OSPAR COMMISSION

EcoQO Handbook

Handbook for the application of Ecological Quality Objectives in the North Sea

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OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.

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Executive Summary

Ecological Quality Objectives (EcoQOs) have been developed as tools to help OSPAR fulfil its commitment to apply the ecosystem approach to the management of human activities that may affect the marine environment. Within the concept of a “healthy and sustainable marine ecosystem” for present and future generations, EcoQOs are intended to provide a set of clear environmental indicators stating aspirations for a healthy North Sea as part of the ecosystem approach. An introduction to the EcoQO system is given in the document Ecological Quality Objectives – Working towards a healthy North Sea (OSPAR publication 2007/318). Section B gives guidance on the implementation of those EcoQOs being applied in the North Sea. Section C gives guidance on the development of new EcoQOs.

This EcoQO handbook is intended to provide a basis for the implementation of Ecological Quality Objectives (EcoQOs) in the North Sea during the period 2007 - 2010 as set out in the OSPAR agreement on the application of the EcoQO system (Agreement number 2006-4). Section B gives guidance on the implementation of those EcoQOs being applied in the North Sea. The EcoQOs covered concern commercial fish species, marine mammals, seabirds, fish communities, benthic communities and eutrophication and their interactions with human activities. For each EcoQO details are given on the overall aims, the methodology, quality assurance, costs of application, reporting requirements and the method of application by the lead country. On the basis of the application of EcoQOs in the North Sea, OSPAR has prepared an evaluations of the results of the EcoQO system in 2009 (OSPAR Publication 2009/406) as a contribution to the Quality Status report 2010.

Further EcoQOs are being developed by OSPAR. Guidance on the steps to be taken for the development of new EcoQOs is given in section C of this handbook.

The handbook is intended to be updated periodically and following initial publication will need to be updated to take into account the results of these evaluations. The edition number indicates which update of the handbook the reader is using.

Récapitulatif

Les Objectifs de qualité écologique (EcoQO) sont des outils qui ont été développés pour permettre à OSPAR de remplir son engagement d’appliquer une approche écosystémique à la gestion des activités de l’homme qui risquent d’affecter le milieu marin. Les EcoQO ont pour objectif de constituer une série d’indicateurs environnementaux clairs qui déclarent les aspirations pour une mer du Nord saine faisant partie de l’approche écosystémique, dans le cadre du concept d’un «écosystème marin sain et durable» pour les générations actuelles et futures. Le document «Objectifs de qualité écologique – travailler dans le sens d’une mer du Nord saine (publication OSPAR 2007/318) présente le système d’EcoQO. La section B donne des orientations sur la mise en œuvre des EcoQO qui sont appliqués dans la mer du Nord. La section C donne des orientations sur le développement de nouveaux EcoQO ou d’EcoQO moins perfectionnés.

Le présent manuel d’EcoQO a pour intention de constituer une base pour la mise en oeuvre des EcoQO dans la mer du Nord entre 2007 et 2010 tel qu’il est défini dans l’accord OSPAR sur l’application du système d’EcoQO (accord numéro 2006-4). La section B donne des orientations sur la mise en œuvre des EcoQO qui sont appliqués dans la mer du Nord. Les EcoQO couverts concernent les espèces halieutiques commerciales, les mammifères marins, les oiseaux de mer, les communautés benthiques et l’eutrophisation ainsi que leurs interactions avec les activités de l’homme. Pour chaque EcoQO des détails sont fournis sur l’objectif général, la méthodologie, l’assurance de qualité, le coût de l’application, les exigences de notification et la méthode d’application par le pays pilote. OSPAR préparera des évaluations des résultats du système d’EcoQO en 2008 et 2009, à partir de l’application des EcoQO dans la mer du Nord.

OSPAR est en train de développer des EcoQO supplémentaires dans le but de mettre en place une série exhaustive et cohérente d'EcoQO pour la mer du Nord. La section C du présent manuel donne des orientations sur les mesures à prendre pour développer de nouveaux EcoQO.

Il est prévu d'actualiser périodiquement le manuel. Celui-ci devra être actualisé après sa publication initiale afin de tenir compte des résultats de ces évaluations. Le numéro de l'édition indique quelle version actualisée est utilisée par le lecteur.

A. Introduction and Background

1. Introduction

This EcoQO handbook is intended to provide a basis for the implementation of Ecological Quality Objectives (EcoQOs) in the North Sea. This implementation follows up the outcome of the Report on the North Sea Pilot Project on EcoQOs published by OSPAR in 2006 (OSPAR Publication 2006/239) and the Evaluation of the Results of the EcoQO system in the North Sea (OSPAR Publication 2009/406). A summarised version of this evaluation has been published as OSPAR Publication 2009/404)

The EcoQOs currently being applied in the North Sea are as follows:

1.1 Spawning stock biomass of commercial fish species (*lead country:* Norway);

2.1a Harbour seal population trends (*lead country:* UK);

2.1b Grey seal population trend (*lead country:* UK);

2.2 Bycatch of harbour porpoise (*lead country:* UK);

3.1 Proportion of oiled common guillemots amongst those found dead or dying on beaches (*lead country:* The Netherlands);

3.3 Plastic particles in seabirds' stomachs (*lead country*: The Netherlands)

4.1 proportion of large fish in fish communities (*lead country*, Norway)

5.1 Imposex in dog whelks (*Nucella lapillus*) (*lead country*: Belgium & Portugal);

9.1 Eutrophication Status of the North Sea (*lead country*: The Netherlands & Norway)

9.1.1 Winter nutrient (DIN and DIP) concentrations;

9.1.2 Phytoplankton chlorophyll a;

9.1.3 Phytoplankton indicator species for eutrophication;

9.1.4 Oxygen;

9.1.5 Kills in zoobenthos in relation to eutrophication

Section B of this handbook provides guidance on the implementation of each of the EcoQOs listed above. The guidance is intended to assist Contracting Parties to support the work of Lead Parties in assembling the data on each EcoQO and producing evaluations of each EcoQO.

Evaluations of individual EcoQOs (or, as the case may be the overview of the integrated suite of eutrophication EcoQOs) will aim to cover, as far as possible, the following issues:

a. whether the EcoQO is met, and if not, why not;

b. (potential) consequences of failing to meet the EcoQO. The consequences of failing to meet an EcoQO will vary case by case and will depend on whether the EcoQO is a target, limit or indicator. Consequences may be viewed from an ecological perspective, or the perspective of the Contracting Parties attempting to manage human activities in such a way as to meet the

EcoQO. If an EcoQO is not met, a study should be initiated to examine the reasons why and, on the basis of this, to determine future action.;

c. suitability of present monitoring and reporting;

d. developments in harmonisation of monitoring and reporting schemes;

e. costs of present monitoring and reporting;

f. extra costs of harmonising the monitoring;

g. performance of the EcoQO in terms of the ICES criteria for good EcoQOs and with regard to the Ecosystem Approach to management (both within OSPAR and the EC Marine Strategy Framework Directive (MSFD));

h. the specific linkages with the MSFD and how the EcoQO might be used in relation to the MSFD initial assessment, drawing up programmes and measures and elaborating GES;

i. gaps in knowledge, present conditions that hamper the implementation process and ways and means to overcome these problems;

j. effectiveness of communication, *i.e.* amount of support and knowledge on this EcoQO among stakeholders; and

k. whether the status of the EcoQO should be target, limit or indicator;

l. if needed, a proposal for modification and improvement of the EcoQO, including consideration on whether the EcoQOs set originally in 1999 would require revision in the light of the timing for GES under the MSD and are consistent with other regional agreements and legislation;

m. proposals for possible milestones up to the achievement of the objective;

n. potential applicability of the EcoQO in other OSPAR regions than the North Sea;

Further EcoQOs are being developed by OSPAR, particularly for the remaining ecological quality objectives, with the aim of developing a comprehensive and coherent set of EcoQOs for the North Sea. Guidance on the steps to be taken for the development of new EcoQOs is given in section C of this handbook.

The handbook will be updated from time to time both to adjust the existing guidance, in the light of experience with its use, and to include guidance on any of the EcoQOs that are currently under development which are added to the above set. For this reason there are gaps at some sections of this version of the handbook where text will be developed in due course. The current edition number and date indicates which update of the handbook the reader is using.

2. Overview of the EcoQO system and glossary of key terms

The EcoQO system is a tool to help OSPAR fulfil its commitment to apply the ecosystem approach to the management of human activities that may affect the marine environment. The underlying concept is that of a “healthy and sustainable marine ecosystem”. As the third recital to the OSPAR Convention says, the aim is to manage “human activities in such a way that the marine ecosystem will continue to sustain the legitimate uses of the sea and will continue to meet the needs of present and future generations”

In the context of the ecosystem approach, marine ecological quality is an expression of the structure and functioning of a marine ecosystem, taking into account its biological community and its natural physiography, geography and climate, as well as physical and chemical conditions, including those resulting from human activities. Ecosystems can be defined at a range of scales. In this context, the relevant ecosystem needs to be specified at a scale which relates to sensible management units.

The system of EcoQOs operates at two complementary levels:

a. reaching a judgement on the overall ecological quality of the marine environment;

b. considering the separate aspects of the marine environment, in order to derive policy conclusions on those aspects.

The basic requirements for the system of EcoQOs are agreements on:

a. the aspects of the marine environment that must be considered in forming a judgement on the overall ecological quality of that environment;

b. the way in which to structure the process of reaching both judgements on overall ecological quality and policy conclusions on the separate aspects;

c. the tasks that OSPAR must carry out to implement the system of EcoQOs.

In following this process, and to avoid confusion, it is essential to be careful in the use of the different terms.

Ecological Quality (EcoQ) can best be defined as "*An overall expression of the structure and function of the marine ecosystem taking into account the biological community and natural physiographic, geographic and climatic factors as well as physical and chemical conditions including those resulting from human activities*."

Within this overall concept, **Ecological Quality Issues** are the fields in which it is appropriate to attempt to measure aspects of the general ecological quality of the marine ecosystem under consideration. These have been selected as:

1. Commercial fish species;
2. Threatened and declining species;
3. Sea mammals;
4. Seabirds;
5. Fish communities;
6. Benthic communities;
7. Plankton communities;
8. Habitats;
9. Nutrient budgets and production; and
10. Oxygen consumption.

Under each of these issues, the **Ecological Quality Elements** are the individual aspects of ecological quality on which it is appropriate to focus. The number of elements selected under each of the issues will vary.

An **Ecological Quality Objective (EcoQO):** is the desired level of an ecological quality. Such a level may be set in relation to a reference level.

The "**reference level**" is the level where the anthropogenic influence on the ecological system is minimal. Terms such as "reference conditions" or "background conditions" are also used interchangeably with "reference level". In the context of eutrophication, the reference level is referred to as "background concentration" or "background level". In this use, "background concentration" is defined, in general, as salinity-related and/or specific to a particular area, and which has been derived from data relating to a particular (usually offshore) area or from historic data.

There will be a one-to-one relationship between ecological quality elements and ecological quality objectives. The desired level of ecological quality will be set in relation to a metric which can be objectively verified. EcoQOs can take the form of targets (values where there is a commitment to attain them), limits (values where there is a commitment to avoid breaching them) or indicators (values which simply show what is happening). In this report each EcoQO is provisionally classified as a target, a limit or an indicator.

For the purpose of eutrophication, the desired levels of ecological quality (the EcoQOs) are referred to as "**assessment levels**". They are based on levels of increased concentrations and trends as well as on shifts, changes or occurrence to take account of natural variability and to allow some eutrophication (or 'slight disturbance' in the terminology for the Water Framework Directive). Parameters which are found to be at levels above the appropriate assessment levels are referred to as "**elevated levels**".

An overview of the EcoQO system is given in Table 2.

Table 2. Overview table of the EcoQO system for the North Sea

Ecological quality issues, related ecological quality elements and corresponding ecological quality objectives (EcoQOs). EcoQOs that are currently under development are shown in plain italic text

Ecological quality Issue	**Ecological quality element and related ecological quality objective (EcoQO*)***
1. Commercial fish species	1.1 **Spawning stock biomass of commercial fish species in the North Sea** Above precautionary reference points[1] for commercial fish species where those have been agreed by the competent authority for fisheries management
2. Marine mammals	2.1 **Seal population trends in the North Sea** a. Harbour seal population size: Taking into account natural population dynamics and trends, there should be no decline in harbour seal population size (as measured by numbers hauled out) of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years) within any of eleven sub-units of the North Sea. These sub-units are: Shetland; Orkney; North and East Scotland; South-East Scotland; the Greater Wash/Scroby Sands; the Netherlands Delta area; the Wadden Sea; Heligoland; Limfjord; the Kattegat, the Skagerrak and the Oslofjord; the west coast of Norway south of 62°N. b. Grey seal pup production: Taking into account natural population dynamics and trends, there should be no decline in pup production of grey seals of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years), within any of nine sub-units of the North Sea. These sub-units are: Orkney; Firth of Forth; the Farne Islands; the Greater Wash; the French North Sea and Channel coasts; the Netherlands coast; the Schleswig-Holstein Wadden Sea; Heligoland; Kjørholmane (Rogaland).[2] 2.2 **By-catch of harbour porpoises** Annual by-catch levels should be reduced to below 1.7% of the best population estimate

[1] In this context 'reference points' are those for spawning stock biomass, also taking into account fishing mortality, where these have been agreed by the competent authority for fisheries management.

