the noise protection values have been reliably maintained and even undercut by the successful use of noise reduction systems. The majority of the construction sites were located at distances of 40 to 50 km from each other, so that there was no overlapping of noise-intensive pile driving that could have led to cumulative effects. Only in the case of the two directly adjacent projects Meerwind Süd/Ost and Nordsee Ost in area 4 was it necessary to coordinate the pile driving and aversive measures.

The evaluation of the noise results with regard to sound propagation and the possible resulting cumulation has shown that the propagation of impulsive sound is greatly restricted when effective sound-reducing measures are applied (BRANDT et al. 2018, DÄHNE et al., 2017).

Cumulative impacts by the plan on the population of harbour porpoise are considered in accordance with the requirements of BMU's 2013 noise abatement plan. To avoid and reduce cumulative impacts on the population of harbour porpoises in the German EEZ, the provisions of the downstream approval procedure stipulate that the noise impact on habitats is to be restricted to maximum permitted areas of the EEZ and nature conservation areas. According to this, the spread of noise emissions must not exceed defined proportions of the German EEZ and nature conservation areas. This ensures that animals have sufficient high-quality habitats available to them at all times for evasion. The primary purpose of the ordinance is to protect marine habitats, by avoiding and minimising disturbances caused by impulsive noise.

In concrete terms, the order in the downstream licensing notices provides for the following:

- It must be ensured with the necessary certainty that at any given time no more than 10% of the area of the German North Sea EEZ and no more than 10% of a neighbouring nature conservation area affected by sound-intensive pile driving for the foundation of the piles are affected by disturbance-inducing sound impacts.
- During the sensitive period of the harbour porpoise from 1 May to 31 August, it must be ensured with the necessary certainty that no more than 1% of sub-section I of the nature reserve "Sylt Outer Reef – Eastern German Bight" with its special function as a rearing area is affected by disturbance-inducing noise of noise-intensive pile driving for the foundation of piles.

By defining the reserve area for the harbour porpoise, the standards for the protection of impulsive noise emissions applicable to projects in the "Sylt Outer Reef – Eastern German Bight" nature reserve will, in future, also apply to projects in and around the reserve area as part of downstream approval procedures.

The area reserved for harbour porpoise during the summer months includes the "Sylt Outer Reef" protection area and its immediate surroundings. Pile-driving operations with the potential to cause disturbance due to noise in the main concentration area of harbour porpoise during the sensitive season are coordinated in such a way that the proportion of the area affected remains below 1% at all times. In addition, in accordance with the BMU's noise abatement concept (2013), all pile driving activities are coordinated with the aim of always keeping sufficient alternative possibilities free in the protected areas, in equivalent habitats and in the entire German EEZ.

The conclusion is that the implementation of the plan will lead to the avoidance and reduction of cumulative effects. This assessment also applies to the cumulative effects of the various uses on marine mammals.

#### 4.10.4 Seabirds and resting birds

Among the uses taken into account in the spatial development plan, the use of offshore wind energy by vertical structures such as platforms or offshore wind turbines, in particular, can have different impacts on seabirds and resting birds, such as habitat loss, an increased risk of collision or a chasing and disturbance effect. These effects are considered on a site and project specific basis in the environmental impact assessment and are monitored in the subsequent monitoring of the construction and operation phase of offshore wind farm projects. For seabirds and resting birds, in particular, the loss of habitat due to the cumulative effects of several structures or offshore wind farms can be significant. Therefore, the cumulative effects of offshore wind energy on seabirds and resting birds are discussed below.

In order to assess the significance of the cumulative effects on seabirds and resting birds, any effects must be assessed on a species-specific basis. In particular, species listed in Annex I of the Directive, species in sub-area II of the nature reserve "Sylt Outer Reef – Eastern German Bight" and species for which avoidance behaviour towards structures has already been established must be considered with regard to cumulative effects.

When assessing the cumulative effects of the realisation of offshore wind farms, special attention must be paid to the group of loons, together with the endangered and at the same time disturbance-sensitive species of red-throated and black-throated divers. GARTHE & HÜPPOP (2004) certify that divers are very sensitive to structures. For the consideration of cumulative effects, both neighbouring wind farms and those located in the same coherent functional spatial unit defined by physically and biologically significant characteristics for a species should be taken into account. In addition to the structures themselves, impacts from shipping traffic (including for the operation and maintenance of cables and platforms) must also be taken into account. Recent findings from studies confirm the scare effect on divers caused by ships. Star divers and black-throated divers are among the most sensitive bird species in the German North Sea to shipping traffic (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019).

The main concentration area takes into account the period of particular importance for the species, spring. On the basis of the data available at the time, the main concentration area was defined in 2009. The main concentration area was home to around 66% of the German North Sea loon population and around 83% of the EEZ population in spring and is, therefore, among other things, of particular importance in terms of population biology (BMU 2009) and an important functional component of the marine environment with regard to sea birds and resting birds. Against the background of current stock assessments, the importance of the main concentration area for loons in the German North Sea and within the EEZ has increased further (SCHWEMMER et al. 2019).

The current results from the operational monitoring of offshore wind farms and from research projects, which partly used investigation methods independent of the standardised monitoring according to the Standard Investigation Concept (SIC) (e.g. telemetry study within the framework of the DIVER project), unanimously show that the avoidance behaviour of loons towards offshore wind farms is far more pronounced than had been anticipated in the original approval decisions of the wind farm projects (cf. Chapter 3.2.6).

The interim results of an FTZ study were presented at the BSH's Marine Environment Symposium 2018. The results have been published (GARTHE et al. 2018, SCHWEMMER et al. 2019). The cumulative consideration of the avoidance behaviour of loons compared to offshore wind farms showed a calculated complete habitat loss of 5.5 km and a statistically significant decrease in abundance up to a distance of 10 km, starting from the periphery of a wind farm (GARTHE et al. 2018). The statistically significant decrease in abundance is not a total avoidance, but a partial avoidance, with increasing densities of loons up to a distance of 10 km from a wind farm. The calculated total habitat loss of 5.5 km is used to quantify the habitat loss in analogy to the former shunning distance of 2 km. It is based on the purely statistical assumption that there are no loons within 5.5 km of an offshore wind farm. A further cross-project study on the occurrence and distribution of, and effects of offshore wind farm projects on loons in the German North Sea commissioned by the BWO provided comparable results for all wind farm projects realised, with a significant avoided distance of 10 km and a calculated total habitat loss of approx. 5 km. The results from GARTHE et al. (2018) regarding the avoidance behaviour of loons are thus confirmed by an independent study (BIOCONSULT SH et al. 2020).

In summary, the results of the monitoring and research projects show that the avoidance behaviour of loons towards offshore wind farms is much more pronounced than previously assumed. A population calculation for the main concentration area within the scope of the FTZ's sea diver study commissioned by BfN and BSH showed an increase in the red-throated diver population for the period 2002 to 2012, which has remained at a relatively constant high level since 2012. However, a decrease in the red-throated diver population has been observed for the entire German North Sea, whose sub-areas have different local significance as a habitat for loons, since 2012 (observation period until 2017) (SCHWEMMER et al. 2019). The study commissioned by the BWO yields qualitatively and quantitatively comparable population figures and population trends for the main concentration area and the German North Sea. Differences can be attributed to different methods of population calculation and modified categorisation bases.

Both studies confirm the overall high and special functional importance of the main concentration area as a habitat for loons in the German North Sea (SCHWEMMER et al. 2019, BIOCONSULT SH et al. 2020). This is particularly true against the background of the pronounced avoidance behaviour and associated habitat loss.

The main concentration area represents a particularly important component of the marine environment in terms of seabirds and resting birds, in particular the group of loons. The spatial planning definition of the main concentration area for loons as a reserved area takes particular account of the protection of loons in this particularly important habitat, especially against the background of the observed avoidance behaviour from the operational phase of the OWP in the North Sea EEZ. The designation of areas EN4 and EN5 within the main concentration area as reserved areas for offshore wind energy takes up the examination of areas N-4 and N-5 for subsequent use in FEP 2019 (BSH 2019) at the level of regional planning. The layout of area EN13 and the maintenance of a distance of 5.5 km from the main concentration area will also avoid further area-related impairments, taking into account the current state of scientific knowledge.

The definitions of other uses are located outside the main concentration area of loons in areas of lesser importance for divers and/or refer to uses whose impacts are mostly temporary and local (cf. corresponding sub-chapters in Chapters 3 and 4). In conclusion, it can be stated that, based on the current state of knowledge and taking into account the provisions and principles for the protection of the main concentration area, no significant cumulative impacts of spatial planning provisions on the group of loons, which is sensitive to disturbance, (in this case red-throated and black-throated divers) are to be expected.

For other species of sea birds and resting birds, it can be assumed that the provisions and principles relating to divers and the main area of concentration will also have a positive effect. The nature conservation priority areas contribute to safeguarding open spaces, as uses incompatible with nature conservation are excluded in them. These definitions protect important habitats and reduce habitat impairment and collision risks there. Outside the nature conservation areas, the occurrence of some species is characterised by the fact that they occur over a large area within the EEZ with no clear distribution priorities (see Chapter 2.8.2). Moreover, the impacts of some uses often have a local impact and are limited to the duration of use (cf. corresponding sub-chapters in Chapters 2and 3). Moreover, some spatial planning regulations, such as those governing shipping, are not expected to lead to a densification or increased intensity of use, but rather represent a record of existing activity levels.

As a result of the SEA, considerable cumulative effects of the spatial planning provisions on the protected property of sea birds and resting birds are not to be expected according to current knowledge.

#### 4.10.5 Migratory birds

Among the uses taken into account in the spatial development plan, the use of offshore wind energy by the vertical structures of offshore wind turbines in particular can have different impacts on migratory birds, such as barrier effects and risks of collision. These effects are considered specifically for each site within the scope of the environmental impact assessment and are monitored within the subsequent monitoring of the construction and operation phase of offshore wind farm projects.

By defining priority and reserved areas for offshore wind energy in a spatial context and securing open space in nature reserves, barrier effects and collision risks in important food and resting habitats are reduced. The effects of the further uses or their definitions are comparatively less space-consuming with regard to the verticality in airspace.

According to current knowledge, significant cumulative effects of the spatial planning definitions of all uses taken into account on migratory birds can be ruled out with the necessary certainty.

## 4.11 Transboundary effects

The SEA concludes that, as matters stand at present, the provisions of the ROP-E will not have a significant impact on the areas of neighbouring countries bordering the German North Sea EEZ.

Significant transboundary impacts can generally be ruled out for the following assets to be protected: seabed, water, plankton, benthos, biotopes, landscape, cultural heritage and other material goods, and the human being and human health. Possible significant transboundary impacts could only arise if all of the planned wind farm projects in the area of the German North Sea are taken into account cumulatively for the highly mobile objects of protection, marine mammals, sea and resting birds, migratory birds and bats and if no avoidance and mitigation measures are ordered in the context of downstream approval procedures.

With regard to fish, the SEA comes to the conclusion that, according to the current state of knowledge, no significant transboundary impacts on fish are to be expected as a result of the implementation of the ROP-E, since, on the one hand, the areas for which the ROP-E has been defined do not have a prominent function for the fish fauna and, on the other hand, the recognisable and predictable effects are of a small-scale and temporary nature. Based on current knowledge and taking into account avoidance and mitigation measures, significant transboundary impacts can also be ruled out for the protected marine mammal species. For example, the installation of the foundations of wind turbines and converter platforms is only permitted in the specific approval procedure if effective noise reduction measures are implemented. With regard to sea birds and resting birds, the "Sydlige Nordsø" Danish bird sanctuary, which is directly adjacent to the German EEZ to the north and also has a high occurrence of divers, must be taken into account when considering possible significant transboundary impacts. Based on current knowledge, the spatial development plan is not expected to have any significant effects as a result of the definitions.

For migratory birds, wind turbines, in particular, can represent a barrier or a collision risk. By defining areas for wind energy exclusively outside marine nature reserves, these impacts are reduced in important resting areas for some migratory bird species. The other uses taken into account in the spatial development plan do not have comparable spatial impacts. Based on current knowledge, no significant transboundary impacts of the provisions of the spatial development plan on migratory birds are to be expected.

# 5 Legal species protection assessment

## 5.1 General part

As explained above, the plan area, the German EEZ in the North Sea, contains several European wild bird species within the meaning of Article 1 of the Birds Directive and marine mammal species listed in Annexes II and IV of the Habitats Directive.

Within the framework of this species protection assessment, it is being investigated whether the plan meets the requirements of Section 44 subsection 1 numbers 1 and 2 of the BNatSchG for specially and specially protected animal species. In particular, it will be investigated whether the plan violates species protection prohibitions.

Under Section 44 subsection 1 number 1 of the BNatSchG, the killing or injury of wild animals of specially protected species, that is, inter alia, animals listed in Annex IV to the Habitats Directive and Annex I to the Birds Directive, is prohibited. The species protection assessment under Section 44 subsection 1 number 1 of the BNatSchG always relates to the killing and injury of individual animals.

Under Section 44 subsection 1 number 2 of the BNatSchG, it is also not permitted to cause significant disturbance to wild animals of specially protected species during the reproduction, rearing, moulting, wintering and migration periods.

It does not matter whether relevant damage or disturbances are based on reasonable grounds, nor does it matter what the reasons, motives or subjective trends are for compliance with the prohibitions. (Landmann/Rohmer Umweltrecht Volume I - Commentary on the BNatSchG, 2018, p. § 44 marginal no. 6).

According to the legal definition of Section 44 subsection 1 number 2 2nd half-sentence BNatSchG, a significant disturbance is deemed to exist if the conservation status of the local population of a species deteriorates. According to the guidelines on the system of strict protection for animal species of Community interest under the Habitats Directive (marginal note 39), a disturbance within the meaning of Art. 12 of the Habitats Directive exists if the survival chances, reproductive success or ability of a protected species to reproduce is reduced by the act in question or if this act leads to a reduction in its range. On the other hand, occasional disturbances which are not likely to have a negative impact on the species concerned are not to be regarded as disturbance within the meaning of Article 12 of the Habitats Directive.

Among the uses specified in the plan, wind power generation is the most intensive use. In recent years, the state of knowledge in connection with impacts relevant to species protection law has been expanded through the use of avoidance and mitigation measures and monitoring of them.

In the following, species protection issues are examined in respect of wind power generation. Subsequently, possible cumulative impacts with other uses are presented.

## 5.2 Marine mammals

In the German North Sea EEZ, the harbour porpoise, common seal and grey seal are species listed in Annex II (animal and plant species of Community interest whose conservation requires the designation of special areas of conservation under the Habitats Directive) and Annex IV (animal and plant species of Community interest requiring strict protection) of the Habitats Directive, which must be protected under Article 12 of the Directive. Harbour porpoises occur throughout the year in varying densities depending on the area. This also applies to common seals and grey seals. In general, it can be assumed that the entire German North Sea EEZ is part of the harbour porpoise habitat. Here, the German EEZ is used by the porpoises for passage but also for stopover and, in some cases, as feeding and nursing grounds.

The occurrence of the animals in the individual areas differs greatly from one area to another, in terms of both space and time. For marine mammals, and in particular for the specially protected harbour porpoise species, the effects of implementing the plan must be assessed in terms of species protection.

In the North Sea EEZ, three nature conservation areas were designated by ordinance in 2017 to conserve and, where necessary, restore to favourable conservation status the species listed in Annex II of Directive 92/43/EEC, namely the harbour porpoise, common seal and grey seal. The nature conservation area "Sylt Outer Reef - Eastern German Bight" serves as a nursing ground. During the period from 1 May to the end of August, mother-calf pairs are frequently recorded in the area of the "Sylt Outer Reef - Eastern German Bight" nature conservation area. The "Borkum Riffgrund" nature conservation area is of great importance for harbour porpoises in spring and partially in the early summer months. Significant densities are regularly recorded during this period. The Doggerbank nature conservation area has a lower occurrence than the other two nature conservation areas. In the Doggerbank area, animals have mainly been recorded during the summer months. Mother-calf pairs also occur here. Their presence during the summer months also suggests that the Doggerbank area is used as a nursing area.

In addition, the noise abatement concept of the Federal Environment Agency (BMU) (2013) identified a main concentration area of harbour porpoise in the period from 1 May to the end of August within the German Bight on the basis of data collected in the period from 2002 to 2010. The main concentration area comprises the nature conservation area "Sylt Outer Reef - Eastern German Bight" and is defined as a conservation area for harbour porpoises in the spatial plan because of its special importance for porpoise population conservation. The special importance of the reserve derives from the regular occurrence of harbour porpoises and the presence of mother-calf pairs during the summer months within this area.

Priority areas EN1, EN2 and EN3 are of medium to high importance for harbour porpoises (during spring), while by contrast they are of low to medium importance for grey seals and common seals. Based on the new findings, reservation area EN4, priority area EN13 and a section of priority area EN11 (near the nature conservation area) are of medium importance for harbour porpoises, even of high importance during summer, and form part of the main identified concentration area of harbour porpoises in the German North Sea (BMU, 2013). The EN5 reservation areas is located in the main harbour porpoise concentration area and is used both as a feeding and nursing ground for harbour porpoises - even though the focus of the concentration is located within sub-area I of the "Sylt Outer Reef - Eastern German Bight" nature conservation area. The EN5 area is of great importance in the summer months as part of the harbour porpoise nursing area in the German Bight.

The priority areas EN6 to EN12 are of medium importance for harbour porpoises and low importance for grey seals and common seals. In general, the EN4 and EN5 priority areas and, to some extent, the EN11 and EN13 priority areas are expected to be of high importance for harbour porpoises. The priority areas EN4 and EN5 are of low to medium importance for grey seals and common seals. Priority areas EN11 and EN13 are of minor importance for grey seals and common seals. Priority areas EN14 to EN18 are of medium importance for harbour porpoises and of low importance for common seals and grey seals. The EN19 reservation area, like the Doggerbank nature conservation area, is of high importance for harbour porpoise during the summer months and marks the edge of a large concentration area east of the British Isles. The EN19 reserve is of minor importance for common seals and grey seals.

### 5.2.1 Section 44 subsection 1 number 1 BNatSchG (prohibition of killing and injury)

Under Section 44 subsection 1 number 1 of the BNatSchG, the killing or injury of wild animals of specially protected species, i.e., inter alia, animals listed in Annex IV to the Habitats Directive, is prohibited. The species protection assessment under Section 44 subsection 1 number 1 of the BNatSchG relates to the killing and injury of individual animals (Gellermann, in: Landmann/Rohmer Umweltrecht, as of 91 EL September 2019, Section 44 of the BNatSchG, margin note 51). The assessment is carried out for all areas of the plan, namely EN1 up to and including EN19.

The main threats with fatal consequences for harbour porpoise in the ASCOBANS Agreement area, which includes the German EEZ in the North Sea, include as by-catch in gillnets but also in trawls, attacks by dolphins, depletion of food resources, physiological effects on reproductive capacity and infectious diseases, possibly as a result of contamination with pollutants. A survey of 1692 deaths along the UK coast between 1991 and 2010 showed that 23% of deaths were associated with infectious diseases, 19% with dolphin attacks and 17% with by-catch. A further 15% had died of starvation and 4% were stranded while alive (Evans, 2020).

Evidence of collisions with ships exists for at least 21 whale species (Evans, 2003, cited in Evans 2020). However, collision risks are highest for large cetacean species, such as the fin whale or the humpback whale (Evans, 2020). A study on the causes of deaths on the coasts of the British Isles has shown that about 15% to 20% of baleen whales (fin whale, minke whale) have had injuries that could have resulted from collisions with ships. In contrast, only 4% to 6% of small cetaceans, such as harbour porpoise and dolphin, had similar injuries (Evans, Baines & Anderwald, 2011, cited in Evans, 2020).

Based on the current state of knowledge, killing or injury of individual animals as a consequence of the uses specified in the plan is possible due to the input of impulse sound during pile driving of installation foundations.

Marine mammals, and in particular the highly protected harbour porpoise species, would be highly likely to be injured or even killed by pile-driving for the foundations of offshore wind turbines, substations or other platforms if no prevention and mitigation measures were taken.

In its statements BfN frequently assumes that, according to current knowledge, injuries in harbour porpoises occur in the form of temporary hearing loss when animals are exposed to a single event sound pressure level (SEL) of 164 dB re 1 µPa2/Hz or a peak level of 200 dB re 1 µPa.

According to the BfN, it is sufficiently certain that, if the specified limits of 160 dB for the sound event level ($SEL_{05}$) and 190 dB for the peak level at a distance of 750 m from the emission point are complied with, killing and injury pursuant to Section 44 subsection 1 number 1 of the BNatSchG cannot occur.

The BfN assumes that use of suitable means such as deterrence conditioning and soft-start procedures will ensure that no harbour porpoises are present within a 750 m radius of the pile-driving site.

The BSH agrees with this assessment in the update of the ROP-E on the basis of the existing knowledge, in particular from the enforcement procedures of installations already in operation. The plan specifies objectives and principles that provide a framework for downstream planning levels and individual licensing procedures. In the downstream procedures, specifications, orders and requirements are made with regard to the necessary noise abatement measures and other avoidance and reduction measures by means of which the realisation of the prohibition can be excluded or the intensity of any adverse effects can be reduced. The measures are strictly monitored using the prescribed monitoring system to ensure with the necessary certainty that the killing and injury pursuant to Section 44 subsection 1 number 1 of the BNatSchG will not occur.

The plan update contains principles according to which the introduction of noise into the marine environment should be avoided during the construction of installations in accordance with the state of the art in science and technology and the overall coordination of the construction of installations located in close proximity to each other should be ensured. Noise abatement measures are to be applied. On this basis, the BSH may, within the framework of the subordinate procedures, the site development plan, the suitability test of sites and, in particular, within the framework of the respective individual licensing procedures and within the framework of enforcement, order suitable specific measures with regard to individual work steps, such as deterrent measures and a slow increase in pile driving energy, by means of soft start procedures. Deterrent measures and a soft-start can ensure that no harbour porpoises or other marine mammals are present in an adequate area around the pile-driving site, which is no less 750 m from the construction site.

In accordance with the precautionary principle, the above-mentioned deterrent and reduction measures may preclude the implementation of the prohibition on killing. The use of appropriate deterrent measures will ensure that the animals are outside the 750-metre radius of the point of emission. In addition, the degree of noise reduction required and specified in the draft suitability assessment must be such that it can be assumed that outside the area in which no harbour porpoises are expected to be present as a result of the deterrent measures to be implemented, there will be no lethal and no long-term adverse effects of the noise.

In the light of the above, it can be concluded with sufficient certainty that the prohibitions under species protection law in Section 44 subsection 1 number 1 of the BNatSchG will not be violated.

According to the current state of knowledge, neither the operation of the installations nor the laying and operation of the farm's internal cabling will have any significant negative impacts on marine mammals that would fulfil the killing and injury criteria under Section 44 subsection 1 number 1 of the BNatSchG.

Since 2018, the Fauna Guard System has been installed as a deterrent measure in all construction projects in the German North Sea EEZ. The use of the Fauna Guard System is accompanied by strict monitoring measures with good results so far. Within the framework of a research project, the effects of the Fauna Guard System are currently being systematically analysed and - if necessary - the application of the system for future construction projects will be optimised (FaunaGuard Study, 2020, in preparation).

To avoid cumulative effects, prohibitions will be imposed in the context of downstream approval procedures and enforcement to ensure that no animals are injured or killed by multiple sources of impulse sound inputs acting at the same time. For example, no pile driving is allowed during the detonation of non-transportable ammunition.

As a result, the principles and objectives laid down in the plan and the measures ordered in the context of subordinate procedures, in particular the approval procedures for individual projects, prevent, with sufficient certainty, violation of the species protection prohibitions of Section 44 subsection 1 number 1 of the BNatSchG.

According to the current state of knowledge, neither the operation of the facilities, nor the laying and operation of the park's internal cabling, nor the laying and operation of the grid connection will have any significant negative impacts on marine mammals that meet the killing and injury criteria under Section 44 subsection 1 number 1 of the BNatSchG.

### 5.2.2 Section 44 subsection 1 number 2 BNatSchG (prohibition on interference)

Under Section 44 subsection 1 number 2 of the BNatSchG, it is also prohibited to cause significant disturbance to wild animals of specially protected species during the reproduction, rearing, moulting, wintering and migration periods.

The harbour porpoise is a specially protected species in accordance with Annex IV of the Habitats Directive and thus is likewise within the meaning of Section 44 subsection 1 number 2 in conjunction with Section 7 subsection 1 number 14 of the Federal Nature Conservation Act (BNatSchG), so that a species protection assessment must also be carried out in this respect.

The species protection assessment under Section 44 subsection 1 number 2 of the BNatSchG (BNatSchG) relates to population-relevant disturbances of the local population, the occurrence of which varies in the German North Sea EEZ.

In its statements in the context of licensing and enforcement procedures, the BfN regularly examines the existence of a disturbance under species protection law within the meaning of Section 44 subsection 1 number 2 BNatSchG. It comes to the conclusion that the occurrence of a significant disturbance caused by construction-related underwater noise in relation to the protected species harbour porpoise can be avoided, provided that the sound event level of 160 dB or the peak level of 190 dB is not exceeded at a distance of 750 m from the point of emission and sufficient alternative areas are available in the German North Sea. BfN demands that the latter be ensured by coordinating the timing of noise-intensive activities of different project developers with the aim of ensuring that no more than 10 % of the area of the German North Sea EEZ is affected by noise (BMU 2013).

<u>Construction-related effects of wind power generation</u>

The temporary pile driving work is not expected to cause any significant disturbance to harbour porpoises within the meaning of Section 44 subsection 1 number 2 of the BNatSchG.

According to the current state of knowledge, it cannot be assumed that disturbances which may occur due to sound-intensive construction operations, provided that deterrent and reduction measures are implemented, would worsen the conservation status of the local population. A local population comprises those (sub-)habitats and activity areas of individuals of a species which are sufficiently spatially and functionally interrelated to meet the habitat requirements of the species. A deterioration of the conservation status is to be assumed in particular if the survival chances, breeding success or reproductive capacity is reduced, in which respect this is to be examined and assessed on a species-specific basis for each individual case (cf. explanatory memorandum to the BNatSchG Amendment 2007, BT-Drs. 11).

Through effective noise abatement management, in particular by applying suitable noise abatement systems in accordance with the principles and objectives in the plan update and subsequent arrangements in the individual BSH approval procedure, and taking into account the requirements of the noise abatement concept of the BMU (2013), negative impacts of the pile driving on harbour porpoises are not to be expected.

The decisions of the BSH will contain specific orders that ensure effective noise abatement management by appropriate measures.

In accordance with the precautionary principle, measures to avoid and reduce the effects of noise during construction are specified according to the state of the art in science and technology. The specifications in the subordinate procedures and, in particular, the measures ordered in the planning approval decisions to ensure the requirements of species protection are coordinated with the BfN in the course of implementation and adapted, if necessary. The following noise-reducing and environmental protection measures are ordered regularly within the framework of the plan-approval procedures:

- Preparation of a noise forecast under consideration of the site- and installation-specific characteristics (basic design) before the start of construction,
- Selection of the construction method with the lowest noise level according to the state of the art and the existing conditions,
- Preparation of a specific noise control concept, adapted to the selected foundation structures and erection processes, for carrying out the pile driving work, in principle two years before the start of construction, and in any case before the conclusion of contracts concerning the components affected by noise,
- Use of accompanying noise-reduction measures, individually or in combination, pile-remote (bubble curtain system) and, if necessary, pile-related noise-reducing systems in accordance with the state of the art in science and technology,
- Consideration of the characteristics of the hammer and the possibilities of controlling the pile driving process within the noise control concept,
- Concept for deterring the animals from the endangered area (at least within a radius of 750 m around the pile-driving site),
- An approach to verify the effectiveness of the deterrent and noise-reducing measures,
- State of the art installation design to reduce operating noise.

As outlined above, deterrent measures and a soft-start procedure must be applied to ensure that animals in the vicinity of the pile-driving operations have the opportunity to move away or to avoid them in good time.

Even a measure ordered to avoid the risk of killing pursuant to Section 44 subsection 1 number 1 of the BNatSchG, such as deterring a species, can in principle comply with the prohibition of disturbance if it takes place during the periods of protection and is significant (BVerwG, judgement of 27 November 2018 - 9 A 8/17, cited in juris).

For deterrence up until 2017, a combination of pingers was used as a pre-warning system, followed by the use of the so-called Seal Scarers as a warning system. All the results of the monitoring by means of acoustic detection of harbour porpoises in the vicinity of offshore construction sites with pile driving have confirmed that the use of deterrence has always been effective. The animals have left the danger zone of the respective construction site. However, scaring deterrence using Seal Scarers is accompanied by a large loss of habitat, caused by the animals' flight reactions and therefore constitutes a disturbance (BRANDT et al., 2013, DÄHNE et al., 2017, DIEDERICHS et al., 2019).

To prevent this, a new system for deterring animals from the danger zone of the construction sites, the so-called Fauna Guard System, has been used in construction projects in the German North Sea EEZ since 2018. For the first time, the development of new deterrent systems, such as the Fauna Guard System, opens up the possibility of adapting the deterrent measures for harbour porpoise and seals in such a way that the contravening of the prohibition of Section 44 subsection 1 number 1 of the BNatSchG can be ruled out with certainty without the simultaneous contravening of the prohibition of Section 44 subsection 1 number 2 of the BNatSchG.

The use of the Fauna Guard System is accompanied by monitoring measures. The effects of the Fauna Guard System are being systematically analysed as part of a research project. If necessary, adjustments in the application of the system will have to be implemented in future construction projects (FaunaGuard study, in preparation).

