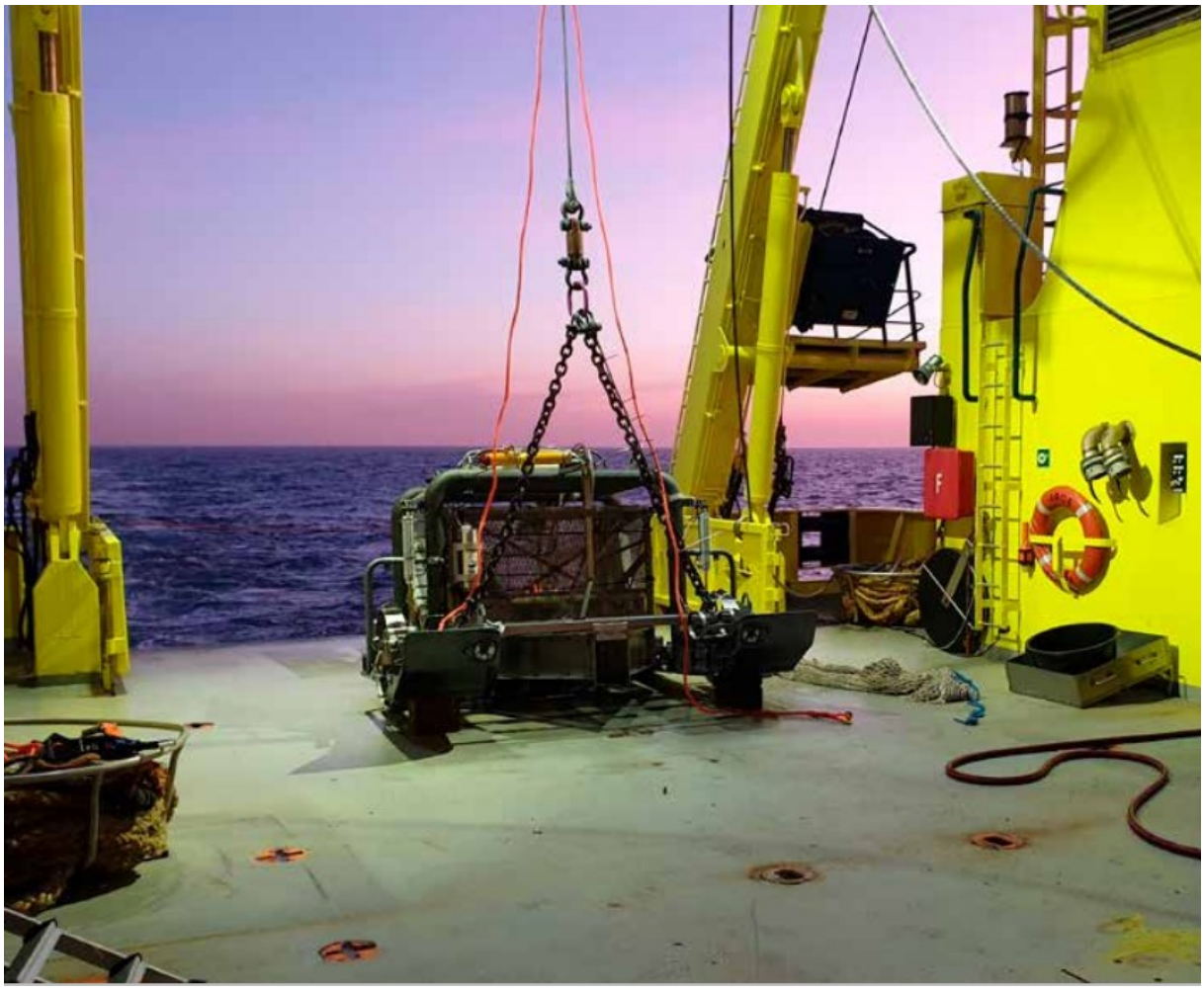
Marine Strategy (Part 2) for the Netherlands

Updating of the MSFD monitoring programme 2020-2026

June 2020



Contents

1. Introduction

MSFD and Marine Strategy

This monitoring programme is the second part of the Marine Strategy for the Netherlands for the period 2020-2026. This integral review of the MSFD monitoring programme in 2014 has been drafted within the deadline prescribed in art. 17 of the European Marine Strategy Framework Directive (MSFD, 2008).

With the Marine Strategy, the Netherlands is implementing the MSFD, the aim of which is to protect and preserve the marine environment, promote the sustainable use of the marine environment and conserve marine ecosystems. To accomplish this, the MSFD provides that the EU member states must take the necessary measures to achieve or maintain good environmental status (GES) in their waters by 2020. Every member state is required to formulate a Marine Strategy with an ecosystem-based approach to the management of the marine environment. The strategy must ensure that the impact of human activities on the marine ecosystem does not compromise the achievement and maintenance of GES.

The Marine Strategy consists of three parts, each of which has to be updated every six years:

- Marine Strategy Part 1: an initial assessment of the marine environment (art. 8 of the MSFD), a description of GES (art. 9), environmental targets and associated indicators (art. 10). The Dutch government adopted the updated version of Part 1 in June 2018.
- Marine Strategy Part 2: the MSFD monitoring programme (art. 11). This document is the updated version of the monitoring programme, which was adopted on [date].
- Marine Strategy Part 3: Programme of measures (art. 13), which was adopted in December 2015.

There is a clear relationship between the three parts: the Marine Strategy Part 1 dictates the information required for Marine Strategy Part 2, and the information in Part 2 is used to update Part 1 and Part 3.

Consultative process

In 2010, the Netherlands anchored the MSFD in the Water Act. The Water Regulations pursuant to the Water Act lays down a consultative procedure. In accordance with that procedure, the Consultative Body for the Physical Environment organised an online consultation process on the Marine Strategy Part 2 from 26 November to 13 December 2019. The seven responses that were received have been incorporated in this final draft. The International Council for the Exploration of the Sea (ICES), and the North Sea Regional Advisory Council were also consulted.

The government adopted this updated Marine Strategy Part 2 2020-2026 for the Netherlands, including the response memorandum, on 10 July 2020. The Netherlands will report on the MSFD monitoring programme to the European Commission using an EU reporting format no later than 15 October 2020.

Structure of Marine Strategy Part 2

The Marine Strategy Part 2 consists of a main document and annexes. The MSFD monitoring programme is summarised in chapter 2 and developed in the form of factsheets in annex VII. The most important changes in the monitoring programme compared with the previous edition in 2014 ensue from the updated Marine Strategy Part 1, which was adopted in 2018. Developments in the area of monitoring and cooperation under the regional maritime OSPAR Convention also led to changes. These changes are reported in chapter 3 and annex VI. Chapter 4 describes the most important national and international alliances and developments affecting the monitoring programme. Chapter 5 gives an outline of the organisation of the MSFD monitoring programme in the Netherlands.

Application of the MSFD

Geographic area covered by the Marine Strategy

The Marine Strategy covers the Dutch section of the North Sea, which embraces the waters, the seabed and the subsoil on the seaward side of the baseline from which the extent of territorial waters is measured (art. 3). The outer limit of the coverage is defined by the international boundaries of the Dutch section of the Continental Shelf (DCS). This is also the boundary of the Exclusive Economic Zone (EEZ).

There is some overlap between the area to which the MSFD applies and the area covered by the Water Framework Directive (WFD), specifically the 'coastal waters', the zone up to 12 nautical miles from the aforementioned baseline. According to art. 2, in that zone the MSFD only applies to aspects that are relevant for the protection of the marine environment and are not already covered by the WFD. In the offshore waters beyond 12 nautical miles, only the MSFD applies.

The Eastern Scheldt, the Western Scheldt and the Wadden Sea do not fall within the area of application of the Marine Strategy; these waters are landward of the baseline. They are covered by the WFD and are also designated as Natura 2000 areas under the Birds Directive (BD) and/or the Habitats Directive (HD). The policy relating to the North Sea, and in particular the North Sea coastal zone, also has a direct or indirect effect on the functioning of these areas.

The Marine Strategy was drafted having regard to the fact that the Dutch section of the North Sea is part of the Greater North Sea MSFD subregion –including the Kattegat and the English Channel – of the North East Atlantic Ocean marine region.

Descriptors and criteria

The MSFD lists 11 descriptive elements – the descriptors – for determining the status of the structure, the function and the processes of the marine ecosystem and disturbances of the marine ecosystem as a result of human activities (also referred to as pressures). In Commission Decision 2017/848/EU these descriptors were broken down into criteria that the member states should use to describe GES. The criteria also have to be used as guidelines in assessing the status of the marine waters. The MSFD distinguishes primary and secondary criteria. The primary criteria are mandatory for all member states and thus create uniformity throughout the European Union; the member states decide individually which secondary criteria to use. Table 1.1 lists the descriptors and the accompanying criteria that were described for the Dutch section of the North Sea in the Marine Strategy Part 1 (2018) and form the basis for the monitoring programme. The complete list of these criteria can be found in annex III.

Environmental targets, GES and indicators

The updated Marine Strategy Part 1 (2018) sets out operational environmental targets for the descriptors. They are related to the most important pressures and activities that cause disturbance and risk (see annex IV) and are derived from what is required for the marine ecosystem to function properly.

Figure 1.1. Areas covered by the MSFD ('Toepassingsgebied KRM'), WFD water bodies ('Waterlichamen KRW') and OSPAR regions

In addition to setting environmental targets, the member states must also define GES for their part of the marine area falling under the MSFD. In the initial MSFD cycle, this was done on the basis of descriptors, which were generally qualitative in nature (the so-called 'overarching' GES in the Marine Strategy Part 1). When the Marine Strategy Part 1 was updated, the descriptions of GES were no longer formulated in relation to descriptors, but in terms of criteria, and, where possible, they were also quantified so that they are also measurable. Each description of GES is linked to an indicator for the purpose of determining the extent to which GES has been achieved.[1]

Monitoring: one of the pillars of the MSFD

The principal purpose of the MSFD monitoring programme is to review the progress that has been made towards achieving GES prescribed for each criterion in the Marine Strategy Part I (2018). This review is based on established indicators. The monitoring can also be used to evaluate the environmental targets defined for each descriptor (for these, see annex IV). The environmental targets are operational in nature and are linked to specific actions and/or measures in the Marine Strategy Part 3. The effects of individual measures cannot generally be linked directly to environmental status or the criteria. Monitoring data can, however, indirectly give an indication of the effectiveness of measures. See also the explanation below. Figure 1.2 shows the interrelationships between descriptors, criteria, GES, indicators and the MSFD monitoring programme.

As prescribed by art. 11, the monitoring programme is based on the indicative lists of ecosystem elements and anthropogenic pressures in Annex III of the MSFD (see annex II of this document). The monitoring programme has also been evaluated in light of the provisions on monitoring in Annex V of the directive. Statistics Netherlands (Statistics Netherlands) collects the economic data in accordance with the requirements of art. 8.

DPSIR: relationship between human activities and the marine environment

The Marine Strategy encompasses every element of the so-called DPSIR cycle: driver, pressure, status, impact and response. The reasoning behind this cycle is that human activities exert pressure on the marine environment, thus altering the status of the environment with potentially negative effects, which can be prevented or reversed by taking measures. The measures taken lead to changes in activities, thus closing the cycle.

The Marine Strategy Part 1 (2018) describes, on the basis of current insight, which drivers relate to which pressures and which pressures have the greatest impact on the environmental status of our marine environment (see annex IV).

[1] Where this was not the case, the MSFD monitoring programme is based on the associated 'overarching' GES.

Table 1.1: Descriptors (shown with code DX) and accompanying criteria (shown with code DXCY) applicable to the Dutch section of the North Sea.

Code	Description of Descriptor/Criteria
D1	Biodiversity
D1C1	Incidental bycatch: Marine mammals, birds, fish and cephalopods
D1C2	Population abundance: Marine mammals, birds, fish and cetaceans
D1C3	Demographic characteristics: marine mammals, birds, fish and cephalopods
D1C4	Distribution of Habitats Directive species: marine mammals, fish
D1C5	Habitat of Habitats Directive species: marine mammals, fish
D1C6	Pelagic habitats
D2	Non-indigenous species
D2C1	Introduced non-indigenous species
D3	Commercially exploited species of fish and shellfish
D3C1	Fishing mortality rate of commercially exploited species
D3C2	Fishing Spawning Stock Biomass of commercially exploited species
D4	Food webs
D4C1	Species composition, density of trophic guilds
D4C2	Species composition, balance of trophic guilds
D4C3	Size structure in trophic guilds
D5	Eutrophication
D5C1	Nutrients
D5C2	Chlorophyll a
D5C5	Oxygen
D6	Sea-floor integrity
D6C1	Extent of physical loss of the sea floor
D6C2	Extent of physical disturbance of the seabed
D6C3	Quality of benthic habitats: status and effects of physical disturbance (DCS)
D6C4	Extent of physical loss of benthic habitats
D6C5	Status of communities: diversity within benthic habitats (OSPAR)
D7	Hydrographical conditions
D7C1	Permanent alteration of hydrographical conditions to the seabed and water column
D7C2	Permanent alteration to hydrographical conditions of benthic habitats
D8	Contaminants
D8C1	Contaminants in water, sediment and biota
D8C2	Effects of contaminants on species
D8C3	Significant acute pollution with oil and oil-like substances
D9	Contaminants in fish and other seafood for human consumption
D9C1	Contaminants in edible tissue
D10	Litter
D10C1	Litter: beaches, seabed, floating
D10C2	Micro-litter
D10C3	Litter in marine animals
D11	Introduction of energy, underwater noise
D11C1	Impulsive noise
D11C2	Continuous noise

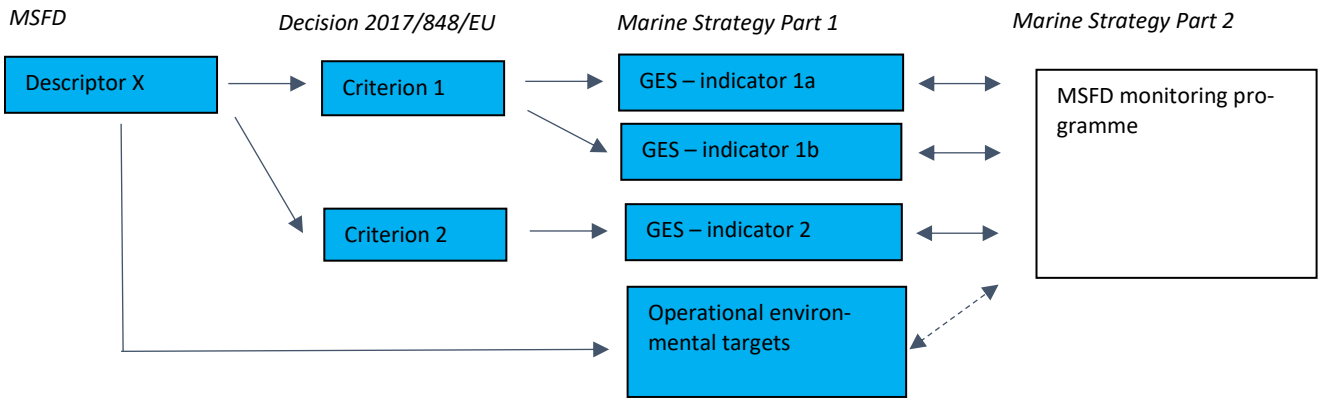


Figure 1.2. Diagram of the interrelationship between descriptors, criteria, GES, indicators and the MSFD monitoring programme.

The European Commission requests that the electronic reports explain how the DPSIR cycle is monitored and to which part of the cycle the monitoring surveys are linked. The MSFD monitoring programme helps to generate better insight into the relationships between the use of the sea and the marine ecosystem. This can be accomplished by monitoring pressures and the underlying activities[2], and by monitoring species and habitats[3] and hydrographical characteristics[4].

The numerous relationships between the various elements of the marine ecosystem are complex, and many are still not known. Consequently, it is often only possible to give an indication of the impact of specific activities on the marine ecosystem.
Experts generally derive DPSIR relationships from the monitoring of pressures/activities and of species and habitats (from the MSFD monitoring programme), in combination with data derived from permits and research programmes. However, some surveys have been established to measure pressures and their effects and/or to learn more about the effectiveness of measures.

In designing the monitoring survey for benthic animals (habitats), the Netherlands explicitly took account of the need to be able to determine the effects of physical disturbance of the seabed and the effectiveness of measures to protect life on the seabed (D6C3). There are also monitoring surveys that are not directly connected with GES or the prescribed indicators, but which do provide insights into pressures and the effectiveness of measures. One such survey is OSPAR's Riverine Inputs and Direct Discharges (RID) monitoring programme, which measures loads of nutrients and contaminants. OSPAR's Comprehensive Atmospheric Monitoring Programme (CAMP) measures the current input of contaminants via atmospheric deposition in the OSPAR maritime area. Furthermore, Rijkswaterstaat is carrying out pilot projects with a view to developing a method for measuring litter in rivers.

[2] D1C1: incidental bycatch, D2: non-indigenous species, D3C1: fish mortality, D5: eutrophication, D6C1/D6C4: physical loss of seabed/habitats and D6C2: fisheries intensity and sand extraction, D8 and D9: contaminants, D10: litter, D11: underwater noise
[3] D1: biodiversity (with the exception of D1C1), D3C2: spawning stock biomass, D4: food web, D6C3/D6C5: habitats
[4] D7

2. Summary of MSFD monitoring programme

The MSFD monitoring programme is based on the updated version of the Marine Strategy Part 1 (2018). Its principal purpose is to monitor the progress being made towards GES as defined for each criterion. Information from the monitoring programme also gives insight in progress of the operational environmental targets. The monitoring programme is not designed to identify causal relationships with effects of individual pressures or measures. Unless otherwise stated, these relationships can only be indicative.

This chapter summarises the following aspects for each descriptor and criterion:

- the requirements of the MSFD with the Marine Strategy, Part I as the starting point
- how this is followed through monitoring (or registration)
- what national or international benchmarks are used (OSPAR, WFD, BD, HD)
- what monitoring surveys are used
- whether changes have been made since 2014.
- Chapter 3 describes those changes in more detail.

D1 Biodiversity: marine mammals

Achieving GES for marine mammals is measured by population abundance, demographics, distribution and habitat. The population trends for harbour porpoise (Phocoena phocoena), harbour seal (Phoca vitulina) and grey seal (Halichoerus grypus) must be at least stable (OSPAR indicator) and their population abundance must correspond with the Favourable Reference Population (FRP) in the Habitats Directive (D1C2). For seals, the extent to which GES has been achieved is also measured by the number of pups that are born (D1C3). The average number of pups must not decline by more than 1 per cent a year. For the grey seal, this indicator corresponds with the OSPAR indicator for the North Sea. There is no OSPAR indicator for pup production of the harbour seal, but data are reported at national level. For the monitoring of cetaceans, including harbour porpoise, OSPAR and ASCOBANS are developing a SCANS survey programme[5] for the entire North Sea with measurements at least once every six years. The Netherlands supplements this monitoring with surveys at DCS level. The monitoring of seals is part of OSPAR and the Habitats Directive and also adheres to the trilateral agreements on the Wadden Sea (under the Convention on the Conservation of Migratory Species of Wild Animals, also known as the Bonn Convention). All surveys of cetaceans and seals are carried out for the Ministry of Agriculture, Nature and Food Quality (WOT) and Rijkswaterstaat (MWTL). The seal counts are conducted several times each year and this frequency has not changed since 2014. The surveys of harbour porpoises will be arranged differently (over the years and within a year) in order to produce a better estimate of the population.

The distribution (D1C4) of harbour porpoise, harbour seal and grey seal has to comply with the Favourable Reference Range (FRR) in the Habitats Directive. Their distribution is not specifically monitored; marine mammals are very mobile and the observed distribution will depend entirely on the extent of the research. It is therefore assumed that both the FRR and the distribution range of the three species encompass the entire DCS (including the coast, the Wadden Sea and the Delta Waters).

The extent and the condition of the habitats of marine mammals (D1C5) must be at least maintained. The assessment is linked to reporting for the Habitats Directive. However, there is still considerable uncertainty regarding the quality of the habitats, mainly because the impact of various pressures, both

[5] Small Cetaceans in European Atlantic waters and the North Sea

now and in the future, is unknown. Studies are being carried out as part of a number of major projects, such as the Offshore Wind Ecological Programme (Wozep), to increase knowledge of the effects of offshore windfarms. Also, there is a monitoring survey (for the Ministry of Agriculture, Nature and Food Quality) to ascertain the cause of death of a subset of stranded porpoises, which may be extended to encompass seals in future. International efforts are also underway to further develop a system of monitoring incidental bycatch of protected species, including harbour porpoises and seals (D1C1), as required by the EU's Common Fisheries Policy (CFP). There is already an OSPAR indicator for incidental bycatch of porpoises, but not yet for seals.

➔ **To the Biodiversity of marine mammals fact sheets:**
D1C1 (Mortality rate per species from incidental bycatch),
D1C2 (Population abundance per species),
D1C3 (Demographic characteristics per species),
D1C4 (Species' distributional range),
D1C5 (Habitat extent and condition for the species)

D1 Biodiversity: marine birds

GES for marine birds is determined to a large extent by the population abundance (D1C2). A new feature is that breeding success (D1C3) and the mortality rate from incidental bycatch of birds in marine fishing (D1C1) are also specifically considered for the MSFD.

GES for the population abundance is measured by OSPAR and the Birds Directive requirements. This means that population abundance in the southern North sea of at least 75% of the bird species in each 'functional group' must be above the threshold value in 1992 (OSPAR). The objective of the Birds Directive is 'to maintain the populations of all wild bird species in the EU at a level which corresponds to their ecological, scientific and cultural requirements, or to adapt the population of these species to that level'. This description is regarded as comparable with the term 'favourable conservation status' in the Habitats Directive. The populations of marine bird species are determined mainly on the basis of aerial counts (by Rijkswaterstaat). Counts by volunteers from the coast (marine bird migration counts) and data from the Breeding Bird Monitoring Programme are also used. Compared with 2014, the number of annual offshore counts will be increased from four to six. The coastal counts will also be refined to provide greater spatial coverage.

The monitoring of breeding success among birds has an early-warning function[6] and is therefore an important addition to the instruments for monitoring trends in bird populations. Changes in populations generally occur over longer periods and are therefore slower to provide insight into reactions to external pressures. GES is achieved if breeding failure does not occur in more than three of every six years (OSPAR indicator). In the Wadden Sea area, there has been a reproduction monitoring survey since 2004 (for the Ministry of Agriculture, Nature and Food Quality). Since there was no permanent survey in place elsewhere along the coast, a survey to monitor breeding success will be launched for the purposes of the MSFD in 2020. If possible, it will be combined with an initiative by provinces and regional land managers in the South-West Delta.

At international level, a system for monitoring incidental bycatch of protected species, including marine birds, is being developed as required by the CFP. No indicator has been formulated for birds yet.

➔ **To the Biodiversity of marine birds fact sheets:**
D1C1 (Mortality rate per species from incidental bycatch),
D1C2 (Population abundance per species),
D1C3 (Demographic characteristics per species).

[6] For the mating period and for the area where the relevant species reside during the mating period, in any case.

D1 Biodiversity: fish (and cephalopods)

The MSFD provides that the population abundance of vulnerable fish species must be sufficient to ensure their long-term viability (D1C2). For commercially exploited species, GES is reached if the requirements for the fish mortality rate and spawning stock biomass are met (corresponding with GES for D3C1 and D3C2, respectively).

Separate descriptions of GES have been defined for non-commercially exploited species (including sharks and rays), fish species referred to in the Habitats Directive (migrant fish species) and other vulnerable species. The data used for the assessment of vulnerable species are collected by means of the fisheries monitoring for the CFP. OSPAR's indicator for vulnerable species is then used to determine whether GES has been achieved. There is no assessment or specific monitoring for sharks and rays. Precautionary measures to improve the status of these species have been adopted in the MSFD Action Plan for Sharks 2015-2021. Experts assess the population abundance (D1C2) and the distributional range of migrant fish species according to the reference values in the Habitats Directive (D1C4), based on the available data from fisheries monitoring (salmon and eel traps) in the inland waters. If necessary, they also use data generated by the Network Ecological Monitoring (NEM).

To determine the 'demographic characteristics' (D1C3) of the fish population, the distribution by size of the fish community is assessed using OSPAR's Large Fish Indicator (LFI). The necessary data are collected via the CFP.
The quality of the habitat for fish is also important for the MSFD (D1C5). The specific requirement is to reduce the barriers in migration routes for migrant species. The monitoring and assessment of this criterion corresponds with the WFD.
The mortality rate of all non-commercially exploited fish species as a result of incidental bycatch must be lower than levels which threaten the species (D1C1). No indicator has yet been formulated for this criterion. The CFP does provide for mandatory registration, but that has still to be fully implemented in practice.

The vast majority of the necessary data are delivered by the monitoring surveys in the context of the CFP. Changes in the monitoring and further elaboration of indicators occur within that framework.

Indicators for the criteria D1C1, D1C2 and D1C3 have to be defined not only for fish species, but also for cephalopods. This has not yet been done, primarily because so little information is available about these species. Research will be conducted into the possibility of formulating these indicators in 2020.

➔ **To the Biodiversity of fish (and cephalopods) fact sheets:**
D1C1 (Mortality rate per species from incidental bycatch),
D1C2 (Population abundance per species),
D1C3 (Demographic characteristics per species),
D1C4 (Species' distributional range),
D1C5 (Habitat extent and condition for the species).

D1 Biodiversity: pelagic habitats

To assess whether pelagic habitats comply with GES it has to be possible to identify changes in the composition, the biomass and the abundance of the plankton community. The Marine Strategy Part 1 (2018) contains two indicators for this aspect.
The monitoring of biomass (chlorophyll a concentrations, see also D5C2) and the composition of species of phytoplankton is covered by Rijkswaterstaat's MWTL programme. In addition, an international monitoring survey (the United Kingdom's SAHFOS[7]) monitors the composition of species and the abundance of both phytoplankton and zooplankton with the Continuous Plankton Recorder (CPR).

The monitoring and assessment system for pelagic habitats is not yet fully developed. For the time being, a pragmatic solution has

[7] *Sir Alister Hardy Foundation for Ocean Science*

been chosen for the purposes of the MSFD. Measurements by the United Kingdom (from the CPR) are used for the assessment of zooplankton, but there are still gaps in our ecological and methodological knowledge. The phytoplankton monitoring survey is still being developed. The aim is to implement a coherent international system of monitoring and assessment as far as possible and jointly expand the number of monitoring sites. The monitoring and the assessment method are expected to have been developed by the end of 2020.

➔ **To the Pelagic habitats fact sheet:** *D1C6*

D2 Non-indigenous species

The introduction of non-indigenous species (NIS) should be limited. Monitoring must provide insight into the number of non-indigenous species that are introduced into the Dutch section of the North Sea in each six-year planning period. To establish the effectiveness of regulatory and other measures, it is important to ascertain the route by which these species have been introduced (the pathway approach). This assessment is made on the basis of expert judgement.

In view of the small chance of their discovery at the introduction stage and the lack of options for intervention if non-indigenous species are discovered, the Netherlands currently opts for assessment on the basis of the best available knowledge. All observations of non-indigenous marine species in the Dutch North Sea are considered together, including those from sources other than regular monitoring surveys. The regular monitoring surveys include the biological measurements by Rijkswaterstaat (MWTL: benthos and phytoplankton) and for the Ministry of Agriculture, Nature and Food Quality (WOT: benthos and fish).

An additional feature compared with 2014 is the additional use of monitoring of specific projects (construction of wind farms, effects of beach nourishment) and of well-documented observations by members of the public (including divers). The MSFD monitoring is linked to developments in OSPAR and any changes that ensue from the European Regulation on the prevention and management of the introduction and spread of invasive alien species (2014) and the Ballast Water Management Convention (2017).

➔ **To the Non-indigenous species fact sheet:** *D2C1 (introduced non-indigenous species)*

D3 Commercially exploited species of fish and shellfish

The aim of the MSFD is to restore and conserve the populations of all commercially exploited fish and shellfish. The CFP constitutes the statutory framework for the fisheries sector and the Netherlands is therefore guided by it to achieve the MSFD objectives. To achieve GES, the fish mortality rate (D3C1) and the spawning stock biomass (D3C2) of all commercially exploited fish species must both comply with the international requirements.

The data for the mortality rate from fishing and spawning stock biomass are derived from monitoring carried out for the WOT Fisheries programme and the Data Collection Framework (DCF). The monitoring surveys are adequate and have not changed. The monitoring programme coordinated and prescribed by the International Council for the Exploration of the Sea (ICES) guarantees the collection of the basic data required for the assessment of commercially caught fish species. This internationally coordinated monitoring and the annual recommendations made by ICES give an indication of the extent to which GES has been achieved. ICES' advice on stock assessments and catch scenarios forms the basis for the adoption of the EU's annual fishing quotas, which the member states use to manage the restoration and conservation of populations of commercially exploited fish species.

➔ **To the Fish mortality rate and spawning stock biomass of commercially exploited species fact sheet:** *D3C1/D3C2*

D4 Food webs

Establishing relationships between elements of the marine food web is one of the most difficult analyses in the Marine Strategy. For example, it is not yet possible to determine whether the diversity (D4C1) or the balance of total abundance (D4C2) between the trophic guilds is adversely affected by anthropogenic pressures. The assessment method for these criteria is still being developed and the associated information requirements are therefore not yet known. The Netherlands follows outcomes at OSPAR level. The expectation is that the future information requirements for D4C1 and D4C2 can be met with the monitoring for D1 (birds, fish, marine mammals, plankton) and D6 (benthos).

The fish community is considered for the assessment of the size distribution of trophic guilds (D4C3). The OSPAR indicator, which takes the so-called typical length as the standard, is used for this purpose: the typical length declines under high fishing pressure. The IBTS monitoring survey, on which this indicator is based, is carried out in the context of the CFP.

No monitoring surveys specifically for D4 have yet been added to the MSFD monitoring programme.

➔ **To the Food webs fact sheets:**
D4C1/D4C2 (species composition, density and balance of trophic guilds),
D4C3 (size structure in trophic guilds)

D5 Eutrophication

Significant progress has been made in improving the monitoring of eutrophication. This is connected with efforts at OSPAR level to establish a coherent international system of monitoring and assessment and the emergence of innovative techniques.

OSPAR is revising the Common Procedure (COMP), the framework for monitoring and assessing eutrophication, in the period 2019-2022. The MSFD monitoring programme will comply with that. Pending the outcome of that review, for the time being the MSFD monitoring programme will be based on GES as defined in the Marine Strategy Part 1 (2018). GES is reached if the concentrations of nutrients (D5C1), chlorophyll a (D5C2) and oxygen (D5C5) comply with the standards in the WFD (coast) and OSPAR (offshore). The monitoring therefore has to meet the monitoring requirements of the WFD and OSPAR. All of the measurements are part of Rijkswaterstaat's monitoring programme (MWTL). In situ measurements of nutrients, chlorophyll a and oxygen in the water have been carried out since 1990. A new feature is the use of satellite observations, which will substantially increase the coverage of the measurement of chlorophyll a. Another method being used is automatic sample collection using FerryBoxes (as well as so-called match-up samples as the satellite passes over) along the routes between the Netherlands, Norway and the United Kingdom. The precise details will be developed in international agreements in the coming years. The foundations were laid in the EU project JMP EUNOSAT, which was completed in 2019 (see box in chapter 4).

➔ **To the Eutrophication fact sheets:**
D5C1 (nutrients),
D5C2 (chlorophyll a),
D5C5 (oxygen)

D6 Seafloor integrity

The aim of the MSFD is to improve the quality of seafloor habitats. Also, there must be no significant decline in the extent of those habitats. Results from the MSFD monitoring programme show whether GES has been achieved and highlight the pressures and their impact. In contrast to the other descriptors, the connected pressure and associated activities are explicitly mentioned: the disturbance of the seabed must not increase.

Any changes in the spatial extent of the seabed and habitats are regulated via licences and can therefore be analysed through administrative records.

The level of disturbance of the seabed by fisheries is derived from data collected under

the CFP by the EU-Vessel monitoring system (VMS). ICES has adopted a standard protocol for converting the VMS and logbook data into maps showing the spatial extent and distribution of fisheries pressure. Data generated by the licensing procedure are used to determine the area of the seafloor disturbed for sand extraction and beach replenishment. There is no indicator yet for sand extraction.

The monitoring and assessment of the quality of habitats at DCS level largely corresponds with the Habitats Directive (national level) and Natura 2000 (area level). The quality of habitats is determined on the basis of the presence of benthic species. The assessment is focused on a set of species that is indicative of the structure and function of the habitat, species that are sensitive to disturbance by human activities, and species that are indicative of recovery (the so-called BISI indicator). Monitoring in both closed and non-closed areas indicates the effectiveness of measures.

At the level of the North Sea region, the assessment is linked to the OSPAR indicator, whereby the quality is shown by a diversity indicator.

Benthic animals are sampled in Rijkswaterstaat's MWTL monitoring programme and the shellfish monitoring WOT for the Ministry of Agriculture, Nature and Food Quality. Since its introduction in 2014, the MSFD monitoring programme has been revised and expanded to match the modified boundaries of the protected (closed) areas.

➔ **To the Integrity of seafloor/habitats fact sheets:**
D6C1/D6C4 (extent of physical loss),
D6C2 (extent of physical disturbance),
D6C3 (quality of benthic habitats: status and effects of physical disturbance (DCS),
D6C5 (condition of communities: diversity of benthic habitats (OSPAR).

D7 Hydrographical conditions

For D7, GES is achieved if the hydrographical conditions of the marine ecosystem are not adversely affected by human activities. Accordingly, assessment focuses on developments that could potentially have an impact on the hydrographical conditions, such as the construction of ports and infrastructure or beach replenishment. The challenges facing the Netherlands (and of neighbouring countries) with respect to the development of offshore renewable energy demands special attention. This development will be accompanied by a large increase in the number of wind turbines in the short and medium term. The studies, monitoring, registration and assessments, including any compensation, required during this process will be carried out in accordance with the existing statutory frameworks (Environmental Impact Reports). Because the monitoring is conducted on a project basis it is not, strictly speaking, part of the MSFD monitoring programme.

Rijkswaterstaat (MWTL) and the Netherlands Hydrographical Service regularly monitor the seabed level, salinity, currents and wave heights in the North Sea. Although these measurements are also not explicitly part of the MSFD monitoring programme, the data support the assessment of D7.

The monitoring for D7 has not changed compared with the previous MSFD monitoring programme (2014).

➔ **To the Hydrographic conditions fact sheet:**
D7C1/D7C2 (permanent changes in hydrographic conditions).

D8 Contaminants

The monitoring of micro-contaminants in sediment or species (biota) for the MSFD is linked to OSPAR's requirements. The relevant contaminants must display a downward trend. The same applies to imposex[8] in sea

[8] Imposex is a deformity that occurs in certain species of sea slug, whereby female animals develop male gender characteristics under the influence of toxic substances. The deformity, which occurs in the common dog whelk (*Nucella lapillus*, an indicator species for the North Sea) and the common whelk (*Buccinum undatum*), causes problems in the animals' reproduction.

slugs (as an indicator of the health of species). For micro-contaminants in water near the coast, the monitoring requirements and the standards of the WFD apply. The monitoring and evaluation of acute contamination with oil corresponds to the requirements under the Bonn Agreement.

The results from the MSFD monitoring programme give an indication of whether GES has been achieved and provide insight into progress with the operational environmental objectives and the impact of pressures (introduction of substances). To this end, other monitoring surveys are also relevant, specifically OSPAR's Riverine Inputs and Direct Discharges (RID) for monitoring loads of nutrients and contaminants and Comprehensive Atmospheric Monitoring Programme (CAMP) for measuring the introduction of contaminants via atmospheric deposition.
The monitoring of contaminants, imposex and oil spills is covered by Rijkswaterstaat's monitoring programme and has remained largely unchanged since 2014. The monitoring survey has been expanded to include the measurement of copper concentrations in sediment and biota because the Netherlands has adopted 'monitoring copper concentrations' as an operational environmental goal since this heavy metal is used as a substitute for tributyltin (TBT).

➔ **To the Contaminants fact sheets:**
D8C1 (contaminants in water, sediment and biota),
D8C2 (impact of contaminants on species),
D8C3 (significant effects of pollution: spills of oil and oil products).

D9 Contaminants in fish and other seafood for human consumption

GES is achieved if the levels of contaminants in fish and other fish products from the North Sea do not exceed the prescribed maximum concentrations. These standards are laid down in EU Regulation 1881/2006 for dioxins, PCBs, PAHs and metals. Monitoring must also show whether concentrations are increasing or declining.

For measurements in fish and other organisms for human consumption, including crabs, shrimps and shellfish, random samples are taken from different landed species at various locations. The monitoring is carried out for the Ministry of Agriculture, Nature and Food Quality. The sampling occurs once a year. Catches from surveys on board research vessels are also used. Fish from both the Dutch section of the North Sea and elsewhere are used. An important criterion is that the collection is representative of the pattern of human consumption.

The monitoring has remained largely unchanged since 2014. PFASs, PBDEs and OCP are now also analysed, but no standards have been established for these compounds yet.

➔ **To the Contaminants in fish and other fish products fact sheet:**
D9C1 (contaminants in edible tissues).

D10 Litter

Marine litter is caused by human activities. Achieving GES calls for a significant decline in the quantity of litter on beaches and on the seafloor, and of litter on the surface layer of the water column (D10C1). Because litter does not respect national borders, the monitoring and assessment is regionally coordinated in OSPAR. To gain insight into the sources of pollution and the effectiveness of measures, a distinction is made between different categories of litter. The assessment is carried out at both DCS level and North Sea level.

For Rijkswaterstaat, samples are taken at Dutch beaches four times a year. The monitoring of litter on the seafloor has been added to the MSFD monitoring programme and is linked to the fisheries monitoring carried out for the purposes of the CFP. The quantity of plastic found in the stomachs of fulmars (Fulmarus glacialis) is used as an indicator for litter on the surface layer. This monitoring survey is also used for D10C3, which relates to the amount of litter ingested by marine animals. No GES has yet been established for micro-litter (D10C2), but OSPAR is expected to formulate an indicator in 2020. A new

monitoring survey for micro-litter in sediment is expected to be launched at the beginning of 2021.

The data for litter on the seafloor are generated by a fish monitoring survey (IBTS[9]). However, this survey is not specifically designed for measuring litter and is therefore not very efficient for that purpose. Furthermore, the data derived by the North Sea countries from the monitoring survey can only be compared qualitatively, not quantitatively.

In the coming years, Rijkswaterstaat will carry out pilot projects to develop monitoring surveys for macro-litter and micro-plastics in rivers. Although they will not be part of the MSFD monitoring programme, these surveys will provide information about sources and the effectiveness of measures.

➔ **To the Litter fact sheets:**
D10C1/D10C3 (litter: beach, seafloor, surface layer and in marine animals),
D10C2 (micro-litter).

D11 Introduction of energy: underwater noise

As a relatively new topic, the issue of underwater noise was not elaborated on in the previous MSFD monitoring programme (2014). The Netherlands has fully supported efforts to develop a European strategy for the monitoring of underwater noise. Major progress has been made in recent years with the monitoring and assessment of impulsive noise (D11C1). Progress has also been made in developing a survey to monitor continuous noise (D11C2), which is expected to be operational in 2021.

The monitoring programme focuses on mapping impulsive noise (D11C1) in terms of the distribution, duration and level of disturbance. International consultation led to the decision to express disturbance in pulse block days (PBDs), i.e., the number of days in an ICES statistical rectangle when an activity that causes impulsive noise occurs. The Netherlands expands on this definition by also taking account of the spatial distribution of noise and by determining the number of days on which the level of noise exceeds the threshold for disturbance of harbour porpoise (porpoise disturbance days). The harbour porpoise is regarded as the species most sensitive to impulsive noise and is therefore used as the benchmark for assessing whether GES has been achieved.

OSPAR and HELCOM have jointly established an international register, which is managed by ICES. The porpoise disturbance days are determined by combining a noise propagation model with a map of the distribution of porpoise. The PBD values (numbers) can be shown in maps directly from the register. A distinction can also be made between the type of source (pile driving, seismics, explosions, sonar) and the strength of the source (low, medium, high).

Although no GES has yet been defined for continuous noise (D11C2), the Netherlands and other countries around the North Sea have initiated the development of a monitoring programme. The JOMOPANS project commenced at the beginning of 2018 and will run until the end of 2020, by which time it is expected that there will be a monitoring programme for continuous noise (see also the box in chapter 4).

➔ **To the Underwater noise fact sheets:**
D11C1 (impulsive noise),
D11C2 (continuous noise).

[9] *International Bottom Trawl Survey*

3. Changes in the MSFD monitoring programme

This MSFD monitoring programme describes the information requirements for the updated Marine Strategy Part 1 scheduled for 2024, and the monitoring required to generate that information. The starting point was the monitoring programme for 2014. Changes were made on the basis of:

- the EU's assessment of the MSFD monitoring programme in 2014 and the Netherlands' implementation of the findings;
- the revised – partly on the basis of Commission Decision 2017/848/EU – Marine Strategy Part 1 (2018);
- the steps taken towards regional cooperation in a coherent monitoring system, as well as other developments such as innovations (see chapter 4).

Reaction to European Commission's assessment of Marine Strategy Part 2 (2014)

The first MSFD monitoring programme was adopted in 2014. A report on the programme was submitted to the European Commission. In its assessment dated 23 January 2017, the European Commission concluded that the Netherlands' MSFD monitoring programme formed a generally suitable framework for monitoring the improvement of the marine environment towards GES. The Netherlands responded to that assessment by incorporating additional monitoring in the programme and by providing specific explanations for identified shortcomings.

- *Breeding marine birds (D1)*: A common indicator developed under the auspices of OSPAR was used for the Dutch MSFD assessment in 2018 (MS1-2018). The counts of breeding birds needed for that indicator have therefore been added to the MSFD monitoring programme.
- *Harbour porpoises (D1)*: the monitoring of stranded harbour porpoises and post-mortem investigation of the cause of death has been incorporated into the MSFD monitoring programme.
- *Fish (D1)*: the densities in which rays and sharks appear are often too small to establish trends by means of proportional monitoring. The Netherlands therefore focuses on measures to protect these vulnerable species.
- *Non-indigenous species (D2)*: up to now, monitoring has been organised on the basis of existing marine monitoring surveys. In addition, the Netherlands has had a list drawn up of all indigenous species found in the Dutch section of the North Sea. The Netherlands has also drafted, on the basis of the best available knowledge from various sources and expert opinion, the most comprehensive possible overview of all non-indigenous species found in the Dutch section of the North Sea, including the year of their introduction and the primary and secondary vectors of their arrival here. This approach yields more information than is generated by the monitoring surveys alone, and it can be repeated periodically. Little or nothing can be done against non-indigenous species that have settled in the marine environment. The Netherlands therefore regards the above approach as more legitimate than launching or intensifying specific monitoring programmes for non-indigenous species. From 2020, the MSFD monitoring for the assessment of pelagic habitats will be expanded to the composition of species of phytoplankton at three locations in the coastal zone. This monitoring survey will also contribute to fulfilling the obligation to establish the presence of non-indigenous phytoplankton species (D2).
- *Hydrographical conditions (D7)*: every activity that influences hydrographical conditions anywhere in the Dutch section of the North Sea is regulated, and is therefore known. The impact of activities on

hydrographical conditions is covered in the mandatory environmental impact reports and the associated monitoring. Possible effects (for example, changes in bed shear stress) are investigated using models which are supplemented, if necessary, with in situ monitoring. In this way, the Netherlands keeps track of the further intensification of the roll-out of offshore wind energy (see also point 4c below). Hydrographical conditions such as bathymetry, wave heights and currents are not explicitly part of the MSFD monitoring programme, but are regularly measured at various locations in the Dutch section of the North Sea.