[2] Revised wording agreed by BDC 2008

Ecological quality Issue	Ecological quality element and related ecological quality objective (EcoQO*)*
3. Seabirds	3.1 **Proportion of oiled common guillemots among those found dead or dying on beaches** 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.[3] 3.2 **Mercury and organohalogen concentrations in seabird eggs** *a. Mercury: The average concentrations of mercury in the fresh mass of ten eggs from separate clutches of common tern (Sterna hirundo) and Eurasian oystercatcher (Haematopus ostralegus) breeding adjacent to the estuaries of the Rivers Elbe, Weser, Ems, Rhine/Scheldt, Thames, Humber, Tees, and Forth, should not significantly exceed concentrations in the fresh mass of ten eggs from separate clutches of the same species breeding in similar (but not industrial) habitats in south-western Norway and in the Moray Firth* *b. Organohalogens: For each site, the average concentrations in fresh mass of the eggs of common tern (Sterna hirundo) and Eurasian oystercatcher (Haematopus ostralegus) should not exceed: 20 ng g−1 of PCBs; 10 ng g−1 of DDT and metabolites; and 2 ng g−1 of HCB and of HCH. Sampling should be of ten eggs of each species from separate clutches of birds breeding adjacent to the estuaries of the Rivers Elbe, Weser, Ems, Rhine/Scheldt, Thames, Humber, Tees, and Forth, and in similar (but not industrial) habitats in south-western Norway and in the Moray Firth* 3.3 **Plastic particles in stomachs of seabirds** There should be less than 10% of northern fulmars (*Fulmarus glacialis*) having more than 0.1g plastic particles in the stomach in samples of 50 to 100 beach-washed fulmars from each of 4 to 5 areas of the North Sea over a period of at least five years 3.4 *Local sand eel availability to black-legged kittiwakes (under development)* *Breeding success of the black-legged kittiwake (Rissa tridactyla) should exceed (as a three-year running mean) 0.6 chicks per nest per year in each of the following coastal segments: Shetland, north Scotland, east Scotland, and east England* 3.5 *Seabird population trends as an index of seabird community health (under development)*
4. Fish communities	4.1 **Changes in the proportion of large fish and hence the average weight and average maximum length of the fish community** Over 30% of fish (by weight) should be greater than 40 cm in length

[3] Revised wording agreed by BDC 2008

Ecological quality Issue	Ecological quality element and related ecological quality objective (EcoQO)
5. Benthic communities	5.1 **Imposex in dog whelks (*Nucella lapillus*) or other selected gastropods** The average level of imposex in a sample of not less than 10 female dog whelks (*Nucella lapillus*) 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, Where Nucella does not occur naturally, or where it has become extinct, the red whelk (*Neptunea antiqua*), the whelk (*Buccinum undatum*) or the netted dog whelk (*Nassarius reticulatus*) should be used, with exposure criteria on the same index of <2.0, <0.3 and <0.3, respectively. 5.2 Density of sensitive (e.g., fragile) species (under development) 9.1.5 **Kills in zoobenthos in relation to eutrophication** This EcoQO is part of the integrated subset of EcoQOs for eutrophication under issue 9. .
6. Plankton communities	9.1.2 **Phytoplankton chlorophyll *a*** This EcoQO is part of the integrated subset of EcoQOs for eutrophication under issue 9. 9.1.3 **Phytoplankton indicator species for eutrophication** This EcoQO is part of the integrated subset of EcoQOs for eutrophication under issue 9.
7. Threatened and/or declining species	7.1 *Presence and extent of threatened and/or declining species in the North Sea, as shown on the Initial OSPAR List (under development)*
8. Threatened and/or declining Habitats	8.1 *Restore and/or maintain the quality and extent of threatened and/or declining habitats in the North Sea, as shown on the Initial OSPAR List (under development)*
9. Eutrophication	9.1 **Eutrophication status of the North Sea** Overarching EcoQO-eutro: All parts of the North Sea should have by 2010 the status of non-problem areas with regard to eutrophication, as assessed under the OSPAR Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area (which consists of the (one-off) Screening Procedure and the (iterative) Comprehensive Procedure) Supporting EcoQOs-eutro: 9.1.1 **Winter nutrient (DIN and DIP) concentrations** Winter DIN and DIP (that is, concentrations of dissolved inorganic nitrogen and dissolved inorganic phosphate) should remain below a justified salinit**y-related and/or area-specific % deviation from background not exceeding 50%.** 9.1.2 **Phytoplankton chlorophyll a** Maximum and mean chlorophyll a concentrations during the growing season should remain below a justified area-specific % deviation from background not exceeding 50%. 9.1.3 **Phytoplankton indicator species for eutrophication**

Ecological quality Issue	Ecological quality element and related ecological quality objective (EcoQO*)*
	Area-specific phytoplankton eutrophication indicator species should remain below respective nuisance and/or toxic elevated levels (and there should be no increase in the average duration of blooms 9.1.4 **Oxygen** Oxygen concentration, decreased as an indirect effect of nutrient enrichment, should remain above area-specific oxygen assessment levels, ranging from 4 – 6 mg oxygen per litre 9.1.5 **Kills in zoobenthos in relation to eutrophication** There should be no kills in benthic animal species as a result of oxygen deficiency and/or toxic phytoplankton species

B. Implementation arrangements for EcoQOs being applied in the North Sea

Ecological Quality Issue 1: Commercial Fish Species

EcoQ 1.1 Spawning stock biomass of commercial fish species in the North Sea

EcoQO 1.1 Above precautionary reference points[4] for commercial fish species where those have been agreed by the competent authority for fisheries management

Photo: Wikipedia

Overall aims

Commercial fish species are important components in marine ecosystems. Several species have large populations in the North Sea (*e.g.* herring and mackerel) and they have major roles in the structuring and functioning of the North Sea ecosystem. North Sea fisheries have a major impact on the North Sea ecosystem, directly on the targeted fish stocks and indirectly through trophic (*e.g.* predator-prey) interactions.

The EcoQO on spawning stock biomass of commercial fish species in the North Sea is currently being applied as a limit/indicator. More information on the development of this EcoQO is presented in the OSPAR background document (OSPAR publication 242).

Methodology

Many commercial fish populations in the North Sea are regularly monitored by North Sea countries and assessed annually by ICES as a basis for advice to fisheries managers. The data sources used in the assessments are information from scientific surveys and data collected on catch statistics. Agencies and scientific institutes in the various North Sea countries carry out the data collection and scientists from these countries contribute data and expertise into stock-assessment working groups (WGs) in ICES. The assessments done by the ICES expert group form the basis for the advice from the ICES Advisory Committee on Fisheries Management (ACFM) to fisheries managers on quotas and other aspects of

[4] In this context 'reference points' are those for spawning stock biomass, also taking into account fishing mortality, where these have been agreed by the competent authority for fisheries management.

fisheries. As information is already collected and data is harmonised there is no need for new procedures for harmonisation.

In agreeing precautionary reference points, the fisheries managers use the system of precautionary reference points for spawning stock biomass (SSB, B_{pa}) and fishing mortality (F_{pa}) as a response to the uncertainty which inevitably surrounds determinations of SSB and F. The system is designed to ensure that there is a high probability of keeping away from the limit reference points for these two factors (B_{lim} and F_{lim}), taking into account the degree of uncertainty of determinations of SSB and F. The limit reference points B_{lim} and F_{lim} have ideally to be designed, on the basis of the fish stock dynamics, as those below which there is a high probability that the stock will collapse. ICES has also in some cases set the limit reference points associated with the lowest observed spawning stock size, to prevent the stock from coming into an area with unknown stock dynamics.

The ICES system is generally based on assessments carried out in year y on the basis of historical series of data up to year *y-1*. These assessments yield estimates for SSB at the beginning (or at spawning time) of year y and estimates of F for year *y-1*. Advice is given for management measures to be adopted for year *y+1* on the basis of catch and SSB forecasts made under different scenarios for years y and *y+1*. In this context, the following procedure should be used:

a. the EcoQO should be taken, as agreed in the Bergen Declaration, as “SSB above precautionary reference points (B_{pa}) for commercial species where these have been agreed by the competent authority for fisheries management”.

b. on the basis of ICES work, OSPAR should compile SSB values for commercial species having populations, at least partially, in the North Sea. The assessment of the ecological status of the North Sea in year y will then be obtained by comparing the current estimates of SSB with the agreed B_{pa};

c. on the same basis, OSPAR should also compile F values for the same stocks, not for the purpose of assessing the current ecological status (year y), but in order to compare this with the agreed values of F_{pa} and warn fisheries management authorities that, if fishing mortality is kept at that level, then there is likely to be a risk that the SSB will fall below B_{pa} under average conditions of recruitment (it is possible that the catch forecasts indicate no immediate risk of SSB falling below B_{pa}, but the warning is a useful indication of misperformance of the fishery).

At present, the fisheries managers with competence for North Sea stocks have agreed values for B_{pa} for a number of stocks. For some joint stocks, such as cod, haddock, whiting saithe, plaice, herring and mackerel, these have been adopted jointly by Norway and the EU in the context of their consultations on mutual fishing possibilities. The EU has also adopted a B_{pa} for the northern stock of hake, which occurs partially in the North Sea.

Quality assurance

Evaluation of whether this EcoQO is met or not is based upon the ICES fisheries advisory system. The ICES fisheries assessment working groups have established handbooks and manuals for the quality assurance of the fisheries advisory process and are working towards the implementation of ICES quality programme for the fisheries advice with the aim of:

a. improving documentation of the advisory process - following data from the points being delivered to ICES through analysis and conclusion as advice;

b. improving fisheries data through assisting the EU Data Collection Programme with planning sampling and setting standards;

c. improving the quality of the advice through strengthening the secretariat function to provide support for the advisory groups – this will improve consistency and secure organisational memory.

Resource requirements (staff time and technical ability, equipment, running costs);

As this is covered as part of the regular activities of the fisheries management system for the North Sea, information has not been collected on the costs.

At the 1997 Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues there was agreement to develop assessments and forecasts for further species of fish in the North Sea and also to develop target reference points for the major commercial populations (Statement of Conclusions, Annex). The former has been developed and implemented by ICES, while the latter will require more resources for research and development.

Reporting requirements for Contracting Parties

There are no additional reporting requirements for Contracting Parties as this EcoQO can be reported on by the lead party on the basis of the existing work of the ICES Advisory Committee.

Method of Evaluation by the lead party

In reporting on this EcoQO, OSPAR will state the proportion of fish stocks for which the operational objective is met, while spelling out the fish stocks for which the objective is not met (so that the environmental, social and economic implications of these failures can be assessed). There are 26 of these fish stocks. On this basis, the EcoQO would be reported as "x out of 26 commercial fish stocks are assessed to meet the EcoQO criteria on spawning stock. Those which fail to do so are…."

Consequences of not meeting the EcoQO

OSPAR has no competence to adopt programmes and measures on questions related to the management of fisheries. Application of the proposed EcoQO for commercial fish species must therefore be regarded as the responsibility of the competent fisheries management authorities. This is significant as it contributes to the further integration of fisheries and environmental protection, conservation and management measures, as called for in the Statement of Conclusions from the Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues in Bergen in March 1997. The competent fisheries management authorities for the North Sea are the European Commission and Norway.

Link with the MSFD

The set of EcoQOs for the North Sea was developed with the aim of being an integral part of the Ecosystem Approach (EA) to the management of the North Sea, contributing to the objectives part of the EA. As such it is particularly important, as it can contribute to the further integration of fisheries and environmental protection, conservation and management measures, as called for in the Statement of Conclusions from the Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues in Bergen in March 1997.

The EcoQO on commercial fish stocks can therefore have an important supplementary role to the MSFD by covering a key aspect of fisheries in relation to the overall objective of achieving good environmental status, especially in respect of Good Environmental Status descriptor 3.

Ecological Quality Issue 2: Marine Mammals

EcoQ 2.1 Seal population trends in the North Sea

EcoQO 2.1A Harbour seal population size*: Taking into account natural population dynamics and trends, there should be no decline in harbour seal population size (as measured by numbers hauled out) of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years) within any of eleven sub-units of the North Sea. These sub-units are: Shetland; Orkney; North and East Scotland; South-East Scotland; the Greater Wash/Scroby Sands; the Netherlands Delta area; the Wadden Sea; Helgoland; Limfjord; the Kattegat, the Skagerrak and the Oslofjord; the west coast of Norway south of 62°N.*

Overall aims

As with others, this EcoQO is designed as an indicator to alert that all is not necessarily well with an important part of the North Sea's mammal fauna. If the EcoQO is not met, then it is unlikely that immediate management action would be taken, instead it is intended that this event should trigger research into the causes of this change. If the cause is found to be related to a human activity, then suitable management measures might then be taken. The trajectory of harbour seal (*Phoca vitulina*) populations has been such that the EcoQO would have triggered research at least twice in recent decades – on two occasions the changes were caused by an epizootic of phocine distemper virus.

The EcoQO trigger level is to an extent arbitrary – it is based on inspection of past performance of harbour seal populations, and not on modelling of populations. This was not considered necessary as the EcoQO is an alerting EcoQO rather than one based on a strict target for the seal population. Such modelling might be necessary should the EcoQO be triggered.

Methodology

Table 2.1.1 outlines current and known monitoring of harbour seal populations in the North Sea. There are a variety of methods in use, with some variation even within a method – for example some aerial surveys use counts from infra-red photographs while others use visual counts. In general methods have evolved to suit local conditions and so long as reasonable standardisation is followed and variance and bias is consistent between sequential surveys of the same sub-unit then such differences do not matter.

