Initial Assessment

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# Table of contents

Management summary ........................................................................................................ 5

1. Introduction ..................................................................................................................... 6
   1.2. Report aim .................................................................................................................. 6
   1.3. Report status .............................................................................................................. 7
   1.4. Relation to other directives and policies ................................................................. 7
      1.4.1 Introduction ......................................................................................................... 7
      1.4.2 General MSFD comparison ................................................................................. 8
      1.4.3 Specific MSFD comparison ................................................................................ 10
   1.5. Ecosystem approach ................................................................................................. 10
   1.6. Sustainable use ........................................................................................................ 10
   1.7. Authorities ............................................................................................................... 10
   1.8. Reader ....................................................................................................................... 11
   1.9. Reference statements and disclaimer .................................................................... 12
   1.10 Reference lists is provided in Annex X and Y respectively chapter wise and in name order .................................................................................................................. 12

2. Description of the Dutch part of the subregion North Sea ........................................ 13
   2.1. General description ................................................................................................. 13
   2.2. Marine protected areas ......................................................................................... 17
   2.3. Climate Change ..................................................................................................... 18
   2.4. References .............................................................................................................. 20

3. Human activities ............................................................................................................ 22
   3.1. Introduction .............................................................................................................. 22
   3.2. Sand extraction ....................................................................................................... 24
   3.3. Oil and Gas .............................................................................................................. 26
   3.4. Wind energy ............................................................................................................ 26
   3.5. Carbon capture and storage .................................................................................. 28
   3.6. Shipping .................................................................................................................. 28
   3.7. Fishing .................................................................................................................... 31
   3.8. Defence .................................................................................................................. 32
      Possible developments until 2015 ........................................................................... 31
      Possible developments after 2015 ......................................................................... 32
   3.9. Tourism and leisure activities ............................................................................... 33
      Possible developments until 2015 ........................................................................... 34
      Possible developments after 2015 ......................................................................... 34
   3.10. Cables and pipes .................................................................................................. 35
      Possible developments ............................................................................................. 35
   3.11. Emissions .............................................................................................................. 36
   3.12. Transboundary effects of human activities ........................................................ 37
   3.13. Linking drivers, pressures and impacts on GES descriptors ................................ 37
   3.14. Cumulative effects ............................................................................................... 38
      3.14.1 Introduction ....................................................................................................... 40
      3.14.2 Results Cumulative Effect assessment EEZ ..................................................... 41
   3.15. References ............................................................................................................ 44

4. Current Environmental Status ..................................................................................... 46
   4.1. General approach ................................................................................................... 46
   4.2. Descriptor 1: Biological diversity ........................................................................... 48
   4.3. Descriptor 2: Non-indigenous species .................................................................. 68
   4.4. Descriptor 3: Healthy stock of commercially exploited fish and shellfish .......... 73
   4.5. Descriptor 4: Marine food webs ............................................................................ 80
   4.6. Descriptor 5: Human induced eutrophication ..................................................... 82
   4.7. Descriptor 6: Sea floor integrity ............................................................................. 89
   4.8. Descriptor 7: Hydrographical conditions .............................................................. 94
   4.9. Descriptor 8: Contaminants ................................................................................. 96
Management summary
1. Introduction

This report is the draft report for the Initial Assessment of the Current Environmental Status for the waters in the Dutch part of the North Sea.

The report is made to focus on the implementation steps required for the MSFD and as a departure point for the separately prepared draft reports on the “Good Environmental Status” and the “Environmental Targets and Indicators”.


The European Marine Strategy Framework Directive, directive 2008/56/EG (Ref. 1) became effective on the 15th of July 2008. This directive is further referred to as the MSFD.

The MSFD establishes a framework within which Member States have to take the necessary measures to achieve or maintain good environmental status in the marine environment by the year 2020 at the latest.

For this purpose, every member state needs to develop and implement a Marine Strategy in order to:

a) protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected;

b) prevent and reduce inputs in the marine environment, with a view to phasing out pollution, so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate use of the sea.

The process towards a Marine Strategy should consist of two phases: the preparation phase and the finalising phase of establishing a programme of measures. Member States sharing a marine (sub-) region should cooperate during the whole process to ensure that their marine strategies are coherent and coordinated and should endeavour to follow a common approach.

The preparation phase consists of four activities:

1. establishment of an Initial Assessment of the Current Environmental Status of the waters concerned and the environmental impact of human activities thereon to be completed by the 15th of July 2012; this report

2. determination of Good Environmental Status for the waters concerned to be completed by the 15th of July 2012;

3. establishment of a series of Environmental Targets and Associated Indicators by the 15th of July 2012;

4. establishment and implementation of a Monitoring Programme for ongoing assessment and regular updating of above targets by the 15th of July 2014.

The programme of measures features:

1. development of a programme of measures designed to achieve or maintain good environmental status by 2015 at the latest;

2. entry into operation of the programme provided by above by 2016 at the latest.

1.2. The initial assessment

The “Initial Assessment of the Current Environmental Status” for the part of the north sea under Dutch jurisdiction is the first step in the obligatory MSFD plan of action to develop a
Marien Strategy. Moreover, this report aims to provide a working model in preparation of the actual and final report. In addition, the report is made to facilitate the orientation on the preparation of the second MSFD report concerning the determination of the Good Environmental Status.

The report is a pure description of the current status and contains no evaluation in the sense of aspects being “good”, “bad” or “intermediate”.

The Initial Assessment of the Current Environmental Status, this report, has to comply with the following:

1. taking account of existing data, where available;
2. analysis of essential features and characteristics, and current environmental status of waters in accordance of a list of 11 elements (MSFD Table 1 of Annex III), and covering the physical and chemical features, the habitat types, the biological features and the hydro-morphology;
3. analysis of predominant pressures and impacts, including human activity, on the environmental status of the waters being based on:
   a. indicative lists of elements (set out in MSFD Table 2 of Annex III), and covering the qualitative and quantitative mix of the various pressures as well as discernible trends;
   b. the main cumulative and synergetic effects and
   c. relevant assessments, which have been made pursuant to existing Community Legislation.
4. an economic and social analysis of the use of the marine waters and of the costs of degradation of the marine environment.

The preparation of the Initial Assessment has to ensure further that:

1. all interested parties are given early and effective opportunities to participate in the implementation of the MSFD, involving when possible existing management bodies or structures, regional sea conventions, scientific advisory bodies and regional advisory councils;
2. publication (and the available making to the public for comment) of summaries of their marine strategies takes place.

1.3. Report status

This draft report has not an official status, it is a living document which should be considered as a work model in progress. It is not endorsed by the Ministry of Infrastructure and Environment. This ministry does not accept responsibility for any quotations from this report. The report can only be used within the above ministry, other ministries and their subsidiaries or organisations / companies given specific permission.

1.4. Relation to other directives and policies

1.4.1 Introduction

The MSFD, and therefore, this Initial Assessment of the current environmental status, is connected with several other EU directives, international and national conventions, policies or treaties and Dutch national legislation. The MSFD itself forms, in addition, the environment paragraph for the future European Integrated Maritime Policy (IMP).

The most relevant EU directives are the Water Framework Directive (WFD), the Birds and Habitat Directive (BHD) and the Common Fisheries Policy.
The most relevant conventions are UNCLOS, OSPAR and IMO.

The most relevant Dutch legislation consists of the Water Act, the Environmental Management Act, the Natural Conservation Act and the Flora and Fauna Act.

A total overview of the relevant directives, policies, conventions and legislation is given in Appendix X. The content of these is, however, not described in the appendix, because these can be found in literature.

It is also apparent that any measures or regulation defined by the MSFD implementation in Dutch North Sea sector can not be in contradiction with existing legislation. The MSFD might however be a leading directive for other legislation.

1.4.2 General MSFD comparison

The overall aim of the MSFD is to promote sustainable use of the seas and to conserve marine ecosystems. The MSFD provides, thereby, for a strategy aimed at achieving a good environmental status of the marine environment by 2020. For most of the descriptors of the environmental status prescribed by the MSFD exist other there are existing regulations and policies in place. The MSFD is not replacing these existing directives, treaties or policies. One of the aims of the MSFD is, in fact, the promotion of the integration of marine environment considerations into all relevant policy areas. Although the good environmental status is yet to be defined [change after writing GES] it is anticipated that the set of measures necessary to achieve the good environmental status will considerably overlap existing policy. The MSFD will identify shortcomings in the effectiveness of existing regulations and policies to achieve the good environmental status, which require additional measures.

1.4.3 Specific MSFD comparison

Some relation, overlap or problematic interference between the MSFD and other regulatory are however mentioned below.

1.4.3.1 MSFD and EU directives

Water Framework Directive. The extension of the Water Framework Directive (WFD) in the North Sea is limited to one nautical mile along the coast for ecological quality objectives and 12 nautical miles for the chemical objectives. The MSFD area ranges from the open sea to 1 mile from the land.

The land enclosed tidal waters of the Dutch Wadden Sea and SW Delta, which are connected to the North Sea by tidal channels, are completely covered by the WFD and assigned as protective areas under the Birds and Habitat directives. The applicability of the MSFD in the coastal waters of amongst others the Wadden Sea area is an issue that has to be clarified by the EU probably by the WFD Navigation Task Group and/or the Marine Strategy Navigation Group during 2010.

In some cases of this document environmental quality issues of the Dutch North Sea part have been formulated taking into account the WFD quality objectives for chemicals and nutrients of the water bodies draining to the North Sea. Methods of measuring qualifiers in the North Sea area are, however, sometimes different than used for the coastal waters by the WFD. Where apparent these are mentioned in the report text.

The WFD is important for only a few GES descriptors of the MSFD (e.g. Nr. 5 Eutrophication and Nr. 8 hazardous substances) and most GES descriptors are not related to the WFD.

Bird and Habitat Directive. Under the Bird and Habitat Directive marine protected areas of outstanding ecological importance are designated, where all activities have to comply with specified ecological targets. This is an important contribution to the achievement of good environmental status under the MSFD.

However, the ecological targets are based on species and habitats in its annexes of the BHC. In these, there are only a few marine species and habitats mentioned. For the MSFD implementation this might be workable for the Dutch North Sea sector, because we have a hallow sea. For other member states, this might be more difficult, because deep sea species and habitats are not included in the Habitat directive.
In general, it can be concluded that the good environmental conditions in the BHC obliged marine protected areas are stricter in comparison to the MSFD obligations.

**Common Fisheries Policy.** Fishery is a human activity with a profound effect on marine ecosystem. The Common Fisheries Policy (CFP) provides for a coordinated regulation of fisheries. Compliance with the rules of the CFP is ensured by the EU system for control, inspection and enforcement. A revision of the CFP is at present in progress. In case the revision aims to achieve sustainable fisheries while maintaining healthy ecosystems, the goals of CFP and MSFD will probably be harmonised. Currently it is unknown if the MSFD will add value to the CFP or if, reversely, the MSFD GES descriptors Nr. 3 and Nr. 9 will only be realised by implementing the revised CFP.

1.4.3.2 MSFD and conventions

**UNCLOS.** The UN Convention on the Law of the Sea (UNCLOS) provides the ultimate legal base for the regulation of activities at sea. This includes the jurisdiction of coastal nations in the exclusive economic zone as well as the obligation to protect and preserve the marine environment. MSFD introduced measures or regulations can not be, in principle, in contradiction with international rights or regulations defined under UNCLOS.

**OSPAR (Oslo-Paris Convention).** During the MSFD, and the use of relevant regional conventions, e.g. OSPAR, assessments for the initial assessment is obliged by the EU. This Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) is the regional sea convention in which countries bordering or draining to the North-East Atlantic cooperate to protect the marine environment. Within OSPAR quality objectives are have been derived for the chemical as well as the ecological status. Both polluting and non-polluting human activities that can adversely affect the sea are also covered by OSPAR. Targets and activities involved in the MSFD implementation show a large degree of overlap with the implementation of the OSPAR convention work. OSPAR is currently reorganizing to facilitate the MSFD implementation. At present, discussions on implementation of the MSFD are ongoing. In this report assessments have been used based on the OSPAR EcoQO’s or other OSPAR assessments and status assessments for among others the WFD biological and chemical objectives. The OSPAR Quality Status Report 2010 forms an important regional contribution to the initial assessment of national marine waters that most OSPAR countries will submit under the MSFD and provides a such a regionally agreed reference point.

**IMO (International Maritime Organization) treaties.** With regard to the reduction of effects of shipping on the marine environment several treaties in IMO context are relevant to the MSFD implementation especially those that deal with the prevention of pollution. These treaties include: the Convention for the prevention of pollution from ships (MARPOL); the Convention on the prevention of marine pollution by dumping of wastes and other matter; the Convention on the control of harmful anti-fouling systems on ships. The Convention for the control and management of ships’ ballast water and sediment is aimed at the prevention of the introduction of non-indigenous species and pathogens. The North Sea is designated as “special area” under MARPOL. Input from IMO is especially needed on the issues of GES descriptors Nr. 10 (litter) and Nr. 11 (energy/noise).

1.4.3.3 MSFD and Dutch national policies and legislation


Activities on the Dutch North Sea are regulated by a range of national laws. These include:

- The Water Act (Water wet)
The Environmental Management Act (Wet Milieu “beheer”), which includes a.o. obligations to perform Environmental Impact Assessments on new activities and new legislation (“besluit” M.E.R.) and the WFD quality objectives (Bkmw).

The Nature Conservation Act (Natuurbeschermingswet, 1998), that allows the protection of areas. (Currently restricted to the territorial waters, but will be extended to the EEZ in the forthcoming years).

The Flora and Fauna Act (Flora en Faunawet), which addresses the protection of species. (Currently restricted to the territorial waters, but will be extended to the EEZ in the forthcoming years).

1.4.4 Additional remarks

1. Marine protected area’s are not obligated under the MSFD, but by several international treaties (Ramsar, Bern Convention, UNCLOS, CBD, World Heritage Convention, CMS, OSPAR) and two instruments in the EU law under the BDC.

1.5. Ecosystem approach

1.6. Sustainable use

1.7. Authorities

1.8. Reader

This report consists of eight chapters.

1. Introduction
2. Description sub-region North Sea
3. Current environmental status
4. Current use of the sea
5. Socio-economic aspects of use
6. Public consultation and information
7. International cooperation
8. Conclusions and actions

The Introduction, chapter 1, provides general information on the Marine Strategy Framework Directive and more in particular the obligation relating to the Initial Assessment. It states also the aim and status of this report compared to some statement concerning the relation with other legislation and some points of reference. The Description of the sub-region North Sea, chapter 2, is a general description highlighting also climate change, ecosystem approach and sustainable use; and lists the competent authorities conform Annex II of the MSFD.

Chapter 3 provides information on the Current Environmental Status being specified according to the 11 descriptive elements mentioned in Annex I of the MSFD.

An overview of the Current Use of the Sea is given in a descriptive manner and in table format in chapter 4. Some fourteen types of use are discussed. The pressures and impacts of each use are characterised according to the tables 1 and 2 of Annex III of the MSFD paying special attention to cumulative effects.

An Economic and Social Analysis is described in chapter 5 depicting trends per use against time and also costs and profits. This is the Economic and Social Analysis mentioned in Art 8. 1 sub c of the MSFD.

Chapter 6 contains a summary of the Public Consultation and Information as required by Art 19 sub 1 and 2 of the MSFD with among others the results of public comment events.

International Cooperation schemes can be found in chapter 7 illustrating compliance with Art 5. 2 of the MSFD.
Conclusions and actions are compiled in chapter 8 containing a summary of important opportunities and challenges, any further MSFD implementation steps.

1.9. Reference statements and disclaimer
Several reference statements are relevant to this report. They are listed below reasoning from various perspectives.

Legal perspective:
- The report is made in line with the MSFD legal text (Ref. 1) and other EU MSFD informative documentation e.g. recommendations, reports and instructions (Ref. 2, 3, ...).
- This assessment is prepared in cooperation Ministry of Agriculture, Nature and Food Quality, Ministry of Economic Affairs, Ministry of Defense, and Ministry of Housing, Spatial Planning and the Environment. These ministries share, therefore, the responsibility for this report.

Report perspective:
- The Dutch Government holds the view that this Initial Assessment of Current Environmental Status should, content wise, not be very different to any other MSFD Initial Assessment for reason of comparability in specific areas as the MSFD North Sea sub-region.
- However, this report is only a draft to a Dutch Initial Assessment and aims, therefore, to be as complete as possible in an effort to be able to address (future) descriptive requirements agreed between EU member states.
- The government also supports the EU Commission idea for the making of only one Initial Assessment for the entire sub-region the North Sea by a joint effort of North Sea neighbouring Member States. This draft, does not yet comply with this principle as an initiative for this is currently not yet in place.

Content perspective:
- The report is a pure description of the current status and contains no evaluation in the sense of aspects being “good”, “bad” or “intermediate”.
- As much as possible this draft Initial Assessment is as much as possible derived from the 2010 OSPAR Quality Status Report and subsidiary documents.
- The report is also written in line with the elements for the Commission decision on criteria on Good Environmental Status (Ref. x), priority is therefore given to the problems to the marine ecosystem and the most serious environmental risks.
- Certain environmental aspects have, therefore, been addressed on different regional scale depending on the diversity of the environmental conditions and human activities.
- Specific use of the sea has been translated to pressures being linked to effects/impacts on the 11 Good Environmental Status elements or groups of these. Special attention is given to accumulation of pressures.
- The draft report is based mainly on current knowledge of the North Sea region. Additional investigations have only been carried out on a limited scale. Any lack of knowledge has, however, been listed in text boxes.
- The report contains some provisional assessment statements with respect to specific aspects of the current environmental status in separate text boxes.
- As far as possible, suggestions have been made for specific GES targets or indicators (text boxes). Certain descriptions are even directed to possible environmental targets and indicators (text boxes). Where possible, the current environmental status has been compared to a tentative good environmental status (text boxes).

Where adequate, reference is made to EU guidance documents (Ref. 2), background reports such as the OSPAR Quality Status Report 2010 (Ref. 3) or relevant literature such as ICES or JRC documents. Certain aspects are illustrated in map format.
Specific details of the various GES elements, economic use and pressures or impacts are clarified in separate annexes forming a background technical reference set.

Reference lists is provided in Annex X and Y respectively chapter wise and in name order
2. Description of the Dutch part of the subregion North Sea

2.1. General description
The total surface area of the Greater North Sea is approximately 575,000 km$^2$, with seven countries directly bordering the North Sea (United Kingdom, France, Belgium, The Netherlands, Germany, Denmark, Sweden and Norway). In addition, two countries (Luxembourg, Switzerland) are (partly) covering watersheds of rivers discharging into the North Sea.

The Dutch part, situated in the Southern Bight, is approximately 58,000 km$^2$ (Figure 2.1.1).

Bathymetry
As part of a continental shelf sea the Dutch part of the North Sea is in general relatively shallow. The deepest areas are found in the north of the central part (the Oyster Grounds) and in the west of the central part (the Cleaver Bank) with depths up to 80 m. The seabed consists mainly of fine to coarse sands, except for the deeper sites where sediments are muddy. Gravel beds are found at the Cleaver Bank. The Southern Bight of the North Sea is typically characterized by sandbanks which are orientated in S-SW to N-NE direction.

Water circulation
The circulation pattern in the North Sea is an anticlockwise gyre mainly driven by tidal forcing (Figure 2.1.2.), although the pattern might be reversed or might cease for limited times as a result of wind forcing. Along the Dutch coast, a northerly orientated residual flow occurs. Saline Atlantic water enters the Southern North Sea through the Channel. Along the continental coast, a coastal river with lower salinity and increased turbidity, strongly influenced by river discharges and freshwater run-off, extends several tens of kilometers offshore (Figure 2.1.3). Atlantic water, flowing into the North Sea from the north and flowing south along the British east coast, influences the northernmost areas of the Dutch part of the North Sea. The inflow of Atlantic water, both from the north and through the Channel, shows large seasonal and interannual variability, driven by the North Atlantic Oscillation (NAO) (Pingree, 2005). The NAO winter index, a measure of the atmospheric pressure gradient between the Azores and Iceland, has undergone long term and short term fluctuations. High (positive) NAO index values are associated with strong inflow and transport of Atlantic through the North Sea (Reid et al., 2003). The NAO index shifted to high values from the late 1980s through the first part of the 1990s, followed by a marked drop to a strong negative anomaly in the winter of 1995/96. These were very marked
climatic events that have been associated with changes in plankton composition (Planque and Batten, 2000, Beaugrand et al., 2002, Beaugrand, 2003, Reid et al., 2003), fish populations and other biota in the North Sea (Reid and Edwards, 2001, Reid et al., 2001, Edwards et al., 2002, Reid and Beaugrand, 2002). An analysis of data from Dutch and other monitoring programmes in the North Sea also indicates regime shifts in 1979 and 1988 and possibly also in 1998. These regime shifts are evident among various biological data series, and were probably triggered by environmental factors such as salinity, temperature and weather conditions (Weijerman et al., 2005). There are a number of frontal systems in the North Sea, such as the Frisian Front north of the coast of the Dutch Wadden Isles. Tidal currents are strong in the Southern North Sea, especially in the coastal regions. The Dutch North Sea is well mixed. Only at the deeper areas of the Oyster Grounds some stratification can occur during summer. The temperature of the surface water is mainly controlled by local solar heating and atmospheric heat exchange, while the temperature of the deeper water in the northern North Sea is influenced largely by the inflow of Atlantic water. The surface water temperature shows an increasing trend (Figure 2.1.4).

Figure 2.1.2: General hydrodynamic transport pattern in the Greater North Sea (ICES, 2008)
Functions and subdivisions
The North Sea is a highly productive sea, with a strong interaction between benthic and pelagic processes. The North Sea, with the exception of the deeper waters along the Norwegian coast, belongs to the cool-temperate, boreal, biogeographic zone.

In the Dutch part of the North Sea, generally a distinction is made between the coastal waters, the offshore waters of the Southern Bight, the Frisian Front and the area north of the Frisian Front, that differ both in abiotic conditions and biological characteristics.

Several areas are distinguished that are considered to be ecologically valuable (Figure 2.1.5) Below is an overall profile of the different areas in the North Sea (VenW, 2009):

**Dogger Bank:** The Dogger Bank is the area where the northern and southern fauna in the North Sea meet. The Dutch part of this sandbank is located at a depth of more than 20 metres. The most typical sandbank community is found in the shallowest part of the sandbank. It is a spawning ground for various species of fish, which draws seabirds and porpoises to the area to forage.

**Cleaver Bank (Klaver Bank):** This is a reef area transected by a deep trough rich in fish. There is a wide variety of benthic life, including Dead man's fingers, a type of coral. There are many sea birds and sea mammals.

**Frisian Front (Friese Front):** This front is the transition between shallow sandy soils and deeper silty soils. Rich in nutrients, the area attracts benthic life, fish, marine mammals and sea birds such as the Guillemot and the Great skua.
| **Brown Ridge (Bruine Bank):** Benthic fauna is not particularly rich, but there are many fish on this high sandbank surrounded by deep sea. It is a spawning ground for flatfish. There are many porpoises in the area. In winter, there are many sea birds (including Guillemots), particularly in the southeastern part. |
| **Central oyster grounds (Centrale Oestergronden):** The silty soil holds a varied benthic life. In summer, large numbers of Fulmars come here to forage. It is also home to the long-living Ocean Quahog, although this shellfish species appears in larger numbers to the northwest of the area. |
| **Gas Seeps (Gasfonteinen):** While gas fountains have been found in this area, the hard substrate that can form and the associated typical benthic life have not been demonstrated. Gas is also bubbling up in various locations on the Dogger Bank. Methane-loving bacteria have been found near these seeps. |
| **Borkum Stones (Borkumse Stenen):** Ongoing research will have to demonstrate the presence of reef structures in this area. Several boulders have been found recently. The area is used as a feeding ground by seals, and porpoises have been sighted. |
| **Zeeuwse Banken:** Landward, these sandbanks merge into the coastal zone. Shell deposits are typical of the area. Red-throated divers have also been seen in the area. |
2.2. Marine protected areas

Several areas in the Dutch North Sea are characterized by high diversity or special ecological features. Several international treaties (Ramsar, Bern Convention, UNCLOS, CBD, World Heritage Convention, CMS, OSPAR) and two instruments in the EU law (Birds and Habitats Directives) provide a framework to establish Marine Protected Areas (MPA’s)\(^1\) (also see §1.4).