- *Litter (D10)*: OSPAR has formulated an indicator for litter on the seafloor, which was used for the MSFD assessment in 2018. The monitoring required for this indicator has been added to the MSFD monitoring programme. OSPAR is also developing an indicator for micro-litter in sediment. The monitoring of micro-litter in sediment is expected to be operational in early 2021.
- *Underwater noise (D11)*: a knowledge gap made it impossible to devise an adequate monitoring programme for underwater noise in 2014. That knowledge gap has been largely rectified and monitoring has now commenced.

In its assessment, the European Commission encourages member states to pursue further integration with other directives, to enhance regional monitoring programmes and to endeavour to improve the comparability of monitoring and assessment at regional level. To achieve this, the Netherlands has supported the development of new common indicators and coherent regional assessment methods in OSPAR (see also chapter 4). The Netherlands has led two European projects devoted to coherent joint monitoring (JMP EUNOSAT[10] – satellite monitoring of eutrophication D5; JOMOPANS[11] – continuous underwater noise D11).

Analysis of the monitoring programme

The Commission's assessment, the changes that have been made in the description of GES on the basis of Commission Decision 2017/848/EU and the progress made in terms of regional cooperation and innovation have been compared with the MSFD-monitoring programme in 2014. For each monitoring survey, it was established whether the data collected had been used for the updating of the Marine Strategy Part 1 (2018) and whether the survey was relevant for assessing the situation in 2024. Monitoring surveys whose relevance could not be properly substantiated are no longer part of this MSFD monitoring programme. The analysis of each MSFD criterion also indicates whether the monitoring will be sufficient to determine the status in 2024. Some gaps have been found in the monitoring and additions have been made to the MSFD monitoring programme.

The complete overview of the analysis can be found in annex VI. The main conclusions are:

1. For the most part, the monitoring surveys in the Marine Strategy Part 2 (2014) are adequate.

2. Surveys that will no longer be part of the MSFD monitoring programme are:
   a. Counts of marine birds from ships (due to improvements in counts from planes)
   b. Oiling of marine birds (GES and the indicator have been revised).

3. Monitoring surveys that will be modified or expanded or that are new and whose details will be developed in 2020:
   a. D1C2 Population abundance of marine birds: expansion of offshore counts (from four to six counts a year) and optimisation of coastal bird counts;
   b. D1C2 Population abundance of harbour porpoise: different distribution of surveys (over years and within a

[10] *Joint Monitoring Programme of the Eutrophication of the North Sea with Satellite data*
[11] *Joint Monitoring Programme of Ambient Noise in the North Sea*

single year) to produce better estimates of the population (without increasing the number of counts);

c. D1C3 Demographic characteristics of marine birds (new criterion): breeding success of coastal breeding birds along the North Sea coast;
d. D1C6 Pelagic habitats: assessment and monitoring survey are under development, in line with OSPAR's results. The Netherlands aims to increase the number of monitoring locations, among other things. Furthermore, the entire species composition of phytoplankton is now taken into consideration (not just the plague alga Phaeocystis);
e. D5C2 Chlorophyll a: innovation with satellite monitoring (following EU project JMP EUNOSAT);
f. D8C2 Impact of contaminants: given the steady and consistent decline in the level of imposex, it has been decided to adopt less frequent measurements and a longer-term assessment;
g. D9C1 Contaminants in edible tissues: supplemented with the substances PFAS, PBDE and OCP;
h. D10C1 Litter on the seafloor: added to the MSFD monitoring programme. The monitoring survey piggy-backs on the fisheries monitoring carried out for the CFP;
i. D10C2 Micro-litter: there will be a new monitoring survey for microplastics in sediment;
j. D11C1 and D11C2 Underwater noise: new monitoring surveys/registration.

4. Monitoring surveys that have been established or modified in another context and will also be part of or contribute to the MSFD monitoring programme:
   a. D1C1 Incidental bycatch of marine mammals, marine birds, fish (new criterion): under the new Data Collection Framework based on Regulation 2017/1004, all incidental bycatch of non-target species, including marine mammals, birds and fish, must be monitored. This might require additional monitoring, depending on the outcome of international efforts thereon;
   b. D1C5 Habitats: the Ministry of Agriculture, Nature and Food Quality will decide in 2020 whether monitoring will cover not only stranded harbour porpoises, but also the harbour seal and the grey seal;
   c. D7 Hydrographical conditions: the subject of the possible effects of the large-scale roll-out of offshore wind energy on hydrographical conditions is on the 2030 Research Agenda for the North Sea. An exploratory study has already been carried out in the Wozep programme[12]. Any further questions that arise will be addressed in this context;
   d. Additional monitoring that might ensue from arrangements in the North Sea Agreement.

5. Changes in the monitoring programme might still be needed because of the more intensive use of the North Sea, developments in monitoring techniques and the further development of indicators. The MSFD monitoring programme will therefore be evaluated annually, with any necessary changes then being implemented.

[12] Offshore Wind Ecological Programme

4. Cooperation and developments

The MSFD provides that the monitoring programmes of countries within a sub-region must be coherent (art. 11). The Dutch section of the North Sea falls within the sub-region North Sea, including the Kattegat and the English Channel (art. 4). The MSFD also states that member states in the same marine region should cooperate (art. 5) and use regional sea conventions, building as far as possible on existing programmes and activities (art. 6).

The Netherlands is committed to maximising international cooperation and coordination in determining the information requirements and their implementation in monitoring programmes and the ultimate assessment. This approach generates efficiency gains and leads to a better understanding of the ecosystem and the factors threatening it. Furthermore, transnational mobile species groups such as marine birds, fish and marine mammals, but also pressures such as underwater noise and pollution, require such an approach.

Accordingly, the elaboration of the Marine Strategy with indicators, monitoring, research programmes and measures corresponds to a large extent with agreements and developments at international level (EU, OSPAR, river basins). Guiding instruments for international coordination and cooperation are:

1. The European Commission's Common Implementation Strategy (EU-CIS): a strategy established by the European Commission to promote cooperation between the member states and the Commission in the coherent implementation of the MSFD. The process is managed by the EU Water and Marine Directors meeting, assisted by the Marine Strategy Coordination Group (MSCG) and a number of working groups (on technical issues);
2. OSPAR's Intersessional Correspondence Group for the Implementation of the Marine Strategy Framework Directive (ICG-MSFD): this coordinating group of MSFD project managers in the OSPAR treaty area has the task of promoting synergy between the MSFD and OSPAR's activities. This corresponds with the MSFD's assignment of making the best possible use of regional sea conventions within the territory of Europe. For specific descriptors, the coordination is delegated to OSPAR working groups.

The Netherlands values international coordination of the MSFD in regional sea conventions and therefore contributes to the OSPAR regional sea convention (see box). Given the importance of sharing information and coordinating activities relating to MSFD, the Netherlands makes an active contribution to all of the relevant OSPAR groups. In addition, 20 countries in the Atlantic region have for years been collaborating effectively in the area of fisheries monitoring under the auspices of ICES (see box).

OSPAR

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention) is intended to protect the north-east Atlantic Ocean, including the North Sea, through international cooperation.

ICES

ICES (International Council for the Exploration of the Sea) is an intergovernmental organisation of marine scientists which provides advice on the sustainable use of the seas and oceans. ICES is developing indicators for D3 (populations of all commercially exploited species of fish and shellfish) in the context of the Common Fisheries Policy. ICES also plays a role in the development of other MSFD indicators and carries out scientific quality controls.

The international approach through OSPAR focuses on developing common indicators for the descriptors in the MSFD, specifically in relation to biodiversity, marine habitats and pressures. Decisions of the OSPAR committee are made by consensus. In 2017, OSPAR published the Intermediate Assessment (IA2017), a description of the OSPAR area based on common indicators. The next Quality Status Report will appear in 2023.

The parties to the OSPAR convention have made agreements on minimum requirements for the data to be collected and the methods for collecting them and on coordination and improvement of assessment methods. These aspects are laid down for each common indicator in the Coordinated Environmental Monitoring Programme (CEMP) guidelines and appendices. The CEMP guidelines lay down technical specifications, the conditions for coordinated monitoring and assessment criteria, among other things. These are updated iteratively. The CEMP appendices provide a summary of the agreements in the guidelines. The parties to the OSPAR convention are asked to carry out the monitoring as described in the CEMP.

With respect to relatively new issues, the absence of existing monitoring surveys can make it easier to develop coordinated monitoring programmes. The process can then start with a coordinated integrated approach. That is the case, for example, with the subjects of micro-litter and underwater noise, on which the work of the EU's Technical Group on Marine Litter and Technical Group on Underwater Noise is followed as far as possible. International harmonisation of monitoring programmes is less straightforward with respect to topics on which countries have adopted a national approach to monitoring for years. Changes can lead to departures from the trend. A particular approach can also be connected with area-specific differences.

Wherever possible, the Netherlands seeks cooperation in monitoring at sea, as with the EU projects JMP EUNOSAT and JOMOPANS (see box), JPI-Oceans, the international Dogger Bank, and with SCANS counts of marine mammals. Innovation is also pursued at international level as far as possible.

The MSFD's objectives, and hence the monitoring, overlap to a large extent with those of other European directives, including the Water Framework Directive (WFD), the Birds Directive (BD) and the Habitats Directive (HD).

Birds Directive, Habitats Directive and Natura 2000

Where possible, the MSFD's objectives and the monitoring required are linked to those of the Birds Directive and the Habitats Directive. At the same time, a distinction is made between national objectives under the Birds Directive and the Habitats Directives, and Natura 2000 objectives at area level.

National objectives under the Birds Directive and the Habitats Directive are laid down in the 'targets document'. In order to achieve these national targets, special protection areas are designated under the Birds Directive and the Habitats Directive for a number of species and habitat types: the Natura 2000 areas. 'Conservation objectives' apply for these species and habitat types, which are adopted by the Ministry of Agriculture, Nature and Food Quality in a designation decree. The targets are developed in a management plan.

The drafting of Natura 2000 management plans is generally the responsibility of the manager administering the largest area. For all marine areas, that is Rijkswaterstaat. Rijkswaterstaat coordinates agreements and responsibilities with the stakeholders, including the Ministry of Infrastructure and Water Management and the Ministry of Agriculture, Nature and Food Quality and, for the coastal waters, the provinces of Zeeland, Zuid-Holland, Noord-Holland and Friesland. Other stakeholders are NGOs and organisations representing the fisheries, sand, shell and salt extraction, oil and gas production, commercial shipping, etc.

JMP EUNOSAT: algae assessed from space

The aim of the European Joint Monitoring Programme of the Eutrophication of the North Sea with Satellite data (JMP EUNOSAT, February 2017 - February 2019) was to monitor and assess algae biomass in the North Sea in a coherent fashion with the help of satellites. The project used the colour of the seawater to determine concentrations of chlorophyll. These data were generated, for example, by the European Copernicus Programme, which guarantees the delivery of data until 2036 with the Sentinel satellites. The project developed a procedure for supplying reliable satellite data. A proposal for a common set of standards and assessment areas was developed with the aim of ensuring coherent assessment of chlorophyll a by North Sea countries. Up to now, the assessment has been conducted nationally. The project provided essential building blocks for the revision of OSPAR's COMP and for a new monitoring strategy for eutrophication, both of which are still being developed (see D5).

JOMOPANS (Joint Monitoring Programme for Ambient Noise in the North Sea)

Underwater noise is a form of pollution that has an impact far from the source. Noise is not impeded by national borders. Accordingly, the most effective way of monitoring underwater noise is in cooperation with other North Sea countries.
The JOMOPANS project was launched in 2018 to establish a joint monitoring programme for continuous underwater noise. The sound environment of the entire North Sea is being mapped with an innovative combination of measurements and numerical modelling.
This will give policy makers insight into the level of disturbance from noise which they can then use to take appropriate measures. See also D11. See also D11.

WFD

The area covered by the MSFD partly overlaps with that of the WFD. This is the zone up to 12 nautical miles from the baseline of the coast ('coastal waters'). Art. 2 of the MSFD provides that within this area the directive only applies to elements that are relevant for the protection of the marine environment and do not fall under the WFD. Where there is overlap, GES, the associated operational environmental targets and the monitoring required for them correspond with the WFD. This applies to:

- D1C5 fish: reducing barriers along migratory routes;
- D5 eutrophication: standards for nutrients, chlorophyll a and oxygen in coastal waters;
- D8 contaminants: standards for priority substances and specific contaminants in coastal waters.

North Sea 2030 Strategic Agenda and North Sea Agreement

In drafting the North Sea 2030 Strategic Agenda, the Physical Environment Consultative Body (OFL) was asked to explore ways of securing public support for a strategic government agenda for the North Sea. On the basis of the advice provided by the OFL in December 2018, in February 2019 the Minister of Infrastructure and Water Management gave instructions, also on behalf of the Minister of Agriculture, Nature and Food Policy, the Minister of Economic Affairs and Climate Policy and the Minister of the Interior and Kingdom Relations, for consultation with civil-society partners, under an independent chairperson with a view to concluding a North Sea Agreement as soon as possible. One of the aspects being discussed is research and monitoring. When the North Sea Agreement is in place, relevant additional monitoring will be included in the MSFD monitoring programme on the basis of the North Sea Agreement. If the North Sea Agreement is not concluded in time to comply with the planning of the mandatory reports for the European Commission, the additional monitoring will be included in the annual update of the MSFD monitoring programme.

Offshore energy ecological programme (Wozep)

Large offshore projects have their own research programmes. Given the Netherlands' ambitions for renewable energy production through the construction of large offshore wind farms, a seven-year research programme was launched in 2016 to investigate the knowledge gaps concerning the ecological

effects of offshore wind energy. Rijkswaterstaat is carrying out the offshore energy ecological programme (Wozep) for the Ministry of Economic Affairs and Climate Policy.

The purpose of the Wozep programme is to investigate the cumulative effects of the construction and use of offshore wind farms for the protected habitats, groups of species and habitats of marine mammals (harbour porpoises and two species of seals), marine birds and waders, migrating land birds, underwater habitats (for benthic fauna and fish) and bats migrating over the North Sea. The impact of underwater noise and measures to mitigate it are also being studied. In 2019, the research programme was extended to 2023. Wozep might generate a structural information requirement, which could in time also become part of the MSFD monitoring programme or lead to changes in it.

5. Organisation

The MSFD monitoring programme is based on the information requirements ensuing from the policies set out in the Marine Strategy Part 1. The Minister of Infrastructure and Water Management is primarily responsible for national implementation of the Marine Strategy.

The Ministry of Infrastructure and Water Management's Directorate General for Water and Soil (DGWB) is primarily responsible for the implementation of the MSFD and is jointly responsible with the Ministry of Agriculture, Nature and Food Quality's Directorate General for Nature, Fisheries and Rural Areas (DGNVLG) for policy implementation. Both policy directorates are responsible for clearly determining and formulating the information requirements. A number of agencies and various departments within the Ministry of Infrastructure and Water Management are involved in implementing the MSFD. Those departments and agencies arrange international coordination of information requirements, for example in the context of OSPAR, the WFD and the CFP.

Most of the monitoring surveys in the MSFD monitoring programme are part of Rijkswaterstaat's (RWS) overarching monitoring programme (MWTL) or the Ministry of Agriculture, Nature and Food Quality's WOT.

The MSFD monitoring programme relies heavily on existing monitoring and is based on the principle that data serve multiple purposes. This calls for efficient coordination of the substantive requirements, the monitoring activities and the responsibilities of the various ministries and research institutes. This monitoring programme guides the organisation of this complex monitoring operation.

The Marine Information and Data Centre (IHM), a joint body of the Ministries of Infrastructure and Water Management, Agriculture, Nature and Food Quality and Defence, coordinates this process.

Table 5.1 provides an overview of the tasks and responsibilities of the major parties involved in the MSFD monitoring programme. For a detailed description of these parties, see the Marine Strategy Part 2 (2014).

Quality assurance: data collection, access and processing

The prescribed methods for collecting data are laid down in protocols. These are public documents, so the process is transparent and the source of the data can be traced. IHM collates and provides the data that have to be collected for the MSFD on behalf of the Dutch government. The specifications of the data required for the MSFD monitoring programme are laid down in information requirements documents. Every year, the parties that have collected the MSFD data deliver them in accordance with the specifications laid down in the information requirements documents. The data standard is AQUO, the standard language for data exchange in the water sector. After they have been assessed and any anomalies have been registered, the data are saved in a central database. From there, they are disseminated via the data viewer on the IHM website. IHM informs the clients about the progress of MSFD monitoring and any anomalies that have been found.

In some cases MSFD data are not included in the MSFD portal because they are easily accessible elsewhere. This applies to data that are collected for the CFP or are available on the ICES website, for example.

Table 5.1: The parties responsible for each element of the MSFD monitoring cycle. Grey: responsible party; light blue: significant contribution.

Organisation	Information requirements	Collection	Storage	Access	Processing	Assessment	Reporting
Ministry of Infrastructure and Water Management: DGWB	MSFD					MSFD	MSFD
Ministry of Agriculture, Nature and Food Quality: DG NVLG	Via Nature/ Biodiversity and CFP	WOT				Via Nature/ Biodiversity and CFP	
IDON[13]	Via North Sea Agreement and Wozep						
IHM	Facilitates/coordinates				Facilitates/coordinates		Implementation
RWS		MWTL					
Statistics Netherlands		Review of monitoring surveys				Review of indicators	

IHM carries out a limited verification of the data. If IHM observes unusual or inexplicable values in the data, it refers the findings to the owner of the source. The basic principle is that data are publicly accessible, except in situations where privacy or sectoral interests are affected and for which arrangements have been made. IHM makes data from all of the sources available to all users requiring information with an overview and selection tool. IHM also provides an overview of the scale and organisation of the Netherlands' overall monitoring effort and its individual elements.

Statistics Netherlands plays an important role in safeguarding the quality of the data and monitoring plan. Statistics Netherlands's expertise lies mainly in the area of statistical assessment of trends, determining required sample sizes, and the statistical power of monitoring surveys. Statistics Netherlands assesses the extent to which MSFD monitoring complies with the measurement targets and identifies points on which improvement (from a statistical perspective) is needed.

Reporting to the European Commission

IHM arranges the electronic reporting for the MSFD (Marine Strategy Parts 1 and 2) to the European Commission. These reports are based on the official documents and are submitted to the EU reporting portal (reportnet).

IHM does not carry out the assessment itself. Ultimate responsibility for the assessment lies with the relevant policy directorate. The executive tasks are delegated to the Ministry of Infrastructure and Water Management and the Ministry of Agriculture, Nature and Food Quality.

Governance

This monitoring programme covers a period of six years. During that period, changes can occur as a result of changes in policy objectives, financial conditions or substantive and/or international developments. Examples might be the development of an innovative method or of an indicator. With any change, a decision has to be made on whether the monitoring programme will still provide sufficient coverage for the purposes of assessment for the next Marine Strategy Part 1.

[13] Interdepartmental Directors, North Sea Consultative Body

To maintain control of (requested) changes in monitoring, the monitoring programme is reviewed once a year. That frequency corresponds with the practice of the WOT Fisheries, Rijkswaterstaat's monitoring programme and the National Network Ecological Monitoring (NEM).

There is a procedure for assessing the effects of a proposed change. Because collected data serve multiple purposes, government agencies that use marine monitoring information should investigate whether a proposed change will have an impact on its own requirements for information relating to its policy field or management tasks. IHM assesses whether the proposed change will have an impact on the information requirement for the MSFD.

Annex I
Abbreviations

ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
BD	Birds Directive
BDHD	Birds Directive and Habitats Directive
CFP	Common Fisheries Policy
DCS	Dutch Continental Shelf
EC	European Commission
EcoQO	Ecological Quality Objective (within OSPAR)
EEZ	Exclusive Economic Zone
EU	European Union
EUNIS	European Nature Information System
EZK	Ministry of Economic Affairs and Climate Policy
GES	Good Environmental Status
HD	Habitats Directive
HELCOM	Helsinki Commission; manages the Convention on the Protection of the Marine Environment of the Baltic Sea Area
I&W	Ministry of Infrastructure and Water Management
IA	Initial Assessment
ICES	International Council for the Exploration of the Sea
IDON	Interdepartmental Director's consultative committee for the North Sea
IHM	Informatiehuis Marien, a partnership between the ministries of Infrastructure and Water Management, Agriculture, Nature and Food Quality, and Defence
IMO	International Maritime Organisation
LNV	Ministry of Agriculture, Nature and Food Quality
MARPOL	International Convention For the Prevention of Pollution from Ships
MSFD	Marine Strategy Framework Directive
MSY	Maximum Sustainable Yield
MWTL	National Water Systems Monitoring Programme (Rijkswaterstaat monitoring survey)
NIOZ	Koninklijk Nederlands Instituut voor Onderzoek der Zee (Royal Netherlands Institute for Research at Sea)
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic Ocean
PAH	Polycyclic Aromatic Hydrocarbons
PBDEs	Polybrominated diphenyl ethers
PCBs	Polychlorinated Biphenyls
RWS	Rijkswaterstaat
SCANS	Small Cetaceans in the European Atlantic and North Sea
Sovon	Sovon Bird research, the Netherlands
TBT	Tributyltin
WFD	Water Framework Directive
WFSR	Wageningen Food Safety Research
WMR	Wageningen Marine Research
Wozep	Offshore wind energy ecological programme

Annex II

Relationship between the indicative lists in Annex III, MSFD and the MSFD monitoring programme

Article 11 of the Marine Strategy Framework Directive (Directive 2008/56/EC) lists the specifications with which the MSFD monitoring programme must comply (see box on page 30). The monitoring programme serves for the on-going assessment of the environmental status (updating of the Marine Strategy, part 1), based on the elements in Annex III of the MSFD. The ecosystem elements and anthropogenic pressures listed in Annex III are indicative. The tables below show the relationship between the various lists[14] (in grey) and the MSFD monitoring programme.

Table 1: Structure, functions and processes of the marine ecosystems

Ecosystem elements	Possible parameters and characteristics	Link with the MSFD monitoring programme
Groups of species (specified in Commission Decision (EU) 2017/848) of marine birds, marine mammals, reptiles, fish and cephalopods in the marine region or sub-region in question	Spatial and temporal variation per species or population: - Distribution, density and/or biomass - Size of body, age/gender structure - Fertility, survival, mortality and injury percentages - Behaviour, including movement and migration - Species habitat (extent, suitability) Species composition of the group	Distribution/density: see D1C2 (marine birds, marine mammals, fish) and D1C4 (marine mammals, fish) Biomass: see D3 (fish) Body size, age structure: see D3 (fish) Demographic characteristics (fertility): see D1C3 (marine birds, marine mammals) Mortality/injury: see D1C1 (bycatch of marine birds, marine mammals, fish) and D1C5 (marine mammals) Habitat types: see D1C4 and D1C5 (marine mammals, fish) Species composition: see D1C2 (marine birds, marine mammals, fish)
Habitats		
Broad habitat types in the water column (pelagic) and the seabed (benthic) (specified in Commission Decision (EU) 2017/848) or other habitat types, including the associated communities in the entire marine region or sub-region in question.	Per habitat type: - habitat distribution and range (and volume, where relevant) - species composition, density and/or biomass (variation in space and time) - size of body and age structure of the species (where relevant) - physical, hydrological and chemical characteristics - Additionally, for pelagic habitats: - concentration of chlorophyll-a - frequencies and spatial extent of planktonic bloom	Benthic habitats: Distribution and range: see EUNIS maps and HD Art. 17 reporting for HD habitat types Species composition/density/biomass/age structure (shell length): see monitoring surveys D6C3 and D6C5 Physical and hydrographical characteristics: see D7 and D6 Chemical characteristics: see D8 - Pelagic habitats: Species composition, density, biomass: see D1C6 Physical and hydrographical characteristics: see D7 Chemical characteristics: see D8 Chlorophyll-a: see D5C2 Planktonic bloom: under development under OSPAR (PH1 and PH3)
Ecosystems, including food chains		
The structure, functions and processes of the ecosystem, made up of: - physical and hydrological features - chemical features - biological features - functions and processes	Variation in space and time in terms of: - temperature and ice - hydrology (wave action and currents, upwelling, exchange of water, residence time, freshwater input, sea level) - bathymetry - turbidity (sludge/sediment load), transparency, noise - seabed substrate and - morphology - salinity, nutrients (N, P), organic carbon, dissolved gases (pCO_2, O_2) and pH - link between habitats and species of marine bird, marine mammal, reptile, fish and cephalopod - structure of pelagic-benthic communities - productivity	Temperature, hydrography, bathymetry: see D7 Noise: see D11 Seabed substrate/morphology: see EUNIS maps Salinity, nutrients, organic carbon, dissolved gases and pH: part of Rijkswaterstaat's monitoring programme (MWTL) Link between habitats and species: see D1, D4 and D6 Structure of pelagic and benthic communities: see D1C6 and D6 Productivity: under development in OSPAR

[14] As per the lists from DIRECTIVE (EU) 2017/845; this list has replaced the original Annex III of the MSFD since May 2017.

Table 2: Anthropogenic pressures affecting the marine environment

Pressure[15]	Link with the MSFD monitoring programme
Biological	
Introduction or distribution of non-indigenous species Introduction of microbial pathogens Introduction of genetically modified species and translocation of indigenous species Loss of or alteration to natural biological communities as a consequence of the breeding of animal or plant species	Introduction of non-indigenous species: see D2 Loss as a result of breeding: n/a. Potential environmental impacts: see monitoring surveys for benthos, fish and phytoplankton
Disturbance of species (e.g. in their breeding, resting and foraging areas) due to the presence of people	Potential environmental impacts derived from distribution and abundance: see monitoring surveys for marine birds and marine mammals (D1)
Removal or death of/injury to species that live in the wild (due to commercial or recreational fishing, or other activities)	See D1C1 (marine birds, marine mammals, fish) and D3 (fish)
Physical	
Physical disturbance of the seabed (temporary or reversible)	See D6C2 Potential environmental impacts: benthos (see D6C3 and D6C5)
Physical destruction (due to a permanent change to the seabed substrate or morphology or by removal of the seabed substrate)	See D6C1 and D6C4 Potential environmental impacts: benthos (see D6C3 and D6C5), birds (breeding or otherwise) (see D1C2 and D1C3)
Changes to hydrological conditions	See D7 Potential environmental impacts: all species and habitats (see D1, D3, D4 and D6)
Substances, litter and energy	
Input of nutrients – diffuse sources, point sources, atmospheric deposition	See D5C1 Potential environmental impacts: phytoplankton (see D5C2 and D1C6), food web (see D4)
Input of organic matter – diffuse sources and point sources	Potential environmental impacts derived from nutrients (D5C1) phytoplankton (see D5C2 and D1C6), food web (see D4)
Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events	See D8 and D9 Potential environmental impacts: potential impact on all species (see D1, D3, D4 and D6)
Input of litter (solid waste matter, including micro litter)	See D10 Potential environmental impacts: marine birds, marine mammals, fish (see D1) and benthos (see D6).
Input of anthropogenic sound (impulsive, continuous)	See D11 Potential environmental impacts: marine mammals and fish (see D1).
Input of other forms of energy (including electromagnetic fields, light and heat)	Still in development. Criteria for these forms of energy are not yet available, so that no GES and environmental targets have yet been formulated. However, measurements are already being taken as part of the process of obtaining licenses and/or conducting research (or other) projects (Wozep, for instance, also assesses the impact on the marine environment of electromagnetic radiation from power-delivery cables from wind turbines)
Input of water - point sources (e.g. brine)	n/a

In table 2, the MSFD gives the following instructions: 'Possible parameters: intensity of, and spatial and temporal variation in, the pressure in the marine environment and, where relevant, at source. For assessment of environmental impacts of the pressure, select relevant ecosystem elements and parameters from Table 1.'

[15] Assessments of pressures should address their levels in the marine environment and, if appropriate, the rates of input (from land-based or atmospheric sources) to the marine environment.

Article 11 Monitoring programmes

1. On the basis of the initial assessment made pursuant to Article 8(1), member states shall establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status of their marine waters on the basis of the indicative lists of elements set out in Annex III and the list set out in Annex V, and by reference to the environmental targets established pursuant to Article 10.
   Monitoring programmes shall be compatible within marine regions or sub-regions and shall build upon, and be in line with, relevant provisions for assessment and monitoring laid down by Community legislation, including the Habitats and Birds Directives, or under international agreements.
2. Member states sharing a marine region or sub-region shall draw up monitoring programmes in accordance with paragraph 1 and shall, in the interest of coherence and coordination, endeavour to ensure that:
   a) monitoring methods are consistent across the marine region or sub-region so as to facilitate comparability of monitoring results;
   b) relevant transboundary impacts and transboundary features are taken into account.
3. Member states shall notify the Commission of the monitoring programmes within three months of their establishment.
4. Specifications and standardised methods for monitoring and assessment which take into account existing commitments and ensure comparability between monitoring and assessment results, and which are designed to amend non-essential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 25(3).

ANNEX III MSFD Indicative lists of ecosystem elements, anthropogenic pressures and human activities relevant to the marine waters

(referred to in Articles 8(1), 9(1), 9(3), 10(1), 11(1) and 24)

See tables 1 and 2

ANNEX V MSFD monitoring programmes

(referred to in Articles 11(1) and 24)

(1) Need to provide information for an assessment of the environmental status and for an estimate of the distance from, and progress towards, good environmental status in accordance with Annex III and with the criteria and methodological standards to be defined pursuant to Article 9(3).

(2) Need to ensure the generation of information enabling the identification of suitable indicators for the environmental targets provided for in Article 10.

(3) Need to ensure the generation of information allowing the assessment of the impact of the measures referred to in Article 13.

(4) Need to include activities to identify the cause of the changes and hence the possible corrective measures that would need to be taken to restore the good environmental status, when deviations from the desired status range have been identified.

(5) Need to provide information on chemical contaminants in species for human consumption from commercial fishing areas.

(6) Need to include activities to confirm that the corrective measures deliver the desired changes and not any unwanted side effects.

(7) Need to aggregate the information from marine regions or sub-regions in accordance with Article 4.

(8) Need to ensure comparability of assessment approaches and methods within and between marine regions and/or subregions.

(9) Need to develop technical specifications and standardised methods for monitoring at Community level, so as to allow comparability of information.

(10) Need to ensure, as far as possible, compatibility with existing programmes developed at regional and international level with a view to fostering consistency between these programmes and avoiding duplication of effort, making use of those monitoring guidelines that are the most relevant for the marine region or sub-region concerned.

(11) Need to include, as part of the initial assessment provided for in Article 8, an assessment of major changes in the environmental conditions as well as where necessary, of new and emerging issues.

(12) Need to address, as part of the initial assessment provided for in Article 8, the relevant elements listed in Annex III including their natural variability and to evaluate the trends towards the gradual achievement of the environmental targets laid down pursuant to Article 10(1), using, as appropriate, the indicators established and their limit or target values.

Annex III

Commission Decision (EU) 2017/848 and implemented criteria

The MSFD lists eleven descriptors, on the basis of which member states determine GES. These descriptors are expanded into criteria in Commission Decision (EU) 2017/848. The complete list of these is shown below, and also which of these criteria (in the Marine Strategy, Part 1 (2018)) have been implemented in relation to the Dutch section of the North Sea (in green, bold). The starting point is that all primary criteria are mandatory, and have therefore been implemented. Secondary criteria are optional and have not, generally, been implemented, except where this relates to a regionally-agreed indicator (OSPAR). Other cases are explained in the table. In a number of cases, those marked with '*', the methods used for monitoring and/or assessment do not yet meet the requirements of the specifications in the Commission Decision, but these methods are currently evolving.

Code	Criteria	Component	Primary/ secondary	Explanation
D1C1	Incidental bycatch	marine birds	**primary**	* Although not yet set out in detail in MS, part 1 (2018), this does form part of the MSFD monitoring programme. Meets requirements for recording marine bird bycatch, which is mandatory under the terms of the CFP.
		marine mammals	**primary**	* The MSFD monitoring programme is in line with the bycatch registration of marine mammals, which is mandatory under the terms of the CFP. At present, the sole indicator to have been set out in detail is that for porpoises.
		Non-commercially exploited fish and cephalopods	**primary**	* Although not yet set out in detail in MS, part 1 (2018), this does form part of the MSFD monitoring programme. Meets requirements for recording fish and cephalopod bycatch, which is mandatory under the terms of the CFP.
D1C2	Population density/size	marine birds	**primary**	
		marine mammals	**primary**	
		fish and cephalopods	**primary**	Set out in detail for fish, but not yet for cephalopods, not least because little information is available about these species. However, cephalopods are present in the Dutch section of the North Sea, so it is important to identify the information that is available on these species, and whether additional monitoring is required. The options for doing this will be explored in the course of 2020.
D1C3	Demographic characteristics	Commercially exploited fish and cephalopods	**primary**	See D1C2.
		other species	**secondary**	Breeding success of marine birds and pup production of grey seal pups are OSPAR indicators (harbour seal: indicator at national level). This type of monitoring has an 'early warning' function[16] and is thus an important addition to the practice of monitoring population abundance (that primarily gives an insight into developments over the longer term and responds less quickly to external pressure factors).

[16] This applies, in any case, to the breeding season and the area in which the species in question live in the breeding season.

Code	Criteria	Component	Primary/ Secondary	Explanation
D1C4	Distribution	HD species	**primary**	
		other species	secondary	
D1C5	Habitat	HD species	**primary**	
		other species	secondary	
D1C6	Pelagic habitats		**primary**	*
D2C1	Introductions of non-indigenous species		**primary**	
D2C2	Established non-indigenous species		secondary	
D2C3	Impact of non-indigenous species		secondary	
D3C1	Commercially exploited fish: death		**primary**	
D3C2	Commercially exploited fish: spawning stock biomass		**primary**	
D3C3	Commercially exploited fish: distribution of age/size		primary	For the management of commercially exploited fish stocks, the Common Fisheries Policy (CFP), in which targets and measures are laid down, is the guiding policy. The targets for MSY (CFP, D3C1 and D3C2) on the one hand, and the age and size distribution (D3C3) on the other may conflict. There is also insufficient information about which other factors, in addition to fishing mortality, could influence the growth of fish. ICES has therefore concluded that this criterion requires further in-depth expansion. Due to these uncertainties and the conflict between the targets for MSY and for the age and size distribution in populations of commercially exploited species, the Netherlands will not implement D3C3 at this stage.
D4C1	Trophic guilds: species composition/density		**primary**	*
D4C2	Trophic guilds: balance between guilds		**primary**	*
D4C3	Trophic guilds: size distribution		**secondary**	The 'typical length' in the fish community is an OSPAR indicator. It describes the size distribution. The 'typical length' decreases relative to increasing pressure from fishing, as fishing generally removes the largest individuals.
D4C4	Trophic guilds: productivity		secondary	
D5C1	Eutrophication: nutrients		**primary**	
D5C2	Eutrophication: chlorophyll-a		**primary**	
D5C3	Eutrophication: algal bloom		secondary	
D5C4	Eutrophication: transparency		secondary	
D5C5	Eutrophication: dissolved oxygen		**primary**	
D5C6	Eutrophication: opportunistic macroalgae		secondary	
D5C7	Eutrophication: macrophytes		secondary	
D5C8	Eutrophication: benthic species		secondary	
D6C1	Seabed: physical loss		**primary**	
D6C2	Seabed: physical disturbance		**primary**	
D6C3	Benthic habitat types: effects of disturbance		**primary**	
D6C4	Benthic habitat types: extent of loss		**primary**	
D6C5	Benthic habitat types: harmful effects		**primary**	

Code	Criteria	Component	Primary/ Secondary	Explanation
D7C1	Hydrographic changes to seabed and water column		**secondary**	The specific details for this descriptor are different. In the Netherlands, monitoring of the impact of activities that may have an influence on hydrographic properties are generally project-based measurements that are mandatory under the terms of licensing or the evaluation of measures. Hence they do not, strictly, form part of the MSFD monitoring programme. Rijkswaterstaat and the Dutch Hydrographic Service bathymetry, salinity, currents and wave heights in the North Sea regularly. Although these measurements, too, do not explicitly form part of the MSFD monitoring programme, the data may provide support when assessing descriptor D7.
D7C2	Hydrographic changes to benthic habitats		**secondary**	See D7C1
D8C1	Contamination: water, sediment and biota		**primary**	
D8C2	Contamination: health of species, habitats		**secondary**	Imposex is one of the common OSPAR indicators. Adverse effects in sea snails have also been reported in the Dutch section of the North Sea as a result of contamination with organotin compounds. The measurement of imposex is used to track the development of these effects.
D8C3	Contamination: significant serious contamination		**primary**	
D8C4	Contamination: effects of significant serious contamination		secondary	
D9C1	Contamination of edible tissue in fish and shellfish		**primary**	
D10C1	Litter: coast, surface layer of the water column, seabed		**primary**	
D10C2	Litter: micro litter		**primary**	*
D10C3	Litter: ingestion by marine animals		**secondary**	Plastic particles ingested by fulmars is an OSPAR indicator, that is covered in reporting by both D10C1 and D10C3. In terms of this criterion it is important to have an idea of the quantity of litter ingested by marine animals, and the harmfulness to specific species must be ascertained. For the purposes of this criterion, the Netherlands follows the developments within OSPAR and Europe.
D10C4	Litter: physical injury to marine animals		secondary	
D11C1	Input of energy: impulsive noise		**primary**	
D11C2	Input of energy: continuous noise		**primary**	*

Annex IV

Environmental targets, pressures and activities

The environmental targets, most significant pressures and activities for each descriptor and, in the case of D1 for each species group, are set out in Marine Strategy, part 1 (2018). A number of descriptors are directly focused on monitoring pressures or activities. The Marine Strategy, part 1 (2018) also lists activities and pressures for which an adverse impact is expected on descriptors that are focused on determining the environmental status.

D1 Biodiversity

Marine mammals

Environmental targets

- **Implementation of mitigating measures in framework of the 2012 Harbour Porpoise Conservation Plan, including:**
  - **bycatch monitoring and research into the use of mitigating measures (pingers)**
  - **preventing and reducing the harmful effects of underwater noise on porpoise populations (Nature Conservation Act)**
  - **further research into the effects of construction and operation of offshore wind farms on porpoise populations (in the context of Wozep).**
- **Recovery of peaceful situations for marine mammals (porpoise and seal) and birds by reducing fishing on the Vlakte van de Raan and in the North Sea coastal zone (in the context of the VIBEG agreement).**
- **Achieving the maintenance targets for habitat types and species in the Natura 2000 areas at sea.**

Pressures and activities

- Extraction or mortality/injury rate of species living in the wild (direct mortality)
  - Fishing and harvesting of shellfish (gillnets).
- Input of anthropogenic noise (loud impulse noise and background noise)
  - Generation of renewable energy (pile driving wind turbines)
  - Extraction of oil and natural gas (seismic exploration)
  - Military operations (sonar, clearing explosives)
  - Transport - shipping.
- Disturbance of species due to human presence
  - Activities in the context of tourism and recreation.

Marine birds

Environmental targets

- **Contributing to the further development of the assessment of bird populations and identifying the most important pressure factors at regional level (OSPAR).**
- **Recovery of peaceful situations for marine mammals (porpoise and seal) and birds by reducing fishing on the Vlakte van de Raan and in the North Sea coastal zone (in the context of the VIBEG agreement).**
- **Achieving the maintenance targets for habitat types and species in the Natura 2000 areas at sea (BDHD).**
- **Monitoring bird collisions with wind turbines in the context of Wozep.**
- **If the BD report for 2019 indicates further decline of marine bird species, consideration will be given to which pressure factors are the cause and in which framework (MSFD or BD) action can best be taken.**
- **There is a knowledge challenge in respect of the causes of decline and cumulation and possible mitigation effects of wind farms.**

Pressures and activities

- Extraction or mortality/injury rate of species living in the wild (direct mortality):
  - Fishing and harvesting of shellfish (gillnets)
  - Generation of renewable energy (wind turbines).
- Extraction or mortality/injury rate of species living in the wild (via food web)
  - Fishing and harvesting of shellfish (discards, Spisula, sand eel, sprat).
- Changes to hydrological conditions
  - Coastal defences and flood protection, land reclamation.
- Disturbance of species due to human presence
  - Activities in the context of tourism and recreation
  - Fishing and harvesting of shellfish (including recreational)
  - Coastal defences and flood protection (sand suppletions)
  - Generation of renewable energy (wind turbines).

Fish

Environmental targets

- **The management of all commercially exploited fish stocks complies with F≤Fmsy and a spawning stock biomass above the precautionary level MSY Btrigger (CFP).**
- **Research into sharks and rays in combination with the taking of mitigating measures as laid down in the Sharks and Rays action plan:**
  - **communication and education**
  - **reduction of unintended bycatch**
  - **increase survival rates.**
- **Achieving the maintenance targets for habitat types and species in the Natura 2000 areas at sea (BDHD).**
-

- **Tackling the remaining fish migration bottlenecks in the Netherlands to recover connectivity between water systems (WFD).**
- **Research into the necessity of fishery-free zones around engineering structures to promote migration opportunities for migratory fish (WFD).**

Pressures and activities

- Extraction or mortality/injury rate of species living in the wild (direct mortality)
  - Fishing and harvesting of shellfish.
- Changes to hydrological conditions (freshwater-seawater migration barriers)
  - Coastal defences and flood protection
  - Canalisation and other watercourse changes (river layout)
  - Physical disturbance of the seabed, fishing and harvesting of shellfish.
- Introduction of anthropogenic noise (loud impulse)
  - Generation of renewable energy (pile driving for wind turbines).
- Temperature rise due to climate change
  - Global emission of greenhouse gases.

Benthic habitats

See D6: Integrity of the seabed (D6)/Biodiversity of benthic habitats (D1).

Pelagic habitats

Environmental targets

- Development and testing of regional assessment methods (OSPAR and ICES) that can be used in the future for assessing benthic and pelagic habitats.
- Supplementary policy challenge: knowledge challenge in relation to the assessment method.

Pressures and activities

- Extraction or mortality/injury rates of species living in the wild
  - Fishing and harvesting of shellfish.
- Introduction or distribution of non-indigenous species
  - Transport - shipping (ballast water).
- Introduction of nutrients and organic material
  - Activities on land (agriculture, urban, industry)
  - Transport - shipping (via air).

D2 Non-indigenous species

Environmental targets

Minimising the risk of new introductions of non-indigenous species via shellfish transport, ballast water and hull fouling.

Pressures and activities

- Introduction or distribution of non-indigenous species
  - Transport: shipping (ballast water, hull fouling)
  - Aquaculture: marine (import of shellfish).

D3 Commercially-fished species

Environmental targets

The management of all commercially exploited fish stocks complies with F≤Fmsy and a spawning stock biomass above the precautionary level MSY Btrigger (CFP).

Pressures and activities

- Extraction or mortality/injury rate of species living in the wild (direct mortality)
  - Fishing and harvesting of shellfish.

D4 Food webs

Environmental targets

Developing and testing regional assessment methods that can be used in the future for assessing the status of food webs. Targets relating to birds, marine mammals, fish, benthic and pelagic habitats also contribute to food webs.

Pressures and activities

See D1 and D6.