Quality assurance

[text to be developed on the basis of submissions by Contracting Parties]

Resource requirements (staff time and technical ability, equipment, running costs)

The UK undertakes surveillance of harbour seal numbers for internal reasons not associated with the EcoQO. The costs of the aerial surveillance amount to approximately £100 000 spread over a 5 year period, with staff an overhead costs, shared with grey seal monitoring, adding approximately another £160 000.

No figures have been provided by other Contracting Parties.

Table 2.1.1. Current and known plans for monitoring of harbour seals by Contracting Parties in the North Sea.

Country	Sub-unit	Current monitoring	Monitoring method	Further needs
United Kingdom	Shetland	Population monitoring during moult	Aerial survey on approximate 5 yearly schedule	None
United Kingdom	Orkney	Population monitoring during moult	Aerial survey on approximate 5 yearly schedule	None
United Kingdom	North and East Scotland	Population monitoring during moult	Aerial survey on less than 5 yearly schedule	None
United Kingdom	South-East Scotland	Population monitoring during moult	Aerial survey on less than 5 yearly schedule	None
United Kingdom	Greater Wash/ Scroby Sands	Population monitoring during moult	Aerial survey on less than 5 yearly schedule	None
France	Baie du Mont Saint Michel	Pup and population monitoring	Aerial surveys 18/year. + 15 census (boat and land)	None
France	Baie de Somme	Pup and population monitoring	Land census each 10 days (January-June). Each day from June to September	None
France	Baie des Veys	Pup and population monitoring	Land and aerial surveys (1/week)	None
Netherlands	Delta	No information provided	No information provided	No information provided
Netherlands/ Germany/ Denmark	Wadden Sea	Population monitoring during moult	Aerial survey annually	None
Germany	Helgoland	No regular programme		Probably none
Denmark	Limfjord	No information provided	No information provided	No information provided
Denmark/ Sweden	Kattegat/Skagerrak	Population monitoring during moult	Aerial survey annually	None
Norway	Skagerrak and Oslo Fjord	No information provided	Aerial survey (frequency?)	No information provided
Norway	West coast, south of 62^{o}N	No information provided	Aerial survey (frequency?)	No information provided

Reporting requirements for Contracting Parties

The lead for this EcoQO requires the following key data for reporting purposes.

a. Number of harbour seals hauled out in sub-unit, or national part of sub-unit of the North Sea

b. Period over which count was made;

c. Any further notes to be taken account of when assessing against EcoQO.

It is likely that correspondence and clarification of results will be necessary between the Lead Country and Contracting Parties.

Method of Evaluation by the lead party

[text needs to be developed]

Consequences of not meeting the EcoQO (target, limit, indicator);

In the case that the EcoQO is not met (*i.e* a decline in population size of ≥10%) research should be triggered into the causes of the change. Further actions should depend upon the outcome of that research.

Link with the MSFD

Seals are not mentioned specifically in the MSFD, however, the status of seal stocks in the North Sea (and elsewhere) is certainly of concern to users of the marine environment and the general public. It would be surprising if seal numbers and trends were not reported as part of the MSFD initial assessment and in descriptions of GES. Seal numbers and trends are also reported under the 'Conservation Status' monitoring of the EU Habitats Directive (92/43/EEC). If the EcoQOs were not met, and following investigation into causes, the EcoQOs could be useful in indicating suitable measures that might be taken. Plainly, it is difficult to take measures against the epizootic-driven declines, but if in the future, causes were found to be directly related to anthropogenic activities, measures should be possible.

EcoQO 2.1B Grey seal pup production:

Taking into account natural population dynamics and trends, there should be no decline in pup production of grey seals of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years) within any of nine sub-units of the North Sea. These sub-units are: Orkney; Firth of Forth; the Farne Islands; the Greater Wash; the French North Sea and Channel coasts; the Netherlands coast; the Schleswig-Holstein Wadden Sea; Heligoland; Kjørholmane (Rogaland).

Photo: Wikipedia

Overall aims

As with others, this EcoQO is designed as an indicator to alert that all is not necessarily well with an important part of the North Sea's mammal fauna. If the EcoQO is not met, then it is not recommended that immediate management action be taken, instead it is intended that this event should trigger research into the causes of this change. If the cause is found to be related to a human activity, then suitable management measures might then be taken.

The EcoQO trigger level is to an extent arbitrary – it is based on inspection of past performance of seal populations, and not on modelling of populations or the effects of such a reduction in pup production. This was not considered necessary as the EcoQO is an alerting EcoQO rather than one based on a strict target for the seal population. Such modelling might be necessary should the EcoQO be triggered, in order to understand possible population consequences of any changes in pup production.

Methodology

Table 2.1.2 outlines current and known monitoring of populations of grey seals (*Halichoerus grypus*) in the North Sea. There are a variety of methods in use, with some variation even within a method – for example some aerial surveys use counts from infra-red photographs while others use visual counts. In general methods have evolved to suit local conditions and so long as reasonable standardisation is followed and variance and bias is consistent between sequential surveys of the same sub-unit then such differences do not matter.

Table 2.1.2. Current and known plans for monitoring of grey seals by Contracting Parties in the North Sea.

Country	Sub-unit	Current monitoring	Monitoring method	Further needs
United Kingdom	Orkney	Pup production monitoring	Annual	None
United Kingdom	Fast Castle and Isle of May	Pup production monitoring	Annual	None
United Kingdom	Farne Islands	Pup production monitoring	Annual	None
United Kingdom	Donna Nook	Pup production monitoring	Annual	None
France	Archipelago of Molene	Pup and population monitoring	Regular (monthly) census and Photo identification	None
France	Archipelago of Sept Iles	Pup and population monitoring	Regular (monthly) census	None
France	North sea and Channel coasts	No information provided	No information provided	No information provided
Netherlands	Coast	No information provided	No information provided	No information provided
Germany	Schleswig-Holstein Wadden Sea	Pup production monitoring	Annual	None
Germany	Heligoland	Pup production monitoring	Annual	None
Norway	Kjørholmane (Rogaland)	No information provided	No information provided	No information provided

Quality assurance

[text needs to be developed on the basis of submissions by Contracting Parties]

Resource requirements (staff time and technical ability, equipment, running costs)

The UK undertakes annual surveillance of grey seal pup production for internal reasons not associated with the EcoQO. The costs of the aerial surveillance amount to approximately £80 000 per year, with staff an overhead costs, shared with harbour seal monitoring, adding approximately another £160 000.

No figures have been provided by other Contracting Parties.

Reporting requirements for Contracting Parties

The lead country for this EcoQO requires the following key data for reporting purposes.

a. Number of grey seals estimated in sub-unit, or national part of sub-unit of the North Sea;

b. Period over which count was made;

c. Count method and method of processing results of counts;

d. Any further notes to be taken account of when assessing against EcoQO.

It is likely the correspondence and clarification of results will be necessary between the Lead Country and Contracting Parties.

Method of Evaluation by lead party

[text to be developed]

Consequences of not meeting the EcoQO (target, limit, indicator)

In the case that the EcoQQ is not met (*i.e* a decline in pup production of ≥10%) research should be triggered into the causes of the change. Further actions would depend on the results of that research.

Link with the MSFD

Seals are not mentioned specifically in the MSFD, however, the status of seal stocks in the North Sea (and elsewhere) are certainly of concern to users of the marine environment and the general public. It would be surprising if seal numbers and trends were not reported as part of the MSFD initial assessment and in descriptions of GES. Seal numbers and trends are also reported under the 'Conservation Status' monitoring of the EU Habitats Directive (92/43/EEC). If the EcoQOs were not met, and following investigation into causes, the EcoQOs could be useful in indicating suitable measures that might be taken. Plainly, it is difficult to take measures against the epizootic-driven declines, but if in the future, causes were found to be directly related to anthropogenic activities, measures should be possible.

EcoQ 2.2 By-catch of harbour porpoise

EcoQO 2.2 Annual by-catch levels should be reduced to below 1.7% of the best population estimate

Overall aims

The objective derives from considerable analysis by the International Whaling Commission (IWC) and the Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas (ASCOBANS). OSPAR has agreed to apply this EcoQO as a limit. By-catch of harbour porpoises (*Phocoena phocoena*) at levels above this are considered to be unacceptable by ASCOBANS as there would not then be a high enough probability of allowing harbour porpoise populations to reach 80% of carrying capacity in the long term. This figure has been considered by both ICES and other advisory structures to the European Commission (responsible for fisheries management issues in all of the North Sea except Norwegian waters). Advice from these sources was consistent with the ASCOBANS evaluation. Although not stated explicitly, this target underlies Regulation (EC) No 812/2004 agreed by EU Fisheries Council in April 2004. This regulation includes requirements for monitoring bycatch as well as taking measures to reduce bycatch in certain fisheries.

Those Contracting Parties which are Member States of the European Union are required under the Habitats Directive (92/43/EC) to introduce a system to monitor the incidental capture and killing of all cetaceans. In light of the results of this monitoring, Member States are required to undertake further research or conservation measures to ensure that the incidental capture and killing does not have a significant negative impact on the species concerned. Member States also have a duty to ensure that any measures taken under the Directive are designed to maintain or restore, at a favourable conservation status, all cetaceans. These obligations do not apply to Norway.

Despite these statutory obligations (most in existence since 1992), knowledge of harbour porpoise by-catch in the North Sea is incomplete. There have been a number of recent reviews of by-catch in European waters, principal among these are:

a. ICES, 2002. Report of the working group on marine mammal population dynamics and habitats. ICES CM 2002/ACE:02;

b. CEC, 2002. Incidental catches of small cetaceans. Report of the meeting of the subgroup on fisheries and the environment (SGFEN) of the Scientific, Technical and Economic Committee (STECF). SEC (2002) 376. Commission of the European Communities, Brussels;

c. CEC, 2002. Incidental catches of small cetaceans. Report of the meeting of the subgroup on fisheries and the environment (SGFEN) of the Scientific, Technical and Economic Committee (STECF). SEC (2002) 1134. Commission of the European Communities, Brussels;

d. Kaschner, K. 2003 Review of small cetacean bycatch in the ASCOBANS area and adjacent waters – current status and suggested future actions. ASCOBANS MoP4/Doc. 21.

Rather than repeat these, a current summary is presented below, but these sources should be consulted if further detail is required. See also Section 6 of the report of the 2003 ICES Advisory Committee on Ecosystems and the Background Document on this EcoQO (OSPAR Publication 2005/244).

Methodology

In order to assess the impact of by-catch on a population, two main figures are needed: numbers being by-caught and an abundance estimate for the population that the by-catch is coming from.

By-catch can only reliably be estimated using a properly designed monitoring scheme that is independent of the fisheries being checked. Although several types of fisheries may occasionally catch harbour porpoises, those that pose the greatest risk to harbour porpoise populations are thought to be bottom-set gill-nets. Such fisheries are relatively common throughout the shallower parts of the North Sea. Prior to 2005, by-catch estimates have been made in most relevant UK, Danish and Swedish fisheries in the North Sea, but not in any French, Belgian, Dutch, German or Norwegian fisheries. Given the range of the harbour porpoise and the scale of relevant fisheries in the North Sea, further information from relevant French, Belgian, Dutch, German or Norwegian fisheries is essential to assess whether or not this EcoQO is being met. There is no additional cost of meeting the monitoring needs of this EcoQO above those needed for the EU Habitats Directive and Fisheries Regulation requirements.

Surveys in order to provide up-to-date abundance estimates for North Sea harbour porpoises were made in 2005 in the SCANS II project, funded by the European Commission and EU Member States. A subsidiary problem is that we do not know the structure of the North Sea harbour porpoise population – we know that animals from the western Channel are different from those in the North Sea, and that there is a difference between animals in the northern and southern North Sea and the Kattegat. There are no sharp lines between these groups, and further research is needed if we are to understand the impact of by-catch on different parts of the North Sea harbour porpoise population. Despite this problem, it should be possible to estimate the proportion of the harbour porpoise population that are by-caught in parts of the North Sea if sufficient by-catch observation is undertaken. Population modelling is underway to address these issues also under the SCANS II project.

Table 2.2.1 outlines current and known plans for monitoring of harbour porpoise by-catch in the North Sea. It appears that despite statutory requirements for monitoring, not all Contracting Parties are undertaking or planning observation programmes. In some cases where such programmes are planned, they appear to be undertaking the minimum necessary to meet the EU fishery regulation.

Table 2.2.1. Current and known plans for monitoring of harbour porpoise by-catch by Contracting Parties in the North Sea.