In 2008 the Netherlands have designated the Voordelta as a Special Protection Area (SPA) under the Birds Directive and a Special Protection Zone (SAC) under the Habitats Directive. The Voordelta occupies an area of the North Sea of more than 900 km\(^2\). At the site, conservation objectives are in place for 'sandbanks which are slightly covered by sea water all the time, subtype North Sea Coastal Zone' (Habitat type 1110_B). Habitat Directives species in the Voordelta are grey seal and harbour seal and the fish species sea lamprey, river lamprey, allis shad and twaite shad. Thirty Birds Directive species are found in the Voordelta: cormorant, shelduck, ringed plover, red-backed sandpiper, common goldeneye, sandeeling, little gull, eider, great crested grebe, greylag goose, sandwich tern, avocet, gadwall, homed grebe, common spoonbill, red-breasted merganser, Northern pintail, red-throated diver, bar-tailed godwit, oystercatcher, Northern shovelier,

\(^1\) Marine Protected Area (MPA) is a protected area whose boundaries include some area of ocean. MPA is often used as an umbrella term covering a wide range of marine areas with some level of restriction to protect living, non-living, cultural, and/or historic resources.
Eurasian wigeon, turnstone, scaup, common redshank, common tern, common teal, curlew, grey plover and black scoter.

In 2009 the Netherlands have designated part of the North Sea Coastal Zone as a Special Protection Area (SPA) under the Birds Directive and a Special Protection Zone (SAC) under the Habitats Directive. A larger area of approximately 1,240 km² was recently designated as Natura 2000 site. The area is situated between the Ems and Bergen aan Zee. It extends from the low water line or the foot of the dunes on the (inhabited) islands to a water depth of 20 m. North Sea Coastal Zone consists of ‘sandbanks which are slightly covered by sea water all the time, subtype North Sea Coastal Zone’ (Habitat type 1110_B). The Habitat Directive species are harbour porpoise, grey seal and harbour seal and the fish species sea lamprey, river lamprey, allis shad and twaite shad. The Birds Directive species are common cormorant, shelduck, ringed plover, red-backed sandpiper, sanderling, little gull, little tern, eider, red knot, avocet, black-throated diver, red-throated diver, bar-tailed godwit, oystercatcher, turnstone, Kentish plover, scaup, curlew, grey plover and black scoter.

The “Vlakte van de Raan” in the mouth of the Westerschelde estuary has been notified to the European Commission as SAC. The Vlakte van de Raan is a Habitat Directive site or SAC of approximately 190 km² that consists of ‘sandbanks which are slightly covered by sea water all the time, subtype North Sea Coastal Zone’ (Habitat type 1110_B). The Habitat Directive species are harbour porpoise, grey seal, harbour seal and the fish species river lamprey, sea lamprey and twaite shad.

Three marine sites (Dogger Bank, Frisian Front, Cleaver Bank) are expected to be designated as Natura 2000 as soon as the Nature Protection Act is applicable in the EEZ. The Dogger Bank is a shallow area that extends across the UK, Dutch, German and Danish sectors of the North Sea, and the Dutch SAC is a marine site of approximately 4,715 km². The Dogger Bank consists of ‘sandbanks which are slightly covered by sea water all the time, subtype Dogger Bank’ (Habitat type H1110_C (Jak et al., 2009)). The relevant Habitat Directive species are harbour porpoise, grey seal and harbour seal.

The Frisian Front will be designated as a SPA. It contains an area of 2880 km². Four Birds Directive species are found on the Frisian Front, namely great skua, great black-backed gull, common guillemot and lesser black-backed gull.

The Cleaver Bank is a Habitat Directive site or SAC in the category of ‘Open-sea reefs’ (Habitat type 1170 (Jak et al., 2009). It is a marine site of approximately 1,235 km². The Cleaver Bank is the only site in the Dutch North Sea where considerable quantities of gravel lie on the sediment surface and larger cobbles with a specific covering of calcareous red algae also occur. The Habitat Directive species are harbour porpoise, grey seal and harbour seal.

For other ecologically valuable areas (Borkumse Stenen, Bruine Bank, Gasfons teinen, Zeeuwse Banken, see Figure 2.1.5), a research project is being carried out to study whether these areas qualify for a protected status. Results are expected to be available in 2012.

2.3. Climate Change

This general description of the effects of climate change in the North East Atlantic is taken from the OSPAR Quality Status report (OSPAR, 2010), and in some cases specific information for The Netherlands is added.

The continued emissions of greenhouse gases at or above current levels are expected to cause further warming and to cause further changes in the global climate system during the 21st century. The changing climate has been linked to a wide range of impacts on marine ecosystems, directly (through changes in sea temperatures) or indirectly (through impacts on the seasonality, distribution and abundance of species). There are many uncertainties in the scenarios for future greenhouse gas emissions and in model forecasts. This, together with the need to better understand how marine ecosystems respond to...
change, makes it difficult to predict impacts of future climate change on marine ecosystems.

A range of potential climate change impacts are predicted for the various components of the marine ecosystem:

- **Increased sea temperatures:** Since 1994 the sea water has warmed at a greater rate in the North Sea than the global mean. Over the past 25 years an increase in sea surface temperature of 1-2°C was observed. A further warming is expected.

- **Increased freshwater input (specifically near the poles):**

- **Shelf sea stratification:** in recent years there is some evidence for earlier stratification and onset of the associated microalgal bloom. In the future, the shelf seas may thermally stratify for longer and more strongly.

- **Increased storms:** severe winds and mean wave heights increased over the past 50 years, but similar strength winds were also present in earlier decades. Projections of storms in future climate are of very low confidence.

- **Increased sea level:** The global sea level rose on average at 1.7mm/yr through the 20th Century. A faster rate of sea-level rise was evident in the 1990s.

  For The Netherlands, scenarios for coastal protection use a maximum sea level rise of 1.3 meter by 2100 (VenW, 2009).

- **Reduced CO2-uptake:** In the North-Atlantic a reduced flux of CO2 into surface waters was observed in 2002-2005 compared to 1994. CO2-uptake is dependent on water temperature, stratification and circulation

- **Acidification:** Since the start of the industrial revolution, a global average decrease in pH of 0.1 units has occurred. During the 21st Century ocean acidity could reach levels unprecedented in the last few million years with potentially severe effects on calcareous organisms.

- **Coastal erosion:** In many areas the combined effects of coastal erosion, infrastructure and sea defense development have lead to a narrow coastal zone. Predictions on what might happen in the future are very uncertain and highly location specific.

- **Nutrient enrichment:** Drier summers may already be contributing to a decrease in nutrient inputs. Higher nutrients input in wet years have caused harmful algal blooms. Predictions are linked to a number of factors

- **Slowed Atlantic overturning circulation** is very likely

- **Reduced Sea Ice on the poles**

The possible impact on the biological marine environment can comprise:

- **Plankton:** Over the last 50 years a 1000 km northward shift of many plankton species has been observed. The timing of seasonal plankton blooms changes.

- **Harmful algal blooms:** In areas affected by lower salinities and higher temperature, harmful algal blooms have occurred. An increasing incidence as a result of changes in sea temperatures, salinities and stratification.

- **Fish:** Northward shifts of both bottom dwelling as pelagic fish have occurred. There is a lack of knowledge on the underlying mechanisms of these shifts which make projections uncertain. Increased temperatures could increase the incidence of disease for farmed species of fish and shellfish.

- **Marine mammals:** the impact mainly concerns more northerly regions, where the loss of sea ice can result in a loss of habitat and the availability of prey species might change.

- **Seabirds:** Impacts on seabirds are likely to be more important through changes in their food supply than through losses of nests due to changed weather.

- **Non-indigenous species:** Increased invasions and establishment may be facilitated by climate change and pose a high risk to existing ecosystems. The establishment of the pacific oyster (Crassostrea gigas) has been linked to climate change.

- **Intertidal communities:** Warm water Intertidal species might expand their...
distribution range, as already observed in the UK

**Benthic ecology:** Benthic sessile organisms are largely tolerant to moderate environmental changes over reasonable adaptive time scales, but are very vulnerable to abrupt and extreme events

Many of the observed physical and chemical changes are consistent with increasing atmospheric CO$_2$ and a warming climate (rising sea temperature, reduced sea ice and acidification) but many of the causative links to climate changes are still not well understood. Therefore, it is difficult to predict the precise rate and magnitude of change, and the direction of change for example for ocean uptake of CO$_2$, salinity, stominess and nutrient enrichment, and to map impacts at local level. Physical and chemical changes have directly been linked to impacts on marine organisms (range shifts in plankton, fish and intertidal species communities) and are suggested to have important secondary effects such as prey availability for seabirds. Uncertainties about the physical changes that will occur makes it difficult however, to predict e.g. effects of stratification on primary production, stominess on seabird nesting sites or nutrient enrichment on harmful algae blooms. The understanding of the links between climate change and impacts on marine ecosystems remains also limited due to insufficient data (e.g. marine mammals; benthic ecology; intertidal communities) and difficulties to establish local effects.

### 2.4. References


3. Human activities

3.1. Introduction
The Dutch part of the North Sea is one of the most intensively occupied seas of the world (VenW, 2009). Next to the exploitation of living resources, the sea is used for shipping, with some of the busiest shipping routes crossing the area, oil and gas exploitation, tourism and recreation, cables and pipelines, sand extraction, dredging and dumping, military activities and, since more recently, wind farms (Figure 3.1.1.). In the past, infrastructural works for coastal defence have changed the exchange between the North Sea and estuaries in the SW Netherlands. At present, land reclamation occurs for the extension of the Rotterdam harbour (Maasvlakte 2), and along the entire coastline beach nourishments are carried out to protect the sandy coast. These activities exert biological, physical and chemical pressures on the marine ecosystem. It is expected that some of these activities on the Dutch part of the North Sea will intensify over the coming decades, like for example, the construction of offshore wind farms and sand extraction for coastal protection. The next paragraphs gives a description of the human use of the Dutch part of the North Sea (based on VenW, 2009). The last two paragraphs of this chapter describe the links between human activities, pressures and the potential effects on the environmental status, and a preliminary assessment of cumulative effects in the Dutch part of the North Sea.
Figure 3.1.1. Map of the current spatial distribution of human use in the Dutch part of the North Sea (VenW, 2009)
3.2. Sand extraction

Current situation
Of all the countries around the North Sea, the Netherlands extracts the largest volume of sand – in excess of 25 million m$^3$ every year. This is approximately half of the total annual sand demand in the Netherlands. Some 12 million m$^3$/year is extracted for coastal replenishment. Marine sand is also used as fill sand on land (approx. 13 million m$^3$/year). Little coarse industrial sand is extracted from the Dutch section of the North Sea. Gravel as a by-product of sand is extracted in very small quantities only. Potential extraction areas for concrete and masonry sand are located in an area to the west of the islands of Zuid-Holland and Zeeland. Because this sand is located some metres below the seabed, large quantities of sand also have to be removed from the cover layer. Sand extraction for the Maasvlakte 2 area will take place at a single location. The creation of this area will result in an extremely large-scale extraction of marine sand (up to 365 million m$^3$). In addition to sand, fossil shells are extracted at sea.

Possible developments
The Netherlands are prone to flooding by the sea. To prevent this, the coastline is maintained and protected by coastal nourishment since 1990. This method is choosen as being the most environmental friendly. An increase of sand extraction is expected in the next decades. To account for the present sea level rise the amount of marine sand for coastal defence will increase from 12 to 20 million m$^3$/year. In case of an acceleration of sea level rise the amount will increase further. In the extreme case of a sea level rise of 130 cm by the year 2100 an amount of 85 million m$^3$/per year will be necessary during the next century. An increase of up to 25 million m$^3$/per year is estimated for using marine sand as fill sand on land. Apart from the above mentioned sand extractions, marine sand can be needed for large projects, e.g. for the Westerschelde Container Terminal 20 million m$^3$ is needed. A suggestion to extend the coastline by one kilometre would result in a maximum of 40 million m$^3$/additional replenishment sand per year. If the aim is to widen dikes and built terps on land, this would lead to a major increase in the demand for marine sand.

Pressures
The main pressures related to sand extraction are physical loss (smothering) and physical damage (selective extraction, abrasion and changes in siltation). Sand extraction causes under water noise. Reduced substances bound in the sediment (e.g., organic matter, sulphides, ammonium) and heavy metals chelated to fine particles, may be released to the water column. The chemical effects of aggregate dredging are however likely to be minor due to the very low organic and clay mineral content of most commercial aggregate deposits in tidal environments. Impact of sand extraction is mainly local. The duration of the extraction of marine aggregates at a specific site depends on several factors: volume of dredged material, type of material, equipment used and environmental factors as wind, waves, etc. Dredging periods at site can take up months to years.
Figure 3.2.1 Map of areas used for sand and shell extraction (www.noordzeeatlas.nl)
3.3. Oil and Gas

**Current situation**
At present, there are about 160 production facilities at sea, 92% of which are for gas extraction and 8% for oil. For the distribution of oil and gas, these facilities are linked to an extensive network of pipelines. For gas, these land in Velsen, Callantsoog, Uithuizen and Hoek van Holland. Oil pipes surface at IJmuiden and the port of Rotterdam (Maasvlakte).

**Possible developments**
Expectations are that in the next ten years only a limited number of new extraction areas are to be developed in the North Sea (two to four a year). The rate at which existing recovery fields are being dismantled depends, among other things, on the price of oil. It is expected that most fields will be closed down between 2020 and 2030 because they have been exhausted.

**Pressures**
Oil and gas exploitation cause physical loss (sealing) and physical damage (abrasion, changes in siltation). Seismic exploration for oil and gas is considered to be the most important source of underwater noise, which could affect marine fauna. Oil and gas exploitation produces underwater noise, and causes changes in salinity and thermal regime. Hazardous substances can be released into the environment. In most cases water is discharged, containing hydrocarbons (≤ 30 ppm oil in OSPAR area), metal salts and mining chemicals (additives). With the aging of oil and gas fields, the volumes of produced water increase. The concentrations of potentially hazardous substances decreases as a function of distance from the platform. Offshore exploration and production of oil and gas is not subject to seasonal variation, and once a platform is taken into production, it can last for approximately 25 years.

3.4. Wind energy

**Current situation**
Two wind farms have been built off the Noord-Holland coast, with a total capacity of 228 MW: the Egmond aan Zee Offshore Windpark and the Princess Amalia Windpark. An additional capacity of approximately 700 MW of wind energy is to be commissioned by 2012.

**Possible developments**
The sustainable resource that is expected to expand most for the coming decade at sea is wind energy. By 2020, a total capacity of 6000 MW is expected to have been built in the Dutch EEZ, which will be equivalent to a total surface area occupied by wind farms of approximately 1000 km².

Ideas for building an island at sea for storing electricity are also in the pipeline. The reason for storage is to counteract the imbalance between supply and demand. Storage at sea could be combined with forms of sustainable energy.

**Pressures**
The pressures related to wind energy are different during construction phase, operational phase and demolition phase. During construction, one of the major impacts on the environment is the production of noise due to pile driving. This mainly affects marine mammals, but may also have an impact on other marine fauna (fish larvae, fish). The distance at which the impact is significant is still under research. The construction and removal of wind farms may, depending on the techniques used, result in local destruction of the seabed, and sediment plumes lead to permanent coverage of the sea floor (physical loss and physical damage). This impact reaches as far as the plume expands. During the operational phase, emission of sounds and vibration to the water body may lead to habitat loss due to avoidance, and to the fragmentation of migratory routes,
feeding and reproduction sites for birds, mammals and fish. The hard substrate introduced in the sandy environment might act as stepping stones for non-indigenous species. The potential impact of cables is described in a separate section. Wind farms, and the associated banning of fisheries from these areas, are suggested to have positive ecological impacts as well, as a consequence of the creation of new habitats and a refuge for species,
3.5. Carbon capture and storage

**Possible developments**
In the coming decades, capturing CO2 at source and transporting it to deep underground storage facilities is seen as an inevitable interim step in the transition to sustainable energy management. Depleted gas fields and their associated pipelines at sea are potential future spaces for CO2 storage, and the area to the north-west of Texel is a particular site for large-scale storage. Locations of certain underground water-retentive soil strata (aquifers) might also be used for CO2 storage. However, use at this scale is not expected before 2020.

3.6. Shipping

**Current situation**
With some 260,000 shipping movements a year, the North Sea is one of the busiest seas in the world. Over 110,000 of these movements are to and from Dutch seaports.

**Possible developments until 2015**
Until 2015, an increase of between 14 and 30% in numbers of shipping movements compared to 2004 is expected. Various factors play a part in this:
1. Increase in shipping movements due to growing transport volumes;
2. Decrease in shipping movements due to larger ship and improved loading;
3. Increase in shipping movements due to shift from road transport to shipping;
4. Increase in shipping movements due to larger seaport capacities (e.g. Maasvlakte 2).

The available capacity of the shipping infrastructure is large enough to accommodate the expected growth in the number of shipping movements up to 2015.

**Possible developments after 2015**
Shipping traffic on the North Sea will not only become busier, but also more diverse. In addition to merchant shipping, sea towage and hydraulic engineering work, this comprises fishing and increased pleasure boating. This means that ships with different manoeuvring characteristics, dimensions and speed all converge in a small area.

**Oil transport**
Because global oil production is dropping, the transport of oil by sea will decrease in the long term. This may be compensated in part by the transport of biofuel.

**Liquefied Natural Gas (LNG)**
The transport of LNG is set to grow in the future. Landing points can be created in the Maasvlakte area.

**Containers**
The volume of container transport and transshipment is rising sharply. By 2040, the current volume will have increased by 50% up to as much as 300%, with the Maasvlakte 2 area, currently under construction, playing a key role in accommodating this growth. The scaling-up of ships is a significant development. Due to draught restrictions, a number of ports in the region will be less suitable or not suitable at all for landing containers. Rotterdam, Antwerp, Hamburg, Bremerhaven and Willemshaven will be the focus for container transport.

**Ports**
The increase in the demand for space for ports until 2040 is between -9 and +30%. The seaward extension of seaport activities would seem the most logical development.

**Pressures**
In accordance with MARPOL 73/78, far-reaching prohibitions and restrictions to spills and wastes at sea are practised. Nevertheless, illegal discharges occur. Shipping can impact on the marine environment with hazardous substances in various ways. Impacts can include the introduction of oil or other noxious substances (e.g., antifouling), via operational discharges, or via the loss of a vessel and/or cargo. Non-indigenous species can be transferred in ballast water, associated sediments, and hull fouling. Effects of shipping noise on birds and fish are to be expected within the maritime routes (few kilometers wide). Marine mammals can be affected by noise up to tens of kilometers distance. Acidification caused by gaseous ship emissions could occur in the proximity of major shipping lanes. There is no temporal variation in the intensity of shipping.
Figure 3.6.1 Map of vessel traffic routes and traffic intensity in number of ships/1000km². (VenW, 2009)
3.7. Fishing

Current situation
In 2006, the Dutch offshore fishing sector had some 440 vessels and over 2,000 crew. In economic terms, plaice and sole are the major catch. Herring and mackerel are the major species terms of catch tonnage. Shellfish and shrimp fishing take place in the coastal waters.

Possible developments until 2015
The Dutch North Sea fishing sector is a highly specialised entrepreneurial industry that is under increasing pressure due to a number of developments:

- Fishing methods used (beam trawling) are very energy-intensive;
- The sector has an economic overcapacity and catch yields are restricted by the Common Fisheries Policy;
- Social pressure on the sector to produce in a more eco- and animal-friendly way is growing;
- The space in the North Sea available for fishing is coming under increasing pressure.

It is expected that as a result of the above trends, there will be an 8% to 50% decrease in the economical value of fishing on the Dutch continental shelf in the 2005-2015 period. At the same time, there will be opportunities for the sector to distinguish itself by responsible fishing using ecolabels for consumers (Marine Stewardship Council, MSC).
Possible developments after 2015
Sustainable fishing
Consumers, the Dutch government and the EU are pressuring on the sector to produce sustainably. The process of transformation that has been initiated is, in all likelihood, set to continue after 2015.

Climate change
The consequences of climate change for the fishing sector are still largely unknown. Some fish species may move north and hence become less attractive in economical terms, and perhaps new and economically interesting species may arrive in the area.

Pressures
The physical impact of bottom tending gear on the benthos results in changes to the physical habitat, which in turn have the potential to cause substantial and long-term changes to benthic ecosystems. Lost fishing nets add up to marine litter. Non-selective extraction occurs for target as well as non-target species. Noise produced by the boats can impact mammals, birds and fish.

3.8. Defence

Current situation
Some 7% of the EEZ is used as military (training) area. These areas are: shooting ranges; flying zones; mine testing areas and former munitions dumping sites (Figure 3.8.1).

Possible developments
No changes regarding requirements are expected in the near future.
3.9. Tourism and leisure activities
**Current situation**

The Dutch coast is a national and international tourist attraction, primarily because of its 250 km of wide sandy beaches backed by dunes and interspersed with seaside resorts and harbours which often have a unique identity.

**Possible developments until 2015**

It is expected that until 2015, the sector will experience an average annual growth of 2.6%. The use made of the coast and the sea play a key role in this, although the international competitive position of the coast is declining. The importance of water sports is on the increase. The bottleneck here is the lack of marinas along the Dutch coast. The potential of various locations (Katwijk, Hoek van Holland, Petten) as coastal marinas is being looked into.

**Possible developments after 2015**

It is expected that the coast and the coastal belt will be more intensively used for a wide range of leisure pursuits.

**Pressures**

One of the pressures associated with maritime tourism in the Dutch part of the North Sea is the introduction of litter. Other pressures are the introduction of synthetic and non-synthetic substances and compounds by ships and yachts, introduction of noise and physical loss and damage.
3.10. Cables and pipes

Current situation
An extensive network of cables and pipes has been laid in the North Sea since the development of oil and gas fields. Given the future of oil and gas recovery in the North Sea, and the existing network, it is to be expected that this situation will stabilise in the future. The building of new international gas pipelines will have to be taken into account, however.

The first cables laid on the seabed were transatlantic telecommunications cables between Europe and North America, several decades ago. Since then, the number of telecom cables has grown steadily but has meanwhile stabilised.

Possible developments
The opening up of the European electricity market has caused an increase in the demand for international power supply links (interconnectors). At present, the Netherlands has an interconnector across the sea, a cable between the Netherlands and Norway (NorNedkabel), and one is currently under construction between the Netherlands and the UK (BritNedkabel). The construction of wind farms at sea will generate an additional need for power cables between the wind farms and the Dutch coast. The government is exploring possibilities for ‘power points at sea’ for the benefit of large-scale wind farms.

Pressures
Sealing of habitat occurs due to the placing of artificial hard substrates. However, these local effects of cables on the marine environment are small and very local. Abrasion resulting from placement of cables and pipelines can affect the seabed floor. The impact of this disturbance, however, is not long lasting (1 – 8 years). Significant changes in thermal regime might occur by heat dissipation of the power cables, and disturbance due to electromagnetic fields might occur too. The latter is speculated to have a potential impact on the orientation ability of sharks and skates.
3.11. Emissions

For many non-synthetic substances and synthetic compounds, river discharges are a major source. The Dutch coastal waters are strongly influenced by riverine discharges from Scheldt, Rhine, Meuse and Ems. Discharges from other rivers (a.o. Seine, Thames, Humber) to some extent also influence water quality in the Dutch part of the North Sea. In addition to river loads, other sources that can be distinguished are:

- atmospheric deposition
- emissions from shipping and offshore installations
- discharges of dredged spoil
- Channel water and water from the northern Atlantic Ocean
- natural background concentrations of non-synthetic substances in riverine and marine waters

It should be realized, that only the emissions from shipping and offshore installations can be considered true sources. The other sources mentioned above are actually pathways for emissions that, to a large extent, occur on land (viz., point or diffuse discharges to surface waters or the air, that are subsequently transported to the sea).

For 31 priority substances, mentioned in Annex X of Directive 2000/60/EC (Water Framework Directive) information on the loads from the above mentioned sources was collected by Van Gils (2007). For 15 of those substances a more or less complete data set on the contribution of various sources could be established. In a follow-up to this study model simulations were carried out to establish the effect of emission reductions on water quality targets.

For a selection of substances (TBT, cadmium, copper, zinc) and five PAH’s (benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene and indeno[1,2,3-cd]pyrene) estimates were made of the contribution of the various sources and the expected trends in concentrations (Van Gils, 2008; Van Gils & Fiocourt, 2008).

The analysis shows that, for metals, loads are dominated by the input from rivers and by loads related to dredging sludge discharges. For PAH’s, atmospheric deposition is a major source in addition to river loads. TBT is almost completely determined by emissions related to shipping (Table 3.11.1; Fig. 3.11.1).

The concentrations of the non-synthetic substances (metals) are, to a large extent, also determined by loads from the Channel, (including natural background concentrations).

| Table 3.11.1 Summary of loads (kg/year) to the Dutch coastal waters (12 mile zone) in 2005. From: Van Gils (2008) |
The expected trends in the concentrations of these substances indicate that after 2015 TBT will no longer exceed the environmental quality standard, as defined under the WFD (also see §4.9).

