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Eutrophication status for Norwegian waters

National report for the third application of OSPARs Common Procedure

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Eutrophication status for Norwegian waters - National report for the third application of OSPARs Common Procedure

Summary - sammendrag

Norway has applied the third Common Procedure for the Identification of Eutrophication Status of the OSPAR Maritime Area. In OSPAR Region I, including the Norwegian and Barents Sea, a screening procedure was applied. In Region II, including the Skagerrak and North Sea, the comprehensive procedure was applied on watertype level. 96% of Region I was classified as non-problem area. In Region II the status had improved since the second application. Offshore and outer coastal areas were classified non-problem area. Inner coastal areas in the Skagerrak were classified problem area. For some coastal areas data are scarce and classification uncertain. Inner parts of the southern North Sea coast, freshwater affected water and areas with naturally low oxygen levels were consequently classified potential problem area.

4 emneord

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Preface

As a contracting party to the Oslo and Paris Commissions (OSPAR), Norway has agreed to apply the Common Procedure for the Identification of Eutrophication Status of the Maritime Area of OSPAR on its coastal waters. This is the third classification for Norwegian waters, and the first to be carried out for the entire Norwegian maritime area. The Common Procedure has been carried out by Norwegian Institute for Water Research (NIVA) in cooperation with the Environmental Agency. We thank Pål Inge Synsfjell for helpful discussions through the project, and to Dag Rosland for delivery of data from the Vannmiljø database which made up the basis for the third application.

The NIVA team was made up by the following: Hege Gundersen has performed statistical analysis, calculated trends and confidence for the indicators used, Tore Høgåsen has calculated the nutrient load to coastal waters and Gunnar Severinsen and Jens Vedal have aided the data management. Torbjørn M Johnsen and Kjell Magnus Norderhaug have worked with biological data and Kai Sørensen and Mats G. Walday have performed quality assurance of the results. Kjell Magnus Norderhaug has also edited this report.

Oslo, 14.6.2016

Kjell Magnus Norderhaug (editor)

Content

1. Introduction

The entire Norwegian maritime area, including both coastal and offshore waters have been classified in the third application of the Common Procedure. In the sparsely populated OSPAR Region I north in Norway, including the Norwegian Sea and Barents Sea, a screening procedure was applied. In the southern and more densely populated Region II, including the Skagerrak and North Sea, the Comprehensive Procedure was applied.

1.1 OSPARs Common Procedure

1.1.1 Screening and Comprehensive Procedure

The Common Procedure is The Oslo and Paris Commissions (OSPAR) procedure for assessment of environmental status according to eutrophication within the OSPAR maritime area. Norwegian water lies within Region I (Norwegian Sea and Barents Sea) and Region II (Skagerrak and the North Sea). The procedure aims at detecting elevated levels of the eutrophication related parameters, generally implemented as 50% deviation from reference conditions. Depending on previous knowledge, two main effort levels of the procedure can be applied:

The screening procedure is a broad brush method to avoid resource consuming assessments in obviously non-problem areas. The screening may include different forms of data e.g. demographic, physical and monitoring data.

According to the OSPAR guidelines, the comprehensive procedure should be applied in areas where screening or earlier assessments have classified them as problem or potential problem areas or areas where there for other reasons is concern for eutrophication related problems. The comprehensive procedure is performed in the following steps:

In the first step, relevant and available assessment parameters are selected, including trends and ratios of nutrients concentrations and discharges, direct effects in the form of elevated algal growth and indirect effects including oxygen consumption, and changes in biological communities.

In the second step, an initial assessment for all assessment parameters is performed. Rating of confidence should be shown in a statistical sound and transparent way.

In the third step, an overall assessment including all relevant and available information is made. This is performed to secure a sound and transparent account of the reasons for giving a particular status to an area.

In the 2002 application, Aure & Skjoldal (2003) concluded Region I was a non-problem area. Therefore, in the third application a screening procedure was applied to the Norwegian and Barents Sea. The second application concluded problem-area in the Skagerrak (Molvær et al. 2007) and a comprehensive procedure was thus applied here. Comprehensive procedure was also applied to the North Sea.

1.1.2 Links to the Water Framework Directive and its use in this report

Although not part of the EU, Norway has implemented the Water Framework Directive (WFD, EU Directive 2000/60/EC) in the Norwegian legislation. Both the Water Framework Directive and the Common Procedure seeks to identify measures necessary to achieve good status (WFD) or non-problem area (Common Procedure) (Figure 1). The OSPAR problem vs non-problem classification system should align with the WFD boundaries between good and moderate. Moreover, OSPAR background levels should be comparable to high status within the WFD. Established class boundaries and classifications already performed have been utilized in the third assessment to avoid duplicate work.

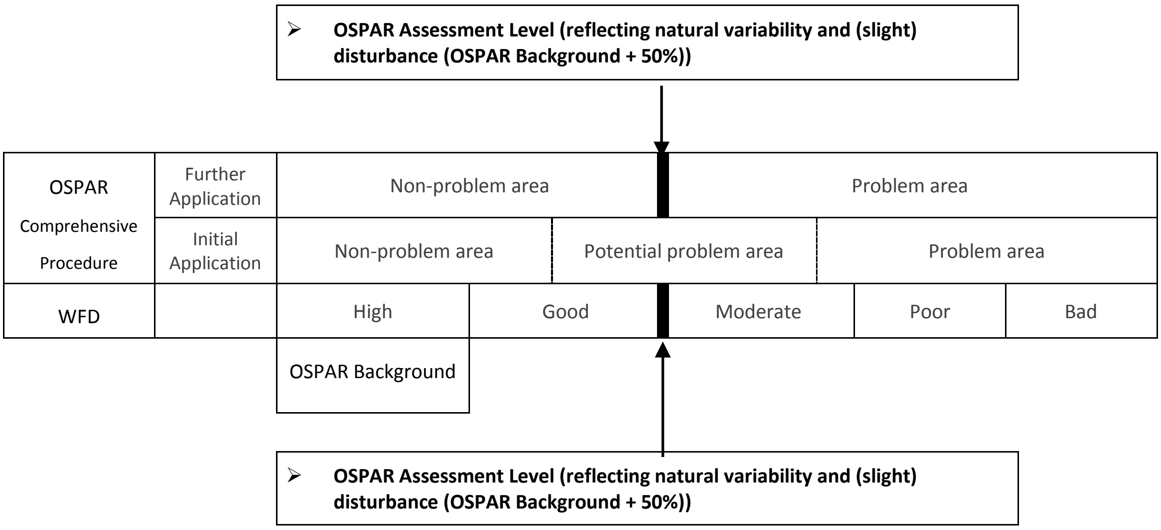

Figure 1 Relationship between the classification under the OSPAR Comprehensive Procedure and the Water Framework Directive (Source: Common Procedure 2013-08).

1.2 The 2007 application for Skagerrak

The Norwegian Skagerrak coast was classified according to the OSPAR Common Procedure in 2002 and 2007 (Aure & Skjoldal 2003, Molvær et al. 2003, Molvær et al. 2007). The second classification from 2007 was based on nutrient load, oxygen conditions, hard bottom fauna and flora (particular emphasis on sugar kelp *Saccharina latissima*), harmful planktonic algae, as well as other data from a number of recipient studies. The overall assessment classified Skagerrak as a problem area. This conclusion was for a number of assessment units based on the assumption that large scale decline of sugar kelp on the Norwegian Skagerrak coast was to some extent caused by eutrophication.

After 2007, extensive research and monitoring have been performed to increase the understanding of the sugar kelp loss, including a PhD project (Sogn Andersen 2013), an assessment (from 2005-2008, Moy et al. 2008) and environmental monitoring with particular focus on sugar kelp (2009-p.t., Norderhaug et al. 2013). The decline in sugar kelp has mainly been explained by global warming, reduced water quality as a secondary effect from climate change as well as eutrophication. In particular, warm summers and melting periods in early spring when sugar kelp is recruiting is thought to have severe impact on sugar kelp recruitment (Moy & Christie 2012). Sugar kelp was not given principal importance as an eutrophication indicator in the third assessment.

1.3 Screening Procedure in Region I

Regional environmental authorities have classified Norwegian coastal waters on water body level (data available from Vann-nett, www.vann-nett.no). The WFD classification and the boundary between good and moderate were used for the screening in Region I, in the Norwegian Sea and Barents Sea. Offshore, monitoring and eutrophication assessments made in management plans were used at region level resolution (Arneberg et al. 2013, www.miljostatus.no).

1.4 Comprehensive Procedure in Region II

Trends and confidence rating was not available from the WFD classification made by regional authorities. Therefore, the Comprehensive Procedure for coastal areas in Region II was applied using national environmental monitoring data from Vannmiljø (www.vannmiljo.no provided by the Norwegian Environmental Agency, NEA). Problem and non-problem areas were classified using WFD class boundaries between good and moderate.
For offshore areas outside the WFD jurisdiction area, no data were available and expert judgement from management plans were used (Skotte et al. 2011).

2. Description of the assessed area

Norwegian waters receive nutrients from southern parts of the North Sea via ocean currents and they are transported further northward via the coastal current. In coastal areas rivers transport nutrients and particles to the marine environment. The most densely populated areas are found in South Norway, particularly around the Oslofjord. Coastal areas were assessed on water body and water type level because of high local variability and to achieve sufficiently large sample sizes. Offshore areas were assessed on ecoregion level.

2.1 Coastal and offshore waters

The Norwegian coastal current flows northward along the coast from Skagerrak to the Barents Sea (Aure & Skjoldal 2003). Coastal water is a mix of Atlantic, Baltic, North Sea and fresh water from land with varying salinity. Rivers transport nutrients and particles to the marine environment from anthropogenic activities including agriculture, industry, forestry and wastewater treatment. This transport is highly seasonal and low during winter when water on land is frozen, high during melting in spring and after heavy rainfall during summer and autumn. The total loading is increasing because of climate change and a milder and wetter weather. Therefore, climate change is interacting with eutrophication and it may be difficult to separate effects from these two factors (Norderhaug et al. 2015).

Fjords are typically described by a shallow sill and a stratified water column with brackish surface water. The deep water is stagnant for shorter or longer periods and deep water replacement may occur in intervals from months to several years. In the end of long periods of stagnant water the oxygen concentrations are low and hydrogen sulphide may form. This may occur naturally or result from eutrophication (Buhl-Mortensen et al. 2006, Molvær et al. 2007).

Offshore waters are dominated by Atlantic water with high salinity. It flows northward from the North Sea and meets arctic water in the Barents Sea.

2.2 North Sea and Skagerrak

The North Sea covers 750 000 km^2 and is shallow, only 94 m on average (www.imr.no). Ocean currents bring Atlantic water into the North Sea which mixes with water from the Jutland current and Baltic water as it approaches the Norwegian coast in the Skagerrak. The main current direction is northwards from the southern North Sea and Denmark and changes to a southwestward direction along the Norwegian Skagerrak coast and then northwards along the North Sea coast.

Some 1.6 million people live in the municipalities surrounding the Oslofjord part of the eastern Skagerrak, which is the area in Norway with highest population density. The population is also dense along the south coast. Anthropogenic activities in the coastal zone includes tourism, fishery and sources from land runoff include agriculture, industry and municipal waste (Syvertsen et al. 2009). The largest city along the North Sea coast is Bergen, with approximately 250 000 citizens, which has the largest impact locally (Syvertsen et al. 2009). Aquaculture is the most important anthropogenic activity in the western North Sea coastal area, followed by agriculture and industry.

2.3 Norwegian Sea

Covers more than 1.1 mill km^2 and have an average depth of 1 600 m (www.imr.no). Atlantic water from the North Sea flows northward outside the coastal current, and mixes with the North Atlantic Current along the continental slope to the Norwegian Sea (Aure & Skjoldal 2003). The population densities are low and the largest city is Trondheim with 185 000 citizens. Human impact includes fishery, oil industry and increasing aquaculture industry.

2.4 Barents Sea

The Barents Sea covers 1.4 mill km^2 and average depth is 230 m (www.imr.no). The coastal current divides into two main currents, one heading north to Svalbard and the other east along the Barents Sea coast. Atlantic water meets cold arctic water in the north-east. The arctic environment is characterized by midnight sun during summer and darkness during winter. The population densities are generally low. The fishery industry in the Barents Sea is large, the oil industry significant, and there is an increasing aquaculture industry. But generally there is lower human impact compared to further south.

2.5 Assessment units in Region I and II

Because the environmental variability is larger in coastal than offshore areas, the assessment resolution scale used was finer in coastal areas. The classification was assessed on sea level in the screening of Region I (Norwegian Sea and Barents Sea) and in offshore areas of Region II (Skagerrak and North Sea). In coastal and fjord areas of Region II, classification was assessed on water type level (calculations from monitoring data) within each WFD region. The water types with sufficient data for classification in the three WFD regions within OSPAR Region II are presented in Table 1. They were used for classification of problem and non-problem areas. All available sampling stations used are shown in Figure 2.