D5 Eutrophication

Environmental targets

- **A lower input of nutrients where not yet compliant with the WFD pursuant to the timetable for the River basin management plans.**
- **Do not allow concentrations of nutrients that already meet the standards set out in the WFD to increase and, where possible, reduce them further.**
- **Potential knowledge challenge in relation to the phosphate-nitrogen balance.**

Pressures and activities

- Introduction of nutrients and organic material
  - Activities on land: agriculture, urban use, industrial use
  - Transport: shipping
  - Restructuring of seabed morphology (dredging).

D6 Integrity of the seabed

Environmental targets

Benthic habitats:

- **10-15 percent of the area of the Dutch section of the North Sea is not notably disrupted by human activities.**
- **Improved quality of the assessed areas and habitats.**
- **Developing and testing regional assessment methods (OSPAR and ICES) that can be used in the future for assessing benthic and pelagic habitats.**
- **Achieving the maintenance targets for habitat types and species in the Natura 2000 areas at sea.**
- **Return and recovery of biogenic reefs such as flat oyster beds.**
- **Supplementary policy challenge: knowledge challenge relating to assessment method, cumulation and hard substrate.**

Physical disturbance/loss:

- **10-15 percent of the area of the Dutch section of the North Sea is not notably disrupted by human activities.**
- **No rise in physical disturbance due to fishing activities over time on the total seabed area of the North Sea as a whole and the DCS in particular, and on the habitats described in the framework of the MSFD.**
- **Achieving the maintenance targets for habitat types and species in the Natura 2000 areas at sea.**
- **Supplementary policy challenge: Knowledge challenge in relation to assessment method, cumulation and hard substrate.**

Pressures and activities

- Physical destruction
  - Land reclamation
  - Extraction of minerals (sand extraction, deep)
  - Generation of renewable energy (pile driving)
  - Extraction of oil and natural gas (pile driving).
- Physical disturbance of the seabed (abrasion/bottom-disturbing)
  - Fishing and harvesting of shellfish (bottom-disturbing).
- Physical disturbance of the seabed (moving sand/sludge)
  - Coastal defences and flood protection (sand suppletion)
  - Extraction of minerals
  - Restructuring of seabed morphology (dredging).
- Changes to hydrological conditions (transparency)
  - Restructuring of seabed morphology (dredging)
  - Coastal defences and flood protection
  - Land reclamation.
- Extraction or mortality/injury rates of species living in the wild
  - Fishing and harvesting of shellfish (demersal).
- Introduction or distribution of non-indigenous species
  - Transport - shipping (ballast water, hull fouling)
  - Aquaculture - marine (import of shellfish).
- Introduction of nutrients and organic material
  - Activities on land (agriculture, urban, industry)
  - Transport - shipping (via air).
- Temperature rise due to climate change
  - Global emission of greenhouse gases.

D7 Hydrographic properties

Environmental targets

- **All developments must satisfy the requirements of the existing legislative regime (for example the Environmental Management Act and the Nature Conservation Act) and statutory assessments must be carried out in such a way that the potential impact of permanent changes to Hydrographic properties, including cumulative effects, are taken into consideration at the most suitable spatial scale, on the basis of the guidelines developed for that purpose (EUNIS level 3, baseline year 2012).**
- **Knowledge challenge in relation to the effects of offshore wind energy, sand suppletion and climate change.**

Pressures and activities

- Changes to hydrological conditions (alterations to bathymetry and current)
  - Land reclamation
  - Coastal defences and flood protection.
- Changes to hydrological conditions (alterations to sludge content)
  - Restructuring of seabed morphology (dredging, raising levels due to spreading)
  - Coastal defences and flood protection (raising levels during reclamations)
  - Transport infrastructure (ports, lowering levels due to sedimentation)
- Temperature rise due to climate change
  - Global emission of greenhouse gases.

D8 Contaminants

Environmental targets

- **coastal waters: reduction in the introduction of contaminants not yet meeting the WFD targets, pursuant to the timetable for the River basin management plans. Concentrations of contaminants that already meet WFD standards must not be allowed to increase.**
- **Offshore: wherever possible, reduce concentrations of contaminants.**
- **Reduction of the introduction of heavy metals into the marine environment.**
- **Regional monitoring of copper concentrations now that this heavy metal is used as a substitute for TBT (OSPAR).**
- **As quickly as possible eradicating acute serious contaminations, wherever necessary in cooperation with the Bonn Agreement.**
- **Reduce use of lead, for example in recreational fishing (WFD).**

Pressures and activities

- Input of other substances (including oil, acute incidents and radioactive substances)
  - Activities on land: agriculture, urban use, industrial use
  - Restructuring of seabed morphology (dredging)
  - Transport: shipping (including fishing vessels)
  - Extraction of oil and natural gas.

D9 Contaminants in fish and other seafood for human consumption

Environmental targets

The levels of contaminants in fish and other seafood for human consumption compliant with national and international legislation must not be allowed to rise and if possible should be further reduced.

- Introduction of anthropogenic noise (loud impulse noise)

Pressures and activities

- Input of other substances
  - Activities on land: agriculture, urban use, industrial use
  - Restructuring of seabed morphology (dredging)
  - Transport: shipping (including fishing vessels)
  - Extraction of oil and natural gas.

D10 Litter

Environmental targets

- **At regional level, working towards quantitative (regional) targets for beach litter (for example: 30 percent reduction) and plastic found in stomachs of fulmars (10 percent of birds; OSPAR EcoQO). Assessing, in conjunction with the EU Action Plan for the Circular Economy, and in careful coordination with neighbouring countries, how such targets can be met.**
- **At regional North Sea level, working on the development of an indicator for microplastics in sediment.**
- **Knowledge challenge in relation to river litter and microplastics.**

Pressures and activities

- Input of litter
  - Transport: shipping
  - Transport: land
  - Activities in the context of tourism and recreation
  - Fishing and harvesting of shellfish
  - Aquaculture: marine
  - Activities on land: urban use, industrial use.

D11 Underwater noise

Environmental targets

- **Continuing tighter rules for the prevention of harmful effects of impulsive noise.**
- **Developing a limit for the number of disturbance days at regional level (OSPAR).**
- **Launching an international monitoring programme for continuous noise to map out the level and distribution of continuous noise.**
-

Pressures and activities

  - Generation of renewable energy (pile driving when installing wind turbines)
  - Extraction of oil and natural gas (seismic exploration)
  - Military operations (sonar, clearing explosives).
- Introduction of anthropogenic noise (background noise)
  - Transport: shipping
  - Generation of renewable energy (operational phase).

Annex V
Measures

Measures aimed at hitting the environmental targets and achieving GES are listed in the Marine Strategy, part 3 (2015)[17].

Overview of international legislation, implementation of measures in Dutch legislation and internet references

The table includes corrections to table 8.1 of the summary report (Marine Strategy for the Dutch section of the North Sea 2012-2020 (part 3))

Measure code	1a measures	European/ International legislation	National toolbox
	Descriptor 1 Biodiversity (Descriptor 4 Food webs, Descriptor 6 Benthic habitats)		
ANSNL-M001	Assessment of interventions (large-scale or otherwise) and compensation for the effects thereof	Directive on the assessment of the effects of certain public and private projects on the environment (2011/92/EU)	Environmental Management Act, EIA Decision
ANSNL-M002	Expansion of scope, Nature Conservation Act		Nature Conservation Act
ANSNL-M003	Restriction of fisheries in the coastal zone	Directive on the Conservation of Wild Birds (BD; 79/409/EEC) Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC)	Nature Conservation Act
ANSNL-M004	Zoning and phasing of activities in coastal waters	Directive on the Conservation of Wild Birds (BD; 79/409/EEC); Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC)	Nature Conservation Act
ANSNL-M005	Regulation of other activities within the coastal zone	Directive on the Conservation of Wild Birds (BD; 79/409/EEC); Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC)	Nature Conservation Act
ANSNL-M006	The issuing of licences is subject to conditions in order to prevent the spread of non-indigenous species	Convention on Biological Diversity; Convention on the conservation of European wildlife and natural habitats; Regulation (EC) concerning use of alien and locally absent species in aquaculture (708/2007); Regulation (EU) on the prevention and management of the introduction and spread of invasive alien species (1143/2014); Directive on the Conservation of Wild Birds (BD; 79/409/EEC); Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC)	Nature Conservation Act; Fisheries Act, 1963; Regulations on the use of alien and locally absent species in aquaculture; policy guidelines, including establishment of policy rules relating to shellfish movements

[17] Explanatory notes on categorisation 1a: Measures that have been identified and implemented from other policy areas; 1b: Measures that have been identified from other policy areas, but not yet (fully) implemented; 2a Measures that build on existing implementation processes and go further than the agreed terms of those frameworks; 2b: New measures outside existing frameworks.

Measure code	1a measures	European/ International legislation	National toolbox
	Descriptor 2 Non-indigenous species		
ANSNL-M007	Management of Natura 2000 areas (non-indigenous species)	Convention on Biological Diversity; Convention on the conservation of European wildlife and natural habitats; Regulation (EC) concerning use of alien and locally absent species in aquaculture (708/2007); Regulation (EU) on the prevention and management of the introduction and spread of invasive alien species (1143/2014); Directive on the Conservation of Wild Birds (BD; 79/409/EEC); Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC)	Nature Conservation Act; Fisheries Act, 1963
	Descriptor 5 Eutrophication		
ANSNL-M008	Implementation of Annex V, MARPOL convention	IMO International Convention for the Prevention of Pollution from Ships (MARPOL)	Prevention of Pollution from Ships Act
ANSNL-M009	Mandatory manure processing	Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive 91/676/EEC); Directive establishing a framework for Community action in the field of water policy (Water Framework Directive, 2000/60)	Fertilisers Act
ANSNL-M010	Treatment of Urban Waste Water; *Urban waste water treatment*	Directive concerning urban waste water treatment (91/271/EEC); Directive establishing a framework for Community action in the field of water policy (Water Framework Directive, 2000/60)	Water Decree; Environmental Management Act
	Descriptor 7 Hydrographic properties		
ANSNL-M011	Assessment of hydrographical interventions and compensation of effects	Directive on the assessment of the effects of certain public and private projects on the environment (2011/92/EU)	Environmental Management Act, EIA Decision
	Descriptor 8 Contaminants		
ANSNL-M012	Implementation of the Bathing Water Directive	Directive concerning the management of bathing water quality and repealing Directive 76/160/EEC (Bathing Water Directive; 2006/7/EC)	Act/Decree on the hygiene of bathing water facilities
ANSNL-M013	Reduction of discharges from ships (MARPOL Annex V)	IMO International Convention for the Prevention of Pollution from Ships (MARPOL)	Prevention of Pollution from Ships Act
ANSNL-M014	Ban on TBT	International Convention on the Control of Harmful Anti-fouling Systems on Ships	Prevention of Pollution from Ships Act

Measure code	1a measures	European/ International legislation	National toolbox
ANSNL-M015	Decrease in contaminants due to reduction in shipping incidents	IMO (shipping lanes)	Amendment to shipping lanes, 1 Aug. 2013
ANSNL-M016	Reduction in the discharge of contaminants by oil and gas producing facilities	Drilling *1) OSPAR Decision 2000/3 on the Use of Organic-phase Drilling Fluids (OPF) and the Discharge of OPF-contaminated Cuttings* *2) OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cutting Piles* Use and discharge of chemicals *3) OSPAR Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals. Amended by Decision 2005/1* *4) OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format Amended by Recommendation 2014/17* *5) OSPAR Recommendation 2010/4 on a Harmonised Pre-screening Scheme for Offshore Chemicals* *6) OSPAR Recommendation 2005/2 Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Contain Added Substances, Listed in the OSPAR 2004 List of Chemicals for Priority Action* *7) OSPAR Recommendation 2006/3 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Which Contain Substances Identified as Candidates for Substitution* Discharge of produced water *8) OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations. Amended by OSPAR Recommendation 2006/4 and Recommendation 2011/8* *9) OSPAR Recommendation 2012/5 for a risk-based approach to the management of produced water discharges from offshore installations* Other waste water from production processes *PARCOM Recommendation of a 40 mg/l Emission Standard for Platforms, 1986*	Mining Act, Mining Decree and Mining Regulations
ANSNL-M017	Prevention and restriction of industrial emissions	Directive on industrial emissions (integrated pollution prevention and control) (2010/75/EU)	*Activiteitenbesluit* (Environmental Management (Establishments) Decree); Water Act; Decree and Regulations on environmental law
ANSNL-M018	Reduction of environmental risks in the aftermath of serious accidents	Directive on the control of major-accident hazards involving dangerous substances (Seveso III); Directive establishing a framework for Community action in the field of water policy (Water Framework Directive, 2000/60)	Major-accident Hazards Decree, 2015
ANSNL-M019	Ban on the discharge of litter from inland shipping vessels	Directive establishing a framework for Community action in the field of water policy (Water Framework Directive; 2000/60);	Decree on litter from shipping vessels on the Rhine and Inland Waterways + Regulations

Measure code	1a measures	European/ International legislation	National toolbox
ANSNL-M020	Sustainable Crop Protection action plan	Directive on the sustainable use of pesticides (2009/128/EC); Directive establishing a framework for Community action in the field of water policy (Water Framework Directive (2000/60)	Plant Protection Products Act
ANSNL-M021	Preparation, co-operation and co-ordination in the approach to incidents and accidents at sea		Maritime Accident Control Act; Decree on Incident Control on the North Sea; Memorandum on maritime and aeronautical emergency help on the North Sea, 2010-2015; Cooperation Agreement on the Control of Contamination in Coastal Waters by Rijkswaterstaat Departments; Cooperation Agreement on Oiled Birds; Memorandum on Capacity, 2006-2010
ANSNL-M022	International cooperation in the event of incidents and disasters	Agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances (Bonn Agreement); *Bonn Agreement Counter Pollution Manual*; International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties	Maritime Accident Control Act; Bonn Agreement Plan of Action, 2013-2016
	Descriptor 9 contaminants in fish		
ANSNL-M023	Standard for contaminants in fish and other seafood	Including Regulation (EC) no. 1881/2006 and Regulation (EC) no. 396/2005	With immediate effect
	Descriptor 10 Litter		
ANSNL-M024	Clean-up (and other) campaigns		Voluntary/Awareness and communications campaigns
ANSNL-M025	'Clean Meuse' approach, Limburg		Awareness and communication
ANSNL-M026	'Act Sustainably' initiative		Awareness and communication
ANSNL-M027	Stakeholder initiatives on beaches		Voluntary
ANSNL-M028	Implementation of EU directive on port reception facilities	Directive on port reception facilities for ship-generated litter and cargo residues (2009/59/EC)	Prevention of Pollution from Ships Act
ANSNL-M029	Ban on the discharge of garbage by ships (MARPOL Annex V)	IMO International Convention for the Prevention of Pollution from Ships (MARPOL)	Prevention of Pollution from Ships Act
ANSNL-M030	Marine environmental awareness course	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (SCTW convention)	Legislation: OWC education and training legislation
ANSNL-M031	Fishing for Litter programme		Voluntary; Awareness and communication
ANSNL-M032	Implementation of litter and waste policy		Awareness and communication
ANSNL-M033	Voluntary reduction of microplastics in cosmetics in the Netherlands		Voluntary

Measure code	1a measures	European/ International legislation	National toolbox
	Descriptor 11 Underwater noise		
ANSNL-M034	Licensing regimes for wind farms	Directive on the Conservation of Wild Birds (BD; 79/409/EEC); Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC)	
ANSNL-M035	Reduction of impulsive noise via the Code of Conduct on Clearing Explosives		Royal Netherlands Navy: Code of Conduct for the Detonation of Unexploded Ordnance in the North Sea, 2005 (Replaced in 2020 by new Royal Netherlands Navy Command regulations)
ANSNL-M036	Use of sonar legislation		Royal Netherlands Navy Command regulations - MWC 230 Operations Directorate Responsible use of active sonar (2015)
ANSNL-M037	Amendment to legislation relating to seismic research	Directive on the Conservation of Wild Birds (BD; 79/409/EEC); Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC)	Mining Act
	Fiscal measures		
ANSNL-M038	Tax incentives for environmentally-friendly technology (MIA/Vamil)		Economic: Deduction for environmentally-friendly investment (MIA); Arbitrary debit of environmental investments (Vamil)

Measure code	1b measures	European/ International legislation	National toolbox
	Descriptor 1 Biodiversity (Descriptor 4 Food webs, Descriptor 6 Benthic habitats)		
ANSNL-M039	Implementation of OSPAR List of threatened species and habitats	OSPAR Commission, *OSPAR List of Threatened and/or Declining Species and Habitats – correction 2014*, Reference Number 2008-6 (2014)	Nature Conservation Act
ANSNL-M040	Restrictions on commercial fishing that disturbs the seabed on the Klaverbank, Doggersbank and Friese Front	Directive on the Conservation of Wild Birds (BD; 79/409/EEC); Directive on the conservation of natural habitats and of wild fauna and flora (HD; 92/43/EEC); Council Regulation (EC) on the Common Fisheries Policy (1380/2013)	Nature Conservation Act
ANSNL-M041	Gap decision on the management of the Haringvliet Sluices (partial opening)		Decree on Management of the Haringvliet Sluices
	Descriptor 2 Non-indigenous species		
ANSNL-M042	Regulation on the prevention and management of invasive alien species	Regulation (EU) on the prevention and management of the introduction and spread of invasive alien species (1143/2014)	With immediate effect
ANSNL-M043	Prevention of the spread of species via ballast water	International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management Convention); OSPAR Convention	Prevention of Pollution from Ships Act

Measure code	1b measures	European/ International legislation	National toolbox
ANSNL-M044	Implementation of protocols for dispensations after the Ballast Water Management Convention comes into effect	International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management Convention); OSPAR Convention	
ANSNL-M045	Implementation of Hull-Fouling Guidelines against fouling by non-indigenous species on ships' hulls	Convention on Biological Diversity; IMO anti-Hull fouling guidelines	Voluntary
	Descriptor 3 Commercially exploited fish and shellfish		
ANSNL-M046	Catch management of commercial fishing	Regulation (EU) on the Common Fisheries Policy (1380/2013)	With immediate effect
ANSNL-M047	Minimising and phasing out discards (landing obligation)	Regulation (EU) on the Common Fisheries Policy (1380/2013)	With immediate effect
ANSNL-M048	Encouragement of use of alternative fishing gear	Regulation (EU) on the European Maritime and Fisheries Fund (EMFF)	EMFF economic instrument "Sustainable Fishing for the Market" Operational Programme
ANSNL-M049	Fishing Industry Sustainability certification	Regulation (EU) on the Common Fisheries Policy (1380/2013)	With immediate effect
	Descriptor 5 Eutrophication		
ANSNL-M050	Fifth Nitrates Directive action programme	Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive, 91/676/EEC)	Fertilisers Act implementation regulations
ANSNL-M051	Delta Plan for Agricultural Water Management		Voluntary, but not without obligation in relation to the Nitrates Directive
ANSNL-M052	Improvement of the purification efficiency of wastewater purification plants.		Voluntary, but not without obligation in relation to the Urban Waste Water Directive
	Descriptor 10 Litter		
ANSNL-M053	From waste to raw material (VANG)		Policy programme
ANSNL-M054	Packaging framework agreement 2013-2022		Covenant
ANSNL-M055	National approach to litter		Voluntary
ANSNL-M056	Plastic cycle value chain agreement		Covenant
ANSNL-M057	National Waste-management plan (NWM) 2		Policy programme
ANSNL-M058	Reducing use of plastic bags	Regulation (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards the consumption of lightweight plastic carrier bags	Packaging management regulations

Measure code	1b measures	European/ International legislation	National toolbox
	Descriptor 11 Input of energy, including underwater noise		
ANSNL-M059	Implementation of IMO Guidelines for the reduction of underwater noise from commercial shipping	Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life, IMO MEPC.1/Circ.833	Voluntary
ANSNL-M060	Restrictions on lighting for oil and gas platforms	Guidelines to reduce the impact of offshore installations lighting on birds in the OSPAR maritime area OSPAR Agreement 2015-08 (2015)	Voluntary
	Descriptor 6 Seabed protection		
ANSNL-M061	Seabed protection, Friese Front and Centrale Oestergronden	Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive, 2008/56/EC); Regulation (EU) on the Common Fisheries Policy (1380/2013)	Proposals for seabed protection, forwarded to the European Commission in June 2019

Measure code	2b measures	European/ International legislation	National toolbox
	Descriptor 10 Litter		
ANSNL-M062	Addressing the issue of litter with stakeholders and in education and training		Awareness and communication
ANSNL-M063	Green Deal Clean Beaches		Covenant
ANSNL-M064	Addressing the issue with water managers		Awareness and communication
ANSNL-M065	Catchment area-specific approach to litter		Awareness and communication
ANSNL-M066	Roll-out of litter collection scheme		Rijkswaterstaat scheme, economic instrument
ANSNL-M067	Green Deal Ships' Waste Chain		Covenant
ANSNL-M068	Green Deal Fisheries for Clean Seas		Covenant
ANSNL-M069	Awareness in the fisheries sector		Awareness and communication
ANSNL-M070	Incentivisation of the reduction of balloons		Voluntary
ANSNL-M071	Application of EU ban on emissions of microplastics in cosmetics and detergents		Withdrawn due to submission of ECHA restrictions

Annex VI

List of monitoring surveys and changes to the MSFD monitoring programme

The table below shows all monitoring surveys required for each criterion for the MSFD. It also identifies changes in relation to the 2014 MSFD monitoring programme. The monitoring programme remains largely unchanged; any amendments generally relate to additions as a result of new subjects, for instance breeding success and/or to (methodological) developments, such as with underwater noise. Two monitoring surveys ('bird population counts from ships' and 'oiled bird counts') no longer form part of the MSFD monitoring programme.

Descriptor	Criterion	Monitoring surveys	Amendment to MSFD monitoring programme in relation to 2014?	Explanation
D1.1 marine birds	Bycatch: marine birds (D1C1)	Fisheries monitoring under the CFP	Yes	In development: monitoring is in line with the bycatch registration of marine birds, mandatory under the Common Fisheries Policy (CFP)
	Population abundance of marine birds: marine bird populations (D1C2)	MWTL counts of marine birds & marine mammals on the DCS	Yes	Statistical analysis by Statistics Netherlands shows a need for increasing the spatial coverage of coastal counts and expansion of the number of offshore counts (six, instead of four times)
		Sea migration counts	No	
		Breeding bird counts	No	
		MWTL bird counts from ships, DCS	Yes	This monitoring was ended because the added value was minimal.
	Demographic characteristics: breeding success or breeding failure of marine birds (D1C3)	Reproduction in the Wadden Sea	Yes	This existing monitoring survey now also forms part of the MSFD monitoring programme
		Reproduction in the Delta area	Yes	Breeding success was introduced in MS, part 1 (2018) as a new topic within the MSFD. As there is no (structural) monitoring of breeding success in the Delta area, a new monitoring survey will be starting here.
		Fisheries monitoring under the CFP	Yes	In development: monitoring is in line with the bycatch registration of fish, mandatory under the Common Fisheries Policy (CFP)
D1.2 Fish	Bycatch: fish (D1C1)	Fisheries monitoring under the CFP	No	
	Population / abundance of fish: recovery in sensitive species (D1C2)	Fish monitoring in freshwater of the Netherlands on behalf of LNV/RWS	No	
	Demographic characteristics: fish – size distribution within fish community (D1C3)	Fisheries monitoring under the CFP	No	
	Distribution of HD species: fish (D1C4)	Fish monitoring in freshwater areas of the Netherlands on behalf of LNV/RWS	No	
	Habitats: fish (D1C5)	No specific monitoring required	No	Assessment in line with HD assessment

Descriptor	Criterion	Monitoring surveys	Amendment to MSFD monitoring programme in relation to 2014?	Explanation
D1.3 Marine mammals	Bycatch: porpoise (D1C1)	Fisheries monitoring in the context of the CFP	Yes	In development: monitoring is in line with the bycatch registration of marine mammals, mandatory under the Common Fisheries Policy (CFP)
		SCANS EU survey	Possible	In development: the Netherlands intends to increase the frequency from once every ten years to once every six years.
	Population/abundance of seals: abundance and distribution of grey and harbour seals (D1C2)	MWTL monitoring of seals, Delta area	No	
		WOT (statutory research tasks) monitoring of seals, Wadden Sea	No	
	Population/abundance and distribution of cetaceans (D1C2)	SCANS EU survey	Possible	In development: the Netherlands intends to increase the frequency from once every ten years to once every six years.
		WOT counts of marine mammals	Yes	Analysis by Statistics Netherlands gives no reason to expand the number of population counts. However, the counts must be spread out (both over the years and within individual years) in a different way in order to achieve a better population estimate.
	Demographic characteristics: seals: pup production (D1C3)	WOT seals, Wadden Sea	No	
		MWTL count of pups, Delta area	No	
	Distribution of HD species: marine mammals (D1C4)	See D1C2	No	
	Habitat: marine mammals (D1C5)	Project monitoring	No	Although this does not formally make up part of the MSFD monitoring programme, research data from large-scale projects (WOZEP) that can identify potential effects on the habitat of marine mammals is (also) used in the assessment of D1C5.
		Beach monitoring survey and autopsy data (on behalf of LNV)	Possible	Options for expanding beaching monitoring surveys to include data on seals are being studied.
D1	Condition of pelagic habitats: pelagic habitats, biomass and abundance, changes in phytoplankton and zooplankton communities (D1C6)	Continuous Plankton Recorder	No	
		MWTL phytoplankton species composition	Yes	Monitoring of phytoplankton species composition at three monitoring locations on the coastline of the Netherlands (rather than just Phaeocystis)
D2 Non-indigenous species	Introductions of non-indigenous species (D2C1)	Fisheries monitoring in the context of the Common Fisheries Policy (CFP)	No	
		MWTL North Sea seabed fauna	No	
		WOT monitoring of shellfish stocks	No	
		Incidental observations	No	Not explicitly part of the MSFD monitoring programme. Incidental, well-documented observations (projects and observations by members of the public) of non-indigenous species are used for the assessment

Descriptor	Criterion	Monitoring surveys	Amendment to MSFD monitoring programme in relation to 2014?	Explanation
D3	Populations of all commercially exploited fish and shellfish species (D3C1 and D3C2)	Fisheries monitoring under the CFP	No	
D4/D1	Species composition and relative density of trophic guilds	See D1 (marine birds, fish, marine mammals) and D6 (benthos)	No	Assessment method not yet fully developed. The intention is to tap into monitoring of fish, marine birds, marine mammals, benthos and phytoplankton (D1 and D6)
	Balance between the trophic guilds (D4C2)	See D1 (marine birds, fish, marine mammals) and D6 (benthos)	No	Assessment method not yet fully developed. The intention is to tap into monitoring of fish, marine birds, marine mammals, benthos and phytoplankton (D1 and D6)
	Size distribution in communities of fish (D4C3)	Fisheries monitoring in the context of the Common Fisheries Policy (CFP)	No	
D5	Concentrations of nutrients (D5C1)	MWTL surface water monitoring survey, Nutrients	No	
	Chlorophyll-a concentrations (D5C2)	MWTL surface water monitoring survey, Chlorophyll	No	
		Satellite monitoring	Yes	Satellite monitoring added (based on results from the JMP EUNOSAT project)
	Dissolved concentrations of oxygen close to the seabed (D5C5)	MWTL surface water monitoring survey, oxygen	No	
D6	Spatial extent of Physical Loss (D6C1)	-	-	Assessment via registration on the basis of licensing
	Distribution and spatial extent of physical disturbance pressures (D6C2)	CFP fisheries (VMS monitoring)	No	
		RWS registration of sand extraction	No	
	Effects of physical disturbance of the seabed on benthic habitats (D6C3)	MWTL North Sea seabed fauna	No, except where new areas are designated	
		WOT monitoring of shellfish stocks	No, except where new areas are designated	
	Extent of loss of benthic habitats (D6C4)	-	-	Assessment via registration on the basis of licensing
	Condition of benthic habitats communities (D6C5)	MWTL North Sea seabed fauna	No	

Descriptor	Criterion	Monitoring surveys	Amendment to MSFD monitoring programme in relation to 2014?	Explanation
D7	Hydrographic properties (D7C1 and D7C2)	-	-	Assessment via registration on the basis of licensing
D8	Contaminants in water, sediment and biota (D8C1)	MWTL monitoring survey, biota/sediment	No	
		MWTL monitoring survey, surface water/biota	No	
	Effects of contaminants: imposex in marine gastropods (D8C2)	MWTL imposex and intersex: effects of TBT	Yes	In the context of a sharp and consistent fall in the prevalence of imposex, a decision has been made to reduce the monitoring frequency and make a longer-term assessment.
	Significant acute pollution with oil and oil-like substances (D8C3)	Monitoring of pollution at sea in the context of the Bonn Agreement	No	
		MWTL oiled marine birds	Yes	No longer a requirement under the MSFD. The indicator is entirely based on monitoring in the context of the Bonn Agreement. Moreover, the number of oiled marine birds has declined to such an extent that the value of this monitoring survey to the MSFD is limited.
D9	Contaminants in edible tissue (D9C1)	WOT monitoring of contaminants in Dutch fish and other seafood	Yes	Monitoring programme expanded to include PFASs, PBDEs and OCIs
D10	Litter (D10C1)	MWTL beach litter	No	
		MWTL/IBTS monitoring of seabed litter	Yes	Monitoring of seabed litter is added as part of the IBTS monitoring
		MWTL plastic in fulmars	No	
	Microlitter (D10C2)	MWTL microplastics	Yes	In development: new monitoring survey expected to start in early 2021
	Accumulation of litter ingested by marine animals (D10C3)	MWTL plastic in fulmars	No	
D11	Impulsive noise (D11C1)	Registration of activities	Yes	Register of activities that cause impulsive noise has been operational since 2016 and contains data from 2015
	Continuous noise (D11C2)	MWTL continuous noise	Yes	In development: monitoring is being operationalised in an international context

Annex VII
Factsheets

Reader's guide

The factsheets in this appendix provide detailed descriptions of the MSFD monitoring programme and form the basis for chapter 2 of the main document. The eleven descriptors are covered in individual chapters, with separate sections devoted to each of the relevant criteria. The structure of each factsheet is the same, but they vary in length and level of detail. For example, greater detail may be needed when a section concerns a supplementary national measure and the related methodological requirements are not described elsewhere.

Structure
The contents of each factsheet are generally arranged in the same (following) way, but some factsheets may have a different structure, for example because the indicator includes an administrative analysis or because no monitoring requirements have been formulated yet so that one or more aspects do not yet apply.

Information requirements
The monitoring programme has to deliver the information required on the basis of the provisions of the Marine Strategy Part 1 relating to the characteristics of GES, the indicator(s) used to assess the current environmental status, and the associated specifications.
The point of departure is the specific GES adopted for each criterion, which is generally quantitative in nature.
Where relevant, any relationship with the so-called 'overarching GES' is mentioned. That is generally qualitative in nature and does not give rise to additional requirements for the monitoring. Some indicators are not linked to a specific GES, in which case the yardstick is the overarching GES. That is the case with D1C2, abundance of harbour porpoises, for example.
For the purpose of defining the information requirements, it is also necessary to identify possible synergies with the information requirements for other directives, such as the Water Framework Directive (WFD), the Birds Directive (BD) or the Habitats Directive (HD), and whether they lead to additional specific requirements.

Functional requirements and monitoring strategy
Functional requirements describe the conditions the monitoring surveys have to meet in order to generate the necessary information. For example, being able to assess a specific status imposes demands on the level of detail of the data collection and on parameters, spatial coverage and monitoring frequency. Specific requirements can also ensue from other directives, conventions or agreements with a link to the monitoring programme.

Monitoring surveys
The descriptions of the monitoring surveys in the factsheets include the relevant parameters, methodology, monitoring frequency and spatial coverage.

Assessment method
To make the link with the monitoring surveys in the next revision of the Marine Strategy Part 1 (2024), there is an explanation of how the monitoring data are used for the assessment, which is based on the indicators from the current Marine Strategy Part 1 (2018).

Analysis of monitoring programme
Any changes in the monitoring programme compared with the Marine Strategy Part 2 in 2014 are reported in each factsheet. The analysis also assesses whether the current monitoring programme is adequate, and if not, where the gaps are.

Cooperation and developments
Wherever possible, the link is made between the MSFD and other, related directives and national or international agreements, with a focus on developments in monitoring, assessment and cooperation.

Descriptor 1: Biological diversity

Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.

1.1 Incidental bycatch: Marine mammals (D1C1)

Criterion D1C1 (primary)
The mortality rate per species from incidental bycatch is below levels which threaten the species, such that its long-term viability is ensured.

GES and indicators

GES Bycatch of harbour porpoises is lower than 1% of the best available population estimate (ASCOBANS).				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
ICES estimate of the number of harbour porpoises caught in commercial nets	OSPAR North Sea	Mortality rate of harbour porpoises as a result of bycatch	1%	OSPAR / ASCOBANS

1.1.1 Information requirements

GES in the Marine Strategy Part 1 (2018) relates only to harbour porpoises. However, the registration of incidental bycatch of other marine mammals is also relevant. By virtue of Commission Decision

2017/848/EU and Regulation 2017/1004,[18] they enjoy the same level of protection. Accordingly, as far as possible seals are also considered under this criterion.

The incidental bycatch of harbour porpoises must not exceed the threshold value adopted by ASCOBANS[19] of 1% of the most recent best estimate of the population in the North Sea region. No indicator or threshold value has yet been formulated for bycatch of seals, but it is also likely to be a maximum percentage of the seal population.

A fundamental requirement is to know the size of the populations of porpoises and seals (see D1C2). Registration of the number of marine mammals caught as bycatch is also necessary.

The necessary monitoring of incidental bycatch is prescribed at EU level in Regulation 2017/1004, by virtue of which the monitoring of bycatch of all species, and particularly protected species, has fallen under the EU Data Collection Framework (DCF) since 2017.

The aim is to provide insight into both the size and composition of the bycatch through sampling programmes. The data collection is designed to help achieve the objectives of the Common Fisheries Policy (CFP). The sampling under the DCF can also give an indication of potential problem areas and periods for protected animal species.

No specific requirements have yet been formulated for bycatch monitoring in other frameworks such as the Conservation Plan for Harbour Porpoises. Nor are there any international agreements on harmonisation of bycatch monitoring.

[18] This refers to 'data to assess the impact of Union fisheries on the marine ecosystem in and outside Union waters, including data on bycatch of non-target species, in particular species protected under Union or international law, data on impacts of fisheries on marine habitats, including vulnerable marine areas, and data on impacts of fisheries on food webs.'

[19] ASCOBANS is the 1992 Agreement on the Conservation of Small Cetaceans of the Baltic, Northeast Atlantic, Irish and North Seas.

1.1.2 Monitoring surveys

Incidental bycatch of marine mammals in Dutch waters is monitored in two ways: through data collection under the EU Data Collection Framework (DCF) and through research into the cause of death of stranded harbour porpoises.

The monitoring under the DCF is covered by the protocols for the sampling of the catch on board commercial fishing vessels in the pelagic fisheries, active demersal fisheries and passive fisheries. However, the choice of vessels to be monitored in terms of spatial coverage, frequency and period is based on surveying commercial fish species and is not designed to determine bycatch of marine mammals. The idea behind the new DCF is that the Regional Coordination Groups (RCGs) can modify the sampling and institute additional monitoring if the results in the existing situation warrant it. In other words, this also applies for protected animal species.

The sampling under DCF is carried out by observers on board commercial fishing vessels or by crew members who have received instruction.

For the active demersal fisheries, a reference fleet of twenty vessels is used. The vessel's own crew carries out sampling on a hundred and sixty trips every year and observers take samples on ten trips. The vessels for the sampling are randomly selected from the reference fleet. For the pelagic fisheries, observers make twelve trips on board trawlers of four fishing companies in the course of a year. For the passive fisheries, observers make ten trips every year on ships longer than 15 metres. These trips are made on an ad hoc basis, not selected at random. However, a large part of the gillnet fleet is smaller than 15 metres. Recreational gillnet fishing is disregarded here.

The same observers and trained crew members who take samples of discards of commercial fish species on board a vessel also keep records of incidental bycatch of marine mammals, marine birds, turtles and protected fish species. In the process, they explicitly keep a record of how much time is actually spent inspecting the incidental bycatch.

In addition to the direct records of bycatch in nets, data on the cause of death of stranded marine mammals can also provide information about bycatch. Accordingly, since 2016 autopsies have been performed every year on 50 harbour porpoises found stranded along the entire coast of the Netherlands as part of the WOT programme[20]. The autopsies are performed on a random basis, exclusively on fresh carcasses. The purpose of this research is to establish causes of death, including incidental bycatch. There is no corresponding research for seals yet. The Ministry of Agriculture, Nature and Food Quality is exploring the possibility of also regularly registering and examining stranded seals.

1.1.3 Assessment method

To assess whether GES has been achieved, it is necessary to know the estimated current population and to make an annual estimate of the number of by-caught harbour porpoises. Since GES and the ASCOBANS target apply for the entire North Sea population, an international approach to the monitoring and assessment of bycatch would be preferable. The same applies for the development of an indicator for seals.

In a five-year pilot project on the Dutch Continental Shelf (DCS) an estimate of bycatches of harbour porpoises is being made by monitoring the bycatch on fourteen gillnet fishing vessels with a Remote Electronic Monitoring system and by comparing the results with estimates of the total number of porpoises (Scheidat *et al*. 2018). For nine hundred fishing days, cameras and sensors are used to collect and analyse video images, the times the harbour porpoises were caught and the locations of the nets. That period represents 11 percent of the total of 8,133 fishing days. The aim is to organise an international follow-up to this pilot project.

Calculations of bycatch do not include strandings of marine mammals, since they occur mainly in or close to the coastal zone. They are not representative of the population and the bycatch numbers in the area as a whole. However, the results of autopsies do provide information about (trends in) bycatch as a cause of death in the Dutch section of the North Sea.

1.1.4 Analysis of monitoring programme

An indicator still has to be developed for incidental bycatch of seals.

The combined monitoring surveys do not yet give a good impression of the annual incidental bycatch of marine mammals. An important reason is the absence of detailed data on the fishing effort, net type, net length, duration of fishing, fishing locations and so on. Moreover, the surveys of the current sample of the fleet do not yet provide sufficient reliable information about bycatch numbers.

A substantial share of the data collected under the EU Data Collection Framework (DCF) comes from areas outside the DCS. The current methods and fleet coverage under the DCF focus primarily on sampling bycatch of various species of fish in the various fishing metiers and are not geared to providing specific information about marine mammals. The method of

[20] For the time being, only stranded harbour porpoises are regularly registered and studied. In the rare instances where other cetaceans become stranded, an autopsy is also performed on them.

surveying should be modified to produce a better sample of the metiers with a potential risk of bycatch of marine mammals. Efforts are being made to arrive at a harmonised international approach. The aforementioned pilot project carried out for the Ministry of Agriculture, Nature and Food Quality from 2013 until March 2017 could be interesting in that context.

1.1.5 Cooperation and developments

The monitoring of incidental bycatch of marine mammals is still inadequate, at both national and international level. Monitoring has to be carried at international level because marine mammals from different national marine areas end up as bycatch in the nets of fisheries from various member states, making it an international problem.

The MSFD monitoring programme adheres to the data and conclusions that are endorsed at international level. In the autumn of 2019, ICES, OSPAR and HELCOM organised a workshop, in association with ASCOBANS and ACCOBAMS, on bycatch of marine mammals and marine birds. The recommendations referred to in section 1.1.4 were confirmed at that workshop. The various organisations will start implementing them, and it is important for the regional fisheries organisations and Regional Coordination Groups (RCGs) to be closely involved in that process. Another conclusion was that ASCOBANS' 1-percent threshold for most species is at present the highest feasible value and should be applied in the next MSFD assessment in 2024. More robust threshold values, as hoped for in the next MSFD cycle, depend first and foremost on more and better data.

Implementation of mitigating measures in the context of the Conservation Plan for the harbour porpoise is an operational environmental objective of the MSFD, and monitoring of incidental bycatch is an element of that. This monitoring also provides insight into the impacts of activities and measures and the quality of the habitat (see also D1C5).
The Netherlands is launching a parallel project on monitoring and mitigation of incidental bycatch, in association with as many neighbouring countries as possible. If this leads to a structural monitoring survey, it will be included in the annual update of the MSFD monitoring programme.


Photo: Jan Kostwinner

1.2 Incidental bycatch: Marine birds (D1C1)

Criterion D1C1 (primary)
The mortality rate per species from incidental bycatch is below levels which threaten the species, such that its long-term viability is ensured.

GES and indicators

GES No GES has yet been adopted specifically for bycatch of marine birds: will follow CFP.
Indicator In development; link to CFP

1.2.1 Information requirements and analysis

Incidental bycatch of marine birds does not yet fall under GES in the Marine Strategy Part 1 (2018).[21] However, it is a primary criterion and is therefore included in the monitoring programme. Commission Decision 2017/848/EU provides that the member states must also establish threshold values for the mortality rate of marine birds - per species - from incidental bycatch.

The necessary monitoring of incidental bycatch corresponds with the existing European rules laid down in Regulation 2017/1004,[22] according to which, since 2017 the monitoring of bycatch of all species, and particularly protected species, falls under the EU Data Collection Framework (DCF), as explained in sections 1.1.1 and 1.1.2.

It is too early to formulate GES, an indicator or threshold values at this stage because there is still too little known about bycatch of marine birds. It is also not yet possible to start a monitoring programme. The current aim therefore is to commence a process that will eventually lead to the development of a monitoring programme, with the associated indicator and threshold values, for the bycatch of marine birds. This is similar to the process that has been initiated by ICES, OSPAR and HELCOM for marine mammals, see section 1.1.5.

1.2.2 Monitoring surveys

Bycatch of marine birds in Dutch waters is monitored in the manner described for marine mammals in section 1.1.2.

1.2.3 Analysis of monitoring programme and Assessment method, Cooperation and developments

The monitoring surveys for registering incidental bycatch of marine birds are not yet entirely adequate or fully consistent with the description for incidental bycatch of marine mammals in section 1.1.4. The same applies for the assessment of incidental bycatch of birds: this assessment will only be possible when there is a formulated GES and an indicator. GES and indicator will have to be adopted at regional level. Marine birds will also be included in the initiatives to improve the monitoring of incidental bycatch of marine mammals.

[21] When the Marine Strategy Part 1 (2018) was being written, the provisions of Commission Decision 2017/848/EU, which was published at roughly the same time, were anticipated as far as possible, but incidental bycatch of marine birds and fish was not included because it was not known in time that it would be a primary criterion. GES will probably be formulated in the forthcoming updating of the Marine Strategy Part 1 (2024).

[22] This refers to 'data to assess the impact of Union fisheries on the marine ecosystem in and outside Union waters, including data on bycatch of non-target species, in particular species protected under Union or international law, data on impacts of fisheries on marine habitats, including vulnerable marine areas, and data on impacts of fisheries on food webs.'

1.3 Incidental bycatch: Fish and cephalopods (D1C1)

Criterion D1C1 (primary)
The mortality rate per species from incidental bycatch is below levels which threaten the species, such that its long-term viability is ensured.

GES and indicators

GES No GES specifically for bycatch of fish and cephalopods has been adopted yet; link to CFP
Indicator In development; link to CFP

1.3.1 Information requirements

Incidental bycatch of fish is not yet a component of GES in the Marine Strategy Part 1 (2018),[23] but it is a primary criterion and is therefore included here. According to Commission Decision 2017/848/EU, the member states must adopt threshold values for the mortality rate of species of fish and cephalopods that are not commercially exploited and whose viability is threatened by incidental bycatch in the region or sub-region.