The metals (cadmium, copper, zinc) do not exceed environmental quality standards at present, and this is not expected to change in the future. The PAH’s are not expected to show significant changes in concentrations up to 2015 (Van Gils & Friocourt, 2008).

For other natural substances, in particular nitrogen and phosphorus, similar estimates can be made to distinguish the contributions of various sources, and to estimate the expected trends in nutrient concentrations in the North Sea. The nutrient loads to the North Sea are discussed in more detail in §4.8.

### 3.12 Transboundary effects of human activities

To be added

### 3.13. Linking drivers, pressures and impacts on GES descriptors
An indication of the expected change in drivers and pressures for the period until 2020, and the relevance of those pressures for the 11 qualitative descriptors of good environmental status (Annex I of the Directive) is given in Table 3.13.1. The table gives a qualitative assessment of the relative importance of the pressures. This relative importance of the pressures is based on the results of an expert workshop in preparation of the OSPAR QSR 2010 (Karman, 2008), recently updated on the basis of expert judgment. The table indicates that the most dominant activities affecting the Dutch part of the North Sea are aggregate extraction, oil and gas exploration, maritime transport, coastal defence, fisheries and land-based emissions. Renewable energy is an activity that is expected to become important in the near future. The main pressures associated with these activities are physical loss and physical damage, underwater noise and marine litter, contamination and nutrient enrichment, introduction of non-indigenous species and selective extraction of species. Those pressures affect nearly all GES descriptors, with descriptors D1 (Biological diversity), D4 (Marine food webs) and D6 (Seafloor integrity) being influenced by the largest diversity of pressures.

Table 3.13.1. A qualitative indication of links between human activities (drivers), pressures and the impacts on the GES descriptors.
<table>
<thead>
<tr>
<th>Pressure</th>
<th>Driver</th>
<th>Biological diversity</th>
<th>Non-indigenous species</th>
<th>Commercially exploited fish</th>
<th>Marine food chains</th>
<th>Human induced eutrophication</th>
<th>Sea floor integrity</th>
<th>Hydrographical conditions</th>
<th>Contaminants</th>
<th>Contaminants in sea food</th>
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<td>Extraction of marine aggregates</td>
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**Driver-pressure table**

Relevance of impact (based on Karman et al., 2008 and expert judgment)
- High impact
- Moderate impact
- High, but very local impact

Expected trend until 2020
- **↑↑** strong increase
- **↑** increase
- → no change
- **↓** decrease

**Pressure - GES descriptor table**

- Pressure of primary importance in Dutch marine waters
- Pressure of secondary importance

(adapted from Cardoso et al., 2010)
3.14. Cumulative effects

3.14.1. Introduction

The ecosystem approach aims to achieve sustainable use of ecosystem goods and services while maintaining quality, structure and functioning of marine ecosystems. It should be based upon the best available scientific knowledge of the cumulative effects of human activities and their interactions with the ecosystem and its dynamics (OSPAR 2010). It is obvious that the human activities in the North Sea described in the previous paragraphs, and their impacts, do not stand alone. Some impacts relate to similar effects on a specific ecosystem component, while other impacts might only affect a specific organism. All impacts and their effects result in cumulative effects.

Cumulative effects can be defined as “All effects on the environment which result from the impacts of a plan or project in combination with those overlapping effects from other past, existing and (reasonably foreseeable) future projects or activities” (Kaman & Jongbloed 2008).

An example of an approach for cumulative effects assessment, comprising the main elements (ecosystem indicators, impacts and activities), is shown in Figure 3.14.1. In this approach, the impact of human activities is determined by the intensity of the activity, while the effect on ecosystem indicators depends on the sensitivity of the indicators. Although this approach does not contain any data or algorithms to calculate effects, it can be useful in planning processes or scoping exercises for environmental impact assessments (EIA) of projects or programmes. It can provide insight in the impacts of human activities on ecosystem indicators and give an indication of the cumulative effects that may be expected. If the relations within the schematic model can be quantified, calculation of actual effects on the selected ecosystem indicators is possible.

When considering cumulative effects environmental pressures from neighbouring countries and regions should be included. Besides clear and direct effects, indirect effects should be considered as well. Indirect effects refer to effects on the environment, which are not a direct result of the activity and are often a result of a complex pathway. However, indirect effects merely represent a possible chain of effects (e.g., toxicants may impair the reproduction of zooplankton, which reduces the food availability and therewith the stock of commercial fish) and not necessarily a cumulation of effects.

The dimensions time and space are important factors to consider in an assessment of cumulative effects:

- **Time**
  Other activities, that need to be considered in a cumulative effect assessment, do not necessarily occur parallel to the activity under study. Effects of activities that have occurred or were initiated in the past also need to be considered. Similarly, a cumulative effect assessment needs to consider effects of activities that will start or last into the foreseeable future. This is especially relevant for disturbances or effects that are persistent over time.

- **Space**
  Comparable to the dimension time, activities in other areas may lead to effects that cumulate with the effect of the activity under study.
3.12.2 Results Cumulative Effect assessment EEZ

Expert workshop
During an expert workshop in 2008 (Karman et al., 2008), relevant ecosystem elements, pressures and activities in the Dutch part of the North Sea were discussed and prioritized. Intensity of the pressures and the vulnerability of ecosystem-elements for these pressures were judged by experts using a classification system (none, marginal, limited, considerable, large). The CEA model was applied to these results, integrating the pressures to a cumulative effect on ecosystem-elements (Karman et al., 2008). The results of the workshop show a relative ranking of importance of pressures and the effects of activities upon the ecosystem. Fisheries was estimated to have the most significant contribution to pressures, followed by land based pollution and shipping (Figure 3.14.2).

Results Cumulative Effect assessment EEZ: geographical distribution
The cumulative effects assessment (CEA) methodology developed for the Dutch EEZ case study assumes that effects are a function of the intensity of pressures and the sensitivity of ecosystem components to those pressures (Karman et al 2008; OSPAR, 2009). A tiered approach was used for the CEA:
1. Scoping, scoring and cumulating
2. Geographic distribution
3. Temporal variability

The quality of the data, originating from an expert workshop, is considered moderate, because of the limited number of experts participating in the workshop, and a lack of clear definitions. A validation of the results with an earlier assessment based on literature (Karman et al., 2001) shows that the ranking of the most important activities was similar in both assessments. It can therefore be concluded that the case-study, using a semi-quantitative approach by expert-judgment, complies in general with available knowledge from literature.

Results (Figures 3.14.3 and 3.14.4) show that the southern part of the Dutch EEZ has the highest collective pressure. Abrasion (and other physical damage to the seabed) has the highest intensity, mainly caused by (beam trawl) fishing. The cumulative effect of pressures has been assessed for benthos, fish, birds, cetaceans and pinnipeds, identifying abrasion, removal of non-target species and noise as important pressures.
An overall map was not presented, since the tier 2 assessment is based only on a subset of pressures and ecosystem components, which easily leads to misinterpretation of the results. Time dependent variability is not taken into account. This could include temporal distribution of activities and ecosystem components and the recovery of ecosystem components.

Figure 3.14.2. Relative ecological risk of various human activities in the Dutch part of the North Sea (Karman et al., 2008),
Figure 3.14.3.: Distribution maps of the following ecosystem components: Benthos, Fish, Birds, Harbour porpoise (Cetacean), Common seal and Grey seal. These final two are combined (by way of addition) into a single pinniped result. Modified and reproduced from Lindeboom et al., 2008 (OSPAR, 2009).
Figure 3.14.4.: Demonstration of the Cumulated Effect Score (CES), a relative indicator for the cumulative effect of pressures on species and habitats of the Dutch EEZ (a higher score represents a higher intensity of cumulative effect). As the figure is for demonstration purposes only, the reference to the specific species on which this figure is based has been removed (Karman et al., 2008; OSPAR, 2009).

3.15. References
OSPAR, 2009. Trend analysis of maritime human activities and their collective impact on the OSPAR maritime area. Intersessional Correspondence Groups for the BA6 Assessment and the Cumulative Effects Assessment
4. Current Environmental Status

4.1. General approach

This chapter gives a description of the current environmental status of the Dutch part of the North Sea. The description in this chapter is not intended to provide an extensive and complete overview of all available data and information on the ecological state and functioning of the Dutch part of the North Sea. A pragmatic approach has been taken, using available knowledge and focusing on the most important environmental issues. This means that this chapter presents a selection out of the sea of data that are available for the North Sea. This selection is limited to those data and information that are relevant for the description of the environmental status in the sense of the Marine Strategy Framework Directive (MSFD), and that can give an impression of the risks of (potential) effects of human activities for current or future environmental status.

This chapter provides a separate description for each of the 11 qualitative descriptors for Good Environmental Status (GES) from Annex I of the MSFD. Each paragraph describes a descriptor, following a similar structure:

- A general description of the descriptor
- Definition from Annex I in the MSFD
- Overview of the criteria and indicators for the descriptor
- Current status of the descriptor in the North East Atlantic
- Present status in the Dutch North Sea

Criteria and indicators

The European Commission provided criteria and methodological standards to allow consistency in approach in evaluating the extent to which Good Environmental Status (GES) is being achieved, in a Commission Decision published 1 September 2010. ICES and JRC provided scientific support for this Commission decision. Task Groups were established in 2009 for each of the qualitative descriptors, with exception of descriptor 7 (Hydrographic conditions). Each Task Group consisted of selected experts providing experience related to the four marine regions (the Baltic Sea, the North-east Atlantic, the Mediterranean Sea and the Black Sea) and an appropriate scope of relevant scientific expertise. Observers from the Regional Seas Conventions were also invited to each Task Group to help ensure the inclusion of relevant work by those Conventions. A Management Group consisting of the Chairs of the Task Groups including those from DG SANCO and IFREMER and a Steering Group from JRC and ICES joined by those in the JRC responsible for the technical/scientific work for the Task Groups coordinated by JRC, coordinated the work.

Based on a further consultation of interested parties, including regional sea conventions, in particular on the scientific and technical assessment prepared by the Task Groups, an EC decision was taken and published September 1.

Status in the North East Atlantic (OSPAR Quality status report)

A general description of the current status of each descriptor in the North East Atlantic is given, based on the draft OSPAR Quality Status Report 2010 (QSR; OSPAR, 2010). The QSR gives an overview of the present environmental status in the entire OSPAR region, following the OSPAR Thematic Strategies. A selection of the information from the QSR was made to give a specific impression of the general environmental status for each GES descriptor.

The final version of the QSR was published in September 2010.

The information for the chapter in this report was compiled in the period January-May 2010, based on earlier draft versions of the QSR. An update is necessary to include the final QSR findings.

Description of the Dutch part of the North Sea

For the Dutch part of the North Sea a more specific description of the status of the GES descriptor is provided. In some cases (e.g. Commercial fish) it was considered more
appropriate to give a description for a larger area, viz. the Greater North Sea. The description of the present status of the Dutch part of the North Sea is based only on available reports and publications. New analyses of data were not performed. As much as possible, the description addresses the criteria and indicators that were suggested by the European Commission (EC, 2010). In many cases, however, available data and information only partly address these criteria and indicators. Moreover, at this moment the Netherlands have not yet determined what should be considered Good Environmental Status (Article 9). Neither has a set of environmental targets and indicators been established yet (Article 10). Consequently, the present assessment is not based on targets and indicators developed for the MSFD. Where possible and applicable, assessment results based on the OSPAR EcoQO’s or other OSPAR assessments and status assessments for the WFD biological and chemical objectives are presented. Although these assessment results are not based on MSFD objectives, targets and indicators, they could be considered as a first indication of present environmental status. In some cases, additional results from national assessments or other relevant information is provided.

The selection of data and information presently included in this report was made based on availability and on the relation with the criteria and indicators proposed by EC (2010). Once Good Environmental Status for the Dutch part of the North Sea has been defined, and environmental targets and indicators have been established, an update of the data and information presented in Chapter 3 will be necessary. The conclusions presented in this chapter are still provisional. Final conclusions on the current Environmental status of the Dutch part of the North Sea can only be drawn once Good environmental status, and targets and indicators have been defined.

References
4.2. 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.

<table>
<thead>
<tr>
<th>Criteria and indicators in the Commission decision</th>
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<tbody>
<tr>
<td><strong>1.1 Species distribution</strong></td>
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<tr>
<td>Distributional range (1.1.1)</td>
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<tr>
<td>Distributional pattern within the latter, where appropriate (1.1.2)</td>
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<tr>
<td>Area covered by the species (for sessile/benthic species) (1.1.3)</td>
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<tr>
<td><strong>1.2 Population size</strong></td>
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<tr>
<td>Population abundance and/or biomass, as appropriate (1.2.1)</td>
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<tr>
<td><strong>1.3 Population condition</strong></td>
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<tr>
<td>Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)</td>
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<tr>
<td>Population genetic structure, where appropriate (1.3.2)</td>
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<tr>
<td><strong>1.4 Habitat distribution</strong></td>
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<td>Distributional range (1.4.1)</td>
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<td>Distributional pattern (1.4.2)</td>
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<td><strong>1.5 Habitat extent</strong></td>
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<td>Habitat area (1.5.1)</td>
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<td>Habitat volume, where relevant (1.5.2)</td>
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<td><strong>1.6 Habitat condition</strong></td>
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<td>Condition of the typical species and communities (1.6.1)</td>
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<td>Relative abundance and/or biomass, as appropriate (1.6.2)</td>
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<tr>
<td>Physical, hydrological and chemical conditions (1.6.3)</td>
</tr>
<tr>
<td><strong>1.7 Ecosystem structure</strong></td>
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<td>Composition and relative proportions of ecosystem components (habitats and species) (1.7.1)</td>
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**General description for the North East Atlantic**

Biologically diverse oceans and seas are important for the proper functioning of marine ecosystems. They are also of high value to man in providing services, sustainable uses and as a basis for human health and livelihoods. However, many marine species, habitats and ecosystems are sensitive to pressures from human activities and there is general agreement that marine biodiversity globally is facing unprecedented threats as a result of human activities in the marine environment, land-based inputs to the sea and climate change.

Pressures such as the removal of species (e.g. by fishing), loss of and damage to habitats, the introduction of non-indigenous species, obstacles to species migration and poor water quality are still present. All can act in concert with each other and be exacerbated by climate change. These pressures result in loss of biodiversity, including declines in the distribution, and population and condition of species and the distribution, extent and condition of habitats, and interruption of ecological processes, for example spawning, migration, and biological communication.

The most sensitive features are those that are easily damaged and slow to recover. Some ecosystems never recover. The common skate for instance is a long-lived species that has
a slow rate of reproduction. It is particularly vulnerable to capture by bottom-trawl fisheries and is severely depleted in many areas and is close to extirpation in large parts of the Greater North Sea. Coastal waters contain feeding grounds, spawning and nursery areas, and feature on migration routes for seabirds and some fish species. The intense and varied human activities taking place in coastal waters, such as fishing, shipping, sand and gravel extraction, construction and marine energy production, lead to a wide range of pressures on species and habitats. These can lead to the damage or loss of key habitats in estuaries and intertidal areas. Coastal waters are also most affected by changes in water quality resulting from land-based sources of pollution. Key areas of the shelf seas include offshore banks and reefs, and frontal zones between different water masses. These play important roles in pelagic productivity but knowledge about the overall structure of shelf sea ecosystems is still developing. Fishing is recognised as a key pressure on species and habitats in the shelf seas. Some key areas are now protected but generally, there continues to be a need for information about ecologically important areas to guide improvements in management.

**Region II (Greater North Sea), regional summary:**
The decline in biodiversity is not halted. 10 habitats and 29 species of the OSPAR list of Threatened and Declining Species and Habitats are still being damaged. The North Sea has greater coverage by MPAs than the other OSPAR Regions, with 5.4% of the waters and seabed protected.

**Good MPA coverage.** Region II has greater coverage by MPAs than the other Regions, with 5.4% of the waters and seabed protected. The challenge now is to integrate management of these MPAs with wider spatial plans.

**Status in the Dutch part of the North Sea**

**Species level**

Birds

The coastal and offshore areas of the Dutch part of the North Sea are periodically of great importance for marine birds (Figure 4.2.1). Different species use the area at different times of the year for different reasons. Neashore waters are critically important for local breeders, such as cormorants, gulls and terns, for finding food within colony range. The same coastal sea is used by even larger numbers of wintering birds, that feed on small fish (divers, grebes, gulls, auks) or on shellfish (sea duck). Finally, tens to hundreds of thousands of migrating seabirds move through the coastal sea, often feeding as they go (including highly significant numbers of vulnerable species, such as terns, Little gull, Great and Arctic skua). Offshore waters are mainly used by non-breeding piscivorous seabirds. Several species use our offshore waters in significant numbers (regarding total population sizes) in the non-breeding season. These include Gannet, Guillemot and Razorbill, while species such as Kittiwake and Fulmar also use the area by the tens of thousands (but have much larger populations outside Dutch waters). In the northwest of the Dutch Continental Shelf several species occur in the thousands or tens of thousands that are only rarely seen by land-based observers in the Netherlands (Puffin and Little Auk). Several important areas have been or will be designated under the Birds Directive (Voordelta and North Sea Coastal Zone in nearshore waters and the Frisian Front further offshore). Moreover, the Cleaver Bank (Habitat Directive) holds a high diversity of seabirds year round, while the Brown Ridge area is being studied because of high densities of wintering auks (Lindeboom et al., 2005). An overview of the species and their conservation goals is given in Appendix A.
The nearshore waters are characterized by high seabird densities. Some species are particularly vulnerable to human activities. Breeding cormorants, gulls and terns need to find sufficient food within a limited range (i.e. near their colonies): some nearshore wintering birds are equally dependent on sufficient availability of food in a narrow strip of sea (e.g. Great Crested grebe, Red-throated diver and Black scoter). These birds spend most of their time on the water and are very sensitive to disturbance, oil slicks, or underwater set-nets. Likewise, auks wintering offshore are very sensitive to oil pollution, particularly when they occur in high densities and are unable to fly. Guillemots, for instance, seek out the Frisian Front shortly after breeding, raising their chicks and molting their flight feathers simultaneously.

Figure 4.2.1: Overview of the bird values on the Dutch part of the North Sea. The bird value combines (1) the ability to reproduce, (2) the vulnerability of the species and (3) the presence of the species (Lindeboom et al., 2008)

Red-throated Diver
Red-throated Divers are an Annex I species under the Birds Directive. They have a rather small total population size that suffers from deteriorating environmental conditions, both in their breeding areas (lake acidification, Eriksson, 1994) and in their winter quarters. Given these stressors, it is surprising that an increase in wintering numbers in Dutch nearshore waters has been noticed over the last 25 years (Camphuysen, 2009a). The reason for this is yet unknown. These birds feed on small and middle-sized fish, that may have become more abundant with the gradual removal of large predatory fishes from the system. More than 20 prey species have been identified, such as small gobids, whiting and herring. Red-throated Diver are very sensitive to disturbance and will leave preferred areas if e.g. recreational disturbance becomes too high. Groups of Red-throated Divers are disturbed by ships on a distance of 1000-1500m and by small airplanes at a distance of 2000m. Resting birds keep a distance of about 500m from busy beaches. Moulting birds are probably even more sensitive (Krijgsveld et al., 2004) and this may be the reason why these divers leave Dutch waters in spring, to moult off NW Germany and Denmark (Skov et al., 1995).

Great Crested Grebe
The Great Crested Grebe has shown a recent shift in wintering occurrence. The main wintering areas were on Lake IJssel and on Lake Grevelingen, but recent years have seen an enormous increase in wintering numbers just off the Dutch mainland coast. No conservation goals have been set for this species at sea and they winter in a rather small marine area, situated between the Natura 2000 sites Voordelta and Noordzeekustzone. Some 28,000 individuals have been counted in a coastal stretch between Hook of Holland and Den Helder (Figure 4.2.2). These birds now winter here both in severe and in mild winters. Before the 1990s, grebes only visited the North Sea in significant numbers if Lake IJssel froze over in severe winters, but this often coincided with high mortality (Camhuysen & Derks, 1989). In recent years, however, mortality has been low and the grebes appear to have adapted well to wintering at sea and finding sufficient food here to survive. Great Crested Grebes feed on small fish, but their marine diet is still largely unknown. Their food base seems to be solid in the North Sea (given the high numbers and low mortality) but the birds must be vulnerable to oil slicks and bottom set-nets.

Figure 4.2.2. Numbers of Great Crested grebes between kop van Goeree and Den Helder (2006). Source: Nederlandse Zeevogelgroep and IMARES

Black scoter
The numbers of Black scoters show high yearly variation (Figure 4.2.3). They are mainly found in shallow coastal waters rich in shellfish (Figure 4.2.4). In the 1980s and 1990s around 100,000 individuals were counted in the Dutch part of the North Sea. These numbers have declined drastically over the last decade. During the last survey in December 2009, only 3500 Black scoters were counted north of the Wadden Islands and a few hundred only in the Voordelta. The fall in numbers coincides with the decline of their preferred food source Spisula subtruncata. Ensis directus, which has largely replaced S. subtruncata, does not seem to be as appropriate as a food item. The Black scoter is very sensitive to disturbance. They fly away when a ship approached them at a distance of about 1500m. Drifting oil slicks are another major threat to the species, that typically occurs in dense concentrations on the water.
Figure 4.2.3. Numbers of Black scoter (annual maximum) in the Dutch coastal area. Between 1987-'94 counts were done from ships, planes and from land. After 1994 only the plane was used to count.

Figure 4.2.4: Maximum numbers of Black scoter counted in the Dutch coastal area between 1990 and 2010

Gulls, terns, cormorants: local breeders
Gulls and terns suffer from increasing recreational pressure (all beaches), development (Maasvlakte/Europoort) and predation in their breeding areas by Red Foxes (entire Dutch mainland), a decrease in availability of discards (gulls only) and possibly sub-optimal water clarity (terns). Gull numbers have soared over the past 100 years, but are now declining. Numbers of terns never fully recovered from the major set-back in the 1960, due
to contamination (DDT and such likes) and land reclamation in the Delta area. In contrast, Great Cormorants have shifted from inland waters to coastal sites, founding over a dozen new, marine colonies. Feeding conditions and breeding success appear to be higher at the coast, and numbers are steadily increasing.

**Kittiwake**
The Kittiwake is the most pelagic species of the North Sea Gulls. It has a large population size, but is at risk because of drastic population declines through lack of good food (sandeels). Recent trends in wintering numbers in Dutch waters are not yet known (but see Berrevoets & Arts, 2003 for a useful approach).

**Auks**
Guillemots and Razorbills occur in significant numbers in the Cleaver Bank to Frisian Front area (and possibly also further north, and on the Oyster Grounds (where species-specific data are scarce), in summer and autumn. In late winter, large numbers of both species occur in the Southern Bight of the North Sea, roughly in the Brown Ridge area. The late-summer birds are post-breeder; the late-winter birds are pre-breeder, probably acquiring body reserves in the Southern Bight before migrating back to their (UK) colonies to breed. Numbers of Puffins and Little Auks in the Dogger Bank area are still poorly known, as is their winter ecology at sea. Razorbills are year-round food specialists, feeding mainly on small sandeels and clupeids. Guillemots take the same foods when breeding, but have a much more diverse diet in winter, including some 20 fish species and a rather large prey size range (Ouwehand et al., 2004). All auks are highly vulnerable to drifting oil slicks, particularly when concentrated at preferred sites.

**Marine Mammals**
The Harbour porpoise has been a common species in the Dutch part of the North Sea up to the first half of the previous century. Since the 1950s, numbers have decreased in the southern North Sea, including the Netherlands. The reason for this decline is still unclear. Since the end of the 1980s numbers of porpoises increase again in the Dutch coastal zone (Figure 4.2.5, Figure 4.2.6). Initially, most animals were observed during winter but at present the larger concentrations can be seen from September until April, with peaks in March (Haelters and Camphuysen, 2009). Thousands of individuals are observed every year and the occurrence of juveniles suggests they can reproduce in the Dutch waters. It is hypothesized that the increase in numbers is not due to local growth of the population but is a result of a shift of animals from the northern North Sea towards the south (Camphuysen, 2004). This shift coincides with a decrease in smelt in the northern North Sea. In the Dutch North Sea, the diet of porpoise mainly consists of gadoids and gobies (www.compediumvoorhetleefmilieu.nl).