Table 1 Reporting units used in the comprehensive procedure in coastal areas in OSPAR Region II

Reporting units assessed in coastal areas of Region II Water type and WFD Region			
Water type	Skagerrak	North Sea S	North Sea N
Open exposed coast	S1	N1	M1
Semi-exposed coast	S2	N2	M2
Sheltered coast/fjord	S3	N3	M3
Freshwater affected and strongly freshwater affected water	S4 and S5	N4 and N5	M4 and M5
Fjords with naturally low oxygen levels	S6	N6	M6

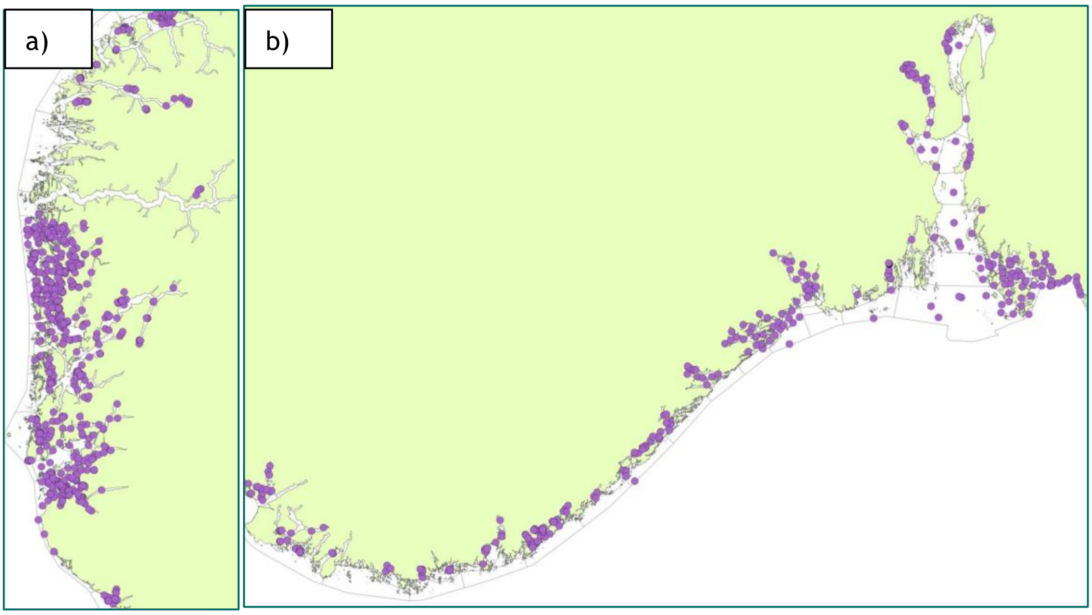

Figure 2. Sampling stations used in the assessment of OSPAR Region II, a) North Sea and b) Skagerrak.

3. Data used in the classification

Monitoring data from the Environmental Agency database (Vannmiljø) were used to calculate status and trends in Region II. Where data was available, we used established WFD class boundaries between moderate and good for classifying non-problem and problem areas. The assessment was performed on water type level within each WFD Region in coastal areas to take into account high local variability in salinity and other parameters. In offshore areas Norway has not implemented class boundaries. Therefore, expert judgement based on management plans for the North Sea and Skagerrak was used.

In Table 2, the parameters used for status classification in Region II are presented. The river inputs dataset represents yearly discharges at the level of water region, divided into six sources (waste water, agriculture, industry, aquaculture, rivers, and nature). The nutrient dataset from Vannmiljø consisted of data from all seasons, and the full dataset has been included in the statistical analyses of non-linear trends for each environmental parameter, whereas only winter observations from the four last years (2012-2015) have been used for the status assessment.

Table 2 data used in the comprehesive procedure in Region II

Data used for comprehensive procedure in Region II Sources, parameters, assessment level and comments		
River inputs	Assessment parameters	Comment
RID and TEOTIL	NO_3, NH_4, total N, total P, PO_4	Monitoring data and modelling
Nutrients		
Vannmiljø	DIN, DIP	Monitoring data (NH4, PO4, N/P-ratio, N, P, NO3)
	Redfield ratio total N/total P	
Particles		
Vannmiljø	Organic carbon	POC, Monitoring data
Biology		
Vannmiljø	Chlorophyll a	90 percentile
	Macroalgae	RSLA, MSMDI (WFD)
	Benthos fauna indices	Monitoring data

Macroalgae and hard bottom fauna were sampled according to the requirements in the national guidelines for the Water framework directive (WFD, guideline 02:2013) and classified accordingly. Indices for the littoral zone RSLA and lower vertical growth limit for nine species of macroalgae MSMDI were used to classify status. Non-problem and problem areas were identified using the class limit good-moderate in the guideline.
Benthos fauna were sampled according to ISO/IEC 17025 and ISO 16665:2005. Diversity indices implemented in the national guidelines for the WFD (guideline 02:2013) were used to classify benthos. Non-problem and problem areas were identified using the class limit good-moderate in the guideline.

3.1 Nutrient loads

For calculations of anthropogenic inputs of nutrients and particles from land, data (NO_3, NH_4, total N, total P and PO_4) from the program Riverine Inputs and Direct Discharges (RID) was available from 10 main rivers with monthly sampling and 36 smaller rivers with sampling four times a year from 1990 to 2014 and calculated at the level of WFD sub-districts. In areas where no data were available, RID data were used to calculate runoff of P and N by TEOTIL modeling (described in Selvik et al. 2012). TEOTIL was also used for calculating anthropogenic versus natural inputs, by use of estimated discharges from industry (Norwegian Environmental Agency), aquaculture (Norwegian Directorate of Fisheries), sewage plants and settlements (KOSTRA, Statistics Norway). Direct inputs from e.g. aquaculture are a significant anthropogenic nutrient source in the North Sea and increasingly significant further north.

3.2 Nutrient and particle concentrations

National monitoring data on nutrient and particle concentrations in sea water (Vannmiljø, 1990-2014) was used in the calculations. According to WFD (Veileder 02:2013), samples down to a depth of 15m were used. Available data are presented in Table 2.

3.3 Biological indicators

The 90-percentile for Chlorophyll a was used as a proxy for phytoplankton. Due to great variations through the year, this parameter should in the WFD be assessed through the whole growth period, which is from February through October for Region II. This criteria has been followed also in this assessment, however the calculations are made on the level of water type instead of water body to also include waterbodies without data. Established indexes within the WFD for macroalgae (littoral zone index RSLA in the North Sea and lower growth limit for nine macroalgal species, MSMDI in the Skagerrak) and soft bottom fauna indexes from Vannmiljø were used for available water types. In the ecoregion North Sea-south, only preliminary RSLA class boundaries were available. For the initial assessment, average index values for all stations were calculated across each water type and WFD region. The one out – all out principle was used in the overall assessment.

3.4 Statistical modeling, status and trend assessment

Norwegian waters cover vast areas (Chapter 2.2-2.4). The monitoring network has a limited spatial and temporal distribution and do not cover all water types in all regions throughout the entire monitoring period 1990-2014. To overcome this shortcoming we used the total dataset in the statistical modeling, but still predicting winter situations at the depth of 2m, at the level of water type for each region. In this way we were able to fill gaps where data were weak and to take advantage of data sampled in other seasons and depths than the ones in focus. To visualize the water type specific non-linear development for all parameters in each WFD region since 1990 we used Mixed Generalized Additive Models (GAMs) (Appendix 1).

For trend assessments, Mixed Generalized Linear Models (GLMs) were used (Appendix 2). Significant ($\alpha<0.05$) and increasing linear trends were identified. For status assessments we estimated average values and standard deviations for all water types in Region II, based on available winter (December-February) data from 2012-2015 and not deeper than 15m. This four year period was chosen to represent the present status, since the data available for 2015 was scarce (for Skagerrak, there were no data available for 2015). On open exposed coast in the North Sea (N1 and M1) and in fjords with naturally low oxygen levels in both the North Sea (N6 and M6) and Skagerrak (S5) there were however too few data to provide solid results and these water types were consequently removed and not assessed. Freshwater affected (type 4) and strongly freshwater affected (type 5) water types were combined because of limited data.

Parameter values for the Skagerrak and North Sea were compared to WFD class boundaries for the Skagerrak, North Sea S and North Sea N, respectively. Since the WFD class boundaries for physical-chemical parameters are not specified for water types, but rather for salinity levels, the water bodies needed to be coupled to salinity classes to be able to use the WFD class boundaries. For waterbodies in type 1, 2, and 3 this was a 1:1 relationship (salinity > 30 in the North Sea and > 25 in Skagerrak), whereas for water type 4, 5, and 6 we chose the most frequent salinity class for each type, which was > 18 for water type 4 (96% of the waterbodies), 5 for water type 5 (85%) and 18 for water type 6 (73%). OSPARs class boundaries were used for the Redfield ratio N/P.

All statistical analyses were performed in R, using the mgcv library for GAMs and nlme for GLMs and ANOVAs.

4. Eutrophication assessment by area

Non-problem areas in 96% of water bodies in Region I (Norwegian Sea and Barents Sea) resulted in an overall classification for Region I as non-problem area and thus Comprehensive Procedure was not applied. However, as anthropogenic inputs increases, eutrophication has the potential to become a problem in sheltered coastal areas also in Region I in the future. Also the majority of water types in Region II (Skagerrak and North Sea) were classified as non-problem area.

4.1 Region I: Norwegian Sea and Barents Sea

According to regional environmental authorities, 96% of the assessed water bodies in the Norwegian Sea and Barents Sea are classified as good or high status, according to the WFD (Vann-nett). Accordingly, the overall classification of coastal areas in Region I is non-problem area (Figure 3). The main anthropogenic sources in coastal areas are agriculture, atmospheric deposition of nitrogen, aquaculture and nutrients carried northward by the coastal current (Arneberg et al. 2013).

Both in the Norwegian Sea and the Barents Sea coastal waters input data showed generally low but increasing anthropogenic inputs, particularly of NH_4 (52% for the Norwegian Sea and 61% in the Barents Sea for the last 10 years), but also total phosphorous and total nitrogen, and nutrients (NO_3, PO_4). The NH_4 inputs were mainly caused by the increasing aquaculture industry (Appendix 4).

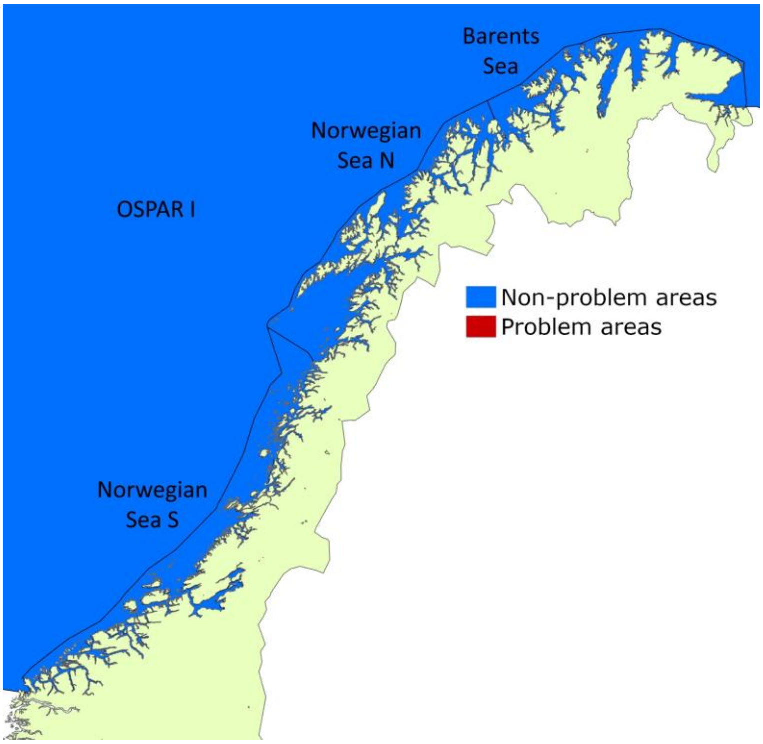

Figure 3. Classification from screening in Region I, including the Norwegian Sea and Barents Sea.

For offshore areas, long term monitoring using water sampling in transects perpendicular to the coast suggest the eutrophication status is good with respect to nutrients (Arneberg et al. 2009).

The monitoring frequency in time and space is scarce in Region I and nutrient inputs from anthropogenic sources, including aquaculture, are increasing. Consequently, monitoring efforts (e.g. frequency, intensity, and extent) should be improved because eutrophication can potentially become a problem in sheltered coastal areas in Region I in the future.

4.2 Initial assessment in Region II

The initial assessment from the comprehensive procedure given in Tables 3 to 15 showed that coastal and offshore waters in the Skagerrak and North Sea are generally non-problem areas. The exceptions were inner coastal areas were some problem areas were found (particularly Skagerrak) and some areas were classified potential problem area due to data scarcity (particularly North Sea coast). Offshore areas of Skagerrak and North Sea were classified as non-problem area. GAM models for visual inspection of the non-linear development of parameters through 1990-2015 are shown in Appendix 1. GLM models for linear trends are shown in Appendix 2 and their associated linear trend slopes and p-values are shown in Appendix 3.

The classification results for Skagerrak showed improved status compared to the second application (Molvær et al. 2007), mainly due to the assessment at water type level in the third application and also because sugar kelp is not being used as a principal eutrophication indicator in the third application (see Chapter 1.2, but sugar kelp is nevertheless included, as being part of the MSMDI index used here). The status for sugar kelp has only improved marginally since the second application (Norderhaug et al. 2013).

4.2.1 Water types in the Skagerrak

No indication of eutrophication on exposed coast was found and this is in line with Oug et al. 2015 and Norderhaug et al. (2015). Exposed coast was consequently initially classified as non-problem area. The parameters winter NH_4, PO_4, NO_3, chlorophyll a and the Redfield ratio N/P was below class boundary. There were no increasing trends in concentrations of NH_4 or NO_3 for the last 10 years and a decreasing trend was found for PO_4. Increasing trends were found in the case of PON, POC and also the N/P-ratio. The input trends showed an increase in the case of PO_4, reduced for NH_4 and no trend for NO_3, tot N and tot P.