Country	Current monitoring	Monitoring method	Needs
Norway	Scheme under development	On-board and shore-based observations	Implementation
Sweden	Scheme prepared and funding available for 1 year	On-board observer scheme	Implementation
Denmark	Scheme under development with limited funds for implementation in Skagerrak only	On-board observer scheme	Implement in Skagerrak; devise and implement scheme in North Sea
Germany	Insufficiently covered: experimental monitoring in force for static gillnet fishery; no monitoring for pelagic trawl fishery	On-board observer scheme	Devise and implement scheme in relevant fisheries
Netherlands	None, though bycatch known to occur	-	Devise and implement scheme in relevant fisheries
Belgium	None, though bycatch known to occur	-	Devise and implement scheme in relevant fisheries
France	A programme to meet the needs of EC Regulation 812/2004 has been devised and will be implanted in 2006	-On-board observer scheme. Pilot programme	Implement planned scheme and determine if meets the needs of Habitats Directive (92/43/EC)
UK	Full scheme implemented from March 2005; in 2006 sampling in gillnetters in the English Channel, netters using pingers and smaller (<15m) netters and drift netters in the North Sea and English Channel will be undertaken.	On-board observer scheme	None

Numerous studies have shown that the only reliable source of information on the scale of by-catch is through the use of independent observers. Schemes that rely on self-reporting by fishers are difficult or impossible to audit (in order to verify figures) and frequently under-report by-catch. On larger vessels, observers are usually accommodated on board; while various techniques may be applied to smaller vessels – there may be logistic problems accommodating observers and the amount of net per vessel (and therefore the number of by-catches per trip) will be lower. The observation of the largest vessels in the “small boat” fleets and of onshore observers have both been used. The use of dedicated porpoise by-catch observers is likely to be necessary in many but not all gillnet fisheries. This is because each haul needs to be observed as the net comes aboard to ensure that any porpoises falling from the net as it breaks the surface are counted. If these animals are not detected then the total mortality will be underestimated. Some schemes have attempted to use observers employed on other duties, but this carries the risk that observers will become overworked and not efficient at either duty. Each fishery needs to be evaluated to determine what tasks can be combined without undue loss of efficiency.

The proportion of the fishing effort observed depends on the precision of results required and the nature of the occurrence of bycatch. Higher precision requires higher observation effort – but a law of diminishing returns applies. The nature of by-catch can vary between a 'constant' background by-catch rate and an episodic and patchy 'many animals in few hauls/ many hauls with no by-catch' situation. The latter scenario generally requires a higher proportion of the fishery to be observed than the former, if the same level of precision is required. A relatively low sampling effort may suffice if sampling is stratified correctly for each fishery; this may mean adaptation of the observer effort as results are built up. The level of coverage should normally be tuned so that the coefficient of variation (CV) of the total kill estimate is roughly equal to the CV of the total population estimate, as this will optimise the accuracy of the estimated kill to population size ratio.

The most efficient way to sample a fishing fleet may not become clear for a number of years, but it is certainly possible to make educated guesses about levels of coverage and stratification at the start of an observer programme. Tuning the programme thereafter becomes an ongoing process. Programmes should therefore be planned to continue over several years if full benefits are to be derived. The continuation of an observer programme over several years also has the advantage of producing longer-term average catch rates which may be more appropriate for longer-lived species such as porpoises. Individual Contracting Parties will need to examine each of their fisheries and adapt the proportion of fishing effort observed to take account of this.

Observer schemes usually monitor only a proportion of a fleet's activities. The number of observed by-caught animals then need to be scaled up to estimate the catch of the whole fleet. This might appear to be a simple mathematical calculation but more often than not, estimating the total effort of a fleet is problematic. There are two major issues of concern, the first is what measure of effort is to be used, which depends on what is available and the second is the accuracy of effort statistics.

It is usual for gillnet observer schemes to try to collect by-catch data in terms of the numbers of animals taken per km of net set. Often it is possible to improve this by collecting numbers per km of net and per hour of soak time. It is very unusual, however for any fishery statistical service to have reliable effort data in terms of km.net.hours. Extrapolating from the sample to the whole fleet therefore needs to rely on cruder indices of effort.

Typically units of effort which might be available from fishery inspectorates or statistical services are the numbers of days spent at sea, or days spent fishing, or the number of trips. These statistics therefore become candidates for collection by the observer scheme. In practice, however, it seems that such statistics are less than reliable and that other measures have to be adopted. There are a number of possibilities ranging from tonnes of fish landed to days at sea. All of these statistics have their biases and carry the risk of various types of misreporting. In any extrapolation exercise it is clearly important to have a clear understanding of any possible shortcomings of the effort collection scheme. Effort statistics can often under-estimate total fleet effort and this can be a significant source of bias in estimating the total kill. This is a problem that all Contracting Parties will need to address in order to ensure that there is no large scale under-reporting of effort. If such under-reporting is suspected then alternative measures of effort will need to be found and employed.

A full review of the requirements for observer schemes for recording cetacean bycatch is available: Northridge, S.P. 1996. A review of marine mammal by-catch observer schemes with recommendations for best practice. *JNCC Report*, No. 219.

Quality assurance arrangements

[text to be developed]

Resource requirements (staff time and technical ability, equipment, running costs)

As noted above, by-catch observation is a statutory requirement for EU Member States. The marginal extra cost for the Contracting Parties is therefore minimal. Notwithstanding this, estimates have been made for the costs of observation schemes.

In the UK and Ireland, a study in the early 1990s had a total budget of around £20 000 and resulted in data collection during 328 days at sea (about 1% of the total effort in these fisheries). This amounts to just £61 per day at sea (or roughly €100). This was only possible by recruiting volunteer observers for the English observer scheme, by subsidising the Irish part of the survey by the use of funds for work on fish discards in the same fishery and by having the data management and analysis done without cost too. A more extensive discard monitoring scheme run by the SERAD Marine Laboratory in Aberdeen was costed at that time at around £520 (€785) per observer day at sea. This was the full economic cost of the scheme and includes staff wages, data handling, transport, analysis and management costs. Inflation of costs will have increased these figures, in some cases to possibly double this level. This range of figures might be used to provide an indication of the scale of expected expenses for any fishery if there is some idea of the total numbers of days at sea which need to be sampled.

Reporting requirements for Contracting Parties

A statutory timetable has been established for reporting under Regulation (EC) No 812/2004. The first report from EU Member States was due in June 2006. This is no similar timetable for reporting observations made in fulfilment of the Habitats Directive, or by Norway. It is suggested that reporting in fulfilment of this EcoQO should not add to the effort of reporting to the European Commission, thus a copy of these reports, sent to the lead country (UK) should suffice. It is not known at present how the European Commission will analyse reports to them, but it is suggested that the lead country will report briefly on progress annually to OSPAR. For observation schemes undertaken by Norway or by EU Member States in addition to Regulation 812/2004, the lead country would prefer to receive reports by November each year.

Key data for inclusion in any report are:

a. estimated number of harbour porpoises killed per fishery;

b. the geographic extent of the fishery (perhaps by ICES sub-area and rectangle)

c. the number of observed porpoises bycaught;

d. the proportion of the fishery observed;

e. any indication of temporal (*e.g.* monthly or diurnal) variance in bycatch (results indicate that there often is some temporal variance);

f. the use (and, if known, the effectiveness) of any mitigation tool (*e.g.* pingers) in the fishery.

It is likely that correspondence and clarification of results will be necessary between the Lead Country and Contracting Parties.

Method of Evaluation by lead party

[text to be developed]

Consequences of not meeting the EcoQO (target, limit, indicator);

A potential consequence of not meeting the EcoQO would be a decline in the harbour porpoise population. This risk might be avoided by asking relevant fisheries managers to take suitable

management measures. In essence, this has occurred in the past prior to the introduction of Regulation 812/2004. The Regulation though does not appear to be effective in that there are technical problems with some of the gear modifications required and there is no requirement to monitor effectiveness of any changes in the fisheries concerned. A consequence of this lack of knowledge might therefore be to improve the gear modification requirements and to ask fisheries managers to require monitoring of a sufficiently high standard in all relevant fisheries. OSPAR might bring this issue to the attention of relevant fisheries managers.

Link with the MSFD

Harbour porpoise by-catch is not mentioned specifically in the MSFD, however, this by-catch is certainly of concern to the public living around the North Sea. By-catch though is closely related to the Common Fisheries Policy and at present the links between this policy and the MSFD are not fully clear. It would be surprising if harbour porpoise numbers and trends, along with known by-catch were not reported as part of the MSFD initial assessment. Harbour porpoises do not respect national borders and the population is international and pressures on the population are international, so it follows that conservation responsibilities should also be international. Harbour porpoise numbers and trends are also reported under the 'Conservation Status' monitoring of the EU Habitats Directive (92/43/EEC). The EcoQO could be useful in indicating suitable measures that might be taken, should the EcoQO not be met.

Ecological Quality Issue 3: Seabirds

EcoQ 3.1 Proportion of oiled common guillemots among those found dead or dying on beaches

EcoQO 3.1 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.[5]

Overall aims

As a result of (chronic) marine oil pollution, many thousands of seabirds wash ashore on the beach every year. The Oiled-Guillemot EcoQO provides a description of the proportion of oiled common guillemots *Uria aalge* among those found dead on beaches within the OSPAR area. It is therefore being applied as an indicator. Systematic beached bird surveys (BBS) provide insight into species composition and oil rates (% of birds oiled of all birds found dead) and have been conducted since the early 1960s to study temporal and spatial trends in oil-related mortality in most countries bordering the North Sea. Spatial patterns in common guillemot oil rates reflect different levels of chronic marine oil pollution around the North Sea, whereas temporal trends in oil rates are indicative for changes in these levels over time.

Common guillemots have been selected because they are highly vulnerable to oil pollution, and are sufficiently abundant and widespread that sample sizes (number of corpses checked) each winter and in all participating countries should be large enough for statistical analysis. Oil rates are species- and area-specific, but also vary seasonally and can even be age-specific (annual natural mortality of juvenile guillemots is proportionally higher than in adults). The use of scavenged or otherwise incomplete corpses ('remains') found on beaches may bias the results. For reasons of consistency, participants are therefore asked to systematically search for guillemots between November and April,

[5] Revised wording agreed by BDC 2008

to identify the birds they find, to check the corpses for missing parts, to age the birds according to standardised ageing techniques, and to carefully check for oil in the feathers.

The Oiled-Guillemot EcoQO is not only meant to monitor current patterns in oil rates, but also to check if set targets are actually reached. In the most polluted parts of the North Sea, currently over 50% of the guillemots found on beaches are oiled. Even though this means a considerable improvement in comparison with the 1960s, 1970s and even 1980s, such levels are considered unacceptable. Law enforcement, perhaps in combination with new measures to minimise chronic oil pollution at sea, should lead to further reductions.

This chapter provides a practical manual of the "Oiled-Guillemot–EcoQO" for regional or national co-ordinators. Annual reports will be compiled based on material submitted by participants working in 15 sub-regions around the North Sea. National or regional co-ordinators will collect these data through volunteer networks (just as in BBS schemes currently operating), by providing adequate instructions to these volunteers (field manuals), they will be responsible for ensuring that surveys take place, for receiving, checking and summarising data, and for sending their data by June each year to the International Co-ordinator for inclusion in an annual report.

For background information on this EcoQO the earlier background document on the Oiled Guillemot EcoQO should be consulted (Camphuysen 2004; OSPAR publication 2005/252). Annex 1 of the background document (Camphuysen 2004) was a provisional manual for volunteer participants, to enable them to identify and age common guillemots as well as to instruct them about how presence of oil on stranded guillemots should be stated. An enlarged and improved version of this manual is included in this chapter. Volunteers working on beaches will have to be provided with clear and short instructions that can be deduced from this manual, in the language that is most appropriate for them. No attempt has been made to include a field manual in this report, but any material required to compose such a document is available on request from the Lead Party.

Methodology

What to do on the beach? [collecting base data]

The necessary data can be derived from standard beached bird surveys, although field workers may need special instructions so that they know how to handle guillemots for the Oiled Guillemot EcoQO. Fieldworkers should go out especially to search for stranded birds and enlarge the sample of checked, beached common guillemots. Basic questions for the fieldworkers to address are:

- What species? Common guillemot or not
- What age? Juvenile, adult or unknown
- What remains? Complete corpse suitable for checking oil or just remains
- Is there any oil in the feathers? Presence absence indication, or a more precise quantification

Fieldworkers should record the location they worked, the distance searched (km), the date, their name and contact address, the conditions of the survey, and the numbers of birds found as in an ordinary beached bird survey, basically according to local or national guidelines. For common guillemots the above questions should be asked and the answers logged.

Identification and ageing

It is assumed that fieldworkers are capable of identifying a common guillemot and separate these from any other auks. To age the bird, fieldworkers should be instructed to check the pattern of the tips of the greater underwing coverts: clear white tips = first year birds, grey tips = older birds (termed ‘adult’

for convenience). In case of doubt (*e.g*. silvery tips in summer plumage individuals), the age should not be recorded but the individual should be logged as “age unknown”.

Visible inspection of white tips on the greater wing coverts in a stranded common guillemot (clearly present in the illustrated case, indicating that this is a juvenile bird). Photograph C.J. Camphuysen.

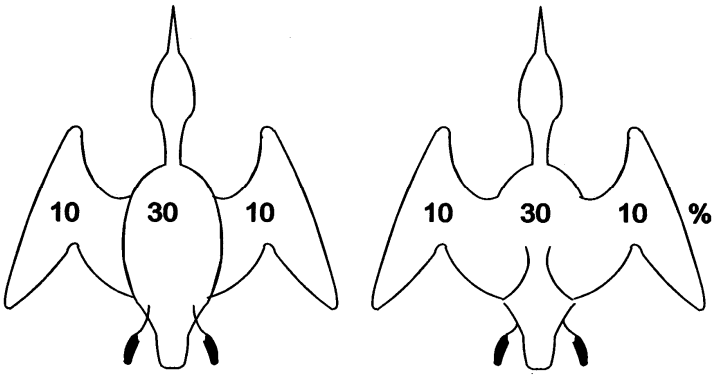
Check if the corpse is intact

Fieldworkers should have clear instructions as what to classify as a complete corpse (entirely intact, or just basically scavenged with all major parts available for inspection) or as ‘just remains’ (*e.g.* wings with sternum, or badly damaged corpse where substantial parts are missing). It is generally a matter of common sense to judge what corpses are sufficiently intact to be part of the main pool: complete, aged carcasses of common guillemots.