The necessary monitoring of incidental bycatch corresponds with the existing European rules laid down in Regulation 2017/1004.[24] According to this regulation, since 2017 the monitoring of bycatch of all species, and in particular protected species, has fallen under the *EU Data Collection Framework* (DCF), which is explained in sections 1.1.1 and 1.1.2.

It is too early to formulate GES, an indicator or threshold values at this stage because there is still too little known about bycatch of species of fish and cephalopods that are not commercially exploited. The current aim therefore is to commence a process that eventually leads to the development of a monitoring programme, with the associated indicator and threshold values, for the incidental bycatch.

1.3.2 Monitoring surveys

For the purposes of the DCF, samples are taken from the catches of the Dutch fishing fleet, including bycatch, discards and bycatch of non-commercially exploited species of fish and cephalopods (Monitoring of bycatch Project, WOT).

1.3.3 Analysis of monitoring programme

The monitoring surveys (DCF and WOT) focus on species that are fished commercially, but also provide information about other species of fish that are by-caught. Article 5(2a) and (2b) of the DCF (Regulation (EU) 2017/1004) provides that reporting on all bycatch by commercial fisheries and - where appropriate – recreational fisheries falls under the multiannual fisheries programme. Bycatch of non-commercially fished species is therefore adequately covered by the legislation. The implementation is laid down in the annual plans of the WOT. As with the commercially exploited species, the incidental bycatch of fish and cephalopods is registered. An important distinction is that the populations of non-commercially exploited species are usually small, which calls for a different type of data analysis that has still to be developed.

[23] When the Marine Strategy Part 1 (2018) was being written, the provisions of Commission Decision 2017/848/EU, which was published at roughly the same time, were anticipated as far as possible, but incidental bycatch of marine birds and fish was not included because it was not known in time that it would be a primary criterion. GES will probably be formulated in the forthcoming updating of the Marine Strategy Part 1 (2024).

[24] This refers to 'data to assess the impact of Union fisheries on the marine ecosystem in and outside Union waters, including data on bycatch of non-target species, in particular species protected under Union or international law, data on impacts of fisheries on marine habitats, including vulnerable marine areas, and data on impacts of fisheries on food webs.'

1.3.4 Cooperation and developments

The monitoring surveys under the DCF constitute an important source of data for various indicators, including incidental bycatch. In the coming years, ways of making even better use of these data will be explored, for example by improving the analysis of the data.

Electric pulse fishing was partially banned in 2019 (Regulation (EU) 2019/1241). Fishers who already used the pulse technique had to stop and switch to a different method to catch the prescribed quota. This development might affect the composition and survival rate of incidental bycatch. The introduction of the landing obligation (Regulation (EU) 2015/812) could also have an impact on the survival rate of incidental bycatch of various species.

In addition to policy developments, technological developments also create possibilities for more selective fishing. Wageningen Marine Research is currently leading a research project into modifications to the nets used in fly-shoot, beam trawl, shrimp and langoustine fishing. Alternative net designs that generate less bycatch are already available. Collaboration between fisheries and product organisations will also be needed to promote their use in the sector.

1.4 Population abundance: Cetaceans (D1C2)

Criterion D1C2 (primary)

The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured.

Criterion D1C2 applies for all; section 1.4 discusses cetaceans, section 1.5 covers seals.

GES and indicators

GES[25] Overarching: Population densities and demography of populations of marine mammals suggest healthy populations.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
OSPAR: Abundance and Distribution of Cetaceans	OSPAR *Greater North Sea*	Trend as GES definition	The trend in the population of harbour porpoises is at least stable	OSPAR

GES[26] The populations of the grey seal (H1364), the harbour seal (H1365) and the harbour porpoise (H1351) comply with the favourable reference value for the population abundance (FRP) according to the Habitats Directive.				
Indicator[27]	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
HD: Favourable Reference Population (FRP)	National	Population size	Compliance with FRP	Habitats Directive

1.4.1 From information requirements to monitoring strategy

GES is assessed at two levels: at the level of the North Sea region in accordance with the OSPAR indicator, and at national level in accordance with the Habitats Directive (HD). Monitoring harbour porpoise numbers also provides insight into the target range of the conservation objectives in Natura 2000 areas, an environmental goal of the MSFD, and into the impacts of pressure factors and measures (see also D1C5 and D1C1).

OSPAR

For the assessment of GES, the population has to be considered at the level of the entire international North Sea Region. This is done using the OSPAR indicator for population abundance. The goal is a healthy population, whose size must not decline. If the population declines as a result of human activities, remedial measures must be taken. Because it is not known how large a healthy population should be in absolute terms, for the time being OSPAR bases itself for a relatively short-term assessment on trends in the population abundance. A population is deemed to be declining if there is a downward trend of ≥5 percent measured over a period of ten years (significance $p<0.05$). An upward trend of ≥5 percent over ten years (significance $p<0.05$) is regarded as an increase. The population is stable if the numbers change by less than 5 percent.

For the longer term, OSPAR assumes stability or an increase compared with the (still to be determined) baseline population abundance for harbour porpoises. In that context, the population must not decline by more than 30 percent over a period of three generations (OSPAR 2018).

[25] This overarching GES encompasses both demographic characteristics and population densities (abundance) of marine mammals. For the harbour porpoise, only the latter is defined. For seals, both are; for demographic characteristics, see D1C3 Seals, for population size, see D1C2 Seals.

[26] This GES relates to all marine mammals. This chapter is devoted entirely to harbour porpoises; for seals, see D1C2 Seals

[27] This indicator is not explicitly mentioned in the Marine Strategy Part 1 (2018), but is derived from GES.

HD
The population abundance at national level, as measured against the Favourable Reference Population (FRP) from the Habitats Directive, is also a factor in determining compliance with GES. The FRP is one of the aspects used to determine the conservation status. It also provides insight into the overarching GES that indicates 'healthy populations'. To assess whether the FRP is met, it must be possible to estimate the harbour porpoise population at national level.

Functional requirements/monitoring strategy

OSPAR
The monitoring of cetaceans follows the requirements agreed on and developed in the CEMP Guideline for M4 Abundance cetaceans (OSPAR, 2018). The recommended method for determining trends in abundance is the use of line-transect surveys using distance sampling. OSPAR suggests that, given the high degree of mobility of the animals, a good assessment calls for large-scale surveys across the entire region every six years, supplemented by more frequent regional surveys using the same method. The focus should also be on integrating the results of national and small-scale surveys according to a standardised method.

HD
For the Habitats Directive, it must be possible to carry out an assessment every six years. The directive does not specify any requirements for the monitoring needed to determine the size of the population, the national FRP or the conservation status, but it does recommend using coordinated international monitoring campaigns, such as SCANS, for highly mobile species such as cetaceans.

In a nutshell, policy measures must ensure compliance with the obligation to carry out an assessment every six years in accordance with the internationally agreed methods. ASCOBANS and OSPAR recommend the use of regional line-transect aerial counts based on distance-sampling methods, with a frequency geared to the MSFD reporting cycles. Given the mobility of the animals, a careful evaluation on a regional scale is particularly important. The monitoring must be effective enough to identify changes over a period of six years for the HD reporting, and to make an estimate of the population.

The methodology is linked as closely as possible to the ten-yearly regional SCANS censuses (Small Cetaceans in European Atlantic waters and the North Sea: Hammond *et al*., 2002, 2013, 2017).

1.4.2 Monitoring surveys

Regional censuses
Three large-scale censuses of cetaceans have been carried out in the North Sea and adjacent areas since 1994. The purpose of these surveys from ships and from planes was to determine the numbers and the distribution of cetaceans. They involved standardised line-transect counts carried out using distance-sampling methods (Buckland et al., 2001). The counts on the DCS fall into two SCANS blocks, with six and eight line transects, respectively. The SCANS surveys are not part of a permanent monitoring programme, but are organised on an ad hoc basis by individual research groups; in the Netherlands, the client is the Ministry of Agriculture, Nature and Food Quality.

National censuses
The number of harbour porpoises on the DCS has been counted from a plane almost every summer since 2010 for the Ministry of Agriculture, Nature and Food Quality. Following a statistical analysis, the timing, and possibly the frequency, of the counts is being revised: see section 1.4.4.

The method used for these surveys is the same as for the SCANS surveys, but in this case the DCS is divided into four sub-areas with a total of thirty line transects. The observations for these surveys extend over a total distance of approximately 3,000 km of transects, which means that over 1 percent of the DCS is covered. Germany and Belgium also use this method in their sections of the North Sea.

In addition to this survey, Rijkswaterstaat's waterbird monitoring survey (see D1C2 population abundance of birds) also provides valuable information. Marine mammals are also counted during these flights. The statistical analysis by Statistics Netherlands (see section 1.4.4) showed that although no estimates of populations can be made with these counts, trends can be clearly identified.

Finally, counts are also carried out on a voluntary basis and yield information about trends and the distribution of cetaceans. A marine migration count programme is carried out from eighteen permanent onshore observation posts along the coast.

1.4.3 Assessment method

OSPAR
The OSPAR assessment system is still under development, so for the time being the assessment is linked to the method in the intermediate Assessment 2017. To date, only three estimates have been made of the size of the harbour porpoise population in the entire North Sea, so it not yet possible to make any statistically significant judgements of trends.

HD
Compliance with the FRP is assessed on the basis of a checklist, which is based as far as possible on data supplemented by expert judgement (Ottburg and Van Swaay, 2014).

1.4.4 Analysis of monitoring programme

In October 2019, Statistics Netherlands performed a statistical analysis of the monitoring survey. The findings revealed no reason to increase the total

number of counts, but suggested that the population estimates could be improved by revising the distribution of the counts across the years and within a year. The precise details of the new arrangement will be fleshed out in 2020 and incorporated in the MSFD monitoring programme as soon as possible. The same applies for changes arising from regional developments (see section 1.4.5).

1.4.5 Cooperation and developments

OSPAR's Marine Mammal Expert Group (OMMEG) resumed operations in October 2018. One of the group's tasks is to improve the monitoring of marine mammals in OSPAR regions in order to comply with the six-yearly quality assessment for the MSFD. In March 2019, OMMEG advised OSPAR's Biodiversity Committee (BDC) to carry out SCANS-type censuses once every six years and to conduct internationally coordinated aerial counts on a smaller scale in the intervening years. OSPAR BDC has given OMMEG the green light to flesh out its recommendation. ASCOBANS' Advisory Committee made the same recommendations to the member states in September 2018.

The Netherlands is also in favour of increasing the frequency of censuses to once every six years, since that will shorten the time span over which a population estimate and regional trend is determined and because this frequency matches the EU reporting cycle for the MSFD and HD.

1.5 Population abundance: Seals (D1C2)

Criterion D1C2 (primary)

The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured.

GES and indicators

GES[28]$_1$ Overarching: Population densities and demography of marine mammal populations suggest healthy populations.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
*Seal Abundance and Distribution (*OSPAR)	*Greater North Sea* (OSPAR)	Abundance	The trend in the population of grey and harbour seals is at least stable	OSPAR

GES[29] The populations of the grey seal (H1364), the harbour seal (H1365) and the harbour porpoise (H1351) comply with the favourable reference value for the population abundance (FRP) according to the Habitats Directive.				
Indicator[30]	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
HD: Favourable reference value for the population abundance (FRP)	national	population abundance	compliance with FRP	Habitats Directive

1.5.1 From information requirements to monitoring strategy

The seal population is assessed at both regional (OSPAR) and national level (HD). The term 'population densities' used in the criterion and GES and the term 'abundance' used in the OSPAR indicator refer to numbers per measured surface area. However, in the case of seals the terms refer to the population abundance (see also monitoring strategy).

OSPAR

For the assessment for GES, the population has to be surveyed at the level of the international North Sea region. The OSPAR indicator of seal abundance is used for this assessment. For the grey seal, a North Sea-wide management unit (Greater North Sea*:* OSPAR Region II) has been chosen. Smaller management units have been defined for the harbour seal. For the Netherlands, these are the Trilateral Wadden Sea and the Delta region including the Belgian coast. According to the indicator, the seal population in a management unit, measured over the preceding six years, must not decline by more than 1 percent a year. In other words, not by more than 6 percent in six years. In addition, the seal population must not decline by more than 25 percent compared with the size of the population in 1992. These criteria apply for both grey seals and harbour seals.

HD

The size of the population at national level as measured against the Favourable Reference Population (FRP) from the Habitats Directive (HD) also counts towards compliance with GES. The FRP is one of the aspects considered in determining the conservation

[28] This overarching GES embraces both the demography and population densities (population size) of marine mammals. For the harbour porpoise, only the latter aspect has been elaborated (see D1C2 Porpoises). For seals, both have been; for demographic characteristics, see D1C3 Seals.

[29] This GES relates to all marine mammals. This chapter is devoted exclusively to seals; for porpoises, see D1C2 Cetaceans. There is also a correlation with GES 'The population densities and demography of marine mammal populations indicate healthy populations'.

[30] The indicator is not explicitly mentioned in the Marine Strategy part 1 (2018), but is derived from GES.

status. It also provides insight into the overarching GES that suggests 'healthy populations'. To assess compliance with the FRP, it must be possible to estimate the populations of both species of seal at national level.

Functional requirements

OSPAR

For the OSPAR indicator, it must be possible to monitor trends in the population of both seal species. A census is required at least once a year. Harbour seals are counted in the summer (June–August), which is both the pupping and the moulting period. The size of the grey seal population is determined by counting the pups[31] and then using a model to calculate the population abundance.

In areas such as the Wadden Sea and the Delta, where the number of grey seals is heavily influenced by the migration of the animals, moulting seals also have to be counted in March and April. The United Kingdom also requests data for the grey seal in the summer (when they are counted at the same time as the harbour seals). The summer data can be used to validate the models based on the pup counts.

For further details of the functional requirements and the monitoring strategy under OSPAR, see the CEMP: Guideline M3: Seal abundance and distribution (OSPAR 2016).

HD

The Habitats Directive calls for an assessment every six years, but does not specify any requirements for the monitoring needed to determine the size of the population and the national FRP or the conservation status.

Monitoring strategy

Seals are seldom clearly visible when they are swimming. They can only be monitored at sea with transmitters. However, they spend part of the time on sandbars, where they can be clearly observed. Accordingly, counts are carried out on sandbars to determine trends in the population of the harbour seal and grey seal. In the Netherlands, they are conducted on the sandbars in the Wadden Sea, Delta and Voordelta regions. Correcting for a certain percentage of the animals that are in the sea at the time of the count,[32] the size of the population can be estimated. To produce the most realistic estimate, sandbar counts are standardised.

Both species of seal spend roughly 20 percent of their time on sandbars. The time spent on the sandbars generally varies greatly from one animal to another. The time they will spend on dry land is easier to predict during the moulting and pupping period, so these are the most suitable periods to count the adult animals - in addition to the pups.

The sandbar counts are used to determine the annual index from which trend changes and pup production can be calculated very accurately. Because sandbar counts are standardised, the total numbers can also be estimated.

1.5.2 Monitoring surveys

Wadden Sea

Seals in the Wadden area are counted from a plane for the Ministry of Agriculture, Nature and Food Quality as part of the Statutory Research Task for Nature and the Environment (WOT N&M) The first census of the harbour seal in the Wadden area was carried out approximately sixty years ago. The grey seal, which had not been seen along the coast of the Netherlands for a long time, returned around 1980 and since 2001 has been counted with the same method and monitoring survey that are used today. The animals used to be counted from boats.

The monitoring survey is designed to monitor population trends at the haul-out sites of the animals when they are moulting or pupping. By performing a number of counts during a single census period, it is possible to identify any changes in the peak and to anticipate the effects. The counts cover the haul-out sites in the entire area.

Harbour and grey seals are counted every year on the sandbars at low tide. There are at least three counts during the pupping period and two during the moulting period. Aerial counts are carried out for grey seals in the winter (November–January) and spring (March–April), and for the harbour seal in the summer (June–August). During every census, all of the adults and any pups of both species are

[31] This is because no counts are carried out during the moulting period in the United Kingdom, where approximately 90 percent of the grey seal population lives. The pupping period also differs within the region: in the west it is in the autumn (September), further east it is in November, while in the Netherlands it is in December.

[32] For the harbour seal, a good estimate for the summer is readily available (inter alia, Ries et al. 1998). Making an estimate for the grey seal is more difficult because most of the animals are from the United Kingdom and are not part of the 'local' population. Nevertheless, the index (the year-on-year difference) is relatively accurate (compared with other marine animals). With the trilateral monitoring survey, seals are one of the few species groups for which relatively small changes in trends can be ascertained with any degree of certainty.

Table 1.5.1: Overview of the number of seal censuses (MWTL biological monitoring survey) per month in the Delta area.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Voordelta	2	2	1	1	1	2	2	1			1	1
Oosterschelde	1	1	1	1	1	2	2	1				1
Westerschelde	1	1	1	1	1	2	2	1				1
Grevelingen	1	1	1	1	1	1	1	1	1	1	1	1

registered. There are calls within the trilateral alliance to carry out extra flights once every five years in order to identify changes in the birth and moulting peaks.[33] Whether that will go ahead depends on the availability of the necessary funding (see also 'Cooperation and developments').

Delta area
Harbour seals and grey seals (including pups) are also counted on sandbars in the Delta area on behalf of Rijkswaterstaat and the Province of Zeeland. Seals have been counted in the Delta area since the end of the 1990s, but the MWTL counts in their current form date from 2014.

Counts in the Delta waters are carried out throughout the year (see table 1.5.1). They are combined with the counts of waterbirds in the area and are carried out from a plane at low tide in the Voordelta, Oosterschelde and Westerschelde, and often from a ship on Lake Grevelingen. During every count, the two species and any pups are registered at specific haul-out sites.

1.5.3 Assessment method

OSPAR
The grey seal population in the United Kingdom is calculated using a model based on pup counts. In the other areas, with small sub-populations that interact intensively with the populations in the United Kingdom, the moulting animals are also counted.[34] For the grey seal, the entire North Sea, including the Wadden Sea, is treated as a single area, while for the harbour seal the North Sea is divided into different management units. The Zeeuwse Delta waters and the Belgian coast fall within the 'Dutch delta' management unit, the Wadden area under the 'Wadden Sea and Helgoland' management unit. The estimate of the harbour seal population is calculated on the basis of the counts (for each counting area) on the sandbars on which the animals haul up.

For the precise Assessment method, see the CEMP Guideline (OSPAR, 2016).

HD
In the national reporting for the Habitats Directive, the conservation status is determined on the basis of the following components: distribution, population, habitat and future perspective (in the Netherlands). The FRP is an element of the conservation status and is determined on the basis of expert judgement, incorporating the data from counts as far as possible (Ottburg and Van Swaay, 2014).

1.5.4 Analysis of monitoring programme

The counts of seals on sandbars suffice both temporally (multiple counts annually, in the relevant periods) and spatially (all sandbars are counted) to monitor population trends very accurately. The frequency of the counts is sufficient to meet the OSPAR requirement of identifying any change of 10 percent in the seal population over a period of ten years (Meesters *et al,* 2007). In addition, the absolute size of the population of harbour seals can be estimated on the basis of a correction factor. However, that factor was adopted more than twenty years ago (Ries *et al.,* 1998), when both the population and the conditions were different.
The correction factor should therefore be updated so that the actual size of the population can be determined, which could be important, for example, in determining the ecological carrying capacity within a management unit.

Besides local seals, the seal population in the Netherlands includes many migratory seals, which is why both the pup production and the numbers of adults of both species are monitored during the moulting period.

Some countries do not have sufficient information about both species. In many areas, only the adult harbour seals and the pups of grey seals are counted. In both cases, the counts produce an incomplete picture. In the United Kingdom, for example, migrating animals are disregarded and only pups are counted. This is connected with the far larger size of populations in the breeding areas of grey seals.

[33] A shift of roughly one month has been observed in recent decades among both grey seals (Brasseur *et al.,* 2015) and harbour seals (Reijnders *et al.,* 2010).

[34] Both local animals (with their own pup production) and animals from the United Kingdom are found in many of these areas. No pups are born in the Delta area, but the area is used by more than 1000 grey seals. The counts during moulting periods illustrate the importance of the area for the species outside the breeding season (Brasseur et. al. 2015).

1.5.5 Cooperation and developments

The monitoring is carried out in accordance with the EU Habitats Directive, OSPAR and the trilateral agreements on the Wadden Sea under the Bonn Convention, or the Convention on the Conservation of Migratory Species of Wild Animals (CMS). The trilateral agreements on the Wadden area are laid down in the Seal Management Plan. In 1990, Denmark, Germany and the Netherlands concluded the Agreement for the Conservation of Seals in the Wadden Sea. The aim of the agreement is to promote cooperation among the countries in the conservation of harbour seals and grey seals in the Wadden Sea (http://www.waddensea-secretariat.org/management/seal-management). The seal counts in the Wadden Sea are coordinated in trilateral consultations and form the basis of the joint management of the area. They also provide underpinning of the assessments for OSPAR and the HD and of the annual reporting to the ministries and on the site of the Common Wadden Sea Secretariat (CWSS). The Seal Management Plan is not explicitly mentioned in the Marine Strategy at the moment, but since the objectives are the same the link is evident.

1.6 Population abundance: Marine birds (D1C2)

Criterion D1C2 (primary)

The population abundance[35] of the species is not adversely affected by anthropogenic pressures, such that its long-term viability is ensured.

GES and indicators

GES[36]

For each functional group, the population abundance of at least 75 percent of the species is above the threshold value for 1992 (OSPAR assessment value).

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Marine bird populations (B1)	Southern North Sea	Wading feeders; Surface feeders; Water column feeders; Benthic feeders; Grazing feeders	For each functional group, the population abundance of at least 75 percent of the species is above the threshold value for 1992 (OSPAR assessment value)	OSPAR

GES[37]

Populations of marine birds must comply with the national targets from the BD.

Indicator[38]	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
BD: numbers, trends, distribution, share in BD areas	National	Marine bird species	Populations at desired level	BD

[35] This refers to the size of the population: the number of breeding pairs or the number of adult birds

[36] There is also a correlation with the overarching GES 'The population abundance and demography of bird populations indicate healthy populations'

[37] There is also a correlation with the overarching GES 'The population abundance and demography of bird populations indicate healthy populations'

[38] The indicator is not explicitly mentioned in the Marine Strategy part 1 (2018), but is derived from GES and comprises information required for the BD reporting.

1.6.1 From information requirements to monitoring strategy

The information required to determine whether GES for this criterion is achieved follows from the OSPAR indicator for marine birds and the requirements for the Birds Directive reporting.

OSPAR
OSPAR has formulated a harmonised indicator for marine birds based on a threshold value. Within each functional group, the size of the population of at least 75 percent of the species in that group must be above the threshold value for 1992.
It follows from this that there must be information about the numbers of every species of bird in each functional group. This applies for both breeding birds and non-breeding birds (wintering and migrating birds). The relevant area for this indicator is the Greater North Sea region. In addition to the DCS, the Dutch section of this region also includes the Wadden Sea and Delta.

The functional groups are classified according to their method of foraging: surface feeders, water column feeders, wading feeders, benthic feeders and grazing feeders. The OSPAR assessment therefore extends beyond the area of application of the MSFD and includes not only 'genuine marine birds', but also species such as ducks and waders.

BD
GES is linked to the BD, and in this context relates to every species for which the DCS is relevant. The objective of the BD is to 'maintain the populations of all indigenous species of birds at a level which corresponds in particular to ecological, scientific and cultural requirements'. This objective is comparable with the 'favourable conservation status' in the Habitats Directive. The BD reporting must contain the following information about the status of the populations of Dutch birds:

- numbers of breeding birds and of a selection of migratory birds (migrating/wintering), non-breeding birds (national level)
- short-term and long-term trend in the numbers of breeding birds and of a selection of migratory birds (the trend in the last twelve years and since 1980, respectively).
- distribution (distribution map), distribution area and distribution trend (for the last twelve years and since 1980), only of breeding birds (reporting in 10 x 10 km in ETRS grid)
- numbers and trend in numbers of species for which Special Protection Areas (SPAs) have been designated (and the other 'Annex I' species) and which actually inhabit an SPA
- information about pressure factors, threats and measures, only for species for which areas have been designated and the other 'Annex I' species. This information is based on expert judgement and is not further discussed here.

In other words, monitoring must be capable of generating sufficient information to identify trends over the last twelve years, and since 1980. It must also be possible to determine actual numbers of breeding birds and non-breeding birds, both at the national level and at SPA level.

In both cases, for EU purposes the numbers of non-breeding birds in January are used, because all other North Sea countries also carry out censuses at that time and the data can be aggregated. In addition, the point of departure for determining the situation in the Netherlands is the month in which the largest numbers of a species occur. For some species, such as the guillemot and the little gull, the EU also requests the maximum numbers during the migration period.

The boundaries of the SPAs at sea correspond with the boundaries of the relevant Natura 2000 areas. The Natura 2000 areas in the North Sea – the North Sea coastal zone, Voordelta and Frisian Front (and possibly also Bruine Bank in the future) – fall under the SPAs in the Birds Directive. These areas are designated for breeding birds (only the North Sea coastal zone) and non-breeding birds, for which conservation targets apply. Conservation targets are formulated differently, and are consequently calculated differently, than the numbers for which SPAs have been designated. The relevant figure for breeding birds is the number of breeding pairs; for non-breeding birds, the calculation is based on seasonal averages, provided there is sufficient information, and sometimes on seasonal maxima. For some species, the seasonal maximum falls in mid-winter (January).

Functional requirements/monitoring strategy

No additional specific requirements for bird monitoring have yet been agreed at OSPAR level. The formulated requirements are derived from the national interpretation of the Birds Directive. The MSFD monitoring programme is based on Van Roomen *et al.* (2013), which takes account of monitoring requirements ensuing from the BD reporting (national level), the Natura 2000 conservation targets and agreements on international censuses.

Monitoring frequency and spatial coverage
For all birds, the MSFD and BD require an assessment every six years of the trends in the size of the population of every species for which the Dutch section of the North Sea is relevant, as well as trends in the distribution of breeding birds. In Natura 2000 areas, the trends in population size of the relevant species also have to be monitored for each management planning period, which is also six years.

The BD does not specify any requirements for the frequency of monitoring, but it does require information about trends in the short term of the preceding twelve years, and over the longer period since around 1980. Nor does the BD impose specific requirements for the accuracy of the data. However, an indication must be given of the quality of the data on which the information about numbers is based: are they based on complete counts or a statistically robust estimate, an estimate based on partial counts, or expert judgement. A data analysis by Sovon (Van Roomen *et al.,* 2013) demonstrated substantial variation from year to year in the numbers and distribution of various species of birds. In order to adequately detect changes in numbers and distribution, it was decided that annual monitoring is required.

The actual occurrence (distribution) has to be reported. Standards have been formulated for the method of supplying the data, but there are no specific requirements for the accuracy of the data. However, the report must mention the type of estimate and the method, as well as indicating whether the data are based entirely on counts, on expert judgement or on a combination of both.

Area characteristics
The coastal zone calls for a relatively high spatial coverage because of the large number of species, the spatial variation in their occurrence and the intensive human use. A lower resolution can be adopted for the counts in the EEZ than in the coastal zone, except in the BD areas Frisian Front and (possibly) the Bruine Bank,[39] where a higher spatial coverage is needed to estimate absolute numbers.

Characteristics of species
The six-yearly reports in relation to the BD/MSFD and the conservation targets require information on the population abundance and distribution for each individual bird species, which means that the monitoring strategy and the monitoring plan must include a method which ensures that individual species can be clearly distinguished during the surveys. Monitoring must also be designed in such a way that it takes account of differences in the spatial distribution patterns of specific species. Scoters (Greater scaup, Common scoter and Eider) occur in large concentrations, forming a small number of large groups in a relatively small area within the coastal zone. The other bird species are far more widely dispersed in smaller densities. The various species display widely varying seasonal patterns. Some visit the North Sea in the winter, others mainly in the summer. For the purpose of the reporting obligations, the data from the peak period are the most important.

Breeding birds
Information about numbers and distribution of breeding birds is gathered by monitoring the numbers of breeding pairs in colonies and the numbers of breeding territories along the coast. Breeding birds for which conservation targets apply (the Ringed Plover, the Kentish Plover and the Little Tern in the North Sea Coastal Zone) are specifically monitored.

1.6.2 Monitoring surveys

Aerial counts
Aerial counts form the core of the monitoring programme. For details, see Fijn *et al.,* (2018). All counts from planes are part of Rijkswaterstaat's MWTL monitoring programme (see also https://waterinfo-extra.rws.nl/). The aerial counts commenced in 1991, since when there have been some changes, for example in the spatial pattern, the frequency and the flight altitude.
As a result of the changes, the counts are a better match for the various information requirements. Scoter are counted separately by actively searching for groups of them along a fixed route.

Spatial and temporal coverage
The aerial counts are carried out according to a fixed method along a predetermined route, with marine birds being counted within transects that are distributed as evenly as possible. There are two distinct sub-areas: the coastal zone – from the low water line to the 12-mile line – and the Exclusive Economic Zone (EEZ), the Netherlands' maritime territory beyond the 12-mile zone. In response to the results of a statistical analysis (Statistics Netherlands, 2019), the spatial coverage will be expanded from 2020, with a transition to a 'cross-shore' flight pattern (see 'Analysis of monitoring programme'). The aerial counts in the EEZ also follow a pattern of transect lines crosswise to the coast (see figure 1.6.1). The homogeneous distribution of the various transects makes it possible to extrapolate the size of the population of each species on the DCS, including a confidence interval. In the Natura 2000 areas in the EEZ (Frisian Front and (potentially) Bruine Bank), a higher spatial resolution is maintained by flying in a zig-zag pattern.

[39] The Frisian Front is designated for the Common guillemot. It is not yet known whether the Bruine Bank will be designated as a BD area, and if so, for which bird species.

Figure 1.6.1: Spatial pattern of the aerial counts ('vliegpatroon') of marine birds and marine mammals (MWTL) in the coastal zone ('kust') and on the Dutch Continental Shelf (DCS: 'NCP'). On the DCS, the spatial coverage is higher on the Friese Front (SPA BD) and Bruine Bank (potential SPA BD).

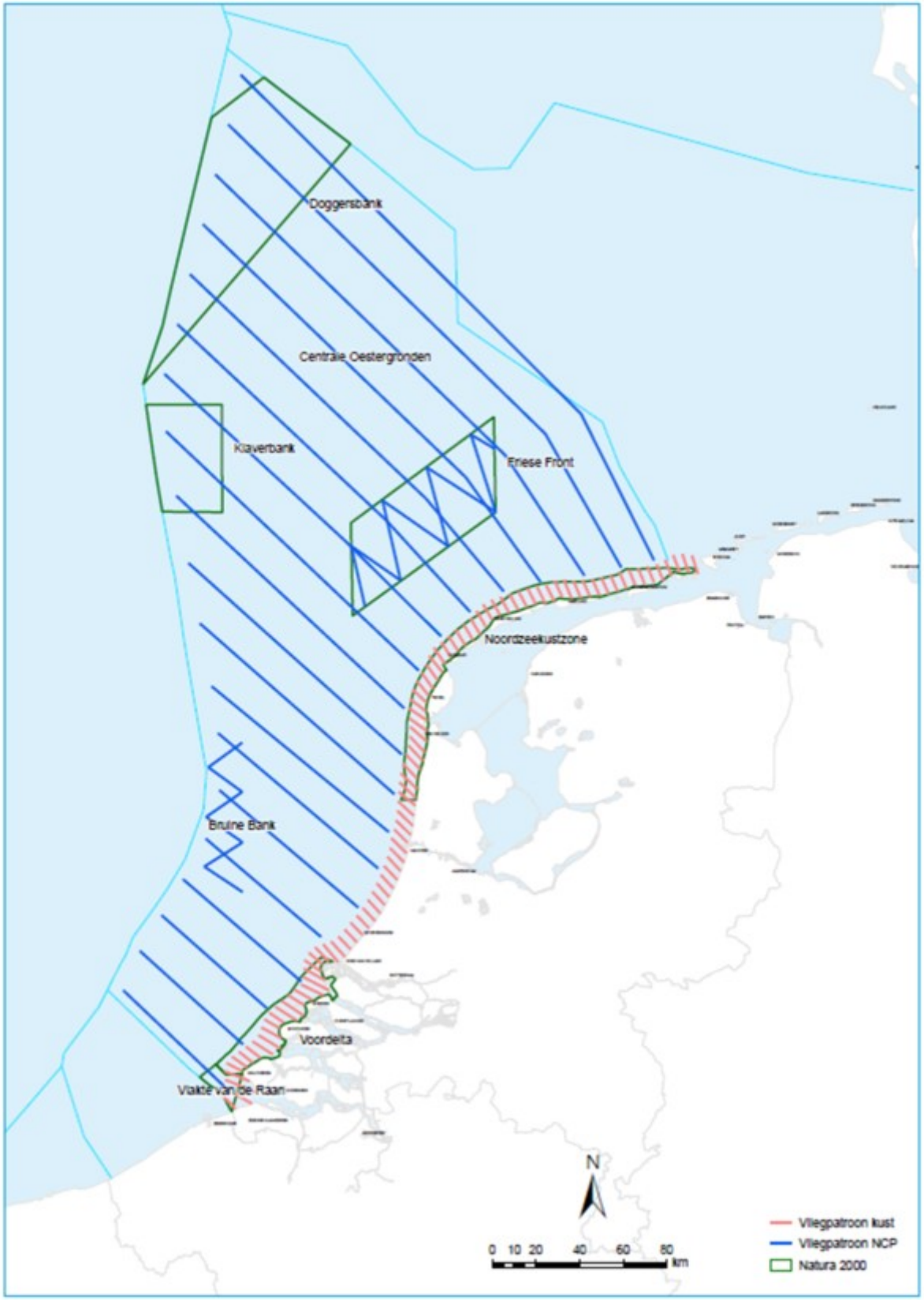


Table 1.6.1: Overview of the counts for different zones and species groups. Counts supplementary to the MSFD monitoring programme 2014 are in bold.

	Nov	Jan	Feb	Apr	Jun	Aug
Coastal Zone	x	x	x	x	x	x
EEZ	x	x	x	**x**	**x**	x
Common Scoter	x	x				

Bird numbers are counted annually. The counting frequency within a year has increased compared to the MSFD monitoring programme in 2014. Two EEZ counts have been added, so there are six counts a year for both the coastal zone and the EEZ (see table 1.6.1 and 'Analysis of the monitoring programme').

Common scoter are counted together with other scoter species every year in Dutch coastal waters and the Wadden Sea. These counts are also carried out by plane as part of the MWTL programme. During the survey, the coastal zone is crossed once to spot scoter groups using binoculars and to estimate their numbers (Lilypaly *et al.,* 2018).

Observations and altitude
The planes used for the counts have domed windows on both sides, so that the marine birds beneath the plane can also be observed. The altitude of 75 metres makes it possible to distinguish species of marine bird, including the razorbill and the guillemot. According to Fijn *et al. (*2018), approximately 90% of the observed birds can be identified. That is more difficult with the Common Tern and Arctic Tern, which can only be distinguished in good conditions.

The number of marine birds can also be established more accurately at a height of 75 metres than at higher altitudes. The counts are carried out with distance sampling. With this method, the results can be corrected for factors such as incomplete detection and differences resulting from weather conditions and observation effects. A broader observation strip also increases the area surveyed and the number of marine birds that are observed, which improves the power (statistical relevance) of the monitoring survey.

Seawatch counts
Migrating birds are also counted by volunteers from the coast. These counts, with the help of a telescope from a number of permanent observation posts, are more or less standardised. They give a good impression of the relative numbers of migrating species flying through the coastal zone. However, the migrating birds are only visible for a limited distance from the coast: smaller species for up to approximately 3 km; species like the Northern Gannet and large seagulls for up to almost 6 km. Another drawback is that the supply of data from voluntary counts is less certain than in the case of commissioned censuses. Experience has shown that this objection is less serious in the important migratory months, when the coverage of the count is substantial.

Breeding bird censuses
The source of the estimates of numbers of breeding birds is the Breeding Birds Monitoring survey, which embraces the Breeding Bird Monitoring Project (BMP) and the counts of birds in colonies. Some of the data for these monitoring surveys are collected by volunteers, and some by professionals in accordance with a protocol drawn up by Sovon. Sovon collects and processes all the data and, in association with Statistics Netherlands (Statistics Netherlands), calculates the annual population estimates and trends per species (for example, Boele *et al.,* 2019).

1.6.3 Assessment method

The assessment is linked to the BD reporting, Natura 2000 management plans and the OSPAR indicator.

BD reporting
SOVON and Statistics Netherlands recently improved the method of calculating the populations and trends for marine birds, but it has not yet been fully developed. With improvements in the aerial counts, it will also be possible to identify trends in specific species that used to be difficult to distinguish, such as the razorbill and the guillemot. A method has recently been developed to link earlier MWTL aerial counts to the current counts to produce a sufficiently lengthy series (>10 years). As a result, the trends for some species, such as the cormorants and gulls, can be determined (in part) on the basis of the aerial counts. The seawatch counts of a number of coastal species (Red-throated diver, and possibly the Black-throated diver) and some scarce species (Shearwaters, Skuas, Grebe, Little gulls and Little terns) can be processed into indices of the trend, which can be used for the Birds Directive reporting. The Birds Directive calls for national trends, but separate North Sea trends will also be calculated as the basis for them. The national trend in species that occur on land and on sea, for example the Great black-backed gull, will be an average of the trend on land and at sea, weighted for the share of the population living on the land and at sea.

Table 1.6.2: Overview of monitoring surveys in relation to different policy frameworks

MSFD area	Monitoring survey			
	Aerial counts	Seawatch counts	Breeding colonies/birds	Waterbird counts
BD reporting	X	X	X	X
OSPAR			X	X
Natura 2000 areas - Offshore areas *Frisian Front, potentially Bruine Bank* - Coastal zone areas *Voordelta (including Westplaat intertidal area), North Sea Coastal Zone (including breeding bird targets)*	X X		X	X

In contrast to the Habitats Directive, there is no threshold value for the reporting for the Birds Directive. All of the aforementioned monitoring surveys are used for the reporting (see table 1.6.2).

Natura 2000 areas
See under functional requirements. All of the aforementioned monitoring surveys are used for the evaluation, with the possible exception of marine migration counts (table 1.6.2).

OSPAR
The OSPAR assessment for marine birds is based mainly on data for breeding populations. The assessment for waterbirds (anatidae and waders) is based mainly on land-based counts of non-breeding populations; in other words, the number of migrating or wintering birds that haul out on tidal or landing areas. The annual estimates of numbers of breeding and non-breeding birds are compared with target values to determine whether the populations of the various species are recovering.

The desired values for the annual relative abundance of a bird species are above 0.8 (80 percent of the reference value) for species that lay one egg and 0.7 (70 percent of the reference value) for species that lay more than one egg. Functional groups are deemed to be healthy if at least 75 percent of the individual species are found to meet the target values (see 'From information requirement to monitoring strategy').

1.6.4 Analysis of monitoring programme

The Statistics Netherlands recently performed a statistical analysis of the MWTL aerial counts (Statistics Netherlands, 2019). The most important findings were:

- Coastal counts: the spatial coverage was inadequate. Consequently, the monitoring survey has been intensified, with a transition to a pattern with cross-shore transects.
- EEZ counts: the temporal coverage in the EEZ was inadequate. The monitoring has therefore been expanded with two extra counts, in April and in June. This makes the number of counts equal to those from the shore. The section that is no longer covered due to the narrowing of the strip for the coastal count will be incorporated in the EEZ counts.
- Wind farms: the loss of statistical power in the counts from the presence of wind farms – as projected up to the end of the Roadmap 2030 – is limited. For the time being, therefore, there is no need to revise the monitoring programme and/or method.

The calculations of the populations and trends of marine birds for the BD were recently improved, but the method of calculation is still being developed (see 'Assessment method').

1.6.5 Cooperation and developments

International cooperation – monitoring, assessment and data sharing
The marine bird populations in the Dutch section of the North Sea are part of larger functional populations. The Netherlands therefore participates in various international bodies established to reach agreements among countries on monitoring, assessment and data sharing. This cooperation enhances interpretation of potential changes in trends.

OSPAR
OSPAR has formulated the indicator for population abundance, but there are still gaps. For example, it was found that only land-based counts were included in the Intermediate Assessment 2017, while aerial counts of birds living at sea are also important. The Netherlands is also in favour of the use of aerial counts, because it provides a better and – in combination with the BD reporting – a more consistent picture of the status of the marine birds. Apart from an annual census of wintering birds in January, there are not enough internationally coordinated surveys, for example in terms of scheduling. This is seen as a shortcoming. There are plans to carry out an internationally coordinated aerial count in all Atlantic and Baltic coastal zones in the winter of 2019/2020, with the aim of producing a more complete picture of the numbers and distribution of species such as cormorants, grebes and scoters. Other objectives are to carry out joint surveys and to develop a method for aggregating and analysing data.

JWGBIRD
The Joint OSPAR/HELCOM/ICES Expert Working Group on Marine birds (JWGBIRD) has been established to provide OSPAR, on request, with advice on marine birds. The working group is also involved with the indicators for marine birds under the MSFD. The Netherlands is represented in this working group by Sovon.

International Waterbird Census
The Netherlands participates in the International Waterbird Census, an international programme which collects international data on numbers of and trends in waterbirds in Europe. The censuses in January and the counts of colonies of species that forage in the North Sea are particularly important.

Data sharing
It is not only important to coordinate censuses, but also for data to be made available and shared. To this end, in time the data from the marine bird censuses (European Marine birds At Sea, including MWTL counts) will be transferred to the ICES data centre. This proposal is on the agenda of JWGBIRD, in which the Netherlands is represented by Sovon.

Multiple use of aerial counts
During the aerial counts, not only birds, but marine mammals are counted as well. This provides information about trends in and the spatial distribution of these animals. The data support the assessment of harbour porpoises under D1C2 (population abundance), D1C4 (distribution) and D1C5 (habitat).

Innovation - Digital aerial surveys
Counting birds on the basis of photographs or videos taken from a plane with high-definition cameras is currently being developed as an alternative survey method. With this method – which is already operational in Germany – specific species can be distinguished even when flying above the tip height of wind turbines (>300 m), which is not possible with visual surveys at that altitude. In the winter season 2020/2021, an initial trial with digital aerial surveys will be carried out over the Gemini wind farm to record avoidance behaviour by razorbills and guillemots.

Statistics Netherlands' statistical analysis (see 'Analysis of monitoring programme') showed no reason to switch to monitoring with high-definition cameras at this stage, but Rijkswaterstaat will continue to monitor developments because it might be worthwhile to make the transition in the future.

Innovation - Drones
A number of experiments have recently been carried out to determine the added value of using drones to count colonial nesting birds. They showed that the numbers of breeding pairs of some species can be determined more accurately, and sometimes with less disruption, with drones than with conventional counting methods (Spaans *et al*., 2018; Blew, 2003). However, there are laws and regulations governing the use of drones. The potential negative impact on birds would also have to be considered.

Offshore Wind Power Ecological Programme (Wozep)
In 2016, a seven-year research programme was launched to investigate gaps in the knowledge regarding the ecological effects of offshore wind energy. Rijkswaterstaat carries out the Offshore Wind Power Ecological Programme (Wozep) for the Ministry of Economic Affairs and Climate Policy. The aim of the programme is to investigate the cumulative impact of the construction and use of offshore wind farms for the protected habitats and for species groups and their habitats.
One possible impact is that birds and bats could collide with wind turbines. For more information about the Wozep programme, see chapter 4.

1.7 Population abundance: Fish (D1C2)

Criterion D1C2 (primary)
The population density of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured.