Table 3 Initial assessment for available parameters in open exposed coast (water type S1). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

S1	Assessment Parameters	Description of Results		Score	Confidence
		Level	Trend	(+ - ?)	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	+	
	Winter DIN and/or DIP concentrations	Below class boundary	No increasing trend	-	**0.99**
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	Increasing trend	+	
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below class boundary		-	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA	Below class boundary		-	
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills	Below class boundary		-	
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

On moderately exposed coast there were no biological indications of problem (this report, Moy et al. 2015), but increasing enrichment including concentrations for PO4. Nutrients were otherwise below class boundary, both in the case of NH4, PO4, NO3, chlorophyll a and also Redfield ratio N/P. Decreasing trends were found for NH4 and NO3. Input trends for the last 10 years was increased for PO4, decreased for NH4, and no trend were found for NO3, tot N and total P. Initial classification was consequently non-problem area.

Table 4 Initial assessment for available parameters in moderately exposed coast (water type S2). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

S2	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Below class boundary	Increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary		**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below class boundary		**-**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA	Below class boundary		**-**	
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills	Below class boundary		**-**	
	Organic carbon/organic matter		No increasing trend	**-**	
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

- \+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- \- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters
- = Not enough data to perform an assessment or the data available is not fit for the purpose

In sheltered coastal areas, variable and reduced status in soft bottom communities and elevated levels of supportive indicators, including small increasing trend in PO_4, were found and resulted in an Initial classification as problem area. Both NH_4, PO_4, NO_3, chlorophyll a, N/P, were below class boundary. Increasing trend was found in the case of PO_4 concentration, while no trend was found for concentrations of NO_3 and NH_4. Input trends for the last 10 years has increased for PO_4, reduced for NH_4, while no significant trend was found for NO_3, tot N and tot P.

Table 5 Initial assessment for available parameters in sheltered coast (water type S3). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

S3	Assessment Parameters	Description of Results		Score	Confidence
		Level	Trend	(+ - ?)	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Below class boundary	Increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary		**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below boundary		**-**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA	Below class boundary		**-**	
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills	Above class boundary		**+**	
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters
= Not enough data to perform an assessment or the data available is not fit for the purpose

The data material for freshwater affected water (S4 and S5) was small. While PO_4 and N/P ratios were below class boundary, NO_3 was above. Increasing trends in concentrations of NH_4 and N/P ratio was found, while no significant trend was found for NO_3 and PO_4. The input trends for the last 10 years has increased for PO_4, decreased for NH_4, while no trend was detected in the case of NO_3, tot N and tot P. Chlorophyll a concentrations were below class limit and showed no increasing trend. Macroalgae communities suggest eutrophication at some stations (Kroglund et al. 2012). The initial assessment was consequently problem area.

Table 6 Initial assessment for available parameters in freshwater affected (water type S4) and strongly freshwater affected water (water type S5). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

S4 and S5	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Above class boundary	Increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	Increasing trend	**+**	
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below class boundary	No trend	**-**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA			**+**	
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills				
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

- \+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- \- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

Also the data material for fjords with naturally low oxygen levels was small. Both PO_4 and NO_3 and N/P were below class boundary, but increasing trends were found for NO_3 and PO_4. No trend was identified for N/P ratio. Input trends for the last 10 years was increased for PO_4, reduced for NH_4, and no trend was found for NO_3, tot N and tot P. Due to the lack of direct and indirect assessment parameters, the initial classification was potential problem area.

Table 7 Initial assessment for available parameters in fjords with naturally low oxygen levels (water type S6). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

S6	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Below class boundary	Increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	No trend	**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration				
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA				
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills				
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

- \+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- \- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

4.2.2 Water types in the North Sea S

On open exposed coast in the south North Sea, NH_4 and N/P were below class boundary. A large increase in input trends were found for NH_4 (43%), NO_3, total nitrogen and phosphorous. No trend was found in the case of NO_3. Lack of direct and indirect assessment parameters altogether resulted in an initial classification of N1 as potential problem area.

Table 8 Initial assessment for available parameters in open exposed coast (water type N1). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

N1	Assessment Parameters	Description of Results		Score	Confidence
		Level	Trend	(+ - ?)	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	+	
	Winter DIN and/or DIP concentrations	Below class boundary		-	**0.99**
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary		-	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration				
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA				
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills				
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters

- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

No signs of eutrophication were found in semi-exposed coastal areas in the southern part of the North Sea coast. Both PO_4, NO_3, chlorophyll a, and N/P were all below class boundary. No trend was found for NO_3, and decreasing trends was found for PO_4 and N/P. A large increase in inputs of NH_4 (43%) and also NO_3, total nitrogen and phosphorous was identified, while no trend was found for NO_3. Consequently, the initial classification was non-problem area.

Table 9 Initial assessment for available parameters in semi exposed coast (water type N2). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

N2	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Below class boundary	No increasing trend	**-**	**0.99**
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	No increasing trend	**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below class boundary		**-**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA				
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills				
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

- \+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- \- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

There is a lack of WFD class limits for macroalgae in the North Sea S but preliminary classification has been performed (Norderhaug et al. 2015). The status in soft bottom communities on sheltered coast was variable but generally non-problem area (Trannum et al. 2012, Norderhaug et al. 2015). Increasing trends for PO_4 and NO_3 were found. No trend was however found for N/P and nutrient concentrations, including NH_4, PO_4, NO_3 and chlorophyll a and N/P ratio was below class boundary. Input trend for the last 10 years, showed an increase in NH_4 (43%) and also increase for NO_3, total nitrogen and phosphorous, while no trend was found for NO_3. Overall, N3 is variable, but biological indicators generally show non-problem area. The preliminary classification is therefore non-problem area.

Table 10 Initial assessment for available parameters in waterype sheltered coast/fjord (water type N3). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

N3	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Below class boundary	Increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	No increasing trend	**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below class boundary		**-**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA	<class boundary		**-**	
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills	Below class boundary		**-**	
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

Little data was available for freshwater affected water. PO_4 and NO_3 and direct effects on chlorophyll a were above class boundary for freshwater influenced waters (N4 and N5, only 27 observations available), while soft bottom communities showed non-problem area (Trannum et al. 2012). N/P ratio was below class boundary. No trends were found for NO_3, PO_4 or N/P ratio. Input trends for the last 10 years, showed increase in NH_4 and also increase in NO_3, total nitrogen and phosphorous, while no trend was found for NO_3. The initial classification was problem area due to chlorophyll a.

Table 11 Initial assessment for available parameters in freshwater affected and strongly freshwater affected water (water types N4 and N5). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

N4 and 5	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Above class boundary	No increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	No increasing trend	**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Above class boundary		**+**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA				
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills			**-**	
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters

- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

4.2.3 Water types in the North Sea N

The littoral community showed no signs of eutrophication in exposed areas on the North Sea north coast. NH_4 and N/P was both below class boundary. For input trends for the last 10 years, a large increase in NH_4 (43%) was detected and also increase in NO_3, total nitrogen and phosphorous while no trend was detected for NO_3. The initial classification was consequently non-problem area.

Table 12 Initial assessment for available parameters in open exposed coast (water type M1). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

M1	Assessment Parameters	Description of Results		Score	Confidence
		Level	Trend	(+ - ?)	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	+	
	Winter DIN and/or DIP concentrations	Below class boundary		-	**0.99**
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary		-	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration				
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA	Below class boundary		-	
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills				
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters

- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

No signs of eutrophication were found on semi-exposed coast in the North Sea north, neither in nutrient levels/trends, chlorophyll a concentrations nor soft bottom communities. The initial classification was consequently non-problem area. In the North Sea, input trend for the last 10 years, showed however large increase in NH_4 (43%) and also NO_3, total nitrogen and phosphorous and no trend for NO_3. Decreasing trends were found for PO_4 and N/P.

Table 13 Initial assessment for available parameters in semi exposed coast (water type M2). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

M2	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Below class boundary	No increasing trend	**-**	**0.99**
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	Decreasing trend	**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below class boundary		**-**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA				
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills	Below class boundary		**-**	
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

- \+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- \- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters
- = Not enough data to perform an assessment or the data available is not fit for the purpose

No signs of eutrophication effects were found in plankton amount (chlorophyll a) or soft bottom communities on sheltered coast/fjord (M3). NH_4, PO_4, NO_3 and chlorophyll a, and N/P were all below class boundary. Increasing trends for nutrients (NO_3 and PO_4) were however found. In the North Sea, input trend for the last 10 years, showed however large increase in NH_4 and also NO_3, total nitrogen and phosphorous. The initial classification for sheltered coast/fjord was therefore non problem area.

Table 14 Initial assessment for available parameters in sheltered coast/fjord (water type M3). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

M3	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Below class boundary	Increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	No increasing trend	**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Below class boundary		**-**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae MSMDI RSLA				
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills	Below class boundary		**-**	
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

- \+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- \- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters
- = Not enough data to perform an assessment or the data available is not fit for the purpose

Little data was available for freshwater affected water. Nutrients, including PO_4 and NO_3 and also direct effects (chlorophyll a) were above class boundary in freshwater affected waters and strongly freshwater affected waters in the North Sea north (M4 and M5, only 31 observations available). N/P ratios were below class boundary. No increasing trends were found for nutrients NO_3, PO_4 or N/P ratio. Input trends for the last 10 years, showed a large increase in NH_4, NO_3, total nitrogen and phosphorous. The initial classification was thus problem area.

Table 15 Initial assessment for available parameters in freshwater affected and strongly freshwater affected coast/fjord (water type M4 and M5). Level shows above or below class boundary for problem-non problem area (equal to the boundary good-moderate in the WFD). Confidence is calculated for the risk of being above class boundary when classified below. Confidence is therefore only calculated for parameters below class boundary. Score is explained below the table.

M4 and M5	**Assessment Parameters**	**Description of Results**		**Score**	**Confidence**
		Level	**Trend**	**(+ - ?)**	
Degree of Nutrient Enrichment (I)	Riverine inputs and direct discharges of total N and total P		Increased trend	**+**	
	Winter DIN and/or DIP concentrations	Above class boundary	No increasing trend	**+**	
	Winter N/P ratio (Redfield N/P = 16)	Below class boundary	No increasing trend	**-**	**0.99**
Direct Effects (II)	Maximum and mean chlorophyll a concentration	Above class boundary		**+**	
	Area-specific phytoplankton indicator species				
	Macrophytes including macroalgae				
Indirect Effects (III)	Oxygen deficiency				
	Changes/kills in zoobenthos and fish kills				
	Organic carbon/organic matter				
Other Possible Effects (IV)	Algal toxins (DSP/PSP mussel infection events)				

Key to the Score

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

= Not enough data to perform an assessment or the data available is not fit for the purpose

4.2.4 Offshore Skagerrak and North Sea

Nutrient concentrations in Skagerrak and North Sea waters are highest in the coastal current (Skotte et al. 2013). Intrusion of Atlantic water mixes with the coastal water as the current moves northward. Water in the inner part of the Skagerrak comprises of approximately 30% Kattegat water, 52% water from the central North Sea and 18% from the German bight. Water from the Kattegat has low nutrient levels while water from the German bight is nutrient rich. Nutrient concentrations generally decrease by distance from the coast.

The eutrophication status of Skagerrak waters are therefore to a high degree dependant on nutrient transport with ocean currents from the south. From the beginning of the 1980s to the middle of the 1990s nutrient concentrations increased and resulted in doubling of the nitrogen concentrations in Skagerrak coastal waters (Aure & Magnusson 2008). After 1995, a gradual decrease in nutrient inputs from the German bight has been observed and was on level with the concentrations in the 1970s in 2011. Classification of winter nitrate concentrations in Skagerrak water in 2010 was very good. For North Sea water less data were available to Skotte et al (2013), but also this area was classified as very good. In summary, all available knowledge suggests offshore Skagerrak and North Sea waters of Region II were non-problem areas.

4.3 Final assessment Region II

Since the second common procedure was applied in 2007, the Water Framework Directive (WFD, EU Directive 2000/60/EC) has been implemented in Norwegian legislation. The use of established WFD class boundaries in this work to classify Norwegian waters according to OSPARs common procedure was performed to secure harmonised results to the national WFD work as well as to neighbouring countries and contracting parties maritime areas.

8 watertypes in Region II, including the ones covering the large offshore and outer coastal areas of the Skagerrak and North Sea, were classified non-problem area (Figure 4, Table 16). On inner coasts of Skagerrak, 2 watertypes were classified problem area. Sheltered Skagerrak coastal areas were problem areas due to reduced ecological status in benthic communities. On inner coast, loss of perennial macroalgae due to warming and eutrophication has also been reported (Moy & Christie 2012). Freshwater affected inner Skagerrak coastal waters, including S4 and S5 were also classified problem area, elevated nutrient concentrations and runoff inputs were found, reduced status in macroalgal communities but no effects in chlorophyll a. No other biological indicators were available in this water type. It is important to notice that there are local variations in impact within this watertype as shown by regional authorities (Appendix 6). S6 (naturally oxygen depleted waters) were classified as potential problem areas in the initial classification because of little available data on direct or indirect eutrophication effects. Increasing trends for runoff inputs of nutrients and elevated levels in nutrient concentrations were also found. The overall classification of Skagerrak shows improvement since the second application of the common procedure (Molvær et al. 2007), when all coastal areas were classified problem areas (offshore areas were not classified). The main reason for the improvement on outer coast may be the reduced nutrient inputs from the southern North Sea after the mid-1990s (Aure & Magnusson 2008). Worsened eutrophication status on inner coast may have been caused by increased runoff and generally high human activity from agriculture and industry in these most heavily populated areas of Norway.

The North Sea is little affected by eutrophication. Offshore North Sea (N1 and M1) as well as coastal areas (N1-3 and M1-3) was non-problem areas (Figure 4). The exceptions were freshwater influenced inner coastal areas (N4, N5, M4, M5). The initial classification of both N4-5 and M4-5 were problem areas due to elevated concentrations of chlorophyll a. However, data scarcity and no indication of reduced status in soft bottom communities (N4-5, Trannum et al. 2012) resulted in final classification as potential problem area. Also in the case of water types N6 and M6, data scarcity resulted in classification as potential problem area.