The selection of noise abatement measures by the subsequent developers of the individual projects must be based on the state of the art in science and technology and on experience already gained in other offshore projects. Findings based on practical experience in the application of technical noise-reducing systems and from experience with the control of the pile driving process in connection with the characteristics of the impact piling hammer were gained, in particular, during the foundation work in the projects "Butendiek", "Borkum Riffgrund I", "Sandbank", Gode Wind 01/02", "NordseeOne", "Veja Mate", "Arkona Basin Southeast", "Merkur Offshore", "EnBWHoheSee" and others. A current study commissioned by BMU (BELLMANN, 2020) provides a cross-project evaluation and presentation of the results from all technical noise abatement measures used in German projects to date.

The results of the very extensive monitoring of the construction phase of 20 offshore wind farms have confirmed that the measures to avoid and reduce disturbances to harbour porpoise arising from impact noise are effectively implemented and that the requirements of BMU's noise abatement concept (2013) are reliably met. The current state of knowledge takes into account construction sites at water depths of 22 m to 41 m, in soils with homogeneous sandy to heterogeneous and difficult to penetrate profiles and piles with diameters of up to 8.1 m. It has been shown that the industry has found solutions in the various procedures to effectively harmonise installation processes and noise protection.

According to the current state of knowledge and on the basis of the development of technical noise protection to date, it can be assumed that considerable disturbance to harbour porpoises can be excluded from the foundation work within the areas covered by the plan, even assuming the use of piles with a diameter of more than 10 m.

In addition, the plan approval decision of the BSH will specify monitoring measures and noise measurements in detail in order to detect a possible hazard potential on site on the basis of the actual project parameters and, if necessary, to initiate optimisation measures.

New findings confirm that the reduction of noise input through the use of technical noise reduction systems clearly reduces disturbance effects that act on harbour porpoises. The minimisation of effects concerns both the spatial and temporal extent of disturbances (DÄHNE et al., 2017, BRANDT et al. 2016, DIEDERICHS et al., 2019).

To avoid cumulative effects due to parallel pile driving on different projects, a temporal coordination of pile driving is ordered within the framework of subordinate planning approval procedures and implementation in accordance with the specifications of the noise protection concept of the BMU (2013). The BMU's noise abatement concept (2013) follows an area approach with the objective of always keeping sufficiently high-quality alternative habitats for the harbour porpoise population in the German North Sea EEZ free of disturbance-inducing noise inputs.

In actual terms, the coordination of pile driving activities, including deterrent measures, across projects will ensure that the noise protection values are complied with at 750 m and that at no time will more than 10% of the area of the German EEZ in the North Sea be affected by disturbance-inducing impulse sound. It is assumed that disturbances can occur at an unweighted broadband SEL of 140 dB re 1µPa2S, which would be expected if the noise protection values mentioned above were observed within a radius of about 8 km around the respective pile-driving point.

Cumulative effects on marine mammals, in particular harbour porpoises, may occur mainly due to noise exposure during the installation of foundations using impact pile driving. For example, marine mammals may be significantly affected if pile driving takes place simultaneously at different sites within the EEZ without equivalent alternative habitats being available.

So far, the erecting of offshore wind farms and platforms has been relatively slow and gradual. In the period from 2009 to 2018 inclusive, pile driving work was carried out on twenty wind farms and eight converter platforms in the German North Sea EEZ. Since 2011, all pile driving work has been carried out using technical sound reduction measures. Since 2014, the sound protection values have been reliably met and even undercut by the successful use of sound reduction systems (Bellmann, 2020 in preparation).

The majority of the construction sites were located at distances of 40 km to 50 km away from each other, so that there was no overlap of noise-intensive pile driving that could have led to cumulative effects. Only in the case of the two directly adjacent projects Meerwind Süd/Ost and Nordsee Ost in area N-4 was it necessary to coordinate the pile driving, including deterrent measures.

The evaluation of the sound results with regard to sound propagation and the possible resulting accumulation has shown that the propagation of impulsive sound is greatly restricted when effective sound-reducing measures are applied (DÄHNE et al., 2017).

Two studies from 2016 and 2019 commissioned by the German Offshore Wind Energy Association (BWO) provide current findings on possible cumulative effects of the impact sound on the occurrence of harbour porpoise in the German North Sea EEZ. Within the framework of the two studies, the extensive data from monitoring the construction phases of offshore wind farms by means of acoustic and visual/digital recording of harbour porpoise were evaluated and assessed across projects (Brandt et al., 2016, Brandt et al., 2018, Diederichs et al., 2019). In both studies, the effects were assessed on the basis of the range and duration of the expulsion of harbour porpoises from the vicinity of pile-driving sites before, during and after pile-driving.

The 2019 study, which is concerned with the evaluation of the data from the period 2014 to 2018 inclusive, comes to the conclusion that the optimised use of the technical sound reduction measures since 2014 and the resulting reliable compliance with the limit value has not led to any further reduction of the displacement effects on harbour porpoises compared to the phase from 2011 to 2013 with sound reduction systems that had not yet been optimised. The displacement radius determined in both studies is approximately 7.5 km, thus confirming the assumptions made in BMU's noise abatement concept (2013). However, the latest study has also shown that no reduction in displacement effects could be detected even at a sound value of 165 dB ($SEL_{05}$ re 1µPa2 s at a distance of 750 m) (Diederichs et al., 2019). The authors of the study put forward various hypotheses for the interpretation of the results, which take into account, among other things, psychoacoustic reactions of the animals, differences in food availability, effects of deterrent behaviour using SealScarer and the activity of the respective construction site, but also differences in data quality. The study also evaluated data from the construction of a wind farm in the EEZ of a neighbouring country without the use of noise reduction measures. It was shown that the displacement and thus the disturbance at construction sites with the use of sound reduction systems is significantly lower than at construction sites without sound reduction (Diederichs et la. 2019).

According to the current state of knowledge, avoidance and mitigation measures, as described above, are required during pile driving operations in order to exclude with certainty any significant disturbance of the local harbour porpoise population.

As a result, applying the above-mentioned stringent sound abatement and sound control measures in accordance with the principles and objectives of the plan and the orders in the planning approval decisions, taking into account the noise control concept of the BMU (2013) and compliance with the limit value of 160 dB $SEL_5$ at a distance of 750 m, no significant disturbances within the meaning of Section 44 subsection 1 number 2 of the BNatSchG are to be expected. Furthermore, the BfN's demand to coordinate the timing of noise-intensive construction phases of different project developers in the German North Sea EEZ in accordance with the BMU's Noise Abatement Concept (2013) is mandated.

<u>Operational effects of wind energy generation</u>

According to the current state of knowledge, the <u>operation</u> of offshore wind turbines cannot be assumed to constitute a disturbance pursuant to Section 44 subsection 1 number 2 BNatSchG. Based on the current state of knowledge, no negative long-term effects from wind turbine noise emissions for harbour porpoises are to be expected assuming the normal design of the plants. Any effects are limited to the immediate vicinity of the plant and depend on sound propagation in the specific area and, not least, on the presence of other sound sources and background noise, such as shipping traffic (MADSEN et al. 2006). This is confirmed by findings from experimental work on the perception of low-frequency acoustic signals by harbour porpoises using simulated operating noises from offshore wind turbines (LUCKE et al. 2007b): masking effects were recorded at simulated operating noises of 128 dB re 1 µPa at frequencies of 0.7, 1.0 and 2.0 kHz. By contrast, no significant masking effects were detected at operating noises of 115 dB re 1 µPa. The first results thus indicate that masking effects due to operating noises can only be expected in the immediate vicinity of the respective plant, with the intensity again dependent on the type of installation.

Standardised measurements during the operating phase of offshore wind farms in the German North Sea EEZ have confirmed that, from an acoustic point of view, the underwater noise outside the wind farm areas cannot be clearly distinguished from the background noise that is permanently present. Only low-frequency sounds can be measured at a distance of 100 m from the respective wind turbine. However, with increasing distance from the wind turbine, the noise of the turbine differs only slightly from the ambient sound. At just 1 km from the wind farm, noise levels are always higher than those measured in the middle of the wind farm. The investigations have shown clearly that the underwater sound emitted by the turbines cannot be identified clearly relative to other sound sources, such as waves or ship noise, even at short distances. It was also hardly possible to differentiate the wind farm related shipping traffic from the general ambient noise, which is introduced by various sound sources such as other shipping traffic, wind and waves, rain, and other uses of the sea (MATUSCHEK et al. 2018). Results from current investigations of underwater noise in the operating phase of offshore wind farms are presented in detail in Chapter 3.2.5

Results of a study on the habitat use of offshore wind farms by harbour porpoises operating from the Dutch offshore wind farm "Egmont aan Zee" confirm this assumption. The acoustic survey was used to assess the use of the wind farm site or two reference sites by harbour porpoises prior to the installation of the turbines (baseline survey) and during two consecutive years of operation. The results of the study confirm a pronounced and statistically significant increase in acoustic activity in the inner area of the wind farm during the operating phase compared to the activity or use during the baseline survey (SCHEIDAT et al. 2011). The increase in harbour porpoise activity within the wind farm during operation significantly exceeded the increase in activity in both reference areas. The increase in use of the wind farm area was significantly independent of seasonality and interannual variability. The authors of the study see a direct correlation between the presence of the turbines and the increased use by harbour porpoises. They suspect the causes to be factors such as an enrichment of the food supply due to a "reef effect" or calming of the area due to the absence of fishing and shipping or possibly a positive combination of these factors.

The results of the investigations during the operational phase of the "alpha ventus" project also indicate a return to distribution patterns and abundances of harbour porpoise that are comparable - and in some cases higher - than those from the baseline survey of 2008.

The results from the monitoring of the operational phase of offshore wind farms in the EEZ have so far not provided clear results. The investigation according to StUK4 by means of aircraft-based recording has so far revealed fewer sightings of harbour porpoises inside the wind farm areas than outside. However, acoustic recording of habitat use by means of special underwater measuring devices, the so-called CPODs, shows that harbour porpoises use the wind farm areas (Butendiek 2017, North Helgoland, 2019, Krumpel et al., 2017, 2018, 2019). The two methods - visual/digital detection from aircraft and acoustic detection - are complementary, i.e. the results from both methods should be used to identify and assess possible effects. The joint evaluation of the data, the development of suitable evaluation criteria and the description of the biological relevance is to be the subject of a research programme.

In order to ensure with sufficient certainty that contravening of the prohibition pursuant to Section 44 subsection 1 number 2 of the BNatSchG will not occur, an operational sound-reducing turbine design in accordance with the state of the art will be used against this background in the sense of the corresponding requirements of the subordinate suitability assessment and the instructions in individual planning approval decisions.

Appropriate monitoring will also be arranged for the operational phase of the individual projects in the areas covered by the plan in order to identify and assess any site and project-specific impacts.

As a result, the protective measures ordered are sufficient to ensure that, where harbour porpoises are concerned, operation of turbines in the areas covered by the plan also does not contravene the prohibitions according to Section 44 subsections 1 and 2 of the BNatSchG.

<u>Cumulative consideration</u>

In Chapter 4.10.3the cumulative effects of offshore wind energy generation on harbour porpoises were presented and at the same time deterrent and mitigation measures were described. However, harbour porpoises are exposed to the impacts of various anthropogenic uses and natural and climate-related changes. Scientifically, it is hardly possible to differentiate or even weight the impact of individual uses on the condition of the population. The designation of priority areas for wind energy exclusively outside nature conservation areas is a measure to ensure the protection of harbour porpoises in the German EEZ. In addition, spatial planning paves the way for downstream planning levels and procedures. Finally, the principles of the plan form the backbone for the specifications in the downstream procedures and for the orders for the protection of harbour porpoise within the framework of individual licensing procedures.

The evaluation of current data on the occurrence of the harbour porpoise in the German North Sea EEZ has shown changes in the occurrence and population trends in the years 2012 to 2018. Results of the large-scale survey of the North Sea population have also demonstrated a shift in the population in the southern North Sea. The authors of the study assume a variety of causes for the observed changes, including previous impacts from fisheries, pollutants, decline in the health status, noise inputs from offshore activities and shipping, changes in food supply due to the displacement of fish stocks and, of course, cumulative effects (Gilles et al, 2019).

Spatial planning or the designations of the plan, including the principles and objectives, is one of the key instruments for reducing or even preventing cumulative impacts on the harbour porpoise population by balancing spatial conflicts between uses and by defining priority and reservations areas for nature conservation.

The designation of priority areas for wind energy exclusively outside nature conservation areas is a measure to ensure the protection of harbour porpoises in the German EEZ. In addition, spatial planning paves the way for downstream planning levels and procedures. Finally, the principles of the plan form the backbone for the designations in the downstream procedures and for the orders for the protection of harbour porpoises within the framework of individual licensing procedures.

In addition, BMU's noise abatement concept for the North Sea of 2013 also contains a number of requirements, based on the pursued habitat approach, that ensure effective prevention and a reduction of cumulative impacts caused by pile driving noise on the local harbour porpoise population in the German EEZ and on the populations in the nature conservation areas. This plan has designated the main concentration area of harbour porpoises in the German North Sea EEZ identified in the context of the preparation of BMU's noise abatement concept (2013) as the reservation area for harbour porpoise during the sensitive period from 1 May to 31 August. As part of the subordinate procedures or in individual licensing procedures for the uses, the special requirements of the BMU's noise abatement concept are mandated in the nature conservation areas and in the reservation area.

In conclusion, with regard to the harbour porpoise, it must be stated that the implementation of the plan ensures that the prohibitions set out in Section 44 subsection 1 numbers 1 and 2 of the BNatSchG are not contravened, even with regard to cumulative effects.

<u>Other marine mammals</u>

In addition to the harbour porpoise, animal species listed as such in a statutory instrument pursuant to Section 54 subsection 1 are considered specially protected under Section 7 subsection number 13 letter c BNatSchG. The BartSchV (Ordinance for the Protection of Wild Fauna and Flora), which was issued on the basis of Section 54 subsection 1 number 1 BNatSchG, lists native mammals as specially protected, which thus also fall under the species protection provisions of Section 44 subsection 1 number 1 BNatSchG. As a matter of principle, the considerations listed in detail for harbour porpoises regarding noise pollution from the construction and operation of offshore wind turbines apply to all other marine mammals occurring in the areas covered by the plan. However, dependent on the species, hearing thresholds, sensitivity and behavioural responses vary considerably among marine mammals. The differences in the perception and evaluation of sound events among marine mammals are based on two components: on the one hand, the sensory systems are morphoanatomically and functionally species-specific. As a result, marine mammal species hear and react differently to sound. On the other hand, both perception and reaction behaviour depend on the respective habitat (KETTEN 2004).

The areas covered by the plan have a low to medium importance for common seals and grey seals. The closest frequently frequented breeding and resting sites are located at a great distance on Helgoland and on the East Frisian and North Frisian islands.

Seals are generally considered tolerant of sonic activity, especially when they have a plentiful supply of food. However, telemetric studies have shown flight reactions during seismic activity (RICHARDSON 2004). According to all current findings, seals can still hear pile-driving sounds at a distance of more than 100 km. Operating noises from 1.5 - 2 MW wind turbines can be heard by common seals even at a distance of 5 to 10 km (LUCKE K., J. SUNDERMEYER & U. SIEBERT, 2006, MINOSplus Status Seminar, Stralsund, Sept. 2006, presentation).

All in all, it can be assumed that the species protection requirements can be met due to the long distances to breeding and resting grounds and the measures taken.

With regard to the common seal and grey seal, the prevention and mitigation measures already mentioned for harbour porpoise apply.

As a result, it can be concluded with regard to seals and grey seals that the implementation of the plan does not contravene the prohibitions under section 44 subsection 1 number 1 and 2 of the BNatSchG (BNatSchG) with regard to other marine mammals either.

## 5.3 **Avifauna**

Protected bird species listed in Annex I of the Birds Directive occur in varying densities in the areas defined in ROP-E. Against this background, the compatibility of the plan with Section 44 subsection 1 number 1 of the BNatSchG (prohibition of killing and injury) and Section 44 subsection 1 number 2 of the BNatSchG (disturbance of specially protected species and European bird species) must be examined and ensured.

All findings to date indicate a medium importance of areas EN1, EN2 and EN3 for seabirds, including species listed in Annex I of the Birds Directive. Although the area EN4 is only of medium importance for most seabird species, divers occur there in high densities in spring. Due to its location within the main concentration area of divers, the EN4 area is of high importance. The EN5 area is also located in the identified main concentration area of divers in spring in the German Bight and is therefore of great importance for the specially protected divers. The EN5 area and its surroundings have a high occurrence of seabird species, in particular protected species of Annex I of the Birds Directive, such as the easily disturbed divers. The area of areas EN6 to EN13 is outside the concentration concentrations of various bird species listed in Annex I of the Birds Directive, such as divers, terns, little gulls and petrels. Areas EN14 to EN19 show a typical community of seabirds, including fulmar, kittiwake, razorbill and guillemot.

In addition, parts of the EEZ have an average to above-average importance for bird migration. It is expected that significant proportions of songbirds breeding in northern Europe migrate across the North Sea. However, guidelines and concentration areas for bird migration are not present in the EEZ. There is evidence that migration intensity decreases with distance from the coast, but this is not clear for the mass of night migrating songbirds.

Among the uses defined in the ROP-E, wind energy production is the most intensive use, also with regard to possible impacts on seabirds. At the same time, wind energy generation is the only use that is controlled by the BSH within the framework of subordinate processes. In recent years, the monitoring of the operating phase of offshore wind farms in the German EEZ has increased the level of knowledge in connection with impacts relevant to species protection law.

### 5.3.1 Section 44 subsection 1 number 1 BNatSchG (prohibition of killing and injury)

The species protection assessment in accordance with Section 44 subsection 1 number 1 BNatSchG relates to the killing and injury of individual animals and is therefore carried out uniformly for all areas of the plan EN1 up to and including EN19.

According to Section 44 subsection 1 number 1 BNatSchG in conjunction with Article 5 of the Birds Directive , the hunting, capture, injury or killing of wild animals of specially protected species is prohibited. The specially protected species include the species listed in Annex I of the Birds Directive, species whose habitats are protected in nature conservation areas and in the reservation area for divers, as well as characteristic species of the areas covered by the plan. Accordingly, injury or killing of resting birds as a result of collisions with wind turbines must be ruled out in principle. The risk of collision depends on the behaviour of the individual animals and is directly related to the species concerned and the environmental conditions to be encountered. For example, a collision of divers is not to be expected due to their pronounced avoidance behaviour in respect of vertical obstacles.

In the planning and approval of public infrastructure and private construction projects, it is to be assumed that unavoidable operationally-related deaths or injuries of individual animals (e.g. through collision of bats or birds with wind turbines) as the actualisation of socially adequate risks do come within the scope of the prohibition (BT-Drs. 16/5100, p. 11 and 16/12274, p. 70 f.). An attribution is only made if the risk of consequences of the project is significantly increased due to special circumstances, such as the design of the turbines, the topographical conditions or the biology of the species. In this context, risk prevention and mitigation measures must be included in the assessment; cf. LÜTKES/EWER/HEUGEL, SECTION 44 BNATSCHG, NUMBER 8, 2011; BVERWG, RULING OF 12 MARCH 2008; REF. 9 A3.06; BVERWG, RULING OF 9 July 2008, ref. 9 A14.07; FRENZ/MÜGGENBORG/LAU, Section 44 BNATSCHG, NUMBER 14, 2011.

In its statements on offshore wind farm projects, BfN regularly states that due to changes in the technical size parameters of the wind turbines in current projects compared to the implementations from 2011 to 2014, the result is generally an increase in vertical obstacles in the airspace. However, based on current knowledge, an increased risk of bird strike cannot be quantified due to the simultaneous reduction in the number of turbines. It is true that individual collision-related losses caused by the erection of a fixed installation in previously obstacle-free areas cannot be completely ruled out. However, the ordered measures, such as minimisation of light emissions, ensure that a collision with the offshore wind turbines is avoided as far as possible or at least this risk is minimised. In addition, monitoring is carried out during the operating phase to enable an improved nature conservation assessment of the actual risk of bird strikes arising from the turbines. Moreover, the right to order further measures is regularly expressly reserved. Against this background, the BSH is of the opinion that no significant increase in the risk of death or injury to migratory birds is to be expected. Consequently, the plan does not violate the prohibition on killing and injury pursuant to Section 44 subsection 1 number 1 of the BNatSchG. The BfN regularly comes to the same conclusion in its statements on wind farm projects.

According to the current state of knowledge, a site-related significantly increased risk of collision of individual stopover bird species in areas EN1 to EN19 of the plan is not apparent.

Therefore, it can be assumed that the prohibition of injury and killing under Section 44 subsection 1 number 1 of the BNatSchG is not violated.

### 5.3.2 Section 44 subsection 1 number 2 BNatSchG (prohibition on interference)

As described above, the plan area is home to several species of European wild birds as defined in Article 1 of the Birds Directive, including the red-throated diver, black-throated diver, little gull, sandwich tern, common tern, arctic tern, petrel, fulmar, gannet and guillemot. Against this background, the compatibility of the plan with Section 44 subsection 1 number 2 BNatSchG in conjunction with Article 5 of the Birds Directive must be ensured.

Under Section 44 subsection 1 number 2 of the BNatSchG, it is prohibited to cause significant disturbance to wild animals of specially protected species during the reproduction, rearing, moulting, wintering and migration periods.

The species protection assessment under Section 44 subsection 1 number 2 BNatSchG refers to the population-relevant disturbances of local stocks, the occurrence of which varies in the areas covered by the plan. The results of the species protection assessment are therefore subsequently presented for individual areas or groups of areas with comparable occurrences.

The species protection assessment is based on the following considerations with regard to seabird species listed in Annex I of the Birds Directive, species with another protected status and those with relatively high abundance in the EEZ:

Diver (*Gavia stellata* and *Gavia arctica*)

Red-throated diver (*Gavia stellata*) and black-throated diver (*Gavia arctica*) are common migratory seabird species in the Northern Hemisphere with breeding grounds in boreal and arctic areas of Europe, Asia and North America respectively. The global population of the red-throated diver is estimated at 200,000-600,000 birds, of which about 42,100 - 93,000 pairs are accounted for by the European breeding population (BIRDLIFE INTERNATIONAL 2015). For the black-throated diver, between 53,800 - 87,800 breeding pairs are assumed in Europe. The worldwide population consists of some 275,000 - 1,500,000 birds (BIRDLIFE INTERNATIONAL 2015). Both diver species do not breed in Germany, but are mainly found there as migratory birds during the species-specific migration periods and in winter.

The local population of divers should be taken into account when assessing the significant disturbance to stopover divers. This is a subset of the NW European winter stopover population, the so-called offshore population of divers. The

NW European biogeographical population, which includes the red-throated divers resting in Germany, has shown strong declines in the years 1970-1990, especially in the Russian and Fennoscandian populations. Despite stable and sometimes increasing population trends, as in the UK, the population has not yet returned to its original numbers. The reasons for this negative trend are of an anthropogenic nature and include environmental pollution, such as oil spills. The oil spill from the tanker "Erika" off the French coast killed 248 red-throated divers (CADIOU& DEHORTER 2003). Gillnet fishing (WARDEN 2010) and the discharge of nutrients into the sea are also contributors to the decline in stocks. The black-throated diver stock has suffered equally from these and other interventions in its natural habitat and has also shown stock reductions over the past 30 years. Despite the development of new potential breeding areas, e.g. in the north-east of Poland and in Ireland, the black-throated diver population continues to decline (BIRDLIFE INTERNATIONAL 2015).

Due to the fact that their populations have still not fully recovered or are still declining, both species of diver are included in endangered categories of some European conservation lists, such as "SPEC 3" ("Widespread species not concentrated in Europe but showing negative trends and an unfavourable conservation status there"). Red-throated divers and black-throated divers also belong to the species listed in Annex I of the EU's Birds Directive and are also listed in the Ordinance establishing the nature conservation area "Sylt Outer Reef - Eastern German Bight".

Aside from the worrying developments in the European population, red-throated and black-throated divers are also among the species most vulnerable to disturbance.

Red-throated and black-throated divers are among the bird species most sensitive to shipping traffic in the German North Sea. Visual disturbance caused by shipping traffic can cause deterrent or avoidance reactions. Ship-based bird counts have already shown that divers at great distances from approaching ships are disturbed and fly up (GARTHE et al. 2002). Current findings from studies confirm the ship-induced deterrence effect on divers (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019).

The most common reaction of the birds is to fly away. Flight distances vary and can be linked to various individual and ecological factors (FLIEßBACH et al. 2019).

Direct effects on divers due to visual disturbance are to be expected, particularly along busy traffic routes or traffic separation areas, but also in the vicinity of wind farms due to wind farm-based shipping traffic (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019).

In order to avoid and reduce significant disturbance to the stock of divers in spring in their main concentration area measures for adapting shipping logistics are being examined. Depending on the location of the wind farm in the main area of concentration of divers, such measures may include shifting certain regular maintenance activities outside spring, reducing navigation speeds or adjusting the route.

As a result, the SEA for the FEP 2019/ Draft FEP 2020 has shown that divers are highly sensitive from a population biological point of view, that the main concentration area is of high importance for the conservation of the local population and that the adverse effects of avoidance behaviour are intense and permanent.

In order to avoid a deterioration of the conservation status of the local population due to the cumulative effects of the wind farms, it is necessary to keep the area of the main concentration area currently available to divers, outside the impact zones of already implemented wind farms, free from new wind farm projects.

For the detailed assessment, reference is made to the species protection law assessment of FEP 2019/ Draft FEP 2020 in Chapter 5 Environmental Report North Sea.

The BSH concludes that a significant disturbance within the meaning of Section 44 subsection 1 number 2 of the BNatSchG (BNatSchG) as a result of the implementation of the plan can be ruled out with the necessary certainty if it is ensured that no additional habitat loss will occur in the main concentration area.

Finally, according to the current state of knowledge, offshore wind farms in areas EN1 up to and including EN19 are not considered to violate the prohibition of Section 44 subsection 1 number 2 BNatSchG.

Little gull (*Larus minutus*)

The population of the little gull in Europe is divided into two biogeographic populations. The population, which breeds from Scandinavia to Russia and partly occurs in the North Sea and Baltic Sea in winter, comprises about 24,000 to 58,000 breeding pairs (DELANEY S. & SCOTT D 2006). Other wintering areas extend further south to the Mediterranean and southeast to the Caspian Sea. In Germany, the little gull can be found in the waters and coastal areas of Lower Saxony and Schleswig-Holstein, particularly during the main migration periods (MENDEL et al. 2008).

With regard to possible impairments of the little gull by the wind turbines, the risk of collision can be classified as low. Studies have shown that the flight altitude is usually below the rotor height (<30m) (Mendel ET al. 2015).

GARTHE & HÜPPOP (2004) classified the little gull with a WSI value (Wind Farm Sensitivity Index) of 12.8 as quite insensitive to offshore wind turbines. Investigations into the potential avoidance behaviour of the little gull do not yet provide a uniform picture.

Due to the relatively low observed densities of the little gull in the areas EN1 to EN13 inclusive, as well as their temporary coupling to the species-specific main migration periods, it can be assumed that the areas are of low to at most medium importance for the little gull. Determinations of the stopover population were based on observed maximum densities which are subject to interannual fluctuations. Cumulative effects on the population are not to be expected according to current knowledge.

Finally, according to the current state of knowledge, offshore wind farms in areas EN1 up to and including EN13 are not considered to violate the prohibition of Section 44 subsection 1 number 2 BNatSchG.

Terns

The sandwich tern (*Sterna sandvicensis*), which breeds in Germany, belongs to the biogeographical population of Western Europe, whose breeding range also extends along the coastal regions of France, Ireland and Great Britain and to a small extent into the Baltic Sea. The population size is estimated at 160,000 - 186,000 birds (WETLANDS INTERNATIONAL 2012). About 9,700 - 10,500 breeding pairs belong to the German breeding population. During the breeding season, sandwich terns move away from their breeding colony within a radius of 30 to 40 km. Hardly any terns seek food in waters more than 20 m deep. The stopover population in the German EEZ corresponds to an estimated 110 - 430 birds all year round, and even fewer in sub-area II of the nature conservation area "Sylt Outer Reef - Eastern German Bight" (MENDEL et. al. 2008).

In general, the stock is attested a stable status. In the European Red List, the species is considered "not endangered" (BIRD LIFE INTERNATIONAL 2015).

Arctic and common terns (*Sterna paradisea, Sterna hirundo*) occur only sporadically in areas EN1 to EN13 inclusive. Higher, albeit low, densities were only found near the coast in the course of the long-range flight transect survey (IFAÖ et al. 2015, BIOCONSULT SH 2015).

In general, terns seem to avoid the area inside a wind farm, but are not driven away completely, but shift their stays to outside areas (PETERSEN et. al. 2006).

On the basis of the present statements, the BSH does not assume, according to the current state of knowledge, that the tern population will be disturbed by offshore wind farms. Finally, according to the current state of knowledge, offshore wind farms in areas EN1 up to and including EN13 are not expected to violate the prohibition of Section 44 subsection 1 number 2 of the BNatSchG.

Auks

Common guillemot (*Uria eel*)

The common guillemot is one of the most common species of seabird in the northern hemisphere and has a breeding population of about 2.35 - 3.00 million birds in Europe. The main breeding grounds are located on the rocky coasts of Iceland and the British Isles, the latter with about 1.4 million birds (BIRDLIFE INTERNATIONAL 2015). Studies on ringed guillemots have shown that birds from these large colonies migrate to the southern and eastern North Sea in the post-breeding period to forage for food (TASKER et al. 1987).