GES and indicators

GES
GES is linked to that of D3 (commercially exploited fish):
D3C1: The fishing mortality rate (F) of populations of commercially-exploited fish or shellfish species is at or below levels which can produce the Maximum Sustainable Yield (MSY): F≤Fmsy.
D3C2: The Spawning Stock Biomass (SSB) of populations of commercially-exploited fish or shellfish species is above the precautionary level MSY Btrigger (in accordance with ICES recommendation).

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Populations of all commercially-exploited fish and shellfish species.	MSFD Greater North Sea	Number of fish stocks	100 percent	CFP

GES
Improvement in the population abundance of sharks and rays in the North Sea, and above all in the coastal zone.

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
No indicator available yet				

GES
Rise in the proportion of vulnerable species of fish in the fish community (OSPAR)

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Restoration of populations of vulnerable fish species	OSPAR Greater North Sea	*Species – individuals*	Significant recovery of populations of sensitive fish species	National interpretation

GES
For the Habitats Directive species, the migratory fish Twaite shad (H1103), salmon (H1106), sea lamprey (H1095), river lamprey (H1099) and Allis shad (H1102): population of migratory fish must satisfy the favourable reference value for population abundance (FRP) according to the Habitats Directive.

Indicator[40]	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
HD: Favourable reference value for population abundance (FRP)	National	Population abundance	Compliance with FRP	Habitats Directive

1.7.1 From information requirements to monitoring strategy

Specific monitoring is required for assessing compliance with the four definitions of GES.[41]

1) Commercially-exploited fish
Compliance with GES for the indicator 'commercially exploited fish and shellfish populations' is determined mainly by the pressure factor 'fishing mortality rate' (F). This is reported individually for each stock, with the requirement that F is at or below the maximum level for achieving the maximum sustainable yield (MSY).

[40] The indicator is not explicitly mentioned in the Marine Strategy Part 1 (2018), but is derived from the defined GES.

[41] It also provides insight into achievement of the overarching GES 'The population densities and demography of fish populations suggest healthy populations'.

Another important factor in assessing whether GES for commercially-exploited species is being attained is the spawning stock biomass (SSB), since it determines the growth of the relevant species in the following year. The SSB is expressed in 'tonnes'. The lower limit of the bandwidth (MSY Btrigger) is the minimum SSB required to produce the maximum sustainable yield (MSY).

The pressure factor 'fishing mortality rate' is more stringent than measured spawning stock biomass because it is plausible that long-term exploitation of all stocks at MSY level will automatically result in an SSB above MSY Btrigger. It is not known how far above because of the influence of external factors such as predation and/or competition with other stocks. The requirements for both F and SSB correspond with those in the Common Fisheries Policy (CFP).

The functional requirements for the Netherlands ensuing from the CFP are included in the Statutory Research Tasks (WOT) for fisheries and the Data Collection Framework (DCF). The necessary stock surveys are carried out every year by research vessels using a standard method and are then assessed per stock at the level of the international North Sea. The standardisation of the monitoring allows for comparison with the results from previous years. Apart from information from the fisheries sector, the surveys also provide an independent assessment of the development of (parts of) the fish populations.

2) Population abundance of sharks and rays

The achievement of GES for the indicator 'population abundance of sharks and rays' is based on the size, distribution and condition of populations of sharks and rays. There are no specific requirements for the necessary monitoring. Given the small size of the populations of sharks and rays in the Dutch section of the North Sea, it is difficult to determine the size, distribution and condition of these animals with a reasonable monitoring effort. It was therefore decided to base the assessment on information from existing monitoring surveys (stock surveys for the CFP), supplemented by measures drawing on the precautionary principle. To this end, the assessment is linked to the MSFD Sharks and Rays Action Plan 2015-2021, which is aimed at mitigating the pressure factor 'extraction or death/injury of sharks and rays by commercial and recreational fisheries'. According to the action plan, the instruments to be used are communication and education, reduction of undesirable by-catch, and other measures to increase the age of sharks and rays. There is a clear link with the recovery of the proportion of vulnerable species in the fish community (see below).

3) Vulnerable fish species (OSPAR)

OSPAR's vulnerable species indicator is a yardstick of the sensitivity of the fish community as a whole. For this indicator, in addition to the data on commercial stocks (number per species, per size class and per trawl), the data on the other fish species are also required. However, monitoring specific vulnerable species is problematic precisely because the most vulnerable species are not abundant. Consequently, there are not enough of them in the counts of the current monitoring programmes to serve as a useful indicator. However, fish species can be classified as vulnerable or otherwise on the basis of the relationship to their environment (autecology). Vulnerable species generally mature late, continue growing for a long time and reach a considerable length. This information is used to produce a time series of the proportion of vulnerable species in the catches of research vessels. It should therefore be possible to assess whether the proportion of vulnerable fish species has increased, or at least has not declined. It is plausible that the trend in this indicator is also representative for sharks and rays.

The data collected for the CFP forms the basis for this OSPAR indicator. If changes are made in the CFP monitoring, it could have an impact on the data available to apply this indicator.

4) Population abundance (FRP) of migratory fish (HD)

To achieve GES, the populations of migratory fish must comply with the reference values prescribed in the reporting for the Habitats Directive. The FRP for migratory fish is based on available data from the monitoring requirements and expert opinion. No requirements are stipulated.

1.7.2 Monitoring surveys

Almost all of the relevant monitoring surveys for D1C2 fall under the monitoring for the CFP. This monitoring is standardised for the various fishing methods and the periods and locations specified for the sampling. Some monitoring surveys date from the end of the 1960s. However, only the data that have been collected since the year in which a monitoring survey was declared to be sufficiently consistent are included. This differs between surveys.

Each monitoring survey has to use the so-called stratified random sampling method, whereby at least one, but often more, hauls are carried out in the ICES blocks to be surveyed, in principle by different countries. The hauls are aggregated each year to calculate the indices.

The monitoring surveys provide data on the age, distribution and – per age group – the number, the average weight, the sex ratio and gender maturity of captured fish. Landing data are also needed, for example to substantiate calculations on fishing mortality. To this end, the CFP obliges fishermen to keep records of landings.

The Netherlands' contribution to the monitoring is part of the WOT Fisheries programme. This monitoring is conducted annually, in consultation with other countries, at the level of the international North Sea. ICES coordinates the monitoring and the quality assurance and the quality control.

The densities of Habitats Directive fish species are very low in the Dutch section of the North Sea. Consequently, few if any are found during the regular monitoring for the CFP. The specific monitoring of these species falls under the Ministry of Agriculture, Nature and Food Quality's WOT and Rijkswaterstaat's MWTL. For these species of migratory fish, the data on the prevalence of freshwater fish in the Netherlands can also be used. These data are available from the Dutch Ecological Monitoring survey (EMN), a programme coordinated by RAVON.

Salmon are monitored mainly with specific monitoring surveys in the inland waters. The species is monitored passively with fyke nets. The data from the Rhine river basin determine the national trend in the population.

Sea lamprey, river lamprey, Allis shad and Twaite shad are also monitored with passive fishing gear (eel traps). To determine the national trend in the populations of these species data from traps in the basins of all the Dutch rivers are mainly used.

1.7.3 Assessment method

Every definition of GES has its own Assessment method.

1) Commercially-exploited fish
The monitoring of commercially caught fish, the conversion of data into information, and the Assessment method have been developed under the Common Fisheries Policy and are agreed within ICES. To meet the requirement for this GES, for every stock F≤Fms is required and the SSB must be above the threshold value (MSY Btrigger*)*. This is the lowest SSB value at which the MSY can certainly be reached. See also ICES (2011, 2012).

2) Population abundance of sharks and rays
No method of assessing compliance with this GES has been designed yet. As a precaution, the measures in the MSFD Sharks and Rays Action Plan (2015-2021) are being implemented to improve the status of these species.

3) Vulnerable fish species (OSPAR)
Under the auspices of OSPAR, an indicator has been developed for the assessment of vulnerable species. For each monitoring survey, it is determined for how many vulnerable species the number of observed individuals per species, for the relevant monitoring year, are in the top 25 percent during the entire time series. Finally, aggregation of the data from the monitoring surveys gives a regional assessment (Greenstreet *et al.,* 2012).
Since 1983, the sampling of vulnerable species in the fish community has been found to be sufficiently consistent for an evaluation of this indicator. An additional quality control (QA/QC) procedure has been incorporated into the calculation of the indicator (Moriarty, 2017, Greenstreet, 2017).

4) Favourable reference value for population abundance (FRP) for migratory fish (HD) The assessment of whether GES has been reached is based on the FRP as defined in Ottburg and Van Swaay (2014). Wherever possible, monitoring data are used for the assessment based on FRP. Given the limited availability of data for these species, up to now the assessment has been based mainly on expert opinion.

1.7.4 Analysis of monitoring programme

There are no changes in the monitoring programmes compared with the MSFD monitoring programme in 2014.
The assessment of the spawning stock has, since the 1950s, been performed by ICES using standardised methods. An indicator has been developed for the assessment of the proportion of vulnerable species of fish in the fish community, which was used in OSPAR's Intermediate Assessment.

Due to the low densities of sharks and rays in the North Sea, the CFP monitoring is unable to provide insight into the size of the population of these species. If possible, the Assessment method for these species must be fleshed out. For the other elements, the monitoring is adequate and an Assessment method is in place.

1.7.5 Cooperation and developments

Monitoring for the MSFD is linked to the monitoring required for the CFP and/or the Habitats Directive and follows any developments in them.

The current monitoring is inadequate for assessing (changes in) the population abundance of sharks and rays. In 2020, therefore, the possibilities for gathering more information about these species will be explored. This could lead to modification of the MSFD monitoring programme. Up to now, the cephalopods found in the Dutch section of the North Sea have been disregarded for the purposes of criterion D1C2, partly because so little information is available about these species. Nevertheless, cephalopods should also be covered in the assessment, and research will therefore commence into the possibilities of identifying the necessary sources of information for these species in 2020. This study should show whether additional monitoring is required.

1.8 Demographic characteristics: Seal pup production (D1C3)

Criterion D1C3 (secondary)

The population demographic characteristics of the population (e.g., body size or age class structure, sex ratio, fecundity and survival rates) of the species are indicative of a healthy population that is not adversely affected due to anthropogenic pressures.

GES and indicators

GES[42]
No reduction in the birth rate of the grey seal by more than 1 percent since the last assessment and not more than 25 percent reduction since 1992 (OSPAR).

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Grey seal: pup production (OSPAR)	Wadden Sea[43]	Percentage development of the number of grey seals born	No reduction in the trend of pup production to the level whereby the maximum decline is 1 percent as compared with the last assessment	OSPAR IA 2017

GES[44]
No reduction in the birth rate of the harbour seal by more than 1percent since the last MSFD assessment and not more than 25 percent reduction since 1992.

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Harbour seal: pup production	Wadden Sea and Southwestern Delta	Percentage development of the number of harbour seals born.	No reduction in the trend of pup production to the level whereby the maximum reduction is 1 percent as compared with the last assessment	National interpretation

[42] There is also a correlation with the overarching GES: 'The population densities and demography of populations of marine mammals indicate healthy populations'.

[43] Pups of grey seals are monitored in both the Wadden Sea and the Zeeuwse Delta, but only the Wadden Sea counts for the purpose of the OSPAR assessment because almost all of the pups are born there.

[44] Pup production by the harbour seal is a supplement to the Marine Strategy Part 1 (2014). GES and the indicator are now the same as for the grey seal. Pups from both the Wadden Sea and the Zeeuwse Delta are considered in the assessment since both are important areas for pup production. In this case, there is also a correlation with the overarching GES: 'The population densities and demography of populations of marine mammals suggest healthy populations'.

1.8.1 From information requirements to monitoring strategy

The birth rate of the grey seal must not decline by more than 1 percent annually since the last assessment (for OSPAR since 2017), and not by more than 25 percent since 1992.[45] This OSPAR indicator is assessed at the level of the North Sea region.[46] Monitoring must therefore provide insight into trends on that scale.

The harbour seal is disregarded in the OSPAR indicator for pup production because many other OSPAR countries do not monitor the species. However, the production of harbour seal pups in Dutch territory, where the limitations of other countries to monitoring do not apply, is included as a national supplement to the OSPAR indicator, since this information provides insight into the extent to which GES 'health of populations of marine mammals' is being achieved. Furthermore, it ties in with assessments for the Habitats Directive and the Trilateral Wadden Cooperation. The monitoring and assessment of the harbour seal in Dutch territory is the same as for the grey seal and at least meets OSPAR's requirements. However, the level of assessment is different: it is the national level for the harbour seal and the North Sea region for the grey seal.

Functional requirements/monitoring strategy

The counting of seal pups is linked to the pupping period. For grey seals, that is December and January; for harbour seals it is June and July. OSPAR imposes no specific requirements on the frequency of monitoring of grey seal pups. Given the great fluctuations in the past, the Netherlands conducts annual surveys of both seal species. To gain insight into any changes in peaks in births and to compensate for variations due to environmental factors, there are three counts during each pupping period.

The OSPAR indicator only covers the pup production of the grey seal. The scale of the assessment is the Greater North Sea (OSPAR Region II). For this purpose, the North Sea is divided into various units. The Dutch Wadden area is part of 'Wadden Sea and Helgoland'; the Zeeuwse Delta (and the adjacent Belgian marine area) fall under 'Dutch Delta'. No grey seal pups have ever been born in the latter area.
The assessment at national level also treats the Wadden area and Zeeuwse Delta as separate units for both seal species.
OSPAR imposes no other explicit requirements on the monitoring. For further details about the functional requirements and monitoring strategy, see the CEMP Guideline (M5: Grey Seal pup production, 2016)

1.8.2 Monitoring surveys

For the monitoring surveys, see D1C2 Population abundance of seals.

1.8.3 Assessment method

OSPAR: grey seal
The survey is intended to determine that the annual birth rate of the grey seal has not declined by more than 1 percent since the last assessment, in other words by more than roughly 6 percent over six years, and not by more than 25 percent since 1992. Pup production is estimated on the basis of the maximum value, the highest number from the three counts during the pupping period, per year. A distinction is made between the various tidal areas where the animals are counted; in the Netherlands these are the Wadden Sea and Delta. For the precise Assessment method, see the M5 CEMP Guideline (OSPAR, 2016). The Trilateral Seal Expert Group (TSEG) coordinates and evaluates the counts trilaterally. Data are supplied to OSPAR for each country and for each tidal area.

National supplement: harbour seal
The same system is used for the assessment of the harbour seal pups as for the grey seal pups, but at national level.

1.8.4 Analysis of monitoring programme

The current monitoring programme (counts of harbour seal and grey seal pups in the Wadden area and the Zeeuwse Delta) is suitable for monitoring the long-term and very long-term trends in pup production and therefore meets the national information requirements and those of OSPAR.

1.8.5 Cooperation and developments

As far as possible, the information for D1C3 corresponds with agreements and developments in OSPAR. The data obtained for Wadden Sea and Delta are provided to OSPAR for joint data analysis.

[45] The latter analysis is of less significance in the Dutch section of the North Sea: the birth of two grey seals was first registered in 1987; in 1992 the number was seventeen. More than a thousand pups are now born every year (Brasseur *et al.,* 2015).

[46] In the United Kingdom, where more than 90% of the grey seal pups are born, pup production is the only indicator for this species. In other areas, like the Netherlands, where fewer pups are born but a lot of animals forage, the total numbers of grey seals are also counted (see D1C2).

Seals fall not only under MSFD and OSPAR, but are also protected under the Habitats Directive. In that context, data on pup production are also taken into account in determining the conservation status of grey and harbour seals.

Because the populations extend beyond national borders, there has been close cooperation with Germany and Denmark since 1974. In the context of the Convention on the protection of migrating wild animal species (Bonn Convention, CMS), since 1994 there has been a joint management system for seals in the Wadden Sea. The countries also coordinate the monitoring in the Wadden area.

1.9 Demographic characteristics: Breeding success of birds (D1C3)

Criterion D1C3 (secondary)
The population characteristics of the population (e.g., body size or age class structure, sex ratio, fecundity and survival rates) of the species are indicative of a healthy population that is not adversely affected due to anthropogenic pressures.

GES and indicators

GES[47] For each species, a lack of breeding success may not occur in more than three years in six (OSPAR assessment value).				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Breeding success or breeding failure among marine birds	OSPAR Greater North Sea	Dutch species: Cormorant, Herring gull, Great black-backed gull, Lesser black-backed gull, Common gull, Black-headed gull, Common tern, Arctic tern, Sandwich tern, Little tern, Black-legged kittiwake	At least three successful breeding seasons in six years. This threshold value applies for all species.	OSPAR

1.9.1 From information requirements to monitoring strategy

GES for breeding success is formulated as a value for the assessment of OSPAR indicator B3 'breeding success' at the level of the entire North Sea (Greater North Sea, OSPAR Region II, North Sea including Skagerrak and the sea between Scotland and West Norway).

Functional requirements/monitoring strategy
The monitoring requirements follow from the specifications of the OSPAR indicator for breeding success, taking into account the need to report at both regional level (OSPAR) and national level (national supplement to MSFD). The assessment at national level is specifically concerned with breeding birds that depend to a large extent on the North Sea (coastal zone and/or EEZ) for their food during the breeding season. The reporting for OSPAR (North Sea level) also includes breeding birds that depend on intertidal areas.

There is a strong similarity in terms of objectives and agreements with the Trilateral Monitoring and Assessment Programme (TMAP[48]), which is therefore also reviewed here.

Bird species
Roughly 21 species of Dutch breeding birds depend heavily on marine waters for food during the breeding season. For ten species, that is mainly the North Sea coastal zone and/or the EEZ (table 1.9.1). Fifteen species were reported on for the Interim Assessment 2017 for OSPAR.

Level of detail of the assessment
To match OSPAR's information requirements, the monitoring of the breeding success counts the number of fledglings per breeding pair each year. This parameter can be used directly (in population models) to assess the species' 'demographic health' and sustainability of populations.

[47] There is also a correlation with the overarching GES 'The population densities and demography of bird populations indicate healthy populations'

[48] http://www.waddensea-secretariat.org/monitoring-tmap/about-tmap

Table 1.9.1 Bird species relevant for monitoring of breeding success for MSFD/OSPAR and TMAP. Included are species that breed in the Netherlands and which depend for food during the breeding season to a large extent on the North Sea (coastal zone and/or EEZ; species in the top half of the table) or on saline intertidal areas (estuaries). Shown under the heading 'reporting' are, respectively, the species reviewed in the OSPAR Interim Assessment 2017 *('x': species reviewed; 'x': species only mentioned as potential addition), species which are to be included in the national supplement to the MSFD report, and species which are monitored in the TMAP reproduction monitoring scheme for the Wadden Sea. The last two columns show the proportion of the Dutch populations that breed in the Wadden Sea area and the Southwestern Delta, respectively.*

Bird species	Foraging habitat			Reporting			% Dutch breeding population	
	estuaries	coastal zone	EEZ	OSPAR	MSFD	TMAP	Wadden	Delta
Black-legged Kittiwake				X	*		0*	0*
Lesser black-backed gull				X	X	X	40	50
Sandwich tern				X	X	X	60	35
European herring gull				X	X	X	50	38
Great black-backed gull				X	X		40	50
Common gull				X	X		50	25
Great cormorant				X	X		17	12
Common tern				X	X	X	25	35
Arctic tern				X	X	X	90	10
Little tern				X	X		30	70
Black-headed gull				X		X	40	30
Eider				X		X	98	2
Common Shelduck				.			±35	±20
Red-breasted Merganser				.			10	90
Eurasian spoonbill				X		X	52	23
Little egret							6	92
Eurasian oystercatcher				X		X	85	15
Pied avocet				X		X	29	46
Common ringed plover				.			30	45
Kentish plover				.			10	80
Common Redshank				.			±25	±10

* In the Netherlands, the Black-legged kittiwake only breeds on drilling platforms in the EEZ. The population is tiny compared with numbers elsewhere around the North Sea, and monitoring numbers and breeding success is logistically problematic.

Moreover, information about specific parameters (hatching success, chick survival) is needed to identify possible pressure factors.

Monitoring frequency and spatial coverage

OSPAR has not yet formulated any specific requirements for the frequency and spatial coverage of the monitoring of breeding success. OSPAR indicators are evaluated and reported on in a six-year cycle. However, the current OSPAR indicator for breeding success – a lack of breeding success may not occur in more than three years out of six – implies annual or almost annual monitoring. The breeding success of marine and coastal birds can vary greatly from year to year depending on variations in food supply, weather conditions and incidental events, such as nests being flooded by storm surges. The annual variation in breeding success is therefore generally (far) greater than the variation in the numbers of birds. A high (annual) monitoring frequency is therefore necessary for the timely discovery of trend changes.

Under OSPAR and TMAP, no specific requirements have been are formulated for the sensitivity of the monitoring survey that lead to a minimum sample size.

The applicable scale for the OSPAR assessment of breeding success is the Greater North Sea. It

is supplemented by an assessment at national level for the MSFD. The data from the Wadden Sea area and the Southwestern Delta are particularly important for determining the breeding success in the Netherlands (see table 1.9.1).

1.9.2 Monitoring surveys

Delta area and North Sea Coast
There has never been a permanent monitoring survey for breeding success in the Delta area and along the Dutch North Sea coast. Surveys were carried out on an ad hoc basis. In the Southwest Delta, the breeding success of gulls and terns will be monitored annually from 2020. Details of the monitoring programme will be fleshed out in early 2020 (see also sections 1.9.4 and 1.9.5.

Wadden Sea
The Wadden Sea Reproduction Monitoring Scheme was established in 2004[49]. In addition to the monitoring of numbers and distribution of breeding birds (see D1C2), data on the breeding success of ten species of coastal breeding birds are collected in the Dutch Wadden Sea (Thorup and Koffijberg, 2016), including a number of species that forage in the North Sea. The Wadden Sea Reproduction Monitoring Scheme is part of the Statutory Research Task Nature Information (WOT-IN). Sovon Dutch Centre for Ornithology carries out the monitoring in association with Wageningen Marine Research (WMR, formerly IMARES). Since 2010, the research has been part of the Trilateral Monitoring and Assessment Programme (TMAP) in the international Wadden Sea.

The Wadden Sea Reproduction Monitoring Scheme monitors the breeding success in the international Wadden Sea of ten species of birds that are regarded as representative of specific habitats and food groups: Spoonbill, Oyster catcher, Avocet, Lesser black-backed gull, Herring gull, Black-headed gull, Eider, Sandwich tern, Arctic tern and Common tern. Of these, the Lesser black-backed gull, the Herring gull, the Sandwich tern, the Arctic tern and the Common tern depend to a large extent on the North Sea coast or the EEZ for their food.

The survey focuses primarily on measuring the number of fledglings per breeding pair each season. To learn about the stage of the breeding cycle in which losses occur, data are also collected about the success rates in the egg and chick phase.

The Wadden Sea Reproduction Monitoring scheme monitors annually. To ensure that the monitoring is representative in spatial terms, the international Wadden Sea is divided into fifteen areas in the TMAP programme. The aim is to perform one or more surveys of the breeding success of each species found there.

The monitoring scheme's database, which is managed by Sovon, contains information about the location, bird species, survival of clutches of eggs and chicks, and the number of fledglings per breeding pair, the estimation method and any additional remarks.

Sovon performs the field work in most of the Wadden area; Wageningen Marine Research (WRM) is responsible for the study of the Oyster catcher population on Texel. The research institutes are assisted by volunteers, ornithologists (on Griend, for example) and other employees of land-management organisations.
In addition to information from the permanent monitoring scheme, data are also used from projects such as the monitoring of terns in the Eemshaven (because of the nuisance they cause for businesses there), research by the NIOZ into the Lesser black-backed gull and the Herring gull on Texel, and research into Spoonbills by the Dutch Spoonbill Working Group and the University of Groningen.

1.9.3 Assessment method

Since 2014, the data from the monitoring survey have been used for the OSPAR biodiversity indicator *B3 breeding success/failure* (OSPAR 2016). This indicator is calculated from time series of annual estimates of the breeding success[50] of marine bird species in colonies/breeding areas throughout the OSPAR region and individual sub-regions. Up to now, all the Dutch data have been generated by the Wadden Sea Reproduction Monitoring survey and are combined with data from other countries to produce the assessment for the Greater North Sea sub-region.

[49] For some species and at some locations, such as the Sandwich tern and the Common tern on Griend, the breeding success has been measured for a far longer period in the context of specific studies.

[50] Number of chicks per pair, but in the absence of data on numbers of young per pair, the parameter can also be derived from data on successful hatching.

The metric used is the annual colony failure rate, in other words the annual fraction of colonies/areas where the reproduction of the relevant species fails. The criterion for 'failure' is a threshold value of 0.1 fledgelings per pair, with some room for other interpretations. Not all of the colonies in the sample have to be surveyed every year. The average annual colony failure rate is calculated as the annual coefficient of a binomial generalised linear model with effects for colony/area and year. On that basis, an assessment is made of the years in which there is 'widespread failure'. The criterion for terns is 'a probability greater than the average value over the preceding fifteen years'; for the other species, it is 'a probability greater than 5 percent'.

For the final OSPAR assessment, the frequency of 'widespread failure' is determined over a period of six years,[51] providing that it must not occur more than three times in six years. One or two years with widespread failure is regarded as acceptable, given the range of possible natural and anthropogenic factors that could cause failed breeding years. However, the cumulative effect of failures in more than half of the years could have significant impacts on regional population development and on the OSPAR indicator for population abundances.

For the purposes of the MSFD, the annual or biannual reports of the Wadden Sea Reproduction Monitoring survey provide a national supplement. This is currently the only systematic monitoring of breeding success in the Netherlands. Since the spatial area of the monitoring is being expanded (see 'Monitoring surveys and Analysis'), this will also be reported (probably annually), with a similar Assessment method.

1.9.4 Analysis of monitoring programme

When the previous Marine Strategy part 2 (2014) was being drafted, the indicator 'breeding success' was not included in the monitoring programme. It has been added since and breeding success is now an explicit component of the Marine Strategy Part 1 (2018).

The monitoring effort in the Wadden area is regarded as adequate (Statistics Netherlands, 2018), and the spatial coverage is relatively good in terms of species that forage in the North Sea to the north of the Wadden area (Koffijberg *et al.,* 2017). The Great cormorant, the Common gull, the Great black-backed gull and the Little tern are not monitored in this survey, but otherwise the entire group of ten TMAP bird species form a representative subset of the species referred to in table 1.9.1.

From 2020, a permanent monitoring scheme for breeding success will also be launched in the Southwestern Delta under the MSFD. Collaboration will also be sought with other parties for this programme (see 'Cooperation and developments'). There has not been a systematic monitoring programme for reproduction outside the Wadden Sea area up to now, but the Delta area is also an important region for breeding marine and coastal birds. It is also home to a large proportion of the Dutch breeding populations of marine foragers: 70 percent of the Little terns, 50 percent of the Lesser black-backed gulls, 38 percent of the Herring gulls, 35 percent of the Sandwich terns, as well as 35 percent of the Common terns and 25 percent of the Common gulls (table 1.9.1). The Dutch coastal strip between Den Helder and the Maasvlakte is of less significance as a breeding area for marine and coastal birds.

However, substantial numbers of Herring gulls, Lesser black-backed gulls and Common gulls breed widely in urban areas. They often nest on rooftops where monitoring is difficult. For a number of years, a large colony of Sandwich terns has bred in Camperduin. There are also four large colonies of cormorants in this coastal strip, from where the birds fish mainly at sea. The colonies in Callantsoog, Castricum, Zandvoort and Wassenaar together make up roughly 15 percent of the Dutch population. In other words, the breeding success of sea-foraging Great cormorants is not monitored anywhere in the Netherlands, although roughly 45 percent of the national population breeds in the Delta, the Wadden area and the Dutch coastal strip combined and the Great cormorant has become an important consumer of fish in the North Sea coastal zone.

Furthermore, this species is the only breeding representative of the OSPAR functional group 'water-column foragers' and hence a relevant yardstick for impacts of pressure factors and measures at sea. Another species that is not monitored is the Black-legged kittiwake. However, this species only breeds on oil and gas platforms in the EEZ, where the logistics of monitoring breeding success pose a major challenge.

Because the numbers involved are small in international terms (several hundred pairs), there is less need for a monitoring programme for this species.

1.9.5 Cooperation and developments

Wadden Sea

The Wadden Sea Reproduction Monitoring scheme is part of the Trilateral Monitoring and Assessment Programme (TMAP), under a ministerial agreement between the Netherlands, Germany and Denmark. Researchers and organisations from the three countries collaborate intensively in TMAP, coordinating their methods, the spatial parameters of the monitoring programme and publications.
For the Dutch component of the programme, Wageningen Marine Research (WMR) and Sovon collaborate with land managers (State Forestry Service (*Staatsbosbeheer*), nature conservation organisation Natuurmonumenten, and the association of private provincial land-management organisations) and some other research organisations (NIOZ, species

[51] An evaluation every six years is consistent with the EU's MSFD reporting cycle.

working groups). The design and management structure of the monitoring survey that has been developed in recent years will be consolidated.

Delta area
The gap that has been identified in monitoring in the Delta area will be filled through an initiative to start monitoring breeding success, survival and certain pressure factors affecting coastal breeding birds in the Southwestern Delta. Various parties, including the Province of Zeeland, Rijkswaterstaat and regional land managers, are fleshing out the details of a monitoring plan in early 2020.

Assessment under OSPAR
The current assessment system for the OSPAR biodiversity indicator B3 'breeding success/failure' has its limitations. The assessment concentrates on extreme events that lead to virtually no young birds being produced in a colony. Hence, it ignores situations where the breeding success is not extremely low, but is still insufficient to ensure a stable population in the long term. The simultaneous, almost total failure of reproduction in entire colonies also occurs more often in colonies of 'genuine marine birds,' such as guillemots and black-legged kittiwakes, than in coastal species, like gulls, terns and waders, which are distributed more widely throughout the Netherlands.

The indicator of breeding success was developed by the Joint OSPAR/HELCOM/ICES Working Group on Marine birds (JWGBIRD), an international working group that advises ICES, OSPAR and HELCOM on indicators for bird communities.[52] To address the shortcomings outlined above, JWGBIRD has in recent years developed a proposal for a revised indicator (JWGBIRD, 2019). It compares average reproduction over a series of years with information on age at recruitment and annual survival rates of the relevant species to generate a direct estimate of the projected rate of long-term population growth with the help of a population model. This would allow for the use of assessment criteria employed by the International Union for Conservation of Nature (IUCN), and others, uses for assessing the conservation status of species and for Red Lists.[53] Details of the approach will be fleshed out in the coming period.

1.10 Demographic characteristics: size structure of fish community (D1C3)

Criterion D1C3 (primary)
The population demographic characteristics (e.g., body size or age class structure, sex ratio, fecundity, and survival rates) of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures.

GES and indicators

GES[54] Increase in the proportion of large fish in the fish community (OSPAR).				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
OSPAR Large Fish Indicator (LFI)	Greater North Sea	Large Fish Indicator (LFI)	Upward trend in the percentage of large fish	OSPAR

1.10.1 From information requirements to monitoring strategy

OSPAR has formulated the Large Fish Indicator (LFI) for determining whether the demographic balance in the fish community is moving towards GES. Since fisheries generally catch the largest individuals, the proportion of large fish could be expected to rise if the pressure from fisheries declines. The data required for the assessment of fish stocks are collected in accordance with the Common Fisheries Policy (CFP). On this point, see D3 'commercially exploited species of fish and shellfish'. The OSPAR indicator describes the demography of the demersal fish community in terms of the size structure and is therefore closely linked to the indicator 'typical length of fish' (D4C3). A difference is that a survey-specific, optimal length that distinguishes between 'large' and 'small' fish is needed for the calculation for the LFI.

[52] HELCOM is the Baltic Marine Environment Protection Commission (Helsinki Commission)

[53] See https://www.birdlife.org/europe-and-central-asia/european-red-list-birds-0 and https://www.iucnredlist.org/about/background-history

[54] There is also a correlation with overarching GES 'The population densities and demography of populations of fish indicate healthy populations'.

The optimal length and target value have been established at international level (ICES and OSPAR). Each survey adopts its own optimal length based on its own time series of the proportion of large fish in the demersal fish community. It should be possible to determine from the time series whether the proportion of large fish has increased, which would indicate recovery of the size-structure of the demersal fish community. GES is achieved if the proportion of large fish exceeds the target value. The OSPAR indicator requires an annual survey with adequate spatial coverage. The existing structure with one or more trawls per ICES block/transect meets that requirement. There are no requirements for statistical reliability; for example, the influence of extra variability due to anthropogenic or natural factors is disregarded.

1.10.2 Monitoring surveys

Most of the data for the OSPAR Large Fish Indicator (LFI) are derived from the International Bottom Trawl Survey (IBTS). This survey falls under the monitoring for the Common Fisheries Policy and has been operational since the end of the 1960s. For the MSFD reporting, data since 1983 are used because the monitoring survey is guaranteed to have the necessary consistency from that year. One way that consistency is ensured is through the use of the standard bottom trawl, the *Grand Ouverture Verticale* (GOV), which involves multiple trawls according to the principles of 'stratified random sampling' in the relevant ICES blocks, in principle by different member states. Every year the trawls are aggregated to calculate the indices (ICES, 2012). The IBTS monitoring survey registers at least the species and size of every fish that is caught.

The Dutch contribution to the IBTS falls under the Statutory Research Task (WOT) for Fisheries and the Data Collection Framework (DCF). This monitoring is conducted annually, in cooperation with other countries, at the Greater North Sea level. ICES coordinates the monitoring and the necessary quality assurance and quality control. Furthermore, an additional quality assurance and quality control process has been incorporated for calculations for this indicator (Moriarty, 2017, Greenstreet, 2017).

1.10.3 Assessment method

The assessment is based on OSPAR's Large Fish Index (LFI), the instrument for assessing the size-structure of fish and cartilaginous fish communities. The target value is based on the situation in the early 1980s on the assumption that the level of exploitation was still sustainable at that time. That has been verified with historic times series, although these were sampled with a different net.

1.10.4 Analysis of monitoring programme

There are no changes in the monitoring compared with the MSFD monitoring programme in 2014. This indicator is part of the OSPAR Intermediate Assessment. The monitoring is adequate, although, in the absence of a threshold value, for some monitoring surveys which are not based on the standard bottom trawl survey (GOV), results can only give an analysis of the trend. But that is not a drawback for the assessment, because it is based mainly on measurements with the GOV. For the time being, a linear relationship is assumed in estimating when the target value will be reached. The estimate is highly arbitrary and will probably have to be revised.

1.10.5 Cooperation and developments

For criterion D1C3, the monitoring for the MSFD uses data collected for the Common Fisheries Policy (CFP). Developments in the monitoring and assessment for the CFP can therefore have consequences for the implementation of this criterion. International cooperation in organisations such as OSPAR, ICES and the EU is therefore essential for the further development of indicators for D1C3. The Netherlands focuses on the size structure and/or age structure of fish populations. For commercially exploited species, further elaboration at ICES level may be required. The Netherlands plans to investigate this further for other fish communities and cephalopods in 2020. In addition to size structure, on which OSPAR's current indicator is based, the European Commission's Decision 2017/848/EU also refers to characteristics such as age-structure, sex ratio, fecundity and survival rates. Indicators could also be developed for these characteristics.

1.11 Distributional range: marine mammals and fish (D1C4)

Criterion D1C4 (primary for HD species)
The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions.

GES and indicators

GES The distribution of harbour porpoise, harbour seal and grey seal[55] satisfies the favourable reference value for population range (FRR) according to the Habitats Directive.				
Indicator[56]	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
HD: Favourable reference value for population range (FRR)	National	Population range	Compliance with FRR	Habitats Directive

GES For the migratory fish covered by the Habitats Directive Twaite shad (H1103), Salmon (H1106), Sea lamprey (H1095), River lamprey (H1099) and Allis shad (H1102): the distribution of migratory fish in the river area complies with the favourable reference value for population range (FRR) according to the Habitats Directive.				
Indicator[57]	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
HD: Favourable reference value for population range (FRR)	National	Population range	Compliance with FRR	Habitats Directive

1.11.1 From information requirements to assessment

GES is linked to the favourable reference value for population range (FRR) in the reporting for Article 17 of the Habitats Directive. To assess whether GES has been reached, the population range of marine mammals (harbour porpoise, grey seal and harbour seal) and migratory fish (Twaite shad, Salmon, Sea lamprey, River lamprey and Allis shad) must be known.

The reference values are established on the basis of a protocol (questionnaire). They are based on scientific insight, using data from the monitoring surveys described under D1C2. If the available findings are not specific enough, expert judgement is relied on. There are no additional monitoring requirements for this criterion. The relevant species are highly mobile. For all species, the observed population distribution depends entirely on the research effort.

Accordingly, the point of departure is that both the FRR and the distribution of porpoise, grey seals and harbour seals encompass the entire DCS, including the coast, Wadden Sea and Delta. Because the harbour seal is regularly sighted in the IJsselmeer, this lake is also regarded as its habitat (Habitats Directive report, 2019).

Migratory fish, which breed in fresh water but live most of their lives in salt water, are known to follow fixed migratory routes. In accordance with the rules of the EC, these routes are included in the FRR. Although these fish occur in both fresh and salt water, the FRR and the population range are based on fresh-water data (which is also in accordance withGES).

1.11.2 Analysis, Cooperation and developments

The assessment of D1C4 is 'administrative' and is linked entirely to the reporting for Article 17 of the Habitats Directive. Any changes and developments are addressed in that context.

[55] The grey seal is added here; it was mistakenly omitted from the Marine Strategy part 1 (2018).

[56] The indicator is not explicitly mentioned in the Marine Strategy part 1 (2018), but is derived from GES.

[57] The indicator is not explicitly mentioned in the Marine Strategy part 1 (2018), but is derived from GES.

1.12 Habitat of Habitats Directive species: marine mammals (D1C5)

Criterion D1C5 (primary: HD species; secondary: other species)
The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.

GES and indicators

GES Preservation of the size and quality of the habitat of the grey seal (H1364), the harbour seal (H1365) and the harbour porpoise (H1351) (Habitats Directive).				
Indicator[58]	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
HD: Preservation of the size and quality of habitat	National	Size and quality of habitat	Preservation	Habitats Directive

1.12.1 From information requirements to assessment

GES is linked to the size and quality of the habitats of marine mammals. The assessment is linked to the reporting of the Habitats Directive, which indicates whether there is sufficient habitat of the necessary quality to sustain the long-term viability of the species. The HD (and hence the MSFD) specifies no requirements for the monitoring to determine the extent of the habitat. In light of the mobility of these animals, the point of departure is that their habitat encompasses the entire DCS, including the coast and Wadden Sea, and also the IJsselmeer for the harbour seal (see D1C4). In other words, it is an 'administrative' assessment.

Nor have any specific requirements been stipulated for the monitoring to determine the quality of the habitats. The assessment is linked to the HD reporting and is based on expert judgement. In that context, as far as possible data on population trends (see D1C2), ecological key factors (such as availability of food) and important pressure factors (see D1C1, D6C2, D8, D10 and D11) are used.

1.12.2 Analysis, Cooperation and developments

The assessment of D1C5 is linked to the reporting for the Habitats Directive. Any changes and developments in the monitoring and assessment are made in that context.

There is still a great deal of uncertainty, particularly regarding the quality of the habitat. In the HD reporting in 2019, the future perspective for the quality of the habitat of all marine mammals was described as 'unknown', mainly because it is not known what impact various pressure factors are having or could have in the future. An important development in that context is the large-scale construction of wind farms, and the accompanying increase in underwater noise. There is also no clear picture of the impacts from other sources of noise and other pressure factors, such as bycatch in the fisheries, pollution, disruption and climate change.

The MSFD monitoring programme is suitable for monitoring trends at DCS or regional level, but is usually not fit for purpose in establishing causal relationships with the effects of individual pressure factors or measures. In appropriate cases, such questions are addressed in research projects, usually as a condition for the licensing of large-scale offshore activities. One of the most important projects is the Offshore Wind Power Ecological Programme (Wozep), the source of the Framework for Assessing Ecological and Cumulative Effects (KEC), which lays down the basic conditions for the licensing of offshore wind energy activities. The framework is based mainly on models which are iteratively modified on the basis of monitoring and research. The Wozep programme includes research into the impact of underwater noise on the presence and behaviour of harbour porpoises, as well as the consequences of disruption for the condition of the porpoises. For example, a network of passive acoustic monitoring stations has been set up to establish the presence of harbour porpoises on the DCS and around wind farms. By attaching a transmitter to seals, their behaviour around wind farms can also be monitored.

In addition to project-based monitoring, there is also a permanent survey to monitor trends in the impact of pressure factors: every year, fifty stranded harbour porpoises are examined for the Ministry of Agriculture, Nature and Fisheries. The researchers determine the cause of death, their diet and whether they have ingested any contaminants. There is no similar research on seals at present; the possibility of including seals in the stranding survey and the post-mortem examination programme is being explored. For monitoring of bycatch of marine mammals, see D1C1.

[58] The indicator is not explicitly mentioned in the Marine Strategy part 1 (2018), but is derived from GES.

1.13 Habitat of Habitats Directive species: fish (D1C5)

Criterion D1C5 (primary: HD species; secondary: other species)
The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species.

GES and indicators

GES Reduction in barriers in migratory routes so that at the latest by 2027 they represent no obstacle for sustainable populations in the river basins (WFD).				
Indicator[59]	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Reduction of barriers in migratory routes (WFD)	National	Number of barriers	Reduction of barriers	River basin management plans (WFD)

1.13.1 From information requirements to assessment

Various migratory fish species fall under the HD. The quality of their habitat is greatly diminished by barriers that prevent migration land inwards in the river basins. GES and the environmental objectives and measures are therefore concentrated on removing these barriers and so improving the quality of the habitat of the migratory species.

In addition, data collected in specific projects, for example on the functioning of fish passages and from telemetric research, could also be used. There are no specific requirements for the monitoring.

The monitoring and assessment are linked to what is being done in this respect under the WFD. The monitoring data for the migratory species and the national fish migration map that shows fish passages and remaining barriers can be used for this purpose.

1.13.2 Analysis, Cooperation and developments

The assessment of D1C5 is linked entirely to the WFD and its elaboration in the River Basin Management Plans. Any changes and developments are addressed in that context.

[59] The indicator is not explicitly mentioned in the Marine Strategy part 1 (2018), but is derived from GES.

1.14 Pelagic habitats (D1C6)

Criterion D1C6 (primary)

The condition of the habitat type, including its biotic and abiotic structure and its functions (for example, its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), is not adversely affected due to anthropogenic pressures.

GES and indicators

GES

For pelagic habitats, GES will have been achieved if the spatial and temporal variation in the plankton community remains within a long-term bandwidth that indicates GES. The bandwidths to be used must still be determined on a regional basis, in cycle two.

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Pelagic habitats biomass and abundance (OSPAR)	OSPAR Greater North Sea	Biomass of phytoplankton and abundance of zooplankton	No threshold values have been determined yet	
Changes in phytoplankton and zooplankton communities (OSPAR)	OSPAR Greater North Sea	Holoplankton versus meroplankton, diatoms versus dinoflagellates and small copepods versus large copepods	No threshold values have been determined yet	

1.14.1 From information requirements to monitoring strategy

To establish whether the environmental status for this criterion complies with GES it must be possible to identify changes in the composition, the biomass and the abundance of the plankton community. The Marine Strategy part 1 contains two indicators for this criterion. Both are still being developed in OSPAR; no threshold values have (yet) been established.