The number of seals – both harbour seals and grey seals - in the Dutch part of the North Sea have increased since mid 1980s (Figure 4.2.7)(Brasseur et al., 2008). Seals spend at least half of their time at sea where they feed mostly on demersal fish. Though great individual variation is observed seals may swim about 100 km from their haul out sites, which is for most animals the tidal sand flats in or close to the Wadden Sea. Though for grey seals migration from the UK initially was the major cause for the comeback of the species (Brasseur et al., 2009), local factors also play an important role. The positive trends in the number of seals can have several causes. The hunting on seals is prohibited in the Netherlands since 1960, and shortly after also in Germany an Denmark (Reijnders, 1983; Reijnders, 1992). Reduced concentrations of PCBs in the environment have had a positive impact on the fertility of seals (Reijnders, 1996; Reijnders, 1986). The availability of prey and the lack of other predators may have helped in the recovery of the marine mammals in the area (Reijnders et al., 2005).
Figure 4.2.5: Distribution of the Harbour porpoise on the Dutch part of the North Sea during March-April. The dotted lines represent the routes of the airplane over the period 2000 - 2006. The dots and crosses are individual observations (not cumulative). The brown tints represent the expected distribution of harbour porpoises in 2006 based on model calculations. (Lindeboom et al., 2008)

Figure 4.2.6.: Number of harbour porpoises from 1970 until 2007 (left) and seals from 1959 until 2009 (right) in the Dutch part of the North Sea (www.compendiumvoordeleefomgeving.nl)
Figure 4.2.7. Distribution map of harbour seal (left) and grey seal (right) (Lindeboom et al., 2008)

Figure 4.2.8.: Overview of the biodiversity of fish (Lindeboom et al., 2008)
Fish

The diversity of fish is highest in the coastal area of the Dutch part of the North Sea and decreases towards the deeper, central area (Figure 4.2.8). Commercial fish species are intensively investigated and show high yearly fluctuations. This is discussed in detail in 4.4. Figure 4.2.9 shows the distribution of a rarity index for fish species per square of 10 by 10 miles. The analysis was done on the whole North Sea – not only the Dutch part – and 148 fish species were included. For each of these species, a ‘rarity-value’ is calculated. Rarity is higher when the species occurs in few squares, and the total number of caught individuals of that species is low. The map is based on data from research vessels obtained between 1970 and 2008.

The rarity index is higher in the coastal zone (up to 20 m of depth) compared to open sea. This index indicates that in the Dutch coastal zone many species occur which are absent from other parts of the North Sea. This can partly be explained by the presence of relatively high numbers of diadrome fish species. Additionally, the relatively warm coastal zone, rich in food, is used as a nursery by several fish species.

Benthos/invertebrates

In the Dutch part of the North Sea a yearly monitoring of the benthos is carried out since 1991 (MWTL monitoring). Between 1991 and 2005 a total of 476 macrobenthic taxa have been distinguished. Many of them are rare species that are found only occasionally in time and space.

The number of macrobenthic species is higher in the northern part of the Dutch North Sea (Dogger Bank, Frisian Front, Oyster Grounds) than in the southern part (other offshore areas and coastal zone) (Figure 4.2.10 and 4.2.11). In spite of temporal changes over the period 1991-2005, the general spatial pattern remains stable. The spatial distribution of the macrobenthic diversity is in correspondence with the general trend in the North Sea (Heip et al., 1992) and can be explained by the higher stability in the deeper areas in the north. In the southern area, salinity is lower, the variability in climate and hydrology is higher, and...
human impacts such as pollution and eutrophication (Craeymeersch et al., 2008) and demersal fisheries are stronger. Benthic biomass is generally higher in the coastal zone than in offshore areas (Figure 4.2.12 and 4.2.13).

Based on box core data, a strong increase in biomass in the coastal area between 2002 and 2005 was observed, but in 2008 the values were back at the lower levels as observed in the years preceding 2002 (Figure 4.2.14). This was mainly due to the patterns in biomass of *Ensis directus*. Since 2002 the total biomass in the coastal area is made up for more than 50% by *Ensis directus*.

No clear trends can be observed for macrobenthic densities (figure 4.2.15).

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**Figuur 4.2.10: Number of species in 1991 - 2005 (co-kriging with EUNIS-ecotopes; see Craeymeersch et al., 2008)**
Figure 4.2.11: Average number of species in the coastal zone (coa), offshore (off), the Dogger Bank (Dog) and the Oyster Grounds (Oys) over the period 1995-2008 (Tempelman et al., 2008)

Figure 4.2.12: Benthic biomass on the Dutch part of the North Sea in 2008 (Tempelman et al., 2009, based on MWTL data)
Figure 4.2.13: Average macrobenthos biomass in the coastal zone (coa), offshore (off), the Dogger Bank (Dog) and the Oyster Grounds (Oys) from 1995 – 2008. For the coastal area, total biomass and the biomass of Ensis directus are shown (Tempelman et al., 2009).

Figure 4.2.14: Macrobenthic densities in the coastal zone (coa), offshore (off), the Dogger Bank (Dog) and the Oyster Grounds (Oys) in 1995-2008 (Tempelman et al., 2009)

Phyto- en zooplankton
Phytoplankton and zooplankton in the North Sea show long-term (decadal) changes in composition. These changes are to a large extent due to changes in oceanic input and water temperatures, and related to meteorological forcing caused by changes in the North-Atlantic Oscillation (Reid et al., 2001). There are indications of changes in phytoplankton composition in the Dutch part of the North Sea, with an increase of dinoflagellates and diatoms and a decrease of flagellates and Phaeocystis (Baretta-Bekker et al., 2009). Zuur et al. (2009) also describe an increase of small diatoms. At present, it is unclear whether these changes are a natural phenomenon or can be related to human impacts. A number of authors suggest that these shifts are due to changes in nutrient concentrations, ratios and limitations (Loebl et al 2009, McQuatters-Gollop et al 2007, Philippart et al 2007, Struyf et al 2004, van der Zee and Chou 2004). For zooplankton, only data from The Continuous Plankton Survey (CPR) surveys are available which cover only the most offshore waters of the Dutch part of the North Sea.

Habitat level
EUNIS habitats
Habitats can be defined at different levels, depending on the level of detail of the characteristics (physical, biological) that are taken into consideration. Five habitat types are distinguished by Lindeboom et al. (2008) in the Dutch part of the North Sea, most of them being characterised by fine to coarse sands. Only in the eastern part, on the Cleaver Bank, a relatively small area with gravel occurs (Figure 4.2.15. and Table 4.2.1). The habitat types were based on the physical parameters depth, grain size and silt content. At this level of the habitat typology (EUNIS level 3) the composition of the benthic community is not taken into consideration. However, the spatial distribution of macrobenthic communities is roughly comparable to the spatial variation in habitat types (Figure 4.2.16). Interpolations of habitat maps and macrozoobenthos data can be used to produce a predictive habitat map (Schokker et al., 2007; Van der Wal et al., in prep).

At present, there is no information available on trends in habitat condition, with the exception of Ntura 2000 sites.

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<th>Ecotope</th>
<th>Surface (km²)</th>
<th>Relative (%)</th>
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<tr>
<td>Deep, silty</td>
<td>11721</td>
<td>20</td>
</tr>
<tr>
<td>Deep, fine and coarse sand</td>
<td>18850</td>
<td>32</td>
</tr>
<tr>
<td>Medium depth, mixed sand</td>
<td>23195</td>
<td>39</td>
</tr>
<tr>
<td>Shallow, fine sand</td>
<td>5362</td>
<td>9</td>
</tr>
<tr>
<td>Gravel</td>
<td>411</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

Table 4.2.1: Surface area of the different habitat types in the Dutch part of the North Sea

Figure 4.2.15.: EUNIS habitat types in the Dutch part of the North Sea (Lindeboom et al., 2008)
Special protection zones (SAC) under the Habitat Directive

The following tables give an assessment of the Status of Conservation of Habitat type 1110_B (North Sea coastal zone), Habitat type 1110_C (Dogger Bank) and Habitat type 1170 (Cleaver Bank), and of the Status of conservation of the Habitat Directive species (Jak et al., 2009)

Subtype H1110_B. Sandbanks covered all the time (North Sea coastal zone)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Favourable</td>
<td>Favourable</td>
<td>Favourable</td>
</tr>
<tr>
<td>Surface area</td>
<td>Favourable</td>
<td>Favourable</td>
<td>Favourable</td>
</tr>
<tr>
<td>Quality</td>
<td>Unfavourable–inadequate</td>
<td>Unfavourable–inadequate</td>
<td>Unfavourable–inadequate</td>
</tr>
<tr>
<td>Future prospects</td>
<td>Unfavourable–inadequate</td>
<td>Unfavourable–inadequate</td>
<td>Unfavourable–inadequate</td>
</tr>
<tr>
<td>Assessment ES</td>
<td>Unfavourable–inadequate</td>
<td>Unfavourable–inadequate</td>
<td>Unfavourable–inadequate</td>
</tr>
</tbody>
</table>
More background information, and information on the Conservation Status of species under the Birds Directive, can be found in Jak et al. (2009). Red-throated diver, Black scoter, Little gull (unfavourable-inadequate) and Eider (unfavourable-bad) have an unfavourable Status, whereas Lesser and Great black-backed gull, Great skua and Common guillemot have a favourable Conservation Status. For the Black-throated diver the status is unknown due to lack of data.
Ecosystem level

Total biodiversity

A general overview of biodiversity in the Dutch part of the North Sea (Figure 4.2.17) is obtained by combining the diversity values for benthos, fish and birds. The biodiversity values for each group are scaled to quantiles from 1 to 10 and summed up (Lindeboom et al., 2008).

Status of biodiversity

The evolution of diversity of several species groups in the ecosystem is assessed by comparing the current status with the ‘natural’ biodiversity expected when human impact is small or absent (Wortelboer, 2010). A natural situation is however not known for many species. In these cases, the first data acquired by monitoring were used as reference dataset. These are mainly data from the 1990’s. The “Nature value indicator” (Natuurwaardegraadmeter) of the ecosystem is represented as a percentage of the reference value, where 100% represents the reference (undisturbed, pristine conditions) and lower values indicate a deviation from this reference (Figure 4.2.18). In the cases where the reference data are recent (1990’s), the current status does not differ much from the reference dataset, and the quality is regarded as high. The calculations for the various species groups are based on averages from a selection of species or indicator scores. A full description of the method is given by Wortelboer (2010). The results of the analysis were included in the Natuurbalans 2008 (PBL, 2008). The current biodiversity in the Dutch part of the North Sea, based on data from 2000-2007, is about half of the expected pristine diversity. However, as discussed by Wortelboer (2010), the deviation from a (to some extent hypothetical) reference value is
less informative than the temporal evolution of the indicator. According to the method described by Wortelboer (2010) the Nature value indicator has remained stable since 1990. The poorest quality is observed for fish and mammals (PBL, 2008). The indicator value for mammals is slightly improving.

![Quality of various species groups of the marine ecosystem, with current biodiversity expressed as a percentage of the pristine status (PBL, 2008; Wortelboer, 2010).](image)

Figuur 4.2.18.: Quality of various species groups of the marine ecosystem, with current biodiversity expressed as a percentage of the pristine status (PBL, 2008; Wortelboer, 2010).

**LNV Nature target species**

In The Netherlands, a system is developed to assess the quality of the environment, by looking at characteristic, sometimes rare, ‘nature target species’ (“doelsoorten”), which are characteristic for certain types of ecosystems (Bal et al., 2001). The target species include birds, fish, mammals and benthic animals (Appendix A). Figure 4.2.19 shows how target species have developed since 1990 in the Dutch part of the North Sea. The status (as reported in 2008) of about 60% of the species is unknown because they are not covered by any monitoring program (Figure 4.2.2.) (van Leeuwen et al., 2008). The graph shows that the status of about 25% of the target species is improving, while for a few percent the status is decreasing.

**Natura 2000 species and habitats**

As reported by PBL (2008), about 15% of all species and habitats which are protected in the framework of the Habitats Directive, and 60% of the bird species protected within the Birds Directive meet the conservation objectives in the North Sea and the Wadden Sea combined².

Overall, 50% of the marine species and habitats meet the Favourable Conservation Status (PBL, 2008) (Figure 4.2.20). It should be noted that this overview relates to the status of coastal habitats only (Natura 2000 sites Voordelta and North Sea Coastal Zone I) in combination with the Natura 2000 site Waddenzee.

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² Similar information is at present not available for only the North Sea.
Figure 4.2.2.: Development of the ‘target species’ of birds, fish and mammals defined by the Ministry of LNV over the period 1990-2006 in the North Sea (van Leeuwen et al., 2008).

Figure 4.2.3.: Conservation status of marine Natura 2000 species and habitats in the North Sea (Voordelta, North Sea Coastal Zone I) and the Wadden Sea combined (Van Leeuwen et al., 2008). The protected species within both Directives are listed in Appendix A.

Summary

Species level
- The coastal and offshore areas of the Dutch part of the North Sea are periodically of great importance for marine birds
- The populations of marine mammals (grey seal, harbour seal, harbour porpoise) have shown an increase in abundance
- Biodiversity of macrozoobenthos is higher in the northern offshore part, density and biomass is higher in the coastal waters
- Many components of the ecosystem are not covered by routine monitoring programmes (e.g. epibenthos, hard substrate biota, zooplankton), hence information on species distribution, population size and population condition is only available for a selection of groups (e.g. marine mammals, birds, commercial fish species, macrozoobenthos, phytoplankton)

Habitat level
- Information is available about the spatial distribution of benthic habitats, but
information on trends in habitat quality is lacking
- The habitat types 'shallow banks' (1110) and Habitat type 1170, that occur in marine Natura 2000 sites, have an unfavourable-inadequate Conservation Status
- All marine Habitat species, except the Harbour seal, have an unfavourable Conservation Status
- Four bird species under the Birds Directive have an unfavourable Conservation Status

Ecosystem level
- According to an assessment by PBL (2008) the Nature value indicator shows no clear trend since the 1990’s
- Approximately 50% of the marine species and habitats (in both North Sea and Wadden Sea combined) meet the Favourable Conservation Status

References
The list of references is still incomplete


Tulp, I., Craeymeersch, J., Leopold, M., van Damme, C., Fey, F., submitted. The role of the invasive bivalve species Ensis directus as food source for fish and birds in the Dutch coastal zone Estuarine, Coastal and Shelf Science


4.3. Descriptor 2: Non-indigenous species

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

<table>
<thead>
<tr>
<th>Criteria and indicators in the Commission decision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Abundance and state characterisation of non-indigenous species, in particular invasive species</strong></td>
</tr>
<tr>
<td>Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species (2.1.1)</td>
</tr>
<tr>
<td><strong>2.2 Environmental impact of invasive non-indigenous species</strong></td>
</tr>
<tr>
<td>Ratio between invasive non-indigenous species and native species in some well studied taxonomic groups (e.g. fish, macroalgae, molluscs) that may provide a measure of change in species composition (e.g. further to the displacement of native species) (2.2.1)</td>
</tr>
<tr>
<td>Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible (2.2.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General description for the North East Atlantic</th>
<th>OSPAR Quality Status Report 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-indigenous species may cause unpredictable and irreversible changes to marine ecosystems, such as predation or competition for indigenous species, modification of habitats and trophic impacts. A variety of economic or human health impacts are possible through, for example, fouling, harmful non-indigenous algal blooms or damage to structures. Over 160 non-indigenous species have been identified in the North East Atlantic but the actual number of introduced species is likely to be greater than this. This is because long-term monitoring and recording data are limited and identifying the species taxonomically can be difficult. Some species are currently misidentified. ICES has identified 30 non-indigenous species that have adverse impacts on ecosystems or human health within the North East Atlantic. Many non-indigenous species have been found in the North Sea. The main vector for the initial introduction of these species has been mariculture followed by ballast water from ships, hull fouling and fishing. The most important and widespread impacts are changes to habitats and competition for food and space with indigenous organisms. Many of these species also have economic impacts. Almost all the species concerned were introduced before the current measures, some as much as several hundred years ago.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status in the Dutch part of the North Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-indigenous species as defined by the JRC Task Group 2 (Olenin et al., 2010) are “species, sub-species or lower taxa introduced outside of their natural range (past or present) and outside of their natural dispersal potential, and that might survive and subsequently reproduce. Their presence in the given region is due to intentional or unintentional introduction resulting from human activities, or they have arrived there without the help of people from an area in which they are alien”.</td>
</tr>
<tr>
<td>Wolff (2005) provided an overview of marine and estuarine species in The Netherlands. In total, 37 species are reported that (might) have established in the Dutch part of the North Sea (Table 4.3.1). Several species were observed a few times in the past only, and are</td>
</tr>
</tbody>
</table>
therefore considered extinct in the Dutch waters. These are not included in the list. Most of the marine non-indigenous species are algae, followed by crustaceans, mollusks and worms (Figure 4.31).

OSPAR has listed 30 species that are considered problematic. Possible impacts have been classified as habitat modification, fouling, algal blooms, trophic impacts (including competition and predation), nutrient regeneration, biodiversity loss, and damage to structures. Ten of these species have been found in the Dutch part of the North Sea (Table 4.3.1).

The American jackknife clam is the most conspicuous non-indigenous species in the Dutch part of the North Sea. It has become very successful over the last two decades (see trends under 4.4). According to the Quality Status Report (OSPAR, 2010) Ensis has an impact on the ecosystem through competition and habitat modification. However, at present there are no clear indications for these impacts in Dutch coastal waters. Also the Pacific oyster is a well known non-indigenous species in the Netherlands, and has spread in the SW Netherlands and the Wadden Sea, where it has a severe impact on the ecosystem. It does not occur on the Dutch North Sea in significant numbers.

Figure 4.3.1.: The number non-indigenous species within taxonomic groups (right) (Gittenberger en Wolff, www.compendiumvoordeleefomgeving.nl). Note: this figure also includes species found in the Wadden Sea or the Delta.

Table 4.31.: Non-indigenous species in the Dutch part of the North Sea, based on Wolff (2005), completed with observations in the DAISIE database (http://www.europe-aliens.org/) (indicated with *). The possible impact of the NIS is based on the QSR (OSPAR, 2010).

<table>
<thead>
<tr>
<th>Species Synonym</th>
<th>Status</th>
<th>Vector</th>
<th>Possible impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHODOPHYTA (Red algae)</td>
<td>Asparagopsis armata Falkenbergia rufolanosa</td>
<td>not established</td>
<td>Shellfish (oyster) transport, secondary spread (floating, rafting)</td>
</tr>
<tr>
<td></td>
<td>Bonnemaisonia hamifera Trailliella intricata</td>
<td>not established</td>
<td>Probably shellfish transport, fouling, secondary spread by currents</td>
</tr>
</tbody>
</table>

3 Wolff (2005) describes non-indigenous marine and estuarine species. Only species which have been found in the North Sea have been included in the list presented here.
<table>
<thead>
<tr>
<th><strong>Polysiphonia harveyi</strong></th>
<th><strong>Neosiphonia harveyi</strong></th>
<th><strong>established</strong></th>
<th><strong>Unknown</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACILLARIOPHYCEAE (Diatoms)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coscinodiscus wailesii</td>
<td>established</td>
<td>Ballast water or shellfish (oyster) transport, secondary transport by currents</td>
<td>Algal blooms</td>
</tr>
<tr>
<td>Odontella sinensis</td>
<td>Biddulphia sinensis</td>
<td>established</td>
<td>Ballast water, secondary transport by currents</td>
</tr>
<tr>
<td>Thalassiosira punctigera</td>
<td>Thalassiosira angustii</td>
<td>established</td>
<td>Probably shellfish (oyster) transport, secondary transport by currents</td>
</tr>
<tr>
<td><strong>PHAEOPHYCEAE (Brown algae)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Botrytella sp</td>
<td>Sorocarpus micromorus</td>
<td>established</td>
<td>Unknown</td>
</tr>
<tr>
<td>Sargassum muticum</td>
<td>established</td>
<td>Shellfish (oyster) transport, secondary spread by currents</td>
<td>Habitat modification</td>
</tr>
<tr>
<td><strong>RAPHIDOPHYCEAE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chattonella marina</td>
<td>established</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Chattonella antiqua</td>
<td>established</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Fibrocapsa japonica</td>
<td>established</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Heterosigma akashiwo</td>
<td>Heterosigma carterae</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td><strong>DINOPHYTA (Dinoflagellates)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexandrium leei</td>
<td>established</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Alexandrium tamarensense</td>
<td>established</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Gymnodinium mikimotoi</td>
<td>Gymnodinium (Karenia) aureolum</td>
<td>established</td>
<td>Ballast water (?)</td>
</tr>
<tr>
<td>Prorocentrum triestinum</td>
<td>Prorocentrum refieldii</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td><strong>CHLOROPHYTA (Green algae)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Codium fragile</td>
<td>Fouling, shellfish transport (?), ballast water (?)</td>
<td>Competition, Habitat modification, Fouling</td>
<td></td>
</tr>
<tr>
<td><strong>PLATYHELMINTHES (Flatworms)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euplana gracilis</td>
<td>unknown</td>
<td>Fouling</td>
<td></td>
</tr>
<tr>
<td><strong>TURBELLARIA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ANNEILDS (Ringed worms)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sabellaria spinulosa</td>
<td>temporarily established</td>
<td>Sabellaria spinulosa temporarily established</td>
<td></td>
</tr>
<tr>
<td><strong>MOLLUSCA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GASTROPODA (Snails and slugs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rapana venosa*</td>
<td>Importation</td>
<td>Competition</td>
<td></td>
</tr>
<tr>
<td><strong>BIVALVIA (Bivalves)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensis directus</td>
<td>Ensis americanus</td>
<td>Established</td>
<td>Ballast water</td>
</tr>
<tr>
<td>Mya arenaria</td>
<td>established</td>
<td>Ballast water</td>
<td>Competition</td>
</tr>
<tr>
<td>Petricola pholadiformis</td>
<td>established</td>
<td>Shellfish (oyster) transport, secondary transport by currents</td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>Abundance</td>
<td>State</td>
<td>Environmental impact</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------</td>
<td>------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Psiloteredo megotara</td>
<td>Wooden vessels</td>
<td></td>
<td>Damage to structures, Habitat modification</td>
</tr>
<tr>
<td>Teredo navalis</td>
<td>Wooden vessels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRUSTACEA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIRRIPEDIA (Barnacles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elminius modestus</td>
<td>established</td>
<td>Fouling, secondary transport by marine currents</td>
<td>Competition, Habitat modification</td>
</tr>
<tr>
<td>Balanus balanus</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balanus amphitrite</td>
<td>established</td>
<td>Fouling, ballast water (?)</td>
<td></td>
</tr>
<tr>
<td>Balanus improvisus</td>
<td>Fouling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Megabalanus coccopoma</td>
<td>unknown</td>
<td>Fouling</td>
<td></td>
</tr>
<tr>
<td>Megabalanus tintinnabulum</td>
<td>unknown</td>
<td>Fouling</td>
<td></td>
</tr>
<tr>
<td>ISOPODA (Isopods)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limnoria lignorum</td>
<td>Wooden vessels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limnoria quadripunctata</td>
<td>Wooden vessels (?), driftwood (?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMPHIPODS (Amphipods)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corophium sextonae</td>
<td>Monocorophium sextonae</td>
<td>established</td>
<td>Fouling</td>
</tr>
<tr>
<td>Platorchestia platensis</td>
<td>established</td>
<td>Dry ballast (?)</td>
<td></td>
</tr>
<tr>
<td>NEMATODA (Roundworms)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anguillicola crassus</td>
<td>established</td>
<td>Eel transport</td>
<td></td>
</tr>
<tr>
<td>INSECTA (Insects)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telmatogoton japonica*</td>
<td>established</td>
<td>Fouling</td>
<td>Competition, Habitat modification</td>
</tr>
<tr>
<td>PISCES (Fish)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atherina boyeri</td>
<td>established</td>
<td>Eggs transported by ships (?)</td>
<td></td>
</tr>
</tbody>
</table>

**Summary**

**Abundance and state**
- For the Dutch part of the North Sea, there are no specific monitoring programmes to monitor the introduction and establishment of non-indigenous species, or databases where observations are reported.
- Observations of estuarine and marine non-indigenous species are concentrated in the estuarine waters in the SW Netherlands and the Wadden Sea, and the coastal waters of the North Sea. The monitoring effort in the offshore waters of the North Sea is much lower.
- The most important vectors for the introduction of non-indigenous species in the Dutch part of the North Sea are maritime transport and aquaculture.