The only breeding colony of the common guillemot in the German North Sea is on Helgoland. The breeding population was estimated at around 2600 pairs in 2012 (GRAVE 2013). In summer, the animals tend to stay in the immediate vicinity of the breeding colony, and only occur in low densities within a radius of 30 km. In autumn and winter, guillemots increasingly spread to the offshore area with water depths between 40 - 50 metres (MENDEL et al. 2008).

With a WSI of 12.0, the common guillemot belongs to the lower third of the species tested in respect of disturbance sensitivity by GARTHE & HÜPPOP (2004). By contrast, the long-term investigations since the commissioning of the "alpha ventus" project have shown a clear avoidance behaviour on the part of the auks (also observed for the razorbill). Based on ship surveys, a reduction in the probability of sightings within the wind farm of up to 75% was found (BIOCONSULT SH & IFAÖ 2014). The results of the StUKplus project "TESTBIRD" support these observations. During surveying flights in the first winter half years of operational monitoring (2009/2010 and 2010/2011), no auks were sighted within the wind farm or within a radius of 1-2 km. From 2012 onwards, auks were observed for the first time in the outer area of the wind farms (MENDEL et al. 2015).

Based on the current state of knowledge, no significant impact on the common guillemot population caused by offshore wind farms is expected due to the large total population and the wide geographical distribution. Finally, according to the current state of knowledge, offshore wind farms in areas EN1 to EN13 are not expected to violate the prohibition of Section 44 subsection 1 number 2 of the BNatSchG.

Razorbill (*Alca torda*)

In addition to the guillemot, the razorbill is another frequently observed auk in the North Sea. The European population is estimated at about 1 million individuals. The largest proportion, about 60%, breed on rocky coasts of Iceland, followed by other important breeding areas in the British Isles and Norway (BIRDLIFE INTERNATIONAL 2015). The only breeding colony in Germany is on Helgoland with a mere 15-20 breeding pairs (GRAVE 2013). During the breeding season, razorbills limit their search for food to the immediate vicinity of the breeding site. The winter resting population in the German North Sea is estimated at 7500 individuals. The birds are increasingly found within the 20m depth range (MENDEL et al. 2008).

Due to the geographically limited distribution of breeding areas, the razorbill is listed in the Red List of Breeding Birds (SÜDBECK et al. 2008) in category "R" (species with geographical restriction). However, the breeding colony on Heligoland is very small and will probably not be decisive for the occurrence of razorbills in the German North Sea.

The BSH currently has no information that would indicate that a disturbance pursuant to Section 44 subsection 1 number 2 of the BNatSchG has occurred. Finally, the current state of knowledge does not indicate that offshore wind farms in areas EN1 to EN13 (inclusive) would cause a violation of the prohibition of Section 44 subsection 1 number 2 of the BNatSchG.

Northern fulmar *(Fulmarus glacialis)*

The fulmar is a typical seabird and is present in the German EEZ all year round. Its main area of distribution lies far from the coast beyond the 30m depth line (MENDEL et al. 2008). The European breeding population is estimated at 3,380,000 - 3,500,000 breeding pairs. The species is listed in the pan-European Red List and the EU27 Red List under "highly endangered" (EN) or "vulnerable" (VU) (BIRDLIFE INTERNATIONAL 2015).

Little is known so far about the fulmar's reactions to offshore wind farms under construction or in operation, as generally low sighting rates and insufficient data do not allow reliable conclusions to be drawn. However, a WSI of just 5.8 indicates very low sensitivity to disturbances (GARTHE & HÜPPOP 2004).

Based on current knowledge, no significant impacts on the population of the northern fulmar caused by offshore wind farms are expected. Finally, according to the current state of knowledge, offshore wind farms in areas EN1 to EN13 are not expected to violate the prohibition of Section 44 subsection 1 number 2 of the BNatSchG.

Northern gannet *(Sula bassana)*

The breeding population of the northern gannet in Europe is estimated at approximately 683,000 breeding pairs (BIRDLIFE INTERNATIONAL 2015). In the German Bight, Helgoland is the only breeding site of the northern gannet. Other European breeding grounds are located, for example, along the Norwegian coast and on the famous Scottish island of Bass Rock. As a highly mobile species, the northern gannet relies on extensive feeding habitats within a radius of up to 120 km from the breeding colony (MENDEL et al. 2008). Although the northern gannet has an area-wide (sporadic) occurrence, it is listed in the Red List in the category "R" (species with geographical concentration) due to the high concentration of breeding areas (SÜDBECK et al. 2008). However, its population is classified as "not at risk" (least concern, LC) according to European endangerment categories (BIRDLIFE INTERNATIONAL 2015).

There are only a few studies available for the northern gannet and they are statistically insignificant, they nevertheless suggest a potential avoidance behaviour towards wind turbines. Unambiguous statements frequently cannot be made due to the high mobility of the species and, similar to the northern fulmar, the associated low sighting rates and small samples.

With regard to the low, interannually fluctuating occurrence of the northern gannet, it can be assumed that the areas are of low to medium importance as resting and feeding areas.

Based on current knowledge, no significant impact on the population of the gannet caused by offshore wind farms is expected. Finally, according to the current state of knowledge, offshore wind farms in areas EN1 to EN13 are not expected to violate the prohibition of Section 44 subsection 1 number 2 of the BNatSchG.

Gulls

Gulls are common in the North Sea and can be observed near the coast or offshore, depending on the species. Recorded densities of the individual species can therefore vary considerably. In addition to the little gull, which has already been dealt with separately, the most common species include lesser black-backed gull, common gull, herring gull, greater black-backed gull and kittiwake.

In general, offshore wind turbines seem to attract seagulls or not to influence their local distribution. They are also known as prominent ship followers. Among the gulls, the common gull is the only species with a classification in SPEC Category 2 (species concentrated in Europe with negative population development and unfavourable conservation status) (BIRDLIFE INTERNATIONAL 2004a). The biogeographical population, which occurs mainly in Germany, is estimated at 1,200,000 - 2,000,000 birds and shows a stable population trend (WETLANDS INTERNATIONAL 2012). In the pan-European Red List and the EU27 list it is considered "not at risk" (BIRDLIFE INTERNATIONAL 2015).

Based on current knowledge, no significant impacts on the population of the common gull caused by offshore wind farms are expected. Finally, according to the current state of knowledge, offshore wind farms in areas EN1 to EN13 are not expected to violate the prohibition of Section 44 subsection 1 number 2 BNatSchG.

Wind energy reservation areas EN14 to EN19

The investigations of the FTZ's Seabird Monitoring on behalf of the BfN provide information on the seabird community in the region comprising the areas EN14 to EN19 in the so-called "duck's beak". This area is one of the typical habitats of seabird species. Northern fulmars and kittiwakes occur all year round, but especially in spring and winter. Razorbills and common guillemots are most abundant in winter, the latter also occurring in spring in this remote area of the EEZ. The Dogger Bank area within the German EEZ is one of the outer areas of the distribution range of the puffin (*Fratercula arctica*). However, the occurrence within the EEZ is very low (BFN 2017, BORKENHAGEN et al. 2017, BORKENHAGEN et al. 2018, BORKENHAGEN et al. 2019). The areas lie outside the distribution range of divers in the North Sea EEZ. Based on current knowledge, it can be assumed that for the species occurring in the areas, the prohibition under Section 44 subsection 1 number 2 BNatSchG is not violated. A detailed species protection assessment for the reserved areas EN14 to EN19 will be carried out at subordinate levels if more detailed information and findings become available.

Cables and pipelines

Deterrent effects acting on seabirds and stopover birds, as well as migratory birds are limited to the small-scale and very short periods required for laying submarine cables and pipelines. These disturbances do not go beyond those generally associated with slow shipping traffic. Therefore, no disturbance relevant to species protection law under Section 44 subsection 1 number 2 BNatSchG is to be expected from the specifications for cables and pipelines.

Cumulative effects

In Chapter 4.10.4cumulative effects of offshore wind energy generation on seabirds, especially on the disturbance sensitive divers, were presented and at the same time the criteria for the qualitative assessment of the effects were described. Seabirds are also exposed to the impacts of various anthropogenic uses and natural and climate-related changes. Scientifically, it is nearly impossible to differentiate or even weight the contribution of effects caused by a single use on the status of the respective population of a species.

Since 2009, the BSH has been carrying out the qualitative assessment of cumulative effects on divers within the framework of approval procedures for offshore wind farms, taking the main concentration area into account in accordance with the position paper of BMU (2009). The cumulative consideration of the avoidance behaviour of divers towards offshore wind farms in studies commissioned by BSH and BfN revealed a calculated total habitat loss of 5.5 km and a statistically significant decrease in abundance up to a distance of 10 km, starting from the periphery of a wind farm (GARTHE et al. 2018). The statistically significant decrease in abundance does not constitute total avoidance, rather a partial avoidance with increasing densities of divers up to a distance of 10 km from a wind farm.

Spatial planning or the designation of the plan, including the principles and objectives, are among the key instruments for reducing or even avoiding cumulative impacts on the diver population by rectifying spatial conflicts among uses and by designating priority and reservation areas for nature conservation.

The nature conservation priority areas contribute to safeguarding open spaces by excluding uses that are incompatible with nature conservation. This designation is an important measure to ensure the protection of seabird species in the German EEZ. In addition, spatial planning paves the way for further measures, such as the preparation of the site development plan and the preliminary investigation and examination of the suitability of sites for offshore wind energy. Finally, the principles of the plan form the backbone for the specifications in the subordinate procedures and for the orders for the protection of harbour porpoise within the framework of individual licensing procedures.

BMU's position paper (2009) on the protection of divers provides the basis for assessing the cumulative effects of wind power generation. The designation of the identified main concentration area as a reserved area for the protection of divers represents the most important avoidance and mitigation measure to rule out cumulative impacts at population level. Due to its special location in the area of the frontal system to the west of the North Frisian Islands with its very high productivity and the resulting rich food supply, the reserve area represents a protected area for the specially protected as well as for the characteristic seabird species of the German EEZ in the North Sea in addition to the three nature conservation areas.

In conclusion, with regard to seabirds and stopover birds, it can be stated that the updating of the plan does not violate the prohibitions under Section 44 subsection 1 numbers 1 and 2 of the BNatSchG, even in respect of cumulative effects.

## 5.4 Bats

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of concrete information on migratory species, migration corridors, migration heights and migration concentrations. Previous findings merely confirm that bats, especially long-distance migratory species, fly over the North Sea.

### 5.4.1 Section 44 subsection 1 number 1 and number 2 BNatSchG

According to expert knowledge, the risk of isolated collisions with wind turbines cannot be ruled out. In terms of species protection law, the same considerations apply in principle as those already mentioned in the assessment of avifauna. Under Article 12 subsection 1 number 1 a) of the Habitats Directive, all deliberate forms of capture or killing of bat species taken from the wild are prohibited. Collision with offshore structures does not constitute deliberate killing. Here, explicit reference can be made to the guidelines on the strict system of protection for animal species of Community interest under the Habitats Directive, which assume in II.3.6 subsection 83 that the killing of bats is unintentional killing which must be continuously monitored in accordance with Article 12 subsection 4 of the Habitats Directive. There are no indications for the examination of further circumstances under Article 12 subsection 1 of the Habitats Directive.

Experience and findings from research projects or from wind farms already in operation will also be adequately considered in further processes.

The data available for the North Sea EEZ is fragmentary and insufficient for drawing conclusions on bat migration. It is not possible to draw concrete conclusions on migratory species, migration directions, migration heights, migration corridors and possible concentration ranges on the basis of the available data. Existing findings merely confirm that bats, especially long-distance migratory species, fly over the North Sea.

However, it can be assumed that any adverse effects of wind turbines on bats will be avoided by the same prevention and mitigation measures that are in place to protect bird migration.

Based on current plans, it is not expected that either the prohibition on killing and injury under Section 44 subsection 1 number 1 of the BNatSchG nor the species protection prohibition on significant disturbance under Section 44 subsection 1 number 2 of the BNatSchG will be violated.

# 6 Impact assessment / territorial protection law assessment

## 6.1 Legal basis

Insofar as a site of Community importance or a European bird sanctuary may be significantly impaired in respect of its elements relevant to the conservation objectives or the purpose of the protection, the provisions of Section 7 subsection 6 in conjunction with subsection 7 ROG, the provisions of the Federal Nature Conservation Act (BNatSchG) on the permissibility and implementation of such interventions, including obtaining the opinion of the European Commission, must be applied when amending and supplementing spatial plans.

The Natura2000 network comprises the sites of Community importance (habitats areas) under the Habitats Directive and the bird protection areas (Special Protection Areas - SPAs) under the Birds Directive, which have now been designated as conservations areas in Germany (e.g. BVerwG, Decision of 13.3.2008 - 9 VR 9/07). The impact assessment carried out here generally takes place at a higher level of spatial planning and sets a framework for subordinate planning levels, insofar as these are available. It therefore does not replace the assessment at the level of the specific project with knowledge of the specific project parameters, which is carried out within the framework of approval procedures. To this extent, further avoidance and mitigation measures are to be expected if they are deemed necessary by the impact assessment within the framework of approval procedures in order to exclude any negative impact on the conservation objectives of the Natura 2000 sites or the protection purposes of the conservation areas by the use inside or outside a nature conservation area. At the same time, it must be taken into account that for some uses - in particular wind energy - the draft spatial plan retraces the projects already in operation and the designations of the FEP sectoral plan, for which impact assessments have already been carried out.

Prior to their designation as protected marine areas pursuant to Sections 20 subsection 2, 57 BNatSchG the nature conservation areas in the EEZ were already included under European law as FFH areas in the first updated list of sites of Community importance in the Atlantic biogeographical region under Article 4 subsection 2 of the Habitats Directive (Official Journal of the EU, 15 January 2008, L 12/1), so that an FFH impact assessment had already been carried out as part of the Federal Offshore Sectoral Plan for the German North Sea EEZ (BSH 2017). In a final step, an impact assessment pursuant to Section 34 subsection 1 in conjunction with Section 36 BNatSchG was carried out as part of the SEA for the site development plan (BSH, 2019).

The German EEZ of the North Sea contains the nature conservation areas "Sylter Außenriff - Östliche Deutsche Bucht" (Ordinance on the establishment of the nature conservation area "Sylter Außenriff - Östliche Deutsche Bucht" of 22 September 2017 (NSGSylV)), "Borkum Riffgrund" (Ordinance on the Establishment of the nature conservation area "Borkum Riffgrund" of 22 September 2017 (NSGBRgV)) and "Doggerbank" (Ordinance on the Establishment of the nature conservation area "Doggerbank" of 22 September 2017 (NSGDgbV)).

The total area of the three nature conservation areas in the German North Sea EEZ is 7,920 $km^2$, of which 625 $km^2$ is covered by the "Borkum Riffgrund" nature conservation area, 5,603 $km^2$ by the "Sylter Außenriff - Östliche Deutsche Bucht" nature conservation area and 1,692 $km^2$ by the "Doggerbank" nature conservation area.

Within the framework of the impact assessment, the habitat types "reef" (EU code 1170) and "sandbank" (EU code 1110) according to Annex I of the Habitats Directive with their characteristic and endangered biocoenoses and species, as well as protected species, specifically fish (river lamprey, twait shad), marine mammals according to Annex II of the Habitats Directive (harbour porpoise), grey seal and common seal), as well as protected bird species listed in Annex I of the Birds Directive (in particular red-throated diver, black-throated diver, little gull, sandwich tern, common tern and arctic tern) and regularly occurring migratory bird species (in particular common and lesser black-backed gulls, fulmar, gannet, kittiwake, guillemot and razorbill).

The impact assessment carried out here takes place at a higher level of spatial planning and sets a framework for subordinate planning levels, where these exist. It therefore does not replace the assessment at the level of the specific project. Depending on the designations of the draft spatial plan for the respective use, the assessment is layered. In the case of wind energy there is a staged planning and approval process. This means that the reviews of the subordinate planning levels are taken into account within the scope of this draft spatial plan. If no review has yet been carried out at subordinate planning levels, the review within the framework of this SEA for the draft spatial plan is carried out on the basis of the available data and knowledge.

There is also a staged planning and approval process for the extraction of raw materials. Insofar as data and knowledge is available, an impact assessment is carried out within the scope of this SEA, otherwise the assessments are reserved for the subordinate planning levels.

The draft spatial plan contains designations relevant to the impact assessment concerning priority and reservation areas for wind energy, reservation areas for cables/pipelines and reservation areas for hydrocarbons, and sand and gravel extraction. The same applies to cables/pipelines.

Scientific designations can only be reviewed insofar as information is available.

For the impact assessment, a distinction must be made between:

Wind Energy

Since, according to the sectoral legislation under Section 5 subsection 3 sentence 2 number 5 a) WindSeeG, areas and sites for wind turbines in the FEP may not be defined within a conservation area designated under section 57 BNatSchG, the draft spatial plan does not contain any area definitions for the use of wind energy within the conservation areas designated by ordinance.

In the following, therefore, the impact assessment relates exclusively to site designations at or near conservation areas designated by ordinance.

For the areas EN1 to EN13, reference is made to the impact assessment of FEP 2019/Draft FEP 2020.

Raw material extraction

The reservation areas for sand and gravel extraction SKN1 and SKN2 lie within the "Sylter Außenriff - Östliche Deutsche Bucht" nature conservation area and the reservation area for hydrocarbons KWN1 lies partly within and otherwise spatially adjacent to the "Doggerbank" nature conservation area.

Where operating plans have already been issued, e.g. for the main operating plan OAMIII in the SKN1 sand and gravel extraction reservation area, a compatibility assessment has already been carried out. For this reason, no separate assessment is carried out here in this SEA.

In addition, the assessment of compatibility is reserved for the downstream procedures, i.e. in particular the procedures for applying for a main operating plan.

Cables/pipelines

The reservation area LN6 crosses the nature conservation area "Borkum Riffgrund". The reservation areas LN1 and LN14 run within the "Doggerbank" nature conservation area.

Scientific uses

The FoN2 reservation area is located within the nature conservation area "Sylter Außenriff - Östliche Deutsche Bucht". As it is only a matter of sampling fish and thus of selective activities without additional burdens, no impact assessment is carried out. Reference is made to Chapter 4.6.

According to Section 34 subsection 2 in conjunction with section 36 BNatSchG, the plan is inadmissible if the impact assessment shows that the specifications may lead to significant negative impacts on a Natura 2000 site in its components relevant to the conservation or protection objectives.

Projects and plans must also be examined for their compatibility with the protection purpose of the respective ordinance even if they are located outside the conservation areas as so-called "environmental projects" (LANDMANN/ROHMER, Section 34 BNatSchG, margin number 10.) (cf. Section 5 subsection 4 NSGBRgV).

## 6.2 Compatibility assessment with regard to habitat types

Due to the exclusion by sectoral legislation of areas and sites for wind energy in the FEP in nature conservation areas, construction, installation and operational impacts on the FFH habitat types "reef" and "sandbank" with their characteristic and endangered biocoenoses and species can be excluded. The areas lie far beyond the drift distances discussed in the specialist literature, so that no release of turbidity, nutrients and pollutants is to be expected that might impair the nature conservation and FFH areas in their components relevant to the conservation objectives or the protection purpose.

Whether or not the designations lead to negative impacts on habitat types must be assessed by forecasting, taking into account project-specific impacts.

For the sections of the LN1 and LN14 pipeline corridors located in the area of the habitat type "Sandbanks which are slightly covered by sea water all the time" (EU Code 1110), it must be ensured that the guide values for the relative and absolute loss of area according to Lambrecht & Trautner (2007) and Bernotat (2013) are not exceeded.

## 6.3 Compatibility assessment with regard to protected species

### 6.3.1 Impact assessment pursuant to Section 5 subsection 6 of the ordinance on the designation of the "Borkum Riffgrund" nature conservation area

Protected marine mammalian species

Pursuant to Section 5 subsection 6 NSGBRgV, the requirements of Section 5 subsection 4 NSGBRgV must be observed in the present assessment.

The assessment of the impact of the plan will be based on the protection purposes of the nearest conservation area "Borkum Riffgrund". According to Section 3 subsection1 NSGBRgV, the protection purpose is to achieve the conservation objectives of the Natura 2000 site. Under Section 3 subsection 2 number 3 NSGBRgV, the conservation and restoration of the specific ecological values and functions of the area, in particular the populations of harbour porpoise and common seal, as well as their habitats and natural population dynamics, are to be protected.

Finally, under Section 3 subsection 5 number 1 to number 5 NSGBRgV, the ordinance sets out objectives to ensure the conservation and restoration of the marine mammal species listed in Section 3 subsection 2 NSGBRgV, namely harbour porpoise, common seal and grey seal, as well as the conservation and restoration of their habitats.

Conservation and restoration:

- No.1: of the natural population densities of these species with the aim of achieving a favourable conservation status, their natural spatial and temporal distribution, health status and reproductive fitness, taking into account natural population dynamics and genetic exchanges with populations outside the area
- No. 2: of the area as a largely undisturbed habitat, unaffected by local pollution, of the species of marine mammals referred to in subsection 3 number 2 and in particular as a habitat of supra-regional importance for harbour porpoises in the East Frisian Wadden Sea area,
- No. 3: of undissected habitats and the possibility of migration of the species of marine mammals referred to in subsection 3 number 2 NSGBRgV within, in particular to neighbouring conservation areas of the Wadden Sea and off Helgoland,
- No. 4: of the essential food sources of the species of marine mammals referred to in subsection 3 number 2 NSGBRgV, in particular the natural population densities, age-group distributions and distribution patterns of the organisms serving as food sources for these marine species of marine mammals, and
- No. 5: of a high vitality of individual animals and species-specific age structure of the stocks of fish and cyclostomes as well as spatial and temporal distribution patterns and populations densities of their natural food sources.

Areas EN1, EN2 and EN3 of the present update of the plan in the German EEZ are located near the nature conservation area "Borkum Riffgrund" (EU code: DE 2104-301).

Reference is made to the results of the impact assessment for FEP 2019/Draft FEP 2020.

Possible negative impacts on the protection purposes of the nature conservation area "Borkum Riffgrund" by the implementation of projects in areas EN1, EN2 and EN3 of the present plan can be reliably excluded if the instructions in the subordinate individual approval procedures are complied with.

An impact assessment of the continuation of the plan in the areas EN4 to N13, N14 to EN18 and EN19 according to Section 34 BNatSchG in connection with the conservation purposes of the nature conservation area "Borkum Riffgrund" with regard to marine mammals is not necessary due to the distance of these areas of the plan from the nature conservation area.

### 6.3.2 Impact assessment pursuant to Section 5 subsection 6 of the ordinance on the designation of the nature conservation area "Sylter Außenriff – Östliche Deutsche Bucht" with regard to marine mammals and protected bird species

According to Section 7 subsection 6 NSGSylV, the requirements of Section 7 subsection 1 and subsection 4 NSGSylV are to be observed for the plan in question, which is to be taken into account in the official decision. Prior to their approval or implementation, projects and plans are to be examined for their compatibility with the conservation objectives of a conservation area if, either individually or in combination with other projects or plans, they are likely to have a significant impact on the conservation area.

The assessment of the impacts of the plan is based on the protection purposes of the nature conservation area "Sylter Außenriff – Östliche

Deutsche Bucht". Under Section 1 of the NSGSylV, the nature conservation area combines the "Sylter Außenriff" FFH area and the "Östliche Deutsche Bucht" European bird sanctuary and is divided into two areas under Section 2 subsection 4 of the NSGSylV: Area I designates the "Sylter Außenriff" area, while Area II designates the "Östliche Deutsche Bucht" area.

According to Section 3 subsection 1 of the NSGSylV, the purpose of protection is to achieve the conservation objectives of the Natura 2000 sites. Under Section 3 subsection 2 number 3 NSGSylV, the conservation and restoration of the specific ecological values and functions of the area, in particular the populations of harbour porpoises, grey seals, seals and seabird species, as well as their habitats and natural population dynamics, must be protected.

<u>Protected marine mammalian species</u>

Finally, under Section 4 subsection 3 numbers 1 to 5 NSGSylV, the ordinance lays down objectives to ensure the conservation and restoration of the marine mammal species listed in Section 3 subsection 2 NSGSylV, namely harbour porpoise, common seal and grey seal, as well as the conservation and restoration of their habitats in Area I.

Conservation and restoration:

- No.1: of the natural population densities of these species with the aim of achieving a favourable conservation status, their natural spatial and temporal distribution, health status and reproductive fitness, taking into account natural population dynamics, natural genetic diversity within the population in the area and genetic exchanges with populations outside the area,
- No. 2: of the area as a habitat largely free of disturbance and unaffected by local pollution of the species of marine mammals referred to in subsection 1 number 2 and, in particular, as a particularly important reproduction, rearing, feeding and migration habitat for harbour porpoises in the Southern North Sea area,
- No. 3: of undissected habitats and the possibility of migration of the species of marine mammals referred to in subsection 1 number 2 into Danish waters, into the immediately adjacent Schleswig-Holstein harbour porpoise conservation area and into the Wadden Sea and Heligoland conservation areas
- No. 4: of the essential food sources of the species of marine mammals referred to subsection 1 number 2, in particular the natural population densities, age-group distributions and distribution patterns of the organisms serving as food sources for these species of marine mammals, and
- No. 5: of a high vitality of individual fish and species-specific age structure of fish and cyclostomes as well as spatial and temporal distribution patterns and population densities of their natural food sources.

The assessment has shown that noise from pile driving during the installation of foundations for offshore wind turbines and platforms can have a significant impact on marine mammals, in particular harbour porpoises, if no noise abatement measures are implemented.

The update of the draft spatial plan also provides for the establishment of a harbour porpoise reservation area in the German North Sea EEZ. The reservation area represents the main concentration area of harbour porpoises in the sensitive period from 1 May to 31 August, which was identified during the preparation of the BMU's noise abatement concept (2013). The harbour porpoise seasonal reservation area covers Area I of the "Sylter Außenriff -Östliche Deutsche Bucht" nature conservation area and its surroundings. In physical terms, the reservation area thus more than covers the area of the frontal system west of the North Frisian islands. Due to weather and currents, the frontal system spreads very dynamically into the reservation area ensuring increased productivity and a rich food supply for top predators such as the harbour porpoise and many species of seabird. By defining the seasonal reservation area, the spatial plan implements a preventive measure to safeguard the porpoise's food-rich alternative habitat outside Area I of the nature conservation area.

Nevertheless, according to the current state of knowledge, effects of noise-intensive pile driving in the immediate vicinity of the nature conservation area are to be expected if no noise-preventing and noise-reducing measures are taken. The exclusion of significant impacts, in particular through disturbance of populations in the nature conservation area and the population of the respective species, requires the implementation of strict noise abatement measures. The updating of the plan includes a number of principles in this respect. In the course of the species protection assessment, noise abatement measures were also specified in accordance with the state of the art in science and technology, the application of which, according to the current state of knowledge, rules out the possibility of significant disturbance to the populations in the nature conservation areas.

With regard to the areas EN4, EN5, EN11 and EN13, which correspond to the areas N-4, N-5, N-11 and N-13, reference is made to the results of the impact assessment for FEP 2019/Draft FEP 2020.

The assessment of the potential impact of the plan has shown that the laying and operation of cable systems will not have significant adverse effects on marine mammals in the vicinity of the cable routes. A negative impact on the conservation objectives of the nature conservation area "Sylter Außenriff -Östliche Deutsche Bucht" by the laying and operation of submarine cables both inside and outside the nature conservation area, in compliance with the planning principles of the FEP and taking into account appropriate measures in the context of implementation, can be safely ruled out.

According to the current state of knowledge, any negative impact on the conservation objectives of Area I of the "Sylter Außenriff -Östliche Deutsche Bucht" nature conservation area by the implementation of projects outside the nature conservation area in areas EN4, EN5, EN11 and EN13 of the present plan can be safely ruled out .

Possible negative impacts on the protection purposes and conservation objectives of the nature conservation area "Sylter Außenriff -Östliche Deutsche Bucht" by the implementation of projects in the remote areas EN1 to EN3, EN6 to EN10 and EN12 as well as EN14 to EN18 and EN19 of the present plan can be reliably excluded due to the distance from the nature conservation area.

Protected seabird and stopover bird species

According to Section 5 subsection 1 number 1 of the NSGSylV, the conservation or, where necessary, the restoration to a favourable conservation status of bird species listed in Annex I of the Birds Directive and regularly occurring migratory bird species occurring in this area are part of the protection purposes of the nature conservation area.

The species mentioned under Section 5 subsection 1 number 1 NSGSylV include the species red-throated diver (Gavia stellata, EU code A001) and black-throated diver (Gavia arctica, EU code A002).

The ordinance then sets out objectives for Area II under Section 5 subsection 2 number 1 to number 4 NSGSylV to ensure the conservation and restoration of the bird species listed in Section 5subsection 1 NSGSylV and the functions of Area II under subsection 1.

Conservation and restoration:

- No.1: of the qualitative and quantitative populations of bird species with the aim of achieving a favourable conservation status, taking into account natural population dynamics and population trends; special attention must be paid to bird species with negative trends in their biogeographical population
- No.2: of the main organisms serving as food for bird species, in particular their natural population densities, age-group distributions and distribution patterns
- No.3: of the increased biological productivity at vertical fronts, which is characteristic of the area, and the geo- and hydromorphological characteristics with their species-specific ecological functions and effects, and
- No.4: of the natural quality of habitats with their respective species-specific ecological functions, their fragmentation and spatial interrelationships, and unimpeded access to adjacent and neighbouring marine areas.