The functional requirements for the monitoring surveys are linked to OSPAR's CEMP Guidelines, PH2 'Changes in Phytoplankton Biomass and Zooplankton Abundance' and PH3 'Changes in plankton diversity', respectively. Given the natural variability of the plankton community and the relatively rapid response time of the indicator, in both cases the sampling frequency must be at least once a month. The monitoring has to provide sufficient information to enable trends to be reported every two or three years. The monitoring must also cover all eco-hydrodynamic units (areas with a similar dynamic and ecology). These units have not yet been defined. That is expected to be done in 2020.

Only the total abundance of copepods is considered in determining the biomass of zooplankton; that group is taken as a proxy for the entire zooplankton community. There are various ways of determining the biomass of phytoplankton. The Netherlands chooses to measure the biomass of chlorophyll a.

1.14.2 Monitoring surveys

There are both national and international monitoring surveys. The national survey, which is part of Rijkswaterstaat's MWTL programme, determines the biomass of phytoplankton on the basis of chlorophyll-a concentrations. For details of its monitoring, see D5C2.

The monitoring of the species composition of phytoplankton will commence in 2020 (since 2014 only the phytoplankton species Phaeocystis has been measured). There are three monitoring locations along the Dutch coast divided among the eco-hydrodynamic units (on the basis of the EUNOSAT project, see section 5.2). Every year, the species composition of phytoplankton is measured once a month during the growing season from March to September. The species composition is determined using microscopic analysis.

The international monitoring survey relies on measurements with the Continuous Plankton Recorder (CPR) and is coordinated by the Sir Allister Hardy Foundation for Ocean Science (SAHFOS) in the United Kingdom (UK). The survey's monitoring sites encompass a wide area of the UK's and neighbouring waters (see OSPAR, CEMP guideline PH1/FW5). The surveys are carried out by ships carrying the sampling equipment on board and following the relevant routes. Samples are taken continuously and are analysed every month. The CPR collects data on the species composition and abundance of both phytoplankton and zooplankton.

Both monitoring surveys adhere as closely as possible to OSPAR's CEMP Guidelines.

1.14.3 Analysis, Cooperation and developments

The assessment is also linked to the OSPAR system. The OSPAR Pelagic Habitats expert group is further developing regional assessment methods for pelagic habitats and threshold values. This requires, among other things, an understanding of the relationship between natural variations in the plankton community and changes due to anthropogenic pressure factors.

Both of these indicators are still under development; no threshold values have been formulated for them yet. The assessment methods that are used can be found in the Intermediate Assessment (2017) (biomass of plankton and composition of plankton).

The system of monitoring and assessment of pelagic habitats has not yet been fully developed. The MSFD monitoring programme is implemented pragmatically. For zooplankton, monitoring with the CPR by the United Kingdom is used. These measurements are a start, but there are still knowledge gaps in terms of ecology and methodology. Monitoring is also not yet based on statistical analysis.

The phytoplankton monitoring survey is also still under development. Pending further international developments, the Netherlands has already started using microscopic analysis to determine the species composition at a small number of monitoring locations. Some of the samples are frozen in anticipation of the development of new DNA techniques. The aim is to adopt a coherent international approach to monitoring and assessment with joint expansion of the number of monitoring locations.

Descriptor 2: Non-indigenous species

Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.

2.1 Introduced non-indigenous species (D2C1)

Criterion D2C1 (primary)
The number of non-indigenous species which are newly introduced via human activity into the wild, per assessment period (six years), measured from the reference year as reported for the initial assessment under Article 8(1) of Directive 2008/56/EC, is minimised and where possible reduced to zero.

GES and indicators

GES[60] Downward trend in the number of introductions of non-indigenous species per policy period (six years).				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Introductions of non-indigenous species in the OSPAR region (and nationally: DCS)	The Dutch section of the North Sea (DCS) and OSPAR Greater North Sea	Presence	Downward trend in the number of new introductions	National interpretation

2.1.1 From information requirements to monitoring strategy

Compliance with the primary criterion D2C1 calls for knowledge of the number of non-indigenous species (NIS) introduced into the Dutch section of the North Sea in each planning period of six years. National, regional and international measures are targeted at regulation. To establish the effectiveness of these measures, it is important to discover the route by which non-indigenous species were introduced (pathway approach).

Functional requirements/monitoring strategy
The non-indigenous species introduced into the Dutch section of the North Sea must be reported every six years. At present there are no specific requirements for the spatial or temporal coverage of the monitoring. To make periodic, statistically valid quantitative judgements on introductions of non-indigenous marine species, the regular monitoring would probably have to be greatly intensified.It might then be necessary to establish a monitoring system specifically designed to quickly detect (new) non-indigenous species. On their introduction, non-indigenous species are present in very small densities so there is little chance of detecting them. It is questionable whether the additional effort required for the early detection of (new) species is in proportion to the unlikelihood of being able to manage or combat non-indigenous marine species at sea once they have been introduced. Furthermore, even with systematic monitoring it would still be possible to miss species that are identified with other methods. For the time being, therefore, the Netherlands chooses the approach of repeated assessment on the basis of best available knowledge. All available observations of non-indigenous marine species in the Dutch section of the North Sea are considered together, including those from sources other than regular monitoring. This method yields the most comprehensive picture of

[60] There is also a correlation with the overarching GES: 'Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.'

the number of introductions, as well being cost effective.

2.1.2 Monitoring surveys

The MWTL (benthos and phytoplankton), the WOT for shellfish and the monitoring of fisheries for the CFP are the regular monitoring surveys used to detect non-indigenous species in the Dutch section of the North Sea. Project-based monitoring (construction of wind farms, impact of beach nourishment) and well-documented observations by the public (divers and beach working groups of the Dutch Natural History Society (KNNV), for example) are also used. The MWTL benthos monitoring is carried out once every three years; the monitoring of phytoplankton is conducted annually, as are the WOT-Shellfish and CFP-Fisheries monitoring. For further details, see D6 (benthos), D1C6 (phytoplankton) and D3 (fish).

No standardised method, monitoring frequency or spatial coverage have been agreed for project monitoring or observations by the public.

2.1.3 Assessment method

The Netherlands assesses the introduction rate of non-indigenous species every six years on the basis of best available knowledge. The assessment embraces all available observations of non-indigenous marine species (i.e., including those from regular monitoring). On the basis of expert judgement, the likely vectors of introduction can also be established for each non-indigenous species. With that information, specific measures that should receive more attention in preventing introductions can be identified (pathway approach). All of the available data is assessed using a method developed by GiMaRIS (Gitenbergen *et al.*, 2017).

An indicator for introductions of non-indigenous species was formulated for OSPAR's Intermediate Assessment. The indicator did not yield any firm conclusions about the number of introductions. The underlying monitoring is not sufficiently standardised or harmonised for that purpose. Systematic monitoring to periodically deliver robust quantitative judgements of the introduction rates of non-indigenous species could require financial resources that are disproportionate to the actions that can realistically be taken.

2.1.4 Analysis of monitoring programme

In the previous MSFD monitoring programme (Monitoring Strategy part 2, 2014), the regular benthos and fisheries monitoring formed the basis for determining the number of introduced non-indigenous species for D2. From now on, all available observations of non-indigenous marine species in the Dutch section of the North Sea will be used for the analysis. This is an important change. 'All available observations' also include data from monitoring for projects such as the construction of wind farms and of the effects of sand suppletions, as well as reliable documented observations by members of the public.

Because all available observations are used for the assessment, the full scale of the monitoring effort is not known. As a result, firm quantitative judgements of the introduction rates of non-indigenous marine species might be more difficult to substantiate.

2.1.5 Cooperation and developments

The MSFD monitoring programme is linked to agreements and developments arising from the Ballast Water Management Convention, EU Regulation 1143/2014 on invasive alien species, and OSPAR.

Ballast Water Management Convention and hull fouling

The entry into force of the Ballast Water Management Convention in 2017 has significantly reduced the risk of introductions of non-indigenous species. Under the convention, ships are obliged to exchange ballast water on the open seas. From 2024, they will be required to have a ballast water treatment system on board. It is expected that statutory obligations will be introduced after 2024 to prevent introductions due to hull fouling.

EU Regulation

Article 14 of the Regulation on the prevention and management of the introduction and spread of invasive alien species (EU Regulation 1143/2014) provides for a surveillance system for the early detection and rapid eradication of such species. The list accompanying the regulation does not contain any marine species that are relevant for the Dutch section of the North Sea, which means that at present there is no reason to consider the species on the Union list for the purposes of the MFSD monitoring programme.

OSPAR

International coordination of monitoring, data management and the development of an indicator for the assessment of non-indigenous species (D2) is organised by an OSPAR expert working group. The Netherlands takes a pragmatic approach, whereby there are no monitoring surveys specifically set up for D2 and the assessment is based on data collected for other purposes.

Descriptor 3: Commercially exploited species of fish and shellfish

Populations of all commercially exploited species of fish and shellfish are within safe biological limits, exhibiting a population age and size structure that is indicative of a healthy stock.

3.1 Fishing mortality rate and spawning stock biomass of commercially exploited species (D3C1 and D3C2)

Criterion (primary)

D3C1: the fishing mortality rate of populations of commercially exploited species is at or below levels which can produce the maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No. 1380/2013.

D3C2: the spawning stock biomass of populations of commercially-exploited species are above biomass levels capable of producing maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No. 1380/2013.

GES and indicators

GES D3C1: For each commercially exploited fish and shellfish stock, the fishing mortality rate (F) must be at or below a value which relates to the Maximum Sustainable Yield (MSY): F≤Fmsy. D3C2: The Spawning Stock Biomass (SSB) of commercially exploited fish and shellfish stock is above the precautionary level MSY Btrigger (in line with ICES recommendations).				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Populations of all commercially exploited fish and shellfish species	MSFD Greater North Sea	Number of commercially exploited stocks	100 percent	CFP

3.1.1 From information requirements to monitoring strategy

To satisfy GES for descriptor D3, the aim is that populations of commercial fish stocks will gradually recover to and be maintained at a biomass level that can produce the maximum sustainable yield. There is international agreement that GES is achieved when both criteria (D3C1 and D3C2) are met for every commercially exploited stock. If that is not the case for a species, the status of that species is not good and GES has not been reached for the commercial fish species as a whole. The monitoring programme must show the fishing mortality rate (F) and, in particular, whether the mortality rate is equal to or below the value for the maximum sustainable yield (Fmsy) for each commercially exploited stock. Keeping F smaller than or equal to Fmsy (F≤Fmsy) can instigate a gradual recovery and conservation of commercial fish stocks.

The monitoring programme also provides information about the spawning stock biomass, from which it can be determined whether the spawning stock biomass of commercially exploited fish and shellfish is above the precautionary level *Btrigger*.

GES for D3 is realised if the management of all commercially exploited stocks satisfies F≤Fmsy and the spawning stock biomass of these species is greater than the precautionary level *MSY Btrigger*.

The monitoring programme generates information that is needed to ascertain the impact of the fisheries. The basis for this is the ICES data that are collected and reported at the level of the entire North Sea. Fish populations are not confined by borders; the fisheries are therefore regulated on an international scale via the CFP. The spawning stock biomass, expressed in tonnes per species, is derived partly from data generated by independent monitoring and partly from data supplied by fisheries. These data concern:

- the age distribution of the fish that are caught
- the numbers by age
- the average weight per age and sex
- information about the sex ratio and sexual maturity.

For commercially exploited species, the CFP is the guiding instrument; the MSFD is in line with this.

Functional requirements/monitoring strategy

The indicators for commercially exploited fish species are incorporated in monitoring programmes carried out for the Data Collection Framework (DCF) and the Statutory Research Tasks (WOT) for Fisheries. For mobile species like fish, data at for the entire North Sea (ICES data) are used, since they provide better insight than data that are collected only on the Dutch Continental Shelf (DCS). The DCF prescribes that reports must be published every one to three years and must adhere to the principles laid down in Article 25 of the Common Fisheries Policy.
Every member state then draws up multiyear work plans setting out how the information will be collected. The structure of the WOT programme is set out in a working plan that is revised annually. Amongst other bodies the CFP and the DCF form the statutory basis for different parts of the WOT; accordingly, the monitoring surveys meet the requirements.

3.1.2 Monitoring surveys

Data Collection Framework (DCF)

Data relating to the fishing mortality rate (F) and the spawning stock biomass of commercially exploited species are collected entirely under the purview of the DCF. The development of the DCF commenced in 2000. The framework is derived from an earlier European instrument. The DCF in its current form has been in operation since 2008. Every member state draws up a national programme enumerating the elements and parameters to be measured for the DCF. In the Netherlands, the programme for the period 2017-2019 was entitled 'Netherlands Work Plan for data collection in the fisheries and aquaculture sectors 2017-2019'. The Dutch Centre for Fisheries Research (CFR) conducts the biological research for the DCF as part of the Statutory Research Tasks programme.

Statutory Research Tasks (WOT)

The Statutory Research Tasks have existed in their present form since 2002, but some of the tasks have been carried out since 1957. The tasks performed by the CFR are incorporated in a continuous programme that encompasses a variety of studies into herring, blue whiting and mackerel, but also into the impact of bottom trawling on demersal fish. The research focuses mainly on commercial species, and the parameters vary according to the project. For example, the project 'sampling' generates data that are used mainly to establish the length and age composition of landed fish. The research method, including the area to be covered and the timing of the research, is documented in a handbook. Another example is the project 'stock surveys at sea', in which data are collected independently of fisheries to acquire a complete picture of commercial fish stocks and their condition. The research provides an insight into the number of fish, fish larvae or fish eggs of a specific species in a particular year. This method is also documented in a handbook. The spatial coverage, density and measurement frequency are different for each survey. For example, the International Bottom Trawl Survey (IBTS) covers almost the entire North Sea every year by fishing each ICES area (roughly 56x56 km) twice with different ships with a bottom trawl.

3.1.3 Assessment method

ICES aggregates the data supplied by the member states and calculates on that basis the fishing mortality rate (F) and the spawning stock biomass (SSB), and then publishes its recommendations. The value for F is established annually for each commercial fish stock. Assumptions are made about fish mortality before the spawning period and the natural mortality rate of fish before they spawn. ICES also indicates whether the SSB for particular commercial stocks is above or below the Btrigger. ICES calculates the SSB at stock level, in other words per population, for the entire North Sea. With the annual ICES recommendations, it is possible to assess whether GES has been reached for each fish stock.

3.1.4 Analysis of monitoring programme

There are no changes compared with the previous monitoring programme. The monitoring programme is entirely adequate and provides sufficient insight into the extent to which GES has been reached.

3.1.5 Cooperation and developments

The ICES recommendations are based on data supplied by all of the relevant countries, which demonstrates that there is broad international cooperation in relation to D3. Recent spatial developments in the North Sea could affect the data collection for the DCF and WOT. For example, the permanent installation of a wind turbine could make a location no longer suitable for monitoring. Any changes in the MSFD monitoring programme follow from agreements made in the context of the DCF and WOT.

Descriptor 4: Food webs

All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.

4.1Species composition, density and balance of trophic guilds (D4C1/D4C2)

Criterion D4C1 (primary)
The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures.

Criterion D4C2 (primary)
The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures.

GES and indicators

GES[61]
D4C1: The diversity (species composition and abundance) of at least three selected trophic guilds is at a level or within a bandwidth which indicates GES. The trophic guilds and levels and bandwidths to be employed must still be regionally determined in the second cycle.
D4C2: The ratio in abundance between at least three selected trophic guilds is at a level or within a bandwidth that indicates GES. The trophic guilds and levels and bandwidths to be employed must still be regionally determined in the second cycle.

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
No indicator available yet.				

4.1.1 Information requirements and developments

Interactions between different trophic levels in the food web suffer negative impacts from interventions by humans. To achieve GES for descriptor D4, these impacts must be reduced. The monitoring must provide the information required to assess environmental status. The Assessment method for the criteria D4C1 and D4C2 is still being developed. The associated information requirements are therefore not yet known. The future information requirements for D4C1 and D4C2 can probably be met by the monitoring for D1 (birds, fish, marine mammals) and D6 (benthos). For the time being, no monitoring surveys have been added to this MSFD monitoring programme specifically for D4. Further expansion of the monitoring and assessment will be linked as far as possible to OSPAR.

[61] There is also a correlation with the overarching GES 'The effect of human interventions on interactions between different trophic levels in the food web is reduced.'

4.2 Size structure in trophic guilds (D4C3)

Criterion D4C3 (secondary)

The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures.

GES and indicators

GES The size structure (length) of the fish community remains above the historic minimum value.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Size structure in fish communities (OSPAR)	OSPAR Greater North Sea	Typical Length (TyL)	Unknown	OSPAR

4.2.1 From information requirements to monitoring strategy

The size structure in trophic guilds is measured in relation to the fish community. Fisheries impose substantial anthropogenic pressure on the fish community, which leads, among other things, to a decline in the number of larger fish, since it is primarily the larger individuals that are caught. The size structure of the fish community is expressed in terms of 'typical length'. The assessment of this criterion is therefore based on data relating to changes in the typical length of the fish community. These data are collected in accordance with the Common Fisheries Policy (CFP). The typical length is determined separately for pelagic and demersal fish. The catches of research vessels – converted into time series for different spatial units for both pelagic and demersal fish – provide information for assessing whether the typical length has changed. An increase indicates recovery and a further decline suggests deterioration in the size structure. To achieve GES, the size structure (length) of the fish community must remain above the historic minimum value. The assessment can be differentiated according to the various spatial units (sub-areas) and the type of fishery. The calculation of the indicator per sub-area requires an annual survey at sufficient locations and over an adequate spatial range in each sub-area. The current design with one or more trawls per ICES area is sufficient.

4.2.2 Monitoring surveys

The size structure of fish is monitored with the International Bottom Trawl Survey (IBTS) as part of the monitoring for the CFP. The monitoring survey has been operational since the end of the 1960s. Only data that have been collected since 1983 are useful for MSFD reporting, since it is plausible that the necessary consistency in the monitoring can only be guaranteed from that year. That certainty arises from, among other things, the introduction of the standard bottom trawl survey, the GOV. The survey employs the stratified random sampling method, with multiple trawls in each relevant ICES area, in principle carried out by different member states. Every year, the results of the trawls are aggregated to calculate the indices (ICES, 2012; ICES, 2009). At least the species and size of each fish caught is registered. The Netherlands contributes to the monitoring via the Statutory Research Tasks (WOT) for Fisheries and the Data Collection Framework (DCF). This monitoring is carried out annually, in consultation with other countries, at the level of the Greater North Sea. ICES coordinates the monitoring and the quality assurance and quality control. Furthermore, an additional Quality Assurance/Quality Control procedure is incorporated for the calculation of this indicator (Moriarty, 2017, Greenstreet, 2017).

4.2.3 Assessment method

To achieve GES, the size structure (length) of the fish community must remain above the historic minimum value. The assessment is based on the OSPAR indicator 'typical length', with which the size structure of fish and cartilaginous fish communities is calculated. The assessment covers the period from 1983 because the survey is deemed to be sufficiently consistent since then. The historic minimum value is determined on the basis of the lowest value prior to the last six years. Experts consider the underpinning of this threshold value to be inadequate to be used to determine whether or not GES has been reached. In the absence of a properly substantiated threshold value, for that reason the question of whether the indicator is increasing, stable or declining will be determined per sub-area.

4.2.4 Analysis of monitoring programme

There are no changes in the monitoring programmes compared with the MSFD monitoring programme in 2014. The monitoring is adequate, but in the absence of a threshold value it is only possible to analyse the trend.

4.2.5 Cooperation and developments

The indicator was developed by ICES and is being fleshed out in OSPAR. In terms of cooperation and developments, the situation is similar to the description with respect to the size structure in the fish community under D1C3: see section 1.10.5.

Descriptor 5: Eutrophication

Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.

Introductory remark: OSPAR is conducting a review of the Common Procedure (COMP), the framework for monitoring and assessment of eutrophication, in the period 2019-2022. This could have consequences for the entire set of eutrophication parameters discussed in this section. Because the outcome of that process is not yet known, the MSFD monitoring programme follows the Marine Strategy part I, which is based on the third application of the COMP during the period 2006-2014. Where possible, there is a preview of the changes.

5.1 Nutrients (D5C1)

Criterion D5C1 (primary)
Nutrient concentrations are not at levels that indicate adverse eutrophication effects.

GES and indicators

GES Coastal waters: nutrient concentrations in the winter comply with the Water Framework Directive (WFD) standards in coastal waters.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Nutrient concentrations in Dutch coastal waters (supplementary Dutch assessment)	Dutch coastal waters (up to 1 mile)	Concentration in water	DIN WFD coastal waters: 0.46 mg N/l	WFD

GES Offshore waters: nutrient concentrations in the winter comply with the OSPAR assessment values.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**[62]	**Source of threshold value/trend**
Nutrient concentrations (OSPAR assessment) in the Greater North Sea, Kattegat and Skagerrak	OSPAR Greater North Sea	Concentration in water	DIN (OSPAR coastal zone): 30 µmol/l; DIP (OSPAR coastal zone): 0.8 µmol/l; DIN (beyond OSPAR coastal zone): 15 µmol/l; DIP (beyond OSPAR coastal zone): 0.8 µmol/l	OSPAR

5.1.1 From information requirements to monitoring strategy

To achieve GES, the offshore zone and coastal waters must comply with the agreements made in OSPAR. The coastal waters must also comply with the requirements of the WFD. Monitoring also provides insight into the extent of compliance which overarching GES 'the concentrations of winter DIN and DIP[63] are below the level suggesting harmful eutrophication effects' and 'human-induced eutrophication is minimised, particularly its harmful effects such as loss of biodiversity, harm to the ecosystem and oxygen deficiency in bottom waters'.

The areas of application of the WFD and OSPAR overlap in the zone from the base coastline to one nautical mile from the coast. The MSFD provides

[62] As adopted in the third application of the COMP, period 2006-2014.

[63] DIN: dissolved inorganic nitrogen, a combination of nitrate, ammonium and nitrite; DIP: dissolved inorganic phosphorus, orthophosphate.

that European directives (including the WFD) must be complied with in that zone.

The requirements stipulated by OSPAR and in the WFD for the method of monitoring are largely similar. It is different with the assessment (see under 'Assessment method'). With respect to D5C1, nutrient concentrations must be monitored for both OSPAR and the WFD. For OSPAR, the input of nutrients must also be determined.

Functional requirements/ monitoring strategy

The functional requirements are laid down in the existing WFD and OSPAR monitoring programmes.

Spatial and temporal coverage

Data collected through monitoring must have sufficient temporal and spatial coverage, encompassing the entire DCS, and must be comparable throughout the marine region. The OSPAR-CEMP tries to provide guidance on this. For example with the instruction that the most suitable period in the year must be chosen for all measurements so that the effects of eutrophication can be determined as accurately as possible. Average winter concentrations of nutrients DIN and DIP in specific areas must be measured once a month between December and February every year.

There is a linear correlation between the salinity and the nutrient concentration in water. The salinity increases and the nutrient concentration declines from the coast to deeper water. In view of this correlation, as well as the DIN and DIP, salinity is measured. The DIN and DIP concentrations are therefore measured along transects perpendicular to the coast. The monthly sampling of area-specific nutrient concentrations can be disrupted by wintry conditions from December until the end of February. There is an extra measurement in November to ensure that the assessment can still be carried out.

Accuracy and reliability

Specific quality requirements have to be met in determining the values for all nutrients. The data must be collected in accordance with the provisions of OSPAR's Background Document on Eutrophication. The technical specifications of the methods are set out in OSPAR's Coordinated Environmental Monitoring Programme (CEMP). The margin of error in the monitoring is determined in accordance with the Guidelines for estimation of a measure for uncertainty in OSPAR monitoring.

The monitoring must also comply with the technical specifications laid down in EU Directive 2009/90/EC (the WFD method).

According to this method of analysis for determining nutrient concentrations, the uncertainty of a measurement may not exceed 50 percent. The method's detection limit may not exceed 30 percent of the relevant environmental quality standard. The parameters for the WFD assessments must comply with the conditions laid down in the Dutch protocol on monitoring and status assessment of WFD surface water bodies (Rijkswaterstaat, 2020, in Dutch only).

The calculation of nutrient loads is linked to the agreements made in the OSPAR Riverine Inputs and Direct Discharges (RID) programme. Under those agreements, the nutrient and pollutant loads in the river discharge into OSPAR areas are calculated on an annual basis and/or are modelled on the basis of discharge data and concentrations of relevant parameters. As common indicator for OSPAR and MSFD, the parameters total nitrogen and nitrate for nutrient loads are provided. The methodology is documented in OSPAR (2014).

5.1.2 Monitoring surveys

All measurements of the nutrients DIN and DIP and of salinity are part of Rijkswaterstaat's monitoring programme (MWTL). The monitoring of these substances commenced around 1990. For the method of sampling and analysis, including information about quality assurance/quality control, see the OSPAR Guidelines (2013). The measurements are performed along transects perpendicular to the coast. Eight coastal locations are sampled every month, also in the winter period. Surveys are carried out at two offshore locations four times a year, thus also once during the winter. DIN and DIP concentrations are determined after filtration.

To calculate the riverine input, including total nitrogen and total phosphate, measurements of substances at WFD locations (MWTL) and discharge data from the National Water Monitoring survey (LMW) are used. Both are Rijkswaterstaat programmes. There are monitoring locations at the Haringvliet locks, Maassluis, IJmuiden, Vrouwezand (for water quality in the IJsselmeer) and Den Oever and Kornwerderzand (for water discharge). Concentrations are measured at least thirteen times a year. The discharges modelled on the basis of measurements are calculated per 24 hours.

5.1.3 Assessment method

The assessment is linked to the WFD and OSPAR. For the WFD, the assessment method is described in the Dutch protocol on monitoring and status assessment of surface water bodies (Rijkswaterstaat, 2020). OSPAR's Common Procedure (OSPAR COMP) is similar, but also provides that inputs of nutrients must be determined and that the coherence of the indicators (criteria) must be assessed.

The OSPAR-COMP assessment requires the following parameters:

1. **The input of nutrients** The input from land (total P and total N) via rivers and canals is to be calculated by multiplying the annual discharge of water into the sea at every estuary by the average of the measured concentrations of the substances. OSPAR uses a model to calculate the nitrogen load from air (atmospheric deposition).
2. **Nutrient levels** Area-specific average winter concentrations (December to February) of nutrients: dissolved inorganic nitrogen (DIN, an aggregate of nitrate, ammonia and nitrite) and dissolved inorganic phosphorus (DIP).
3. **Direct effects** Determination of the 90th percentile value of the concentration of chlorophyll a during the growing season of phytoplankton (March to October). On this point, see D5C2.
4. **Indirect effects** Oxygen concentrations, measured at various depths in the water column. On this point, see D5C5.

5.1.4 Analysis of monitoring programme

Up to now, the monitoring programme that has functioned well for years at OSPAR level has been used for an assessment at national level. The monitoring programme has been unchanged since 2014 and will also suffice for the MSFD for the period until 2026. An important requirement for the MSFD is that assessments and monitoring programmes of countries that share a (sub-)region must be comparable and coherent. For the Intermediate Assessment 2017, a step was taken in the joint assessment of eutrophication on a North Sea scale (southern and northern parts). It revealed that a number of major improvements are needed in both monitoring programmes and assessment for eutrophication.

5.1.5 Cooperation and developments

OSPAR is revising the Common Procedure (COMP), the framework for monitoring and assessing eutrophication, in the period 2019-2022. The reason is the current incoherence in the application of the COMP by parties to the OSPAR convention and/or EU member states. That leads to dissimilar assessments, which is contrary to the requirements of the MSFD. In the EU project JMP EUNOSAT (2017-2019[64]), an alternative approach has been devised for monitoring and assessing chlorophyll a and nutrient concentrations, which is coherent for countries. Aspects of this method are:

a. division of the North Sea into ecologically relevant assessment areas for all eutrophication parameters
b. adjustment of the winter period and the growing season depending on the observed seasonal patterns in these areas
c. where necessary, changes in monitoring methods in the interests of comparability between countries that share an assessment area
d. adjustment of background concentrations and threshold values in line with ecological characteristics and making them coherent between countries
e. centralisation and automation of the eutrophication assessment at the ICES Data Centre.

These aspects could all have consequences for the entire set of eutrophication parameters discussed in this section. The aim is to apply the new approach at the next OSPAR assessment of eutrophication in 2022.

The monitoring and assessment for D5 are linked to OSPAR and the WFD. In light of the MSFD requirement that the monitoring and assessment must be comparable and coherent, OSPAR ICG-EUT has developed a new approach in an EU project in which all agencies responsible for national monitoring of eutrophication in the North Sea all participated (JMP EUROSAT, 2019). The project focused mainly on chlorophyll a (see D5C2), but also produced a proposal for formulating coherent threshold values for DIN and DIP based on area-specific background concentrations.

The recommendations will be fleshed out in OSPAR. The aim is to introduce the new approach for the next application of the Common Procedure (COMP4, 2022) and for the OSPAR Quality Status Report (QSR 2023), which will form the common basis for the MSFD assessment in 2024. Another objective, in addition to the aforementioned improvements, is to achieve greater harmonisation, for example by adopting the same definition of the winter period during which nutrients are measured. There is also room for improvement in modelling the input from rivers and the atmosphere. Agreed methods will be incorporated into the Common Procedure and in the fourth OSPAR assessment of eutrophication. The Netherlands is actively involved in this process and will adhere as closely as possible to it in its operational programme.

[64] https://www.informatiehuismarien.nl/projecten/algaeevaluated/

5.2 Chlorophyll a (D5C2)

Criterion D5C2 (primary)

Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment.

GES and indicators

GES Algal biomass (determined on the basis of chlorophyll-a measurements) in coastal waters is not higher than the good status pursuant to the WFD for the relevant coastal water types.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Chlorophyll a concentrations in Dutch coastal waters (WFD)	Dutch coastal waters (up to 1 mile)	Concentration in water	6.7 µg/l or 9.3 µg/l (depending on the coastal water type)	WFD

GES Algal biomass (determined on the basis of chlorophyll-a measurements) in offshore waters satisfies the assessment values of OSPAR.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**[65]	**Source of threshold value/trend**
Chlorophyll a concentrations in the Greater North Sea and Celtic Sea (OSPAR assessment)	OSPAR Greater North Sea	Concentration in water	Not higher than 50% above background value according to the objectives of the OSPAR COMP: 15 µg/l (coast) and 4.5 µg/l (beyond coastal waters)	OSPAR

5.2.1 From information requirements to monitoring strategy

To achieve GES[66], the offshore zone and coastal waters must meet the standards agreed at OSPAR. The coastal waters must also meet the requirements of the WFD. The areas of application of the WFD and OSPAR are complementary, but there is an overlap in the zone from the base coastline to one nautical mile from the coast. The MSFD states that European directives (including the WFD) must be complied with in that zone, but also to build on the programmes and activities under the regional marine conventions (OSPAR). OSPAR and the WFD prescribe largely similar requirements for monitoring methods. The assessments differ, however (see under 'Assessment method'). To assess whether GES has been achieved for criterion D5C2, the concentrations of chlorophyll a have to be monitored for both OSPAR and the WFD.

In that context, the Netherlands will follow the coherent international approach required for the MSFD as far as possible.

Functional requirements/monitoring strategy

The functional requirements are laid down in the existing WFD and OSPAR monitoring strategies. For D5C2, this involves determining the level of chlorophyll a (biomass) in the surface water.

In-situ measurements

Data collected through monitoring must have a good temporal and spatial coverage, embracing the entire DCS, and be comparable throughout the marine region. OSPAR-CEMP tries to guide in-situ measurements in that direction, with the instruction that all measurements should be carried out in the most suitable period in the year for determining the effects of eutrophication as clearly as possible. Specifically for D5C2, the concentrations of chlorophyll a have to be measured during the growing season every year.

Nutrient concentrations are highest along the Dutch coast

[65] As adopted in the third application of the COMP, period 2006-2014.

[66] Also overarching GES: 'Algal biomass (determined on the basis of chlorophyll-a measurements) is not at a level that suggests harmful effects of enrichment with nutrients, pursuant to the assessment according to WFD and OSPAR' and 'human-induced eutrophication is minimised, particularly its harmful effects such as loss of biodiversity, harm to the ecosystem and oxygen deficiency in bottom waters'.

due to input of nutrients from the rivers. The chance of algal blooms is greatest in that zone. Accordingly, chlorophyll a is measured every two weeks between March and September in the coastal zone. The frequency is once a month in areas that are further from the coast, and once every two months in the remote areas of the DCS.

Measurements are carried out along transects perpendicular to the coast, similar to other water quality parameters.

For information about accuracy and reliability, see D5C1.

Satellite observations

The Netherlands will adopt new techniques in response to the desire for better spatial coverage and an approach that is coherent with those of other countries.
Satellite observation of chlorophyll a (ocean colour) provides a lot of information in spatial and temporal terms. This improves the ability to detect changes and - especially in combination with modelling - to assess the effectiveness of measures. An important advantage is that these observational techniques monitor large parts of the North Sea simultaneously, thus optimising the comparability of the data from North Sea countries. However, in-situ monitoring will continue to be necessary, also in the long term, to calibrate satellite observations.

5.2.2 Monitoring surveys

In situ measurements

Measurements of chlorophyll a are all part of Rijkswaterstaat's monitoring programme (MWTL). The monitoring of chlorophyll a commenced around 1990. For the methods of sampling and analysis, including information on quality assurance/quality control, see the OSPAR CEMP (2016). See the references to D5C1. Monitoring is carried out every two weeks during the summer period from March to September at six coastal locations. The frequency is once a month in areas further from the coast (at two locations) and once every two months in the remote areas of the DCS (also at two locations).

Satellite observations

The Sentinel satellites of the European Copernicus programme pass over the North Sea almost every day. They observe the colour of the water with optical sensors. That colour can be converted into the concentration of chlorophyll a. The satellites also measure suspended matter and CDOM (coloured dissolved organic carbon). These parameters can affect the observation of chlorophyll a, and must therefore also be measured to correct the data for chlorophyll a later if necessary. The satellites observe a stretch of the North Sea surface each time they pass over. Combining multiple stretches produces area-wide maps. The Sentinel-3 satellites measure with a resolution of 300 metres. The Sentinel-2 satellites have a resolution of 10-20 metres, which makes them more suitable for observations close to the coast. Two of each type of satellite have been launched since 2015. The Copernicus programme guarantees the supply of data until the end of 2036.

The quality of the observations depends on factors such as the aforementioned masking of suspended matter and CDOM, limited visibility due to cloud cover, other atmospheric disturbances and the angle of the sunlight. This latter factor makes measurements in the winter months less reliable. Algorithms, which are optimised for specific conditions, are also needed to translate the signal from the satellite sensor to chlorophyll a. In the JMP EUNOSAT project, a quality control system has been designed for the North Sea to ensure that data are reliable.
The intention is to perform the quality control centrally for the entire North Sea.

Calibration and correction for atmospheric conditions is performed with sun photometers from AERONET-OC, a worldwide network organised by NASA. Rijkswaterstaat wants to contribute to this network with its own sensors on permanent platforms. Belgium and the United Kingdom also use these sun photometers, and Denmark may also start doing so soon.

5.2.3 Assessment method, analysis, Cooperation and developments

For the Assessment method, cooperation, analysis of the monitoring programme and developments, see D5C1.

OSPAR is also considering the use of satellite observations specifically for D5C2. Although their use is not sufficiently developed for some areas in other OSPAR countries, JMP EUNOSAT has demonstrated the added value of satellite monitoring for the MSFD. Work will continue in the coming period to resolve area-specific issues.
The results of the project include:

- a proposal for coherent threshold values for chlorophyll a, derived from area-specific background concentrations
- a reliable chlorophyll-a satellite product that takes account of the properties of satellite sensors and the optical conditions of the water (such as suspended matter) that affect the satellite observation
- cross-border assessment areas, based on the seasonal dynamic of chlorophyll-a concentrations and on physical characteristics that influence the growth of algae.

- an initial trial assessment of the eutrophication status of the North Sea on the basis of chlorophyll-a data.

The JMP EUNOSAT project was completed in 2019. The results and recommendations are being fleshed out by OSPAR, which has also developed a web tool (OSPAR/ICES COMPEAT) to improve the efficiency of automated assessments.

One of the results of the JMP EUNOSAT project was the conclusion of an agreement to install a new ferrybox on a cargo ship sailing between Rotterdam, Immingham (UK) and Tananger (Norway). This connection is expected to be operational in the spring of 2020. The ferrybox on the ship will automatically collect information about chlorophyll a, among other parameters. In the coming period, the EU's JERICO-S3 project will investigate how these data can be compared with the other data that are collected in situ. Roughly forty European partners are involved in this project.

5.3 Oxygen (D5C5)

Criterion D5C5 (primary)

The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects.

GES and indicators

GES Coastal waters: the lowest water layer (stratified waters) or the surface water layer of mixed waters in coastal waters is saturated with at least 60 percent oxygen.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Dissolved oxygen concentrations near the seafloor (WFD)	Dutch coastal waters (up to 1 mile)	Concentration in water	>60% oxygen saturation	WFD

GES Offshore waters: in offshore waters, the lowest water layer (stratified waters) or the surface water layer in mixed waters contains at least 6 mg/l oxygen.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Dissolved oxygen concentrations near the seafloor (OSPAR assessment)	OSPAR Greater North Sea	Concentration in water	>6 mg/l oxygen (coast and beyond coastal waters)	OSPAR

5.3.1 From information requirements to monitoring strategy

To achieve GES, the offshore zone and coastal waters must both comply with the agreements made in OSPAR. The coastal waters must also satisfy the requirements of the WFD. Monitoring also provides insight into the extent to which the overarching GES is being achieved: 'No oxygen deficiency due to eutrophication in the deeper water layer (stratified waters) or in the surface water layer of mixed waters' and 'eutrophication caused by humans is minimised, particularly the harmful effects thereof, such as loss of biodiversity, damage to the ecosystem and oxygen deficiency in bottom waters'.

The areas of application of the WFD and OSPAR are complementary, but there is overlap in the zone from the base coastline to one nautical mile from the coast. The MSFD provides that European directives (including the KRW) must be complied with in that zone, but also that measures should build on the programmes and activities of the regional marine conventions (OSPAR).

To assess whether GES is being achieved for criterion D5C5, the oxygen concentrations have to be monitored for both OSPAR and the WFD. The requirements stipulated by OSPAR and the WFD

for the method of monitoring are largely similar. The assessment methods differ, however. See under 'Assessment method'.

Functional requirements/monitoring strategy

The functional requirements are laid down in the existing WFD and OSPAR monitoring strategies. For the WFD, all water bodies on the coast must be surveyed to determine the oxygen saturation level at least once a month. OSPAR's specifications are set out below.

Spatial and temporal coverage

Data collected through monitoring must have a good temporal and spatial coverage and must be comparable throughout the marine region. The monitoring must encompass the entire DCS. The OSPAR-COMP tries to provide guidance for this with the instruction that all measurements should be carried out in the most suitable period in the year for determining the effects of eutrophication as clearly as possible. For D5C5, that is the summer, when oxygen deficiency or oxygen absence can occur. At least three vertical measurements are taken during the period from March to September. On the DCS, possible problems with the oxygen level only arise in the Central Oyster Grounds, a sedimentary area where measurements are taken at various depths.

Parameters/compartments

The MSFD parameter for the assessment of D5C5 is local oxygen deficiency in areas of high sedimentation and under floating layers of heavy algal blooms. Anoxic conditions, caused by the massive death of algae, can only occur in the Dutch section of the North Sea directly beneath the algal layer. In this case, the absence of oxygen therefore poses no risks for benthic life.

In areas where seawater stratification occurs in the summer, for example the Central Oyster Grounds, oxygen deficiency and oxygen absence can occur near the seabed. However, this situation is caused by hydrographic factors and is not related to eutrophication. To determine the oxygen deficiency at various depths and close to the seafloor, a comparison has to be made with the values where the water is saturated with oxygen. The maximum value depends on the temperature and the salinity. Therefore, temperature and salinity have to be measured, in addition to the oxygen level.

Accuracy and reliability

See D5C1.

5.3.2 Monitoring surveys

All oxygen measurements are part of Rijkswaterstaat's monitoring programme (MWTL). The monitoring of oxygen commenced around 1990. For the method of sampling and analysis, including information about quality assurance/quality control, see the OSPAR CEMP (2016). See references under D5C1. At least three measurements are taken at three locations in the Central Oyster Grounds from March to September. If there is a metalimnion layer at the monitoring locations, oxygen is measured close to the surface, at the depth of the metalimnion and near the seafloor. If there is no metalimnion layer, the measurements are taken close to the surface, at half depth and close to the seafloor[67].

In the coastal zone, measurements of oxygen saturation for the WFD are taken in five water bodies: coastal zone Zeeland, coastal zone Northern Delta, coastal zone of Holland, Wadden Sea coastal zone and Ems-Dollard. There is one monitoring site in each water body, where monthly measurements are taken at a depth of one metre.

5.3.3 Assessment method, analysis, Cooperation and developments

For the Assessment method, cooperation, analysis of the monitoring programme and developments, see D5C1. The existing method needs to be further developed having regard to the feasibility and practicality of monitoring and assessment of oxygen just above the seafloor.

[67] There is stratification if the water column can be divided into multiple (in general two) layers. The interface between the top layer (epilimnion) and the bottom layer (hypolimnion) is called metalimnion and can be identified by a clear difference in temperature (thermocline), and in transitional waters also by salinity (halocline). Identification of metalimnion and maximum levels of fluorescence are established according to Rijkswaterstaat guidelines.

Descriptor 6: Sea-floor integrity

Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

Descriptor 6 covers the integrity of the sea floor The biodiversity of benthic habitats (D1) is incorporated in this descriptor (under D6C3 and D6C5).

6.1Extent of physical loss of the sea floor (D6C1) and benthic habitats (D6C4)

Criterion D6C1 (primary)
The spatial extent and distribution of physical loss (permanent change) of the natural seabed.

Criterion D6C4 (primary)
The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.

Criterion D6C1 and criterion D6C4 concern the physical loss of the seabed and habitat types, respectively. Because, in practice, they both relate to marginal areas, the two criteria are interpreted in the same way.

GES and indicators

GES[68] D6C1: No significant loss of the natural seabed as compared with the situation in 2012 as a result of human activities. D6C4: No significant loss as a result of human activities of the habitats described in the framework of the MSFD.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Spatial extent of physical loss	Dutch section of the North Sea (DCS)	Surface area	Not established	

6.1.1 Information requirements and analysis

To establish whether GES is maintained it must be possible to determine the physical loss of both seabed and habitats. Every activity that could lead to physical loss (to a significant extent) of the seabed must be covered. The Netherlands regulates all activities that could lead to physical loss, as well as compensation in case of significant loss, as was the case with the construction of Maasvlakte 2.

Accordingly, no structural monitoring is required for the evaluation of environmental status, which is therefore an administrative analysis.

The main activities that lead to physical loss in Dutch territorial waters and are therefore included in the administrative analysis are land reclamation, the construction of platforms for oil and gas exploration and the construction of wind farms. Cables and pipelines are generally buried and therefore cause no loss.

[68] There is also a correlation with overarching GES: 'Physical loss of the seabed due to human activities is restricted to ensure that the scope, condition and global distribution of populations of the community of characteristic benthos species rise, and targets for specific habitats are achieved'.

Ripraps are only laid at junctions with other cables and pipelines. Sand extraction also leads to no loss as referred to here, but does temporarily impair the quality of the habitat, which could have effects on the status of the communities described under other criteria (D6C3, D6C5).