The southern North Sea coast is characterised by variable environmental and eutrophication status and periods with reduced conditions that may be caused by naturally occurring upwelling (Norderhaug et al. 2015). It is therefore uncertain to what extent variable eutrophication status is caused by anthropogenic or natural causes. The North Sea coast is otherwise less populated than the Skagerrak but it receives an increasing amount of nutrients from an increasing aquaculture industry, which is a concern (Appendix 4). Offshore areas outside the WFD jurisdiction area, was classified as non-problem areas with low concentrations of nutrients.

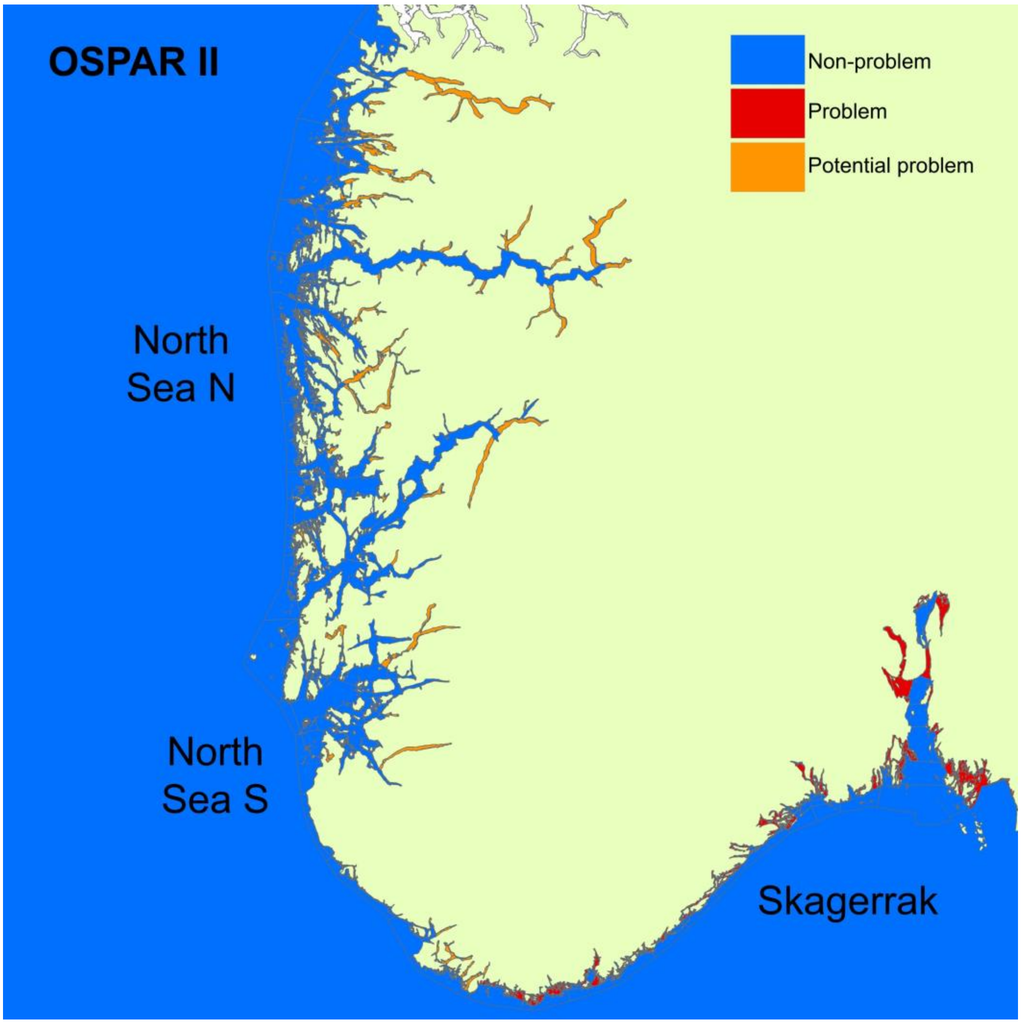

Figure 4. Final assessment in Region II, including the North Sea N and S and Skagerrak. The application was performed on water type level thus all water bodies of each water type have the same status and local variation on a smaller scale is not taken into account. Regional authorities classification on water body level is shown in appendix 6.

Table 16 Final assessment for available parameters for Skagerrak waters (S1-S6).

Area	**Category I** Degree of nutrient enrichment		**Category II** Direct effects		**Category III and IV** Indirect effects/other possible effects				Initial classification	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors)	Final classification	Assessment period
S1	NI	+	Ca	-	O_2		At		Non-problem area		Non-problem area	1990-2014
	DI	-	Ps		Ck	-						
	NP	+	Mp	-	Oc							
S2	NI	+	Ca	-	O_2		At		Non-problem area		Non-problem area	1990-2014
	DI	+	Ps		Ck							
	NP	-	Mp	-	Oc							
S3	NI	+	Ca	-	O_2		At		Problem area		Problem area	1990-2014
	DI	+	Ps		Ck	+						
	NP	-	Mp	-	Oc							
S4 and S5	NI	+	Ca	-	O_2		At		Problem area		Problem area	1990-2014
	DI	+	Ps		Ck							
	NP	+	Mp	+	Oc							
S6	NI	+	Ca		O_2		At		Potential problem area	Expert judgement spatial coverage	Potential problem area	1990-2014
	DI	+	Ps		Ck							
	NP	-	Mp		Oc							

Key to the table

NI	Riverine inputs and direct discharges of total N and total P	Mp	Macrophytes including macroalgae
DI	Winter DIN and/or DIP concentrations	O_2	Oxygen deficiency
NP	Increased winter N/P ratio	Ck	Changes/kills in zoobenthos and fish kills
Ca	Maximum and mean chlorophyll *a* concentration	Oc	Organic carbon/organic matter
Ps	Area-specific phytoplankton indicator species	At	Algal toxins (DSP/PSP mussel infection events)

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters

- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

? = Not enough data to perform an assessment or the data available is not fit for the purpose

Note: Categories I, II and/or III/IV are scored '+' in cases where one or more of its respective assessment parameters is showing an increased trend, elevated levels, shifts or changes.

Table 17 Final assessment for available parameters for south North sea waters (N1-N6).

Area	**Category I** Degree of nutrient enrichment		**Category II** Direct effects		**Category III and IV** Indirect effects/other possible effects				Initial classification	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors)	Final classification	Assessment period
N1	NI	+	Ca		O_2		At		Potential problem area	Management plan (Skotte et al. 2011)	Non-problem area	
	DI	-	Ps		Ck							
	NP	-	Mp		Oc							
N2	NI	+	Ca	-	O_2		At		Non-problem area		Non-problem area	1990-2014
	DI	-	Ps		Ck							
	NP	-	Mp		Oc							
N3	NI	+	Ca	-	O_2		At		Non-problem area		Non-problem area	1990-2014
	DI	+	Ps		Ck	-						
	NP	-	Mp	-	Oc							
N4 and N5	NI	+	Ca	+	O_2		At		Problem area	Expert judgement spatial coverage	Potential problem area	1990-2014
	DI	+	Ps		Ck	-						
	NP	-	Mp		Oc							
N6	NI	+	Ca		O_2		At		Potential problem area	Expert judgement spatial coverage	Potential problem area	1990-2014
	DI		Ps		Ck							
	NP		Mp		Oc							

Key to the table

NI Riverine inputs and direct discharges of total N and total P
DI Winter DIN and/or DIP concentrations
NP Increased winter N/P ratio
Ca Maximum and mean chlorophyll *a* concentration
Ps Area-specific phytoplankton indicator species
Mp Macrophytes including macroalgae
O_2 Oxygen deficiency
Ck Changes/kills in zoobenthos and fish kills
Oc Organic carbon/organic matter
At Algal toxins (DSP/PSP mussel infection events)

\+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
\- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters
? = Not enough data to perform an assessment or the data available is not fit for the purpose

Note: Categories I, II and/or III/IV are scored '+' in cases where one or more of its respective assessment parameters is showing an increased trend, elevated levels, shifts or changes.

Table 18 Final assessment for available parameters for north North Sea waters (M1-M6).

Area	**Category I** Degree of nutrient enrichment		**Category II** Direct effects		**Category III and IV** Indirect effects/other possible effects				Initial classification	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors)	Final classification	Assessment period
M1	NI	+	Ca		O_2		At		Non-problem area	Management plan (Skotte et al. 2011)	Non-problem area	
	DI	-	Ps		Ck							
	NP	-	Mp	-	Oc							
M2	NI	+	Ca	-	O_2		At		Non-problem area		Non-problem area	1990-2014
	DI	-	Ps		Ck	-						
	NP	-	Mp		Oc							
M3	NI	+	Ca	-	O_2		At		Non-problem area		Non-problem area	1990-2014
	DI	+	Ps		Ck	-						
	NP	-	Mp		Oc							
M4 and M5	NI	+	Ca	+	O_2		At		Problem area	Expert judgement spatial coverage	Potential problem area	1990-2014
	DI	+	Ps		Ck							
	NP	-	Mp		Oc							
M6	NI	+	Ca		O_2		At		Potential problem area	Expert judgement spatial coverage	Potential problem area	1990-2014
	DI		Ps		Ck							
	NP		Mp		Oc							

Key to the table

NI	Riverine inputs and direct discharges of total N and total P	Mp	Macrophytes including macroalgae
DI	Winter DIN and/or DIP concentrations	O_2	Oxygen deficiency
NP	Increased winter N/P ratio	Ck	Changes/kills in zoobenthos and fish kills
Ca	Maximum and mean chlorophyll *a* concentration	Oc	Organic carbon/organic matter
Ps	Area-specific phytoplankton indicator species	At	Algal toxins (DSP/PSP mussel infection events)

\+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters

\- = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters

? = Not enough data to perform an assessment or the data available is not fit for the purpose

Note: Categories I, II and/or III/IV are scored '+' in cases where one or more of its respective assessment parameters is showing an increased trend, elevated levels, shifts or changes.

5. Spatial and temporal variability

Norwegian maritime areas covers huge areas and particularly in Region I there was generally low spatial and temporal data resolution. Increased monitoring according to the requirements in the Water framework directive has however increased the spatial cover of monitoring stations in coastal areas and included the North Norway coast. Increased human activity in northern areas will demand higher focus on eutrophication also in these previously little affected waters.

The data cover was highly variable in time and space. Sampling varied with season and more data was available from summer than winter months. Freshwater affected waters and outer coastal areas held in general few data and most of the monitoring are focused to areas between sheltered coast and fjord and semi exposed coast.

We expect the classification to be conservative with regard to eutrophication effects for two main reasons. The one-out, all-out rule in the Common procedure increases the risk of concluding problem area by chance with increasing number of indicators used. We also expect data sampling to be biased towards impacted waters because more assessment and monitoring are generally performed in (suspected) impacted waters. This will have consequences for the results and areas with poor condition will drive the conclusion within the water type. Therefore it is important to interpret the results on a water type level. The eutrophication status locally is assessed elsewhere (e.g. regional authorities assessment of water bodies according to the WFD, vannett.no).

Appendix 5 shows the dataset available for analyses, status and trend assessment for the the Comprehensive procedure in the Skagerrak and North Sea.