The update of the draft spatial plan also provides for the establishment of a reservation area for divers in the German North Sea EEZ. The reservation area represents the main concentration area of divers during spring in the German EEZ, which was identified during the preparation of the BMU position paper (2009). The reservation area covers Area II of the nature conservation area "Sylter Außenriff -Östliche Deutsche Bucht" and its surroundings. In physical terms, the reservation area thus more than covers the area of the frontal system to the west of the North Frisian Islands. Due to weather and currents, the frontal system spreads very dynamically into the reservation area and ensures increased productivity and a rich food supply for top predators such as divers but also many other species of seabirds. By designating the reservation area, the spatial plan implements a preventive measure to ensure a food-rich alternative habitat for divers outside Area II of the nature conservation area.

With regard to the areas EN4, EN5, EN11 and EN13, which correspond to the areas N-4, N-5, N-11 and N-13, reference is made to the results of the impact assessment for FEP 2019/Draft FEP 2020.

As a result, a significant negative impact on the protection purposes of Area II of the nature conservation area "Sylter Außenriff -Östliche Deutsche Bucht" by the implementation of the plan with regard to areas EN11 and EN13 can be safely ruled out.

According to the current state of knowledge, areas EN1 to EN3, EN6 to EN10, EN12, EN14 to EN18 and EN19 are of no significance with regard to the occurrence of divers in Area II of the nature conservation area "Sylter Außenriff - Östliche Deutsche Bucht" due to their distance away from the area.

Examination of the potential effects of the plan has shown that the laying and operation of cable systems will not have a significant adverse impact on bird species in the vicinity of the cable routes. A negative impact on the protection purposes of the nature conservation area "Sylter Außenriff -Östliche Deutsche Bucht" by the laying and operation of cables in compliance with the planning principles of this plan and taking into account appropriate measures in the context of its implementation can be safely ruled out.

A significant negative impact on the protection purposes and conservation objectives of Area II of the nature conservation area "Sylter Außenriff -Östliche Deutsche Bucht" through the implementation of projects in areas EN1 to EN3, EN6 to EN10, EN12, EN14 to EN18 and EN19 can be ruled out due to the distance from the area.

As a result, a significant negative impact on the protection purposes of Area I of the nature conservation area "Sylter Außenriff -Östliche Deutsche Bucht" can be safely ruled out by implementing the plan and taking into account avoidance and mitigation measures.

### 6.3.3 Impact assessment under Section 5 subsection 7 of the ordinance on the designation of the "Doggerbank" nature conservation area

The plan designates areas for wind power generation in the immediate vicinity of the nature conservation area "Doggerbank", (EU code: DE 1003-301) with the areas EN14 to EN18 and EN19. This was established by the ordinance of 22 September 2017 ("Ordinance on the Establishment of the "Doggerbank" nature conservation area, Federal Law Gazette I, I S, 3400").

Under Section 34 subsection 1 BNatSchG and Section 5 subsection 6 NSGDgbV, projects must be examined for their compatibility with the conservation objectives of a conservation area before they are approved or implemented if, either individually or in conjunction with other projects or plans, they are likely to have a significant impact on the conservation area and do not directly serve the management of the area.

The assessment of the effects of the plan's continuation will be based on the conservation purposes of the "Doggerbank" conservation area. According to Section 3 subsection 1 NSGDgbV, the protection purpose is to achieve the conservation objectives of the Natura 2000 site. According to Section 3 subsection 2 number 2 NSGDgbV, the conservation and restoration of the specific ecological values and functions of the area, in particular the populations of harbour porpoise and seals and their habitats, and the natural population dynamics are to be protected.

Finally, under Section 5 subsection 1 to subsection 4 NSGDgbV, the ordinance sets out objectives to ensure the survival and reproduction of the marine mammal species listed in Section 3 subsection 2 NSGDgbV, namely harbour porpoise and common seal in Annex II of the Habitats Directive (92/43/EEC), and to conserve and restore their habitats.

Conservation and restoration:

- Subsection 1: of the natural population densities of these species with the aim of achieving a favourable conservation status, their natural spatial and temporal distribution, health status and reproductive fitness, taking into account natural population dynamics and genetic exchanges with populations outside the area,
- Subsection 2: of the area as a habitat for harbour porpoises and harbour seals that is largely undisturbed and unaffected by local pollution, and in particular as a significant feeding, migration, reproduction and rearing habitat for harbour porpoises in the central North Sea area,
- Subsection 3: of undissected habitats and the possibility of migration of harbour porpoises and seals within the German North Sea and into Dutch, British and Danish waters; and
- Subsection 4: of the main organisms that act as a source of food for harbour porpoises and seals, in particular their natural population densities, age-group distributions and distribution patterns.

The examination of the potential impact of the update of the plan in Chapters 3.2.5and 4.2.5has shown that the construction and operation of the offshore wind turbines and the laying and operation of the cable systems will not have a significant adverse impact on marine mammals. This also applies to marine mammals in the reservation areas EN14 to EN18 and EN19 and LN1 and LN14.

Based on the experience gained so far within the framework of the subordinate planning and licensing procedures, avoidance and mitigation measures are ordered for the noise-intensive installation of the turbines and platforms in accordance with the specifications of the noise abatement concept of the BMU (2013). Special attention is paid to the overall coordination of the noise-intensive work to avoid and mitigate disturbing sound discharges in the area of nature conservation areas. The data set with regard to the areas EN14 to EN19 has so far been considerably less than is the case for the priority areas EN1 to EN13. Preliminary investigations are carried out within the framework of the subordinate procedures, in particular for determining the suitability of areas. The results of the preliminary assessment are necessary both to check the suitability of the sites and to examine the need for additional avoidance and mitigation measures or, if necessary, to adjust the measures in force at the time of the present assessment.

The assessment has shown that noise from pile driving during the installation of foundations for offshore wind turbines and platforms can have a significant impact on marine mammals, in particular harbour porpoises, if no noise abatement measures are taken. The exclusion of significant impacts, in particular those caused by disturbance of the local population and the overall population of the species concerned, requires the implementation of stringent noise abatement measures. The plan contains a number of principles in this respect. Within the framework of the species protection assessment, noise abatement measures were also described in accordance with the state of the art in science and technology, the application of which, according to the current state of knowledge, rules out any significant disturbance of the population in the areas and sites. Since 2008, the BSH has introduced orders in its approval notices that include binding limit values for impulse noise input from pile driving. The introduction of the binding limit values is based on findings on the triggering of temporary hearing threshold shifts in harbour porpoises (Lucke et al., 2008, 2009). Compliance with the limit values (160 dB individual sound event level (SEL05) re 1µPa2s and 190 dB re 1µPa at a distance of 750 m) is monitored by the BSH by applying standardised measurement and evaluation methods. Additional noise abatement measures with regard to the coordination of parallel pile driving and to reduce the impact on nature conservation areas are also derived from the noise abatement concept of the BMU (2013) and are adapted, ordered and also monitored by the BSH within the framework of individual licensing procedures, adapted to the site- and project-specific characteristics.

Since 2011, all pile driving work has been carried out using noise reduction systems. The monitoring of the noise-reduction measures has shown that they have been very effective since 2014, so that a significant disturbance of the populations and a resulting negative impact on the local population in the German North Sea EEZ can be excluded.

In particular, it must be ensured that there is the possibility of migration between the habitats in German and Danish waters and to the Schleswig-Holstein conservation area.

The assessment of the potential impact of the plan has shown that the laying and operation of cables will not have a significant adverse effect on marine mammals in the vicinity of the cable routes. A negative impact on the protection purposes of the nature conservation area "Doggerbank" by the laying and operation of cables both inside and outside the nature conservation area in compliance with the planning principles of the FEP and taking into account appropriate measures in the course of implementation can be safely ruled out.

According to the current state of knowledge, any negative impact on the conservation objectives of the "Doggerbank" nature conservation area by the implementation of projects outside the nature conservation area in areas EN1 to EN13 of the present plan can be safely ruled out due to the distance from the nature conservation area.

### 6.3.4 Natura2000 sites outside the German EEZ

The impact assessment also takes into account the remote effects of the designations made within the EEZ on the conservation areas in the adjacent
12-mile zone and in the adjacent waters of neighbouring countries. This also applies to the assessment and consideration of functional relationships between the individual conservation areas and the coherence of the network of conservation areas under Section 56 subsection 2 BNatSchG, since the habitat of some target species (e.g. avifauna, marine mammals) may extend over several conservation areas due to their large distribution radius.

Specifically, the conservation areas are the "Lower Saxony Wadden Sea National Park" and the EU bird protection area "Lower Saxony Wadden Sea and Adjacent Coastal Sea" in the coastal sea of Lower Saxony, the "Schleswig-Holstein Wadden Sea National Park", the "Ramsar Area Schleswig-Holstein Wadden Sea and Adjacent Coastal Areas", the FFH area "Steingrund" and the "Seabird Sanctuary Helgoland" in the territorial sea of Schleswig-Holstein as well as the Natura 2000 site "Sydlige Nordsø" in the Danish EEZ, the Dutch bird sanctuary "Friese Front" and the Dutch FFH area "Doggersbank".

The protection and conservation objectives for the Natura 2000 sites outside the EEZ were taken from the following documents:

- FFH area "Lower Saxony Wadden Sea National Park": Section 2 in connection with Annex 5 Law on the "Lower Saxony Wadden Sea National Park" (NWattNPG) of 11 July 2001 (http://www.lexsoft.de/cgi-bin/lexsoft/niedersachsen_recht.cgi?chosenIndex=Dummy_nv_6&xid=173529,3)
- EU Bird Sanctuary "Lower Saxony Wadden Sea and Contiguous Coastal Sea": Natura 2000 sites of the Tideweser in Lower Saxony and Bremen (http://www.umwelt.bremen.de/sixcms/media.php/13/Fachbeitrag-1_Natura%202000_Teil%203.pdf)
- FFH area "Schleswig-Holstein Wadden Sea National Park and adjacent coastal areas": Conservation objectives for the FFH proposal area DE-0916-391 "NTP S-H Wadden Sea and adjacent coastal areas" (http://www.umweltdaten.landsh.de/public/natura/pdf/erhaltungsziele/DE-0916-391.pdf)
- EU Bird Sanctuary "Ramsar Area S-H Wadden Sea and adjacent coastal areas": Conservation objectives for the DE- 0916-491 "Ramsar Area S-H Wadden Sea and adjacent coastal areas" (http://www.umweltdaten.landsh.de/public/natura/pdf/erhaltungsziele/DE-0916-491.pdf)
- "Seabird Sanctuary Helgoland**":** conservation objectives for the DE-1813-491 "Seabird Sanctuary Helgoland" (http://www.umweltdaten.landsh.de/public/natura/pdf/erhaltungsziele/DE-1813-491.pdf)
- FFH site "Steingrund": conservation objectives for the site DE 714-391 "Steingrund", designated as a site of Community importance (www.umweltdaten.landsh.de/public/natura/pdf/erhaltungsziele/DE-1714-391.pdf)
- Denmark: Habitats and Bird Sanctuary "Sydlige Nordsø": EUNIS factsheet (http://eunis.eea.europa.eu/sites/DK00VA347)
- Netherlands: "Friese Front" bird sanctuary: EUNIS factsheet (https://eunis.eea.europa.eu/sites/NL2016166)
- The Netherlands: Habitats Area "Doggersbank": EUNIS Factsheet (https://eunis.eea.europa.eu/sites/NL2008001)

An impact assessment of the plan's update under Section 34 BNatSchG in connection with the conservation purposes of the above-mentioned Natura 2000 sites with regard to protected species is not necessary due to the distance of the plan's areas from the Natura 2000 sites.

## 6.4 Outcome of the FFH impact assessment

To conclude, a significant negative impact on the protection purposes of the nature conservation areas "Borkum Riffgrund", "Sylter Außenriff - Östliche Deutsche Bucht", "Doggerbank" and the protection purposes of the FFH area "Lower Saxony Wadden Sea National Park" can be safely excluded by updating the plan, taking into account avoidance and mitigation measures for FHH habitats, marine mammals, avifauna and other protected animal groups.

It should be noted that the FFH impact assessment carried out here was not able to examine project-specific properties which are only specified and set out by project developers in the course of planning approval procedures. The impact assessment is therefore carried out in the context of planning approval procedures for the respective project, with the aim of deriving and defining the necessary avoidance and mitigation measures at project level.

According to the current state of knowledge, significant negative impacts on the FFH habitat types "reefs" and "sandbanks which are slightly covered by sea water all the time" can be ruled out even if the plan and existing projects for the nature conservation areas "Borkum Riffgrund", "Sylter Außenriff -Östliche Deutsche Bucht" and "Doggerbank" as well as for the "Lower Saxony Wadden Sea National Park" in the territorial sea are considered cumulatively, due to the small-scale effects on the one hand and the distances from the areas on the other.

# 7 Overall plan evaluation

In summary, with regard to the designations of the spatial plan, the aim is, as far as possible, to minimise the impacts on the marine environment through orderly, coordinated overall planning. Ensuring that the nature conservation areas defined by ordinance are designated as nature conservation priority areas serves both to ensure the conservation objectives and also to safeguard open spaces. By strictly adhering to avoidance and mitigation measures, in particular for sound abatement during the construction phase, significant impacts can be avoided, in particular by implementing the designations for offshore wind energy and cables/pipelines. No priority or reservation areas for wind energy are defined in the nature conservation priority areas. Most of the reservations areas for cables and pipelines also run outside ecologically significant areas.

On the basis of the above descriptions and evaluations as well as the species and area protection law assessment, the strategic environmental assessment concludes, also with regard to possible interactions, that based on the current state of knowledge and at the comparatively abstract level of spatial planning, no significant impacts on the marine environment within the area under investigation are to be expected from the planned designations.

Many environmental impacts, such as those from shipping or fisheries, are independent of the implementation of the spatial development plan and can only be controlled to a very limited extent by spatial planning.

Most of the environmental impacts of the individual uses for which designation are made would also occur - based on the same medium-term time horizon - if the plan were not implemented, as it is not apparent that the uses would not take place or would take place to a significantly lesser extent if the plan were not implemented. From this point of view, the provisions of the plan appear in principle "neutral" in terms of their environmental impact. Although it is in principle possible that, due to the concentration/bundling of individual uses over certain sites/areas, some of the plan designations within the range of a specific site could well have negative environmental impacts, an overall balance of the environmental impacts would tend to be positive due to the bundling effects, since the remaining areas/sites would be relieved and hazards to the marine environment (e.g. the risk of collision) would be reduced.

For wind energy use, the potential impacts are often small-scale and frequently short-term because they are limited to the construction phase. For the cumulative assessment of impacts on individual protected species such as bats, there is a lack of sufficient scientific knowledge and uniform assessment methods.

For the wind energy reservation areas and the cable/pipeline reservation areas in the area north of shipping route SN10, detailed data and findings are lacking for individual protected assets. For this reason, the potential impacts cannot be conclusively assessed within the scope of this SEA, or are subject to uncertainties and require more detailed examination in the context of subsequent planning stages.

# 8 Measures to prevent, reduce and offset significant negative impacts of the spatial plan on the marine environment

## 8.1 Introduction

Pursuant to number 2 letter c Annex 1 to Section 8 subsection 1 ROG, the environmental report contains a description of the measures planned to prevent, reduce and, as far as possible, compensate for significant adverse environmental impacts resulting from the implementation of the plan.

The basic principle is that thanks to the spatial plan, consideration of the needs of the marine environment is improved. The effect of the designations of the spatial plan is to prevent negative impacts on the marine environment. This is due in particular to the fact that it is not apparent that the uses would not take place or would take place to a lesser extent if the plan were not implemented. The need to expand offshore wind energy and the corresponding connecting cables and pipelines exists in any case and the corresponding infrastructure would have to be created even without the spatial plan (cf. Chapter 3.2). If, however, the plan were not implemented, the uses would develop without the space-saving and resource-conserving steering and coordination effect of the spatial plan.

In addition, the provisions of the spatial plan are subject to a continuous optimisation process, as the findings continuously gained in the course of the SEA and the consultation process are taken into account in the preparation of the plan.

While individual preventative, mitigation and compensation measures can be initiated at the planning level, others only come into effect during the actual implementation phase and are regulated there in the individual approval procedure on a project- and site-specific basis.

## 8.2 Measures at plan level

With regard to planning preventative and mitigation measures, the draft spatial plan makes spatial and textual designations which, in accordance with the environmental protection objectives set out in Chapter 1.4serve to prevent or reduce significant negative impacts of the implementation of the draft spatial plan on the marine environment. This essentially relates to

- the designation of all nature conservation areas in the EEZ identified by ordinance as nature conservation priority areas,
- the designation of the main concentration area of divers as the reservation area for divers,
- the designation of the main distribution area of harbour porpoises as the harbour porpoise reservation area,
- the renouncement of the designation of wind energy priority or reservation areas in nature conservation priority areas,
- the designation of cable/pipeline reservation areas in which lines are to be laid, mainly outside nature conservation priority areas,
- the principle that existing nature conservation areas should be taken into account in the planning, laying and operation of cables/pipelines,
- the principle of noise reduction during the construction of wind turbines,
- the principle of overall coordination of the construction of power generation installations and the laying of cables/pipelines,
- the principle of choosing the least disruptive laying method for cables/pipelines,

- the principle of as far as possible avoiding the heating of sediments by live cables,
- the principle of taking into account best environmental practice as defined in the OSPAR Convention and the current state of science and technology
- the principle of avoiding, as far as possible, the mining of sand and gravel in the diver reserve during the period 1 March to 15 May,
- and the least possible use of space, ensured by the following principles
  - economic uses should be as space-saving as possible.
  - fixed installations are to be dismantled at the end of their use.
  - when laying cables/pipes, the aim should be to achieve the greatest possible bundling in the sense of parallel routing. In addition, the route should be as parallel as possible to existing structures and buildings.

## 8.3 Measures at the specific implementation level

In addition to the measures at plan level mentioned in Chapter 8.2, there are measures for certain designations or associated uses, such as offshore wind energy, cables/pipelines and sand and gravel extraction, to avoid and reduce both slight and significant negative impacts in the actual implementation of the draft spatial plan. These reduction and preventative measures are specified and ordered by the respective competent licensing authority at project level for the planning, construction and operating phases.

With regard to the specific preventative and reduction measures for offshore wind energy at sea and for cables/pipelines, in any event the power cables, reference is made to the comments in the environmental report on FEP 2019/ draft FEP 2020. These measures, e.g. sound abatement for offshore wind turbines, are described in detail in Chapter 8.

Concrete preventative and reduction measures for cables/pipelines include, for example, construction time restrictions for laying within protected areas, a reduction in light emissions during construction work, the general avoidance of rubble and loose boulders and measures to protect cultural and property assets.

For sand and gravel extraction, the specific preventative and reduction measures are derived from the main operating plans. These measures include, for example, a restriction on extraction voyages during periods sensitive to divers, the provision that only ships with a certain sound spectrum may be used, the instruction to exclude certain rock fields or reef types from extraction and to prevent habitat impairments resulting from screening, as well as strict surveillance by means of appropriate monitoring (cf. Chapter 10.2).

# 9 Assessment of alternative option

## 9.1 Principles behind assessment of alternatives

### 9.1.1 General

For the draft Spatial Plan, a staged review of alternative options is carried out. Depending on the increasingly more specific planning, the alternative options to be examined are reduced during the course of the planning process and become increasingly (spatially).more specific

In general, the environmental report pursuant to Article 5 subsection (1) first sentence 1 of the SEA Directive in conjunction with the criteria defined in Annex I to the SEA Directive and Section 40 subsection (2) number 8 of Germany’s Environmental Impact Assessment Act (UVPG) contains a brief description of the reasons for the choice of the reasonable alternatives to be examined.

In describing and assessing the environmental impacts identified under Section 8 subsection (1) of the Federal Regional Planning Act (ROG), the report shall contain information on the other planning options under Annex 1 number 2 point c) to Section 8 subsection 1 of the ROG, taking into account the objectives and the spatial scope of the Spatial Plan. The prerequisite is always that they take the objectives and the spatial scope of the Spatial Plan into account.

At the same time, the identification and examination of the planning possibilities or planning alternatives under consideration must also be based on what can reasonably be required in terms of the content and level of detail of the Spatial Plan. The following applies here: The greater the expected environmental impacts and thus the need for planning conflict resolution, the more extensive or detailed investigations are required.

Annex 4 number 2 to the UVPG gives examples of the examination of alternatives with regard to the design, technology, location, size and scope of the project, but explicitly refers only to projects. Hence, the conceptual and strategic design and spatial alternatives play a major role at the planning level.

In principle, it should be noted that a preliminary examination of possible and conceivable planning options is already inherent in all specifications in the form of objectives and principles. As can be seen from the justification of the individual objectives and principles, in particular those relating to the environment, the respective definition is already based on a weighing up of possible public interests and legal positions affected, so that a "preliminary investigation" of planning possibilities or alternatives has already been carried out. A large number of different uses and legally protected interests already exist in the EEZ.

In addition to the zero alternative, the environmental report examines in particular spatial planning possibilities and alternatives, where relevant for the individual uses.

The SEA and thus also the alternative assessment for the draft Spatial Plan are characterised by a larger scope of investigation and a lower level of detail compared to environmental assessments at subsequent planning and licensing levels.

### 9.1.2 Process of reviewing spatial plan alternatives

The framework for selecting and evaluating alternative options is first provided by the general guidelines, which serve as starting point at an early stage of the planning process with three planning options each, as overall spatial planning solutions. Then, various selected sectoral and sub-regional planning options are examined as planning becomes more concrete, in parallel with preparation of the first draft plan (cf. Figure 42 below).

In the final planning phases - for the revised draft plan as well as the final version - the planning options selected, weighed and defined from the various alternatives are justified in the environmental reports.

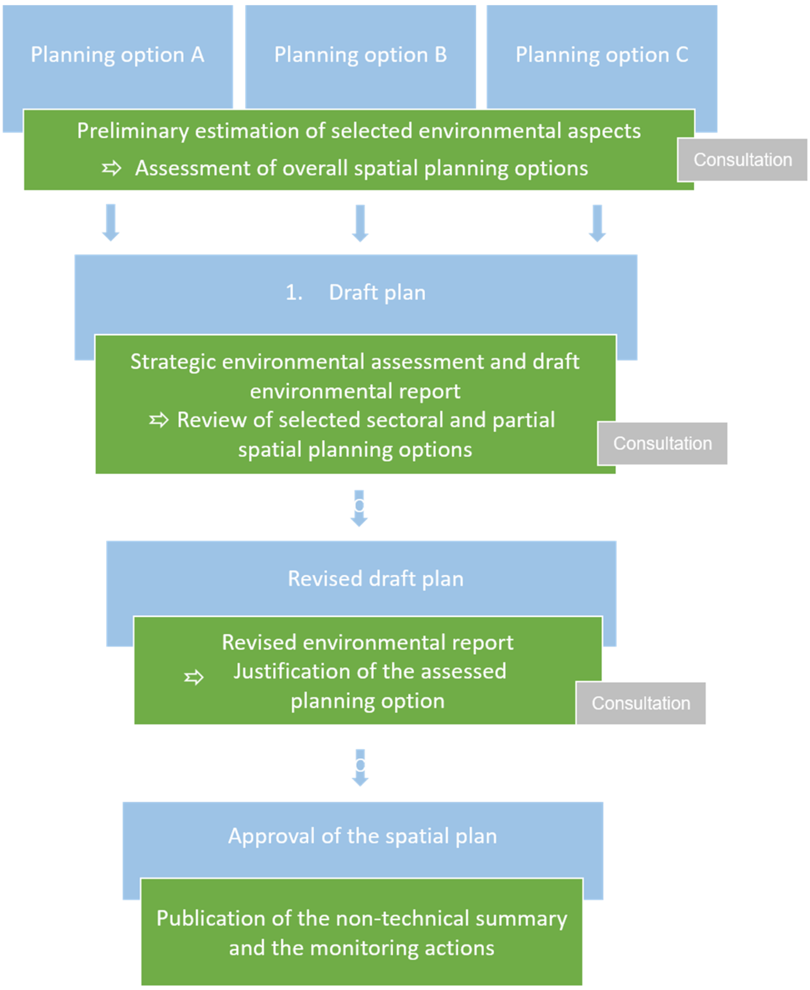



Figure 42. Staged approach to reviewing alternative options.

Section 1 of the draft plan formulates the mission statement and, below it, guidelines for the draft Spatial Plan. The following overall objectives can be derived from this, against which the planning alternatives considered below are measured.

<u>The draft Spatial Plan shall:</u>

- support coherent international maritime spatial planning and territorial cooperation with other countries and at the regional seas level,

- take into account land-sea relations and planning in territorial waters,
- lay the foundations for a sustainable maritime economy in the spirit of Blue Growth, and
- contribute to the protection and improvement of the status of the marine environment and to the prevention and reduction of disturbance and pollution.

These objectives are to be achieved through:

- the coordination of current and future spatial requirements, with
- the identification of suitable areas, in particular for economic and scientific uses, but also for the marine environment and other concerns,
- a prioritisation of sea-specific uses and functions,
- the balancing of environmental, economic and social concerns,
- the conserving and optimised use of the areas allocated to the uses, in particular the areas for fixed infrastructure, which also includes the reversibility of fixed installations
- the holistic view of the various activities in the sea,
- with their interactions and cumulative effects,
- and by applying the ecosystem approach and the precautionary principle.

## 9.2 Assessment of alternatives within the planning concept (January 2020)

The planning concept was prepared as a first informal planning step. In the early stages of the process of updating the Spatial Plans in the German North Sea and Baltic Sea EEZ, the concept for updating the Spatial Plans comprised three planning options (A-C) as overall spatial plan variants. The early and comprehensive consideration of several planning options represents an important planning and review step in the updating of the Spatial Plans.

The concept for the plan revision represents the claims on utilisation of different sectors from three different perspectives - in terms of overall plan alternatives, which are all taking into account the general framework conditions described above and the basic assumptions listed below, and are thus to be understood as "reasonable" alternatives. In this way, spatial and content-related dependencies and interactions as well as corresponding planning principles were taken into account, and it has been shown how maximum demands of individual sectorshave been limited in this respect.

A preliminary assessment of selected environmental aspects for this revision concept was already carried out before this environmental report was prepared. The preliminary assessment of selected environmental aspects in the sense of an early examination of variants and alternatives should support the comparison of the three planning options from an environmental standpoint.

The three planning options at a glance:

(A) The focus of planning option A is on traditional uses of the sea, with particular attention to the interests of shipping, raw materials extraction and fisheries.

(B) Planning option B shows a climate protection perspective in which a lot of space is given to future use of offshore wind energy.

(C) Planning option C focuses in particular on broadly securing extensive areas for marine nature conservation. In addition to the initial, mainly spatial definitions, there are some supplementary textual definitions.