**Environmental impact**
- The America razor clam has successfully established in the Dutch coastal zone, but at present there are no clear indications of impacts on the ecosystem.
References
4.4. Descriptor 3: Healthy stock of commercially exploited fish and shellfish

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

**Criteria and indicators in the Commission decision**

<table>
<thead>
<tr>
<th>Criteria and indicators</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.1 Level of pressure of the fishing activity</strong></td>
<td></td>
</tr>
<tr>
<td>Fishing mortality (F) (3.1.1)</td>
<td></td>
</tr>
<tr>
<td>Secondary indicator: Ratio between catch and biomass index (hereinafter catch/biomass ratio) (3.1.2)</td>
<td></td>
</tr>
<tr>
<td><strong>3.2 Reproductive capacity of the stock</strong></td>
<td></td>
</tr>
<tr>
<td>Spawning Stock Biomass (SSB) (3.2.1)</td>
<td></td>
</tr>
<tr>
<td>Secondary indicator: Biomass indices (3.2.2)</td>
<td></td>
</tr>
<tr>
<td><strong>3.3 Population age and size distribution</strong></td>
<td></td>
</tr>
<tr>
<td>Proportion of fish larger than the mean size of first sexual maturation (3.3.1)</td>
<td></td>
</tr>
<tr>
<td>Mean maximum length across all species found in research vessel surveys (3.3.2)</td>
<td></td>
</tr>
<tr>
<td>95% percentile of the fish length distribution observed in research vessel surveys (3.3.3)</td>
<td></td>
</tr>
<tr>
<td>Secondary indicator: Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation (3.3.4)</td>
<td></td>
</tr>
</tbody>
</table>

**General description for the North East Atlantic**

The status of approximately 130 commercial fish stocks in the OSPAR area is assessed annually by ICES as a basis for advice to fisheries authorities on the management of fishing. The approach used is to assess individual fish stocks in terms of spawning stock biomass (SSB), representing the total weight of fish in the stock able to spawn, and fishing mortality (F), representing the fishing pressure on the stock. Within the fisheries management framework the use of spawning stock biomass and fishing mortality is guided by defined reference points for SSB and fishing mortality. These provide an expression of the status of the stock. For SSB, these reference points include a limit reference point (B_{lim}) below which reproductive capacity is considered to be impaired and there is a probability of stock collapse, and a precautionary limit reference point (B_{pa}) which, traditionally, has been the reference point below which stocks are described as being outside of safe biological limits. Since 2004, stocks with a SSB below B_{pa}, but greater than B_{lim}, have been described as being at risk of suffering reduced reproductive capacity. Reference points for fishing mortality (F_{lim} and F_{pa}) define whether harvest rates are sustainable; when the fishing mortality of a stock is greater than F_{lim}, the stock is being harvested unsustainably. If SSB is kept above the agreed precautionary limit (B_{pa}) it is likely that the point at which there is a serious stock collapse is never reached. The safest way to achieve this is to keep fisheries mortality below the levels that would in the long term result in SSB below the agreed precautionary limit. This is illustrated in figure CS1.
Figure CS1: Advisory framework of the current precautionary approach to fisheries management. The EcoQO is based on evaluations of the status of commercial fish stocks used in fisheries management.

Remark 1: Within the fisheries management framework, an adjusted system is proposed that will use fishing mortality to guide management by defined target reference points \( F_{\text{MSY}} \) and the subsequent SSB that will occur after fishing at \( F_{\text{MSY}} \) (See Guidance JRC taskgroup). These targets may also be used as an expression of the status of the stock. Targets for fishing mortality \( F_{\text{MSY}} \) will be determined that account for the selectivity of the fisheries, the productivity of the fish stocks and the susceptibility of those stocks to exploitation. For SSB, the reference points (the SSB when fishing at \( F_{\text{MSY}} \)) will act to ensure that reproductive capacity is not impaired by exploitation. This proposed framework will probably be called the MSY approach to fisheries management. The use of the old limit reference points as determined by the precautionary approach will end. (Dicky-Collas, pers comm.)

Remark 2: The QSR 2010 does not mention commercially exploited shellfish

**Region II (Greater North Sea), regional summary:**

**Some fish stocks improved.** Fisheries management is changing for the better, with long-term management plans for key stocks and substantial decreases in destructive practices such as beam and otter trawl fishing in some areas. The excessive discards of fish are beginning to be addressed. There are signs that fish communities near the seabed may be starting to recover.

**Progress towards sustainable fishing is slow** Some important North Sea fish stocks are still outside sustainable limits and while damaging practices have been reduced, the picture is not uniformly good. The poor status of cod is of particular concern. By-catch of rays, sharks, porpoises and dolphins in fishing nets is also of concern.

### Status in the Greater North Sea

**Fish**

**Level of pressure of the fishing activity and reproductive capacity of the stock** The status of commercially exploited fish is generally assessed at the stock level (ICES) and not at a national level of catch or national fishing fleets. In this section, the status of several commercially exploited species within the Greater North Sea will be discussed in relation to the current management framework of the precautionary approach (OSPAR 2010). There is currently no estimation of the status of the stocks in relation to the MSY approach. The precautionary limits for spawning stock biomass (SSB) and fishing mortality \( F \) which are used within the EcoQO are based on the limits set by ICES.
The status of SSB in relation to the EcoQO for the stocks for which precautionary reference points have been defined for the North Sea is shown in table 4.4.1. and is represented for some species (herring, cod, plaice and sole) in figure 4.4.1.. The evaluation of fishing mortality is also shown in table 4.4.1.

Since 1998, there has been an improvement in the status of several fish stocks in the North Sea, including plaice and hake, which have both been the subject of recovery plans under the Common Fisheries Policy.

The status of cod stocks throughout the North Sea continues to be of concern, as both SSB (Figure 4.4.1.) and fishing mortality are beyond the precautionary limit reference points. SSB for North Sea herring is currently at risk of suffering reduced reproductive capacity (Figure 4.4.1.), although fishing pressure is considered sustainable. The sole stock shows fluctuations (Figure 4.4.1.). Since 1996 SSB is near the precautionary limit, with extreme low values in 1998 and 2007.

Mackerel is at risk of being exploited unsustainably. The North Sea mackerel stock, which is assessed within the combined western stock, has been considered depleted since the 1970’s. Herring and mackerel populations have major a role in the structure and function of the North Sea Ecosystem. The North Sea and Eastern Channel stock of whiting is among the eleven further stocks in the North Sea whose status is uncertain either due to a lack of defined reference points or inadequate data; however indicators suggest that the SSB is close to the lowest ever observed.

Figure 4.4.1.: Stocks of spawning stock biomass (SSB) of herring (upper left), cod (upper right), plaice (lower left) and sole (lower right) since the late 1950s, with the indication of the precautionary limit (green dotted line) and the limit of sustainability (orange dotted line) (www.compendiumvoordeleefomgeving.nl, source: ICES,2009)

Table 4.4.1.: Fishing Mortality and Spawning Stock Biomass and for the stocks for which reference points have been defined within the North Sea (OSPAR, 2010)

<table>
<thead>
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<tbody>
<tr>
<td>Cod</td>
<td>North Sea, Eastern Channel, Skagerrak</td>
<td><img src="red" alt="1" /></td>
<td><img src="red" alt="1" /></td>
<td><img src="red" alt="1" /></td>
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<tr>
<td>Haddock</td>
<td>North Sea, Eastern Channel, Skagerrak</td>
<td><img src="red" alt="1" /></td>
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<tr>
<td>Saithe</td>
<td>North Sea, Skagerrak and W of Scotland</td>
<td><img src="red" alt="1" /></td>
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</tbody>
</table>
Population age and size distribution

There has been a decline in the length composition of demersal fish in the North Sea (Figure 4.4.2.). Before 1980 large fish (>25 cm) made up more than 30% of the weight of the catches. This has declined to about 10% in 2007. It reflects a shift in the age distribution towards younger fish. This has ecological and economic consequences. The resilience of populations may decline, interactions between species change, and also the exploitation of the fisheries will change (www.compediumvoordeleefomgeving.nl).

Figure 4.4.2.: Percentage of large fish (>25 cm) from trawl surveys of ground fish. Dots: yearly values, line: average over 5 years (www.compediumvoordeleefomgeving.nl, source: IMARES)
Shellfish

Up to the late 1990s, the most important commercially exploited shellfish species in the Dutch coastal zone was Spisula subtruncata (Figure 4.4.3.). Their abundance and biomass showed high yearly fluctuations (figure 4.4.3.). Over the last decade however, S. subtruncata has disappeared almost completely from the coastal zone. Only above Ameland, considerable densities are still present. The reason for their decline is not clear. The disappearance of Spisula coincided with the appearance of Ensis directus, an introduced species that was able to colonize the space previously occupied by Spisula (figure 4.4.4.). Abundance and biomass of Ensis directus has increased since the beginning of this century (Figure 4.4.3.). They often occur in very high densities, and dominate the benthic community biomass. In recent years, limited fishing on Ensis has been permitted. Other types of shellfish fisheries (such as fisheries for mussels or cockles) are currently hardly of importance.

Figure 4.4.3.: Stock (10\(^6\) individuals) and biomass (10\(^6\) kg) of Spisula subtruncata (left) and Ensis directus (right) (pink: densities, blue: biomass) (Data: WOT survey – IMARES).
Figure 4.4.4.: Distribution of Ensis directus (left) and Spisula subtruncata (right) on the Dutch part of the North Sea (Lindeboom et al., 2008). The densities of E. directus are averaged over 11 years (1995-2005) and densities of S. subtruncata are averaged over 13 years (1993-2005)

<table>
<thead>
<tr>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of pressure of the fishing activity</strong></td>
</tr>
<tr>
<td><strong>Reproductive capacity of the stock</strong></td>
</tr>
<tr>
<td>- Since 1998, there has been an improvement in the status of several fish stocks in the North Sea, including plaice and hake</td>
</tr>
<tr>
<td>- The status of cod and whiting stocks throughout the North Sea continues to be of concern</td>
</tr>
<tr>
<td>- Data on Fishing mortality (F) and Spawning Stock Biomass (SSB) are only available for a limited number of commercially exploited fish species</td>
</tr>
<tr>
<td>- No information is available for the MSY approach for fish stocks</td>
</tr>
<tr>
<td><strong>Population age and size</strong></td>
</tr>
<tr>
<td>- There has been a decline in the length composition of demersal fish in the North Sea over the period 1975-2005</td>
</tr>
<tr>
<td>- Data on the full spectrum of fish size in the North Sea are not available as yet. All current techniques only use the results of trawl surveys, that only target a certain type of fish (demersal fish)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>The list of references is still incomplete</td>
</tr>
<tr>
<td>ICES 2009</td>
</tr>
</tbody>
</table>

Draft version 1, 1 June 2010
4.5. Descriptor 4: Marine food webs

<table>
<thead>
<tr>
<th>Annex I MSFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria and indicators in the Commission decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Productivity (production per unit biomass) of key species or trophic groups</td>
</tr>
<tr>
<td>Performance of key predator species using their production per unit biomass (productivity) (4.1.1)</td>
</tr>
<tr>
<td>4.2 Proportion of selected species at the top of food webs</td>
</tr>
<tr>
<td>Large fish (by weight) (4.2.1)</td>
</tr>
<tr>
<td>4.3 Abundance/distribution of key trophic groups/species</td>
</tr>
<tr>
<td>Abundance trends of functionally important selected groups/species (4.3.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General description for the North East Atlantic</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the northern North Sea, some seabirds have suffered a decade of breeding failure, possibly due to the combined effects of climate change and fishing on key prey species. Although breeding success was good for the first time in 2009, the long-term picture is still one of serious concern.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status in the Dutch part of the North Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>As is stated in the Commission decision, the further development of criteria and potentially useful indicators requires additional scientific and technical support. Due to a lack of suitable indicators and limited availability of data with respect to the criteria suggested in the Commission decision, this descriptor can only be covered partly at present.</td>
</tr>
</tbody>
</table>

**Productivity (production per unit biomass) of key species or trophic groups**

Primary production of the phytoplankton is not measured by present monitoring programs. However, by a combination of remote sensing data and ecological modeling, rates of primary production for the Dutch part of the North Sea could be estimated. For higher trophic levels, no estimates for productivity are available.

The Marine Trophic Index is based on the mean trophic level of fisheries landings in a specific area, and expresses the mean position of fish species in the food web. When the MTI declines over the years, it might be an indication of “fishing down marine food webs” (Pauly et al., 1998) and an indication of unsustainable fisheries.

The application of the MTI in the Dutch North Sea has been investigated by Fey-Hofstede & Meesters (2007). The trophic levels per species were estimated by the simulation model ECOPATH and based on diet composition data (Pauly 1998; website: www.seaaroundus.org). Fey-Hofstede & Meesters (2007) argued that the MTI at present cannot be applied to the Dutch North Sea.

**Proportion of selected species at the top of food webs**

Proportion of large fish
The trend in the proportion of large fish in the Greater North Sea in 1969 – 2008 is presented in . The proportion of large fish (>25 cm) has declined from more than 30% before 1980 to 10% in 2007.

**Abundance/distribution of key groups/species**

Abundance trends of functionally important selected groups/species

Currently no indicators are selected taking account their importance to food webs, and the suitability of groups/species in a region, sub-region or subdivision.

A suitable indicator may be marine mammals, such as seals and harbour porpoises, as representative of groups/species at the top of the food web. The abundance and distribution of seals and harbour porpoises are discussed in 4.2. Abundance of these species has increased over the last decade. Current status of these species as described for Natura 2000 are ‘moderately unfavourable’ for harbour porpoises and grey seals and ‘favourable’ for harbour seals (Jak et al., 2009).

<table>
<thead>
<tr>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity (production per unit biomass) of key species or trophic groups</td>
</tr>
<tr>
<td>- Data to address energy flows in food webs as suggested by EC (2010) are not provided by current monitoring programmes within the Netherlands.</td>
</tr>
<tr>
<td>Proportion of selected species at the top of food webs</td>
</tr>
<tr>
<td>- The proportion of large fish (&gt;25 cm) has declined from more than 30% before 1980 to 10% in 2007.</td>
</tr>
<tr>
<td>Abundance/distribution of key groups/species</td>
</tr>
<tr>
<td>- No indicators have been selected yet</td>
</tr>
<tr>
<td>- A suitable indicator may be the populations of marine mammals (grey seal, harbour seal, harbour porpoise). These populations have shown an increase in abundance over the past decade.</td>
</tr>
</tbody>
</table>

**References**


4.6. Descriptor 5: Human induced eutrophication

Nutrients, especially nitrogen and phosphorus, are essential for the growth of aquatic plants, which are at the basis of the marine food webs. The natural balance between nutrients, growth of plants and growth of animals is disturbed by an excess of nutrients which are introduced by human activities. This may result in an accelerated algal growth and an adverse effect on water quality and the ecology of the marine system.

Eutrophication is “the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned” (EC, 2009). Eutrophication generally favors the growth of opportunistic algae and animals. Dense growth of algae in the water column can reduce the depth at which light is available for long-lived seagrass species. The decay of the algae leads to the release of toxic hydrogen sulphide and oxygen depletion. This may kill fish and benthos. Some algae produce toxins which are harmful to animals. Also humans can be affected when eating for instance contaminated shellfish. In coastal and marine waters, an elevated level of nitrogen is generally considered to be the main cause of eutrophication.

Climate change may alter the impact of eutrophication in marine waters. More rain and increased flooding as result of climate change are expected to enhance nutrient enrichment through increased freshwater input and run-off from land. Rising sea temperature and change in salinity and stratification may influence phytoplankton composition.

Nutrients are imported through river run off, which transports land-based nitrogen and phosphorus into the sea. The amount of nutrients released on land varies according to land use and population density. Urban areas (point release) and farming areas (diffuse

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**Criteria and indicators in the Commission decision**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>5.1 Nutrients levels</strong></td>
</tr>
<tr>
<td>Nutrients concentration in the water column (5.1.1)</td>
</tr>
<tr>
<td>Nutrient ratios (silica, nitrogen and phosphorus), where appropriate (5.1.2)</td>
</tr>
<tr>
<td><strong>5.2 Direct effects of nutrient enrichment</strong></td>
</tr>
<tr>
<td>Chlorophyll concentration in the water column (5.2.1)</td>
</tr>
<tr>
<td>Water transparency related to increase in suspended algae, where relevant (5.2.2)</td>
</tr>
<tr>
<td>Abundance of opportunistic macroalgae (5.2.3)</td>
</tr>
<tr>
<td>Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms (e.g. cyanobacteria) caused by human activities (5.2.4)</td>
</tr>
<tr>
<td><strong>5.3 Indirect effects of nutrient enrichment</strong></td>
</tr>
<tr>
<td>Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency (5.3.1)</td>
</tr>
<tr>
<td>Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned (5.3.2)</td>
</tr>
</tbody>
</table>

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**General description for the North East Atlantic**

OSPAR Quality Status Report 2010

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.
release) are the main sources of the nutrient input. Nutrients which are stored in soils of farming areas can be released over decades after the nutrient input has been reduced. Deposition from atmospheric nitrogen, originating from agriculture and combustion processes associated with industry and traffic, is another pathway of eutrophication of the sea. The emission is not necessarily deposited in areas close to the emission source. It can be carried over long distances by winds. Eutrophication is not a local problem, but transboundary transport is significant in the North Sea. Water masses from different regions interact and transport nutrients from one area to another. Nutrient-rich water from the Atlantic is transported with residual currents northwards along the continental West European coast. Models have shown that the German Bight receives nutrients that originate in the Atlantic and which become progressively enriched by nutrients from river inputs and atmospheric deposition as they move through the Channel and the North Sea. Countries bordering the North Sea have done great efforts over the last decades to reduce the input of N and P. Reducing the input of P was more successful than measures to reduce the input of N. Differential reductions in nitrogen and phosphorus inputs can, however, alter nitrogen/phosphorus ratios in seawater and this may cause shifts in algal species composition, for example from diatoms to flagellates, some of which are toxic.

Region II (Greater North Sea), regional summary:
Reduced inputs of hazardous substances and nutrients. Most OSPAR countries have met and many exceeded the OSPAR target for reducing phosphorus inputs to eutrophication problem areas, and three countries are approaching the 50% reduction target for nitrogen. Inputs of mercury and lead to the sea from several major rivers have dropped
Eutrophication on the coasts. Eutrophication caused by nutrient inputs is a problem along the east coast of the North Sea from Belgium to Norway, and in some small estuaries and bays of eastern England and north-west France. Associated problems include fish dying in the fjords of Denmark and Sweden, and sugar kelp declining along parts of the Norwegian coast. Nitrogen inputs, largely from agriculture, are the biggest cause of eutrophication and few countries approach OSPAR's 50% reduction target for nitrogen inputs to problem areas. It can take decades before reduced nutrient inputs benefit the marine environment because nutrients can be released from soil and sediments.

Status in the Dutch part of the North Sea

Nutrient levels
Input of nutrients into the Dutch part of the North Sea
The Dutch continental shelf is affected by the discharges of the catchment areas of Rhine, Meuse, Scheldt and Ems (>400,000 km², ca 80 million inhabitants; Tockner et al., 2009), from which the Rhine catchment is by far the largest one with contributions from Switzerland, Germany, France, Luxembourg and the Netherlands. The Offshore part of the Dutch continental shelf is not a homogeneous water mass. The Southern Bight offshore, the southern part of the Dutch continental shelf is not very deep (30 m) and has a well mixed water column. Nutrient concentrations are influenced by inputs from the Channel (oceanic water) and freshwater discharges from France, Belgium, the UK and the Netherlands. The Oyster Grounds are on average 45 m deep, and the water column is stratified during some summers. The Oyster Grounds receive nitrogen and phosphorus from UK rivers and from the Atlantic Ocean in almost equal proportions, with minor contributions from the Channel, and France, Belgium and the Netherlands. The Dogger Bank is influenced mainly by nutrients from the Atlantic Ocean, imported into the North Sea from the north. Deposition from atmospheric nitrogen is another pathway of eutrophication of the sea. The contribution of atmospheric deposition is approximately 25% of the total anthropogenic nitrogen load into the Greater North Sea. For the Dutch part of the North Sea, where the relative contribution of river loads is larger, it was estimated that in the years 2001 to 2004 on average 15% (with a range from 12 to
18%) of the total nitrogen input to the Dutch Continental Shelf originates from atmospheric deposition (Table 4.6.1).

Table 4.6.1.: Estimated total nitrogen load into the Dutch continental shelf by river inputs and atmospheric deposition (from: Baretta-Bekker et al., 2007)

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimated total-N deposition in Dutch continental shelf (kt/year)</th>
<th>River input in Dutch continental shelf (kt/year)</th>
<th>Contribution of atmospheric deposition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>61.0</td>
<td>382</td>
<td>14</td>
</tr>
<tr>
<td>2002</td>
<td>56.2</td>
<td>429</td>
<td>12</td>
</tr>
<tr>
<td>2003</td>
<td>49.3</td>
<td>219</td>
<td>18</td>
</tr>
<tr>
<td>2004</td>
<td>50.5</td>
<td>265</td>
<td>16</td>
</tr>
<tr>
<td>Average</td>
<td>54.3</td>
<td>324</td>
<td>15</td>
</tr>
</tbody>
</table>

Nutrient concentrations in Dutch coastal waters show a strong correlation with riverine nutrient loads, which are dominated by the loads from the Rhine. Riverine phosphorus loads have shown a decrease of over 50% during the period 1990-2006, and concentrations in the coastal waters have decreased with approximately 40%. Nitrogen loads have decreased with approximately 20-40% during the same period, and this resulted in decreased concentrations in coastal waters as well. As a consequence of the strong impact of river discharges on nutrient concentrations, the concentrations are highly correlated with salinity and are high near the coast and low and close to natural background concentrations in the offshore areas. Winter averaged dissolved inorganic nitrogen concentrations, normalized for salinity, are still higher than the OSPAR elevated level of 50% above natural background concentrations in the coastal waters (30 μM at salinity 30), while they are below the assessment level in the offshore areas (Baretta-Bekker et al., 2007). An assessment for the years 2006-2008, using the WFD classification, also showed that winter averaged dissolved inorganic nitrogen concentrations are above the WFD assessment level (33 μM at salinity 30) in all coastal WFD water bodies, and those water bodies were classified as ‘moderate’ or ‘poor’ status with respect to the nitrogen concentration (Bommelé & Baretta-Bekker, 2009).

Direct effects of nutrient enrichment

Chlorophyll concentrations
Chlorophyll-a concentrations are high near the coast and low in the offshore areas. In the assessment of the OSPAR Comprehensive Procedure (OSPAR COMPP), elevated levels of chlorophyll-a are defined as 50% above regionally specific natural background concentrations. The assessment (Baretta-Bekker et al., 2007) shows that chlorophyll-a levels in the coastal waters in the years 2001-2005 are still above the assessment level, although there was a decreasing trend over the period 1995-2005. In the WFD assessment, chlorophyll-a is a submetric of the Biological quality element Phytoplankton. To account for differences in salinity, there are differences between the various coastal water bodies in the class boundaries that are applied in the classification. As a result, the WFD classification differs from the OSPAR assessment in the water bodies that are near the mouth of the main river discharge points Haringvliet, Nieuwe Waterweg and Ems-Dollard. Over the years 2006-2008, the chlorophyll-a concentrations in the coastal water bodies fluctuated near the Good/Moderate boundary. Water bodies “Zeeuwse kust” and “Noordelijke Deltakust” were classified as Moderate in all three years, whereas water bodies Hollandse kust, Waddenkust and Eems kust varied between Good and Moderate status (Bommelé & Baretta-Bekker, 2009 and background data).
Water transparency related to increase in suspended algae
In Dutch coastal waters turbidity levels are high as a result of high natural levels of suspended sediment. Consequently, the enhanced levels of algal biomass have an insignificant contribution to water transparency.

Species shifts in floristic composition – nuisance algal bloom
Blooms of the nuisance alga *Phaeocystis globosa* are considered to be one of the most conspicuous symptoms of eutrophication in the Southern Bight of the North Sea (Lancelot et al., 2009). Blooms mainly affect the Dutch coastal waters and the offshore Southern Bight area (Figure 4.6.1), but do not occur further north at the Oyster Grounds or the Dogger Bank.

In the OSPAR assessment (Baretta-Bekker et al., 2007) *Phaeocystis globosa* is used as an area-specific indicator species. Its blooms show a clear spatial pattern, but up till now no clear long-term temporal trends have been observed. In the OSPAR assessment concentrations of *Phaeocystis* in the coastal waters and the offshore Southern Bight exceeded the assessment level (maximum concentration exceeding $10^7$ cells/l).

In the WFD assessment, *Phaeocystis* blooms are the other submetric of the Biological quality element Phytoplankton (in addition to chlorophyll-a), and the assessment is based on the frequency of blooms exceeding a level of $10^6$ cells/l. Based on this submetric, some Dutch coastal water bodies were classified as Moderate status in 2008, whereas the classification for other years and other water bodies was Good status. It should be noted however, that there is a large annual variation in *Phaeocystis* blooms, and observations over the years 1990-2008 show no trends. The overall WFD classification for Phytoplankton in the coastal water bodies was Moderate status.
Figure 4.6.1.: Average (top panel) and maximum (bottom panel) concentration of Phaeocystis (cells/liter) at sampling stations on a transect off Noordwijk, at 2, 20 and 70 km offshore. Note difference in vertical scales.