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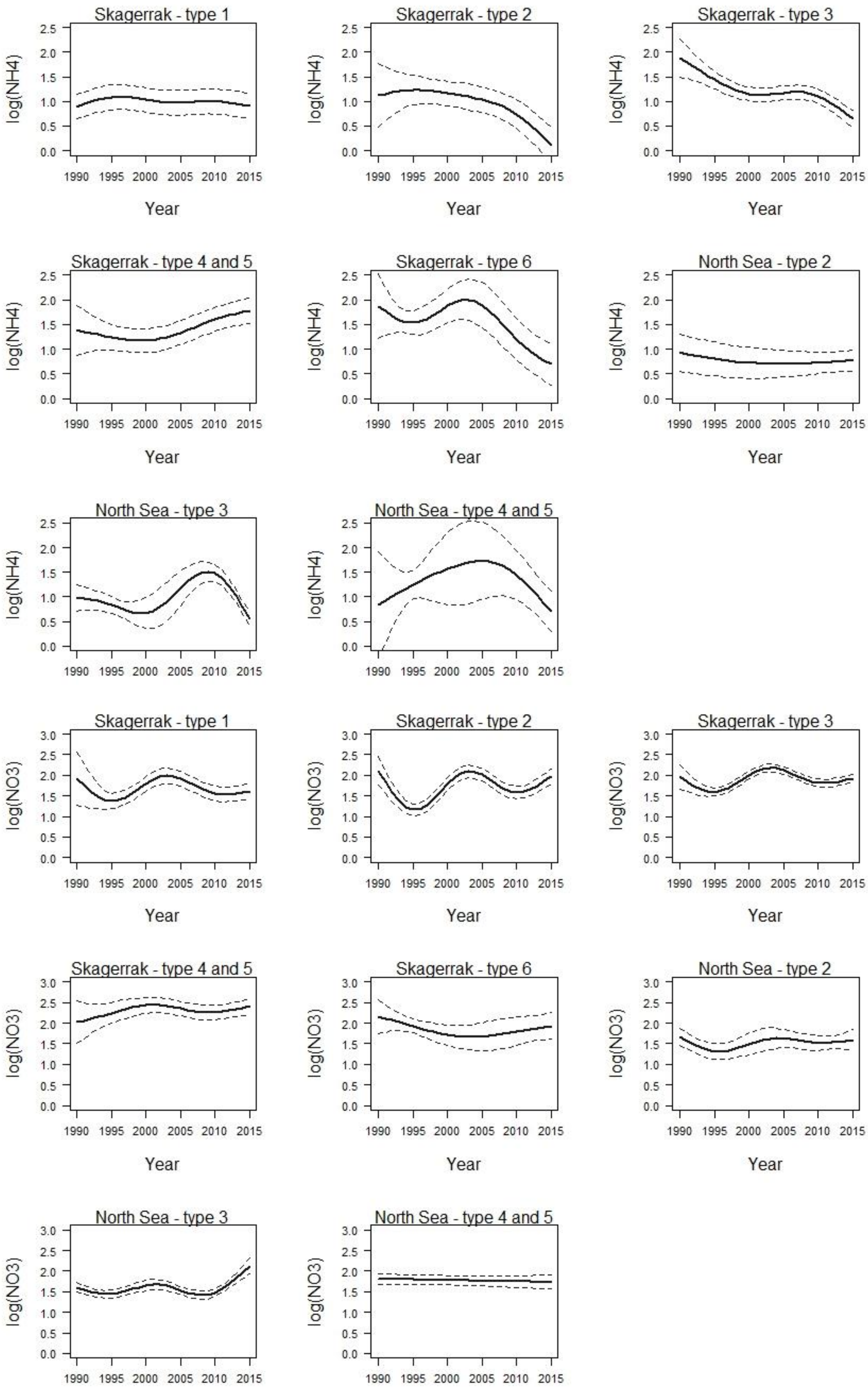
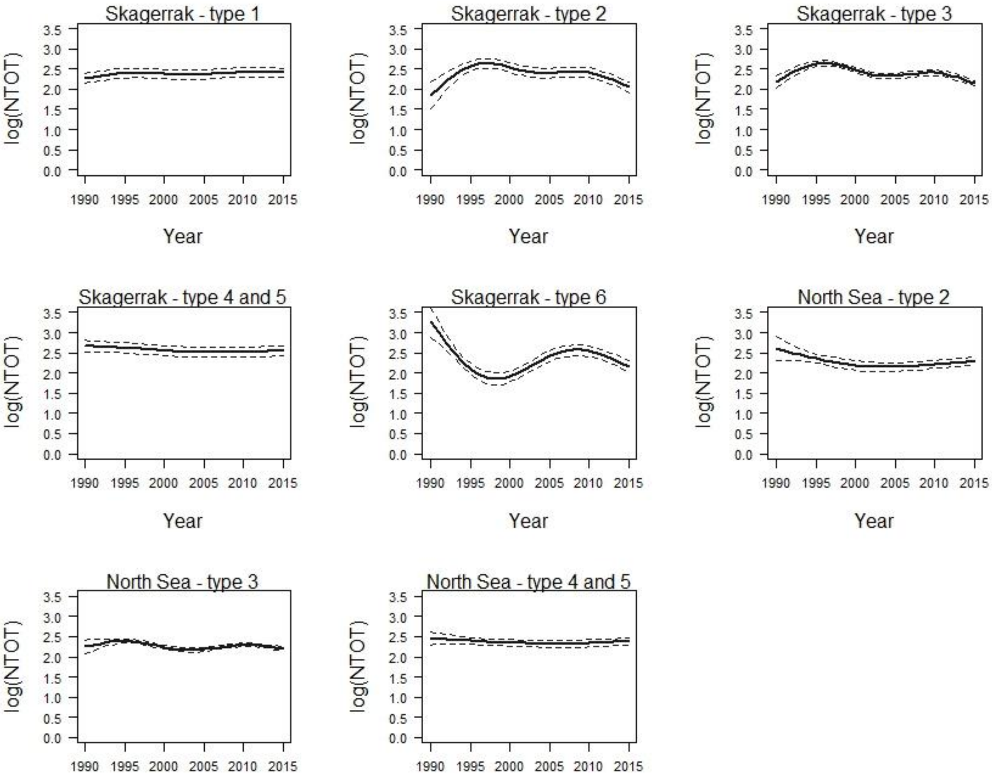
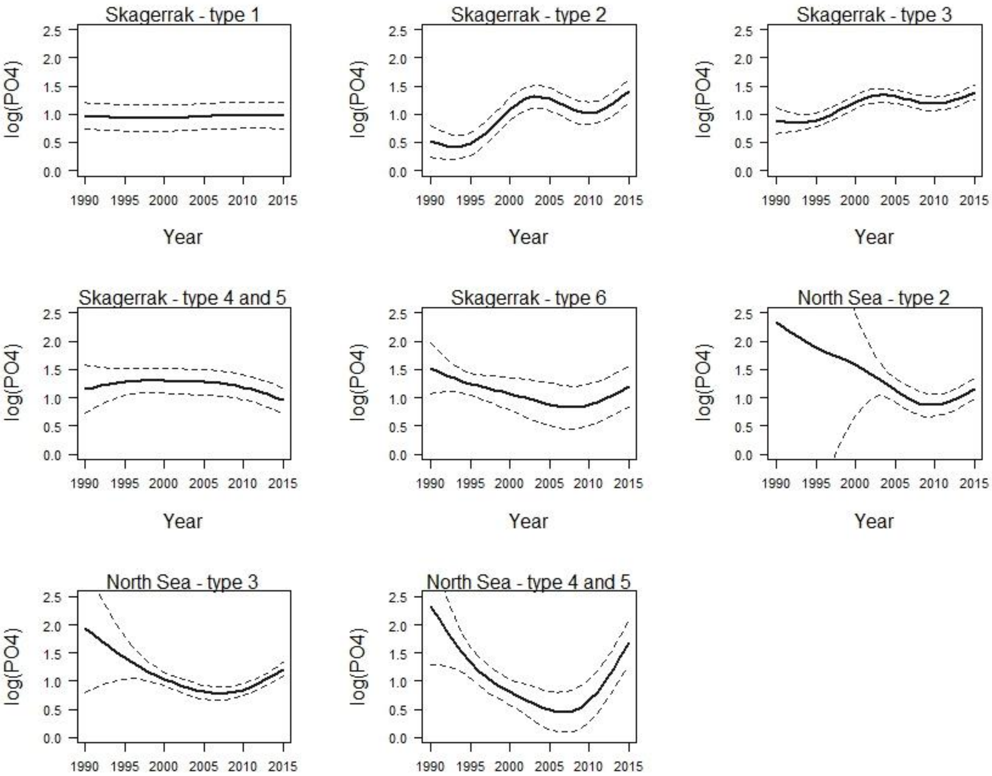
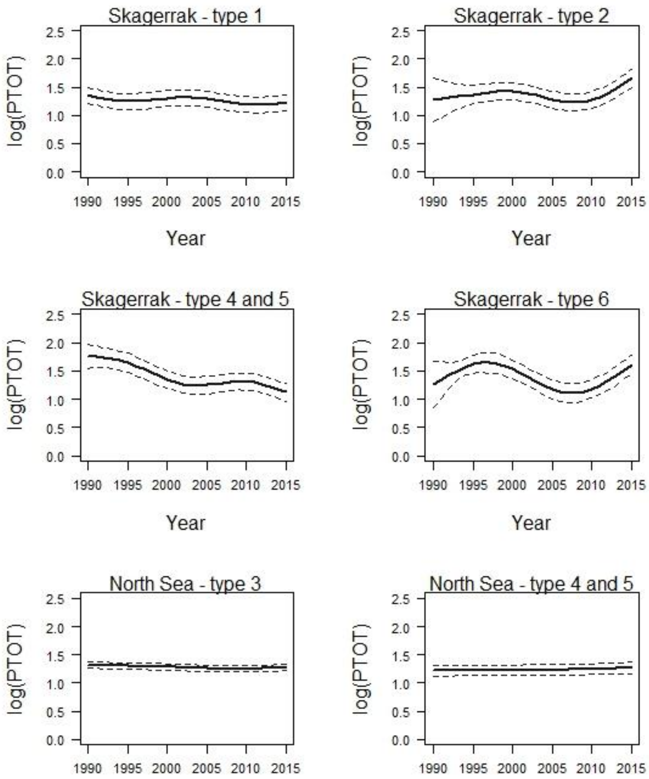
Appendix 1

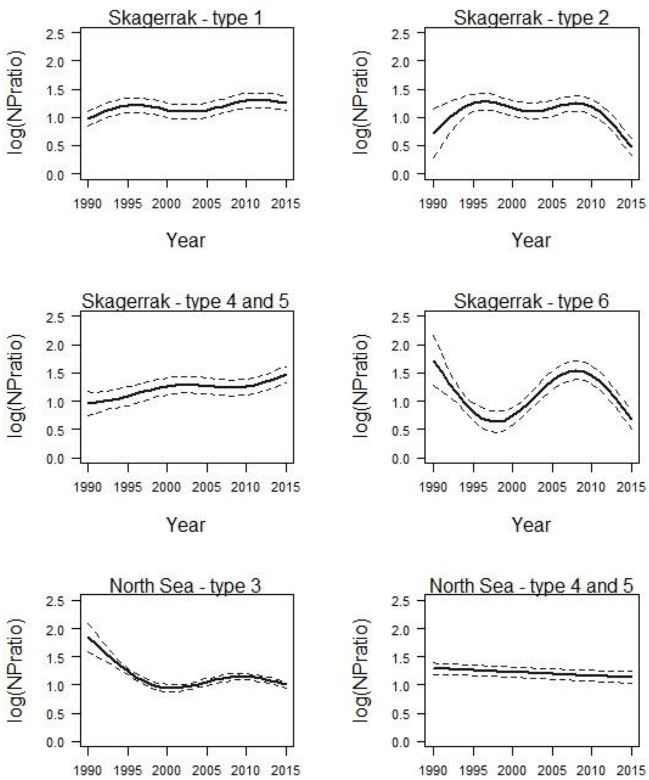
Results from GAM analysis for parameter levels, predicted for winter levels at 2m depth, for each WFD region and water type, separately.




Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(NTOT)
Year
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5
1990 1995 2000 2005 2010 2015

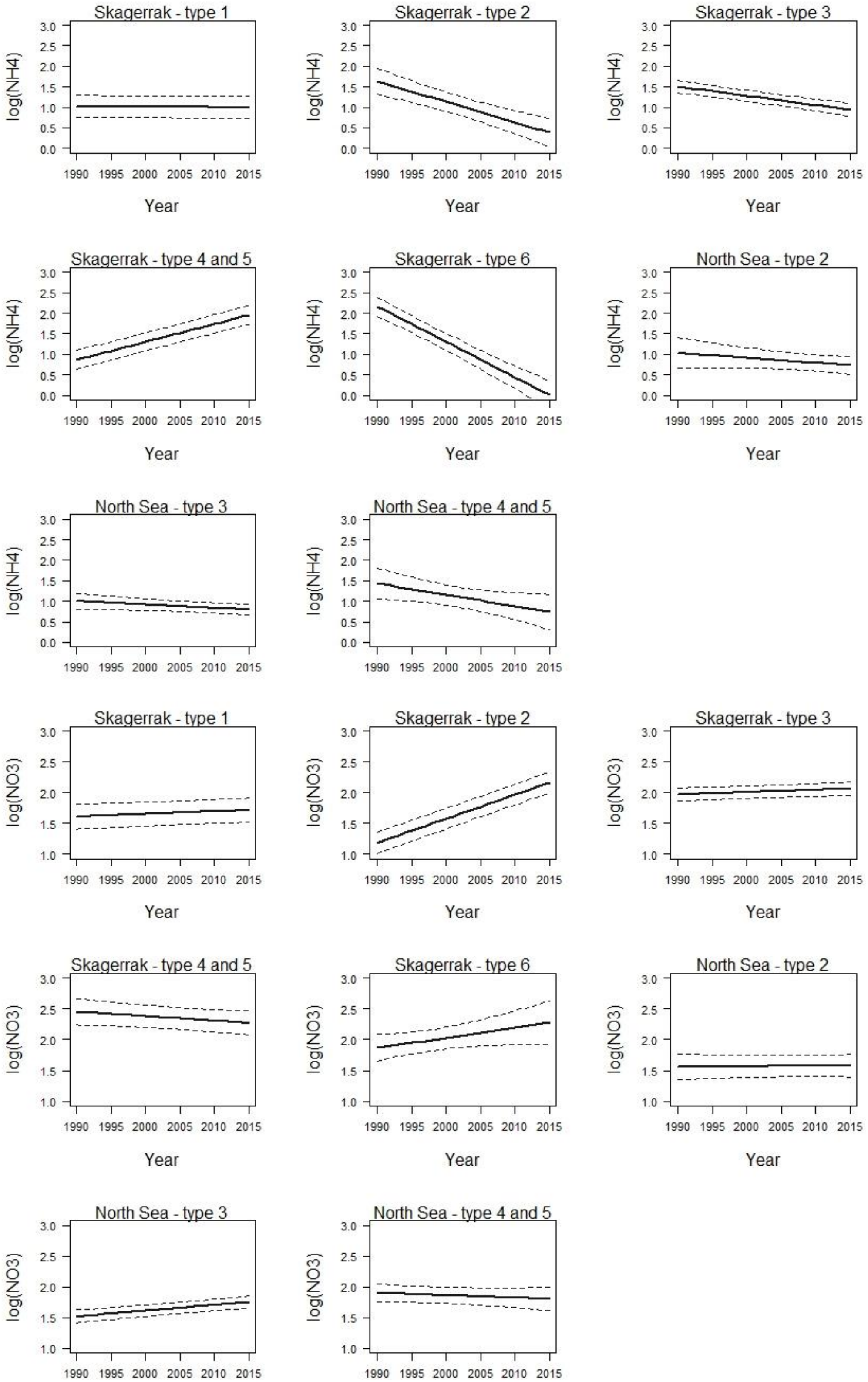

Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(PO4)
Year
0.0 0.5 1.0 1.5 2.0 2.5
1990 1995 2000 2005 2010 2015