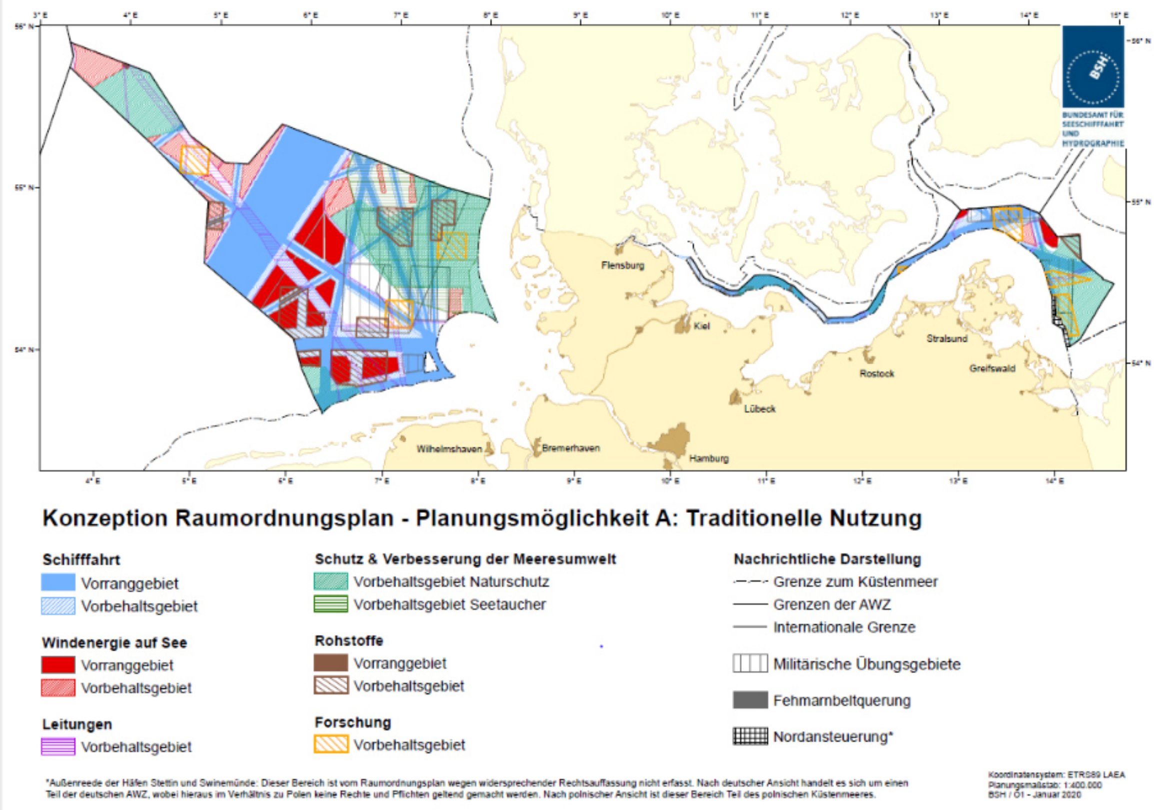



Figure 43: Concept of the Spatial Plan - planning option A for "traditional use"

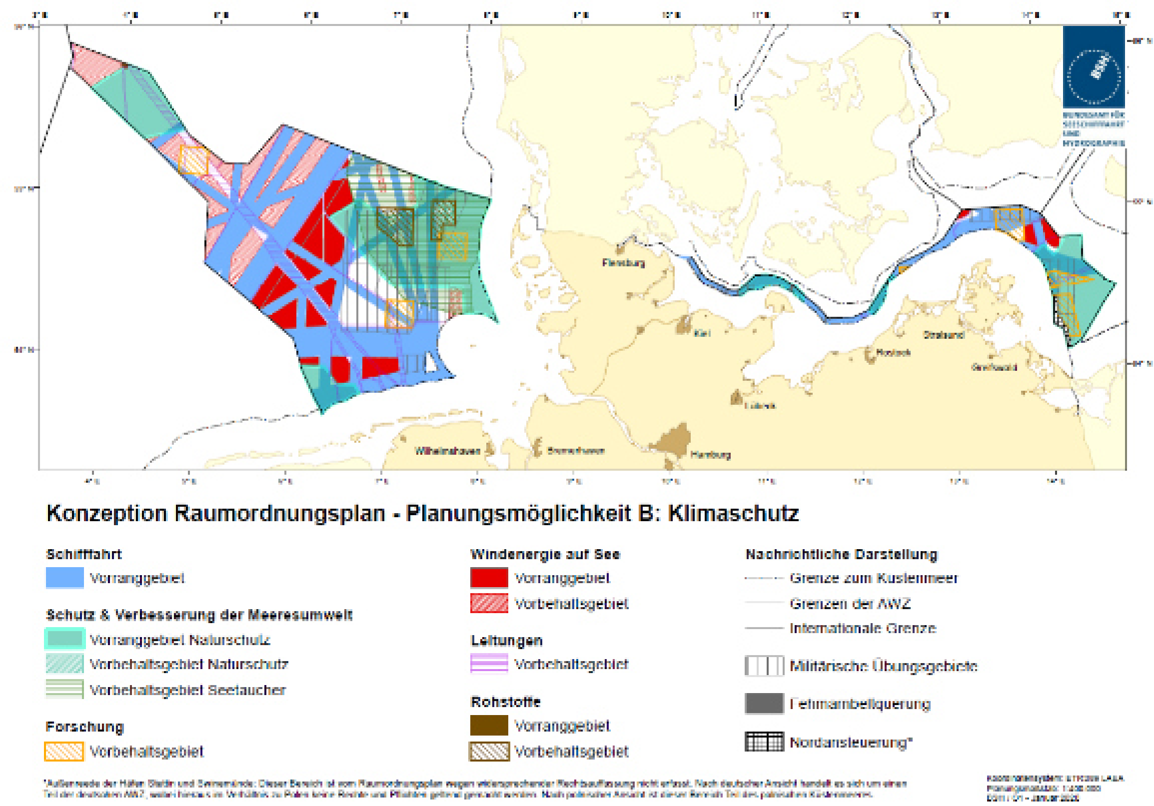



Figure 44: Concept of the Spatial Plan - planning option B for "Climate protection"

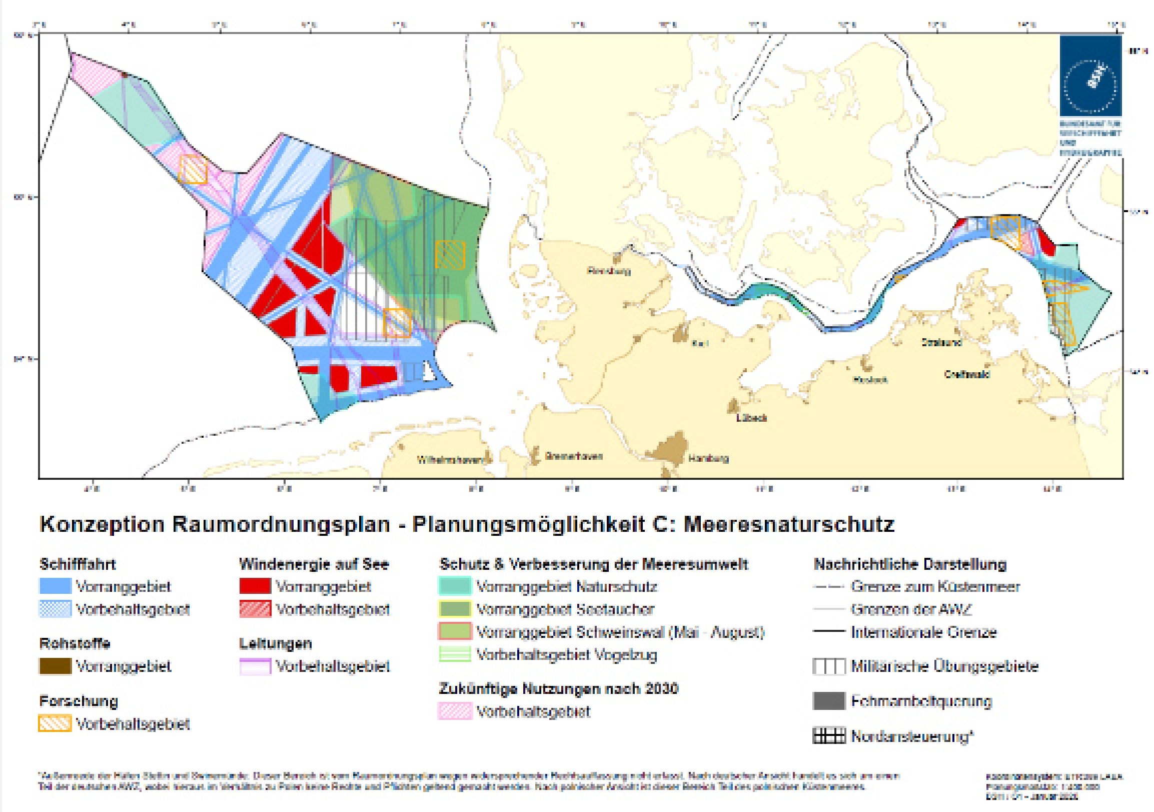



Figure 45: Concept of the Spatial Plan - planning option C for "Marine nature conservation"

In addition to general basic assumptions and overall objectives that applied to all three planning options (cf. conception), the individual planning options were based on the following additional objectives.

*Planning option A*

Shipping

- Barrier effects must be prevented, especially with regard to the possible establishment of future maritime traffic separation schemes (TSS), and sufficient space must be secured for this in the long term, especially along Route SN10.

Raw material extraction

- The extraction of raw materials should also be made possible in combination with other uses and in nature conservation areas, and should be given special weight in the overall balance. Permit areas in accordance with the Federal Mining Act (BBergG) are defined as reservation areas.

Fisheries

- For fisheries, opportunities are to be created to limit the restrictive effects of uses, in particular through further expansion of offshore wind energy, and to generate income opportunities through joint use in wind farm areas; this is explained in the text.

*Planning option B*

Offshore wind energy

- Areas for further development of offshore wind power production beyond 2030 that maximises installed electrical generating capacity must be comprehensively secured. To this end, areas for shipping along Route 10 in the North Sea will be designated only for the areas of the main traffic flows.

- The future extraction of hydrocarbons, which, depending on the location of production facilities, could hamper the expansion of wind energy, is not supported by the designation of reservation areas, but permit areas for sand and gravel extraction are taken into account.

*Planning option C*

Protection and improvement of the marine environment

- Economic uses not compatible with the purpose of protection in areas earmarked for protection and improvement of the marine environment should be excluded as far as possible.
- Raw materials extraction of sand and gravel, but also of hydrocarbons, should not be privileged by dispensing with spatial definitions for all raw materials.
- For bird migration in the Baltic Sea, a reserved area is established in the area of the Fehmarn-Lolland route.

### 9.2.1 Environmental assessment of the alternative specifications in the planning concept

The table below lists only those planning topics for which alternative planning solutions have been presented in the planning options. In assessing the environmental aspects, impacts are primarily named which relate to the spatial definitions, and here in particular to the differences between the three planning options.

In general, it can be stated from an environmental standpoint that no clear preference for a planning option can be identified. For shipping, differences between the three planning options in terms of environmental impacts cannot really be determined at such a general level. This is because the same basic assumptions such as traffic volume, ship types and ship classes were used as a basis in all plan variants. For example, the fact that in planning option B broader priority areas are defined within nature conservation areas does not de facto lead to an increase in shipping traffic in these areas. For offshore wind energy there are different spatial definitions between the planning options. Here, the extent of the area definitions varies greatly. From a climate protection perspective, this leads to different levels of $CO_2$ savings potential. In a relative comparison, planning option B offers significantly greater $CO_2$ savings potential than A and C based on the assumed installed capacity. On the other hand, the three planning options lead to different sea use, ranging between 9 and 20% of the total North Sea and Baltic Sea EEZ area. This refers to the total area of the defined priority and reservation areas for offshore wind energy. In general, however, less than 1% of the designated areas are actually sealed. The nature conservation areas account for a large part of the EEZ area. Over a third of the North Sea EEZ and more than 50% of the Baltic Sea EEZ are protected. These are relatively large areas, but this does not necessarily mean zero use in these areas. The nature conservation priority areas help to safeguard open spaces, as uses incompatible with nature conservation are excluded in these areas. The quantitative differences in terms of area definitions for the protection and improvement of the marine environment are rather small between the three planning options. In this case, the qualitative criterion is the protection purpose of the areas defined; for example, in some options the main distribution area of divers (loons) and harbour porpoises is defined as a priority area. In this respect, planning option C is to be preferred from the pure perspective of nature conservation and the precautionary principle. However, the climate protection aspect must be taken into account here, which is given much less consideration in planning option C.

The differences in the area definitions are described in detail below.

| | Area definitions | Selected environmental aspects |
|---|---|---|
| **Shipping** | | |
| A | Navigation routes as priority areas with accompanying reservation areas | • Some crowding out and bundling effects are to be expected. |
| B | All shipping routes across the whole width of the area Priority areas; SN10 is divided into three main traffic routes, leaving gaps which are presented as reservation areas for offshore wind energy | • Possibly increased risk of collision with corresponding environmental risks compared to planning options A and C due to reservation areas of wind energy within route SN10, and the concentration of traffic in the remaining corridors, without additional navigation areas. |
| C | Navigation routes as priority areas with accompanying reservation areas; SN10 along the main traffic flows as priority area Navigation, with remaining gaps as temporary priority area until 2035 | • Due to the temporary priority area, there are no additional environmental impacts in the medium term compared to planning option A. |

| Offshore wind energy / Future uses | | |
|---|---|---|
| A | Designation of areas as priority and reservation areas for offshore wind energy production for approx. 35 to 40 GW of installed electrical generating capacity;<br><br>Definition of areas EN1 to EN3, and EN6 to EN12, and EO1 and EO3 as priority areas for offshore wind energy. | • Sea area use approx. 5,000 km², approx. 15% share of the North Sea and Baltic Sea EEZs. |
| B | Sea area allocations with more extensive priority and reservation areas for wind energy, also within SN10 for approx. 40 - 50 GW;<br><br>Definition of areas EN1 to EN3, and EN6 to EN13 and EO1 to EO3 as priority areas for offshore wind energy. | • Sea area u approx. 6,400 km², approx. 20% share of the North Sea and Baltic Sea EEZs, considerably larger than in planning option A.<br>• $CO_2$ savings potential under climate protection aspects: In relation to planning options A and C, the $CO_2$ savings potential is significantly greater when taking into account the capacities for the installed electric power.<br>• It is possible that a higher risk of collision could result from the location of wind energy areas within the main shipping route 10. |
| C | Designation of areas with less extensive priority and reservation areas wind energy production for approx. 25 to 28 GW of installed electrical generating capacity;<br><br>Definition of areas EN1 to EN3, and EN6 to EN12, and EO1 and EO3 as priority areas for offshore wind energy.<br><br>In the *Entenschnabel* ("Duck's Bill"), i.e. the German EEZ in the North Sea, reservation areas are planned for future use, with wind energy as just one possible use;<br><br>No designation of areas for wind energy in the reservation areas for divers (loons) and porpoises. | • Compared to planning options A and B, the $CO_2$ savings potential already secured for wind energy by the specifications<br>is significantly lower.<br>• At approx. 3,000 km², approx. 9% of the area used for wind energy, the North Sea and Baltic Sea EEZs account for about 9%, which is significantly lower than in planning options A and B.<br>• In an area of around 1,600 km² or about 6% of the North Sea EEZ, future use will be kept open, but no prioritisation will be given to offshore wind energy, for example, thus maintaining the option for uses with less environmental impact in the long term.<br>• Subsequent use of wind energy at the sites of the wind farms in the main distribution areas of divers (loons) and harbour porpoises is ruled out, so that a positive long-term environmental impact can be expected compared with the status quo.<br>• Overall, compared with planning options A and B, a significantly higher weighting of marine nature conservation concerns is to be expected, with a potentially lower impact on the marine environment as a result. |
| **Raw materials** | | |

| | | |
|---|---|---|
| A | Reservation areas for all permits, for hydrocarbons and areas for sand and gravel extraction | • A possible adverse impact can be caused by avoidance effects and potential physical disturbance / injury by underwater sound during seismic surveys. In addition, there would be possible effects from the construction and operation of production platforms<br>• Mining in the sand and gravel reserves, all of which are located in nature conservation areas, can have the following effects: damage to the seabed through physical disturbance, impairment and avoidance effects through turbidity plumes, habitat change through removal of substrates and habitat and area loss. |
| B | Reservation areas for sand and gravel extraction only | • Fewer impairments than in planning option A are to be expected, because only specifications for sand and gravel extraction are provided for and there is no prioritisation of hydrocarbon extraction by regional planning. |
| C | No specifications for raw materials extraction | • By dispensing with specifications for the extraction of raw materials as a whole, including protected areas, a lower burden can arise compared with planning options A and B, since regional planning does not set any priorities here compared with other uses. In this case, the use is carried out solely on the basis of the operational plans following approval under mining law. These may include measures that must be taken to reduce and limit the environmental impacts of the projects as far as possible. |
| **Nature conservation** | | |
| A | For nature conservation, reservation areas are shown in the extension of existing nature conservation areas.<br>In addition, the main concentration area of divers (loons) in the North Sea is designated as a reserved area. | • Restrictions in nature conservation areas generally exclude offshore wind energy and thus support the conservation purpose of these areas. In the context of further land development for offshore wind energy and a subsequent update of sectoral planning, regional planning would only give nature conservation the weight of a reservation when weighing up the interests here.<br>• The restrictions governing the area of the divers (loons) dictate that subsequent use or expansion of wind energy is subject to reservations. |
| B | Priority areas for nature conservation are defined in the extent of existing nature conservation areas, with the exception of areas overlapping with the reservation areas for sand and gravel extraction. | • The designation of priority areas for nature conservation supports the conservation purposes of the nature conservation areas. However, where specifications for sand and gravel extraction overlap with a nature conservation area, nature conservation is only assigned a reservation. |

| | | |
|---|---|---|
| | The main concentration area for divers (loons) in the North Sea is defined as a reservation area, as in planning option A. | • The use of wind energy in the priority area and in the nature conservation area is excluded.<br>• The restrictions governing the area of the divers (loons) dictate that subsequent use is subject to reservation.<br>• Compared to planning option A, nature conservation is given greater weight in the overall picture. |
| C | Priority areas for nature conservation are defined in the extension of all nature reserves, as well as for the main concentration area of divers (loons) and the main distribution area of harbour porpoises (these are limited to the months of May to August).<br><br>In the area between Fehmarn and Lolland, a bird migration reserve is defined. | • The designation of the nature reserves as well as the main concentration areas of great cetaceans and harbour porpoises as nature conservation priority areas supports the protection purposes of the nature conservation areas and other areas of outstanding nature conservation importance. As a result, nature conservation is given greater weight when weighing up against other uses within these areas.<br>• The priority of the main concentration area of divers (loons) also leads here to the exclusion of a subsequent use of the existing wind farm areas within the area, as well as the exclusion of wind energy development in the priority area of harbour porpoises. In the long term, this could mitigate or compensate for the observed avoidance effects and habitat losses of the divers (loons).<br>• The Fehmarn-Lolland bird migration reserve in the Baltic Sea will serve as an additional definition in support of the MSFD measure to protect migratory species. |

## 9.3 Review of alternative options within the framework of preparing the first draft plan

The first draft plan was prepared on the basis of the planning concept, the comments received on it and further findings and requirements from subsequent informal technical and departmental discussions.

On the one hand, the selection was made on the basis of the assessments of comparative environmental impacts presented in Section 1.2 (cf. also Section 5 of the Conceptual Design), with adoption as implemented in the respective planning option, but also partly spatially adapted due to other considerations, or as further development of a combination of different aspects of individual planning solutions.

The overall context of the plan is to be considered and, in the choice of plan solutions, in addition to taking account of nature conservation concerns and avoiding or reducing possible negative environmental impacts, the aim is to achieve the greatest possible balance in the overall picture with other economic, scientific and safety concerns. The decisive factor is that, based on current knowledge, at the level of this SEA no significant impacts on the marine environment are to be expected from the provisions set out in the draft Spatial Plan.

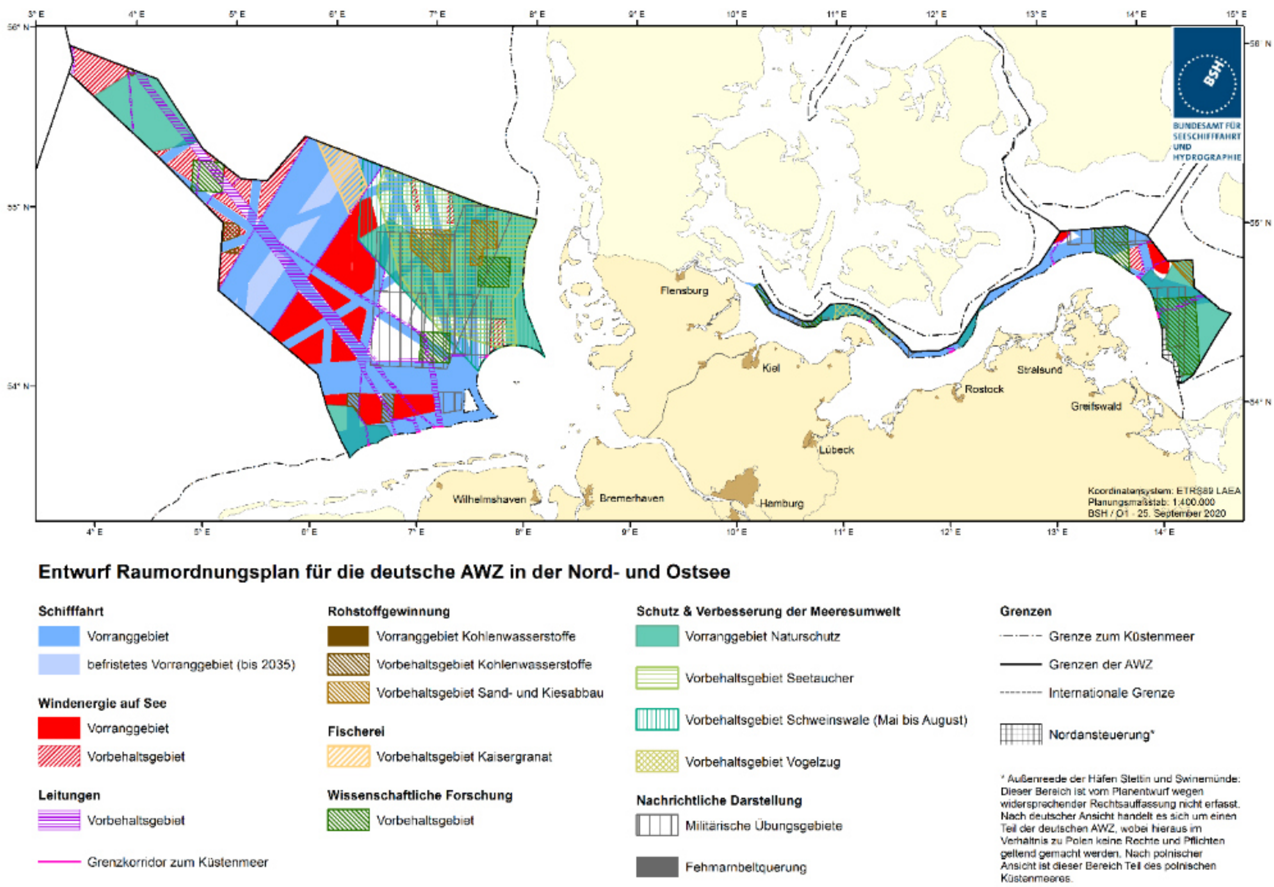



Figure 46: Draft Spatial Plan for the German North Sea and Baltic Sea EEZ

### 9.3.1 Zero alternative

The zero option, i.e. not updating the Spatial Plan, is not considered a reasonable option.

Overall, overarching and forward-looking planning and coordination taking into account a large number of spatial requirements is likely to lead to comparatively lower spatial utilisation and thus to lower environmental impacts (cf. Section 3).

### 9.3.2 Spatial alternatives

When drawing up the draft plan, the following alternatives (for the entire area / for sub-areas) were considered.

#### 9.3.2.1 Shipping

Compared to the planning concept, the designations for shipping represent a combination of different approaches from planning options A, B and C:

- Generally only priority areas for shipping, and in area ES10 main routes highlighted as priority areas without any time limit as in B, but no designations for wind energy between these main routes;
- Similar to C, differentiation between main routes and other areas, designation of these interspaces not as reservation areas but as temporary priority areas with conditional (if no traffic control measures are introduced by 2035) transfer to reservation areas

Offshore wind energy designations within Route SN10 are not specified, in particular for reasons of safety and efficiency of navigation.

As a result, there would be less pollution in this area, which would be expected from the construction and operation of the installations, including the additional construction and maintenance traffic.

In addition, all shipping routes are designated as priority areas, as in planning option B. In Route SN10, areas away from areas with the heaviest traffic are designated as temporary priority areas. If no traffic-control measures are taken by 2035, which might have to include these areas, they would be "downgraded" to shipping reservation areas.. In contrast to C, however, the general designation of reservation areas for shipping along all shipping routes has been dispensed with (cf. further justifications in the draft spatial plan).

The foregoing of the differentiation between shipping priority and reservation areas has no influence on potential environmental impacts. The designation of priority areas for shipping within nature conservation areas reflects the existing traffic flows and serves to keep the routes clear. The priority areas do not de facto change shipping traffic. In any case, the number of ship movements in the Sylter Außenriff is relatively low, while in the nature conservation area Borkum Riffgrund the heavily used IMO route Terschelling German Bight had to be taken into account. The conservation area ordinance itself also takes this important shipping function into account for zoning within the area.

| **Alternative: shipping** | |
|---|---|
| Brief description | Shipping areas in nature conservation areas are designated as reservation areas across their whole width.. |
| Presentation of the alternative in comparison to the draft plan | The draft plan designates all routes as priority areas, including in nature conservation areas. |
| Points of conflict with other uses | • According to the provisions of the UNCLOS to be applied under Section 1 subsection 4 ROG, a restriction of shipping in the EEZ is only possible under the conditions laid down in it, so that there can be no legal conflict of interests. Furthermore, Section 57 subsection 3 number 1 BNatSchG stipulates that restrictions on shipping are not permitted in nature conservation areas<br>• In particular in the nature conservation area Borkum Reefground, the international shipping route in traffic separation scheme Terschelling German Bight would not be adequately safeguarded by spatial planning. |
| Environmental assessment | • There would probably be no change in the environmental impact of shipping, because the freedom of navigation and, in the traffic separation schemes, for large vessels calling at seaports, the obligation to use them, would continue to exist.<br>• It is not possible to make provisions through spatial planning to avoid certain areas, or to change routes in nature conservation areas. However, the number of ship movements outside the traffic separation scheme, especially in the Sylter Außenriff, is rather low.<br>• The priority areas for shipping are mainly intended to keep the important shipping routes clear of fixed installations and are therefore complementary to the priority areas for nature conservation in their regulatory purpose of preventing accidents. |

#### 9.3.2.2 Offshore wind energy

The spatial designations of planning option A are used for offshore wind energy. This option offers sufficient safeguarding of areas for the objectives of wind energy expansion.

Beyond areas for 20 gigawatts of offshore wind energy production required by law as the basis for designating priority areas, all areas likely to be required for the expansion of offshore wind energy by 2035 (approx. 30 GW) - as the medium-term planning horizon of the Spatial Plan - are designated as priority areas for wind energy.

In addition, areas in zones 4 and 5 (in the "Duck's Bill"), as well as the areas in cluster N-4 and N-5, which are under consideration in FEP 2019 and which have already been developed with offshore wind farms or will be developed with them in the future (in the "Helgoland Cluster" N-4), will be designated reservation areas for wind energy. This means that the EN4 area has been "downgraded" from being a priority area for wind energy compared to the designations of the 2009 spatial plan.

For the designation as reservation areas, current findings from many years of wind farm monitoring are decisive here. These findings have revealed significantly larger-scale avoidance effects and habitat loss for the wind farms located within the sea diver's main concentration area than had previously been assumed during the approval and planning procedures at the time.

Compared to planning option A, the site layout for the EN13 area was adapted:

- On the one hand, the EN13 area has been reduced in size compared to the FEP in order to create a buffer zone of 5.5 km to the border of the reservation area for the conservation of the diver, thus preventing or reducing the impacts of future wind farms on the conservation area.
- On the other hand, the small northern area enclosed by shipping routes 7, 10 and 15 is no longer necessary.

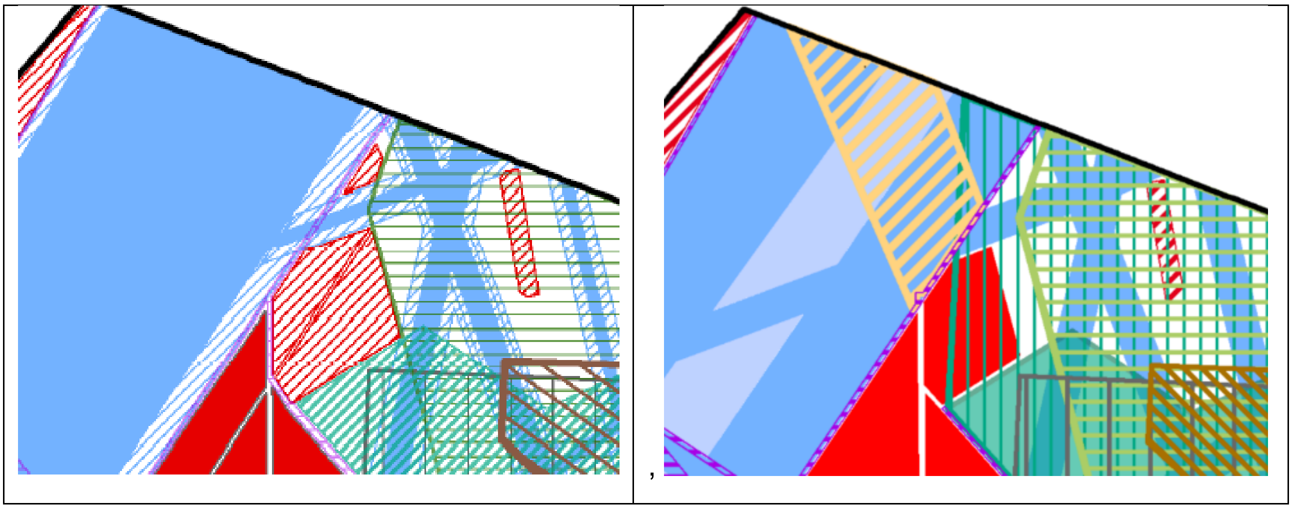


Figure 47: Excerpts from Planning Concept A (left) and the draft spatial plan (right)

The sea areas northwest of shipping route 10 are shown as reservation areas. This means that they are not conclusively secured for wind energy in their respective extent, but are subject to weighing up of against other key interests for this use. Compared to planning option C, with the "future uses" designation, this means a stronger weighting for offshore wind energy use. This designation at the level of spatial planning appears to be suitable for adequately considering the requirements of climate protection and marine conservation.

For the areas EN9 to EN13, in which no actual projects have been implemented so far, the SEA for FEP 2019 comes to the conclusion that, according to the current status and by applying strict and effective avoidance and mitigation measures, no significant environmental impacts are to be expected, at least at the level of sectoral planning.

For the areas beyond this, which would have to be used for an expansion to 40 GW, the draft spatial plan merely contains a reservation in order to be able to examine these in more detail in a later update of the FEP and to define them as specific areas, if the environmental assessment supports this.