Corpses need be complete for a valid inspection. Scavengers may have entered the corpse or even have torn it apart (left), but the corpse may still be considered "complete". Only when vital parts are missing (right) should the corpse be considered "incomplete" (in the illustrated case: feet, some skeleton remains, sternum and wings, head and neck torn inside out by scavenging gulls at sea). Photographs C.J. Camphuysen

Checking for oil

All parts of the body should be checked for oil. Note that small amounts may be present around the tail, on the flanks or on the wings on otherwise, superficially clean carcasses. Blood stains, certainly in partly scavenged specimens, should not be confused with mineral oil contamination. For the EcoQO it is essential to know if a bird is oiled or not (need-to-know data). The *amount* of oil present on a corpse of a bird is interesting information, but not essential (nice-to-know data). Follow these guidelines, when possible, if information on the amount of oil is to be obtained:



Each side of the body is regarded as 30%, each wing area as 10% (Σ 100%). Scores should not be overdone, but simplified as follows by rounding:

- 1% - a few specks of oil
- 5% - small oiled area
- 10% - moderate oiled area
- 25% - about one quarter oiled
- 50% - about half of corpse oiled
- 75% - nearly all of the corpse oiled
- 100% - completely covered with oil

Record the presence of oil (yes, no or unknown) and if there is any oil, indicate the percentage covered of the corpse according to the following scheme:

Type of oil

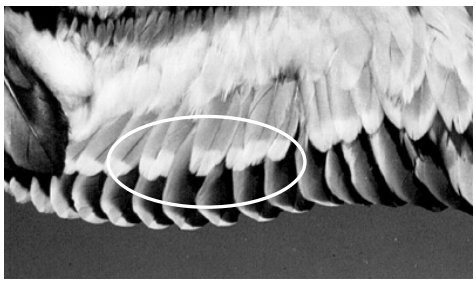
When the Oiled-Guillemot EcoQO is fully established, the type of oil needs be established from a representative sample of birds. This document does not provide the guidelines for this because the possibilities to fund this part of the monitoring programme have not been identified. Sampling oil is easy and can be done by well-instructed volunteers during their walks on beaches, the chemical analysis of oil samples is specialist work that needs to be done in high quality and experienced laboratories. Sampling and analysis techniques have been proposed by Camphuysen & Dahlmann (1995).

Without the collection of samples, the identification of oil types is impossible, for different oil types cannot be separated by eye (Timm & Dahlmann 1991; Dahlmann *et al.* 1994). In fact, to say whether a substance is ‘mineral oil’ or any other lipophilic substance disrupting a bird’s plumage is not always possible. Therefore, in the absence of a sampling programme, all substances damaging bird plumages will be included in the census and notes made by observers and regional or national co-ordinators that may shed light on the type of pollution encountered are welcomed.

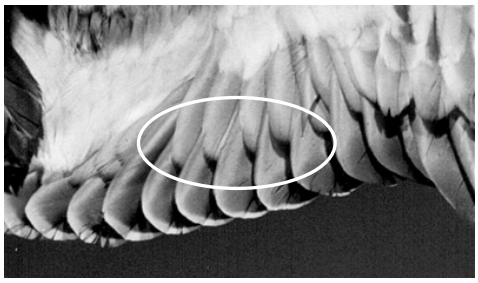
Checklist

In short, the following data need to be collected

- Site, distance, date, observer
- Subregion
- Species, age (check greater underwing coverts for white tips):
  - White tips present (*i.e.* juvenile)



  - White tips absent (*i.e.* 'adult')



- Completeness of corpses (more or less intact / just remains)
- Oiling

It will be hard to age birds that are completely covered with oil and sometimes the ageing will be "forgotten" by field workers. To avoid losing material, and because recent oil rates will have to be compared with data collected in historical times when ageing was not common practice, the record form will accommodate such incomplete records, so that every guillemot found can be listed. It is advisable, however, to keep pointing at the ageing characteristics that need to be used, as a reminder, and as a guarantee that the highest quality data is collected.

Quality assurance arrangements

[text to be developed]

Resource requirements (staff time and technical ability, equipment, running costs)

An important assumption for the budget presented below is that budgeted costs include *only* costs necessary for the successful completion of the project: an international collation of data. Such (annual) costs include: overall international co-ordination and an annual report (lead country only, estimated at *c.* € 13 250,= per annum) and national expenses on top of the costs required to run a BBS and to organise the participating volunteers (estimated at € 1500,= per annum for participating countries). The actual costs of a national BBS varies per country and these are not budgeted here, for these are seen as a national responsibility of countries represented at the North Sea Ministers Conference; those that signed the Bergen Declaration

Extra costs are involved when the monitoring programme will include systematic oil sampling and the analysis of these samples as a study of the sources of oil. Costs would than include materials for sampling, the distribution of sampling tools and the central collection of the samples. A central laboratory is the most cost-effective solution for this task. Budgeted costs are based on estimates by the Bundesamt für Seeschiffart und Hydrographie in Hamburg (Germany). It should be highlighted that

the Oiled Guillemot EcoQO could start even if a choice regarding the need for chemical analysis of oil samples is postponed.

Co-ordination, lead country	**Days**	**Rate (€)**	**Subtotal**	**Remarks**
*Project co-ordination (work time)	10	750	7500	p.a.
*Production annual report	5	750	3750	p.a.
*Mailing, printing report, expendables		1000	1000	p.a.
*Travel		1000	1000	p.a.
Subtotal			13250	p.a.
National co-ordination				UK, N, DK, FRG, NL, B, F
*****Running BBS			p.m.	National responsibility; costs depend on present state of volunteer network and travel expenses
*EcoQO participation	2	750	1500	p.a. per country, as a compensation for work needed to implement the EcoQO on a national level: data preparation and steering of volunteers to follow the protocols exactly
Chemical analysis of oil and other substances				
*technician	full time		40000	BSH, Hamburg
*****supervision of work and reporting	5		3750	BSH, Hamburg
			43750	

Reporting requirements for Contracting Parties

An example data sheet for count results is below although the exact procedures are at the discretion of the regional or national data coordinator.

Avoid double counts

Stranded corpses should be recorded only once. Different BBS schemes have different means of avoiding double counts. Some have instructed participants to remove the corpses, others have given instructions to mark them as ‘being recorded’ by clipping the primaries. It is important that clear instructions are given to field workers as how to avoid double counts in this programme.

Oiled Guillemot EcoQO record sheet				
Subregion:	#	Date (dd/mm/yy):	- - 20	
Site:				
Contributor:				
Contact address:				
Quality of count:	poor / moderate / good		Total effort *km*:	km
Complete birds (May be scavenged corpses, but all major feather parts available for inspection)	Adults 	Juveniles 	Not aged	Totals
Oiled *n*				
Unoiled *n*				
Total *n*				
Oil rate	%	%	%	%
Remains	Adults	Juveniles	Not aged	Totals
Oiled *n*				
Unoiled *n*				
Total *n*				
All birds *n*				Σ
Densities *n/km*	/km	/km	/km	/km

Optional datasheet for Oiled-Guillemot EcoQO counts. Most cells ask for concrete data, the bottom rows are meant to sum up all guillemots recorded (no matter what condition and age, including the individuals where oiling was uncertain). The 'Quality of count" box is a subjective indicator of the conditions of a survey and whether or not densities found are probably reliable of seriously biased as a result of poor conditions.

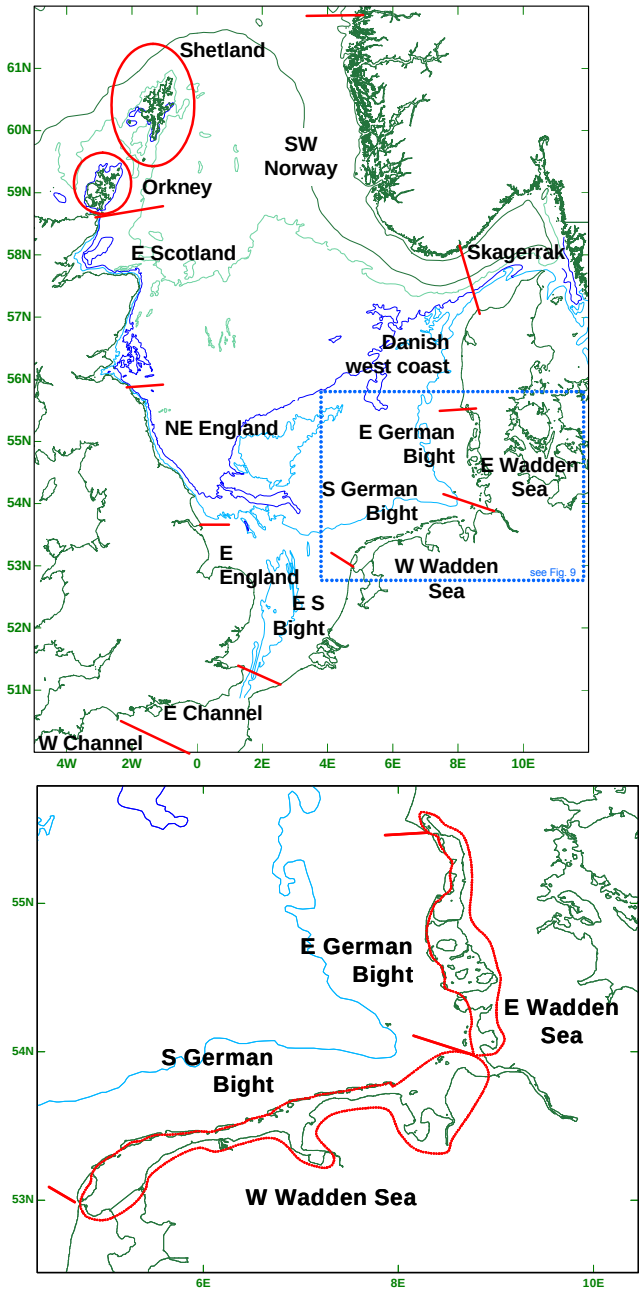
What sub-regions do we use?

Data should be submitted for the 15 sub-regions described below. Note that some subregions cross regional or even national borders, so that data submitted by one Contracting Party may contribute to the outcome of a given subregion rather than provide all the available material. Data that has been collected in more than one subregion should not be combined and even very small datasets are useful, as these may contribute to the bigger overall picture..

Fifteen sub-regions for the Oiled Guillemot EcoQO.

1	Shetland	Shetland Islands	UK
2a	Orkney	Orkney Islands	UK

2b	North Scotland	north coast of Scotland	UK
3	East Scotland	Duncansby Head to Berwick on Tweed	UK
4	Northeast England	Berwick on Tweed to Spurn Head	UK
5	East England	Spurn Head to North Foreland	UK
6	Eastern Channel	line between North Forland and Belgian French border to line between Cherbourg - Portland	UK, B. F
7	Western Channel	line between Cherbourg and Portland to Land's End to Ouessant	UK, F
8	Eastern Southern Bight	mainland coast Belgian/French border to Texel	B, NL
9	Southern German Bight	North Sea coast Frisian Islands Texel to Elbe	NL, FRG
10	Western Wadden Sea	mainland and Wadden Sea coast Frisian Islands Texel to Elbe	NL, FRG
11	Eastern Wadden Sea	mainland coast and Wadden Sea coast Elbe to Esbjerg	FRG, DK
12	Eastern German Bight	North Sea coast Wadden Sea Islands Elbe to Fanø	FRG, DK
13	Danish west coast	mainland coast Esbjerg – Hanstholm	DK
14	Skagerrak	east of line between Hanstholm - Kristiansund, north of a line from Skagen - Gothenburg	N, DK, S
15	SW Norway	Kristiansund to Stadt	N



Fifteen sub-regions for the Oiled Guillemot EcoQO. The inset (Wadden Sea area) is enlarged in the right-hand figure. The Orkney Islands (encircled in the left hand map) includes the Scottish north coast, to the west of Duncansby Head.

How to collate the data regionally or nationally?

Because sub-regions may cross regional or even national borders, the easiest way of contributing to the joint database that will be constructed for the Oiled Guillemot EcoQO is by labelling each survey result with a date/subregion tag. Not every participant may be able to achieve full coverage (monthly samples of most of their study area between November to April). Therefore, the smallest unit stored into the joint database will be sub-region/month data rather than sub-region/winter data.

National and regional co-ordinators are requested to collate the data in a single table format, in excel or any other database or spreadsheet software, using the following fields:

Tabulated results by regional or national co-ordinators for the Oiled Guillemot EcoQO. The headers are in bold, options are provided for each field. A database contribution for a given subregion in a given month may end up in a 27 line record (three options for age x three options for state of corpse x three options for oiling), and where fields Subreg-Km are copied down for each line of data.

Subreg	**Ctry**	**Year**	**Month**	**Km**	**Contrib**	**Age**	**State**	**Oiling**	**Number**
[1-15]	[Abbrev.]	[Value]	[1-12]	[value]	[Abbrev.]	Adult	Complete	Oiled	[Value]
						Juv	Remains	Unoiled	
						Unknown	Unknown	Unknown	

Example of tabulated results, reporting survey results in subregion 8 (i.e. mainland coast Belgian/French border to Texel), in the Dutch part of the subregion (NL), in March 2006, by Royal NIOZ, covering 25 km which resulted into a sample of 14 Common Guillemots, 10 of which were complete corpses that could be aged.