6.1.2 Registration and Assessment method

Licensing conditions and general rules prescribe that on completion of the construction of a wind farm or the laying of a cable or pipeline the as-built data must be provided to Rijkswaterstaat. These data are then entered in GIS files, which can also be consulted by third parties. Rijkswaterstaat's Sea and Delta unit is responsible for keeping these records up to date.

The indicator describes the spatial extent and distribution of the physical loss (permanent change) of the natural seabed.

6.1.3 Analysis, Cooperation and developments

Information relating to the criteria will be registered in the same way as in the previous monitoring cycle. Data from the licensing procedure will be used for that purpose. TG Seabed is currently formulating threshold values and the intention is that they will be in place before the next updating of the Marine Strategy part 1 (2024).

6.2 Extent of physical disturbance of the seabed (D6C2)

Criterion D6C2 (primary)
The spatial extent and distribution of physical disturbance pressures on the seabed.

This section explains the interpretation of D6C2 and the part of criterion D6C3 concerning physical disruption.

GES and indicators

GES[69] D6C2: No rise in physical disturbance over time on the total seabed of the entire North Sea and the DCS. D6C3: No rise in physical disturbance over time in the habitats described in the framework of the MSFD.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
The spatial extent and distribution of physical disturbance of the seabed, including any habitat type that has been damaged by changes to its biotic and abiotic structure and their functions (D6C2 and D6C3).	ICES Greater North Sea	Pressure from fishing and impact on the seabed	Not yet established	ICES

6.2.1 From information requirements to monitoring strategy

The proportion of the seabed that has been physically disturbed by human activities must be established every six years. The necessary monitoring consists of the registration of activities that disturb the seabed. In the Dutch section of the North Sea, those activities are bottom-disturbing fisheries and sand extraction. No threshold value or desired trend has yet been established for this indicator[70].

The extent of the disturbance of the seabed by fisheries is derived from data collected by the EU Vessel Monitoring System (VMS) within the framework of the Common Fisheries Policy (CFP). The area of seabed disturbed by sand extraction and suppletion is included in the data that sand extraction companies are required to supply during the licensing procedure.

[69] There is also a correlation with the overarching GES: 'Physical loss of the seabed due to human activities is restricted to ensure that the scale, condition and global distribution of populations of the community of characteristic benthos species increase, and targets for specific habitats are achieved'.

[70] For the determination of the effects on seabed life, see D6C3 and D6C5.

Functional requirements/monitoring strategy

The CFP requires monitoring of the position and speed of all fishing vessels longer than 12 metres while they are in EU waters. The EU Vessel Monitoring System (VMS) is used for this purpose. Under this system, every fishing vessel transmits signals with a frequency such that it can be determined, on the basis of its speed, whether the ship is fishing or sailing without nets in the water. In combination with the mandatory logbook data from the fishing vessel, for example on the type of nets it uses, it can be established where the seabed has been disturbed by fishing (in km^2)

The precise locations of sand extraction can be derived from the data that companies are required to supply under the terms of their licence to carry out sand extraction in the North Sea.

6.2.2 Monitoring surveys

The relevant monitoring surveys are as follows:

- The EU Vessel Monitoring System (VMS)
- Logbook data from fishing vessels
- Sand extraction data in accordance with the licensing conditions.

The use of the VMS system was made compulsory in the legislation implementing the CFP in 2000, initially only for ships longer than 24 metres, but from 2013 for all vessels longer than 12 metres. This system records the location and speed of all fishing vessels larger than 12 metres in the North Sea at least once every two hours. The method and GA/GC [quality control] are described in an ICES advisory report (ICES, 2017) and in http://nielshintzen.github.io/ vmstools/.

Under the CFP, fishing vessels are obliged to keep logbook data and report them. The obligation means that every ship longer than 10 metres must register, by day and by trawl, the type of fishing gear that was used and the ICES area in which it fished. For each trawl, the catch (per kilogram) of the primary target species must also be recorded. The requirements are set out in the implementing regulation for ensuring compliance with the rules of the Common Fisheries Policy (EC, 2011).

Rijkswaterstaat Sea and Delta keeps the data for current sand extractions up to date. The licences for sand extraction on the DCS provide that the precise locations of the extraction must be registered with a mandatory blackbox system, so that it is known where sand is actually being extracted. The volumes of excavated sand must also be reported on a monthly basis.

6.2.3 Assessment method

The surface area of the seabed that is physically disturbed due to human activities can be calculated on the basis of the EU Vessel Monitoring System (VMS) and sand extraction data. The analysis provides the basis for evaluating the extent to which GES and the environmental targets are being achieved.

Like every other EU country, the Netherlands only has access to the national VMS data. Overviews of international data can only be acquired through international coordination (ICES, OSPAR). For the Marine Strategy part 1 (2018), ICES carried out the assessment for the entire Greater North Sea. This analysis has to be repeated at least once every six years for the mandatory updating of the Marine Strategy.

ICES has drawn up a standard protocol (ICES, 2017) for converting VMS and logbook data into maps showing the spatial extent and distribution of the pressure from fisheries. Those data can be used to calculate the percentage of the total seabed or of relevant sea-floor habitats that is physically disturbed by fisheries. It can also be established whether this percentage has remained stable, or has increased or declined, for both the entire North Sea or just the Dutch section of the North Sea. This indicator forms the basis for the assessment of D6C2 and the part of D6C3 that relates to it.

No indicator has yet been defined for disturbance due to sand extraction.

6.2.4 Analysis of monitoring programme

The monitoring programme is in principle adequate, but the absence of international VMS data limits its usefulness. The most important change needed by comparison with the previous Marine Strategy is therefore not a modification of the monitoring survey, but a coordinated action by ICES to consolidate the international VMS data for the purposes of joint analysis. Data about sand extraction are available from Rijkswaterstaat.

6.2.5 Cooperation and developments

The international VMS and logbook data required for analysis can only be acquired through international cooperation. Analysis is therefore only ultimately possible if the various member states voluntarily supply their national VMS data.

Data on sand extraction are collected by the ICES expert group (WGEXT) and supplied to OSPAR (ICES, 2018). The expert group is also drafting an indicator for disturbance due to sand extraction.

6.3 Quality of benthic habitats: status and effects of physical disturbance (DCS) (D6C3)

Criterion D6C3 (primary)

The spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions (e.g., through changes in species composition and their relevant abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance.

GES and indicators

GES[71]
Improvement in the quality of the assessed areas and habitats in the Dutch section of the North Sea (Benthic Indicator Species Index).

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Quality of benthic habitats (BISI)	Dutch section of the North Sea (DCS)	Trend as in definition of GES	The quality of the assessed areas and habitats in the Dutch section of the North Sea (Benthic Indicator Species Index) is improving	National interpretation

GES
For the habitats described in the framework of the Habitats Directive, the targets for the conservation status of these habitats apply.

Indicator[72]	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Conservation targets for habitat types	Natura 2000 areas in the Dutch section of the North Sea	Surface area and quality (largely determined by BISI)	Conservation of surface area and conservation / improvement of the quality of habitat types H1110B/C and H1170	National interpretation

[71] There is also a correlation with overarching GES: 'Improvement in the size, condition and global distribution of populations of the community of benthos species.'
[72] See footnote 71.

6.3.1 From information requirements to monitoring strategy

The information requirements for the MSFD are linked to those for the Habitats Directive (HD), and specifically the Natura 2000 areas. Both directives are intended to protect the seafloor habitats of the North Sea. For an evaluation of GES, changes have to be identified; monitoring has to indicate whether, and preferably to what extent, improvements are occurring over time.

The monitoring focuses on a selection of species that as a whole are indicative of the structure and function of the habitats, of disturbance by human activities, and of the degree of recovery. The so-called typical species (in accordance with the Habitats Directive) are included in the selection if they are sufficiently sensitive to enable
change in quality to be detected. The monitoring results yield the necessary information for:

- a six-yearly assessment of the quality of seabed habitats throughout the DCS, having regard to the status of the benthos communities in six dominant ecotopes/habitats
- a six-yearly assessment of the benthos communities in the seabed protection areas. The assessment in the Natura 2000 areas (North Sea Coastal Zone, Voordelta, Vlakte van de Raan, Dogger Bank and Cleaver Bank) is linked to the conservation targets. In the other seabed protection areas (Frisian Front and Central Oyster Grounds), the environmental status is determined.
- insight into the effectiveness of the measures taken, with an update every six years.

Functional requirements/monitoring strategy

Habitats/areas and parameters

The monitoring plan meets the structural information requirements ensuing from the MSFD, and hence also the requirements for the Habitats Directive (conservation status) and Natura 2000 (conservation targets). The surveys focus mainly on seabed protection areas, with the most suitable monitoring technique being selected for each type of indicator. However, in the interests of good coverage of the DCS (relatively speaking, as intensively as the seabed protection areas), the Bruine Bank area is also monitored. This area is deemed to be representative of the Southern Bight and the ecotope composition there. Additional, less intensive monitoring, with just one of the monitoring methods, in other parts of the DCS also provides a general impression of the status of the DCS. There is also specific monitoring to assess the effectiveness of measures. Areas in which protective measures have been taken are compared with reference areas with the same habitat composition but where no protective measures have been taken (*Before-After-Control-Impact* [BACI] design).

It is not yet possible to formulate threshold values for environmental targets and GES, so the point of departure is to be able to establish trends and/or significant differences in the situation when various measurements are in place and the baseline situation in 2015. The monitoring plan provides insight into changes in the presence and distribution of indicator species, including most of the typical species (benthos) under the Habitats Directive. The selected species are indicative of various pressure factors and of (initial) recovery. For example, benthic species with a long lifespan are generally more sensitive to seabed disturbance than species with a short lifespan.

The monitoring survey is designed in such a way that - on the basis of the hit rate - at least a change of 50 percent in the spatial distribution of at least some indicator species between two measurements can be observed. The reliability of this observation is 95 percent and it provides a basis for conclusions that will probably be correct in 80 percent of cases (actual power).

The monitoring does not focus specifically on biogenic structures or on rare species. To detect changes in the numbers and distribution of species that naturally occur in small densities (such as the ocean quahog) would require a very intensive monitoring programme. The same applies for the monitoring of the location of small areas of biogenic structures. Furthermore, MSFD monitoring is mainly expected to yield data for the early identification of the start of changes and improvements. Recovery of specific biogenic structures can only be expected in the medium term, when the seabed disturbance has ended. In fact, any large-scale recovery of biogenic structures will also be evident in the regular BISI assessment of habitat quality (see 'Assessment method').

The quality status of a habitat, the achievement towards GES and the effectiveness of measures are assessed on the basis of changes in the spatial distribution of populations or - where possible - abundance of indicator species. In each sampling, every other species that is found is also registered, including the 'typical species' for the HD. In every sampling, the minimum information to be registered for every species (including non-indicator species) is what has to be assessed; for most species this is 'densities', but for a few species it is presence or absence.
It might in future be possible, for example on the basis of OSPAR indicators, to formulate a broader information requirement so that parameters such as biomass and individual lengths could also become relevant.

Spatial and temporal coverage

The MSFD and the HD do not specify any requirements for the spatial and temporal coverage of the monitoring programme, but it must be sufficient to report on the proportion of habitats that are in good condition every six years. To that end, for substantive, strategic and statistical reasons it has been decided to perform measurements every three years. Whether this coverage meets the information requirements is evaluated every six years. If necessary, the monitoring plan is revised.

Table 6.3.1: Overview of the benthos monitoring programme, with numbers of monitoring locations/samples per sub-area, the sampling technique, and the function of the location in the monitoring programme.

AT = Monitoring location for general assessment of quality status.

EM = Monitoring location for assessment of effectiveness of measures.

AT+EM = Monitoring location for both types of evaluation.

** = Areas lying outside the seabed protection areas per MSFD zone.*

Trawl samples in the coastal zone, including North Sea coastal zone, Voordelta and Vlakte van de Raan, are part of the WOT survey (for the Ministry of Agriculture, Nature and Food Quality); the other measurements fall under Rijkswaterstaat's monitoring survey (MWTL).

	Box corer	Trawl			Grab			Video	
Area name	**AT**	**AT**	**AT+EM**	**EM**	**AT**	**AT+EM**	**EM**	**AT+EM**	**EM**
Central Oyster Grounds	18	9	3	11					
Frisian Front	9	8	7	28					
Cleaver Bank	1				3	14	20	16	17
Dogger Bank	22	9	7	49					
Vlakte van de Raan	8	0	39	39					
Voordelta	16	83	0	0					
North Sea Coastal Zone	16	0	66	66					
Bruine Bank	7	9	0	0					
Oyster Grounds other*	24	0	0	10					
Offshore other*	28	0	0	37					
Coastal Zone other*	16	77	0	0					
Total	**165**	**557**			**37**			**33**	

The evaluation coincides with the six-yearly updating of the Marine Strategy part 2, when any trends or differences in levels compared with the T0 status for the defined indicators are assessed. On that basis it can be determined whether the environmental targets have been reached and whether GES can be achieved or maintained.

The report of the six-yearly assessment of the environmental status of the Dutch section of the North Sea distinguishes six 'most common habitats/ecotopes' at EUNIS-4 level and - under the title 'special habitats' - the Natura 2000 areas in the DCS. The report also describes the search areas for seabed protection measures under the MSFD as 'habitats deserving particular attention'.

Spatially representative benthos data are needed for all these habitats in order to assess changes in the quality status of the seabed. These data must be sufficiently statistically distinctive and accurate.The EUNIS-4 habitats cover the entire area of the Dutch section of the North Sea. The other habitats that are reported on (such as HD habitat types) overlap with the EUNIS-4 habitats, so that in part the same monitoring locations can be used for the assessment.

For the habitats on the DCS, the minimum number of monitoring locations required is determined on the basis of statistical analysis. The starting point is that it must be possible to make well-founded judgements regarding the development of habitats protected under the MSFD and the HD, about developments in the seafloor protection areas and about the effectiveness of the management measures.

Statistical analysis also forms the basis for determining the number and types of samples required for each of the habitats to be assessed.
Where relevant, account is taken of the possibility of differentiating between benthic communities according to their relationship with existing ecotopes and in relation to geographic zoning with targeted seabed protection measures.

Monitoring locations in each area are distributed by surface area ratio, but randomly within separate ecotopes and/or zones (stratified random sampling). Like

the temporal coverage, the spatial coverage is evaluated every six years.

Method
The choice of monitoring technique is customised, because the various habitats, size classes of benthic animals and abundance of benthic species impose specific requirements in terms of type and measurement of the monitoring instruments if sampling is to be representative. The monitoring plan for benthic animals therefore encompasses a variety of monitoring instruments:

- Box corer with a mesh size of 1 mm: suitable for the smallest indicator species present in relatively high densities in fine sediment.
- Trawl with a mesh size of 5 mm: for sampling in larger survey areas, suitable for the larger indicator species larger than 0.5 to 1 cm in size (depending on the shape of the species) present in relatively low densities in fine sediment.
- Hamon grab: suitable for smaller indicator species in relatively high densities in rough sediment (such as gravel).
- Video: suitable for species larger than 1 cm (including hard substrate species and species inhabiting specific types of soft substrate) on reefs in open sea, specifically for surveying a large surface area.

Effects of natural variability (such as seasonal influences) can be minimised by employing a fixed monitoring period. Variations that can occur from year to year are avoided by sampling the monitoring locations with the appropriate instrument as far as possible in the same year for each evaluation (area, habitat or measure). The quality of the information also benefits from the fact that the monitoring is conducted as regularly as possible (every three years).

In connection with the Assessment method, at least 'numbers per species' must be registered for each sampling location. In light of future developments, it could also be relevant to register biomass and/or lengths. In the interests of consistency and cost efficiency, the MSFD monitoring plan is linked as closely as possible to the monitoring programmes for the HD and WFD.

6.3.2 Monitoring surveys

The survey of benthic animals is part of Rijkswaterstaat's monitoring programme (MWTL) and the Statutory Research Tasks (WOT) shellfish survey for the Ministry of Agriculture, Nature and Food Quality. Since 2015, the benthic fauna monitoring programme in the North Sea has been adapted to the needs of the MSFD (and HD). Within the MWTL programme, since then samples have been taken not only with box corers, but also with a trawl, video and Hamon grabs. The number of monitoring locations was also greatly expanded at the time.

The number of monitoring locations was expanded again in 2018 following the definitive demarcation of the boundaries of the Frisian Front and the Central Oyster Grounds. The WOT survey has been expanded with 51 locations since 2015. Table 6.3.1 lists the number of monitoring locations for each sampling device and for each area.
Figure 6.3.1 gives an impression of the spatial distribution of the measurement locations. Measurements are carried out every three years in the spring. Video monitoring is carried out in the summer.

A large proportion of the measurements for the MWTL and WOT already commenced in the 1990s. For the methods, parameters such as numbers, biomass and length, and other specifications, see the protocols of Rijkswaterstaat and WOT. The parameters to be measured correspond with the specifications that are needed for the assessments (see under 'Assessment method'). The parties that carry out the monitoring are required to provide a guarantee of quality in the form of certification (ISO 9001) and accreditation (NEN-EN-ISO/IEC 17025). This guarantees a certain accuracy of measurements and (taxonomic) analysis within predefined limits. For further details of the monitoring programme, see Wijnhoven (2019).

6.3.3 Assessment method

For the assessment of criterion D6C3, the Benthic Indicator Species Index (BISI) is used (Wijnhoven and Bos, 2017; Wijnhoven, 2018). The BISI was specifically developed for assessments and reports under the MSFD and the Habitats Directive, the evaluation of Natura 2000 management plans and evaluation of the effectiveness of protective measures undertaken.

The indicator provides insight into the quality and development of areas and sub-areas of the Dutch section of the North Sea. It is not possible to establish a threshold value at this stage in the absence of a scientific basis due to the limited supply of data. However, with the indicator, data for a set of indicator species can be converted into an index value for the general quality of an area. On that basis, it is possible to make judgements about whether the quality is increasing, declining or remaining stable. The indicator can also be used to identify possible causes of observed changes in the quality status of benthic habitats, and their consequences, by calculating specific BISI values on the basis of subsets of indicator species.

6.3.4 Analysis of monitoring programme

Following the introduction of the MSFD monitoring programme (Marine Strategy part 2) in 2014, the existing monitoring programme for the Dutch section of the North Sea was adapted and expanded to match the requirements arising from the MSFD and Natura 2000 as closely as possible. With the development of a suitable Assessment method (BISI indicator), the focus shifted to a larger set of indicator species than before. This has created greater statistical power. The suitability of the monitoring programme and the Assessment method will constantly be periodically reviewed. The monitoring programme and the associated Assessment method are adequate for the MSFD and the HD and for evaluation of the Natura 2000 management plans (including assessment of the effectiveness of measures for benthos). There are a few exceptions, however. The management areas of the Voordelta are assessed on the basis of project monitoring with a separate assessment system. Moreover, there is a specific method of evaluation for individual areas with different management regimes within the framework of VIBEG (management type II to IV; Ministry of Economic Affairs, 2017). Such areas are to be found in the Vlakte van de Raan and in the North Sea coastal zone. All of the areas that are entirely closed to fishing (VIBEG type I) are assessed, by HD area, on the basis of the MSFD monitoring programme and the BISI.

6.3.5 Cooperation and developments

The MSFD monitoring programme serves a number of purposes. Monitoring data are also used for the national reporting for Article 17 of the Habitats Directive and for the evaluation of the Natura 2000 management plans, and possibly also for assessing requests for permits and/or dispensations under the Nature Protection Act.

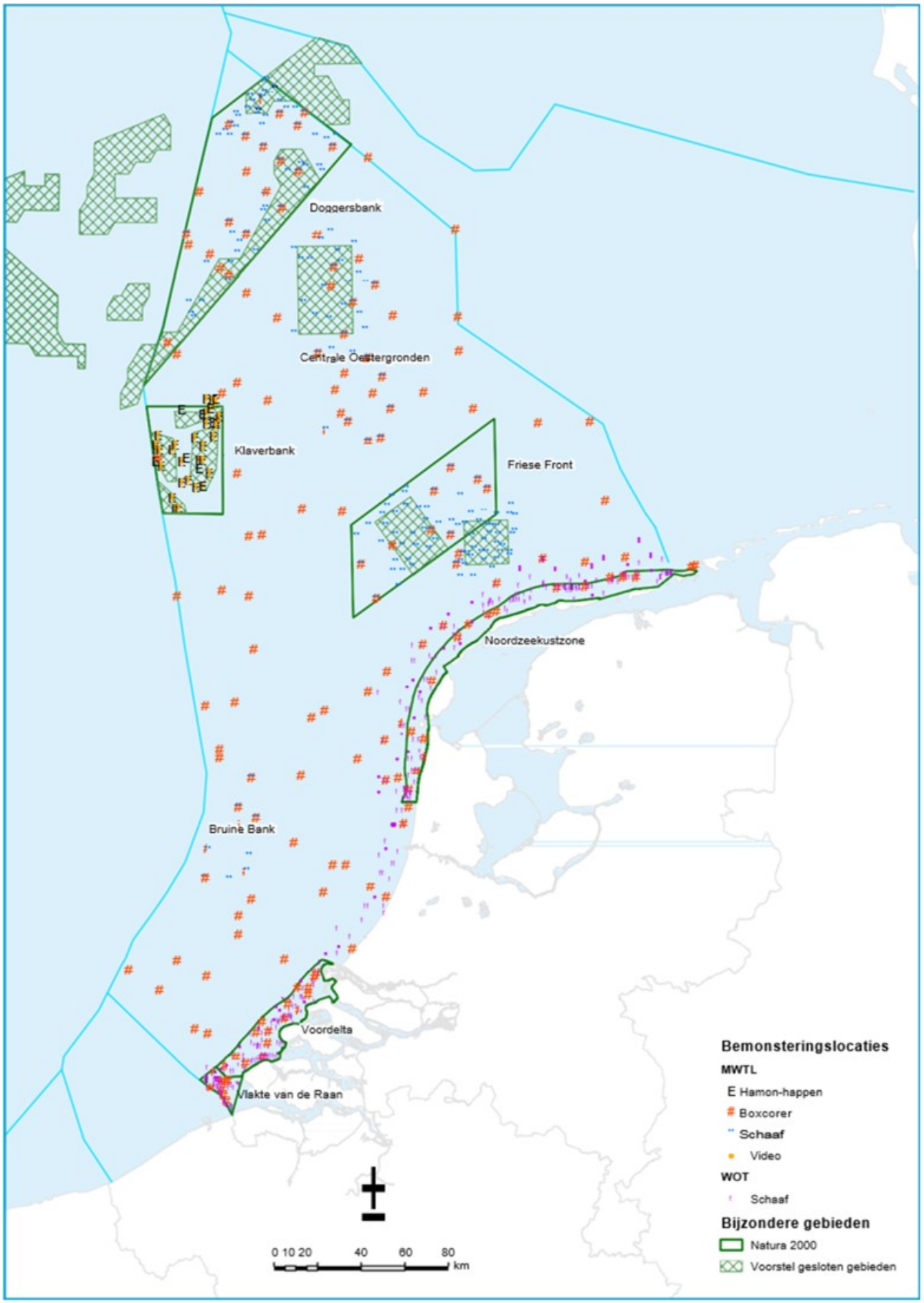
The picture of the ecological status of the North Sea derived from information from the MSFD monitoring programme is useful for drawing a baseline providing insight into the development of the system, without the effects of large projects and interventions such as sand excavation, offshore wind energy and land reclamation.

The Assessment method using the BISI indicator also has multiple applications, such as the national reporting for Article 17 of the Habitats Directive and the evaluation of the conservation targets in Natura 2000 areas. OSPAR is currently exploring the possibility of also using the BISI indicator for assessments at regional scale. That would meet the environmental targets for D1: 'Further development and testing of regional assessment methods (OSPAR and ICES) that can be used in the future for assessing benthic and pelagic habitats' and for D1/D6: 'There is a knowledge assignment in respect of assessment methodology, cumulation and hard substrate'.

In addition, OSPAR's Benthic Habitat Expert Group (OBHEG) is investigating ways of improving the coordination of monitoring activities and monitoring programmes, and perhaps ultimately conducting them jointly. The group has taken the findings from the Joint Monitoring Programme (JMP NS/CS) as its starting point and is further analysing the applicability with regards to benthos.

Germany, the United Kingdom and the Netherlands have recently been actively involved in the joint sampling and analysis programme on the international Dogger Bank (Dogger Bank Monitoring Group). The results have been reported to the Dogger Bank Steering Group. More generally, the aim is to follow the developments and agreements made in the EU MSFD CIS TG Seabed as closely as possible.

Figure 6.3.1: MSFD monitoring locations for benthic animals ('bemonsteringslocaties'), broken down by monitoring method (Hamon grab, boxcorer, trawl ('schaaf') and video). The trawl locations along the coast fall under the WOT, all others are covered by the MWTL. Special areas are also indicated: the Natura 2000 areas and the areas where there are plans to close them to seafloor-disturbing fisheries ('voorstel gesloten gebieden').



6.4 Status of communities: diversity within benthic habitats (OSPAR) (D6C5)

Criterion D6C5 (primary)
The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relevant abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), do not exceed a specified proportion of the natural extent of the habitat type in the assessment area.

GES and indicators

GES[73] The diversity of benthos displays no downward trend in the assessed areas (OSPAR).				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Condition of Benthic Habitat Communities: Subtidal Habitats of the Southern North Sea (OSPAR)	OSPAR Southern North Sea	Margalef Index (species richness corrected for total abundance)	Not yet established	

6.4.1 From information requirements to monitoring strategy

To evaluate the extent to which GES has been achieved, any deterioration in diversity has to be identified. To keep track of diversity, monitoring aims to follow all benthic species. The results of the monitoring provide the information needed for a six-yearly assessment of the diversity of the benthos communities at DCS level.

Functional requirements/monitoring strategy
Monitoring must be able to indicate any increase or decrease in diversity in terms of trends and/or significant differences between the six-year periods. No threshold values have been established for GES. On the assumption that the natural variability at the level of ecotopes/habitats is smaller than the impact of anthropogenic factors, it was decided to use permanent monitoring locations for each ecotope.

[73] There is also a correlation with overarching GES 'Improvement in the size, condition and global distribution of populations of the community of benthos species.'

Table 6.4.1: Overview of the number of box corers per zone, for assessment with the Margalef index.

Research area	Coastal zone	Offshore	Friese Front	Oyster Grounds	Dogger Bank
Number of box corers	5 6	3 2	2 1	3 6	1 9

Every six years, during the updating of the Marine Strategy part 2 or the preceding joint OSPAR assessment, data must be available about trends or differences in levels compared with the T0 situation for the defined indicator. Earlier evaluations for the MSFD and OSPAR suggest that sampling every three years can be expected to meet these data requirements.

At DCS level, five zones have been designated for monitoring the diversity of species: coastal zone, Dogger Bank, Frisian Front, offshore and Oyster Grounds. These zones differ in terms of sediment type, depth and location in relation to the coast.[74]

To assess the community of species as a whole, box cores, which are suitable for the smallest indicator species in relatively high densities in fine sediment, are used. With this method, the benthos sample is sifted over 1 mm and then, if possible, taxonomically classified to species level. The index is sensitive to the level of classification. It is also important whether specific groups or size classes are included or not. All benthos is determined to species level, with the exception of sessile arthropods, bryozoa, colonial tunicates, hydrozoa, entoprocta and porifera, whose presence is registered at group level. Sampling has to be done in the spring, preferably before the spatfall, since the index is sensitive to the observation of large numbers of juveniles if the sampling continues until after the spatfall. Juveniles must in any case be identified separately so that they can be excluded in the calculation of the index.

6.4.2 Monitoring surveys

For the characteristics of the monitoring survey, see D6C3. Specific box corer locations are selected for the Margalef index. Table 6.4.1 shows the distribution of the number of box corers in each zone. For the spatial positioning of the five zones on the DCS and their location in relation to seabed protection areas, see Van Loon and Walvoort (2018).

6.4.3 Assessment method

The Margalef index, which OSPAR formulates as common indicator BH2, is used for the assessment of D6C5. That index is a measure of the benthos diversity, which is assumed to correspond with the quality and level of disturbance of the benthic communities.

Relationships between index results and the extent of seafloor-disturbing fisheries and organic pressures have been shown (Van Loon and Walvoort, 2018; Van Loon *et al.*, 2018).

6.4.4 Analysis of monitoring programme

The number of box corer monitoring locations has not changed compared with the MSFD monitoring programme in 2014, but three monitoring points have been relocated. On the basis of the information requirements for the MSFD, the number of monitoring points that were needed was established at the time with a power analysis. It can therefore be assumed that the current monitoring survey is adequate. By the time the MSFD monitoring plan is being updated again there will have been sufficient measurements to re-evaluate the necessary monitoring effort.

6.4.5 Cooperation and developments

The Margalef index is accepted as a common indicator (BH2) for OSPAR regions II, III and IV, and was accordingly part of the OSPAR Intermediate Assessment. The index is applied to monitoring data from various countries mainly in the southern North Sea region (II) (OSPAR, 2017).

OSPAR has proposed using the index in combination with evaluations of pressure factors, in particular pressure from fisheries and organic pressures, to determine the relationship between pressures and effects. In that context, it is assumed that enough is known about the dominant pressure factors. However, the Margalef index does not respond to a specific type of disturbance, but to the totality of disturbances. The Netherlands therefore also suggests the BISI (see D6C3) to be used at regional level, since it can provide insight, on the basis of selections of indicator species, into the type and extent of disturbances that play a role in the observed quality. The possibilities for this are being investigated at OSPAR level.

It might be preferable to adopt a new delineation of the five zones on the DCS which coincides with the boundaries of the seabed protection areas and/or habitat levels (EUNIS 4). That depends on developments and agreements made in the EU MFSD CIS TG Seabed.

[74] By using five zones, the Margalef index does not directly follow the EUNIS classification, in contrast to the BISI (see D6C3).

Descriptor 7: Hydrographical conditions

Permanent alteration of hydrographical conditions do not adversely affect marine ecosystems.

7.1 Permanent alteration of hydrographical conditions (D7C1 and D7C2)

Criteria (both secondary)

D7C1: Spatial extent and distribution of permanent alteration of hydrographical conditions (e.g., changes in wave action, currents, salinity, temperature) to the seabed and water column, associated in particular with physical loss of the natural seabed.

D7C2: Spatial extent of each benthic habitat type adversely affected (physical and hydrographical characteristics and associated biological communities) due to permanent alteration of hydrographical conditions.

GES and indicators

GES There is no description of GES at criterion level. There is an overarching GES: the marine ecosystem suffers no negative effects as a result of permanent changes to the hydrographical properties due to human activities.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
No indicators anticipated				

7.1.1 Information requirements and analysis

Hydrographical changes are changes to the state of the seabed, currents and waves. These changes influence physical and chemical properties of the sea, for example bottom shear stress, sediment transport, salinity or water temperature. These impacts on marine ecosystems can be relevant if they occur on a larger scale and are permanent in nature. As a result, marine habitats could change or disappear entirely.

GES for D7 is preserved if the marine ecosystem does not suffer any negative effects from permanent alterations in hydrographical properties as a result of human activity.

Developments such as the construction of wind farms, harbours and hard surfaces, as well as sand extraction and suppletion, could have an impact on hydrographical properties and are therefore assessed for their potential effects. This calls for monitoring, registration and assessment (including compensatory measures if necessary) in accordance with the existing statutory frameworks. This usually involves environmental impact reports (EIAs).[75] One major project for which this procedure was followed was the construction of Maasvlakte 2. The licence prescribed compensating measures that resulted in steps to protect the seabed and the creation of rest areas in the Voordelta. Another large-scale development that could have consequences for hydrographical properties is the construction of wind farms. See 'Cooperation and developments'. There is no permanent survey in place specifically for the monitoring and assessment of D7;

[75] Relatively limited interventions, such as sand extraction, sand suppletion and dredging, are regulated by licensing; negative effects on the marine ecosystem are mitigated. The local effects of such interventions are relatively small and are not permanent. The same applies for interventions like the construction of the Sand Motor. The evaluation of the large-scale sand excavation for the construction of Maasvlakte 2 showed that the effects were highly localised and far smaller than expected (Rijkswaterstaat, 2014).

individual projects are instead monitored, registered and assessed through the licensing and EIA procedures.

7.1.2 Monitoring surveys

The monitoring of the effects of activities that could influence the hydrographical properties is carried out in the context of licensing procedures or during the evaluation of measures taken. Because the measurements are performed for a specific project they are not, strictly speaking, part of the MSFD monitoring programme.

Rijkswaterstaat (the MWTL programme) and the Hydrographic Service of the Royal Netherlands Navy regularly monitor the state of the seabed, salinity, currents and wave heights in the North Sea. Although these measurements are not explicitly part of the MSFD monitoring programme, the data can support the assessment for D7. Further information about these surveys is available on the website https://waterinfo-extra.rws.nl/monitoring.

7.1.3 Assessment method

Projects such as land reclamation, large-scale sand extraction and the construction of wind farms can lead to changes in hydrographical conditions. For each project, the extent of the affected area of the seabed is determined during the environmental impact procedure, which includes an EIA, by performing model calculations of aspects such as currents, salinity, sludge content, bottom shear stress and sediment transport. On that basis, the area that will be affected by changes and the extent to which those changes will occur are determined.

The extent of altered habitat types and changing functions of habitats is then determined. Consequently, the area in which the benthic fauna are being damaged can be determined. If necessary, the benthic fauna are sampled and monitored.

7.1.4 Cooperation, analysis and developments

The implementation of D7 has not changed compared with the previous MSFD monitoring programme. GES has been maintained during that period by including requirements in the licensing of new activities. No new interventions that will clearly influence the hydrographical properties of the North Sea are planned in the period up to 2024. The current approach (via licensing) provides sufficient information for assessing environmental targets and GES.

The Dutch and international assignments for the development of offshore renewable energy demand special attention. They will lead to a substantial increase in the number of wind turbines. The physical damage is expected to be local and relatively minor. Nevertheless, the cumulative effects could be significant. Research into the effects of large-scale construction of offshore wind farms is included in the North Sea Knowledge Agenda 2030 and an exploratory study has already been carried out (Boon *et al.*, 2018).

The influence of climate change might also be relevant for permanent alteration of hydrographical properties. Rising sea levels and alterations in the discharges from the large rivers[76] could have direct effects on the hydrographical conditions, for example.

[76] Monitoring of sea level and discharges from rivers are covered by Rijkswaterstaat's monitoring survey (MWTL).

Descriptor 8: Contaminants

Concentrations of contaminants are at levels not giving rise to pollution effects.

8.1 Contaminants in water, sediment and biota (D8C1)

Criterion D8C1 (primary)
The concentrations of contaminants do not exceed threshold values.

GES and indicators

GES[77]
For coastal waters (up to 12 nautical miles): the concentrations of contaminants relevant for the marine environment, measured in the most appropriate compartment (water or biota) comply with the environmental quality standards used for the WFD in the 12-mile zone (for priority substances) or in the 1-mile zone (for all other substances), respectively.

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
The status of the concentrations of the WFD's priority substances and specific pollutants in water	For the WFD specific pollutants up to 1 nautical mile; for the WFD priority substances up to 12 nautical miles	Concentration in water	For the WFD assessments and the WFD data, see: http://cdr.eionet.europa.eu/nl/eu/wfd2016/districts/ http://cdr.eionet.europa.eu/nl/eea/wise_soe/	WFD

GES[78]
For offshore waters (beyond 1 and 12 nautical miles, respectively): the concentrations of contaminants relevant for the marine environment, measured in the most suitable compartment (sediment or biota) demonstrate a downward trend (pursuant to OSPAR).

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Metals in biota (OSPAR assessment)	OSPAR Southern North Sea	Concentration in biota	Cadmium, mercury, lead: downward trend; copper: not applicable.	National interpretation, pursuant to OSPAR
Metals in sediment (OSPAR assessment)	OSPAR Southern North Sea	Concentration in sediment	Cadmium, mercury, lead: downward trend; copper: not applicable.	National interpretation, pursuant to OSPAR
Organotin in sediment (OSPAR assessment)	OSPAR Southern North Sea	Concentration in sediment	Monobutyltin, dibutyltin, tributyltin: declining	National interpretation, pursuant to OSPAR
PAHs in biota (OSPAR assessment)	OSPAR Southern North Sea	Concentration in biota	Declining (PAH: 9 substances)	National interpretation, pursuant to OSPAR
PAHs in sediment (OSPAR assessment)	OSPAR Southern North Sea	Concentration in sediment	Declining (PAH: 9 substances)	National interpretation, pursuant to OSPAR

[77] There is also a correlation with the overarching goal 'concentrations of contaminants relevant for the marine environment, measured in the most suitable compartment (water, sediment or biota) are lower than the concentrations whereby negative effects can occur, or demonstrate a downward trend'.
[78] See footnote 61.

PBDEs in biota (OSPAR assessment)	OSPAR Southern North Sea	Concentration in biota	Declining (PBDEs: 6 substances)	National interpretation, pursuant to OSPAR
PBDEs in sediment (OSPAR assessment)	OSPAR Southern North Sea	Concentration in sediment	Declining (PBDEs: 6 substances)	National interpretation, pursuant to OSPAR
PCBs in biota (OSPAR assessment)	OSPAR Southern North Sea	Concentration in biota	Declining (PCBs: 7 substances)	National interpretation, pursuant to OSPAR
PCBs in sediment (OSPAR assessment)	OSPAR Southern North Sea	Concentration in sediment	Declining (PCBs: 7 substances)	National interpretation, pursuant to OSPAR

8.1.1 From information requirements to monitoring strategy

To establish whether GES for criterion D8C1 has been achieved, concentrations of contaminants have to be monitored. The Marine Strategy part 1 states that the European directives will be complied with and that the programmes and activities of the prevailing regional sea conventions (OSPAR) will be built upon. The European directives pertaining to contaminants are the Water Framework Directive (WFD) and the Priority Substances Directive.

The areas of application of the MSFD and the WFD overlap in the zone up to 12 nautical miles from the base coastline, the so-called 'coastal waters'. GES for contaminants in the coastal waters is linked to the requirements of the WFD, and hence of the Priority Substances Directive; for the substances, standards and time path, the WFD is followed. In the offshore waters, from the external boundary of the WFD water body (1 or 12 nautical miles), only the MSFD applies, and GES is linked to the OSPAR assessment.

Functional requirements/monitoring strategy

Choice of compartment

For an accurate assessment and to establish reliable trends of contaminants, samples must be collected in the most suitable compartment. This means that polar substances should preferably be measured in water and non-polar substances in biota and sediment.

Spatial coverage

The six-yearly update of the Marine Strategy must include an assessment of the environmental targets and whether GES will eventually be reached or maintained. To this end, the data must have ample spatial coverage, namely the entire DCS, and they must be suitable for a regional assessment, i.e., internationally coordinated.

Frequency

Coastal waters: the WFD provides that concentrations of priority substances in water must be assessed at least once every six years and, once good status has been reached, at least once every eighteen years. Measurements for this assessment must be taken every month for a year. For specific pollutants, the monitoring frequency is once a quarter. For priority substances with a biota standard, measurements must be taken once every three years.

Offshore waters: OSPAR's Coordinated Environmental Monitoring Programme (CEMP) prescribes that contaminants in sediment and biota should be monitored at least every three years, and preferably every year.

Measurement window

All measurements are performed in the most suitable period of the year for ensuring that the effect is determined as accurately as possible. This requirement relates mainly to measurements in biota. The sampling of fish to determine the contaminants in biota must be carried out in the period of stable physiological status, in any case outside the spawning period. In addition, the timing within that period must be the same every year. The suitable sampling periods for flounder and plaice are August and September.

Parameters in coastal waters

The WFD applies in marine waters from the baseline to 12 nautical miles from the coast for priority substances and to 1 mile from the coast for the specific pollutants. The concentrations of the contaminants are measured in water or biota. The choice is determined by the compartment (sediment or biota) for which the WFD standards were adopted.

Parameters in offshore waters

In the offshore waters, i.e., the entire Dutch Continental Shelf from 1 or 12 nautical miles from the coast, respectively, the concentrations of the contaminants relevant for the marine environment are measured in the most suitable compartment: sediment or biota, or both.

Within OSPAR, the following common indicators have been agreed:

- concentrations of polycyclic aromatic hydrocarbons (PAH) in biota and sediment: phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[a]pyrene, benzo[ghi]perylene, indeno[123-c,d]pyrene
- concentrations of polychlorinated biphenyls (PCBs) in biota and sediment: congeners 28, 52, 101, 118, 138, 153 and 180
- concentrations of polybrominated diphenyl ethers (PBDEs) in biota and sediment: congeners 28, 47, 99, 100, 153 and 154
- concentrations of organotin compounds in sediment: monobutyltin, dibutyltin, tributyltin
- concentrations of metals in biota and sediment: mercury, cadmium and lead.

With respect to the environmental target 'regional monitoring of copper concentrations, now that this heavy metal is used as a substitute for TBT (OSPAR)',[79] in addition to the OSPAR indicators, the Netherlands also monitors concentrations of copper in sediment and biota. Monitoring and assessment are carried out in accordance with OSPAR.

Accuracy and reliability

There are specific requirements for the quality of the measurements of all the substances. The measurements in coastal waters are performed in accordance with the technical specifications of Directive 2009/90/EC (WFD method). The parameters for the WFD assessments must comply with the conditions laid down in the Dutch protocol on monitoring and status assessment of WFD surface water bodies (Rijkswaterstaat, 2020). Measurements of substances in biota and sediment in the offshore waters are performed according to the OSPAR methods. For the technical specifications of the methods and the measurement uncertainty, see the OSPAR Guidelines (2011, 2012, 2018).

8.1.2 Monitoring surveys

The measurements for D8 are all part of Rijkswaterstaat's monitoring programme (MWTL). The monitoring of these substances commenced around 1990. Revisions have been made over the years, mainly because of changes in the information requirements. The monitoring surveys in their current form have been largely operational since 2014. For the method of sampling and analysis, including information about quality assurance/quality control, see the OSPAR Guidelines (2011, 2012, 2018).

Coastal waters

The boundaries of the coastal waters correspond with those for the WFD. The monitoring is carried out at a single representative location for each WFD water body. The following water bodies overlap with the MSFD area:

- coastal zone Zeeland
- coastal zone Northern Delta
- coastal zone of Holland
- Wadden coastal zone
- Ems-Dollard

Water: the cycle for the WFD monitoring programme is followed. The specific pollutants under the WFD (see list of substances in the Decree on Quality Requirements and Monitoring of Water (BKMW) at www.helpdeskwater.nl) are measured in water within the 1-mile zone; the priority substances under the WFD (see the list in the Priority Substances Directive on the Helpdesk Water website) in water in the 12-mile zone. Monitoring is carried out once a quarter for specific pollutants and once a month for priority substances.

Biota: the concentrations of all WFD priority substances with a standard for biota (see Guidance on Priority Substances on the Helpdesk Water website) are measured in flounder (*Platichthys fesus*). PAH are an exception; those measurements are taken in shellfish. The monitoring frequency of fish and shellfish is once every three years.

Offshore waters

Sediment: the monitoring is linked to OSPAR's area classification. The concentrations of PCBs, PAH, PBDEs, organotin compounds and metals are measured in sediment samples. The sampling takes place at more than ninety locations in the Dutch section of the Southern North Sea. For the regional OSPAR assessment, the monitoring locations are divided among nineteen areas that partly overlap with the WFD area. The Netherlands supplements the OSPAR assessment using trends for the Southern North Sea with a national MSFD assessment using trends, which covers four marine areas lying outside the WFD 12 nautical-mile zone:

- the area west of Walcheren (three monitoring locations)
- the area west of Noordwijk (five monitoring locations)
- the area north-west of Texel (seven monitoring locations)
- the area north of the Wadden Sea (four monitoring locations)

Sediment is monitored once every three years.