Figure 4.6.2.: Overall assessment results from the application of the OSPAR Comprehensive Procedure (Baretta-Bekker et al., 2007). Left: Classification taking into account all criteria; Right: Final classification where phytoplankton indicator species (other than Phaeocystis) were excluded. Red: Problem Area; Green: Non-Problem Area. Black shading: Oyster Grounds proper.
In the OSPAR Comprehensive Procedure (COMPP) several other species have been used as indicator species for eutrophication. This includes a number of dinoflagellate species that potentially form toxic blooms. Several of the potentially toxic dinoflagellate species exceed assessment levels, also in the offshore areas Oyster Grounds and Dogger Bank. The results of the OSPAR COMPP (Figure 4.6.2) show that the offshore areas Oyster Grounds and Dogger Bank are considered eutrophication problem areas, but this is only due to the exceeding of the assessment levels by the phytoplankton indicator species *Alexandrium* spp., *Chrysochromulina* sp and *Dinophysis* spp., whereas all other indicators in the OSPAR COMPP do not show a problem in these areas. Therefore these areas are classified as potential problem area in the final classification (Baretta-Bekker et al., 2007). However, the application of these (potentially toxic) phytoplankton species as eutrophication indicators is subject to criticism (ICES, 2004) and it is felt that more research is needed on the causal relationship with increased nitrogen fluxes. Another indicator species that has been used is the heterotrophic species *Noctiluca scintillans*, that is also considered as a nuisance species as it can form dense floating layers that may severely deplete oxygen. This species remained below assessment levels in the years 2001-2005. The use of this species as indicator also lacks causal evidence (Van Duren, 2006). None of these indicator species are included in the WFD assessments.

**Indirect effects of nutrient enrichment**

Abundance of perennial seaweeds and seagrasses
In Dutch coastal waters turbidity levels are high as a result of high natural levels of suspended sediment, and enhanced levels of algal biomass do not contribute to decreases in water transparency. Moreover, perennial seaweeds and seagrasses hardly occur in the Dutch part of the North Sea.

Dissolved oxygen
Oxygen concentrations in the well-mixed areas of the Dutch part of the North Sea (coastal waters and offshore Southern Bight) never reach values below 6 mg/l (Baretta-Bekker et al., 2007). In the summer stratified parts of the North Sea (Oyster Grounds), in some years oxygen concentrations have reached values well below 6 mg/l (e.g. 3.3 mg/l in the summer of 2003). Low oxygen levels at the Oyster Grounds indicate that this area has the potential of developing hypoxia. Also in later years (2007, 2008) low oxygen levels have been observed at the Oyster Grounds. Low oxygen conditions are to a large extent due to physical conditions, viz. thermal stratification (Weston et al., 2008; Greenwoord et al., 2009).

Effects of oxygen depletion on benthic fauna or fish are not monitored.

<table>
<thead>
<tr>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nutrient levels</strong></td>
</tr>
<tr>
<td>- Riverine loads are the main anthropogenic source of nitrogen and phosphorus in Dutch marine waters; nitrogen loads have decreased by 20-40% since 1990, phosphorus loads have decreased by &gt;50%</td>
</tr>
<tr>
<td>- According to both the WFD assessment and the OSPAR Comprehensive Procedure, the target for nitrogen concentrations in coastal waters has not been achieved yet</td>
</tr>
<tr>
<td><strong>Direct effects</strong></td>
</tr>
<tr>
<td>- According to both the WFD assessment and the OSPAR Comprehensive Procedure, concentrations of chlorophyll-a and of the indicator species <em>Phaeocystis</em> in coastal waters are still higher than target levels</td>
</tr>
<tr>
<td><strong>Indirect effects</strong></td>
</tr>
<tr>
<td>- Occasionally, low oxygen levels occur at the Oyster grounds, but this is to a large extent due to (natural) physical factors</td>
</tr>
</tbody>
</table>
References


Lancelot C., Rousseau V. & Gypens N., 2009. Ecologically based indicators for Phaeocystis disturbance in eutrophied Belgian coastal waters (Southern North Sea) based on field observations and ecological modeling. J. Sea Res. 61: 44-49


OSPAR, 2008. Trends in atmospheric concentrations and deposition of nitrogen and selected hazardous substances to the OSPAR maritime area. Draft CAMP Assessment, ASMO 09/6/2-E


4.7. Descriptor 6: Sea floor integrity

<table>
<thead>
<tr>
<th>Full description</th>
<th>Annex I MSFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea-floor integrity is at a level that ensures that the structure and function of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria and indicators in the Commission decision</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.1 Physical damage, having regard to substrate characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Type, abundance, biomass and areal extent of relevant biogenic substrate (6.1.1)</td>
<td></td>
</tr>
<tr>
<td>Extent of the seabed significantly affected by human activities for the different substrate types (6.1.2)</td>
<td></td>
</tr>
<tr>
<td><strong>6.2 Condition of benthic community</strong></td>
<td></td>
</tr>
<tr>
<td>Presence of particularly sensitive and/or tolerant species (6.2.1)</td>
<td></td>
</tr>
<tr>
<td>Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (6.2.2)</td>
<td></td>
</tr>
<tr>
<td>Proportion of biomass or number of individuals in the macrobenthos above some specified length/size (6.2.3)</td>
<td></td>
</tr>
<tr>
<td>Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community (6.2.4)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General description for the North East Atlantic</th>
<th>OSPAR Quality Status Report 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not specifically mentioned</td>
<td></td>
</tr>
</tbody>
</table>

**Region II (Greater North Sea), regional summary:**

**Damage to seabed habitats.** Significant damage has occurred to shallow sediment habitats and reefs as a result of bottom fishing practices, especially beam trawling. In the western Channel, thick beds of red calcareous seaweed called maerl declined in extent and quality, partly as a result of damage resulting from its extraction for use as an agricultural soil conditioner.

**Status of the Dutch part of the North Sea**

**Physical damage**

Lanice conchilega is a tube dwelling polychaete from intertidal and subtidal areas of the North Sea (Figure 4.7.1.). They can be considered reef-building ecosystem engineers (Rabaut, 2009). The tubes are build from mucus and particles and stick out of the sediment surface for 1-4 cm. They trap sediment particles and alter as such the sedimentary and hydrodynamic environment. Their presence alters infaunal abundance, diversity and species composition. Juveniles of the flatfishes Pleuronecta platessa and dab use the Lanice reef for shelter and as feeding ground. Lanice conchilega is relatively resistant to physical disturbance, for instance from bottom trawling. The impact on the associated fauna is more pronounced, but the recovery rate is fast (Rabaut, 2009 and references therein).

Extent of the seabed significantly affected by human activities
The sea floor of the Dutch part of the North Sea is highly impacted by beam trawling, otter trawling and shrimp fishery (Figures 3.7.1). Beam trawling with tickler chains has a severe impact on the sea bed. Heavy chains are attached to the net, and the sediment is disturbed up to a depth of 2 to 6 cm (‘geploegde bodem’ in Figure 4.7.3). The in- and epifauna are either killed or distributed over the seabed. The impact of ottertrawling and shrimp fishery is less severe (‘geharkte bodem’ in Figure 4.7.3). The nets are pulled over the seabed and have as such an impact on the epifauna, but the infauna is less disturbed. Both types of fishing have an impact on the biodiversity of the seabed (Lindeboom et al., 2008).

Sand extraction and beach and shore nourishments have strong impacts on the integrity of the sea floor, but the effects are very local and recolonization of the sites occurs within 4-6 years. The extent of the seabed affected by sand extraction and nourishments is considered to be of minor importance at present (Prins et al., 2009).

Figure 4.7.1.: Distribution of Lanice conchilega on the Dutch part of the North Sea (Lindeboom et al., 2008). Densities are averaged over 11 years (1995-2005) (based on NIOZdata).
Condition of benthic community

Presence of particularly sensitive species

*Arctica islandica* shows an exceptional longevity and can live up to 400 years in the wild. On the Dutch part of the North Sea, individuals of about 170 years have been found. *Arctica islandica* starts reproducing at about 6 years of age (Witbaard, 2007). Relatively high densities (1 m$^{-2}$) are a prerequisite for successful reproduction. The species is only found in the northern part of the Dutch North Sea (Figure 4.7.4) with densities around 0.75 individuals per m$^2$, which might not be sufficient to reproduce (Witbaard, 2007). Near the Oystergrounds and the Frisian Front, only accidentally juveniles are found. The bivalve lives in the seabed, just below the surface, and beam trawling has been shown to have a negative effect on the population (Lindeboom et al., 2008). Recent assessments (2006-2007) show that the population along the southern edge of the Frisian Front has strongly declined in comparison to the 1980’s. A decrease in population size is also observed on the Oyster Grounds (Lindeboom et al., 2008).
Figure 4.7.4: Distribution of Arctica islandica on the Dutch part of the North Sea (Lindeboom et al., 2008). Densities are averages over 11 years (1995-2005) (based on NIOZ data).

Multi-metric indexes
Benthic community composition and diversity is discussed in 4.2.

Size composition of benthic community
This information could, to some extent, be compiled from present monitoring data.

<table>
<thead>
<tr>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical damage</td>
</tr>
<tr>
<td>• The sea floor in a large part of the Dutch North Sea is strongly influenced by fishing</td>
</tr>
<tr>
<td>• Sand extraction has strong, but very local, impacts</td>
</tr>
<tr>
<td>Condition of the benthic community</td>
</tr>
<tr>
<td>• The population of the long-living species Arctica islandica is declining in comparison to the 1980s</td>
</tr>
</tbody>
</table>

References

Draft version 1, 1 June 2010 92

Witbaard, R. 2007. Evaluatie van streefdoelen voor de noordkromp-populatie op het Friese Front en in de Oestergronden, Imares rapport C041/07
### 4.8. Descriptor 7: Hydrographical conditions

<table>
<thead>
<tr>
<th><strong>Full description</strong></th>
<th><strong>Annex 1 MSFD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Criteria and indicators in the Commission decision</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7.1 Spatial characterisation of permanent alterations</strong></td>
</tr>
<tr>
<td>Extent of area affected by permanent alterations (7.1.1)</td>
</tr>
<tr>
<td><strong>7.2 Impact of permanent hydrographical changes</strong></td>
</tr>
<tr>
<td>Spatial extent of habitats affected by the permanent alteration (7.2.1)</td>
</tr>
<tr>
<td>Changes in habitats, in particular the functions provided (e.g. spawning, breeding and feeding areas and migration routes of fish, birds and mammals), due to altered hydrographical conditions (7.2.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>General description for the North East Atlantic</strong></th>
<th><strong>OSPAR Quality Status Report 2010</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction activities can have a range of impacts on the marine environment. They may cause loss or damage of coastal habitats, changes to the physical nature of the seabed, which in turn cause erosion, sedimentation and physical and chemical disturbance of ecosystems (…)</td>
<td></td>
</tr>
<tr>
<td>OSPAR countries regulate land reclamation, coastal defence works and the construction of other structures through national legislation. The aim is to minimise and put right any adverse environmental effects. National regulations for coastal defence often prioritize natural and soft techniques. This is supported by EU legislation, such as the EIA Directive, the Habitat and Birds Directives and the Recommendation on Integrated Coastal Zone Management.</td>
<td></td>
</tr>
<tr>
<td>EIA for land reclamation, coastal defence works and other structures have identified various effects on marine ecosystems. Although the regulatory system appears adequate for controlling impacts on a site by site basis, in most cases monitoring data are not available to evaluate the actual changes in environmental quality. For the recently started expansion of the port of Rotterdam in the Netherlands (Maasvlakte) an extensive monitoring programme will be carried out to investigate the recovery of benthic fauna, concentrations and spread of suspended matter, physical effects and underwater noise. In such developments, when negative effects are expected or observed, compensation is often more feasible than remediation</td>
<td></td>
</tr>
<tr>
<td><strong>Region II (Greater North Sea), regional summary:</strong></td>
<td></td>
</tr>
<tr>
<td>No information</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Status in the Dutch part of the North Sea</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spatial characterisation of permanent alterations</strong></td>
</tr>
<tr>
<td>Extent of area affected by the alteration</td>
</tr>
<tr>
<td>The Maasvlakte extension to the harbour of Rotterdam built in 1970 is one of the largest land reclamation projects in the OSPAR area to date, covering 2000 ha. An extension to this site, Maasvlakte 2, was proposed in 1997 comprising a further 2000 ha to provide port facilities and deep water wharfs for container ships, chemical carriers and other large vessels. Reclamation began in September 2008 with the aim that the new facility would be operational from 2013 onward and completed in 2033.</td>
</tr>
</tbody>
</table>
A series of environmental assessments were published in 2007 to comply with Dutch and EU regulations (Berkenbosch et al., 2007). The studies concluded that, although the project design minimises environmental impact as far as possible, there were unavoidable environmental impacts in the nearby marine and coastal environment. The impacts for the marine environment concerned loss of Habitat 1110, and loss of foraging area for Sandwich tern, Common tern and Black scoter. The assessments used worst case scenarios, and acknowledge uncertainties in the prediction of longer term impacts.

**Impact of permanent hydrographical changes**

*Spatial extent of benthic habitat affected by the permanent alteration*

There will be a loss of 2.8% (2455 ha) of shallow sandbanks (classified as Habitat type 1110_B under the EU Habitats Directive). Loss of benthic biomass will be compensated for by the creation of an area of 24550 ha where beam trawl fisheries (>260 pk) is excluded, which should lead to an improvement of the nature values that were predicted to be lost due to the construction of the Maasvlakte extension.

*Changes in habitat functions*

The EIA for the Maasvlakte 2 project indicates that there are no permanent alterations of habitat functions outside the area directly affected by the land reclamation.

**Summary**

<table>
<thead>
<tr>
<th>Spatial characterization of permanent alterations</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Maasvlakte 2 project is presently the largest reclamation project in the North Sea, covering approximately 2000 ha</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact of permanent hydrographical alterations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2455 ha of benthic habitat (Habitat type 1110_B) is lost due to the Maasvlakte 2 project.</td>
</tr>
<tr>
<td>The Maasvlakte 2 project does not lead to permanent alteration of habitat functions on other sites than the reclamation site</td>
</tr>
</tbody>
</table>

**References**

4.9. Descriptor 8: Contaminants

<table>
<thead>
<tr>
<th>Full description</th>
<th>Annex I MSFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrations of contaminants are at levels not giving rise to pollution effects.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria and indicators in the Commission decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1 Concentration of contaminants</td>
</tr>
<tr>
<td>Concentration of the contaminants mentioned above, measured in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC (8.1.1)</td>
</tr>
<tr>
<td>8.2 Effects of contaminants</td>
</tr>
<tr>
<td>Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored (8.2.1)</td>
</tr>
<tr>
<td>Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution (8.2.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General description for the North East Atlantic</th>
<th>OSPAR Quality Status Report 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals can be naturally occurring, like metals in the Earth's crust, formed as unintended by-products of natural and human-induced chemical processes, or synthesized specifically for use in industrial processes and consumer products. Some of these substances are hazardous because they are persistent, liable to accumulate in living organisms and toxic. They can contaminate the marine environment, with harmful effects on marine life and ultimately human health via the food web. Hazardous substances are found in seawater, sediments and marine organisms throughout the North-East Atlantic. Historic pollution in riverine, estuarine and marine sediments acts as a continued source for releases, especially where sediments are dredged from rivers and estuaries to improve navigation and are disposed of at sea. Various biological effects have also been observed. The production of specific enzymes, changes in tissue pathology and death have been reported. TBT is known to cause imposex in gastropods. Endocrine-disrupting effects in fish occur in many areas, although their extent, severity, and consequences are not clear. Recent studies of individual fish diseases have been able to link a general decline in liver tumors in fish in the Netherlands' waters of the North Sea since the late 1980s with a decrease in exposure to organic pollutants, such as genotoxic/carcinogenic PAHs. It is not yet possible in most cases to link the chemical monitoring with observations of effects in species in such a way that conclusions can be drawn about the impact of contaminants on the functioning of ecosystems at a regional level.</td>
<td></td>
</tr>
<tr>
<td>Hazardous substances are released, either as emissions to air, discharges to water or as losses during the lifecycle of products. These substances are transferred to the marine environment along a range of environmental pathways:</td>
<td></td>
</tr>
<tr>
<td>• <strong>Directly</strong>, for example through sewage and industrial discharges, or from offshore activities such as oil and gas extraction, shipping and mariculture</td>
<td></td>
</tr>
<tr>
<td>• <strong>By rivers</strong>, which collect inputs from inland sources such as industry and agriculture</td>
<td></td>
</tr>
<tr>
<td>• Through <strong>atmospheric transport</strong> volatile substances and substances attached to particles reach the sea mainly through deposition</td>
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</tbody>
</table>
Global change (2.4) might alter the pathways of these chemicals. Warming of the atmosphere may increase evaporation and transport of contaminants by air, rainfall may increase and flooding may result in higher run-off from land and river inputs. Increased storminess may result in additional remobilization of contaminants from marine sediments. Changes in the food web structure, such as the introduction of new species, may affect contaminant pathways.

Since the 1980’s measures have been taken to reduce to regulate the emission and discharge of hazardous substances (OSPAR, EU legislation). The phase-out of many chemicals is well underway in the North East Atlantic, but several are being replaced by other chemicals. This often benefits the environment, but can lead to new and unexpected problems if properties of the replacement chemicals are not well understood.

Region II (Greater North Sea), regional summary:

Pollution with hazardous substances. Concentrations of metals (cadmium, mercury and lead) and persistent organic pollutants are above background in some offshore waters of the North Sea, and unacceptable in some coastal areas. Lead levels, for example, were unacceptable at 40% of locations monitored, while PAHs and PCBs were at unacceptable levels at more than half of the monitoring sites.

Status of the Dutch part of the North Sea

Concentrations of contaminants

Concentration of the contaminants mentioned above, measured in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC.

Besides the source and volume of contaminants introduced into the environment, the concentrations of contaminants in the marine environment depend on the matrix in which the contaminant is measured. Some contaminants dissolve well in water and can be easily monitored in this matrix, whereas other contaminants do not dissolve well in water, attach to sediment and other particles, and are consequently only found in low concentrations in water. However, when taken up by organisms these substances can accumulate in marine organisms to higher concentrations.

EU guidelines and monitoring programmes use different approaches in the measurement of contaminants in the environment. The WFD prescribes the analyses of chemical substances in total water, whereas at OSPAR level, it has been agreed to measure chemical substances in sediment and marine organisms as well. The MSFD states that measurement should take place in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC (EU Water Framework Directive) (see §1.4).

According to WFD measuring and assessment methods, chemical substances (excluding nutrients) seldom exceed the WFD standards in the North Sea up to the maximum of 12 nautical miles. In the WFD assessments, TBT exceeds assessment levels in all Dutch coastal water bodies (Bommelé & Baretta-Bekker, 2009). TBT concentrations are expected to decrease (Figure 4.9.1).

Several of the priority substances of Annex X of the WFD and other relevant substances are considered “substances of special attention” (Bommelé & Baretta-Bekker, 2009), because these substances cannot be assessed properly as a consequence of analytical limitations due to low concentrations of these substances in water (due to their physico-chemical properties as described above). Until proven otherwise, these substances are considered potential problem substances. These substances of ‘special attention’ are (Bommelé & Baretta-Bekker, 2009):

Priority substances

4-tert-octylphenol
Sum of benzo(g,h,i)perylene and indeno(1,2,3)pyrene
Sum PDBE’s
Other substances
Dibutyltin
Dichlorvos (2,2-dichlorovinyl dimethyl phosphate (DDVP))
Tetrabutyltin
Cis-heptachloroepoxide (coastal water body Hollandse kust)
Heptachlor (coastal water body Hollandse kust)
Trichlorofon (coastal water body Hollandse kust)
Triphenyltin (coastal water body Wadden kust)

In the OSPAR assessment of contaminant concentrations in biota and sediment (OSPAR, 2009) several metals (cadmium, lead, mercury), some PCB congeners and some PAHs (benzo[ghi]perylene, benz[a]anthracene, chrysene) exceed assessment levels in the coastal zone, reaching concentration where there is a potential for significant adverse effects to the environment or to human health.

Concentrations of most metals and organic compounds in sediments show a steep decrease since 1980, but since 2000 the decrease in concentrations has slowed down. In the Dutch part of the North Sea, highest concentrations of contaminants are found at the Dutch coast, lowest concentrations are found 50-70 km offshore. Most concentrations comply with the Dutch MTR (Maximum Toelaatbaar Risico) concentration, with exception of vanadium and TBT. Exceeding of the VR (Verwaarloosbaar Risico) concentration at the Dutch coast is observed for cadmium, lead, zinc, nickel, barium, cobalt, selenium, vanadium, sum PAH, HCB and TBT (in 2006). At the central North Sea VR concentrations are exceeded for barium, cobalt, selenium, vanadium, sum PAH, HCB and TBT (Hegeman and Laane, 2008).
Figure 4.9.1. Modeled concentration of TBT (total water in ng/l) in 2009, 2015, 2021 and 2027. Colours indicate assessment on the WFD quality standard (0.2 ng/l) (Van Gils & Friocourt, 2008).

**Effects of contaminants**

Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored.
It is demonstrated that a wide range of chemicals in sediments and water are responsible for toxicological and undesirable effects in a large variety of marine organisms in many areas of the European marine environment. Such effects range from mortality, cellular and biochemical alterations, and histopathological lesions, to subtle impacts on reproduction and normal endocrine function, and are particularly marked in estuaries and other semi-enclosed marine waters. Although contaminants will affect processes from molecular to ecosystem level, the contaminant specificity of detection methods is complex. There are limited direct relationships between tissue levels of contaminants and their biological effects and there is limited understanding of the effects of mixtures of contaminants and of interactions between contaminants and other environmental stressors (TG 8 JRC report).

No indicators for this criterion have been selected at this stage. Therefore assessments from ongoing monitoring and research programmes are presented here.

- Imposex and intersex: EcoQO TBT-specific effects
Biomarkers that are used in international marine monitoring programmes are the assessment of imposex and intersex in gastropods. These are TBT-specific biomarkers that are part of OSPAR CEMP and JAMP (OSPAR 2008, Schipper et al., 2008a). Different countries bordering the North Sea use intersex in Littorina littorea to demonstrate the effects of TBT (WG BEC, 2009). Intersex in the periwinkle is induced at TBT-concentrations of higher than 15 ng / l (Bauer, 1997). A similar phenomenon is imposex in the dog whelk, which is induced at concentrations of 1 ng / l and higher (Gibbs et al. 1988).

The provisional assessment criteria for the OSPAR EcoQO TBT-specific biological effects (agreement 2004-15) are: “the average level of imposex in a sample of not less than 10 female dog whelks should be consistent with exposure to TBT concentrations below the environmental assessment criterion (EAC) for TBT – that is, <2.0, as measured by the Vas Deferens Sequence Index (VDSI). Where the dog whelk does not occur naturally, or where it has become extinct, the red whelk, the whelk or the netted dog whelk should be used.”

In the Dutch coastal waters TBT effects are assessed in dog whelks or in the periwinkle (Table 4.9.1.; Schipper et al. 2010), and by studying population trends of gastropods in this area (Figure 4.9.3.; Schipper et al. 2010). The calculated potentially affected fraction of species indicates that there is no risk in the North Sea (Table 4.9.1).

The provisional assessment criteria for the EcoQO TBT-specific biological effects are not yet met in The Netherlands.

<table>
<thead>
<tr>
<th>Area</th>
<th>Mean [TBT] in sediment (µg/kg dw)</th>
<th>[TBT] in biota (µg/kg dw) in blue mussel</th>
<th>Observed ISI in periwinkle (min-max)</th>
<th>Observed VDSI in dog whelk (min-max)</th>
<th>TBT PAF (%) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Sea</td>
<td>40</td>
<td>134</td>
<td>0.0-0.1</td>
<td>1.0-2.5</td>
<td>6.2</td>
</tr>
</tbody>
</table>

Table 4.9.1.: Ecotoxicological risk determined as potentially affected fraction (PAF %) based on the sediment levels interpolated in the SSD for TBT (from Schipper et al., 2008a), in the field observed intersex index (ISI) values in periwinkle and Vas Deferens Sequence Index (VDSI) in dogwhelk as biomarkers for TBT-exposure (Schipper et al., 2010).
Fish diseases
Fish disease studies in the OSPAR region (including the Netherlands) showed a worsening of the status of fish disease of dab in the majority of geographical areas at the North Sea in the period 2000-2005. Although the fish disease index is not considered a direct measure of effects of exposure to chemical contaminants, liver neoplasms in wild fish have been associated with exposure to chemical contaminants such as PAHs and chlorinated hydrocarbons (e.g., PCBs) in numerous field studies in Europe and North America. The observation on the worsening status should be considered an alarm bell to stimulate more research on the identification of causes of this general phenomenon (ICES, 2009).