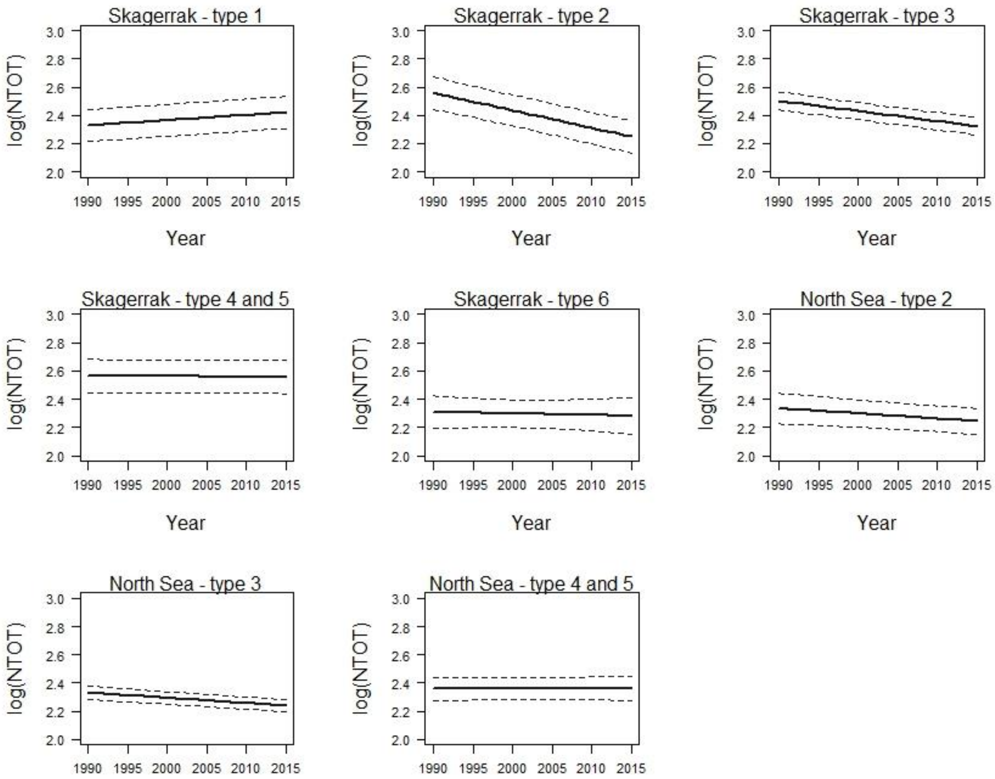

Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(PTOT)
Year
2.5
2.0
1.5
1.0
0.5
0.0
1990 1995 2000 2005 2010 2015

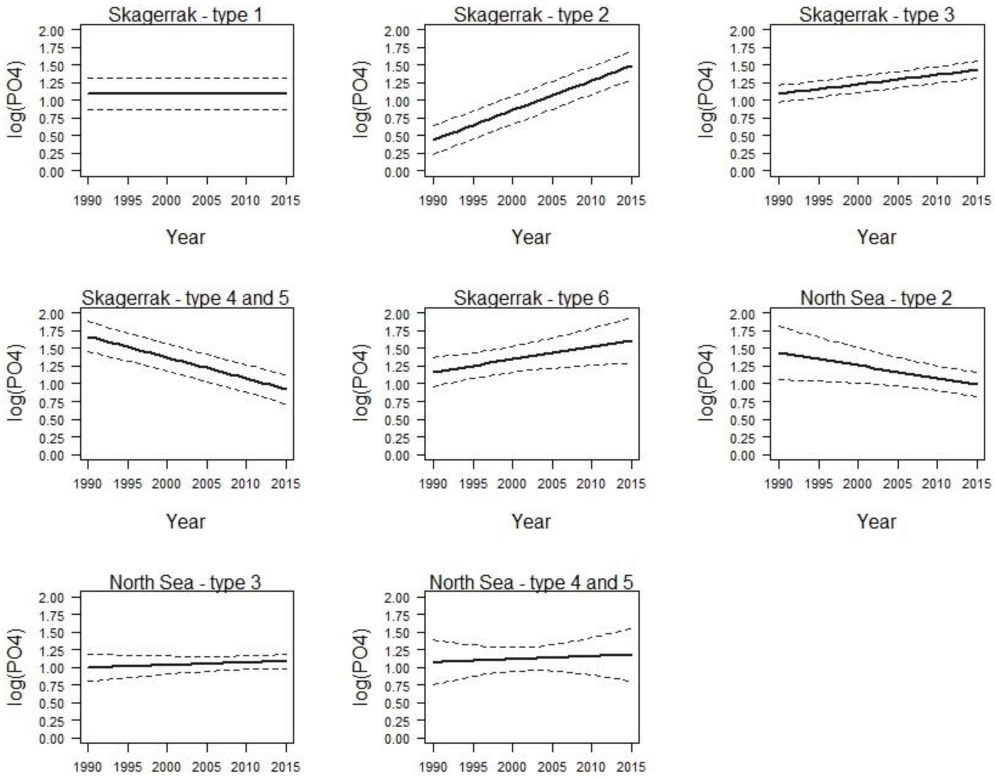

Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(NPratio)
Year
2.5
2.0
1.5
1.0
0.5
0.0
1990 1995 2000 2005 2010 2015

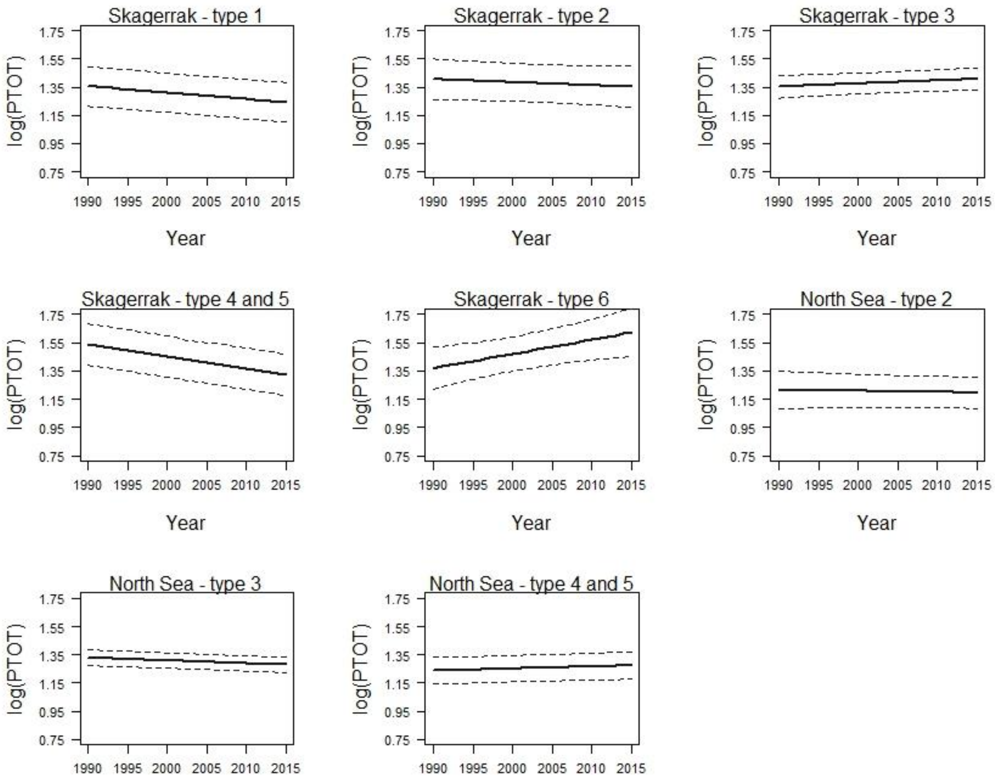
Appendix 2

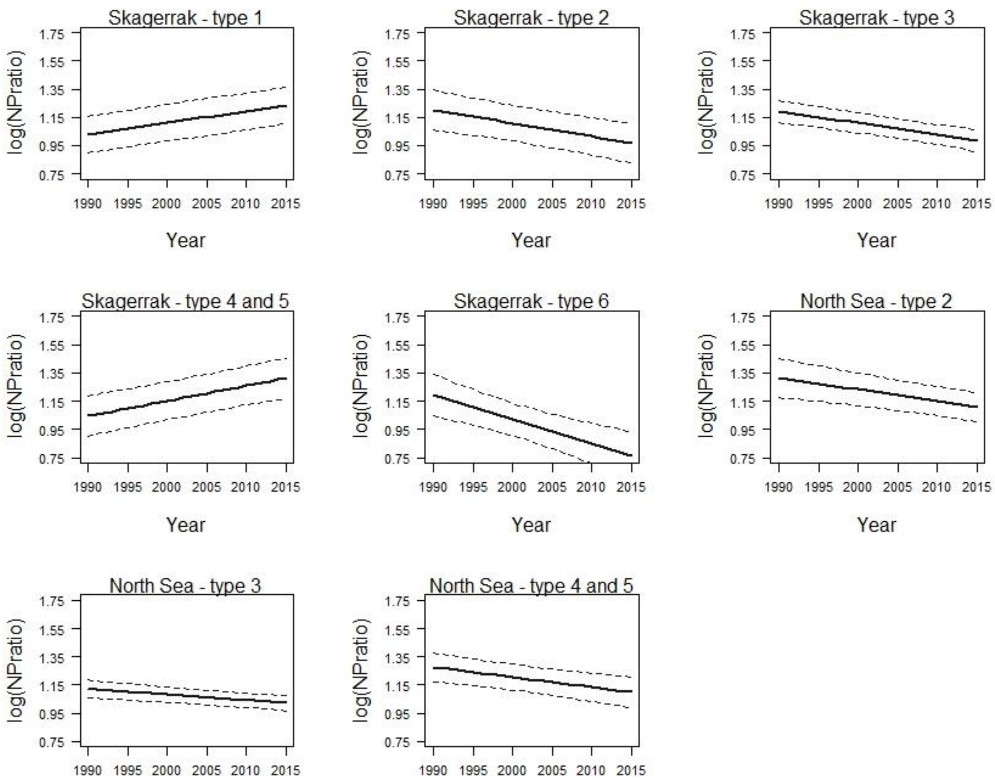
Results from linear GLM trend analysis, predicted for winter levels at 2m depth, for each WFD region and water type, separately.




Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(NTOT)
Year


Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(PO4)
Year


Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(PTOT)
1.75
1.55
1.35
1.15
0.95
0.75
1990 1995 2000 2005 2010 2015
Year


Skagerrak - type 1
Skagerrak - type 2
Skagerrak - type 3
Skagerrak - type 4 and 5
Skagerrak - type 6
North Sea - type 2
North Sea - type 3
North Sea - type 4 and 5
log(NPratio)
1.75
1.55
1.35
1.15
0.95
0.75
1990 1995 2000 2005 2010 2015
Year

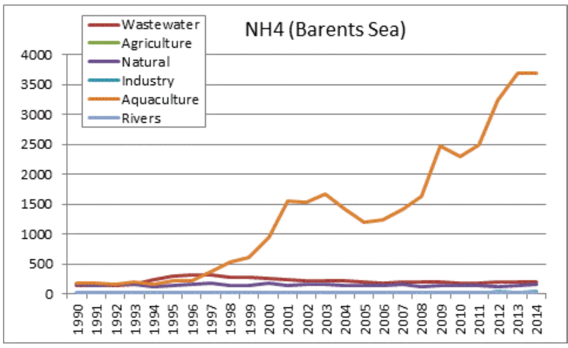
Appendix 3

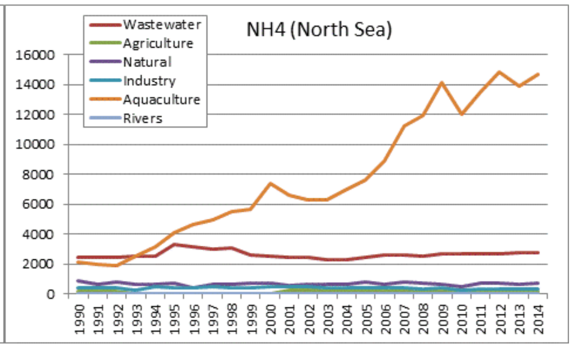
Linear trend slopes and p-values from GLM analyses.