Designating the areas now planned as reservation areas for wind energy as priority areas is not seriously considered, as this would not be compatible with the competence of spatial planning:

a) Spatial planning is medium-term planning, and in this time horizon there is no need, in terms of surface area, to develop wind farms on areas designated as reservation areas (as this would exceed 25 GW);

(b) A final balance is not possible because of the uncertainty regarding developments in the EEZ beyond 2035.

| **Alternative 1: wind energy** | |
|---|---|
| Brief description | • Areas for wind energy that are not required for the 20 GW of installed capacity stipulated by law, but only for expansion beyond this, are designated as reservation areas for wind energy. |
| Presentation of the alternative in comparison to the draft plan | • The draft plan designates all areas likely to be required for the medium-term development of wind energy up to 2035 as priority areas (EN1 to EN3, EN6 to EN13), all other areas (E4, 5 and 14 to 19) as reservation areas. |
| Consequence / implications for the next planning levels | • FEP 2020 does not yet define sites for the areas EN11 to EN13. The preliminary examination of sites and the suitability assessment will only be carried out for those sites defined in the FEP. Thus, the designation as reservation areas has no direct consequences at the downstream level for the time being, but further designations in the course of an update of the FEP for wind energy expansion up until 2025 could not exclude the priority areas in the spatial plan. A partial update of the spatial plan for these areas could then become necessary. |
| Environmental assessment | • The designations of EN11 to EN13 as reservation areas mean the securing of offshore wind energy is still open to the extent that no final assessment has been made in favour of this use. This means that even more extensive environmental assessments will be required at a later date, for which it is expected that the knowledge from the procedures in the areas EN9 and EN10 that may already be available at that time can be used.<br>• However, based on the above-mentioned results of this SEA and the SEA for the FEP, the data and knowledge base is already sufficient to define the areas EN11 to EN13 as priority areas for wind energy. |
| **Alternative 2: wind energy** | |
| Brief description | • The areas of wind farms in the main distribution area of divers in areas EN4 and EN5 are not designated as reservation areas for wind energy. |
| Presentation of the alternative in comparison to the draft plan | • This would mean that in the long term, no areas for wind energy would be allowed in the reservation area for divers for a subsequent use of existing wind farms, while at the same time excluding the construction of installations outside the areas designated for this purpose. |

| | |
|---|---|
| Points of conflict with other uses | • Even if all other areas defined in the draft plan were to be used, this solution would probably lead to a situation where there would not be enough areas available in the German EEZ to achieve the long-term expansion target for wind energy of 40 GW. |
| Consequence / implications for the next planning levels | • In areas EN4 and EN5, no repowering permit would be granted after the expiry of the operating permits for the existing and approved wind farms and the dismantling of the installations. |
| Environmental assessment | • With regard to environmental impacts, the observed avoidance effects and habitat losses of divers could - in line with planning option C - be mitigated or compensated in the long term by the wind farm projects implemented in the main concentration area. |
| **Alternative 3: wind energy** | |
| Brief description | • Area EN13 is designated as a wind energy reservation area |
| Presentation of the alternative in comparison to the draft plan | • Similar to planning option A, the spatially adapted area EN13 is defined as a reservation area for wind energy, whereas the draft plan provides for a priority area here. |
| Consequence / implications for the next planning levels | • Early wind energy development in offshore areas required |
| Environmental assessment | • The reservation for the EN13 area could, from a precautionary point of view, result from the situation at the diver reservation area and/or the partial overlap with the harbour porpoise reservation.<br>• The current draft plan provides for a buffer to the main concentration area of divers in order to protect them.<br>• As regards the overlap with the harbour porpoise reserve, potentially significant impacts could result from the pile driving of wind turbines, especially during the sensitive period from May to August. For EN13, the data set for harbour porpoise can be considered good. Possible effects of impulse sound input during pile driving have been well researched and there is ongoing very dynamic development in respect of effective technical noise control measures covering all construction aspects. |

#### 9.3.2.4 Cables and pipelines

The reservation areas for cables and pipelines correspond to those which have already been presented in all three planning options in the planning concept. Only those corridors have been designated in which at least two lines exist or are planned, or which are reserved for future lines.

These provisions

- are required for the submarine cable systems to transport the electricity from the offshore wind farms to the grid connection onshore based on the provisions of the site development plan,
- secure the routing of existing interconnectors and pipelines, and
- secure routes for future cables and pipelines.

Nature conservation areas are as far as possible excluded from the designations, with the following exceptions:

- The routes of existing pipelines crossing the Dogger Bank nature conservation area,
- The route for the existing and planned connecting cables in the direction of the Ems corridor through the nature conservation area Borkum Riffgrund

By not designating corridors for individual lines, some existing or planned cable routes through nature conservation areas are not designated.

Compared to the planning concept, gates at the transition of the line routes into the territorial sea are supplemented similarly to the designations of the spatial plan 2009 and in line with the designations of the FEP.

The reservation areas for the cables and pipelines can be an instrument, for example in approval procedures for transit pipelines and transboundary submarine cables, for requiring lines be routed, where possible, within these spatially suitable corridors, and thus avoiding routing through nature conservation areas and associated adverse effects. Where individual cables or other linear infrastructure currently pass through nature conservation areas, no reference can be made to a reservation from spatial planning in the event of changes or new projects, but where appropriate, more ecologically compatible routing can be demanded, and where possible, the use of the designated corridors can be worked towards.

| Alternative: Cables and Pipelines | |
|---|---|
| Brief description | • Cable corridors for cable systems for conducting wind power generated in the EEZ are not routed through nature conservation areas but around them. |
| Presentation of the alternative in comparison to the draft plan | • This alternative would mean that the cable corridor, which runs through the Borkum Riffgrund nature conservation area in the draft plan, would either not be shown or would have to be laid completely around the conservation area. |
| Points of conflict with other uses | • This would be in conflict with the sectoral planning and the Lower Saxony spatial planning for the territorial sea, and with the cable systems already in place here and other cable systems required to conduct power generated in the EEZ towards the Ems corridor. |
| Consequence / implications for next planning levels | • Future cable systems would have to be routed primarily in a corridor around the nature conservation area Borkum Reefground. This would lead the cable in the direction of the gate through which the Norpipe pipeline runs, and from there it would have to be routed in the territorial sea back to the Ems corridor. However, there is no option in the territorial sea for this which is secured from a spatial planning point of view. |
| Environmental assessment | • Although a - future diversion of cable routes around the nature conservation area would reduce the impact on the conservation area, the new routing and the significant increase in cable lengths would - apart from the lack of a basis for planning - be expected to result in loading additional pressure on the environment both in the EEZ and in the area of the territorial sea. |

#### 9.3.2.5 Raw material extraction

Hydrocarbons

For the designations for raw material extraction in the North Sea EEZ, the draft includes the approach of planning option A - in addition to the assumptions on which all planning options are based:

Reservation areas for the extraction of hydrocarbons as well as for sand and gravel extraction are defined on the basis of planning option A, with an additional area added between the priority areas for wind energy EN1 and EN2. The Borkum Reefground nature conservation area was excluded from the sea area layout.

The area of the gas production platform A6/B4 at the outermost edge of the Duck's Bill will - in contrast to the three planning options - also be defined only as a reservation area for the extraction of raw materials and no longer as a priority area, because gas production has already ceased and the end of the current use of the platform for the processing of oil from Danish production is already foreseen.

In the south-western part of the EEZ, extensive area licences have been granted for the exploration and production of gas, and there are indications of deposits worthy of production. The licences also cover the area of the nature conservation area Borkum Reefground. If, as in planning options B and C, no reservation areas for extraction are designated, the spatial planning authorities cannot refer to the principle which gives preference to a specific sub-area in the context of licensing procedures under mining law, and as such refer to sites for fixed exploration or production equipment outside the conservation area. Even if the extraction of raw materials is not excluded in principle in the nature conservation area, this appears to be a possibility to support the exclusion of gas extraction activities. In the overlap area with reservation areas for offshore wind energy, synergy effects could be used with regard to area-efficient use for fixed infrastructure. KWN4 and 5 are located in the area of shipping routes SN3 and SN11. Here, locations in less frequented peripheral areas, possibly in close proximity to existing or planned neighbouring wind farm projects, would be preferred for fixed infrastructure.

Sand and gravel

The licence areas for sand and gravel extraction within the nature conservation area Sylt Outer Reef are defined as reservation areas in accordance with planning options A and B. Here the interaction with the designations of the reservation area for divers and the priority area for nature conservation must be taken into account. The principle of avoiding mining from 1 March to 15 May is intended to protect the divers for which the area has an important function as a stopover area during this period.

The alternative of not defining areas, as provided for in planning option C, would probably not lead to any de-facto reduction in environmental pollution, since sand and gravel extraction is in principle permitted as a privileged use in the nature conservation area, and if it is granted, corresponding conditions are imposed to reduce and avoid impairments of the protected assets and protection objectives.

| **Alternative: raw material extraction** | |
|---|---|
| Brief description | • The hydrocarbon exploration permits issued by the Mining Office are fully defined as reservation areas for the extraction of hydrocarbons (gas). |
| Presentation of the alternative in comparison to the draft plan | • The draft plan only includes individual sub-areas as reservation areas for raw material extraction. Overlaps with the nature conservation area Borkum Reefground are avoided, but there are spatial overlaps with areas for wind energy, shipping routes and cable/pipeline corridors. |
| Points of conflict with other uses | • The licence areas overlap in different ways with various uses and functions, with the nature conservation area Borkum Reefground, main shipping routes, cable/pipeline corridors. |
| Consequence / implications for next planning levels | • The spatial planning authorities would not be in a position to work towards the adoption of preferred locations for fixed infrastructure for the exploration or production of hydrocarbons which are less conflicting with other interests of use and protection. |
| Environmental assessment | • The designation of a reservation area for the extraction of hydrocarbons, in particular in a nature conservation area, would give additional weight to this use in the context of spatial planning, despite the possible negative effects, inter alia through |

| | |
|---|---|
| | fixed infrastructure. In this respect, the omission of a designation for hydrocarbons within the conservation area, as envisaged in the draft plan, contributes to avoiding possible significant effects on the conservation area and its protection purposes. |

#### 9.3.2.6 Fisheries

As regards fisheries, a new reservation area for fishing for Norwegian lobster (*Nephrops Norvegicus*) is established compared to the concept which did not include spatial designations.

In contrast to other target species and fisheries, the occurrence and fishing effort for Norwegian lobster in the German EEZ can be determined and delimited relatively easily (see Chapter 2.2.5 of the draft spatial plan).

Spatial control of Norwegian lobster cannot be achieved through the spatial plan. By defining the reservation area, however, special weight can be given to fisheries here in relation to competing uses.

For the delineation of the area, the evaluation of VMS data for the years 2012 to 2018 was used - the reservation area roughly covers the core area of fishing effort in these years (Letschert et al., 2020).

Overlapping with priority areas for shipping is not considered problematic or conflicting.

Nephrops fishing in this area of the North Sea is carried out with trawls. This can affect sensitive benthic species and habitats, particularly in the area of the Southern Mud Bank. The bottom trawls penetrate deep into the muddy bottom and can destroy the burrows of the megafauna. However, the population of *Nephrops Norvegicus* is considered stable and not endangered.

| **Alternative: fisheries** | |
|---|---|
| Brief description | • There is no spatial designation for fisheries (Norwegian lobster fishery). |
| Presentation of the alternative in comparison to the draft plan | • The draft plan establishes a reservation area for a Norwegian lobster fishery. |
| Points of conflict with other uses | • Fisheries are experiencing major spatial restrictions due to the extensive exclusion in areas for wind energy and, in future, management measures in nature conservation areas. If the reservation for the special fishery for Norwegian lobster, as provided for in the draft plan, is removed, no greater weight can be given to fisheries over other spatial concerns here either - as in large parts of the EEZ. |
| Consequence / implications for next planning levels | • Negotiations on traffic management measures at IMO level would not be able to address fishing concerns which are spatially determined by national spatial planning. |
| Environmental assessment | • The removal of such a designation will not lead to a reduction in scampi fisheries, and therefore will not reduce the impact of Nephrops fisheries, in particular on the seabed and benthos. |

#### 9.3.2.7 Protection and improvement of the marine environment

With the spatial designations for protection and improvement of the marine environment in the North Sea EEZ, the nature conservation areas Sylt Outer Reef – Western German Bight, Borkum Reefground and Dogger Bank, which were established by ordinances, are also secured in spatial planning and their conservation objectives are supported. In addition, the designation of further areas with a special ecological function also supports the MSFD environmental objective 3 "Oceans without deterioration of marine species and habitats due to the impact of human activities": the main concentration area of divers [12]and the main distribution area of harbour porpoise [13]as reservation areas, the latter being limited to the months of May to August, which are particularly sensitive for the species. This means that the planning approach from planning option C of the concept is included for the nature conservation areas, and the designation as in planning options A and B for the diver area. In contrast to the draft (reservation area), the harbour porpoise area was designated as a priority area (May - August) in option C.

In the Sylt Outer Reef nature conservation area, the priority for nature conservation in the area for sand and gravel extraction is not downgraded to a reservation (planning option B).

For the shipping priority areas through these areas, the nature conservation designations do not have a restrictive effect.

Sand and gravel extraction is still permitted in the Sylt Outer Reef, but the designation as a nature conservation priority area, also in the area of the SKN 1 and SKN2 areas, can help to ensure that the interests to be protected are taken into account in approvals and licences in addition to the requirements of the nature conservation area ordinances.

The diver reservation area also includes the existing wind farms in areas EN4 and 5, which supports a special consideration of the extent to which additional habitat disturbance and significant cumulative impacts on the diver population are to be expected and the sites may need to be reassessed for possible subsequent use of the areas. These areas are also presented in the spatial plan as being under consideration.

The EN13 area partly overlaps with the harbour porpoise reservation area. Here, requirements for suitable and effective measures to avoid and reduce impulse sound emissions are to be supported as part of future procedures for the erection of wind turbines. This is to be ensured in particular during the sensitive period for harbour porpoises in order to provide them with sufficiently high-quality habitats at all times.

[12] Position paper of the division of the Federal Environment Ministry on the cumulative assessment of diver habitat loss from offshore wind farms (2009)

[13] Noise protection concept of the Federal Environment Ministry (2013)

# 10 Measures planned to monitor the environmental impact of implementing the spatial plan

## 10.1 Introduction

Pursuant to number 3 letter b Annex 1 to Section 8 subsection 1 ROG, the environmental report also contains a description of the planned monitoring measures. Monitoring is necessary, in particular, to identify unforeseen significant impacts at an early stage and to be able to take appropriate remedial action.

With regard to the envisaged monitoring measures, it should be noted that the actual monitoring of potential effects on the marine environment can only start at the moment when the spatial plan has been implemented, i.e. when the designations made in the plan are realised. Nevertheless, the natural development of the marine environment, including climate change, must not be overlooked when evaluating the results of the monitoring measures. However, general research cannot be carried out based on the monitoring. Therefore, project-related monitoring of the impacts of the uses regulated in the plan is of particular importance. This mainly concerns designations for offshore wind energy, cables/pipelines and areas for raw material extraction.

The main task of monitoring the plan is to bring together and evaluate the results of different phases of monitoring at the level of individual projects or clusters of projects developed in a spatial and temporal context. The assessment will also cover unforeseen significant impacts of the implementation of the plan on the marine environment and the assessment of the forecasts of the environmental report.

In addition, results from existing national and international monitoring programmes must be taken into account, which will also avoid duplication of work. The monitoring of the conservation status of certain species and habitats required under Article 11 of the Habitats Directive must also be taken into account, as well as the investigations to be carried out as part of the management plans for the nature conservation areas "Sylter Außenriff - Östliche Deutsche Bucht", "Borkum Riffgrund" and "Doggerbank", among others. There will also be links to the measures designated in the MSFD.

## 10.2 Planned measures in detail

In summary, the planned measures for monitoring the potential impact of the plan can be summarised as follows:

- Compilation of data and information that can be used for the description and assessment of the status of areas and protected assets,
- Development of specialised information networks for the assessment of potential impacts from the development of individual projects and cumulative impacts on the marine ecosystem
    - MarinEARS (Marine Explorer and Registry of Sound) and National Sound Registry,
    - MARLIN (Marine Life Investigator),
- Development of suitable procedures and criteria for the evaluation of the results of the effect monitoring of individual projects,
- Development of procedures and criteria for the assessment of cumulative effects,
- Development of procedures and criteria for forecasting the potential impact of the plan in a spatial and temporal context,
- Development of procedures and criteria for the evaluation of the plan and adaptation or,

if necessary, optimisation in the context of the update,

- Evaluation of measures to prevent and reduce significant impacts on the marine environment,
- Development of norms and standards.

The following data and information are required to assess the potential impact of the plan:

1. Data and information available to the BSH within the scope of its responsibility:
   - Data sets from previous EIAs and monitoring of offshore projects which are available to the BSH for examination (according to SeeAnlV)
   - Data sets from the right of subrogation (according to WindSeeG),
   - Data sets from the preliminary investigations (according to WindSeeG),
   - Data sets from the monitoring of construction and operation of offshore wind farms and other uses
   - Data from national monitoring, collected by or on behalf of the BSH,
   - Data from BSH research projects.
2. Data and information from the areas of responsibility of other federal authorities and federal state authorities (on request):
   - Data from the national monitoring of the North and Baltic Seas (formerly BLMP (German federal and state-level monitoring programme)),
   - Data from monitoring activities in the context of the implementation of the MSFD,
   - Data from the monitoring of Natura2000 sites,
   - Data from the federal states from monitoring in the territorial sea,
   - Data from other authorities responsible for authorising uses at sea under other legal bases, such as BbergG, maritime traffic monitoring (AIS), fisheries monitoring (VMS)
3. Data and information from federal and state research projects, including
   - HELBIRD / DIVER,
   - Sediment EEZ
4. Data and information from assessments carried out as part of international bodies and conventions:
   - OSPAR
   - ASCOBANS
   - AEWA
   - BirdLife International

For reasons of practicability and appropriate implementation of the requirements of the strategic environmental assessment, the BSH will adopt an approach that is as ecosystem-oriented as possible when monitoring the potential impacts of the plan and that focuses on the interdisciplinary integration of marine environmental information. To be able to assess the causes of plan-related changes in parts or individual elements of an ecosystem, the anthropogenic variables from spatial observation (e.g. expert information on shipping traffic from the AIS data sets) must also be considered and included in the assessment.

When combining and evaluating the results from monitoring at project level and from other national and international monitoring programmes and from accompanying research, an assessment of the gaps in knowledge or of the forecasts subject to uncertainties will have to be carried out. This concerns, in particular, forecasts relating to the assessment of significant impacts on the marine environment of the uses regulated in the spatial plan. Cumulative effects of specified uses are to be assessed both regionally and supra-regionally.

The investigation of the potential environmental impacts of areas for wind energy has to be carried out at the downstream project level in accordance with the standard "Untersuchung von

Auswirkungen von Offshore-Windenergieanlagen (StUK4)" (Investigation of the impacts of offshore wind turbines) and in coordination with the BSH. The monitoring during construction of foundations by pile driving includes, among other things, measurements of underwater sound and acoustic recordings of the impact of pile driving on marine mammals using POD measuring instruments. The data are quality-checked and processed in the BSH's specialist information system for underwater sound MarinEARS. Information and evaluations are made available via the web portal MarinEARS (https://marinears.bsh.de/FIS_SCHALL_PORTAL/pages/index.jsf ).

With regard to the specific measures for monitoring the potential impacts of wind energy use, including the impacts from power cables, reference is made to the detailed statements in the environmental report on FEP 2019/ draft FEP 2020.

For the approval of areas for sand and gravel extraction, for example, it applies that before the next main operating plan approval, it must be proven by suitable monitoring that the maximum permitted extraction depth is not exceeded and that the original substrate is demonstrably preserved. It must also be demonstrated that between the excavation tracks there are still sufficient areas that have not yet been excavated, so that potential for re-colonisation exists.

For pipelines, a project-specific monitoring concept for the construction and operation phase must be submitted prior to construction. Monitoring measures during the construction phase include the documentation of turbidity plumes, hydro-acoustic measurements and the recording of marine mammals and sea and resting birds. The essential monitoring measures during the operating phase of pipelines include annual documentation of the positional stability of the pipeline and the coverage heights, as well as annual documentation of the epifauna on a ground-laid pipeline for a period of five years after commissioning.

The strategic environmental assessment for the plan will use new findings from the environmental impact studies and from the joint analysis of research and EIA data. The joint analysis of research and EIA data will also produce products that will provide a better overview of the distribution of biological assets in the EEZ. The pooling of information leads to an increasingly solid basis for impact forecasting.

The general intention is to keep data from research, projects and monitoring uniform and to make it available for competent evaluation. In particular, the creation of common overview products for the examination of the effects of the plan is to be aimed at. The spatial data infrastructure already in place at the BSH with data from physics, chemistry, geology and biology and uses of the sea will be used as a basis for the compilation and evaluation of ecologically relevant data and will be further developed accordingly.

With regard to the consolidation and archiving of ecologically relevant data from project-related monitoring and accompanying research, detailed plans exist for consolidating data collected within the framework of accompanying ecological research at the BSH and for its long-term archiving. The data on biological protected assets from the baseline surveys of offshore wind energy projects and from monitoring of the construction and operation phases are already being collected and archived at the BSH in a specialist information network for environmental assessments, known as MARLIN (MarineLife Investigator).

# 11 Non-technical summary

## 11.1 Subject and occasion

Maritime spatial planning in the German Exclusive Economic Zone (EEZ) is the responsibility of the Federal Government under the Regional Planning Act (ROG)[14]. In accordance with Section 17 subsection 1 of the ROG, the competent Federal Ministry, the Federal Ministry of the Interior, Building and Community (BMI), in agreement with the federal ministries concerned, draws up a spatial plan for the German EEZ as a statutory instrument. In accordance with Section 17 subsection 1 sentence 3 ROG, the BSH carries out the preparatory procedural steps for drawing up the spatial plan with the consent of the BMI. When drawing up the spatial plan, an environmental assessment is carried out in accordance with the provisions of the ROG and, where applicable, those of the Environmental Impact Assessment Act (UVPG)[15], referred to as the strategic environmental assessment (SEA).

According to Article 1 of the SEA Directive 2001/42/EC, the objective of the SEA is to ensure a high level of environmental protection in order to promote sustainable development and to help to ensure that environmental considerations are adequately taken into account during the preparation and adoption of plans well in advance of their actual planning.

The main document of the strategic environmental assessment is the present environmental report. It identifies, describes and assesses the likely significant effects that the implementation of the spatial plan will have on the environment, as well as possible and alternative planning options, taking into account the essential purposes of the plan and the spatial scope of application.

According to Section 17 subsection 1 ROG, the spatial plan for the German EEZ is to define designations, taking into account any interaction between land and sea as well as safety aspects

1. To ensure the safety and ease of navigation
2. For further economic uses,
3. For scientific uses and
4. To protect and improve the marine environment.

According to Section 7 subsection 1 ROG, spatial plans for a specific planning area and a constant medium-term period must contain designations as **objectives and principles** of spatial planning for the development, order and safeguarding of the area, in particular for the uses and functions of the area.

Under Section 7 subsection 3 ROG, these designations may also define areas, such as priority and reserved areas.

In the German EEZ area, a multi-stage planning and approval process is planned for some uses, such as offshore wind energy and power cables. In this context, the instrument of maritime spatial planning is at the highest and superordinate level. The spatial plan is the forward-looking planning instrument that coordinates the most diverse usage interests of industry, science and research as well as protection claims. The SEA to the spatial plan is related to various downstream environmental assessments, in particular the directly downstream SEA to the side development plan (FEP).

The FEP is the sectoral plan for the orderly expansion of offshore wind energy. In the next

[14] Of 22 December 2008 (BGBl. I p. 2986), last amended by Article 159 of the Ordinance of 19 June 2020 (BGBl. I p. 1328).

[15] In the version promulgated on 24 February 2010, BGBl. I p. 94, last amended by Article 2 of the Act of 30 November 2016 (BGBl. I p. 2749).

step, the areas for offshore wind turbines designated in the FEP are pre-examined. If the suitability of a site for the use of offshore wind energy is established, the site is put out to tender and the winning bidder can apply for approval for the construction and operation of wind turbines on the site. In view of the character of the spatial plan as a controlling planning instrument, the depth of the assessment of likely significant environmental impacts is characterised by a greater breadth of investigation and, in principle, a reduced depth of investigation. The focus of the assessment is on the evaluation of cumulative effects and the examination of alternatives.

The preparation or updating of the spatial plan and the implementation of the SEA will be carried out taking into account the objectives of environmental protection. These provide information on the environmental status that is to be achieved in the future (environmental quality objectives). The objectives of environmental protection can be seen in an overall view of the international, Community and national conventions and regulations which deal with marine environmental protection and on the basis of which the Federal Republic of Germany has committed itself to certain principles and objectives.

## 11.2 Strategic environmental assessment methodology

The present environmental report builds on the existing SEA methodology of the spatial plan and develops it further bearing in mind the additional designations made in the spatial plan.

The methodology is based primarily on the designations of the plan that are to be assessed. Within the framework of this SEA, it is determined, described and evaluated for each of the designations whether the designations are likely to have significant impacts on the affected protected assets. The object of the environmental report corresponds to the designation of the spatial plan as listed in Section 17 subsection 1 ROG. In particular, the effects of the spatial designations are decisive. Textual objectives and principles without direct spatial designation often also serve the purpose of preventing and reducing environmental impacts, but may in turn lead to impacts, so that an assessment is required.

The assessment of the likely significant environmental impacts of the implementation of the spatial plan shall include secondary, cumulative, synergistic, short-, medium- and long-term, permanent and temporary, positive and negative impacts relating to the protected assets. A detailed description and assessment of the state of the environment forms the basis for the assessment of possible effects. The SEA has been carried out with regard to the following protected assets:

- Site
- Seabed
- Water
- Plankton
- Biotope types
- Benthos
- Fish
- Marine mammals
- Avifauna
- Bats
- Biological diversity
- Air
- Climate
- Landscape
- Cultural and other property goods
- People, in particular human health
- Interactions between protected assets

The description and assessment of the probable significant environmental impacts is carried out for the individual graphic and textual designation on the use and protection of the EEZ in relation to the protected assets, taking into account the state assessment.

All plan contents that could potentially have significant environmental impacts are examined. Both permanent and temporary, e.g. construction-related, impacts are considered. This is followed by a presentation of possible interactions, a consideration of possible cumulative effects and potential transboundary impacts.

An assessment of the impacts resulting from the designations of the plan is performed on the basis of the state description and status assessment and the function and significance of the respective defined areas for the individual protected assets on the one hand, and the impacts emanating from these designations and the resulting potential impacts on the other hand. A forecast of the project-related impacts during implementation of the spatial plan is made dependent on the criteria of intensity, range and duration of the effects.

Within the framework of the impact forecast, specific framework parameters are used as an assessment basis, depending on the specifications for the respective use.

With regard to the priority and reservation areas for offshore wind energy, certain parameters are assumed in the form of ranges for a consideration of the protected assets. In detail, these are, for example, output per turbine, hub height, rotor diameter and total height of the turbines. Certain framework parameters are also assumed for cables/pipelines, sand and gravel extraction, fisheries and marine research. In order to assess the environmental impact of shipping, it is necessary to examine what additional effects can be attributed to the designation of the spatial plan. The BSH has commissioned an expert's report on the traffic analysis of shipping traffic, which is expected to include current evaluations.

## 11.3 Summary of protection-related audits

### 11.3.1 Floor/ Area

The seabed in the German North Sea EEZ shows regional differences in sedimentology and morphology which may be distinguished by dividing it into four sub-areas (see also Chapter 2.1.2):

The sub-area "Borkum und Norderneyer Riffgrund" (water depth: 18 to 42 m) consists mainly of medium to coarse sandy sediments. The sediments feature ripple fields and are occasionally interspersed with gravel and cobbles. Morphologically significant are the spurs of shoreface-connected ridges on the southern edge of the sub-area, which run in a northwest–southeast direction and are subject to pronounced sediment dynamics.

The sub-area "Nördlich Helgoland" (water depth: 9 to 50 m) is characterised by a highly unsettled topography, considering the conditions in the German Bight. Ice age ridges feature a characteristic covering of residual or relic sediments (coarse sand, gravel and stones). Between these residual sediment deposits there are thin fine to medium sands, which are subject to constant rearrangement. In comparison with the other sub-areas, a high density of stones can be observed on the seabed.

The seabed of the sub-area "Elbe-Urstromtal und westliche Ebenen" (water depth: 30 to 50 m) has a very balanced topography, and is largely flat. It consists of fine sands, some of which contain significant amounts of silt and clay. The defining element in the subsoil is the Elbe glacial valley on the eastern edge of the sub-area. This former valley, which is about 30 km wide, is filled with alternating layers of sandy and silty-clayey sediments.

The area known as the "Duck's Bill" contains the sub-area "Dogger- und Nördliche Schillbank". The north-eastern spur of the Dogger Bank – a submarine ridge – crosses this area. The seabed largely lacks structure and consists mainly of a fine sand cover with significant silt and clay content. The seabed as a factor is mainly impaired offshore wind farms, raw material extraction, pipelines and fishing.

The installation of wind turbines, platforms, submarine cable systems and pipelines (including scour protection) create permanent but very small-scale sealing of the surface. Impacts during construction activities mainly include the formation of turbidity plumes and the sedimentation of resuspended material, which can also be classified as small-scale.

In the course of sand and gravel extraction, the seabed is mainly affected by the removal of substrate, a change in the bottom topography and the sedimentation of resuspended material. However, current extraction activities in permit area OAM III do not appear to cause any significant impairment of the legally protected biotopes and the seabed as a factor.

A levelling of the seabed can also be observed in intensive fisheries, as can the formation of turbidity plumes near the bottom.

With the exception of two points (see below), the above impacts occur independently of the spatial plan and no significant negative impacts on the seabed as a factor are expected. Rather, adverse impacts can be avoided by the coordinating rules of the draft spatial plan and by the specifications regarding the best environmental practice to be applied in each case.

As far as wind energy is concerned, the rules of the draft spatial plan involve an expansion of the usable area; the spatial rules also assign longer-term space requirements to raw material extraction. In both cases, given modern technology/extraction practices, no significant impacts on the seabed are expected.

### 11.3.2 Benthos and biotopes

The German EEZ in the North Sea is not of major importance in terms of species inventory of benthic organisms. Nor do the benthic communities identified show any special features, as they are typical of the North Sea EEZ, due to the predominant sediments. Investigations of macrozoobenthos within the framework of the licensing procedures for offshore wind farms and from Alfred Wegener Institute (AWI) projects from 1997 to 2014 have revealed communities typical of the German North Sea. The species inventory found, and the number of Red List species, indicate an average importance of the study area for benthic organisms.