Subreg	**Ctry**	**Year**	**Month**	**Km**	**Contrib**	**Age**	**State**	**Oiling**	**Number**
8	NL	2006	3	25	NIOZ	Adult	Complete	Oiled	6
8	NL	2006	3	25	NIOZ	Adult	Complete	Unoiled	4
8	NL	2006	3	25	NIOZ	Juvenile	Remains	Unknown	2
8	NL	2006	3	25	NIOZ	Unknown	Remains	Oiled	2

Contributed data should be exported as excel files and sent to the international co-ordinator by e-mail.

What data are expected for the annual report?

Regional or national co-ordinators are requested to check, analyse and organise the data collected and to forward the material in the fixed tabulated format shown earlier. Densities of guillemots encountered around the North Sea (all guillemots found dead) are also taken into account, but mostly in accurate oil rates of birds that could be aged and that are classified as ‘complete’ corpses.

All data should be accompanied by a short description of the circumstances that characterise the period/area in which the material was collected. Shipping accidents or oil-incidents are known to affect the oil rates in different ways. Regional and national co-ordinators are therefore requested to keep a log on special events. Key issues to report are: were there any remarkable spills, influxes of birds, unusual weather, or major shipping accidents of guillemots that may have biased the results one way or the other. The report should be a short text, with clear references to particular datasets, so that the reports can be linked to particular data in the relational database.

An accompanying text should make clear if some material is considered to be of low-quality and explain the reasons, with clear reference to the data produced.

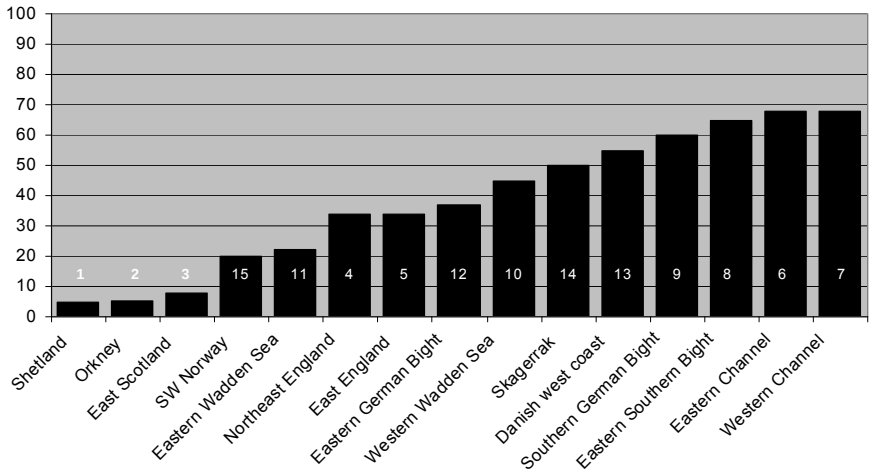
Timing

The data should be collected between November and April, summaries of results should be forwarded to the international co-ordinator *before* June of each year of monitoring, so that an Annual Report can be drafted in July and published in August, well before the next season's start.

Method of Evaluation by the lead party

Contents of the annual report

The annual report will provide the international overview of trends in oil rates by listing updates from each of the 15 sub-regions (spatial patterns), and while comparing these with historical material to evaluate the temporal trends. The expected situation, based on collected material (Camphuysen 2004), educated guesswork, and combination of the two age categories of guillemots in the absence of the concrete data of age composition, is a pattern as shown here:



Expectation of current oil rates of common guillemots around the North Sea in 15 pre-defined sub-regions based on recent data (Camphuysen 2004), and guesses (sub-regions 14 and 15). Oil rates below 10% are expected in three out of 15 areas. Numbers refer to sub-region numbers (Table 1).

The material in the annual report will be organised such that changes over time and shifting spatial patterns are most visible. This could be achieved by mapping data, and/or by the use of graphs or tables.

This update will however require an explanatory text, compiled from the reports submitted with the data from regional or national co-ordinators, indicating *why* certain values are particularly low or rather high and whether or not full coverage and adequate samples sizes have been achieved in each subregion.

Consequences of not meeting the EcoQO (target, limit, indicator)

The ecological consequences of failing to meet the EcoQO do not only apply to guillemots, but also to other species of birds, and other elements of the North Sea ecosystem.

From a management point of view, exceeding the level of 10% indicates oil rates that should be reduced. The Pilot project mentioned the following management measures that could be taken to achieve the EcoQO:

The North Sea is a "Special Area" under MARPOL which means that discharge into the sea of oil or oily mixture from any oil tanker and ship over 400 gt is prohibited. There are also further measures to reduce oil in discharges of produced water from offshore installantions under OSPAR. Other possible

measures are related to control and enforcement of MARPOL, prevention, oil recovering/clearing and education.

Link with the MSFD

The EcoQO on oiled guillemots can be used to contribute to the GES generic descriptor for "Concentrations of contaminants are at levels not giving rise to pollution effects". Oil is a significant issue in the North Sea. The EcoQO expresses its impact at the level of individual organisms and populations. This EcoQO was defined as an aspirational objective in 1999, on the base of what was achieved in terms of measures to address impacts from a single source in a remote area. This was well in advance of the concept of a region wide GES under the MSFD. The original objective of 10% may not therefore be realistic for areas subject to impacts from multiple pressures and therefore may have to be redefined for use in a GES context. The objective of 10% would still serve as the long-term objective (to reach by 2030). For the short term, however, an adjustment to 20% is recommended based on the current rate of decline in the number of oiled guillemots.

References

Camphuysen C.J. 2002. Oil rates in Common Guillemots. CSR Report, Project INTERNAT*NZM-DNZ, OSPAR Biodiversity Committee, BDC 03/2/4, Annex 1, 22pp.

Camphuysen C.J. 2004. North Sea pilot project on Ecological Quality Objectives, Issue 4. Seabirds, EcoQO element F. Proportion of oiled Common Guillemots among those found dead or dying - revised edition (June 2004). CSR Report 2004-012, Texel, 26pp. (OSPAR Publication no: 252)

Camphuysen C.J. & Dahlmann G. 1995. Guidelines on standard methodology for the use of (oiled) beached birds as indicators of marine pollution. Ad Hoc working group on Monitoring, Oslo and Paris Convention for the Prevention of Marine Pollution. MON 95/7, Agenda item 7, 13-17 November 1995, Copenhagen.

Dahlmann G., Timm D., Averbeck C., Camphuysen C.J. & Skov H. 1994. Oiled seabirds - Comparative investigations on oiled seabirds and oiled beaches in the Netherlands, Denmark and Germany (1990-1993). Mar. Poll. Bull. 28: 305-310.

Timm D. & Dahlmann G. 1991. Investigations into the source of non-mineral oils in the feathers of seabirds. In: Camphuysen C.J. & J.A. van Franeker (eds). Oil pollution, Beached Bird Surveys and Policy: towards a more effective approach to an old problem. Proc. Int. NZG/NSO workshop, 19 April 1991, Rijswijk, Sula 5 (special issue): 15-17.

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Plastic particles in stomachs of seabirds

EcoQ 3.3 Plastic particles in stomachs of beached seabirds (Northern Fulmar – *Fulmarus glacialis*)

EcoQO 3.3 There should be less than 10% of northern fulmars (*Fulmarus glacialis*) having more than 0.1 g plastic particles in the stomach in samples of 50 to 100 beach-washed fulmars from each of 4 to 5 areas of the North Sea over a period of at least five years.

Overall aims

Marine litter, in which plastic has the dominant role, causes huge economical damage through costs for coastal clean-ups, reduced tourism, disabled ship propellers and engines, tainted fish-by-catch, and damage to coastal agriculture. Furthermore, marine litter causes ecological damage to a wide range of marine organisms, including at least marine mammals, birds, turtles and fish. Such damage results from a) the entanglement in litter items leading to lethal injury, drowning or starvation, and b) the ingestion of plastic and other litter by many species that mistake marine debris for food. Ingested plastics, if not directly lethal, deteriorate body condition by a reduced intake of normal food, negative effects on digestion and elevated body-burdens of toxic chemicals. The occurrence of litter in the marine environment is due solely to human activities, and can therefore be controlled by human management.

The Northern Fulmar is a particular convenient species to measure plastic pollution by stomach content analysis. Like the whole group of 'tubenosed' seabirds (the albatrosses and petrels), it frequently ingests plastic litter. The Fulmar is particularly abundant in the North Sea, forages exclusively at sea (unlike *e.g.* gulls), retains slowly digesting materials in the stomach, and thereby 'integrates' litter pollution levels encountered at sea. Sources of plastic litter in the North Sea area are 1) ship's garbage and operational or cargo-related wastes, 2) lost and discarded fisheries materials from vessels and mariculture, 3) land-based wastes from coastal or riverine disposal, 4) recreational littering.

A monitoring programme using litter abundance in stomachs of a seabird, the Northern Fulmar, has been in effect in the Netherlands from 1982. A North Sea international study of fulmar stomach contents became possible as a part of the 'Save the North Sea (SNS)' project. SNS is an international

and interdisciplinary initiative to reduce marine litter, which received co-funding from EU Interreg IIIB program for the North Sea over the years 2002-2004. The fulmar is used as the symbol of the SNS campaign. The SNS Fulmar study established a research network in all countries around the North Sea, currently cofunded by the NYK group Europe Ltd. Combined results from Dutch long-term work and the 2002-2006 North Sea study show the fulmar to be a sensitive and robust monitoring tool for spatial and temporal trends in the marine litter situation.

This chapter provides a practical manual of the EcoQO on plastic particles in stomachs of seabirds for regional or national coordinators. For further background information on this EcoQO the earlier background document can be consulted as well as a number of reports on the ”Save the North Sea” pilot study and the Dutch monitoring programme as well as scientific papers. References to these can be found in the OSPAR publication 2008/355 (OSPAR Background Document on the EcoQO on plastic particles in stomachs of seabirds).

Methodology

Collection

Searches for beachwashed fulmars can be conducted as a part of regular Beached Bird Survey (BBS) programmes, or as a part of more local beach inspections for different reasons. In either system it may be important to rely not only on the standard schedule of full surveys (*e.g.* monthly), but to attempt to have a less formal but more frequent partial survey that would detect increased numbers of corpses. Fulmars often wash ashore in irregular pulses or wrecks related to conditions of weather, food, disease or pollution incidents. Bird corpses that are left in the tideline for prolonged periods of time do not only suffer decay, but are frequently scavenged by other birds or mammals. Coordinators may ask their contacts to keep an eye open all the time, and to be informed on any apparent increase in beachwashed birds. When such happens, temporarily increased search effort in surrounding areas can assist in obtaining adequate sample sizes of beachwashed Fulmars.

Results from the Dutch pilot study indicate that about 40 fulmar stomachs are an adequate sample size to provide a reliable figure for the litter situation at a particular location and point in time. Ideally, the different regions or countries would thus aim to collect 40 or more beachwashed or other dead fulmars per year. For some regions this will definitely be a difficult task due to the length or type of coastline, prevailing winds, removal of corpses by scavenging mammals, or scarcity of Fulmars offshore. In the SNS study however, suboptimal local sample sizes were dealt with by combining regions (*e.g.* different locations around Skagerrak). With regard to adequate sample sizes it is important to note that there is no need to restrict collection to ‘fresh’ specimens. Even fairly decayed or partly scavenged corpses can be used, as long as the stomach is intact. For analyses of relations between stomach contents and variables such as sex, age, cause of death or condition it is not necessary that all variables are known for all samples. In a regional comparison, also non-sexed or aged birds can be used.

Already at the beach, especially if birds are fouled by oil or other contaminants, corpses should be individually packed to avoid transfer of fouling from one bird to the other. It is important that collected corpses are immediately individually labelled with information on location, date, finder and any possible relevant information (for example if the bird was entangled in a net or other indicators for cause of death). Corpses should be stored deep-frozen (-16°C or below) in a well-sealed plastic bag, and then with the label in a second plastic transparent bag, again well sealed. The ‘double bag’ procedure prevents fouling or wetting of the label (which could become unreadable) and at the same time prevents the corpse from drying out in the freezer.

Most BBS participants will be well aware of risks of searching beaches and picking up birds. Toxic substances may wash ashore and may have fouled birds. Also, birds may carry diseases. The

potential contact with toxic chemicals and diseases urges a number of common sense procedures during beach surveys and laboratory investigations

Dissection

At dissections, some data need to be recorded that are of use to determine sex, age, breeding status, likely cause of death, and origin of the bird. Age, so far the only variable found to influence litter quantities in stomach contents, needs to be assessed by both external characters and the development of sexual organs (size and shape) and presence of Bursa of Fabricius (a gland-like organ positioned near the end of the gut which is involved in immunity systems of young birds; it is well developed in chicks, but disappears within in the first year of life or shortly after). Details are provided in Van Franeker 2004.

EcoQO dissection procedures may seem elaborate but are essential to keep track of variables that may influence the outcome of monitoring data. From the Dutch pilot study and later analyses, there is no doubt that age of birds affects the amount of litter in stomachs (young birds having higher load of plastics). This implies that bias in the monitoring result may occur if the age composition in sampled birds changes over time, and thus needs to be controlled for in the EcoQO monitoring system. Other parameters recorded during dissection concern the origin of the bird (colour phase, part of measurements), body condition and issues indicating cause of death. The pilot study for the EcoQO found no statistical evidence of these factors on amounts of plastic in the stomach, but subtle effects may (or are even likely) to occur and may become relevant in future evaluations of EcoQO data. Within the whole dissection procedure, cutting out a few elements that seem less essential at the moment, would save no more than an estimated 10% of time and costs. However, such reduction represents significant risk to future robustness and scientific quality of the monitoring system. Thus, it would be unwise to restrict on the dissection protocol.