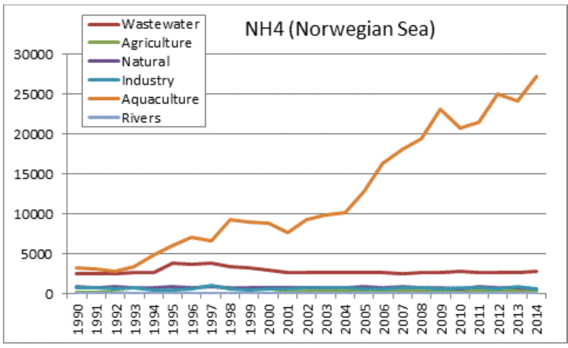
	NH4		NO2		NO3		NTOT		O2		OMETN		POC		PON		POP		PO4		PTOT		Npratio		SIO2	
Skagerrak	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p	Slope	p
Type 1	-0,0012	0,1952	0,0041	0,0003	0,0043	0,3852	0,0037	<0.0001	-0,0101	0,0096	0,3731	0,0958	0,0074	<0.0001	0,0118	<0.0001	-0,0005	0,1835	-0,0003	0,0216	-0,0046	0,0320	0,0083	<0.0001	-0,0015	0,0598
Type 2	-0,0501	0,0023	-0,0008	0,0017	0,0391	<0.0001	-0,0124	<0.0001	0,0192	<0.0001	0,1738	0,0518							0,0421	0,0000	-0,0021	0,6428	-0,0093	0,7256	0,0668	<0.0001
Type 3	-0,0228	0,2332	0,0007	0,0302	0,0038	0,4418	-0,0072	0,0316	-0,0664	<0.0001	0,2366	<0.0001							0,0136	0,0000	0,0022	0,1532	-0,0082	0,9991	0,0216	<0.0001
Type 4/5	0,0438	<0.0001	0,0210	0,0014	-0,0073	0,1326	-0,0002	0,0489	-0,0859	<0.0001									-0,0298	0,1449	-0,0087	0,0009	0,0107	<0.0001	-0,0192	0,0481
Type 6	-0,0863	<0.0001			0,0164	0,1000	-0,0010	0,4135	-0,1356	<0.0001	0,4322	0,1366							0,0178	0,0007	0,0101	0,0147	-0,0171	0,0685		
North Sea																										
Type 2	-0,0120	0,1500			0,0007	0,8395	-0,0037	0,0067	-0,0311	0,0001	1,2825	<0.0001							-0,0178	0,0192	-0,0008	0,6393	-0,0082	0,0001		
Type 3	-0,0082	0,6866			0,0093	0,0337	-0,0037	0,9766	-0,0016	0,0004	-0,0106	<0.0001							0,0036	0,0128	-0,0020	0,5077	-0,0040	0,0779		
Type 4/5	-0,0278	0,3039			-0,0039	0,3909	0,0002	0,0430	-0,0149	0,0951	0,0181	<0.0001							0,0042	0,1231	0,0015	0,2292	-0,0072	0,7342		

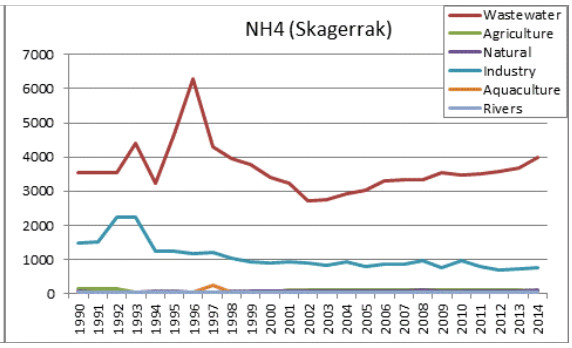
Appendix 4

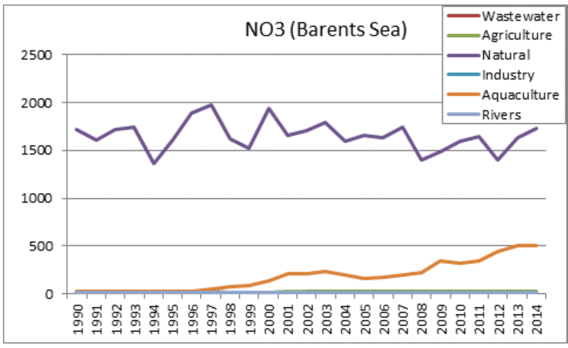
Changes in river inputs to the WFD regions, specified to source (waste water, agriculture, industry, aquaculture, rivers, and nature). Distinct changes in natural input of phosphorus from 2000-2001 are due to changes in background calculations. Numbers on y-axes are tonnes.

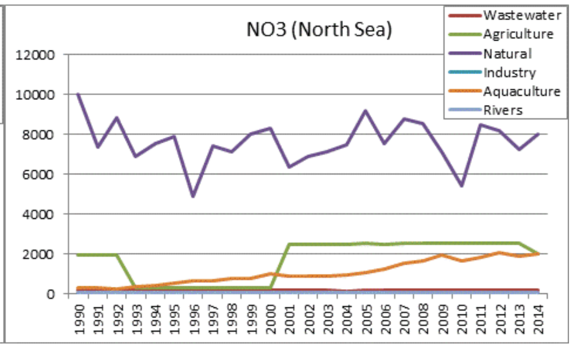


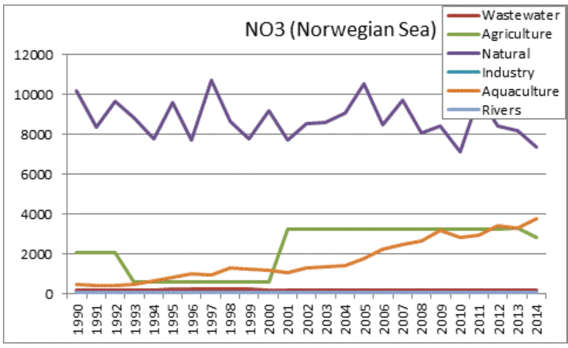


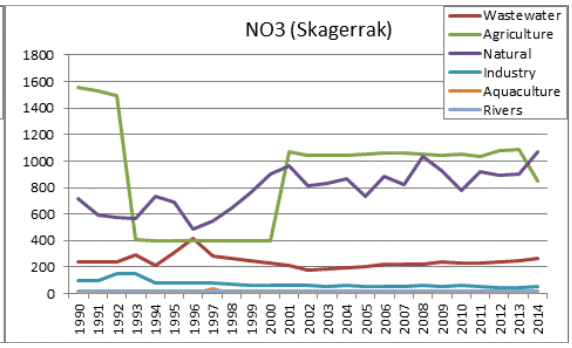


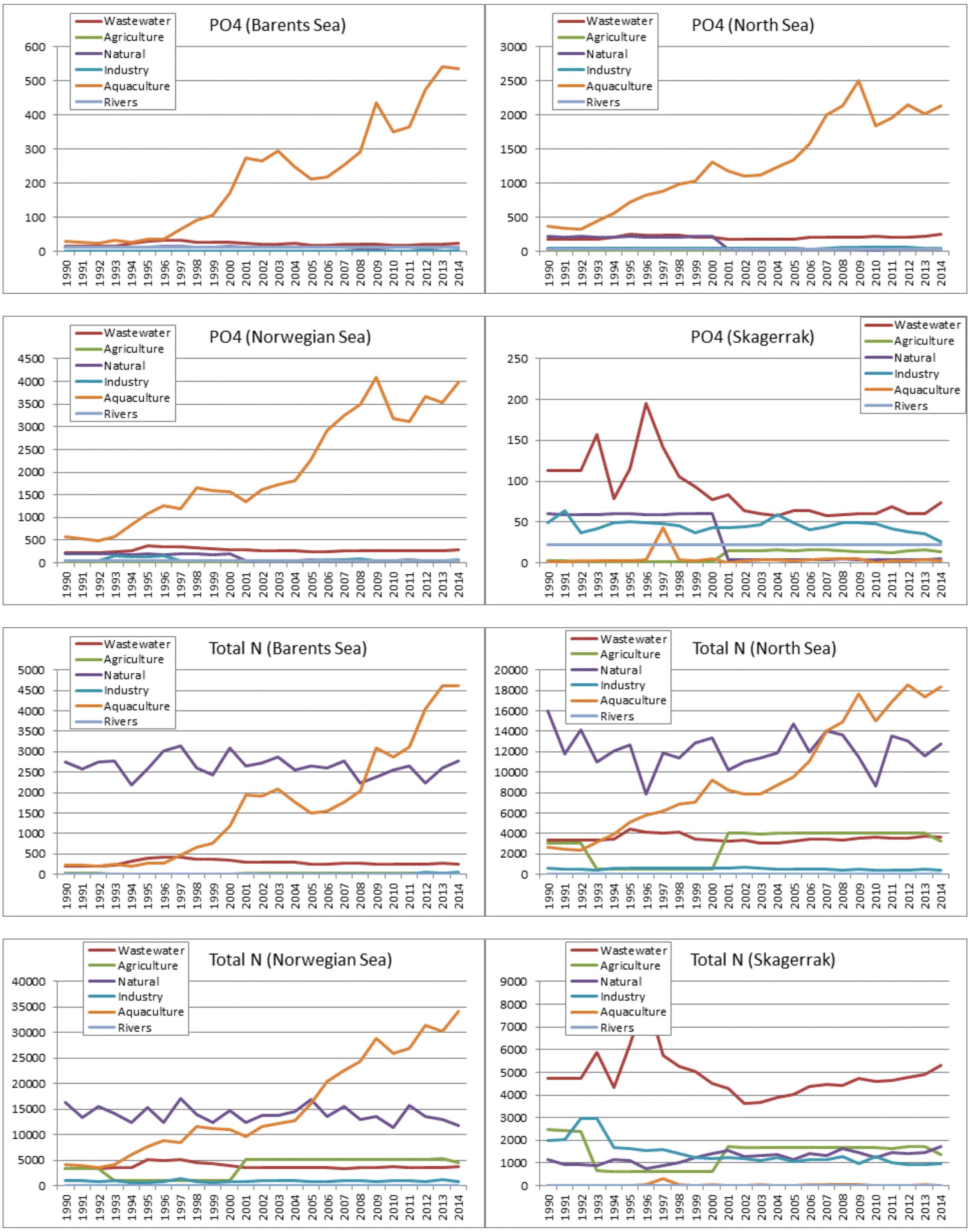


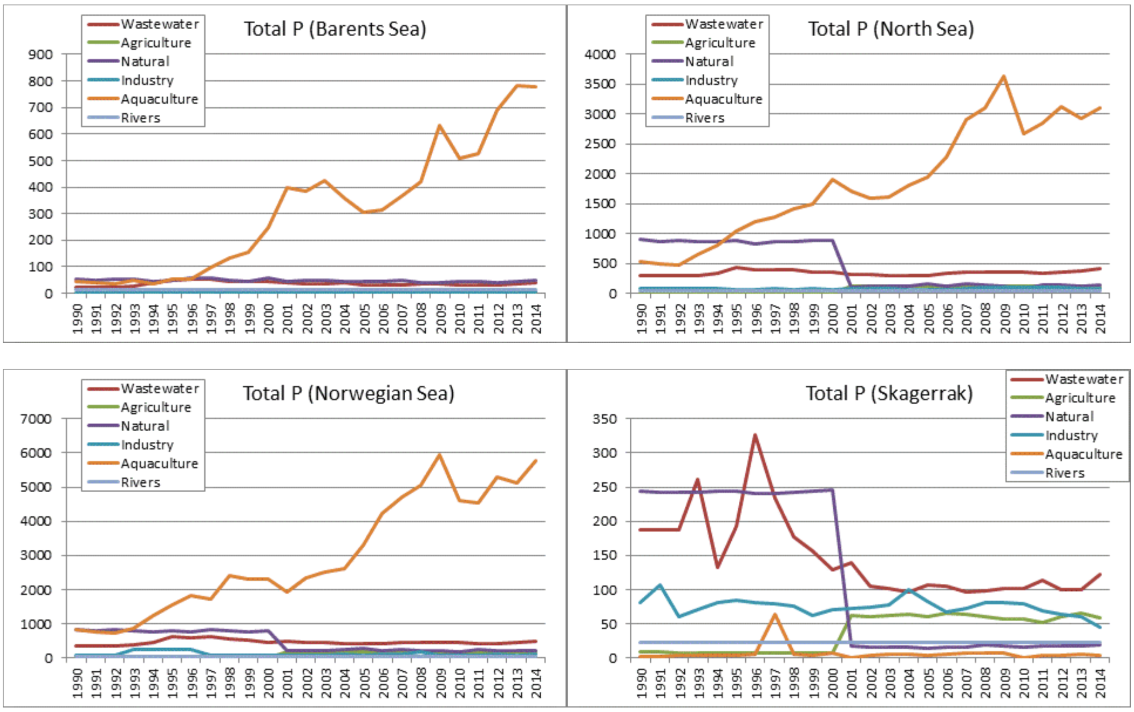









PO4 (Barents Sea)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers
PO4 (North Sea)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers
PO4 (Norwegian Sea)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers
PO4 (Skagerrak)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers
Total N (Barents Sea)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers
Total N (North Sea)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers
Total N (Norwegian Sea)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers
Total N (Skagerrak)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers


Total P (Barents Sea)
Total P (North Sea)
Total P (Norwegian Sea)
Total P (Skagerrak)
Wastewater
Agriculture
Natural
Industry
Aquaculture
Rivers

Appendix 5

Total dataset (number of observations) available for analyses, status and trend assessment. Included here is also data from deeper than 15m and for parameters not used in the assessment. See Chapter 3 for which data is used in the different calculations and analyses.