Installation of deep foundations for wind turbines and platforms causes disturbances of the seabed, sediment resuspension and the formation of turbidity plumes. The resuspension of sediment and subsequent sedimentation can result in impairment or damage to the benthos and pressure on biotopes in the immediate vicinity of the foundations for the duration of construction activities. However, due to the prevailing sediment composition, these impairments will be limited in extent and duration. In general, the concentration of resuspended material decreases rapidly with increasing distance. Depending on the structure, changes in species composition may occur due to local sealing of the seabed and the introduction of hard substrates in the immediate vicinity.

The laying of the submarine cable systems is also expected to cause only small-scale and short-term disturbances of the benthos and biotopes, through sediment resuspension and turbidity plumes in the area of the cable route. Possible impacts on the benthos and biotopes depend on the installation methods used. With the comparatively gentle installation by jetting, only minor disturbances in the area of the cable route are to be expected. Local sediment shifts and turbidity plumes are to be expected for the duration of installation of the submarine cable systems. Due to the predominant sediment composition in the North Sea EEZ, most of the sediment released will settle directly at the construction site or in its immediate vicinity. Benthic habitats will be built on directly where rock fills are required for cable crossings. The resulting habitat loss is permanent but small-scale. The result is a non-native hard substrate which can cause changes in the species composition on a small scale.

Permanent habitat changes are confined to the immediate vicinity of foundations and rock fills, which are required for cables laid on the seabed and cable crossings. Rock fill represents a permanent hard substrate that is foreign to the site. This provides new habitats for benthic organisms and can lead to a change in the species composition. No significant impacts on benthos and biotopes are expected from these small areas. The risk of a negative impact on the benthic soft soil community by species not typical of the area is low, since recruitment of these species will most likely take place from natural hard-substrate habitats.

In operation, warming of the uppermost sediment layer of the seabed can occur directly above the cable system. Provided the cable is laid at sufficient depth, and taking into account the confined extent of the effect, no significant impacts on benthic communities are expected according to the current state of knowledge. Principle (8) on piping and cables of the draft spatial plan stipulates that potential adverse effects of sediment warming should be avoided as far as possible.

At present, the rules for piping and cables are not expected to have any significant impacts on benthos and biotopes, provided that sediment warming is reduced to a tolerable level. The ecological impacts are small-scale and mostly short-term.

With regard to the rules on the use of raw materials, long-term monitoring of the gravel sand area OAM III in the nature reserve Sylter Außenriff – Östliche Deutsche Bucht currently provides no indication that the extraction activities carried out to date have led to a fundamental change in the sediment structure or composition in the extraction area. Overall, the investigations show that it has been possible to preserve the original substrate in the area and that there is a capacity for regeneration, particularly for species-rich gravel, coarse sand and shell layers. On the basis of the monitoring carried out so far and in compliance with the ancillary provision of the main operating plan, it can therefore be assumed that significant impairment of benthic habitats and their communities can be ruled out with the necessary certainty by the rule for raw material use.

The proposed area reserved for *Nephrops* fishing has been the traditional main *Nephrops norvegicus* fishery area for decades, with catches ranging from around 200 to 350 tonnes per year. No increase in fishing effort due to the designation of the reserved area are forecast. This means that significant impacts on benthic communities and biotopes can be ruled out on the basis of the draft spatial plan's rules for fisheries.

With regard to shipping, marine research and other uses, no significant impacts – beyond the general effects of use in the absence of these rules – on benthos or biotopes are to be expected on the basis of the rules of the draft spatial plan.

Designation of the nature conservation areas of the North Sea EEZ as nature conservation priority areas supports the positive effects on benthic communities and biotopes that can be expected on the basis of appropriate management measures for the nature conservation areas.

### 11.3.3 Fish

The fish fauna in the North Sea EEZ has a typical species composition. The demersal fish community in all areas is dominated by flatfish, which is typical for the German Bight. According to current knowledge, the priority areas for wind energy do not represent a preferred habitat for any protected fish species. Consequently, according to current knowledge, the fish population in the planning area is of no more ecological significance than adjacent marine areas. According to current knowledge, the planned construction of wind farms and the associated converter platforms and submarine cable routes is not expected to have a significant adverse effect on protected fish species. The impact on fish fauna from the construction of wind farms, converter platforms and submarine cable systems are limited in terms of space and time. Fish fauna may be impacted temporarily in small areas by sediment turbulence and the formation of turbidity plumes during the construction of the foundations and converter platforms and the laying of submarine cable systems. The turbidity of the water is expected to decrease rapidly due to the prevailing sediment and current conditions. According to current knowledge, the impact will therefore remain small-scale and temporary. Overall, minimal small-scale impact on adult fish can be expected. Moreover, the fish fauna has adapted to the natural sediment upheavals caused by the storms typical for this area. Furthermore, fish may be frightened away temporarily by noise and vibration during the construction phase. Noise during the construction phase must be reduced by means of appropriate measures. There may be further local impact on fish fauna due to the additional hard substrates introduced as a result of possible changes in benthos.

According to the current state of knowledge, the designation of priority areas for nature conservation may have a significant positive impact on fish fauna and counteract the overexploitation of some fish stocks in the North Sea.

According to information available to date, the definition of other applications in the spatial development plan – such as raw material extraction, shipping or Norway lobster fishing – will have no significant effects on fish fauna beyond the general effects of the applications without definition.

#### 11.3.4 Marine mammals

According to the current state of knowledge, it can be assumed that harbour porpoises cross and remain in the German EEZ and also use it as a food and area-specific breeding ground. Given the available findings, it can be concluded that the EEZ is of medium to high importance for harbour porpoises in terms of the areas they pass through. Use of the EEZ differs in the various sub-areas. This is also applicable to harbour seals and grey seals. Priority areas EN1 to EN3 are of medium to high importance for harbour porpoises (seasonally in spring) and low to medium importance for grey seals and harbour seals. Priority area EN4 is located in the main concentration area of harbour porpoises identified in the German Bight during the summer months and is therefore of high importance. Priority area EN4 is of medium importance for harbour seals and grey seals. Priority area EN5 is located in a large area used as both a feeding ground and a breeding site for harbour porpoises, although the main concentration area is situated within Area I of the “Sylt Outer Reef – Eastern German Bight” nature conservation area. In general, priority area EN5 for harbour porpoises is expected to be of high importance. Area EN5 is of medium importance for harbour seals and grey seals. Priority areas EN6 to EN12 are of medium importance for harbour porpoises. However, parts of priority areas EN11 and N13 are used intensively by harbour porpoises as a feeding ground in summer. These are located in the immediate vicinity of the contiguous main concentration area of harbour porpoises in the German Bight and are therefore of high importance for harbour porpoises in the summer months. Priority areas EN6 to EN13 are of minor importance for harbour seals and grey seals. Priority areas EN14 to EN18 are of medium importance for harbour porpoises and low importance for harbour seals and grey seals. Reserved area EN19 is of medium importance for harbour porpoises and high importance seasonally, in the summer months. It is of minor importance for harbour seals and grey seals.

The plan identifies three priority areas for nature conservation: “Sylt Outer Reef – Eastern German Bight”, “Borkum Reef Ground” and “Dogger Bank”. The plan also specifies the main concentration area in the German EEZ that was identified during the preparation of the noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013) as a priority area for the protection of harbour porpoises during the rearing season from 1 May to 31 August.

The spatial development plan identifies areas for wind energy production outside protected areas. The ESDP thus ensures that direct impact from the construction and operation of offshore wind farms within protected areas is eliminated.

The ESDP also provides for the establishment of a protected area for harbour porpoises in the German North Sea EEZ. The protected area represents the main concentration area of harbour porpoises in the sensitive period from 1 May to 31 August, which was identified during the preparation of the noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013). The seasonal reserve for harbour porpoises covers Area I of the “Sylt Outer Reef – Eastern German Bight” nature conservation area and its surroundings. In physical terms, the reserve thus generously covers the area of the frontal system to the west of the North Frisian islands. Weather and currents cause the frontal system to spread very dynamically into the protected area, ensuring increased productivity and a rich food supply for top predators such as harbour porpoises and many seabird species. By defining the seasonal reserve, the spatial development plan adopts a preventive approach to safeguarding the food-rich alternative habitat for porpoises outside Area I of the protected area.

Hazards to marine mammals may be presented by noise emissions while driving piles for the foundations of offshore wind turbines and converter platforms. Significant disturbance to marine mammals during pile driving could not be excluded without application of noise prevention measures. In the specific approval procedure, therefore, the driving of piles for offshore wind turbines and converter platforms will only be permitted if effective noise reduction measures are applied. The plan specifies principles and objectives for this purpose.

These stipulate that the foundations must be installed using effective noise reduction measures so as to comply with applicable noise prevention specifications. In the specific approval procedure, extensive noise reduction measures and monitoring measures are ordered to comply with applicable noise prevention specifications (sound event level (SEL) of 160 dB re 1μPa²s and maximum peak level of 190 dB re 1μPa at a distance of 750 m around the pile driving or placement site). Appropriate action must be taken to ensure that no marine mammals are present in the vicinity of the pile driving site.

Current technical developments in the field of underwater noise reduction show that the impact of noise on marine mammals can be reduced significantly by taking appropriate action. In addition, the noise prevention concept of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety has been in force since 2013. According to this noise prevention concept, pile driving activities must be coordinated in such a way that sufficiently large areas, particularly within protected areas and the main harbour porpoise distribution area in the summer months, are kept free from the effects of impact noise. According to current knowledge, significant impact on marine mammals due to the operation of offshore wind turbines and converter platforms can be excluded.

After implementation of the reduction measures that are to be ordered in the individual procedure so as to comply with applicable noise prevention specifications in accordance with the planning principle, no significant adverse effects on marine mammals are currently to be expected from the construction and operation of the planned offshore wind turbines and converter platforms. No significant impact on marine mammals is expected from the laying and operation of submarine cable systems.

### 11.3.5 Seabirds and resting birds

The North Sea EEZ can be subdivided into various sub-areas, each of which has a seabird population to be expected in view of the prevailing hydrographic conditions, distances from the coast, existing prior pollution and species-specific habitat requirements.

The applications taken into account in the spatial development plan have various effects on seabirds and resting birds, most of which have a spatially and temporally limited impact on the area, or impact it for the duration of the activity. For species sensitive to disturbance, such as red-throated and black-throated divers, offshore wind farm projects have disturbing effects which – according to current scientific findings – lead to large-scale avoidance behaviour. No findings on habituation effects are available to date. For other species, e.g. common guillemots, there are also findings concerning avoidance behaviour towards offshore wind farm projects, albeit to a lesser extent compared with divers and with an intensity that varies from season to season and from site to site.

The designation of areas EN4 and EN5 as reserved areas for offshore wind energy takes into account the review position of areas N-4 and N-5 for subsequent use for the protection of divers in SDP 2019. Area EN13 takes into account a distance of 5.5 km from the main concentration area of divers in order to reduce potential additional habitat loss in the area. Excluding offshore wind energy in marine protected areas means that effects such as habitat loss in these important habitats will be reduced. The spatial development plan also identifies the protected areas as priority areas for nature conservation and the main concentration area west of Sylt as a nature conservation reserve for divers in the spring. Principles of the spatial development plan also provide for temporal and spatial coordination in the construction of offshore wind farm projects.

The spatial definition of other applications, such as shipping, raw material extraction (particularly sand and gravel mining) and fishing, does not automatically mean increased intensity of use. Rather, these spatial definitions are an observation of previous activities.

Hence no significant impact of the provisions in the spatial development plan on protected seabirds and resting birds can be ruled out with the necessary certainty.

### 11.3.6 Migratory birds

The North Sea EEZ is of average to above average importance for bird migration. It is assumed that significant proportions of the songbird populations breeding in northern Europe migrate across the North Sea. No specific migratory corridors can be identified for any migratory bird species in the area of the North Sea EEZ, as bird migration is either based on guidance and takes place close to the coastline, or there is unspecified broad-fronted migration across the North Sea. There are indications that the intensity of migration decreases further away from the coast, but this is not clear for the mass of songbirds that migrate at night.

The potential impact of offshore wind energy on migratory birds may relate to the fact that they constitute a barrier or a risk of collision. Collision and barrier effects in important habitats are reduced by excluding wind energy in nature conservation areas. The other applications considered in the spatial development plan do not represent vertical barriers in the area.

According to the current state of knowledge, the spatial planning provisions are not expected to have a significant impact on migratory birds.

### 11.3.7 Bats

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of specific information on migratory species, migration corridors, migration heights and migration concentrations. Previous findings merely confirm that bats, in particular long-distance migratory species, fly over the North Sea.

Bats may also be at risk of colliding with offshore wind turbines due to the verticality of the airspace. According to the current state of knowledge, there are no findings on possible significant impairments of bat migration over the North Sea EEZ. Other applications considered in the spatial development plan do not constitute comparable obstacles in the airspace.

According to the information available to date, the spatial provisions of the spatial development plan have no significant impact on bats.

### 11.3.8 Air

The provisions on wind energy in the ESDP have not measurable effects on air quality. The effects of shipping on air quality are independent of the implementation of ESDP.

### 11.3.9 Climate

The $CO_2$ savings associated with the provisions on offshore wind energy can be expected to have a positive long-term impact on the climate.

### 11.3.10 Landscape

Impairment of the coastal landscape due to the planned wind farms in the German EEZ can be classified as minor. Coordinated and harmonised overall planning means that the provisions of the ESDP can minimise the area required for expansion of offshore wind energy and thus – compared to non-implementation of the plan – also reduce the impact on the protected landscape.

Adverse impact on the landscape due to the installation of pipelines in or on the seabed must be excluded.

### 11.3.11 Cultural and other material assets

With further large-scale expansion of wind energy in the German EEZ, both known and previously undiscovered cultural assets and traces of settlement may be at greater risk of damage or destruction. However, this risk can be reduced by comprehensive coordination and reconciliation with the sectoral planning agencies. At the same time, underwater archaeology can be expected to provide a great deal of information about underwater cultural heritage and other traces of human life.

### 11.3.12 Biodiversity

Biodiversity encompasses diversity of habitats and biotic communities, diversity of species and genetic diversity within species (Article 2 of the Convention on Biodiversity, 1992). Public focus is on species diversity.

As regards the current state of biodiversity in the North Sea, there is ample evidence of changes in biodiversity and species composition at all systematic and trophic levels in the North Sea. These are due mainly to human activities such as fishing and marine pollution, or to climate change. Red lists of threatened animal and plant species are important for monitoring and warning purposes in this context, as they indicate the status of the populations of species and biotopes in a region. Possible impact on biodiversity is discussed in the environmental report for the individual protected assets. In summary, according to current knowledge the provisions of the ESDP are not expected to have a significant impact on biodiversity.

### 11.3.13 Interactions

In general, impact on protected assets leads to various consequences and interactions between protected assets. The food chains provide the essential interdependence of biotic protected assets. Possible interactions during the construction phase result from sediment shifting and turbidity plumes, as well as noise emissions. However, these interactions occur only very briefly and are limited to a few days or weeks.

Interactions relating to the facilities – due to the introduction of hard substrate, for example – are permanent, but to be expected only on a local level. This could lead to small-scale change in the food supply.

The variability of the habitat means that interactions can only be described very imprecisely overall. In principle, it can be stated that according to the current state of knowledge, no interactions are discernible that could result in a threat to the marine environment.

### 11.3.14 Cumulative effects

**Soil/area, benthos and biotopes**

A substantial element of the environmental impact on soil, benthos and biotopes due to the areas for offshore wind energy and areas reserved for pipelines will occur only during the construction period (formation of turbidity plumes, sediment relocation, etc.) and over a very limited area. Construction-related cumulative environmental impact is unlikely due to the gradual implementation of the construction projects. There is possible cumulative impact on the seabed, which could also have a direct impact on the benthic material to be protected and on specially protected biotopes, from the permanent direct use of land by the turbine foundations and the pipelines laid. The individual effects are generally small-scale and local.

The impairment of sediment and benthic organisms will essentially be temporary in the area where pipes are laid. Permanent impairment would have to be assumed for structures crossing particularly sensitive biotope types such as reefs or species-rich gravel, coarse sand and schill beds.

Please refer to the environmental report on SDP 2019 or the draft SDP 2020 with regard to balancing of land use. This includes estimation of direct land use by wind energy and power cables using model assumptions.

No statement can be made on the use of specially protected biotopes pursuant to Article 30 of the Federal Nature Conservation Act due to the lack of reliable scientific data. Extensive sediment and biotope mapping of the EEZs that is being carried out at present will provide more reliable assessment data in future.

Besides the direct use of the seabed and thus of the habitat of the organisms settled there, turbine foundations, pipelines on the seabed and necessary intersections lead to an additional supply of hard substrate. Alien hard-substrate-loving species may settle as a result and change the species composition. This can lead to cumulative effects due to the construction of multiple offshore structures, pipelines or rock fills at pipeline intersections. Benthic fauna adapted to soft soils is also losing habitat due to the hard substrate introduced. However, according to current knowledge no significant impact is to be expected in the cumulative area which would endanger the marine environment with regard to the seabed and benthos, since only a very small area will be taken up by both the grid infrastructure and the wind farms.

**Fish**

The impact of the specifications on fish fauna is probably influenced most strongly by the implementation of an initial 20 GW of wind energy in the reserved areas of the North Sea and Baltic Sea. The effects of the OWFs are concentrated on the regular closure of the area for fishing, and also on habitat changes and their interaction.

The expected fishing-free zones within the wind farm areas could have a positive impact on fish communities by eliminating the adverse effects of fishing, such as disturbance or destruction of the seabed and the catching and bycatching of many species. The lack of pressure from fishing could lead to more natural age distribution among fish fauna, leading to an increase in the number of older individuals. The OWF could develop into an aggregation site for fish, although whether wind farms attract fish is not yet clear.

Besides the absence of fishing, an improved food resource for fish species with a wide range of diets is plausible. Growth of sessile invertebrates on wind turbines could favour benthos-eating species and provide fish with a larger, more diverse source of food (Glarou et al. 2020). This could improve the condition of the fish, which in turn would have a positive effect on their fitness. There is currently a need for research to transfer such cumulative effects to fish population level.

Species composition could also change directly, as species with habitat preferences different from those of established species – such as reef dwellers – find more favourable living conditions and occur more frequently. At the Danish Horns Rev wind farm, seven years after construction, a horizontal gradient in the occurrence of hart-substrate-loving species was found between the surrounding sand areas and near the turbine foundations: goldsinny wrasse, eelpout and lumpfish were found much more frequently near the wind turbine foundations than in the surrounding sand areas (LEONHARD et al. 2011). Cumulative effects resulting from a major expansion of offshore wind energy could include

- an increase in the number of older individuals,
- better conditions for fish due to a larger, more diverse food resource,
- further establishment and distribution of fish species adapted to reef structures,
- recolonisation of areas that were previously fished heavily,
- better living conditions for territorial species such as cod-like fish.

Besides predation, intraspecific and interspecific competition, also known as density limitation, is the natural mechanism for limiting populations. It is not possible to rule out the onset of local density limitation within individual wind farms before the positive effects of the wind farms are reproduced spatially through the migration of "surplus" individuals, for example. In this case, the effects would be local and not cumulative. The effects that changes in fish fauna could have on other elements of the food web, both below and above their trophic level, cannot be predicted at this stage.

Together with the designation of protected areas, wind farms could help to bring about positive stock development and thus recovery of fish stocks in the North Sea.

**Marine mammals**

Cumulative effects on marine mammals, in particular harbour porpoises, may occur mainly due to noise exposure during the installation of deep foundations. For example, marine mammals can be significantly affected by the fact that there is not enough equivalent habitat available for evasion and retreat if pile driving is carried out simultaneously at different sites within the EEZ.

The implementation of offshore wind farms and platforms to date has been relatively slow and gradual. Between 2009 and 2018, pile driving work took place at twenty wind farms and eight converter platforms in the German North Sea EEZ. Since 2011, all pile driving work has been carried out using technical noise reduction measures. Since 2014, the noise prevention specifications have been observed reliably and even undercut due to successful application of noise reduction systems. Most of the construction sites were located 40 to 50 km away from each other, so there was no overlapping of noisy pile driving that could have led to cumulative effects. It was only necessary to coordinate pile driving and deterrent measures in the case of the two directly adjacent projects, Meerwind Süd/Ost and Nordsee Ost in area 4.

Evaluation of the results with regard to sound propagation and potential resulting cumulation has shown that the propagation of impulsive noise is restricted greatly when effective sound reduction measures are applied (BRANDT et al. 2018, DÄHNE et al., 2017).

Cumulative impact of the plan on the harbour porpoise population is considered in accordance with the requirements of the 2013 noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. To avoid and reduce cumulative impact on the harbour porpoise population in the German EEZ, the provisions of the subordinate approval procedure stipulate that the noise impact on habitats is to be restricted to maximum permitted areas of the EEZ and nature conservation areas. According to these regulations, the spread of noise emissions must not exceed defined areas of the German EEZ and nature conservation areas. This ensures that animals have sufficient high-quality habitats available to them at all times so that they can evade the noise. The primary purpose of the order is to protect marine habitats by avoiding and minimising disturbances caused by impulsive noise.

In concrete terms, the order in the subordinate approval notices provides for the following:

- It is necessary to ensure, with the requisite certainty, that no more than 10% of the area of the German North Sea EEZ and no more than 10% of an adjacent nature conservation area is affected at any given time by noisy pile driving for the pile foundation by noise impact that causes disturbance.
- During the sensitive period for harbour porpoises from 1 May to 31 August, it is necessary to ensure with the requisite certainty that no more than 1% of subsection I of the "Sylt Outer Reef – Eastern German Bight" protected area, with its special function as a rearing area, is affected by noise causing disturbance due

to noisy pile driving for the pile foundation.

Defining the protected area for harbour porpoises means that the standards for the protection of impulsive noise emissions applicable to projects in the "Sylt Outer Reef – Eastern German Bight" protected area will also apply in future to projects in and around the protected area as part of subordinate approval procedures.

The area reserved for harbour porpoises during the summer months includes the "Sylt Outer Reef" protected area and its immediate surroundings. Pile driving operations with the potential to cause disturbance due to noise in the main concentration area of harbour porpoises during the sensitive season are coordinated in such a way that the proportion of the area affected remains below 1% at all times. In addition, in accordance with the noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013), all pile driving activities are coordinated with the aim of always keeping sufficient alternative options free in the protected areas, in equivalent habitats and throughout the German EEZ.

In conclusion, implementation of the plan will lead to avoidance and the reduction of cumulative effects. This assessment also applies to the cumulative effects of the various applications on marine mammals.

**Seabirds and resting birds**

Any effects must be assessed on a species-specific basis so as to assess the significance of cumulative effects on seabirds and resting birds. In particular, species listed in Annex I of the Directive, species in sub-area II of the "Sylt Outer Reef – Eastern German Bight" protected area and species for which avoidance behaviour towards structures has already been established must be considered with regard to cumulative effects.

When assessing the cumulative effects of the implementation of offshore wind farms, special attention must be paid to divers, including endangered red-throated and black-throated divers, which are sensitive to disturbance. GARTHE & HÜPPOP (2004) confirm that divers are very sensitive to structures. For consideration of cumulative effects, both adjacent wind farms and those located in the same coherent functional spatial unit defined by physically and biologically significant characteristics for a species should be taken into account. Besides the structures themselves, impact from shipping (including for the operation and maintenance of cables and platforms) must also be taken into account. Recent findings from studies confirm the deterrent effect of shipping on divers. Red-throated and black-throated divers are two of the bird species most sensitive to shipping in the German North Sea (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019).

The main concentration area takes into account spring, which is the period of particular importance for the species. On the basis of the data available in 2009, when the main concentration area was defined, the main concentration area was home to around 66% of the German North Sea diver population and around 83% of the EEZ population in spring, and is therefore of particular importance in terms of population biology (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2009) and an important functional component of the marine environment with regard to seabirds and resting birds. The importance of the main concentration area for divers in the German North Sea and within the EEZ has further increased against the background of current stock assessments (SCHWEMMER et al. 2019). The definition of the main concentration area for divers is based on the data – which is considered to be very good – and expert analyses that have gained broad scientific acceptance. The area includes all areas of very high diver density and most areas of high diver density in the German Bight. The definition of the main concentration area of divers in the German North Sea EEZ as part of the policy paper of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2009) is an important measure to ensure protection of red-throated and black-throated divers, which are sensitive to disturbance. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety decreed that for future approval procedures for offshore wind farms, the main concentration area should be used as a benchmark for the cumulative assessment of diver habitat loss.

The current results from the operational monitoring of offshore wind farms, and also from research projects that partly used investigation methods independent of standardised monitoring according to the Standard Investigation Concept (SIC) (e.g. telemetry study within the framework of the DIVER project), unanimously show that the avoidance behaviour of divers towards offshore wind farms is far more pronounced than had been anticipated in the original approval decisions of the wind farm projects (see section 3.2.6).

Interim results from an FTZ study were presented at the BSH's Marine Environment Symposium in 2018. The evaluations have since been published (GARTHE et al. 2018, SCHWEMMER et al. 2019). A cumulative perspective on the avoidance behaviour of divers in respect of offshore wind farms resulted in a calculated total habitat loss of 5.5 km and a statistically significant decrease in abundance up to a distance of 10 km, starting from the periphery of a wind farm (GARTHE et al. 2018). The statistically significant decrease in abundance is not total avoidance, but partial avoidance; with increasing diver densities up to a distance of 10 km from a wind farm. The calculated total habitat loss of 5.5 km is used to quantify the habitat loss in analogy to the previous avoidance distance of 2 km. It is based on the purely statistical assumption that there are no divers within 5.5 km of an offshore wind farm. A further cross-project study on the occurrence and distribution of divers and the effects of offshore wind farm projects on divers in the German North Sea, which was commissioned by the Association of German Offshore Wind Farm Operators, provided comparable results for all wind farm projects implemented, with a significant avoidance distance of 10 km and a calculated total habitat loss of approx. 5 km. The results from GARTHE et al. (2018) regarding the avoidance behaviour of divers are thus confirmed by an independent study (BIOCONSULT SH et al. 2020).

In summary, the results of the monitoring and research projects show that the avoidance behaviour of divers towards offshore wind farms is much more pronounced than was assumed previously. A population calculation for the main concentration area within the scope of the FTZ's diver study commissioned by the German Federal Agency for Nature Conservation and BSH showed an increase in the red-throated diver population between 2002 and 2012 which has remained at a relatively constant high level since 2012. However, a decrease in the red-throated diver population has been observed since 2012 (observation period to 2017) for the entire German North Sea, where the sub-areas are of varying local significance as a habitat for divers (SCHWEMMER et al. 2019). The study commissioned by the Association of German Offshore Wind Farm Operators yields qualitatively and quantitatively comparable population figures and trends for the main concentration area and the German North Sea. Differences can be attributed to different methods of population calculation and modified basic data.

Both studies confirm the overall high and particular functional importance of the main concentration area as a habitat for divers in the German North Sea (SCHWEMMER et al. 2019, BIOCONSULT SH et al. 2020). This is particularly true given pronounced avoidance behaviour and the associated habitat loss.

The main concentration area represents a particularly important component of the marine environment in terms of seabirds and resting birds, in particular divers. The spatial planning definition of the main concentration area of divers as a reserved area, according to which the planning, construction and operation of energy generation plants in the main diver concentration area should not take place if this leads to significant impairment of the diver habitat, specifically takes into account the protection of divers in this particularly important habitat, especially given the avoidance behaviour observed from the operating phase of the OWFs in the North Sea EEZ. The designation of areas EN4 and EN5 within the main concentration area as reserved areas for offshore wind energy addresses the assessment of areas N-4 and N-5 for subsequent use in SDP 2019 (BSH 2019) at the regional planning level. The layout of area EN13 and maintenance of a distance of 5.5 km from the main concentration area will also avoid further spatial impairments, taking into account the current state of scientific knowledge.

The definitions of other applications are located outside the main diver concentration area, in areas of lesser importance for divers, and/or that refer to applications where impact is mostly temporary and local (see corresponding sections in Chapters 3 and 4). In conclusion, it can be stated that given the current state of knowledge, and taking into account the provisions and principles for the protection of the main concentration area, no significant cumulative impact of spatial planning provisions on divers sensitive to disturbance (in this case red-throated and black-throated divers) is to be expected.

For other seabird and resting bird species, it can be assumed that the provisions and principles relating to divers and the main area of concentration will also have a positive effect. Furthermore, the exclusion of offshore wind energy in the protected areas of the EEZ and the designation of protected areas as priority areas will protect important habitats and reduce habitat disturbance and collision risks there. Outside the nature conservation areas, the occurrence of some species is characterised in that they occur over a large area within the EEZ without clear distribution priorities (see section 2.8.2). Moreover, the effects of some applications often have a local impact and are limited to the duration of the use (see corresponding sections in Chapters 2and 3). Further, some spatial planning regulations, such as those governing shipping, are not expected to lead to densification or increased intensity of use, but rather represent a record of existing activity levels.

As a result of the SEA (strategic environmental assessment), considerable cumulative effects of the spatial planning provisions on protected seabirds and resting birds are not to be expected according to current knowledge.

**Migratory birds**

Barrier effects and collision risks in important food and resting habitats are reduced by defining priority and reserved areas for offshore wind energy in a spatial context and excluding offshore wind energy in protected areas. The effects of further applications or their definitions are comparatively less extensive on a spatial level with regard to verticality in airspace.

According to current knowledge, significant cumulative effects of the spatial planning definitions of all applications taken into account with regard to migratory birds can be ruled out with the necessary certainty.