Stomach content analysis

After dissection, stomachs of birds are opened for analysis. Stomachs of fulmars have two 'units': initially food is stored and starts to digest in a large glandular stomach (the proventriculus) after which it passes into a small muscular stomach (the gizzard) where harder prey remains can be processed through mechanical grinding. For the purpose of efficiency in this EcoQO study, contents of proventriculus and gizzard are combined.

Oil and chemical types of pollutants are first sub-sampled and weighed before rinsing the remainder of stomach contents. In further sorting natural food and non-food items have to be separated from the anthropogenic litter components in the sample. Non-plastic rubbish, such as paper, food waste, etc is also separated from plastics. Finally, the plastic particles are separated in two categories: industrial plastic and user plastics (sheets, threads, foamed, fragments and other).

After sorting above categories under a binocular microscope, the following parameters of plastics are recorded:

- incidence (presence or absence) and
- abundance by number (count of Number of items)
- abundance by mass (Weight in grams to 0.1 mg) using Sartorius electronic weighing scale after a one to two day period of air drying at laboratory temperatures.

Stomach content analyses are described in full detail in Van Franeker & Meijboom (2002) as are the methods for data analysis and presentation of results.

Analytical procedures for stomach contents have been reduced to the level needed for evaluation of the EcoQO. The different trends in industrial versus user-plastics, changes in size of plastic litter, and different relative abundances of subcategories of litter have shown their value in interpretation of the

EcoQO and identification of different sources of pollution, which is a prerequisite for taking effective policy measures. Further simplification would have virtually no cost-reducing effect as most effort in the stomach analysis is in unavoidable rinsing and separating food from non-food categories under binocular microscope, but would have the unacceptable effect of reducing the applicability of the EcoQO for management.

Data processing and reporting

Data from dissections and stomach content analysis are recorded in Excel spreadsheets and stored in Oracle relational database. GENSTAT 8 is used for statistical tests. The Fulmar-Litter-EcoQO requests information on 'total plastic' and annual or 5-year averages for mass of the combined plastics in the bird stomachs. Data on the trends in the different categories of plastics is also recorded and analysed. Tests allocating the collected data to specified main litter categories, continue to play an important role for the correct interpretation of the EcoQO metric.

Reporting will follow the format of the recent reports (Van Franeker 2008).

Quality assurance

The current procedures have been developed in regular interaction with the ICES seabird working group and relevant OSPAR committees. Regular workshops are held to coordinate sampling programmes and to train national participants in the dissection work. Stomach content analyses are done by IMARES. MARES utilises an ISO 9001:2000 certified quality management system (certificate number: 08602-2004-AQ-ROT-RvA). The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2000 accreditation for test laboratories with number L097.

Resource requirements (staff time and technical ability, equipment, running costs)

Litter EcoQO monitoring in the North Sea has been operational since 2002 by the combination of an existing Dutch monitoring programme of the Netherlands Ministry of VenW, the international 'Save the North Sea' project (EU funded under Interreg IIIB), and support by NYK Europe Ltd. The Dutch monitoring is anticipated to continue.

Collection of beached fulmars is embedded in existing beached bird surveys or other activities, and requires virtually no additional cost. Currently, the monitoring network for the Fulmar-Litter-EcoQO in the North Sea consists of a highly diverse group of participants. Some of these are professional organisations, but many are partly or completely dependent on NGO-based volunteer networks. Dissections are partly conducted at sampling locations and partly during workshops in the Netherlands. During project workshops, some participants have been trained to do their local dissection work, allowing part of such work to be decentralized. But only a few have the expertise, laboratory space or equipment to conduct stomach- laboratory analyses for the EcoQO and to complete database work and reporting.

Up until now, all stomach analyses in this EcoQO project have been conducted in the Netherlands, with obvious advantages for consistency in methods and maximum comparability of results. Also all database work, calculations and reporting have been integrated in the Netherlands, in association with the Dutch long term monitoring project for marine litter. Participants in the SNS fulmar study group favour the option that project coordination and at least stomach content analysis, database work and reporting continues centrally in the Netherlands.

Implementing this EcoQO with the current arrangements implies the following costs which need to be covered by the lead country.

- International Coordination (coordination, organisation of workshops and meetings)

- Laboratory processing of stomach samples
- Data management, analysis and reporting
- Reporting

All together this amounts to on average two hours per stomach, with an average rate of € 125 per hour, this would amount to € 250 per stomach.

A North Sea wide Fulmar-Litter-EcoQ monitoring programme in which the actions above will be performed in the Netherlands, would require a contribution of € 10 000 per Contracting Party per year on top of the current Dutch effort. For this contribution about 40 stomachs per year can be analysed. Countries providing large numbers of samples should take into account national costs for dissections. For countries with fewer birds the Netherlands also performs (part of) the dissection work and sometimes even covers the costs for transport of the samples.

The level of the contribution should be reviewed every 5 years. Attention should be paid to whether this is a justified average amount for national contribution.

Reporting requirements for Contracting Parties

Reporting is included in the cost. The lead country is fully responsible for the reporting to OSPAR. Furthermore the lead country will report the national figures of each participating country back to the contact point for further national use.

Method of Evaluation by the lead party

[text to be developed]

Consequences of not reaching the EcoQO (target, limit, indicator)

The ecological consequences of failing to meet the EcoQO do not only apply to fulmars but also to other species of birds, marine mammals, fish and other elements of the marine ecosystem. Damage results from a) entanglement in litter items leading to lethal injury, drowning or starvation, and b) ingestion of plastic and other litter by many species that mistake marine debris for food (Laist 1997;Derraik 2002). A more recent concern is the issue of microplastics and toxic chemicals built into or adhered to the surface of plastics acting as a booster of bioaccumulation of toxic chemicals in marine organisms eating plastic. Small microscopic size plastic particles become increasingly abundant in the marine environment and are ingested by all filter feeders (Thompson et al. 2004; Teuten et al. 2007). The economic consequences of continued high levels of marine litter include high costs for coastal clean-ups, damage to fisheries and danger for shipping accidents. From a management point of view, exceeding the level of 10% indicates that the amount of plastic entering the marine environment should be further reduced.

Link with the MSFD

The EcoQO on plastic particles in stomachs of seabirds can be used as an indicator for descriptor 10 of Annex 1 of the MSFD: *"Properties and quantities of marine litter do not cause harm to the coastal and marine environment"*

For seabird based monitoring of plastic in southern OSPAR regions and the Mediterranean, where fulmars do not occur, a pilot study is being conducted using the Cory's Shearwater (*Calonectris* sp). There are suitable comparable indicator species of tube-nosed seabirds (albatrosses and petrels) occurring worldwide.

References

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Van Franeker, J.A. 2004. Save the North Sea - Fulmar Study Manual 1: Collection and dissection procedures. Alterra Rapport 672. Alterra, Wageningen. 38pp.

Van Franeker, J.A. & Meijboom, A. 2002. Litter NSV - Marine litter monitoring by Northern Fulmars: a pilot study. ALTERRA-Rapport 401. Alterra, Wageningen, 72pp

All these and other reports are available on http://www.zeevogelgroep.nl/Downloads

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Ecological Quality Issue 4: Fish Communities

EcoQ4.1 Changes in the proportion of large fish and hence the average weight and average maximum length of the fish community

EcoQO4.1 Over 30% of fish (by weight) should be greater than 40 cm in length

OSPAR has no competence in questions related to fisheries management. The EcoQO on proportion of large fish relates to fisheries management and measures to achieve it must be taken by relevant fisheries management authorities. This EcoQO is aspirational and may be applied as an indicator on a trial basis. The EcoQO, the time frame for achieving it and the scientific justification will be further examined.

Overall aims

In exploited fish assemblages, larger fish generally suffer higher fishing mortality than smaller individuals and the size distribution becomes skewed towards the smaller end of the size spectrum. The susceptibility of late-maturing and larger fish species to fishing implies that small and early-maturing species increase in relative abundance. There is evidence that a change in the size distribution of fish communities in the North Sea has taken place. The average weight or maximum length can be expected to decrease when fishing effort increases, though natural factors will impact the size distribution as well.

From a conservation perspective, appropriate EcoQOs would move these metrics towards a larger proportion of large fish and would improve fisheries yields.

ICES has suggested that the goal for the North Sea fish community should be to halt as rapidly as possible, and begin to reverse by 2010, the decline in the proportion of large fish (OSPAR publication 356).

Methodology

The metric for the EcoQO (proportion of fish greater than 40 cm) is calculated for the demersal part of the fish community as sampled in the ICES Quarter 1 International Bottom Trawl Survey (IBTS). The

demersal fish community includes commercial groundfish and flatfish species like cod, haddock, whiting, saithe, Norway pout, plaice and sole. Pelagic species including herring, sprat and sandeels, which are also caught in variable numbers in the bottom trawl, have been excluded from the calculation of the metric.

The earliest year from which IBTS survey data are available in a standardized form is 1983, and the value of the 'Proportion of Large Fish' calculated from IBTS data in the years 1983 - 1985 varies between 0.24 and 0.30, with the highest value in 1983. This is also the most recent period when "maintaining the status quo" constituted the ICES advice for most commercial stocks, and ICES recommends the 1983 value of 0.3 as the target for this metric. This value also corresponds to the average for the Scottish Autumn Ground Fish Survey (SAGFS) prior to 1983.

While a metric for mean weight of fish is not needed as a basis for an EcoQO, ICES recommends that it should still be retained as a supplementary metric that reflects important fish community properties such as recruitment events.

Quality assurance

Evaluation of whether this EcoQO is met or not is based upon the ICES fisheries advisory system. The ICES fisheries assessment working groups have established handbooks and manuals for the quality assurance of the fisheries advisory process and are working towards the implementation of ICES quality programme for the fisheries advice with the aim of:

a. improving documentation of the advisory process - following data from the points being delivered to ICES through analysis and conclusion as advice;

b. improving fisheries data through assisting the EU Data Collection Programme with planning sampling and setting standards;

c. improving the quality of the advice through strengthening the secretariat function to provide support for the advisory groups – this will improve consistency and secure organisational memory.

Resource requirements (staff time and technical ability, equipment, running costs)

As this is covered as part of the regular activities of the fisheries management system for the North Sea, information has not been collected on the costs.

Reporting requirements for Contracting Parties

There are no additional reporting requirements for Contracting Parties. This EcoQO can probably best be reported on annually by the ICES secretariat as part of the agreement between OSPAR and ICES.

Method of Evaluation by the lead party

The proportion (by weight) of fish greater than 40 cm in length is reported by ICES based on results from the Quarter 1 International Bottom Trawl Survey (IBTS).

Consequences of not meeting the EcoQO

OSPAR has no competence to adopt programmes and measures on questions related to the management of fisheries. Application of the proposed EcoQO for commercial fish species must therefore be regarded as the responsibility of the competent fisheries management authorities. This is significant as it contributes to the further integration of fisheries and environmental protection, conservation and management measures, as called for in the Statement of Conclusions from the Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues in Bergen in

March 1997. The competent fisheries management authorities for the North Sea are the European Commission and Norway.

Link with the MSFD

The set of EcoQOs for the North Sea was developed with the aim to being an integral part of the Ecosystem Approach (EA) to the management of the North Sea, contributing to the objectives part of the EA. As such it is particularly important, as it can contribute to the further integration of fisheries and environmental protection, conservation and management measures, as called for in the Statement of Conclusions from the Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues in Bergen in March 1997.

The MSFD includes fisheries related issues as part of the definition of Good Environmental Status *i.e.* GES descriptors (1), (3) and (4)

(1) 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.

(3) Populations 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.

(4) 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.

The EcoQO on proportions of large fish can therefore have an important supplementary role to MSFD by covering a key aspect of fisheries in relation to the overall objective of achieving good environmental status and the above descriptors. However, measures concerning fisheries would appear to lie outside the scope of the Directive as the competence for fisheries management has been given to the European Commission.

Ecological Quality Issue 5: Benthic Communities

EcoQ 5.1 Imposex in dog whelks (*Nucella lapillus*) or other selected gastropods

EcoQO 5.1 The average level of imposex in a sample of not less than 10 female dog whelks (*Nucella lapillus*) 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, Where Nucella does not occur naturally, or where it has become extinct, the red whelk (*Neptunea antiqua*), the whelk (*Buccinum undatum*) or the netted dog whelk (*Nassarius reticulatus*) should be used, with exposure criteria on the same index of <2.0, <0.3 and <0.3, respectively.

Overall aims

The justification for this EcoQO is that the female dogwhelk (*Nucella lapillus*) is particularly sensitive to tributyl tin (TBT), which has been extensively used as an anti-fouling treatment on ships. TBT is linked to the incidence of imposex in dogwhelk. Imposex is the condition where female individuals develop non-functional male characteristics, eventually leading to sterilisation and a serious population decline. This phenomenon is fully developed at ambient TBT concentrations of 1-2 ng l^{-1}, and females are fully sterilized at concentrations above 5 ng l^{-1}. A standard method exists for measuring imposex: the Vas Deferens Sequence Index (VDSI). Besides the dog whelk, other gastropods such as red whelk (*Neptunea antiqua*), common whelk (*Buccinum undatum*), netted dog whelk (*Nassarius reticulatus*)

and periwinkle (*Littorina littorea*) proved to be vulnerable to the effects of TBT. Besides for *N. lapillus*, the VDSI can be used as a measure for specific biological effects of TBT on *N. reticulatus* and *N. antiqua*. For specific effects on *L. littorea* and *B. undatum* other measures are used for classifying the specific biological effects of TBT: respectively Intersex State Index (ISI or intersex) and Penis Classification Index (PCI). Intersex is expressed at higher concentrations of TBT (10 ng l^{-1}).