North Sea	Param.	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
WT1	NH4																									15	18
	NO2																										
	NO3																						64				
	DIN																										
	TOT N																						64	18		15	18
	O2	20	27	3	4	5	12			1													32	4	2		
	POC																										
	PON																										
	POP																										
	PO4																						64	18		15	18
	TOTP																						68	18		15	18
	N/P																						64	18		15	18
	SALIN	21	27	3	4	5	12			8																	
	SIO2																										
WT2	NH4	37					43																		105	184	108
	NO2																								83	88	
	NO3	37			21	7	43									18							124	12	83	84	
	DIN																								50	52	
	TOT N						42		4							18			9		13	22	124	56	140	215	103
	O2	373	26	17	11	23	95	10	20	7					6	15				12	29		62	26	120	154	191
	POC																		7		13	22					
	PON																		7		13	22					
	POP																		9		13	21					
	PO4															18			9				124	56	83	127	103
	TOTP				7	7	43		4							18			9		13	21	126	56	140	216	108
	N/P						42		4							18			9		13	21	124	56	140	214	103
	SALIN	372	26	17	11	23	111	10	21	31					6	15			9	14	41	22		5	198	124	189
	SIO2																								86	88	
WT3	NH4	11					123	4					16	32			9	16			108				144	434	159
	NO2																									77	
	NO3	123	216	232	308	112	122	21	9							254					180	2	491	113		77	
	DIN																									47	
	TOT N			2			123	74	36		8	72	48	67	58	254	9	20			115	24	557	328	144	1166	159
	O2	497	915	792	803	226	282	61	42	8	4	36	12	20	14	270		13			18		277	130	225	848	34
	POC																9	21			17	22	55	54		57	
	PON																9	21			17	22	55	55		57	
	POP																	18			17	21	66	55		57	
	PO4							4			8	72	48	68	58	5	9	21			216	2	557	330		227	159
	TOTP	112	212	213	214	25	123	74	36		8	72	48	68	58	254	9	21			239	23	559	330	144	1166	159
	N/P			2			122	74	36		8	72	48	67	58	254	9	20			113	23	557	328	144	1166	159
	SALI	48	91	60	62	19	30	6	4	3				5		27	9	3			52	2	54	429	21	761	34

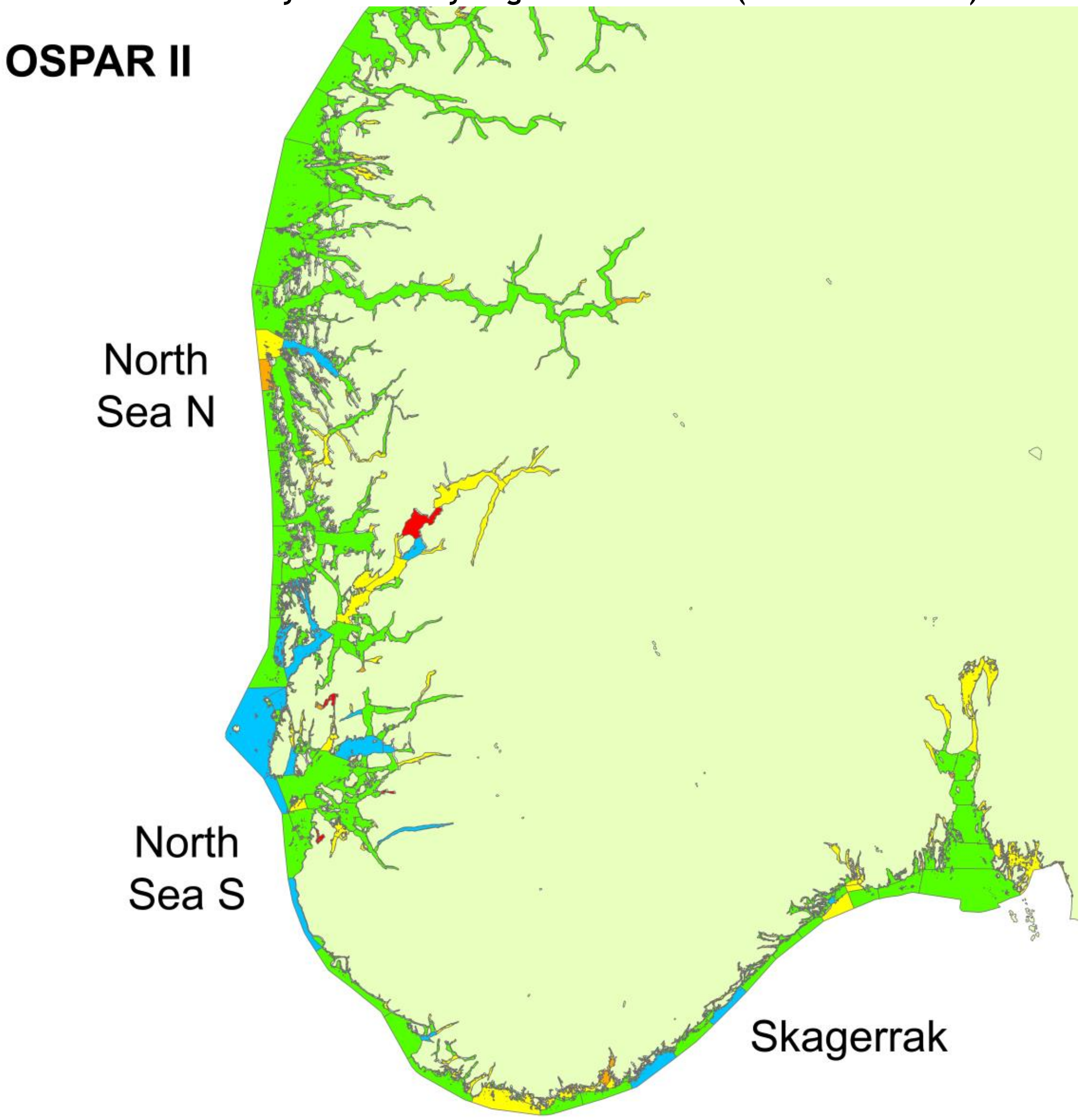
	N	2	4	2	7	2	6	6	2	3						5		4				2		3	5		
	SIO2																9	21						67		77	
WT4	NH4					48	34																		18	75	53
	NO2																										
	NO3	44	63	65	66	69	34					48	36			57							54	6			
	DIN																										
	TOTN					48	34		5			36	36			57							54	24	18	171	53
	O2	214	378	137	148	138	101	16		2		4	18	9	59	94	144			72	113		30	11	33	359	448
	POC																										
	PON																										
	POP																										
	PO4					48	2					46	24										54	24		45	53
	TOTP	46	66	68	58	48	34		5			36	36			57							54	24	18	171	52
	N/P					48	34		5			36	36			57							54	24	18	171	52
	SALIN	214	367	137	148	27	80	17		9			18	9	60	94	153			63	112			419	72	358	448
	SIO2																										
WT5	NH4							17																			
	NO2																										
	NO3				6			22																			
	DIN																										
	TOTN							22	2																		
	O2	34	83	5	13			18																			
	POC																										
	PON																										
	POP																										
	PO4							22																			
	TOTP				6			22	2																		
	N/P							22	2																		
	SALIN	34	83	5	13			24																			
	SIO2																										
WT6	NH4					24	2	16																			
	NO2																										
	NO3	24	25	36	43	24	2	29	7		6					53											
	DIN																										
	TOTN					24	2	30	8		6					53										104	
	O2	150	197	161	166	77	16	36	7		20					55										69	
	POC																										
	PON																										
	POP																										
	PO4					24	2	16																			
	TOTP	30	30	45	37	24	2	30	8		6					53										104	
	N/P					24	2	30	8		6					53										104	
	SALIN	136	197	162	166	46	10	35	7		23					55										53	
	SIO2																										

Skagerrak	Param.	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
WT1	NH4	337	495	432	288	285	289	289	298	252	320	298	336	351	285	196	188	187	176				139		94	95	337
	NO2						69	96	144	108									60	100	64	68			262	260	
	NO3						69	108	144	108			31	28	18	20	8	9	71	106	64	68			262	260	
	DIN																								94	95	
	TOTN	337	495	433	294	289	290	300	297	259	320	317	376	459	396	475	437	435	533	106	486	404	120	12	178	153	337
	O2		347	431	288	296	343	430	404	339	320	294	617	580	524	619	517	501	505	78	394	385	130		238	160	
	POC	237	356	325	246	234	234	233	240	208	257	240	240	306	264	316	305	306	338		269	255	95	11	10	10	237
	PON	237	352	325	246	230	233	233	239	208	257	240	240	306	270	318	306	306	338		319	260	95	11	10	10	237
	POP	241	361	325	246	227	234	233	228	209	257	241	240	310	270	312	306	306	338		317	301	114		10	11	241
	PO4	339	494	433	305	288	359	385	442	367	320	298	321	418	363	434	405	405	512	106	64	68	137	12	262	260	339
	TOTP	338	495	432	305	290	290	300	298	259	320	317	375	455	395	473	437	434	533	106	486	396	120	12	178	153	338
	N/P	337	495	432	293	289	290	300	297	259	320	317	375	455	395	473	437	434	533	106	486	396	120	12	178	153	337
	SALIN	339	494	438	306	291	357	457	442	368	313	407	635	601	538	648	541	581	593	88	1933	2347	120	12	269	148	339
	SIO2	337	495	433	290	290	359	385	441	367	320	298	298	400	356	423	399	400	485	106	64	68		12	262	260	337
WT2	NH4			2	4								64	50	36	35	22	24					55	55	44	44	
	NO2						167	232	348	261									108	172	108	112			150	128	
	NO3			2	4		368	512	652	261			48	52	34	45	17	16	122	182	108	112			155	128	
	DIN																								44	44	
	TOTN			2	4		3	6					80	60	52	60	32	28	122	184	108	110	110	122	123	114	
	O2			4	138		399	537	620	197			483	415	378	409	218	198	173	161	104	106	113	109	124	112	
	POC																						55	67	55	55	
	PON																						55	67	55	55	
	POP																						66	55	55	55	
	PO4			2	4		341	470	615	261			32	21	17	22	15	11	122	184	108	112	110	122	155	128	
	TOTP			2	4		3	6					79	56	52	57	31	25	122	184	108	110	110	122	123	114	
	N/P			2	4		3	6					79	56	52	57	31	25	122	184	108	110	110	122	123	114	
	SALIN			5	147		460	631	747	252			483	416	378	409	218	200	173	171	2379	3120	110	122	248	49	
	SIO2						377	520	672	261									114	184	108	112		122	155	128	
WT3	NH4			16	11		5	6	6				255	217	161	176	113	46	10				110	110	110	109	
	NO2						138	192	288	216									164	247	128	144		8	315	311	
	NO3			16	12		155	226	311	216			197	220	152	208	113	38	199	256	128	144		8	315	311	
	DIN																							4	110	109	
	TOTN			16	11		10	18	6				286	270	192	278	140	53	180	257	177	208	187	229	237	230	
	O2			14	583		357	468	431	160	3	6	912	874	719	855	439	175	253	188	153	182	208	197	286	248	
	POC																				35	50	120	120	121	121	
	PON																				35	51	122	121	121	121	
	POP																				35	50	132	121	121	121	
	PO4			16	12		155	214	311	216			124	126	69	129	50	24	198	257	128	144	207	206	315	311	
	TOTP			16	11		10	18	6				286	240	188	273	129	53	180	257	177	208	187	217	237	230	
	N/P			16	11		10	18	6				286	240	188	273	129	53	180	257	177	208	187	217	237	230	
	SALI			17	60		38	82	52	21	3	6	90	89	71	85	43	18	26	24	27	38	20	94	45	34	

	N			8		2	7	1	4			9	0	5	7	9	7	1	6	39	88	7	2	2	4
						15	20	30	21									17	25	12	14		20	31	31
	SIO2					0	8	5	6									5	7	8	4		6	5	1
WT4	NH4		2	5								22	21	20	24	52	13	4							
	NO2																		20	16	20			30	36
	NO3		2	5								23	26	26	28	66	14	12	24	16	20			30	36
	DIN																								
	TOT		2	5								24	26	26	28	66	14	12	24	16	18			10	8
	N																								
			2	2								65	70	75	82	15	34	10	10	8	10			50	20
	O2															4									
	POC																								
	PON																								
	POP																								
	PO4		2	5								14	14	17	18	32	10	11	24	16	20			30	36
	TOT		2	5								24	26	26	28	60	14	12	24	16	18			10	8
	P																								
	N/P		2	5								24	26	26	28	60	14	12	24	16	18			10	8
	SALI		2	5								71	72	75	82	15	34	17	30	24	30			40	56
	N															4				0	0				
	SIO2																	8	24	16	20			30	36
			1	2								24	30	19	32	24	38	5			7	6	9	6	18
WT5	NH4																								4
	NO2																	32	42	16	16			51	53
	NO3		1	2								24	36	24	40	28	41	40	42	16	23	6	9	57	57
	DIN																								
	TOT	5	1	2								24	36	24	40	28	43	38	44	21	23	6	9	23	19
	N																								6
		4	2	21		88	90	96				83	13	96	17	12	10	54	21	8	8			14	42
	O2			6									3		6	6	7							1	
	POC																								
	PON																								
	POP																								
	PO4		1	2								12	19	12	22	13	24	38	42	16	23	6	9	57	57
	TOT	5	1	2								22	33	23	38	27	42	37	44	21	23	6	9	23	19
	P																								6
		5	1	2								22	33	23	38	27	42	37	44	21	23	6	9	23	19
	N/P																								6
	SALI		4	21		89	90	96				10	10	70	14	81	96	64	39	82	82			12	14
	N			8								0	8		1					0	0			4	7
	SIO2																	32	42	16	16			51	53
WT6	NH4		11	8		67							12	5								50	55	55	55
	NO2																							77	77
	NO3		9	13		77							12	5										77	77
	DIN																							55	55
	TOT		11	8		27		14				12	13	5								60	93	77	77
	N																								
		18	29	11		20		54		35	79	10	27	9								63	65	77	77
	O2					5						0													
	POC																					40	44	44	43
	PON																					40	44	44	43
	POP																					50	44	43	45
	PO4		11	13		76							11	5								60	65	77	77
	TOT		11	8		27		13				12	12	5								60	85	77	77
	P																								
	N/P		11	8		27		13				12	12	5								60	85	77	77
	SALI	16	45	28		25		18		34	77	10	36	16								60	65	77	
	N					6						0													
	SIO2																						65	77	77

Appendix 6

Classification of water bodies according to the Waterframework Directive for coastal waters of Norway assessed by Regional autorities (from vannett.no).



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The Norwegian
Environment Agency is working for a clean and diverse environment. Our primary tasks are to reduce greenhouse gas emissions, manage Norwegian nature, and prevent pollution.

We are a government agency under the Ministry of Climate and Environment and have 700 employees at our two offices in Trondheim and Oslo and at the Norwegian Nature Inspectorate's more than sixty local offices.

We implement and give advice on the development of climate and environmental policy. We are professionally independent. This means that we act independently in the individual cases that we decide and when we communicate knowledge and information or give advice.

Our principal functions include collating and communicating environmental information, exercising regulatory authority, supervising and guiding regional and local government level, giving professional and technical advice, and participating in international environmental activities.