Fish diseases are part of the OSPAR CEMP and JAMP (OSPAR 2008). There is evidence for a link between exposure to carcinogenic/genotoxic compounds such as PAHs and the development of liver tumours and other liver lesions in flatfish (Vethaak et al. 2009). A significant decrease towards natural background level has been reported for PAH-related liver tumours and major skin diseases in Dutch flatfish populations in the past 15 to 20 years. Although not having a direct impact on the population of flatfish, the improved health status of fish has been attributed to improved water quality in this region, including a decrease in carcinogenic and other toxic contaminants (Vethaak et al., 2009).

Other biological effects in Dutch estuarine / marine waters
There has been an increasing emphasis on the use of toxicity bioassays to identify and qualify the toxicity of estuarine and coastal environments. For Dutch estuarine and coastal waters there are several research studies that have demonstrated biological effects, such as:

Results of toxicity tests show dioxin-like, estrogenic and genotoxic activity in coastal and offshore sediment and suspended matter extracts by known and yet unknown contaminants (Klamer et al. 2005).

Using a newly developed early life stage (ELS) test by (Foekema et al. 2008), adverse effects are reported for the dioxin-like PCB 126 on the early development of sole. Prolonged ELS with this native marine flatfish suggests that reproductive success of fish populations at contaminated sites can be affected by persistent compounds that are accumulated by the female fish and passed on to the eggs (Foekema et al. 2008).

DR CALUX tests indicate the presence of toxicity by dioxine-like compounds in suspended matter and sediment in Dutch coastal waters and estuaries (Schipper et al., 2010)
Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution

- EcoQo on Oiled Guillemots

OSPAR has formulated an EcoQO on the amount of oiled seabirds. The assessment criterion for this EcoQo is: "The average proportion of oiled common guillemots in all winter months (November to April) should be 20% or less by 2020 and 10% or less by 2030, of the total found dead or dying in each of 15 areas of the North Sea over a period of at least 5 years."

Common Guillemot oil rates (% oiled) stranded on the Dutch coast in the period 1997/98-2001/02 was 61.4%. The amount of oil found on Guillemot corpses in The Netherlands is shown in Figure 4.9.4. The proportion of oiled guillemots washing ashore on Dutch beaches is declining (Figure 4.9.5). The OSPAR assessment criteria as set for the EcoQO Oiled guillemots is not yet met, but if the current trend is continued, the goal may be met by 2020.

![Figure 4.9.4. Percentages of oiled guillemots, ranging from corpses with a few specks of oil only (blue) to birds completely covered with oil (red). NZG/NSO database, C.J. Camphuysen unpubl. data.](image-url)
Concentrations of contaminants

- In the WFD assessments of concentrations in water, TBT exceeds assessment levels in all coastal water bodies. TBT concentrations are predicted to decline to non-problem levels in 2021.
- There is a list of so-called ‘substances of special attention’ that are to be considered potential problems until it can be proven (=properly assessed) otherwise.
- In the OSPAR assessments of concentrations in sediments and biota, several metals, PCB’s and PAH’s have concentrations that have a potential for significant adverse effects.
- Concentrations of most contaminants are decreasing.

Effects of contaminants

- The provisional assessment criteria for the OSPAR EcoQO for TBT-specific effects are not met, indicating that TBT levels are still too high.
- The average proportion of oiled guillemots beached along the Dutch coast is higher than the assessment criteria for the OSPAR EcoQO Oiled guillemots. The proportion of oiled guillemots is declining.

References

The list of references is still incomplete.


ICES 2009: Assessment of data on fish diseases in the OSPAR maritime area (ASMO 09/3/Info.2-E (L))


4.10. Descriptor 9: Contaminants in fish and sea-food

<table>
<thead>
<tr>
<th>Full description</th>
<th>Annex 1 MSFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria and indicators in the Commission decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1 Levels, number and frequency of contaminants</td>
</tr>
<tr>
<td>Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels (9.1.1)</td>
</tr>
<tr>
<td>Frequency of regulatory levels being exceeded (9.1.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General description for the North East Atlantic</th>
<th>OSPAR Quality Status Report 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>No information available</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status in the Dutch part of the North Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levels, number and frequency of substances</td>
</tr>
<tr>
<td>Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels</td>
</tr>
<tr>
<td>A current Dutch monitoring program designed to address requirements as set by the JAMP program (Joint Assessment Program) and run by Rijkswaterstaat is focused on analysis of contaminants in flatfish (flounder) and blue mussel in the Dutch coastal areas (Westerschelde, Oosterschelde, Dutch coast, Waddenzee and Eems-Dollard). See Table 4.10.1 for contaminants that are analyzed in this program.</td>
</tr>
<tr>
<td>Another monitoring program of LNV, run by RIKILT and IMARES, is called “Monitoring NL”. In this program, fish and seafood is being tested for a wide variety of contaminants. Table 4.10.2 shows the contaminants that have been analyzed in this program.</td>
</tr>
</tbody>
</table>

Table 4.10.1. Contaminants analyzed in flounder and mussel samples of the Dutch coast (JAMP program). Mussels were collected in October, Flounder was caught in September.  

<table>
<thead>
<tr>
<th>Chemical group</th>
<th>Analyzed in flounder</th>
<th>Analyzed in mussel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>cadmium, copper, zinc, lead in liver, and mercury in filet</td>
<td>cadmium, copper, chrome, zinc, lead, nickel, mercury and arsenic</td>
</tr>
<tr>
<td>Organotin</td>
<td>TBT, DNT, MBut and TPhT, DPhT, MPhT</td>
<td></td>
</tr>
<tr>
<td>PBDEs</td>
<td>47, 99 and 100</td>
<td>47, 99 and 100</td>
</tr>
<tr>
<td>PCBs/OCPs</td>
<td>28 PCBs and HCB, HCB, HCD, β-</td>
<td>7 indicator PCBs and QCB,</td>
</tr>
</tbody>
</table>
HCH, p,p-DDE, p,p-DDD, dieldrin (also in liver)

Table 4.10.2. Contaminants analyzed in the LNV monitoring program ‘Monitoring NL’, period 2004-2008.

<table>
<thead>
<tr>
<th>Chemical group</th>
<th>Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>Cadmium, mercury, lead, zinc and selenium</td>
</tr>
<tr>
<td>Dioxins, furans</td>
<td>17 dioxin- and furan congeners plus 12 non- and mono-ortho PCB congeners</td>
</tr>
<tr>
<td>and dioxin-like</td>
<td>P,p'-DDE, p,p'-DDD, p,p'-DDT, α,γ-DDT, HCB, HCBD, α-HCH, β-HCH, γ-HCH, pentachlorbenzene</td>
</tr>
<tr>
<td>PCBs</td>
<td>Indicator PCBs: CB-28, 52, 101, 118, 138 (+163), 153, 180</td>
</tr>
<tr>
<td>TCPM(e)</td>
<td>Tris(4-chlorophenyl)methane (TCPMe), tris(4-chlorophenyl)methanol (TCPM)</td>
</tr>
<tr>
<td>PAHs</td>
<td>Acenaftylene, acenaftene, phenantrene, fluoranthene, pyrene, benz[a]anthracene, chrysene,</td>
</tr>
<tr>
<td>PBDEs (only in</td>
<td>PBDE17, 28, 47, 49, 66, 71, 75, 77, 85, 99, 100, 119, 138, 153, 154, 183, 190, 203, 205, 206, 207,</td>
</tr>
<tr>
<td>2008)</td>
<td>208, 209</td>
</tr>
</tbody>
</table>

- JAMP monitoring program (RWS)
  
The maximum allowed levels for food safety, both for mussels as for flounder (note, most contaminants were analyzed in liver) have not been exceeded. Lead and cadmium levels in mussels are relatively high in contaminated coastal areas but do not exceed the legal limits.
  
Decreasing trends of contaminants are less pronounced in the sea than in fresh waters. As in fresh waters, the main decrease in contaminant loads has been achieved in the 1980s and early 1990s.

- Dutch Monitoring programme (LNV)
  
Also in this program, the allowed levels for food safety have not been exceeded (Table 4.10.3). Only fish from relatively polluted coastal areas have elevated levels of contaminants, yet all clearly under the maximum levels. These results indicate that for the contaminants that are currently analyzed and have a food safety norm, there is a minor risk of exceeding the limits. For contaminants, which have no legal limit (yet) and have been tested, there are no indications that there is reason for concern. For some contaminants like PBDEs and PFCs exposure limits are under discussion, the concentration levels of these compounds can be substantial in fish in some areas.
  
Trends can not be established, as products have been tested from several places and taken from fish auctions (no exact location known).

Table 4.10.3. Levels of contaminants in fishery products from Dutch coastal waters in the period 2004-2008

<table>
<thead>
<tr>
<th>Species</th>
<th>number of samples</th>
<th>Cadmium</th>
<th>Mercury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Allowed</td>
<td>Allowed</td>
</tr>
<tr>
<td>Species</td>
<td>Lead</td>
<td>Selenium</td>
<td>Zinc</td>
</tr>
<tr>
<td>--------------</td>
<td>------</td>
<td>----------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>range (mg/kg)</td>
<td>level (mg/kg)</td>
<td>range (mg/kg)</td>
</tr>
<tr>
<td>Shrimp</td>
<td>&lt;0.04 - 0.11</td>
<td>0.5</td>
<td>0.38 - 0.97</td>
</tr>
<tr>
<td>Herring</td>
<td>&lt;0.04 - 0.19</td>
<td>0.3</td>
<td>&lt;0.2 - 0.49</td>
</tr>
<tr>
<td>Cod</td>
<td>&lt;0.04 - &lt;0.068</td>
<td>0.3</td>
<td>&lt;0.2 - 0.30</td>
</tr>
<tr>
<td>Pollack</td>
<td>&lt;0.068</td>
<td>0.3</td>
<td>0.22</td>
</tr>
<tr>
<td>Norway</td>
<td>&lt;0.05 - 0.056</td>
<td>0.5</td>
<td>0.76 - 0.84</td>
</tr>
<tr>
<td>Lobster</td>
<td>&lt;0.04 - &lt;0.068</td>
<td>0.3</td>
<td>&lt;0.2 - 0.58</td>
</tr>
<tr>
<td>Mackerel</td>
<td>0.14 - 0.26</td>
<td>1.5</td>
<td>&lt;0.2 - 0.58</td>
</tr>
<tr>
<td>Mussel</td>
<td>0.12</td>
<td>1.5</td>
<td>0.28</td>
</tr>
<tr>
<td>Oyster</td>
<td>&lt;0.04</td>
<td>0.3</td>
<td>0.30</td>
</tr>
<tr>
<td>Red Perch</td>
<td>&lt;0.005 - &lt;0.04</td>
<td>0.3</td>
<td>&lt;0.2 - 0.20</td>
</tr>
<tr>
<td>Dab</td>
<td>&lt;0.005 - 0.09</td>
<td>0.3</td>
<td>&lt;0.2 - 0.44</td>
</tr>
<tr>
<td>Haddock</td>
<td>&lt;0.005 - &lt;0.068</td>
<td>0.3</td>
<td>&lt;0.2 - 0.47</td>
</tr>
<tr>
<td>Plaice</td>
<td>&lt;0.04</td>
<td>0.3</td>
<td>0.17</td>
</tr>
<tr>
<td>Smelt</td>
<td>&lt;0.05</td>
<td>0.3</td>
<td>0.46</td>
</tr>
<tr>
<td>Turbot</td>
<td>&lt;0.05</td>
<td>0.3</td>
<td>0.46</td>
</tr>
<tr>
<td>Sole</td>
<td>&lt;0.005 - 0.069</td>
<td>0.3</td>
<td>&lt;0.2 - 0.30</td>
</tr>
<tr>
<td>Seabass</td>
<td>&lt;0.05</td>
<td>0.3</td>
<td>&lt;0.2 - 0.28</td>
</tr>
</tbody>
</table>

**Total**

<table>
<thead>
<tr>
<th>Species</th>
<th>Lead</th>
<th>Selenium</th>
<th>Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frequency of regulatory levels being exceeded
No regulatory levels have been exceeded.

**Summary**
**Levels, number and frequency of substances**

- The maximum allowed levels for food safety, both for mussels as for flounder (note, most contaminants were analyzed in liver) have not been exceeded.
- Fish from relatively polluted coastal areas have elevated levels of contaminants, yet all are below the allowed levels.
4.11. Descriptor 10: Marine litter

<table>
<thead>
<tr>
<th>Full description</th>
<th>Annex I MSFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties and quantities of marine litter do not cause harm to the coastal and marine environment.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria and indicators in the Commission decision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10.1 Characteristics of litter in the marine and coastal environment</strong></td>
</tr>
<tr>
<td>Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)</td>
</tr>
<tr>
<td>Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea-floor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2)</td>
</tr>
<tr>
<td>Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro-plastics) (10.1.3)</td>
</tr>
<tr>
<td><strong>10.2 Impacts of litter on marine life</strong></td>
</tr>
<tr>
<td>Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General description for the North East Atlantic</th>
<th>OSPAR Quality Status Report 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine litter is a collective term for any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. It includes a wide variety of slowly degradable items. The main sources include tourism, shipping and fishing, including abandoned and lost fishing gear. Marine litter is a persistent problem affecting the entire marine environment, including the seabed, water column and coastlines. It poses risks to a wide range of marine organisms. Seabirds, marine mammals and turtles ingest the litter or get entangled in for instance old fishing nets. Trends in the amount of litter in the North Sea can be estimated by monitoring litter washed ashore. Floating litter at sea can be identified through analysis of stomach contents of northern fulmars, which forage at sea. Despite initiatives to reduce the amount of marine litter in the OSPAR area overall levels are frequently unacceptable (DEZE ZIN IS IN DE DEF QSR VERANDERD MAAR WEET NIET HOE; LO). Beaches in the OSPAR area have an average of 712 litter items per 100 m. Sixty-five percent of items monitored on beaches are plastic. These degrade very slowly over hundred-year time scales and are prone to breaking up. The widespread presence of microscopic plastic particles and their potential uptake by filter-feeding organisms is of increasing concern given their ability to absorb, release and transport pollutants.</td>
<td></td>
</tr>
<tr>
<td><strong>Region II (Greater North Sea), regional summary:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Amounts of litter are a concern.</strong> Over 90% of fulmars have microscopic plastic particles in their stomachs and 45% to 60% have more than the Ecological Quality Objective (EcoQO) set by OSPAR. Beach litter in the southern North Sea is at OSPAR-wide average (around 700 items per 100 m beach), but levels are higher in the northern North Sea.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status in the Dutch part of the North Sea</th>
</tr>
</thead>
</table>
Characteristics of litter in the marine and coastal environment

Amount of litter washed ashore

In the framework of OSPAR a beach litter monitoring program is running since 2002. In The Netherlands four reference beaches have been selected: Bergem, Noordwijk, Veere and Terschelling. Items are counted over 100 m and 1 km. On the 100m transect items of various sizes are collected, while on the 1 km transects items larger than 50 cm are counted (Dagevos and Hougee, 2010).

Figure 4.11.1.: The average number of litter items washed ashore on the reference beaches in 2002-2009 on a length of 100 m for items of various size (left), and on a length of 1 km for items > 50 cm (right) (Dagevos and Hougee, 2010).

Figure 4.11.2.: Proportion of marine litter categories on Southern North Sea beaches (OSPAR 2009)

According to Dagevos and Hougee (2010), the average number of litter items (of various size) on 100 meter of the reference beaches in 2009 is 321 items. This is a slight decrease in comparison with 2008. The average number of items per reference beach varies between 250 and 500 per 100 m between 2002 and 2009. (figure 4.11.1.). The average number of items (>50 cm) on 1 km of the reference beaches in 2009 is 59, which is a decrease in comparison with 2008 (Figure 4.11.1.). Both trends are however not statistically tested. Within OSPAR a method is being developed to obtain statistically significant data. Most of the litter washed ashore in the Southern North Sea are plastics (75% Figure 4.11.2)

Amount of litter on the surface, in the watercolumn and on the seabed

Quantitative data on amounts of litter floating at the surface or in the water column are not known for the Dutch sector. Data on amounts of litter on the seabed are scarce and need some further evaluation. Possibly, International Bottom Trawl Surveys (IBTS) can
contribute to more regional patterns of amounts of litter on the seabed. Data for 1988 give values between 100 and 1000 items per km² in the Dutch EEZ (Galgani et al., 2000).

Figure 4.11.3. shows the different types of litter items that were collected by fisherman in The Netherlands and Belgium. In 2009 approximately 75 ships participated in Fishing for Litter initiatives collected 5 – 10 ton per ship per year. The percentage of plastic items collected from the seabed is lower than for the coastline. This is to be expected as many plastic items are buoyant and either remain on the surface of the sea or wash up on the coastline. Different marine litter items were found, mostly rubber (104 gauntlets, 47 strings and belts) and textile (91 items from clothing and shoes), also mechanically processed wood such as wooden pallets, plastic and polystyrene (69 buoys, 32 ropes and cords, 49 fishing nets and fishing lines, 20 large oil barrels and also metal oil drums (OSPAR 2009)).

Figure 4.11.3.: Types of items of marine litter collected by fishermen participating in KIMO Netherlands and Belgium Fishing for Litter Schemes (OSPAR 2009).

Figure 4.11.4.: Difference in number and mass proportions of debris in a large clean-up on the island of Texel in April 2005 (Van Franeker, 2005).

Most surveys of debris on beaches or seabed are based on ‘number’ of items. Due to the extremely different sizes of objects of different nature, characterization by number of items gives totally different results than by volume or mass. The latter metrics are more difficult to assess but more relevant in terms of environmental pollution and its impacts. In a large cleanup of the beach on Texel in April 2005, c.a. 30 tons of litter were removed and analyzed both in terms of number of items and mass (Figure 4.11.4.). By number of items,
over 70% of items was classified as synthetic (plastic, rope & net; textile, large rubber), not unlike the results in Fig. 3.10.2. However, by mass these same categories represented ca. 45% of the debris. Processed wood, mainly pellets represented over 50% of litter mass, but only 16% of numbers of items (Van Franeker 2005).

Amount of microparticles
At present, no information available is available for the Dutch part of the North Sea

**Impact of litter on marine life**
OSPAR has set an EcoQO on plastic particles in seabird stomachs. To meet the goal set by the OSPAR EcoQO there should be less than 10% of northern fulmar having more than 0.1 g plastic particles in the stomach in samples of 50 to 100 beach-washed fulmars found from each of 4 to 5 areas of the North Sea over a period of at least five years. This goal has not yet been met in The Netherlands (Figure 4.11.5.). In 2004-2008 more than 60% of individuals had this amount of plastic in their stomach.

Figure 4.11.5.: Development of the Northern fulmar – litter EcoQO 1980-2008. The trend in the percentage of Northern fulmars that contains more than 0.1 g of plastics in their stomach, as moving average over 5-year periods. For the 1980s only a single average is calculated. Note Y-axis scale, where lowest value shown is 50% of birds, well above the critical EcoQO level of 10% (Van Franeker, 2010).

**Summary**

**Characteristics of litter**
- The monitoring of numbers of litter items on beaches has been standardized by OSPAR, but strong local variability and analytical problems have so far prevented the identification of a target value for acceptable quality.
- No clear trend can be observed in the number of litter items found on Dutch beaches since 2002
- No direct knowledge exists on the amount or composition of litter on the sea surface or in the water column in the Dutch sector. Data on litter on the seabed are fragmentary and not developed as a monitoring tool, although international trawl surveys may contain some information.

**Impacts of litter on marine life**
- A monitoring method considering the impact of litter on marine life has been developed by OSPAR as EcoQO using the mass of plastic in the stomachs of Northern fulmars. Trends of different categories of plastic have been monitored over the past decades. OSPAR has identified a target value for acceptable ecological quality for the North Sea
- The target for the EcoQO on plastic in the stomachs of Fulmar has not yet been met in the Dutch part of the North Sea

**References**

**Full description**

Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

**Criteria and indicators in the Commission decision**

**11.1 Distribution in time and place of loud, low and mid frequency impulsive sounds**

Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as Sound Exposure Level (in dB re 1µPa² s) or as peak sound pressure level (in dB re 1µPa peak) at one metre, measured over the frequency band 10 Hz to 10 kHz (11.1.1)

**11.2 Continuous low frequency sound**

Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1)

**General description for the North East Atlantic**

Many of the human activities (described in previous sections of the QSR) generate noise and contribute to the general background level of noise in the sea. For example, offshore construction, sand and gravel extraction, drilling, shipping, use of sonar, underwater explosions, seismic surveys, acoustic harassment devices and scarers (pingers). Marine mammals, many fish species and even some invertebrates use sound in communication - to find mates, to search for prey, to avoid predators and hazards, and for navigation. Underwater noise from anthropogenic sources has the potential to mask biological signals and to cause behavioural reactions, physiological effects, injuries and mortality in marine animals. Impacts depend on both the nature of the sound and the acoustic sensitivity of the organism. There are difficulties in quantifying the extent and scale of the impacts as there is great variability in the characteristics of the sounds, the sensitivities of different species and the scale of noise-generating activities. Data on all these aspects is generally scarce. But with the relatively intense concentrations of human activities in the North Sea, and the probability that these will increase, it is important that the effects of increased levels of underwater sound are fully considered. Studies show that noise does affect marine organisms but so far there is a lack of knowledge on specific effects and possible cumulative effects which hampers understanding of dose-response relationships. Research is needed on the propagation and effects of underwater sound on marine life, as well as behavioural and auditory studies, programmes to monitor the distribution of sound sources and the relevant marine species, and anthropogenic sound budgets. There is an urgent need to standardise methods for assessing the impacts of sound on marine species and to address the cumulative effects of different sources.

**Status in the Dutch part of the North Sea**

Cooling water

Under this descriptor, the MSFD does not only include underwater noise, but also other introductions of energy. The Task group 11 report mentions other sources, like heat.
dissipation from underwater power cables and cooling water discharges from power plants. For these latter sources, no criteria and indicators are mentioned in the Commission decision, however. The power plant at the Maasvlakte (Rotterdam port area) discharges cooling water into the North Sea. According to WFD assessments in the river basin management plan, this discharge does not cause adverse ecological effects.

Underwater sound

Anthropogenic sound emitted to the marine environment can potentially affect marine organisms in various ways. Documented effects on marine life vary greatly from very subtle behavioural changes, avoidance reaction, hearing loss, injury and death in extreme cases.

Assessing the scale of the potential effects is challenging. The report of the OSPAR Commission 2009, Assessment of the environmental impact of underwater noise, suggested that pressures due to underwater noise emissions might be relatively high in OSPAR Regions II and III due to the comparably high amount of human activities in these areas- and within Regions II the Southern North Sea is likely one of the most intensively used areas. In order to assess the possible impact of various activities, it is important to identify some key ones, most likely to be problematic for marine life, for example the ones with highest acoustic energy emitted into the environment and sort out those where relatively low level noise is a mere by-product of the activity.

In 2009 such an assessment was made of anthropogenic sound sources in the Dutch part of the North Sea, identifying the existing knowledge and revealing the gaps in knowledge (Ainslie, 2009). In this study an inventory of all relevant natural and anthropogenic sources of sound in the water column was made.

For these anthropogenic sources, source levels, frequency bands, and other characteristic information were collected. Based on that information, an acoustic energy budget comparison was made. The study concluded that the main contributions to anthropogenic sound energy in the Dutch part of the North Sea come from shipping, seismic surveys (airguns), underwater explosions and pile driving (Table 4.12.1)

<table>
<thead>
<tr>
<th>Type of source</th>
<th>Order of magnitude estimate of annual average of acoustic power output in the North Sea [GJ/year]</th>
<th>Order of magnitude estimate of frequency [kHz]</th>
<th>Order of magnitude estimate of absorption [dB/km]</th>
<th>Order of magnitude estimate of total (free space) energy E = W/(2πc) [kJ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airgun arrays</td>
<td>100</td>
<td>0.1</td>
<td>0.0012</td>
<td>8000</td>
</tr>
<tr>
<td>Shipping</td>
<td>270</td>
<td>0.3</td>
<td>0.01</td>
<td>3000</td>
</tr>
<tr>
<td>Wind farm construction</td>
<td>9</td>
<td>0.1</td>
<td>0.0012</td>
<td>700</td>
</tr>
<tr>
<td>(pile driving)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosions</td>
<td>7</td>
<td>0.1</td>
<td>0.0012</td>
<td>500</td>
</tr>
<tr>
<td>Navigation echo sounders</td>
<td>60</td>
<td>30</td>
<td>8.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Fisheries sonar</td>
<td>10</td>
<td>30</td>
<td>8.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Military search sonar</td>
<td>0.2</td>
<td>10</td>
<td>1.2</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Table 4.12.1. Estimation of total acoustic energy for the largest anthropogenic sources.
Similar to the findings in the OSPAR Commission 2009 assessment and the OSPAR QSR 2010, in this research effort it was concluded that clear generic guidelines / procedures should be established for the measurement, processing and quantification of underwater sound, such that future studies and measurement campaigns will lead to comparable results; there is a large demand for proper measuring protocols and measurements of natural and anthropogenic underwater sound in the North Sea (i.e. measurements that comply with the mentioned guidelines) for further development of the propagation modelling and validation of the resulting sound maps.