### 11.3.15 Transboundary effects

The SEA concludes that as things stand at present, the provisions of the ESDP will have no significant impact on the areas of adjacent countries bordering the German North Sea EEZ.

Significant transboundary effects can generally be ruled out for the following protected assets: soil, water, plankton, benthos, biotope types, landscape, cultural heritage and other material assets, and humans and human health.

With regard to fish, the SEA concludes that according to the current state of knowledge, no significant transboundary effects on fish are to be expected as a result of the implementation of the ESDP; since the areas for which the ESDP has been defined have no prominent function for fish fauna, and since the recognisable and predictable effects are small-scale and temporary in nature.

According to the current state of knowledge and taking into account measures to minimise impact and limit damage, significant transboundary effects can also be ruled out for protected marine mammal species. For example, installation of the foundations of wind turbines and converter platforms is only permitted in the specific approval procedure if effective noise reduction measures are applied.

With regard to seabirds and resting birds, the Danish “Sydlige Nordsø” bird sanctuary directly adjacent to the German EEZ to the north and also home to high numbers of divers must be taken into account when considering possible significant transboundary effects. Based on current knowledge, the spatial development plan is not expected to have any significant effects as a result of the definitions.

For migratory birds, wind turbines erected may in particular represent a barrier or a collision risk. By defining areas for wind energy exclusively outside marine protected areas, these effects are reduced in important resting areas for some migratory bird species. The other applications taken into account in the spatial development plan have no comparable spatial effects. Based on current knowledge, no significant transboundary effects of the provisions of the spatial development plan on migratory birds are to be expected.

## 11.4 Examination of species protection law

Whether the plan meets the requirements of Article 44(1) nos. 1 and 2 of the Federal Nature Conservation Act for specially and strictly protected animal species will be examined as part of the species protection review; examining in particular whether the plan violates species conservation prohibitions.

According to Article 44(1) no. 1 of the Federal Nature Conservation Act, killing or injuring wild animals of specially protected species – that is to say, including animals listed in Annex IV to the Habitats Directive and Annex I to the Birds Directive – is prohibited. The species conservation review according to Article 44(1) no. 1 of the Federal Nature Conservation Act always relates to killing and injuring individuals.

According to Article 44(1) no. 2 of the Federal Nature Conservation Act, causing significant disturbance to wild animals of strictly protected species during the reproduction, rearing, moulting, wintering and migration periods is also prohibited.

Protected marine mammal species

The update of the plan includes principles according to which the introduction of noise into the marine environment should be avoided during the construction of turbines in accordance with the state of the art in science and technology, and overall coordination of the construction of turbines located in close proximity to each other should be ensured. Noise prevention measures are to be applied. On this basis, the BSH may operate within the framework of the subordinate procedures, the site development plan, the site suitability test and, in particular, during the respective individual approval procedures and implementation, to order suitable specifications with regard to individual work steps, such as deterrent measures and a slow increase in pile driving energy by means of what are known as “soft start” procedures. Deterrent measures and soft start procedures can ensure that no harbour porpoises or other marine mammals are present over an adequate area around the pile driving site, but at least over a distance of up to 750 m from the construction site.

The range of measures avoids the species protection concerns of Article 44(1) no. 1 of the Federal Nature Conservation Act with sufficient certainty.

According to the current state of knowledge, neither the operation of the turbines nor the laying and operation of the wind farm's internal cabling will have any significant negative impact on marine mammals that meet the killing and injury criteria pursuant to Article 44(1) no. 1 of the Federal Nature Conservation Act.

The temporary pile driving work is not expected to cause any significant disturbance to harbour porpoises within the meaning of Article 44(1) no. 2 of the Federal Nature Conservation Act.

According to the current state of knowledge, it cannot be assumed that disturbances that may occur due to noisy construction measures would worsen the conservation status of the local population, provided that avoidance and reduction measures are implemented. A local population comprises those (sub-)habitats and activity areas of individuals of a species which are sufficiently spatially and functionally interrelated so as to meet the habitat requirements of the species. Deterioration of the conservation status is to be assumed in particular if the chance of survival, breeding success or reproductive capacity is reduced, whereby this has to be examined and assessed on the basis of each individual species (see the explanatory memorandum to the Federal Nature Conservation Act Amendment 2007, BT-Drs. 11).

Negative impact of pile driving on harbour porpoises is not to be expected due to effective noise prevention management, in particular by applying suitable noise prevention systems in accordance with the principles and objectives in the update of the plan and subsequent arrangements in the individual approval procedure of the BSH, and taking into account the requirements of the noise prevention concept of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013).

The decisions of the BSH will include concretising orders that ensure effective noise prevention management by appropriate means.

- Preparation of a noise forecast, taking into consideration the characteristics specific to the site and turbines (basic design) before construction begins,
- Selection of the construction method producing the lowest noise level according to the state of the art and the existing conditions,
- Preparation of a specific noise prevention concept, adapted to the selected foundation structures and construction processes, for implementation of pile driving, in principle two years before the start of construction, and in any case before the conclusion of contracts concerning components affected by noise,
- Use of noise-reducing accompanying measures, individually or in combination, noise-reducing systems remote from the piles (bubble curtain system) and, if necessary, noise-reducing systems close to the piles in accordance with the state of the art in science and technology,
- Consideration of hammer characteristics and the options for controlling the pile driving process in the noise prevention concept,
- Concept for scaring animals away from the hazard area (within a radius of at least 750 m around the pile driving site),
- Concept for verifying the effectiveness of the deterrent and noise-reducing measures,
- State of the art turbine design so as to reduce operational noise.

To avoid cumulative effects due to parallel pile driving on different projects, temporal coordination of pile driving is ordered within the framework of subordinate planning approval procedures and implementation in accordance with the specifications of the noise prevention concept of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013). The noise prevention concept of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013) maintains an area approach, with the objective of always ensuring that sufficiently high-quality alternative habitats are available for the harbour porpoise population in the German North Sea EEZ, free of noise inputs inducing disturbance.

In conclusion, applying the above-mentioned stringent noise prevention and noise-reducing measures in accordance with the principles and objectives of the plan and the orders in the planning approval decisions, taking into account the noise prevention concept of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013) and compliance with the limit value of 160 dB $SEL_5$ at a distance of 750 m, no significant disturbances within the meaning of Section 44(1) no. 2 of the Federal Nature Conservation Act are to be expected.

According to the current state of knowledge, the <u>operation</u> of offshore wind turbines cannot be assumed to constitute a disturbance pursuant to Article 44(1) no. 2 of the Federal Nature Conservation Act.

Spatial planning or the specifications of the plan, including the principles and objectives, is one of the key instruments for reducing or even preventing cumulative effects on the harbour porpoise population by rectifying spatial conflicts between applications and defining priority and reserved areas for nature conservation.

The designation of priority areas for wind energy exclusively outside native conservation areas aims to ensure protection of harbour porpoises in the German EEZ. In addition, regional planning paves the way for subordinate planning levels and procedures. Finally, the principles of the plan form the backbone for the specifications in the subordinate procedures and for the arrangements for protection of harbour porpoises within the framework of individual approval procedures.

In addition, the 2013 noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety for the North Sea includes a number of requirements, through the habitat approach pursued, which ensure effective prevention and reduction of cumulative effects on the local harbour porpoise population in the German EEZ and the populations in the nature conservation areas due to impact noise. This plan has designated the main concentration area of harbour porpoises in the German North Sea EEZ that was identified, during the preparation of the noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013), as the protected area for harbour porpoises during the sensitive period from 1 May to 31 August. The special requirements of the noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety are arranged in the nature conservation areas and the protected area as part of the subordinate procedures or individual approval procedures for applications.

In conclusion, with regard to harbour porpoises, it is necessary to state that the implementation of the plan does not meet the concerns laid down in Article 44(1) nos. 1 and 2 of the Federal Nature Conservation Act with regard to cumulative effects.

<u>Cumulative consideration</u>

Cumulative effects of offshore wind energy generation on harbour porpoises were presented in section 4.10.3and avoidance and mitigation measures were described. However, harbour porpoises are exposed to the effects of various anthropogenic applications and natural and climate-related changes. Differentiation or even weighting of the proportion of the effects on the state of the population due to a single application is hardly possible from a scientific standpoint. The designation of priority areas for wind energy exclusively outside nature conservation areas is a means of ensuring the protection of harbour porpoises in the German EEZ. In addition, regional planning paves the way for subordinate planning levels and procedures. Finally, the principles of the plan form the backbone for the specifications in the subordinate procedures and for the arrangements for protection of harbour porpoises within the framework of individual approval procedures.

Spatial planning or the specifications of the plan, including the principles and objectives, is one of the key instruments for reducing or even preventing cumulative effects on the harbour porpoise population by rectifying spatial conflicts between applications and defining priority and reserved areas for nature conservation.

The designation of priority areas for wind energy exclusively outside native conservation areas aims to ensure protection of harbour porpoises in the German EEZ. In addition, regional planning paves the way for subordinate planning levels and procedures. Finally, the principles of the plan form the backbone for the specifications in the subordinate procedures and for the arrangements for protection of harbour porpoises within the framework of individual approval procedures.

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In conclusion, with regard to harbour porpoises, it is necessary to state that the implementation of the plan does not meet the concerns laid down in Article 44(1) nos. 1 and 2 of the Federal Nature Conservation Act with regard to cumulative effects.

Protected seabird species

Article 44(1) no. 1 of the Federal Nature Conservation Act in conjunction with Article 5 of the Birds Directive prohibits the hunting, capture, injuring or killing of wild animals of specially protected species. Specially protected species include the species listed in Annex I of the Birds Directive, species whose habitats and habitats are protected in nature conservation areas and in the area reserved for divers, as well as characteristic species of the areas to which the plan relates. Accordingly, injuring or killing resting birds as a result of collisions with wind turbines must be ruled out in principle. The risk of collision depends on the behaviour of the individual animals and is related directly to the species concerned and the environmental conditions to be encountered. For example, collision by divers is not to be expected due to their pronounced avoidance behaviour towards vertical obstacles.

However, the measures ordered, such as minimisation of light emissions, ensure that collision with offshore wind turbines is avoided as far as possible, or at least that this risk is minimised. In addition, monitoring is carried out during the operating phase so as to facilitate an improved nature conservation assessment of the actual risk of bird strikes at the turbines. Moreover, the right to arrange further measures is expressly reserved on regular occasions. Against this background, the BSH is of the opinion that no significant increase in the risk of death of or injury to migratory birds is to be expected.

It cannot therefore be assumed that the prohibition of injury and killing pursuant to Article 44(1) no. 1 of the Federal Nature Conservation Act has been implemented.

As a result, the assessment within the framework of the SEA for SDP 2019 / draft SDP 2020 has shown that divers are highly sensitive in terms of population biology, that the main concentration area is of great importance for the conservation of the local population, and that the adverse effects caused by avoidance behaviour are intensive and permanent.

To prevent deterioration of the conservation status of the local population due to the cumulative effects of wind farms, it is necessary to ensure that new wind farm projects are not implemented in the main concentration area currently available to divers, outside the impact zones of wind farms implemented already.

For the detailed assessment, reference is made to the species protection law assessment of SDP 2019/draft SDP 2020.

The BSH concludes that significant disturbance within the meaning of Article 44(1) no. 2 of the Federal Nature Conservation Act as a result of the implementation of the plan can be ruled out with the necessary certainty if efforts are made to ensure that no additional habitat loss will occur in the main concentration area.

Cumulative effects

Seabirds are exposed to the effects of various anthropogenic applications and natural and climate-related changes. Differentiation or even weighting of the proportion of the effects on the state of the respective population of a species due to a single application is hardly possible from a scientific standpoint.

The BSH has been working since 2009 to carry out qualitative assessment of cumulative effects on divers within the framework of approval procedures for offshore wind farms, taking into account the main concentration area in accordance with the policy paper of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2009). A cumulative perspective on the avoidance behaviour of divers in respect of offshore wind farms in studies commissioned by BSH and the German Federal Agency for Nature Conservation revealed a calculated total habitat loss of 5.5 km and a statistically significant decrease in abundance up to a distance of 10 km, starting from the periphery of a wind farm (GARTHE et al. 2018). The statistically significant decrease in abundance is not total avoidance, but partial avoidance; with increasing diver densities up to a distance of 10 km from a wind farm.

Spatial planning or the specifications of the plan, including the principles and objectives, is one of the key instruments for reducing or even preventing cumulative effects on the diver population by rectifying spatial conflicts between applications and defining priority and reserved areas for nature conservation.

Planning of wind power generation outside protected areas is a fundamental measure to ensure the protection of seabird species in the German EEZ. In addition, regional planning paves the way for further measures such as preparation of the site development plan and the preliminary investigation and assessment of the suitability of sites for offshore wind energy. Finally, the principles of the plan form the backbone for the specifications in the subordinate procedures and for the arrangements for the protection of harbour porpoises within the framework of individual approval procedures.

The policy paper of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2009) on the protection of divers provides the basis for assessment of the cumulative effects of wind energy generation. The designation of the identified main concentration area as a reserved area for the protection of divers represents the most important avoidance and mitigation measure so as to rule out cumulative effects at population level. The reserved area represents a protected area for the strictly protected and also the characteristic seabird species of the German EEZ in the North Sea in addition to the three nature reserves due to its special location in the area of the frontal system to the west of the North Frisian Islands, with its very high productivity and the resulting rich food supply.

In conclusion, with regard to seabirds and resting birds, it can be stated that the continuation of the plan does not meet the concerns laid down in Article 44(1) nos. 1 and 2 of the Federal Nature Conservation Act with regard to cumulative effects.

<u>Bats</u>

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of specific information on migratory species, migration corridors, migration heights and migration concentrations. Previous findings merely confirm that bats, in particular long-distance migratory species, fly over the North Sea.

According to expert knowledge, the risk of isolated collisions with wind turbines cannot be ruled out.

However, it can be expected that any adverse effects of wind turbines on bats will be avoided by the same prevention and mitigation measures that are in place to protect bird migration.

According to the current plans, neither killing and injury pursuant to Article 44(1) no. 1 of the Federal Nature Conservation Act nor the species protection concerns regarding significant disturbance pursuant to Article 44(1) no. 2 of the Federal Nature Conservation Act is expected to be implemented.

## 11.5 **Impact assessment**

Insofar as a site of Community importance or a European bird sanctuary may be significantly impaired in its elements relevant to the conservation objectives or the purpose of protection, the provisions of Article 7(6) in conjunction with Article (7) of the Federal Regional Planning Act, the provisions of the Federal Nature Conservation Act on the permissibility and implementation of such interventions, including obtaining the opinion of the European Commission, must be applied when amending and supplementing regional development plans.

The impact assessment carried out here generally takes place at a higher level of regional planning and defines a framework for subordinate planning levels, where applicable. Therefore, it does not replace assessment at specific project level, carried out within the framework of approval procedures with knowledge of the specific project parameters. To this extent, further avoidance and mitigation measures are to be expected if they are deemed necessary by the impact assessment within the framework of approval procedures so as to exclude any impairment of the conservation objectives of Natura 2000 sites or the protection purposes of the protected areas by the use inside or outside a nature conservation area. At the same time, it is necessary to take into account the fact that for some applications, in particular wind energy, the ESDP traces projects that are already running and the specifications of the SDP sectoral plan for which impact assessments have already been carried out.

Before being designated as marine areas pursuant to Article 20(2) 57 of the Federal Nature Conservation Act under European law, the nature conservation areas in the EEZ had been included as FFH sites in the first updated list of sites of Community importance in the Atlantic biogeographical region pursuant to Article 4(2) of the Habitats Directive (Official Journal of the EU, 15 January 2008, L 12/1), so an FFH impact assessment had already been performed as part of the Federal Offshore Sectoral Plan for the German North Sea EEZ (BSH 2017). Most recently, an impact assessment pursuant to Article 34 para(1) in conjunction with Article 36 of the Federal Nature Conservation Act was carried out as part of the SEA for the site development plan (BSH, 2019).

The German EEZ of the North Sea contains the nature conservation areas “Sylt Outer Reef – Eastern German Bight” (Regulation on the establishment of the nature conservation area “Sylt Outer Reef – Eastern German Bight” of 22 September 2017), “Borkum Reef Ground” (Regulation on the establishment of the nature conservation area “Borkum Reef Ground” of 22 September 2017) and “Dogger Bank” (Regulation on the establishment of the nature conservation area “Dogger Bank” of 22 September 2017).

The total area covered by the three nature conservation areas in the German North Sea EEZ is 7,920 $km^2$, of which 625 $km^2$ is covered by the “Borkum Reef Ground” nature conservation area, 5,603 $km^2$ by the “Sylt Outer Reef – Eastern German Bight” nature conservation area and 1,692 $km^2$ by the “Dogger Bank” nature conservation area.

Within the framework of the impact assessment, the habitat types “Reef” (EU code 1170) and “Sandbank” (EU code 1110) according to Annex I of the Habitats Directive with their characteristic and endangered biocoenoses and species, as well as protected species, specifically fish (lamprey, twaite shad), marine mammals according to Annex II of the Habitats Directive (harbour porpoise, grey seal and common seal), and protected bird species listed in Annex I of the Birds Directive (in particular red-throated diver, black-throated diver, little gull, sandwich tern, common tern and Arctic tern) and regularly occurring migratory bird species (in particular common gull and lesser black-backed gull, fulmar, gannet, kittiwake, guillemot and razorbill).

The impact assessment also takes into account the remote effects of the provisions adopted within the EEZ on the protected areas in the adjacent 12-mile zone and the adjacent waters of neighbouring countries.

Construction, installation and operational effects on the FFH habitat types “Reef” and “Sandbank” with their characteristic and endangered biocoenoses and species can be excluded due to the exclusion by technical legislation of areas and sites for wind energy in the SDP in nature conservation areas. The areas lie far beyond the drift distances discussed in the specialist literature, so no release of turbidity, nutrients and pollutants is to be expected which could impair the nature conservation and FFH areas in their components relevant to the conservation objectives or the protection purpose.

Whether or not the specifications will lead to impairments of habitat types must be assessed prognostically, taking into account project-specific effects.

For the sections of the LN1 and LN14 pipeline corridors located in the area of the habitat type “Sandbanks which are slightly covered by sea water all the time” (EU code 1110), it is necessary to ensure that the guide values for the relative and absolute loss of area according to Lambrecht & Trautner (2007) and Bernotat (2013) are not exceeded.

The assessment of the compatibility of the plan with regard to the strictly protected harbour porpoise species has shown that according to the current state of knowledge, significant impairment of the conservation objectives of the nature conservation areas can be ruled out with the necessary certainty by implementing the noise prevention measures as ordered.

The ESDP also provides for the establishment of a protected area for harbour porpoises in the German North Sea EEZ. The protected area represents the main concentration area of harbour porpoises in the sensitive period from 1 May to 31 August, which was identified during the preparation of the noise prevention concept for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013). The seasonal reserve for harbour porpoises covers Area I of the "Sylt Outer Reef – Eastern German Bight" nature conservation area and its surroundings. In physical terms, the reserve thus generously covers the area of the frontal system to the west of the North Frisian islands. Weather and currents cause the frontal system to spread very dynamically into the protected area, ensuring increased productivity and a rich food supply for top predators such as harbour porpoises and many seabird species. By defining the seasonal reserve, the spatial development plan adopts a preventive approach to safeguarding the food-rich alternative habitat for porpoises outside Area I of the protected area.

Various measures have already been established pursuant to the SDP in order to protect divers. Besides the preventive measure implemented by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2009), restricting offshore wind energy within the main concentration area for divers, exclusion of the "Butendiek" offshore wind farm for possible subsequent use is another important mitigation measure. Finally, the requirement to examine the possible subsequent use of areas EN4 and EN5 within the framework of the site development plan constituted a further monitoring measure.

In addition, the update of the SDP provides for establishment of a reserved area for divers in the German North Sea EEZ. The reserved area is the main concentration area for divers in the German EEZ in spring which was identified during the preparation of the policy paper for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2009). The protected area covers Area II of the nature conservation area "Sylt Outer Reef – Eastern German Bight" and its surroundings. In physical terms, the reserve thus generously covers the area of the frontal system to the west of the North Frisian islands. Weather and currents cause the frontal system to spread very dynamically into the protected area, ensuring increased productivity and a rich food supply for top predators such as divers and many other seabird species. By designating the reserve, the spatial development plan adopts a preventive approach to safeguarding the divers' food-rich avoidance habitat outside area II of the nature conservation area.

Taking into account the above-mentioned measures ensuring the protection of divers both inside and outside the nature conservation area "Sylt Outer Reef – Eastern German Bight", significant impairment of the conservation objectives can be ruled out with the necessary certainty.

## 11.6 Measures to prevent, reduce and offset significant negative impact of the site development plan on the marine environment

Pursuant to no. 2 c) of Annex 1 to Article 8(1) of the Federal Regional Planning Act, the environmental report contains a description of the measures planned to prevent, reduce and – as far as possible – compensate for significant adverse environmental impact resulting from implementation of the plan.

Essentially, the SDP takes the interests of the marine environment into account more effectively. The provisions of the SDP prevent negative impact on the marine environment. This is due in particular to the fact that it is not apparent that the applications would not take place or would take place to a lesser extent if the plan were not implemented. The need to expand offshore wind energy and the corresponding connecting pipelines, for example, does nevertheless exist, and the corresponding infrastructure would have to be created even without the SDP (see section 3.2). If the plan is not implemented, however, the applications would develop without the space-saving and resource-conserving steering and coordination effect of the SDP.

Moreover, the provisions of the SDP are subject to a continuous optimisation process as the findings identified continuously over the course of the SEA and the consultation process are taken into account in the preparation of the plan.

While individual avoidance, mitigation and compensation measures can be initiated at the planning level, others take effect only during the specific implementation phase and are regulated there in the individual approval procedure on a project and site-specific basis.

With regard to planning-related avoidance and mitigation measures, the ESDP makes spatial and written specifications which, in accordance with the environmental protection objectives set out in section 1.4serve to avoid or reduce significant negative impact of ESDP implementation on the marine environment. This concerns factors such as spatial definitions of priority areas for nature conservation and other ecologically valuable areas, exclusion of applications in priority areas for nature conservation that are not compatible with nature conservation, the principle of noise reduction in the construction of wind farms, the principle of avoiding heating of sediment by live cables as far as possible, and the principle of taking into account best environmental practice in accordance with the OSPAR Convention and the current state of science and technology in the case of economic and scientific applications.

The following principles ensure minimal land usage:

- Economic applications should save as much space as possible.
- Fixed installations must be dismantled when they are no longer used.
- When laying cables, the aim should be to achieve the greatest possible bundling in the sense of parallel routing. Moreover, the route should run parallel to existing structures and buildings wherever possible.

Besides the above-mentioned measures at plan level, there are measures for certain specifications or associated applications such as offshore wind energy, pipelines and sand and gravel extraction so as to avoid and reduce insignificant and significant negative effects in the concrete implementation of the ESDP. These reduction and avoidance measures are specified and ordered by the relevant competent regulatory authority at project level for the planning, construction and operation phases.

## 11.7 Alternative assessment

Pursuant to Article 5(1) No. 1 of the SEA Directive in conjunction with the criteria in Annex I of the SEA Directive and Article 40(2) no. 8 of the Environmental Impact Assessment Act, the environmental report contains a brief description of the reasons for selection of the reasonable alternatives examined while preparing the draft of the spatial development plan. The conceptual/strategic design and spatial alternatives play a major role at plan level.

In principle, it should be noted that preliminary assessment of possible and conceivable planning options is already inherent in all definitions in the form of regional planning objectives and principles. As can be seen from the justification of the individual objectives and principles, in particular those relating to the environment, the definition in question is already based on consideration of possible affected public interests and legal positions, so “preliminary assessment” of possible planning options or alternatives has already taken place.

Besides the zero option, the environmental assessment examines in particular spatial planning possibilities or alternatives insofar as they are relevant to the individual applications.

The basis for the planning solutions to be assessed and the assessment of alternatives are provided by the mission statement and planning guidelines (ESDP, Chapter 1). While three overall alternative plans were assessed initially while preparing the planning concept on the basis of selected environmental aspects, in particular individual area definitions, further (sub-)spatial alternatives or different regional planning areas (such as priority areas, reserved areas) were considered and evaluated from an environmental perspective for the preparation of the first draft plan. The definition of areas for wind energy in the outer EEZ is subject to detailed environmental assessment at subordinate planning levels.

The zero option is not deemed to be a reasonable alternative for updating the spatial development plan as requirements and spatial demands have changed considerably since the 2009 SDP came into force, and the need for more far-reaching specifications – particularly for nature conservation – has become clear. With more comprehensive, higher-level and forward-looking planning and coordination, taking into account a large number of spatial requirements, the draft plan is likely to lead to comparatively lower land use overall and thus to less environmental impact (see Chapter 2).

The planning solution to be preferred from an environmental point of view was not always included in the draft plan. Rather, the overall context of the plan was to be considered, and when choosing plan solutions, besides taking into account nature conservation concerns and avoiding or reducing possible adverse environmental impact, the aim was to achieve the greatest possible balance with other economic, scientific and safety concerns. The crucial factor is that at the level of this SEA, no significant impact on the marine environment is to be expected for the provisions made in the spatial development plan according to the current state of knowledge.

## 11.8 Measures planned for monitoring the environmental impact of implementing the spatial development plan

Pursuant to no. 3 b) Annex 1 to Article 8(1) of the Federal Regional Planning Act, the environmental report also contains a description of the planned monitoring measures. Monitoring is in particular necessary so as to identify unforeseen significant effects at an early stage and make appropriate remedial action possible.

Monitoring also serves to verify gaps in knowledge or forecasts with uncertainties as presented in the environmental report. Pursuant to Article 45(4) of the Environmental Impact Assessment Act, the results of monitoring are to be taken into account when updating the SDP.

The actual monitoring of potential effects on the marine environment can only commence once the applications regulated pursuant to the plan are realised. This is why project-related monitoring of the effects of offshore wind farms, pipelines and the extraction of raw materials is of particular importance. The main objective of monitoring is to bring together and evaluate the findings from the various monitoring results at project level. Moreover, existing national and international monitoring programmes have to be taken into account, also for avoidance of duplication of work.

The potential environmental impact of areas for wind energy has to be investigated at subordinate project level in accordance with the standard “Untersuchung von Auswirkungen von Offshore-Windenergieanlagen (StUK4)” [Investigation of effects of offshore wind farms (StUK4)] and in coordination with the BSH.

Reference is made to the detailed explanations in the environmental report on SDP 2019/draft SDP 2020 with regard to specific measures for monitoring the potential effects of wind energy use, including the effects from power cables.

For the approval of areas for sand and gravel extraction, for example, before the next main operating plan approval, suitable monitoring is required to demonstrate that the maximum permitted extraction depth is not exceeded, the original substrate is preserved and sufficient areas that have not been extracted remain to ensure that there is potential for recolonisation.

For pipelines, monitoring measures during the construction phase include documentation of turbidity plumes, measurements of underwater noise and keeping records relating to marine mammals, seabirds and resting birds. The main monitoring measures during the pipeline operating phase include annual documentation of the positional stability of the pipeline and the depth of cover, as well as annual documentation of epifauna on the overlying pipeline for a period of five years after commissioning.

The BSH is implementing a whole series of projects as part of the accompanying research into the possible effects of offshore wind turbines on the marine environment. These include the ANKER project “Approaches to cost reduction in the collection of monitoring data for offshore wind farms”, the R&D study BeMo “Evaluation approaches for underwater noise monitoring in connection with offshore approval procedures, regional planning and the Marine Strategy Framework Directive” and various sub-projects within the R&D network NavES “Eco-friendly developments at sea”. The results of the BSH’s current projects will be incorporated directly into the further development of standards and norms such as StUK5.

The pooling of information creates an increasingly robust basis for impact forecasting. The research projects serve to provide continuous further development of a consistent, quality-assured foundation for information on the marine environment for the assessment of the possible effects of offshore installations, and form an important basis for updating the SDP.

## 11.9 Overall plan evaluation

In summary, with regard to the provisions of the spatial development plan, the aim is to minimise the effects on the marine environment as far as possible through orderly, coordinated overall planning. Ensuring that the nature conservation areas defined by regulation as priority nature conservation areas serves to safeguard the protective purposes and secure open spaces. The areas reserved for pipelines run mainly outside ecologically significant areas. Significant effects can be avoided if avoidance and mitigation measures are adhered to strictly, particularly by implementing the provisions for offshore wind energy and pipelines.

On the basis of the above descriptions and assessments, as well as the species and area protection law assessment, the Strategic Environmental Assessment concludes – also with regard to possible interactions – that no significant effects on the marine environment within the area under investigation are to be expected from the planned specifications according to the current state of knowledge and at the comparatively abstract level of regional planning.

Most of the environmental effects of the individual applications for which specifications are defined would also occur – on the basis of the same medium-term timescale – if the plan were not implemented, as it is not apparent that the applications would not take place, or would take place to a significantly lesser extent if the plan were not implemented. From this standpoint, the provisions of the plan essentially appear to be “neutral” in terms of their environmental impact. Although it is possible in principle that some of the provisions of the plan in the vicinity of this specific area may well have negative environmental impact due to the concentration/bundling of individual applications in certain areas/regions, overall balance of the environmental effects would tend to be considered positive due to the bundling effects, as pressure on the remaining areas/regions will be relieved and hazards to the marine environment (e.g. the risk of collision) will be reduced.

No detailed data or findings are available for individual protected assets for certain specifications in the area north of shipping route SN10. For this reason, the SEA forecasts for these specifications require more detailed assessment in the context of subordinate planning stages.

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