Biota: outside the 12-mile zone, PCBs, PBDEs and metals are measured in plaice (*Pleuronectes platessa*). Plaice are sampled in a number of trawls in three areas: North-west Terschelling, Bruine Bank and Dogger Bank. The fish monitoring is conducted annually

[79] No common indicator has been established yet at OSPAR level.

8.1.3 Assessment method

Coastal waters

The assessment of the coastal waters is linked to the assessment for the WFD. The chemical status is determined with assessments of the WFD priority substances, which are measured within the 12-mile zone and assessed against the EU's Environmental Quality Standard (EQS). The substances with an EQS in water are measured in water; the substances with a standard in biota are measured in biota.

The assessments of the specific pollutants support the integrated assessment of ecological status. The WFD-specific pollutants are measured in the 1-mile zone and assessed against the national standards adopted for water. Assessment is based on the multi-year average of the three most recent annual averages. The method for the WFD assessment is described in the Dutch protocol on monitoring and assessment of WFD surface water bodies (Rijkswaterstaat , 2020). Rijkswaterstaat performs assessments annually. The WFD findings are reported to Brussels every six years in a River Basin Management Plan. Factsheets with the official findings as reported to the European Commission can be found on the Dutch water quality portal.

Offshore waters

The assessment of offshore waters is linked to the joint OSPAR assessment of the Southern North Sea. Trends calculated by OSPAR MIME are also used for the national MSFD assessment, see the site http://dome.ices.dk/osparmime/main.html. Every year MIME assesses the status of and trends in the various OSPAR parameters, including OSPAR's common indicators and other parameters such as copper.

However, OSPARs objectives, target values and assessment values are not always adopted literally for the description of GES. The objectives are regarded as aspirational goals for the long term. There is no international agreement to use those values as threshold values for the MSFD. The assessment values have no legally binding status and often also relate to the functioning of sub-areas of the total ecosystem. The Netherlands therefore adopts a downward trend (pursuant to OSPAR) as its starting point.

8.1.4 Analysis of monitoring programme

The monitoring programme is being expanded with measurements of concentrations of copper in sediment and biota.

8.1.5 Cooperation and developments

The MSFD requires EU member states to coordinate regional monitoring and assessment. As a regional platform, OSPAR plays an important role in this international cooperation. Developing common indicators, coordinating monitoring and joint assessment all fall under the auspices of OSPAR. Monitoring of contaminants is part of OSPAR's Coordinated Environment Monitoring Programme (CEMP). As far as possible, common criteria and indicators adopted under the auspices of OSPAR are used for the assessment of the environmental status of the Dutch section of the North Sea. Information specific to the Netherlands is only added to the assessment if necessary and where available.

The assessment for the coastal waters is linked entirely to the WFD. Any changes and developments are agreed at international level in the context of the WFD (CIS).

8.2 Effects of contaminants on species (D8C2)

Criterion D8C2 (secondary)
The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants, including cumulative and synergetic effects.

GES and indicators

GES[80] Downward trend as compared with Imposex in 2012.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Imposex (OSPAR assessment)	OSPAR Southern North Sea	Vas deferens index	Downward trend	National interpretation, pursuant to OSPAR

8.2.1 From information requirements to monitoring strategy

The MSFD provides that the health of the species must not be adversely affected by contaminants. The indicator for the assessment of criterion D8C2 is imposex in marine snails; for GES, the trend must be downward compared with 2012. Measuring imposex in marine snails is a suitable method of measuring the effect of contamination with tributyltin (TBT), also known as organotin. It is plausible that increased TBT concentrations in snails are connected with biological effects such as impaired growth, sterility and mortality in the snail population. TBT is toxic for numerous marine organisms even in very small concentrations, and it has been established that it affects the reproductive capacity of various species of molluscs. Some female marine snails develop male genital features after being exposed to TBT. In predatory sea snails, this phenomenon is known as 'imposex'. In addition to normal genitalia, the female animals develop male genitalia, which ultimately block the oviduct, leading to sterility. TBT adversely affects numerous organisms, but marine snails, such as the dog whelk, are the most sensitive to it. Algae grazers, such as the common periwinkle, are far less sensitive to TBT than the dog whelk. Nevertheless, exposure to TBT can lead in these species to 'intersex', a deformity whereby the female genitalia grow into male genitalia, with sterility as a result.

Functional requirements/monitoring strategy

Imposex in marine snails is one of OSPAR's common indicators. The indicator is linked to the monitoring and assessment described in the OSPAR-CEMP (Coordinated Environmental Monitoring Programme). For the technical specifications of the method, see OSPAR JAMP Guidelines (2017).

8.2.2 Monitoring surveys

The MSFD monitoring programme is linked to the existing OSPAR monitoring of biological effects on marine snails. In the Netherlands, the monitoring falls under Rijkswaterstaat's monitoring programme (MWTL). The sampling is combined with shellfish research that is carried out for the Ministry of Agriculture, Nature and Food Quality between March and July every three years (see 'Analysis of monitoring programme').

To determine the biological effects, snails are collected in the following areas along the Dutch coast: eastern Wadden Sea coastal zone, western Wadden Sea coastal zone, northern coastal zone of Holland, central coastal zone of Holland, southern coastal zone of Holland, Haringvliet coastal zone, Grevelingen coastal zone, Eastern Scheldt coastal zone and Western Scheldt coastal zone.

In accordance with the CEMP, to establish the effects of TBT on snails, the extent of imposex is determined in the most representative species, such as the dog whelk (*Nucella lapillus*) and the netted dog whelk (*Nassarius reticulatus*). If sensitive species in areas with a lot of TBT contamination are absent, the degree of intersex in the common periwinkle (*Litorina litorea*) is determined. The CEMP provides that the biological effects in sea snails must be monitored once a year. The TBT concentration in the snails is also measured.

[80] There is also a correlation with overarching GES 'the health of the species is not adversely affected by contaminants.'

8.2.3 Assessment method

The OSPAR VDSI (Vas Deferens Sequence Indicator) has been developed for determining the extent of imposex. This index is based on specific characteristics of the penis and the vas deferens in the snails. High values for the VDSI indicate reduced capacity to reproduce in female snails. The results are reported at the level of the Southern North Sea, as was the case in the OSPAR Intermediate Assessment (2017). Trends calculated by OSPAR MIME are also used for the Dutch areas, see http://dome.ices.dk/ osparmime/main.html.

8.2.4 Analysis of monitoring programme

Given the steady and consistent decline in the level of imposex, the measurement frequency can be reduced. Instead of every year, monitoring will be carried out every three years, which is still more often than the OSPAR requirement of once every six years. The monitoring locations and the methodology of the imposex monitoring survey remain unchanged.

8.2.5 Cooperation and developments

The EU member states collaborate in the regional implementation of the MSFD. As a regional platform, OSPAR plays an important role in this international cooperation, for example by formulating common indicators and carrying out joint assessments. The current MSFD environmental status was therefore also evaluated in a regional context in OSPAR's Intermediate Assessment 2017. Jointly agreed criteria and indicators were used for the updating of the environmental status of the Dutch section of the North Sea. OSPAR also coordinates the monitoring of contaminants as part of the Coordinated Environment Monitoring Programme (CEMP)

8.3 Significant acute pollution with oil and oil-like substances (D8C3)

Criterion D8C3 (primary)
The spatial extent and duration of significant acute pollution events are minimised.

GES and indicators

GES The spatial extent and duration of significant acute pollution events are minimised.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Contamination with oil and other oily substances (Bonn Agreement)	Area of Bonn Agreement	Ratio: Count/Flight hours	Downward trend	National interpretation

8.3.1 From information requirements to monitoring strategy

For criterion D8C3, it is essential for significant acute pollution to be cleaned up as quickly as possible, where necessary in cooperation with other parties to the Bonn Agreement. Among other things, this requires that incidents with contaminants at sea are identified in good time. The evaluation of the extent to which GES for this criterion is achieved calls for registration of significant pollution incidents at sea, which also means that the spatial extent and total duration of pollution events must be reported every year.
Structural monitoring is not necessary; it is an administrative registration and analysis.

8.3.2 Monitoring surveys

Incidents at sea with oil and other oily substances have been monitored in the area covered by the Bonn Agreement since 1986 (www.bonnagreement.org). The Netherlands makes an active contribution to detect such incidents using targeted aerial observation. Rijkswaterstaat has capacity available day and night for this monitoring, with roughly 1,200 flying hours annually and a day:night ratio of 75:25. The timing of the monitoring is geared to the European satellite monitoring by CleanSeaNet (CSN) of the European Maritime Safety Agency (EMSA). This satellite monitoring can give an initial indication of the presence of oil compounds on the sea's surface.

Data from monitoring flights are entered in a Rijkswaterstaat database (VluVerO). Records of all incidents and details of how they were dealt with are registered.

8.3.3 Assessment method

Since 2008, the Netherlands, together with neighbouring countries, reports the number of observed pollution events at sea for the Bonn Agreement (Bonn Agreement, 2016). These reports form the basis for the six-yearly assessment for the MSFD, which establishes whether the number of pollution events at sea is declining.

8.3.4 Analysis of monitoring programme

In the initial MSFD monitoring programme (2014), oil effects at sea were monitored by counting the number of dead or dying oiled common guillemots that were washed up. However, those data were not used for the OSPAR Intermediate Assessment (OSPAR, 2017).

These monitoring results were mentioned in the last MSFD assessment, but the assessment was otherwise based on the monitoring for the Bonn Agreement. The registration and monitoring for the purposes of that agreement are therefore sufficient for the evaluation of D8C3. The monitoring survey of oiled marine birds is therefore no longer part of the MSFD monitoring programme.

8.3.5 Cooperation and developments

The oil detection system CleanSeaNet (CSN) make it possible to identify oil spills more quickly. On the basis of Sentinel satellite images and monitoring of ship movements (VMS), CSN can pinpoint locations that might be polluted with oil. Planes can then be sent out to ascertain whether there actually is any pollution.

Descriptor 9: Contaminants in seafood

Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.

9.1 Contaminants in edible tissue (D9C1)

Criterion D9C1 (primary)
The level of contaminants in edible tissue (muscle, liver, roe, flesh or other soft parts, as appropriate) of seafood (including fish, crustaceans, molluscs, echinoderms, seaweed and other marine plants) caught or harvested in the wild (excluding fin fish from mariculture) does not exceed defined maximum levels.

GES and indicators

GES
The levels of contaminants (including PAHs, dioxins and heavy metals) in fish and other seafood for human consumption from the North Sea do not exceed the maximum values defined in EU Regulation (EC) No. 1881/2006.

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Contaminants in edible tissue	Greater North Sea	Concentration of contaminants in fish and other seafood	Maximum levels of dioxins, PCBs, PAH and metals (cadmium, lead, mercury)	Regulation 1881/2006 setting maximum levels for contaminants in foodstuffs

9.1.1 From information requirements to monitoring strategy

Monitoring is necessary to establish whether the concentrations of contaminants in fish and other seafood comply with the agreed national and international standards. The monitoring is therefore directly linked to assessment of GES.

The MSFD monitoring programme is linked to the standards for food safety laid down in Regulation (EC) No. 1881/2006 of 19 December 2006. The regulation sets maximum levels (MLs) for certain contaminants in foodstuffs. The monitoring is designed in such a way that the seafood to be analysed is representative of the pattern of human consumption.

The Netherlands not only wants to comply with the current MLs, but also endeavours to ensure that the levels of contaminants in fish and other seafood that fall within the statutory national and international standards do not increase, and decline further where possible.

Functional requirements/monitoring strategy
Pursuant to Regulation (EC) No. 1881/2006, contaminants must be permanently monitored and assessed against the European standards. The Netherlands measures the concentrations of the following substances in fish and other seafood: polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), dioxins and dioxin-like PCBs, cadmium, lead, mercury, arsenic, polycyclic aromatic hydrocarbons (PAHs), polybrominated biphenyl ethers (PBDEs) and per- and polyfluoroalkyl compounds (PFAS).

The EU has set statutory MLs for PCBs, dioxins, cadmium, lead, mercury and PAH.

Frequencies and locations

Samples are takenfrom landed fish and other organisms for human consumption, including crab, shellfish and shrimp, at various locations. The catches from surveys on board research vessels are also sometimes sampled. Their geographic origin (the area), and usually also the precise coordinates, is known. The fish can be from the Dutch section of the North Sea or elsewhere. The locations vary every year, but also the species that are sampled. An important criterion is that the collection is representative of the pattern of human consumption. The surveys take place once a year. Measures to further reduce contamination have been agreed in the context of the WFD. Research projects are carried out to monitor the variation within the pool of investigated fish.

9.1.2 Monitoring surveys

The Netherlands has two programmes to monitor contaminants in fish and seafood for human consumption. Both are carried out by Wageningen Food Safety Research (WFSR):

- Monitoring Dutch seafood
- Cod liver and hake liver programme.

Monitoring of Dutch seafood

Since 2006, concentrations of contaminants have been measured in approximately twenty seafood products. The contaminants are: organochlorine pesticides (OCPs), dioxins and dioxin-like PCBs, non-dioxin-like PCBs, cadmium, lead, mercury and arsenic, PAH, PBDEs and PFAS.

Cod liver and hake liver programme

Since 1977, every year samples of cod have been taken at three locations, and of hake at a fourth location, for the cod liver and hake liver programme. The substances that are measured in the livers are PCBs, OCPs, PFAS, tributyltin and toxaphene. The purpose of this programme is to identify trends in the level of bioaccumulating substances in fish, such as persistent organic contaminants (POPs).

The analyses are carried out according to validated and ISO17025[81]-accredited monitoring methods (for heavy metals, dioxins and PCBs) and validated monitoring methods (for other contaminants). The fitness for purpose of the monitoring methods is tested several times a year.
Wageningen Food Safety Research is the national reference laboratory for dioxins, PCBs and metals in food. See also the underlying research report by the University of Wageningen.

9.1.3 Assessment method

The assessment is based on the contaminants for which MLs were defined in Commission Regulation (EU) No. 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs. Those contaminants are heavy metals (cadmium, lead and mercury) and organic contaminants such as polycyclic aromatic hydrocarbons (PAH), polychlorinated dibenzodioxins and dibenzofurans (PCDDs/PCDFs, also known as 'dioxins') and polychlorinated biphenyls (PCBs).

Measurements of dioxins and PCBs are aggregated, having regard to their toxicity factor. The results are expressed as dioxin TEQ and total TEQ (dioxins and dioxin-like PCBs). Six non-dioxin-like PCBs, known as NDL-PCBs, are also measured. In addition, flame retardants (polybrominated biphenyl ethers (PBDEs), perfluoroalkyl substances (PFAS) and organochlorine pesticides (OCPs) are measured. No MLs have been established for this latter group of contaminants.

9.1.4 Analysis of monitoring programme

There have been changes in the monitoring since the last Marine Strategy. In addition to the substances for which MLs have been fixed, PFAS, PBDEs and OCPs are also measured in the samples. Monitoring of HBCDD commenced after 2014, but was then terminated because the concentrations were almost always below the detection limit.

9.1.5 Cooperation and developments

Contaminants in fish are also measured for D8, but that monitoring is not representative of the pattern of human consumption because the concentrations are determined in the entire organism. The monitoring for D9 focuses on the edible parts.

Measures to further reduce contamination have been agreed in the context of the WFD. Chlorinated paraffins (CPs) have recently attracted the attention of various European organisations, including the European Food Safety Authority (EFSA), the European Commission´s Directorate General for Health and Food Safety and the European Reference Laboratory for POPs. It is to be expected that CPs will be included in the monitoring of seafood in the future.

[81] ISO 17025 accreditation indicates that a research laboratory carries out the relevant measurement methods correctly and that the data are therefore reliable.

Descriptor 10: Litter

Properties and quantities of marine litter do not cause harm to the coastal and marine environment.

10.1 Litter: beaches, seabed, floating (D10C1) and in marine animals (D10C3)

Criterion D10C1 (primary)

The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment.

Criterion D10C3 (secondary)

For criterion D10C3, insight is needed into the amount of litter ingested by marine animals. The harmfulness of the litter for species also has to be established. For this criterion, the Netherlands follows the developments within OSPAR and in Europe. For the time being, the monitoring of plastic particles in the stomachs of Northern fulmars is used for the reporting on criterion D10C3. Plastic in the stomachs of Northern fulmars is an indicator of the floating litter in the sea (D10C1). The monitoring and assessment of D10C3 is linked entirely to D10C1 (floating litter) and is therefore not described separately here.[6]

GES and indicators

GES[82]

For litter on beaches: a significant downward trend in the total of the most common categories of litter (which contribute to 80 percent of the total volume of litter) found on the beach.

Indicator	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Beach litter - Volume, composition and trends (OSPAR assessment)	OSPAR Greater North Sea	Macro litter (items/m)	Downward trend	National interpretation
Beach litter - Volume, composition and trends (additional assessment for the Netherlands)	Dutch section of the North Sea (DCS)	Macro litter (items/m)	Downward trend	National interpretation

GES[83]

For floating litter: a significant downward trend in the number of northern fulmars with more than 0.1 g of plastic particles in their stomach during the past ten years.

Indicator[84]	Reporting scale	Parameter	Threshold value or desired trend	Source of threshold value/trend
Plastic particles in the stomachs of Northern fulmars in the North Sea (OSPAR assessment) as a proxy for floating litter	OSPAR Greater North Sea	Plastic particles - Mass (g/Northern fulmar)	Downward trend.	National interpretation
Plastic particles in stomachs of Northern fulmars in the North Sea as a proxy for floating litter (additional Dutch assessment).	Dutch section of the North Sea (DCS)	Plastic particles - Mass (g/Northern fulmar)	Downward trend.	National interpretation

[82] GES for beach litter, seabed litter and floating litter is also related to the overarching goal 'The volume of marine litter will decrease over time'.

[83] This GES also applies for D10C3 and is related to the overarching GES: 'The quantity of litter and micro litter ingested by marine animals is at a level that is not harmful to the health of the species concerned'.

[84] OSPAR is investigating the possibility of developing a future indicator for microplastics in mussels. Mussels filter (micro) plastics from the water and increased concentrations are therefore excepted to be found in these shellfish.

GES For seabed litter: significant decrease in the volume of litter on the seabed.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Seabed litter (OSPAR assessment)	OSPAR Greater North Sea	Macro litter (items/km^2)	Downward trend	National interpretation
Seabed litter (additional assessment for the Netherlands)	Dutch section of the North Sea (DCS)	Macro litter (items/km^2)	Downward trend	National interpretation

10.1.1 From information requirements to monitoring strategy

To assess whether GES is being achieved for criterion D10C1, information is needed on trends in the quantity and composition of litter on Dutch beaches, on the seabed and floating on the sea surface. Litter is a cross-border problem, so the MSFD requirement of coordinated regional monitoring and assessment is also important for this descriptor. The Netherlands uses the monitoring methods developed and agreed in OSPAR. The assessment is fleshed out for both the Dutch section of the North Sea and for the Greater North Sea.

Functional requirements/monitoring strategy

To evaluate the extent to which GES has been reached, trends must be assessed every six years. The necessary data are collected and analysed in accordance with the internationally agreed method, OSPAR's CEMP Guidelines. The monitoring is designed to provide insight into changes in the Greater North Sea, but also for the assessment of the Dutch section of the North Sea. To establish the effectiveness of measures, it is important to understand the composition, and if possible the origin, of the litter.

A large proportion of the litter comprises plastics, but it also includes other materials, such as wood, glass and metal. The distinction between micro and macro plastics is based on the following classification: microplastics <5 mm, meso plastics <2.5 cm, macro plastics >2.5 cm (JRC, 2013). This distinction is relevant because both the effects and the sampling techniques are related to the size of the plastic objects and particles.

The CEMP Guidelines contain additional specifications for the monitoring and assessment of litter on the beach, on the seabed, and for floating litter.

Litter on the beach

Because the quantities of litter on beaches vary greatly per season, every year the same four beaches in the Netherlands are surveyed every quarter. Every item of litter found on these reference beaches then has to be counted and classified using uniform OSPAR lists (CEMP Guidelines, 2017).

Litter on the seabed

The monitoring of litter on the seabed piggybacks on the monitoring for the Common Fisheries Policy (CFP). The method is laid down in OSPAR's CEMP Guidelines (2017): items of litter must by counted by type. All ICES quadrants in the North Sea must be surveyed at least once a year.

Litter on the sea surface (floating)

The volume of plastic in the stomachs of Northern fulmars is used as the yardstick for floating litter. The birds eat various floating items as they forage at sea, including plastic litter, and these contaminants are found in the stomachs of dead Northern fulmars. To determine whether or not GES has been reached, it should be established whether the number of Northern fulmars with more than 0.1 g of plastic particles in their stomach has declined significantly during the past ten years. According to OSPAR's CEMP Guidelines (2019), at least forty dead birds found along the Dutch North Sea coast must be examined every year to reliably establish a trend.

Table 10.1.1: Overview of litter monitoring surveys

Monitoring survey	Commencement year	Element/compartment	Parameter	Frequency
Beach litter	2001	Macro litter (>2.5 cm) on the beach	Total abundance/100 m, made up of approx. 115 types of litter	Four times a year
Plastics in stomachs of Northern fulmars	1996	Plastic particles, mainly meso (0.5-2.5 cm) and micro (0.1-0.5 cm, only pellets) and a small quantity of macro plastics (>2.5 cm)	Total weight of plastics per bird stomach; divided into consumer plastics and industrial plastics (pellets)	Continuous collection of dead birds on the beach
Seabed litter	2013	Macro litter (>2.5 cm) on the seabed, divided into litter groups	Total abundance per km^2, divided into litter groups	Once a year

10.1.2 Monitoring surveys

Litter on the beach
Surveys are conducted four times a year on four reference beaches in the municipalities of Terschelling, Bergen, Noordwijk and Veere for Rijkswaterstaat. At each location the litter is classified according to the 115 waste types in the OSPAR CEMP Guidelines (OSPAR, 2017). The waste categories in the OSPAR list include plastic, rubber, glass, wood, metal, textiles, paper/cardboard. Items are clustered as specific types of litter under one of these categories. For each type of litter, the number of items per 100 metres is counted along the entire width of the beach. Only items of litter that are visible on the surface are counted.

Litter on the seabed
Since 2013, litter on the seabed has been collected as 'bycatch' during the International Bottom Trawl Survey (IBTS) (O'Donoghue and Van Hal, 2018). The IBTS monitoring is carried out every year for the Ministry of Agriculture, Nature and Food Quality for the purposes of the Common Fisheries Policy (CFP) in order to gain insight into the existing fish stocks. For the IBTS, ICES quadrants (areas of roughly 56 x 56 km) are sampled with a standard bottom trawl, the *Grand Ouverture Verticale* (GOV), with a narrow mesh size (10 mm at the cod end of the net) and a net opening roughly 30 metres wide and 5 metres high (Van Hal, 2019). Every area is fished in accordance with the standard ICES protocol. Litter that surfaces in the process is classified according to a list of forty types of litter, divided into the categories plastic, metal, rubber, glass/ceramics, natural materials and miscellaneous. The number of items of each type of litter is registered during each 30-minute trawl. The method to be used is laid down in the OSPAR CEMP Guidelines (OSPAR, 2017). The observations are then converted into the number of items of litter per square kilometre of seabed according to a standardised method

Litter on the sea surface (floating)
The survey for monitoring plastics in the stomachs of birds has been part of Rijkswaterstaat's MWTL programme since 2004, but has been operational since 1996.
The data are provided every year by volunteers of the Northern fulmar working group, who collect dead Northern fulmars that have washed up along the Dutch coast during the year. Professionals then analyse the contents of the birds' stomachs to determine the volume of plastics (the total mass of plastic particles in grams and the total number of particles in the stomach). The plastics found are divided into consumer plastics and industrial plastics (pellets). The method is documented in the OSPAR CEMP Guidelines (OSPAR, 2019).

10.1.3 Assessment method

An assessment system has been devised for all three indicators. The assessment method for each monitoring survey is briefly described below. Future threshold values will be linked to developments in the EU Technical Group Marine Litter and OSPAR.

Litter on the beach
OSPAR calculates trends in the total number of items of litter, each type of litter and each category of litter for the North Sea as a whole. Registering the individual types of litter provides insight into the responsible sources. At national level, the situation on the Dutch beaches is also analysed specifically for the purpose of ascertaining the effectiveness of measures (Boonstra and Hougee, 2018).

Litter on the seabed
The description of GES provides that it has to be determined whether there has been a significant decrease in the quantities of litter on the seabed. Given the limitations to the quality of the combined dataset on the seafloor of the North Sea, OSPAR recently revised the Assessment method into an analysis of the presence or absence of seabed litter per trawl.

Litter on the sea surface (floating)
The assessment of plastics in the stomachs of Northern fulmars is based on the five-year average of the most recent monitoring years for the entire North Sea. On the basis of the results, the average is calculated for the entire North Sea and for the sub-regions. The percentage of Northern fulmars with more than 0.1 grams of plastics in their stomach is calculated. The current long-term objective is to keep this percentage below 10 percent. For the assessment of GES, the trend in the total mass of plastics in the stomachs of Northern fulmars has to be calculated over the last ten years.

To relate the plastics found to the effectiveness of measures, the plastics are divided into the categories of consumer plastics and industrial plastics, for which the trends are also calculated separately.

10.1.4 Analysis of monitoring programme

The monitoring programme for beach litter provides sufficient data for reliable trend analyses (Schulz *et al*., 2019). The monitoring also yields sufficient data for the indicator 'plastics in the stomachs of Northern fulmars'. Significant trends are identified and the statistical sensitivity of the method is sufficient. Floating micro (>1 mm) and meso plastic in particular are adequately covered with this indicator. International research will be carried out in the coming period to discover how representative the monitoring is for floating macro litter.

The monitoring and assessment of litter on the seabed is additional to the previous MSFD monitoring programme (2014). The survey, which was primarily established to monitor fish stocks, also gives an initial impression of the quantity of litter on the seabed.

However, its efficiency in 'catching' litter on the seabed is low, probably less than 5 percent. The actual quantities of seabed litter are therefore significantly larger than reported. The combined data on litter on the seabed from different North Sea countries are also inadequate for quantitative analysis, but that comparison can be made with a presence/absence analysis.

The MSFD monitoring programme will continue to anticipate any further requirements and developments, for example arising from OSPAR or new legislation.

10.1.5 Cooperation and developments

OSPAR collaborates closely with the EU Technical Group Marine Litter (TGML). Both groups will investigate the point made earlier about floating macro plastic (see section 10.1.4). The TGML is also expected to make a proposal for threshold values for beach litter and for plastics in Northern fulmars in 2020. Steps are also being taken to improve the quality assurance and quality control of the monitoring, for example with updates of the OSPAR CEMP Guidelines, technical workshops on the subject of seabed litter, storage of data on beach litter by the OSPAR secretariat, and verification of the quality of data.

The European Union recently adopted the Single-use Plastics Directive (2019), the aim of which is to combat the most common types of waste found on Europe's beaches. Agreements on monitoring for this directive could in future lead to adjustments to the MSFD monitoring programme.

There are a number of research projects that are not part of the MSFD monitoring programme but which could provide additional information about the relationship with sources of pollution. For example, the Clean Rivers consortium is investigating macro litter in rivers (SDN, IVN, PSF; https://www.schonerivieren.org/). Another project involves monitoring of macro litter in the Wadden Sea. The Fishing for Litter programme also provides some indication of the volume of litter on the seabed and its composition. The Clean Beaches Green Deal is specifically intended to prevent litter on the beach from ending up in the sea and thus makes a contribution to the Netherlands' assignment under the MSFD. The 'abridged OSPAR monitoring', which is carried out for the election of the cleanest beach, and monitoring of cleanliness, places the emphasis on litter generated or found on tourist beaches (Hougee, 2017).

If suitable methods for project-based joint monitoring are adopted, the Netherlands will incorporate them in the annual updating of the MSFD monitoring programme. Until then, ongoing and promising studies will be supported. Where possible, a link will already be made with sources of plastics and the effectiveness of measures within the river basins. This issue will be included in the updating of the Programme of Measures (Marine Strategy part 3, 2021).

10.2 Micro-litter (D10C2)

Criterion D10C2 (primary)
The composition, amount and spatial distribution of micro-litter on the coastline, in the surface layer of the water column and in seabed sediment, are at levels that do not cause harm to the coastal and marine environment.

GES and indicators

GES There is not yet a quantitative description of GES for micro waste. There is an overarching GES: 'the quantity of micro-litter at sea will decrease in the long term'.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
No indicators anticipated.				

10.2.1 Information requirements and analysis

To determine whether GES is being achieved for D10C2, insight is needed into the volumes and composition of microplastics at sea. An indicator is being developed for microplastics in sediment, which will have to be approved within OSPAR in 2021. On this point, see 'Assessment method'.

The survey to be developed for monitoring at sea will have to be compatible with the technical specifications that are ultimately adopted in OSPAR's CEMP Guidelines. Although not yet finalised, the following specifications are being considered:

- Spatial coverage: the DCS will be sampled at multiple locations, with the greatest density in the coastal zone since that is where the largest concentrations are.
- Monitoring frequency: a limited number of locations in the coastal zone will be sampled annually to allow for an analysis of the trend after five years of measurements. Monitoring every three years is sufficient for the other locations.
- Method: methods being considered to allow a quantitative analysis are sampling with box corers (subtidal) or trawls (intertidal).
- Parameters: the total number of microplastic particles in each sample and the total mass (per kg dry weight) will be determined in the sand fraction. Only the top layer (to a depth of 5 cm) will be sampled because that is where the concentration of microplastics occur and the greatest changes are observed. The upper limit for microplastic particles is 5 mm.

10.2.2 Assessment method

'Micro plastics in sediments' is a candidate indicator being developed within OSPAR (monitoring survey, method, Assessment method). The aim is that this indicator will acquire the status of common indicator in 2021. A monitoring survey for microplastics in

marine sediment could start providing data about the quantity and spatial and temporal variation of microplastics in sediment from 2021.

10.2.3 Analysis, Cooperation and developments

Microplastics were not previously covered in the MSFD monitoring programme. On the basis of technical specifications and in consultation with OSPAR, Rijkswaterstaat is developing a method and a monitoring survey for microplastics in sediment. The method is expected to be operational from the beginning of 2021.

International coordination takes place under the auspices of OSPAR, to which the MSFD monitoring programme is linked as closely as possible. In recent years, a lot has been learned about the presence, the analysis and the effects of microplastics in national and international research programmes, including JPI Oceans and EU programmes, and in the context of regional sea conventions.

The monitoring of emissions of microplastics is still in the research phase. Various long-term research programmes are underway in the Netherlands, including the TRAMP project financed by the Technology Foundation STW.[85]

Steps will be taken in the coming years to develop a first monitoring programme for microplastics in fresh water, primarily designed to determine and model the microplastics mass load. A second objective is to identify microplastics (including types and forms of polymer) and connect them to sources. Both programmes will generate information for analysing and assessing the status of and trends in microplastics in Dutch waters.

[85] TRAMP = *Technol*[85] GES for beach litter, seabed litter and floati

Descriptor 11: Introduction of energy: underwater noise

Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

11.1 Impulsive noise (D11C1)

Criterion D11C1 (primary)
The spatial distribution, temporal extent and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.

GES and indicators

GES[86] For harbour porpoises, reduction of population size is prevented by imposing a limit on the number of harbour porpoise disturbance days.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
Distribution of Reported Impulsive Sounds (OSPAR)	OSPAR Greater North Sea	Pulse block days	Being developed	OSPAR
Supplementary Dutch assessment	Dutch section of the North Sea (DCS)	Harbour porpoise disturbance days	Being developed	National interpretation

11.1.1 From information requirements to monitoring strategy

Impulsive sound is caused by activities such as seismic research, piling activities for wind farms, sonar activities and explosions. Depending on the sound level, these activities can disturb marine animals. The effects range from temporary or permanent hearing damage to behavioural disorders. The objective is to mitigate this disturbance as far as possible. To this end, in the Marine Strategy part 3 a number of measures were proposed which have already been implemented (wind farm site decisions, codes of conduct and rules for military impulsive sound) or are being prepared (regulation of seismic research).
Underwater noise is a relatively new topic and there is therefore no history of its monitoring. The Netherlands has heavily promoted the development of an international, EU-wide strategy for monitoring underwater sound.

Where necessary, OSPAR formulates a specific strategy for the North Sea. The monitoring programme should be sufficient to determine what part of the North Sea is in good condition.

Functional requirements/monitoring strategy
The aim of the monitoring programme is to map the distribution, duration and level of disturbance due to impulsive noise. There is international agreement that disturbance will be expressed in terms of pulse block days (PBDs), i.e., the number of days that an activity causing impulsive noise takes place within an ICES block.

The Netherlands expands on that definition by also investigating the spatial distribution of noise and by determining the number of days that the noise level is above the disturbance threshold for harbour porpoises, the harbour porpoise disturbance days. The assessment is based on the harbour porpoise because it is regarded as the species that is most sensitive to impulsive noise.

ng litter is also related to the overarching goal 'The volume of marine litter will decrease over time'.
and levels of loud impulsive noise sources are such that the direct and indirect effects of loud impulsive sound do not threaten the favourable conservation status of maintenance of species.'

The theme of 'underwater noise' is still evolving. To assess whether GES for impulsive noise is being reached, the sound-producing activities are registered. That creates a basis for establishing threshold values for the pressure factors. This subject is being discussed in the EU TG Noise working group. Initial steps could also be taken in developing a system for determining the effects of impulsive noise.

The monitoring strategy described in OSPAR's CEMP Guidelines (2017) is based on registration of human activities that cause impulsive sound. In other words, there are no direct measurements[87] of impulsive sound. The following parameters are registered:

- type of activity
- duration (starting date and end date) with a resolution of one day
- location (at least the relevant block, but preferably the precise location of the activity)
- number of peaks in impulsive sound
- category of the level of impulsive sound
- possible mitigation
- spectral information, if available

Impulsive sound is assessed on the basis of 'pulse block days' (PBDs). The Netherlands also uses the concept of harbour porpoise disturbance days, which is the number of days that the impulsive noise within a block is such that harbour porpoises are disturbed by it. This is determined using acoustic modelling.

11.1.2 Monitoring surveys

The major monitoring activities are data collection and analysis of the Impulsive Noise Registry, an international register jointly created by OSPAR and HELCOM to store data relating to human activities in the OSPAR and HELCOM regions. The International Council for Exploration of the Seas (ICES) manages the register, which contains records of all human activities that cause impulsive sound (pile driving, sonar, seismic, explosions). The location, date, number of impulses per day, mitigation and type of sound are registered. The register does not contain any measurements, but is filled with data by many OSPAR countries annually.
Some countries have difficulty collecting and reporting their data, but the Dutch report does cover all the relevant[88] sources of noise. The register has been operational since 2016; the first data entered in it were from 2015. All of the relevant activities are regulated in the Netherlands, either through licensing or because they fall under specific laws, such as the Mining Act. The data are collected annually from the licensing bodies. The method is described in OSPAR's CEMP Guidelines.

11.1.3 Assessment method

The number of PBDs can be downloaded directly from the register and their spatial distribution can be mapped. The data can be broken down by type of source (pile driving, seismic, explosions, sonar) and by the strength of the source (low, medium, high). The data are analysed regularly and reported in a multiyear assessment.

The harbour porpoise disturbance days are determined as follows:

- The sound level around impulsive sources is determined using a sound propagation model. The area in which this level exceeds the threshold value for harbour porpoises (140 dB [SEL] re 1 μPa_2s) is the disturbance area.
- With these data, the number of disturbance days can be determined for any location, but in practice it is again the ICES blocks that are used.

See also Von Benda Beckmann *et al.* (2017).

The EU TG Noise working group is currently formulating threshold values and is expected to publish its recommendations in 2021, in time for their inclusion in the next assessment (updating of the Marine Strategy part 1, 2024).

11.1.4 Analysis of monitoring programme

The noise register was not yet operational at the time of the previous reporting for the Marine Strategy part 2 (2014). The correct parameters are saved in the register, but OSPAR is reviewing the classification of sources (high, medium, low) because it does not work satisfactorily in practice. The biggest problem with the current monitoring is that some countries do not report sufficient data.

The analysis and the Assessment method will be improved within OSPAR in the coming years in order to produce an 'impact indicator'. A project in the Netherlands to draft a proposal for this is already underway.

[87] Measurements are used to validate propagation models for sound, but they are collected in the context of other activities. These measurements are taken during the construction of wind farms and during seismic surveys.

[88] The Netherlands only reports sources that make a significant contribution to underwater noise. Other sources, such as sub-bottom profilers, are disregarded.

11.1.5 Cooperation and developments

A lot of knowledge has been developed in the past ten years in relation to the design of a monitoring and assessment system for underwater noise. This research has been and continues to be conducted in an intensive joint programme with the national research programmes on offshore wind energy:

- Offshore Wind Energy Master Plan
- Follow-up Implementation of the Master Plan
- Offshore Wind Power Ecological Programme

A lot of information has also been collected during the construction of wind farms and from some seismic surveying. Further research is needed into the effects of seismic research, particularly for the assessment of impulsive sound.

Sound transmission is far better in water than in air and the sound is less attenuated. Sound travels over great distances, so impulsive sound does not stop at national borders. Given the transnational nature of underwater sound, it has to be addressed internationally. This is coordinated at OSPAR level. For the Netherlands, Rijkswaterstaat and the Ministry of Infrastructure and Water Management make an important contribution to this effort.

OSPAR is currently working on the development of a future indicator based on impact (see Merchant *et al.,* 2018). It will involve a risk assessment made by comparing the disturbances with the population distribution of sensitive animal species. The Netherlands is endeavouring – as a first step – to have the harbour porpoise disturbance days indicator adopted internationally. The intention is that it would later also cover other species. The question remains of where distribution maps are available and how accurate they are.

It is not yet possible to link underwater noise to effects on sensitive animal species through monitoring. Data collected from monitoring for D1 are used to assess the effects of underwater noise, and the results of specific studies can also be used.

In addition to underwater sound, other forms of energy, such as electromagnetic fields, also fall under the descriptor D11. Because there are still no criteria for these forms of energy, no GES or environmental objectives have been formulated for them yet. However, measurements are already being taken in licensing procedures and/or in research and other projects. For example, the Wozep programme also investigates the effects of electromagnetic radiation from transport cables from wind turbines on the marine environment.

11.2 Continuous noise (D11C2)

Criterion D11C2 (primary)
The spatial distribution, temporal extent and levels of anthropogenic continuous low-frequency noise do not exceed levels that adversely affect populations of marine animals.

GES and indicators

GES It is not yet possible to formulate a quantitative description of GES for continuous noise. However, there is an overarching GES: Distribution in time and space and levels of continuous sound are such that they do not threaten the favourable conservation status of maintenance of species.				
Indicator	**Reporting scale**	**Parameter**	**Threshold value or desired trend**	**Source of threshold value/trend**
No indicator available yet				

11.2.1 From information requirements to monitoring strategy

Continuous noise is caused mainly by shipping, but also by operational wind farms. Depending on the level of the sound, it can disturb marine animals, for example in their communication ('masking'), which can lead to behavioural disorders. The objective is to mitigate this disturbance as far as possible.

Knowledge about continuous sound is still limited; there are no data (either at national or international level) available on levels of and trends in continuous noise. It is therefore not possible to formulate a quantitative description of GES. There is a qualitative description of the overarching GES for continuous sound: 'Distribution in time and space and levels of continuous sound are such that they do not threaten the favourable conservation status of maintenance of species'.
In terms of monitoring, the main focus will be on launching an international monitoring programme for continuous noise, in order to map the level and distribution of continuous noise.

Functional requirements/ monitoring strategy

The monitoring programme is designed to give a reliable impression of the sound levels at sea and their spatial distribution. This information is needed in order to perform risk analysis of continuous noise, which also requires more knowledge of the effects of anthropogenic noise on marine animals. The latter is being addressed in various international studies and falls outside the scope of the MSFD monitoring plan.

The monitoring programme should provide a basis for determining which part of the North Sea is in good condition. That will not yet be possible at this stage because the theme of 'underwater noise' is still evolving.

The programme is based on the monitoring strategy devised by TG Noise (Dekeling *et al.*, 2014), which has been elaborated at OSPAR level (Snoek *et al.*, 2015). The key to that strategy is a combination of measurements and numeric modelling, using data on human activities at sea (such as AIS) and meteorological data, from which sound maps of the North Sea can be made.

It has been decided to use statistical characteristics (different percentiles) of the average sound pressure level, having regard to the natural levels as a result of wind, waves, rain, currents and noise from animals. These parameters are determined per season for the entire North Sea.

11.2.2 Monitoring surveys and Assessment method

The Netherlands has taken the initiative to establish a joint monitoring programme with the other countries around the North Sea. The JOMOPANS project (Joint Monitoring Programme of Ambient Noise North Sea) started in January 2018, and will continue until the end of 2020, after which an operational monitoring programme for continuous sound is expected to be in place.

A total of fourteen monitoring stations are being installed throughout the entire North Sea during the project, one of them in Dutch waters. The stations continuously register underwater sound over long periods. See Snoek *et al.* (2015) for a description of the methodology.

In addition, sound maps of the entire North Sea are being produced with the help of numerical modelling, with a resolution of at least the ICES blocks, but possibly also higher. The input for the numerical modelling are physical features such as the bathymetry and seabed composition (from EMODNET) and the conditions, such as meteorological and oceanographic parameters (waves, current, water temperature). The sources of noise from human activities form the most important input for the modelling. These are derived from AIS and VMS for shipping and fisheries and from the international register for impulsive sound (see section 11.1.3). In the sound maps of the North Sea, the 5th 10th, 25th, 50th, 75th, 90th, and 95th percentiles of the sound pressure level are calculated for each season (Merchant *et al.*, 2018). The measurements are used to validate the numerical calculations and to produce a confidence map of the results.

11.2.3 Analysis of monitoring programme

The development towards a monitoring programme for continuous noise is progressing well, while in 2014 there was no programme to report. The expectation is that an operational monitoring programme along the lines described above will be implemented in 2021.

11.2.4 Cooperation and developments

The design of the monitoring and assessment system for underwater noise is based mainly on the Baltic Sea Information on the Acoustic Soundscape (BIAS) project. There is close collaboration between JOMOPANS and the Jonas project (Atlantic region), QuietMed (Mediterranean Sea region) and the ECHO project (Vancouver, Canada).

In light of its transnational nature, underwater sound is only addressed internationally. For the North Sea, this is done in OSPAR, in which Rijkswaterstaat and the Ministry of Infrastructure and Water Management contribute for the Netherlands.

In the JOMOPANS project, a web-based tool (GES tool) is also being developed for marine managers and policy makers. This tool can be used to assess the results of the monitoring and to develop measures. In it, the noise maps of the North Sea will be combined with maps showing the distribution of relevant marine animals generated by other monitoring programmes or projects. The availability of distribution maps and their accuracy have still to be investigated.

For the time being, monitoring for D11C2 focuses on quantifying sound levels. It is not yet possible to link underwater sound to effects on sensitive animal species with monitoring. Data from monitoring for D1 are used to assess the effects of underwater sound, while results from specific surveys can also be used (Southall *et al.*, 2019).

Annex VIII

Sources

References are listed according to Annex VII Factsheets

1.1 Incidental bycatch: Marine mammals (D1C1)

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Colophon

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