As stated before, the need for acoustic measurement guidelines and standards was recently identified. However, since 2009 considerable work has been done on this identified knowledge gap in an international research effort; institutes from the Netherlands, United Kingdom and Germany have made a first proposal towards European standardization for measuring and reporting underwater sounds, and follow on work was carried out in 2010 and 2011, leading to .......... (TNO/NPL/ITAP 2011 report on acoustic standards). Although wider adoption and a process of formal standardization will take some more years, it is felt that considerable progress is made in this field.

Summary

Distribution in time and place of loud, low and mid frequency impulsive sounds and Continuous low frequency sound

- The main contributions to anthropogenic sound energy in the Dutch part of the North Sea come from shipping, seismic surveys (airguns), underwater explosions and pile driving
- Generic guidelines/procedures for the measurement and quantification of underwater sound are presently lacking

References

5. Social and economic analysis of the use of the North Sea and analysis of the costs of degradation of the marine environment

This chapter deals with “the economic and social analysis of the use of the marine waters and the analysis of the cost of degradation of the marine environment” as obligated for the Initial Assessment by art 8.1.c of the MSFD. Both subjects are contained in two separate subchapters.

5.1 Socio economic analysis of the use of the North Sea: current use and baseline scenario

5.1.1 Approach
According to the MSFD, an economic and social analysis should be performed. The working group on Economic and Social Analysis has discussed whether this means that two separate analyses should be performed; an economic and a social analysis. The various Member States agreed that social aspects are important when deciding upon for example the programme of measures. However, it was decided that for this the regular socio-economic analyses will provide adequate and sufficient information; e.g. the spreading of costs and benefits over sectors, or the implications on employment. It was generally agreed that socio-economic analyses are more than just a financial analysis. It is this ‘more’ that is seen as the social analysis as required in the MSFD. Therefore, the Dutch understand the social and economic analyses as meaning socio-economic analyses; stressing the fact that something more is meant than financial economic analysis only, but that no additional social indicators have to be developed.

One of the similarities between the article 5 report for the WFD and the Initial Assessment for the MSFD is that both ask for an economic analysis of the use of water. For the economic analyses of river basin districts for the WFD, the Dutch Centre for Water management together with Statistics Netherlands developed a new database called NAMWA (National Accounting Matrix including Water Accounts). NAMWA links the economic activities in the seven WFD river basin districts in the Netherlands (Meuse, Scheldt, Ems and the Rhine split up in 4 sub-basins) to their corresponding emissions and water use. The structure is based on the National Accounting Matrix including Environmental Accounts (NAMEA), which was developed by Statistics Netherlands in the beginning of the 1990s (de Haan et al., 1993). The economic data presented in NAMWA have proven to be a very useful source of data for the economic analysis of river basin districts as part of the article 5 report, but also for the update presented in the river basin management plans (for more details on NAMWA, see Brouwer et al. (2005) and Van der Veeren et al (2004)).

Since NAMWA is based on the System of National Accounting for which internationally agreed definitions and methods apply, it is possible to present data that are internationally comparable. This has been very useful in discussions in the various international river basin commissions when drafting the article 5 reports. Therefore, as part of the preparations for the Initial Assessment for the MSFD, the Dutch Centre for Water management together with Statistics Netherlands have developed a new database based on the System of National Accounting, but this time applied to economic activities on the Dutch part of the North Sea, so that also for the MSFD a database has become available, that provide us with internationally comparable data, based on a consistent methodology.

This ‘NAMWA for the North Sea’ thus is the source of data on the economic importance of the current use of the marine environment. However, in order to determine the difference between expected environmental situation and the good environmental status, it is not
only important to know something on the present situation, but also how economic indicators that drive environmental pressures evolve over time. This is analysed in the baseline, or business as usual, scenario.

The steps undertaken in this analysis of future trends are:

- Assessment of trends of key hydrological and socio-economic factors/drivers that are likely to affect pressures (demography, climate, sector policies, e.g. common agricultural policy, technological development...);
- Identify proposed measures and planned investments for implementing existing water legislation, e.g. Common Fisheries Policies and other policies that would also have been in place if no MSFD measures would have to be implemented;

This resulted in the Business As Usual scenario for economic activities. For the relevant data, prospective analyses of likely development of key economic sectors/economic drivers influencing significant pressures were performed, based on data and experts from the Dutch Central Planning Bureau, combined with expert judgement from specialists in various subfields for more detailed information, where necessary. This resulted in general information on population growth, economic growth, sector growth patterns and future policies including existing water legislation, e.g. Water Framework Directive, Common Fisheries Policies, and estimate of technological developments. This analysis was performed to be able to present the expected future developments in human activities, as were already presented in Chapter 3 in physical terms. This Chapter presents what these developments mean in socio-economic terms (changes in production values, value added and employment) and consequences for land use.

5.1.2 Social and economic analysis of the use of the North Sea (current use and baseline scenario)

This paragraph presents the social and economic analysis of the use of the North Sea, by presenting data for both the present situation (2004) and expected trends until 2015, on production value, value added and employment for various economic activities. Also present and future space claims are presented.

Of all economic activities taking place in and on the North Sea, shipping is the most important one, with a value added of €2.6 billion and more than 12,000 people employed, which outstrips the other activities by far (see Table 1; numbers 2004). Next to the direct economic importance, shipping is also very important for a large number of other economic activities, for example in the Rotterdam harbour, the largest harbour in Europe. The importance of the seaports as a whole (including allied industries, inland transport and services) is far greater and lies somewhere in the region of €23 billion a year (approx. 7% of GNP). In 2006, some 163,000 people were employed in the port areas, almost 2% of total employment in the Dutch economy. The direct economic value of maritime transport (ports and transshipment) was about €2.5 billion in 2004, providing employment for over 10,000 people (NWP).

Offshore oil and gas production is the second important activity, with a value added of more than €1.5 billion and an employment of more than 1,800 people. The economic importance of this activity is largely determined by the oil prices. Other important sectors are fisheries, wind energy and tourism and recreation. In 2006, turnover in the fisheries sector totaled approx. €440 million (0.1% of GNP; not including the processing industry). In addition to its economic significance, the Dutch fishing industry has an important social and cultural significance due to its traditional alliance with the country. For tourism and recreation, no data were available. Also for nature, cables, sediment disposal and defence no data were available, but these sectors are assumed to be of minor direct economic importance.

De directe werkgelegenheid in de toerismesector wordt geschat op 80.000 arbeidsplaatsen, en de indirecte werkgelegenheid op 30.000 arbeidsplaatsen (IBN 2015, 2005). Het is hierbij echter onduidelijk welk deel toekomt aan kusttoerisme. Een schatting van het economisch belang van toerisme voor de Noordzeekooplatsen is wel te maken op basis van het aantal overnachtingen. Ervar uitgaan dat een kwart van alle toeristische overnachtingen plaatsvindt langs de kust, kan worden gesteld dat ook
een kwart van de totale toegevoegde waarde en werkgelegenheid toekomt aan de Nederlandse kust. Uiteraard is dit een vrij simplistische benadering. De toegevoegde waarde zal door gebruik te maken van deze methode neerkomen op circa 3,3 miljard, en de directe werkgelegenheid op circa 20.000 arbeidsplaatsen (zie ook tabel 23).

Cijfers over productiewaarde, toegevoegde waarde en werkgelegenheid met betrekking tot recreatieve activiteiten langs de Nederlandse kust zijn ook nauwelijks voorhanden. Een uitzondering is de zeesportvisserij. Nederland telde in 2006 650.000 zeesportvissers, waarvan het merendeel mannen zijn (zie figuur 5). De economische waarde van de zeesportvisserij wordt geschat op 167 miljoen, en er zijn circa 800 arbeidsplaatsen mee gemoeid (Noordzeeloket, 2009). Hierbij dient vermeld te worden dat dit inclusief de Waddenzee betreft. De daadwerkelijke waarde van alleen de Noordzee zal daarom lager zijn.
In the near and far future, shipping will remain to be the most important economic activity. For 2015, the value added is estimated to increase by 40% to be around €3.6 billion (see Table 2). The offshore industry is expected to face a serious decline in economic importance (more than 50%), due to the limits to the availability of natural resources. As a result of sustainable production and restrictions due to other uses, fisheries are expected to decline in economic value of the fisheries sector by 40%. At the same time, there will be opportunities for the sector to distinguish itself by responsible fishing using ecolabels for consumers (Marine Stewardship Council, MSC). Activities that are expected to increase significantly are wind energy (Dutch Parliament wants to install a capacity of 6,000 MW, where in 2004 there was practically none) and sand and gravel mining (for enlargements of the Rotterdam harbour and flood protection measures, production is expected to double).

Future use of the North Sea is likely to be influenced by the appointment of five nature protection zones with a total of 20% of the surface area.

Next to these activities, plans exist to use the North Sea also for other purposes, e.g. aquaculture, carbon storage, and activities that need not take place on the (scarce) land. What will be realised is not clear yet.
All the economic activities described so far, take about 40 to 70 percent of the Dutch part of the North Sea. Shipping takes most of this for shipping routes and clearways. In 2004, wind energy was not present on the Dutch part of the North Sea. Next to these static activities, fisheries and recreation also take some space.

As can be seen from Table 3, the surface used by the various economic activities is expected to increase significantly. One of the major causes is the obstacle free zones required around wind turbines, but also the reservation of 20% for nature reserve areas means a significant claim. In total, by 2015, all the claims together might be more than 100%. This would mean that the Dutch part of the North Sea might not be large enough to accommodate (the development of) all economic activities. This might give rise to conflicts in interests with respect to claims in spatial planning, and makes it necessary to look for opportunities of multiple use of the limited amount of space, e.g. by first mining sand and than building wind turbines at that location.

5.2 Costs of environmental degradation

5.2.1 Approach

Article 8.1.c states that ‘Member States shall make an initial assessment of their marine waters, taking account of existing data where available and comprising the following:… the cost of degradation of the marine environment.’

The MSFD therefore requires an analysis of the costs of environmental degradation, but does not prescribe how this analysis has to be performed. Since this analysis is not a standard economic analysis, the European Working Group on Economic and Social Analysis has discussed a number of alternatives. One of the options is by analysing the current expenditures for environmental protection. The basic rationale behind this method
is that, by assuming that the current costs for measures to prevent environmental degradation would only have been made since the value of what we are getting for it (preventing degradation), current costs can be seen as an underestimate for the present costs of degradation.4

Costs currently already incurred for preventing environmental degradation of the marine environment include:

- Money paid to sailors for garbage collection on land (to prevent disposal at sea)
- Additional costs for sustainable fisheries compared to regular fisheries
- And all other types of additional costs imposed on activities for environmental measures

By giving an overview of the current costs incurred by the various sectors, it becomes clear what protection of the marine environment is apparently worth to society (revealed preference). At the same time, it becomes clear who is paying how much, and how the burden is shared among economic actors. This gives insight in the existing financing structure for the protection of the marine environment (in much the same way as the cost recovery issue in article 5 of the WFD gave insight in the existing financing structures for the WFD related activities). The information on the financing structure will be useful for the remainder of the MSFD process, at the moment when the costs of the additional measures become clear, to be able to say who will be paying for these costs, and whether the additional costs result in a serious increase of the existing burden or not (relevant for the disproportionally issue).

5.3 References

- Handboek WG ESA (in prep.)
- Economic analysis of the use of the North Sea (Keijser and van der Veeren, 2009)

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4 This is the same kind of reasoning one could follow when trying to estimate the value of a statistical life: If a municipal council decides to install traffic lights, the value attached to prevented casualties should at least be as large as the costs made to install the traffic lights (and congestion costs), otherwise the municipality wouldn’t have installed the light.
6. Aspects of MSFD implementation (text Zijp; status 6/5: draft ready)

6.1 Summary of important opportunities and challenges

6.1.1 Important opportunities

To be elaborated later.

The MSFD implementation provides some important opportunities to:

- develop and establish a Dutch governmental Marine Strategy, being in line and non-different to the marine policy part of the Dutch National Water Management Plan (the NWP = “National Water Plan”).
- focus nation-wide on the environmental problems and ecological risks present in the North Sea region being partial of a natural character and partial a consequence of human activities.
- find and define environmental targets.

6.1.2 Important challenges

The MSFD implementation forms a challenge with regard to

- the improvement of the marine environment via environmental targets and associated indicators in respect to the limitations of
  - the vastness and complexity of the North Sea marine ecosystem
  - the limitation on active human interference by size of measures required
  - the limitation of funds
  - the socio-economic considerations
  - the national safety requirements with respect to protection of the land against high seas.
- The compliance with the EU MSFD instructions and other national and international regulation or legislation.
- The effectiveness of the international cooperation inside the OSPAR treaty or bilateral.

6.2 Public consultation and information (text Zijp; status 29/4: draft ready)

Public consultation and information is in the MSFD regulated by:

A. Art. 19.1 states that Member States, in accordance with existing Community legislation, shall ensure that all interested parties are given early and effective opportunities to participate in the implementation of the Directive, involving where possible, existing management bodies or structures, including Regional Sea Conventions, Scientific Advisory Bodies and Regional Councils.

B. Art. 19.2 states that Member States shall publish, and make available to the public for comment, summaries of the following elements of their marine strategies, or related updates, as follows:
   - the initial assessment and the determination of good environmental status;
   - the environmental targets;
   - the monitoring programmes;
   - the program of measures.

C. Art. 19.3 states that the environmental information has to be made available for public access.

In addition to the MSFD requirements are also various other EU or global treaties applicable to the MSFD public consultation and information. These are a) xxxxx, b) yyyyyyy and c) the global Arhus Convention (being the most important one??).
The public consultation and information with respect to this Initial Assessment report, is described below under reference to A through C of the above.

Ad A:
The following participation opportunities have been given specified for the specific parties.

Opportunities to management bodies or structures:
- Participation is continuously offered to Rijkswaterstaat Directorate North Sea being the predominant policy executing management body regarding the North Sea.
- To be completed later.

Opportunities to Regional Sea Conventions:
- The OSPAR organisation (text block to be prepared).
- To be completed later.

Opportunities to Scientific Advisory Bodies:
- Definition of the role of Deltares, Imares and PBL to be yet inserted.
- ICES
- JRC
- To be completed later.

Opportunities to Regional Councils:
- Participation is offered to the international “Advisory Regional North Sea Council” (regionale adviesraad voor de Noordzee).
- To be completed later.

Ad B:
The Dutch government has published to her citizens and made therefore available for comment, not only summaries of but also the entire reports as mentioned in Art. 19.2 (see also above). Public consultation and information incorporated also additional activities. These are in short described below.

- Regular consultation and information of the stakeholder platform OWN.
- Regular consultation and information of an OWN selected marine orientated group of stakeholders.
- Public consultation and information was during 2010 also facilitated in participative workshops on the subject of preparation of the draft reports Initial Assessment, Good Environmental Status and Environmental Targets. These workshops were well attended and produced many valuable ideas to the content of the named reports.
- Regular consultation and information of selected groups of the public named “focus groups”.
- Structured public consultation and information has been also exercised by open display of all reports mentioned under Art. 19.2 in the building of the Ministry of Transport, Public Works and Water Management and via an interactive website option available under the responsibility of this ministry (www.noordzeeloket.nl/krm) during a period of six weeks before finalisation. Any comment received has been carefully considered and, if appropriate, has been followed up.

All comments are available at the above ministry and summaries of highlights are provided in Annex XX. In this annex the comments are listed according to the obligatory subjects a) the initial assessment and the determination of good environmental status; b) the environmental targets; c) the monitoring programmes; d) the program of measures.

Ad C:
From the above sub B it is evident that all the environmental information is made available for public access in various manners being directed to the MSFD implementation. In addition, the normal public consultation and information route of the Dutch legal and democratic system has been followed.

**Text block / insert 1:**
The Dutch Government and more specific the Ministry of Transport, Public Works and Water Management, favours extensive public participation and information in the process of the national implementation of the MSFD. This is expressed by the numerous occasions such as workshops, whereby the public and other MSFD target parties have been given the opportunity to learn off and to participate in the preparation of MSFD documents. These occasions are listed in the text and annexes.

**Text block / insert 2:**
The OWN, the “Overleg Water Nederland”, is a selection of Dutch Stakeholders which is invited by the Ministry of Public Works and Water Management, to participate on a regular base on general matters with respect to water management issues. This participation is directed to harvest stakeholder points of view and interests in an effort to avoid operational and policy issues to become de-railed during implementation. Participants in the OWN are: (formally) the vice minister of Transport Public Works and Water Management, nature-, environment- and recreation organisations, the oil industry, the chemical industry, the (water related) building industry, Water related industry, employers organisations and representatives of the agriculture and fisheries. Observers are representatives of central and de-central governmental authorities. A from the OWN selected group of stakeholders was consulted frequently on specific topics.

**Text block / insert 3:**
The role of OSPAR (to be completed later by Lisette Enserink?)

**Text block / insert 4:** To be completed by Maarten Mulder.
The importance and role of the various participating and informed stakeholders was investigated in a recognisance study. The result are points wise presented below:

1. xx
2. yy

### 6.3 Further MSFD implementation steps.

**Legal implementation**
The legal implementation of the MSFD in the Dutch national legislation has been initiated earliest after the formal publication of the MSFD by the 15th of July 2008. The MSFD will therefore be incorporated in the Dutch laws before the 15th of July 2010 by publication in the Bulletin of Acts and Decrees (Staatsblad). The MSFD will be implemented through the Water governmental decree (Waterbesluit) under chapter four “Plans” of the Water Act (Waterwet). The following table contains the provisions of the MSFD as implemented in Dutch legislation:

<table>
<thead>
<tr>
<th>Section MSFD</th>
<th>Implementation in national legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sections 1.1 of the Water governmental decree and 1.4 and 2.1, sub b, of the Water Act; for the rest of the section implementation through legislation isn’t necessary</td>
</tr>
<tr>
<td>2, first subsection</td>
<td>Art. 1.4 of the Water Act; for the rest of the section implementation through legislation isn’t necessary</td>
</tr>
<tr>
<td>2, second subsection</td>
<td>Implementation through legislation isn’t necessary</td>
</tr>
<tr>
<td>3</td>
<td>Sections 1.1 of the Water governmental decree</td>
</tr>
<tr>
<td>4</td>
<td>Art. 1.4 of the Water Act; for the rest of the section implementation through legislation isn’t necessary</td>
</tr>
<tr>
<td>5, first subsection</td>
<td>Sections 4.6, second subsection, 4.16, first subsection, sub c, and 8.1a, of the</td>
</tr>
<tr>
<td>Draft version 1, 1 June 2010</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>Other reports</td>
<td></td>
</tr>
<tr>
<td>This draft report for the MSFD Initial Assessment, as ready by 30th of May 2010, is one of three draft reports to be prepared as part of the 2010 MSFD implementation activities. The other two reports are the drafts for the Good Environmental Status report and the Environmental Targets and Associated Indicators report. These are anticipated to be ready on the 31st of September and the 30th of November respectively.</td>
<td></td>
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<tr>
<td>EU instructions</td>
<td></td>
</tr>
<tr>
<td>To date, May 2010, the instructions of the EU regarding the MSFD implementation, are not yet available to the full. This report will therefore be updated in the last month of 2010 to comply with any aspect of the EU instructions or additional regulations.</td>
<td></td>
</tr>
<tr>
<td>International cooperation</td>
<td></td>
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<tr>
<td>The Dutch government seeks with respect to the establishment of the MSFD Initial Assessment during the forthcoming years until 2012 close cooperation with a) the OSPAR treaty member states, b) all the North Sea bounding countries and c) bilaterally with North Sea countries if appropriate.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Water governmental decree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5, second subsection</td>
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<tr>
<td>5, third subsection</td>
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<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
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<tr>
<td>8, first and second subsection</td>
</tr>
<tr>
<td>8, third subsection</td>
</tr>
<tr>
<td>9, first subsection</td>
</tr>
<tr>
<td>9, second and third subsection</td>
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<tr>
<td>10, first subsection</td>
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<tr>
<td>10, second subsection</td>
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<tr>
<td>11, first and second subsection</td>
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<td>11, third and fourth subsection</td>
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<td>13, first to forth subsection</td>
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<td>13, fifth subsection</td>
</tr>
<tr>
<td>13, sixth subsection</td>
</tr>
<tr>
<td>13, seventh and eighth subsection</td>
</tr>
<tr>
<td>13, ninth subsection</td>
</tr>
<tr>
<td>14-16</td>
</tr>
<tr>
<td>17, first and second subsection</td>
</tr>
<tr>
<td>17, third and forth subsection</td>
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<td>18</td>
</tr>
<tr>
<td>19, first subsection</td>
</tr>
<tr>
<td>19, second subsection</td>
</tr>
<tr>
<td>19, third subsection</td>
</tr>
<tr>
<td>20 - 28</td>
</tr>
</tbody>
</table>
Public participation and information
During the writing of the Initial Assessment public participative events have taken place via a brainstorming workshop during January 2010. Such brainstorm sessions will also be organised in preparation of the Good Environmental Status and Environmental Targets reports.
Public participation and information will frequently be organised with the OWN and OWN core group (see chapter 6.2 and insert/comment box). This report will be come available for comment during the submission for public consultation in the month of May 2011 (??).
All comments given will be reviewed and applied if beneficial.

Time scale
The MSFD dictates that this report, the Initial Assessment, is finalised by the 15th of July 2012. Considering both a six month period to be necessary to accomplish firstly international and thereafter national and governmental “consultation”, it is necessary to finalise this report in July 2011. This leaves just the first half year of 2011 for semi-final editing.
7. Conclusions and actions

7.1 List of Conclusions
To be written later.

7.2 List of actions
To be written later.
### 9. Glossary

#### Species names
(English names in alphabetical order)

<table>
<thead>
<tr>
<th>English</th>
<th>Dutch</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>allis shad</td>
<td>elf</td>
<td>Alosa alosa</td>
</tr>
<tr>
<td>American jack knife clam</td>
<td>Amerikaanse zwaardschede</td>
<td>Ensis directus</td>
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<tr>
<td>avocet</td>
<td>kluit</td>
<td>Recurvirostra avosetta</td>
</tr>
<tr>
<td>bar-tailed godwit</td>
<td>roos grutto</td>
<td>Limosa lapponica</td>
</tr>
<tr>
<td>black scoter</td>
<td>zwarte zee-eend</td>
<td>Melanitta nigra</td>
</tr>
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<td>black-throated diver</td>
<td>zwartkeelduiker</td>
<td>Gavia arctica</td>
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<td>blue whiting</td>
<td>blauwe wijting</td>
<td>Micromesistius poutassou</td>
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<tr>
<td>cod</td>
<td>kabeljauw</td>
<td>Gadus morhua</td>
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<td>common goldeneye</td>
<td>brilduiker</td>
<td>Bucephala clangula</td>
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<td>common guillemot</td>
<td>zeekoet</td>
<td>Uria aalge</td>
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<td>Platalea leucorodia</td>
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<td>wintertaling</td>
<td>Anas crecca</td>
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<td>cut trough shell</td>
<td>halfgeknotte strandschelp</td>
<td>Spisula subtruncata</td>
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<td>schar</td>
<td>Limanda limanda</td>
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TBT tributyl tin
Zn zinc

Geographic terms

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## Appendix A

### Instandhoudingsdoelen Voordelta

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Marine species from the Habitat Directive, OSPAR, the Flora-en fauna wet, the Dutch Red List and the ‘Nature target species’ Source: PBL 2008

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| Vaalplanten                     |              |              |       |         |                |               |
| Groenknolorchis - Liparis fuscelli | X        | X            | X     | X       |                |               |
| Groot zeegras - Zostera marina | X            | X            |       |         |                |               |
| Klein zeegras - Zostera noltii | X            | X            |       |         |                |               |

<p>| Vissen                          |              |              |       |         |                |               |
| Centrophorus aquamocuus         | X            |              |       |         |                |               |
| Centroscymnus coriophes         | X            |              |       |         |                |               |
| Doornhaai - Styrus acanthias    | X            |              |       |         |                |               |
| Eel - Alosa alosa                 | X            | X            |       |         |                |               |
| Fint – Allosa affinis           | X            |              | X     | X       |                |               |
| Gevlekte gladde haai – Mustelus asterias | X    | X            |       |         |                |               |
| Gevlekte gnoit – Zeaopterus punctatus | X          | X            |       |         |                |               |
| Gevlekte rog - Raja montagui    | X            | ?            |       |         |                |               |
| Groene zeedonderpad – Taurulus bubalis | X          |               |       |         |                |               |
| Grote pieterman – Trachurus draco  | X            | X            |       |         |                |               |</p>
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**Weekdieren**

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**Reptielen en amfibieën**

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