Periwinkle, whelk, red whelk and netted dog whelk may be used as an alternative biomonitor for TBT pollution to cover areas where dog whelk does not occur naturally, or where it has become extinct.

A detailed background document on this the EcoQO was published by OSPAR in 2005 (OSPAR Commission, 2005a). The EcoQO is being applied in the North Sea as an indicator.

Methodology

Monitoring guidelines and methods

Organotins in sediments and TBT specific effects have become mandatory determinants of the OSPAR Co-ordinated Environmental Monitoring Programme (CEMP) from 2003 onwards (OSPAR Agreement 2010-1).

Guidance for monitoring is provided in Technical annex 3 (TBT-specific biological effects monitoring) of the JAMP Guidelines for contaminant-specific biological effects monitoring (OSPAR Agreement 2008-9). This technical annex describes the sampling strategy, the choice of sampling locations, the methods to be used, the temporal trend monitoring, the field sampling and sampling equipment, the storage of samples and the determination of imposex or intersex in *B. undatum, N. antiqua, L. littorea, N. reticulatus and N. lapillus*.

There is, for the moment, no need for a further elaboration of the monitoring guidelines and methods for the work of OSPAR on the EcoQO imposex in dogwhelks. However, Contracting Parties to OSPAR only carrying out monitoring of TBT specific biological effects on one gastropod species could be encouraged to extend this monitoring to other relevant species living in their waters (such as *B. undatum* or *N. reticulatus*), given the different habitats the relevant species occur in. Given the relatively low sensitivity of *L. litorea* to TBT, a national or regional monitoring system only using this species should, if possible, be extended to other species.

The monitoring frequency (and subsequent reporting) should be harmonised between Parties to every two years, so that a more complete assessment could be carried out in the future on a more regular interval and on data which are intercomparable throughout the area concerned.

Quality Assurance

Laboratories collecting data on TBT-specific effect under the CEMP should participate in the “Quality Assurance of Information for Marine Environment Monitoring in Europe” (QUASIMEME) laboratory performance scheme. QUASIMEME is a platform for exchange of laboratory performance studies and test material to support improvement of data quality by laboratories, and for verification of the performance of all participating laboratories. QUASIMEME covers all the matrix-determinant combinations of the CEMP. New determinants are added to QUASIMEME upon demand. OSPAR is represented in the advisory board of QUASIMEME, and CEMP data of Contracting Parties have to go through QUASIMEME QA testing before being forwarded directly by QUASIMEME to ICES (as CEMP data centre) with a QA statement. OSPAR annually reviews developments in QUASIMEME.

Resource Requirements

Given that the monitoring of TBT specific effects has become mandatory under the CEMP since 2003, there should be no additional cost for implementing the monitoring required for this EcoQO. Assessments under the current CEMP should allow determination whether the EcoQO is met or not.

However, if the monitoring frequency is increased, if the current monitoring is extended to include other relevant species occurring at different locations (*e.g.* inshore – offshore) and/or if sample sizes and the number of sites sampled are increased, then costs will rise accordingly.

Reporting requirements for Contracting Parties

The required data for the biological effects measurements, including the supporting parameters, have been described in technical annex 3 (TBT-specific biological effects monitoring) of the JAMP guidelines for contaminant-specific biological effects monitoring (OSPAR Agreement, 2008-9). Data monitored under the CEMP should be reported to the ICES environmental databases in accordance with the latest ICES reporting formats by 1 August in the year following monitoring.

Method for Evaluation of the data

As monitoring of TBT specific biological effects is already a mandatory component of the CEMP, it should be possible to determine whether or not the objective is met from assessments of the existing monitoring.

Assessments of the data collected under the CEMP have been assessed by the OSPAR Working Group on Monitoring (MON) in 2008 and 2009 (OSPAR Commission, 2008, OSPAR Commission 2009).

Assessment criteria for organotin specific biological effects in gastropods

Monitoring data has little importance if one cannot interpret, or assess, their significance to man or to the environment. Therefore a set of criteria or a reference scale is needed to describe the significance of the data. Assessment criteria were derived for the VDSI in *Nucella lapillus*, representing the most sensitive species known. Considering the absence of populations of *N. lapillus* in some coastal areas, other species should be used for monitoring the effects of TBT. The criteria for *Nucella* were presented alongside equivalent VDSI/ISI values for other gastropods *(N. reticulatus, B. undatum, N antiqua* and *L. littorea*). The effects of TBT on different species were compared using sympatric populations in the field. The proposed criteria enable the consideration of the likely effects on *N. lapillus* based on effects in other species and allow the adoption of a consistent approach over the whole OSPAR region. Six assessment classes were defined for the various gastropods considered. These provisional assessment criteria for TBT were adopted by OSPAR in 2004 and updated in 2008 (OSPAR Agreement 2004-15). An overview of the assessment classes is given in the Table 5.1. The Environmental Assessment Criteria (EAC) are concentrations above which there is concern that negative effects might be observed in marine organisms.

Table 5.1. Assessment classes for N. lapillus and other selected gastropods

<table>
<tr><th rowspan="2">Assessment class</th><th>Nucella</th><th>Nassarius</th><th>Buccinum~</th><th>Neptunea#</th><th>Littorina</th></tr>
<tr><td>VDSI</td><td>VDSI</td><td>PCI</td><td>VDSI</td><td>ISI</td></tr>
<tr><td>A
Level of imposex is close to zero</td><td>< 0.3</td><td rowspan="2">< 0.3[1]</td><td rowspan="2">< 0.3[1]</td><td>< 0.3</td><td rowspan="2">< 0.3[2]</td></tr>
<tr><td>B
Level of imposex (~30-~100% of the females have imposex) indicates exposure to TBT concentrations below the EAC derived for TBT</td><td>0.3 - <2.0</td><td>0.3 - <2.0</td></tr>
</table>

C Level of imposex indicates exposure to TBT concentrations higher than the EAC derived for TBT	2.0 < 4.0	0.3 < 2.0	0.3 < 2.0	2.0 < 4.0[3]	
D Reproductive capacity in the gastropod populations is affected as a result of the presence of sterile females, but some reproductively capable females remain	4.0 - 5.0	2.0 - 3.5	2.0 - 3.5	.4.0[3]	0.3 - < 0.5
E Populations are unable to reproduce. The majority, if not all females within the population have been sterilised	>5.0	> 3.5[4]	> 3.5[4]		0.5 - 1.2
F Populations are absent/expired	-				> 1.2

[1] This species cannot be used to distinguish between class A and class B. The assessment class is therefore by definition B.

[2] This species cannot be used to distinguish between classes A, B and C. The assessment class is therefore by definition C.

[3] This species cannot be used to distinguish between class C and higher classes. If a VDSI of 4.0 is reached, additional observations are required to determine the assessment class e.g. by using another species. If a VDSI of 4.0 is observed, the assessment class is therefore by definition F. [4] These species cannot be used to distinguish between class E and class F. Therefore, additional observations are required to determine the assessment class e.g. by using another species. If the VDSI (*Nassarius*) or the PCI (*Buccinum*) is >3.5, the assessment class is therefore by definition F.

Consequences of not meeting the EcoQO (target, limit, indicator)

The EcoQ is intended to provide a basis for monitoring the level of TBT in the environment after implementation of the following measures:

a. restrictions on the marketing and use of organic tin compounds as antifouling under Directive 1999/51/EC of the Commission of 26 May 1999 adapting to technical progress for the fifth time Annex I to Council Directive 76/769/EEC;

b. International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention) adopted on 5 October 2001 which bans the application of TBT based anti-fouling paints by 1 January 2003 and a ban on the presence of TBT on ships' hulls by 1 January 2008;

c. EC Community Regulation, (Regulation (EC) No 782/2003) implementing the AFS Convention within the EU;

d. PARCOM Recommendations 87/1 on the Use of Tributyl-Tin Compounds and PARCOM Recommendation 88/1 on Measures to Reduce Organotin Compounds Reaching the Aquatic Environment through Docking Activities.

Given the comprehensive nature of these measures in addressing sources of TBT in the marine environment, any failure to meet the EcoQO indicates the need for the further implementation of the agreed measures. Therefore the progress made in implementing the key measures (AFS and Regulation 782/2003) should also be taken into account. In the immediate future status in relation to the EcoQO should be assessed on a regular basis to check the progress being made and the effectiveness of the measures, however it is recommended that if the EcoQO has not been met by *e.g.* 2020, there should be an analysis of the need to urge improved implementation of the existing measures or the adoption of additional measures.

Link with the proposed MSD

In the context of the initial assessment under the EC MSFD, this EcoQO is able to provide an indication of the environmental quality status with regard to inputs of a synthetic chemical giving rise to concern (*i.e.* TBT).

The EcoQO provides an indicator and an environmental target in relation to the GES conceptual descriptor: “concentrations of contaminants are at levels not giving rise to pollution effects”.

In terms of programmes and measures the EcoQO is a means of measuring the effectiveness of measures addressing the marketing and use of TBT, including EC Community Regulation, (Regulation (EC) No 782/2003) implementing the AFS in the EU.

References

OSPAR Commission (2008) 2007/2008 CEMP Assessment: Trends and concentrations of selected hazardous substances in sediments and trends in TBT-specific biological effects. OSPAR Commission 2008/378

CEMP assessment report: 2008/2009 Assessment of trends and concentrations of selected hazardous substances in sediments and biota. OSPAR Commission 2009/390.

Ecological Quality Issue 9 Eutrophication

Overall aims

The use of the integrated set of five eutrophication Ecological Quality Objectives (EcoQOs) is identical to the application of the Comprehensive Procedure, both in procedure and frequency of application, and they can be seen as part of the target-oriented approach of the Eutrophication Strategy. Their implementation is through the applications of the Comprehensive Procedure to produce integrated reports on eutrophication status. The second of these was published by OSPAR 2008.

The ecological quality issue 9 – Eutrophication – comprises one overarching EcoQO and an integrated set of five sub-EcoQOs for eutrophication. The five sub-EcoQOs and their relation to the assessment parameters of the Common Procedure are presented in Table 9.1.

Table 9.1. Overview of the overarching ecological quality objective for eutrophication and its integrated set of EcoQOs, in relation to the assessment parameters of the Common Procedure

EcoQ eutrophication element	EcoQOs for eutrophication	Common Procedure assessment parameter and related elevated levels
9.1 Eutrophication status of the North Sea	Overarching EcoQO: All parts of the North Sea should have by 2010 the status of non-problem areas with regard to eutrophication, as assessed under the OSPAR Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area (which consists of the (one-off) Screening Procedure and the (iterative) Comprehensive Procedure).	
9.1.1 Winter nutrient concentrations	Winter concentrations of dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphate (DIP) should remain below a justified salinity-related and/or area-specific % deviation from background not exceeding 50%.	Category I: Degree of nutrient enrichment:: Nutrient concentrations (area-specific): • Elevated level(s) of winter DIN and/or DIP
9.1.2 Phytoplankton chlorophyll *a*	Maximum and mean chlorophyll a concentrations during the growing season should remain below a justified area-specific % deviation from background not exceeding 50%.	Category II: Direct effects of nutrient enrichment: Chlorophyll a concentration (area-specific): • Elevated maximum and mean level
9.1.3 Phytoplankton indicator species for eutrophication	Area-specific phytoplankton eutrophication indicator species should remain below respective nuisance and/or toxic elevated levels (and there should be no increase in the average duration of blooms)	Category II: Direct effects of nutrient enrichment: phytoplankton indicator species (area-specific): • Elevated levels of nuisance/toxic phytoplankton indicator species (and increased duration of blooms)
9.1.4 Oxygen	Oxygen concentration, decreased as an indirect	Category III: Indirect effects of

		effect of nutrient enrichment, should remain above area-specific oxygen assessment levels, ranging from 4 – 6 mg oxygen per litre	nutrient enrichment: Oxygen deficiency: • Decreased levels (< 2 mg/l: acute toxicity; 2 - 6 mg/l: deficiency) and lowered % oxygen saturation
9.1.5	Kills in zoobenthos in relation to eutrophication	There should be no kills in benthic animal species as a result of oxygen deficiency and/or toxic phytoplankton species	Category III: Indirect effects of nutrient enrichment on zoobenthos and fish: • Kills (in relation to oxygen deficiency and/or toxic algae)

Detailed Methodology

The OSPAR Eutrophication Monitoring Programme (*OSPAR agreement 2005-4; see table 9.2*) and the related JAMP Monitoring guidelines provide adequate monitoring data (including supporting environmental information) for eutrophication issues. Coherent monitoring, in accordance with the OSPAR Joint Assessment and Monitoring Programme (JAMP) and the JAMP guidelines should be maintained.

The OSPAR Eutrophication Monitoring Programme is an integral part of the OSPAR Eutrophication Strategy. It provides the basis for enabling Contracting Parties to assess and classify the eutrophication status of their maritime waters under the "Comprehensive Procedure" of the Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area ("Common Procedure", reference number: 2005-3).

The Eutrophication Monitoring Programme forms part of the OSPAR Coordinated Environmental Monitoring Programme (the CEMP – *OSPAR agreement 2009-1*). Contracting Parties shall report the monitoring results for the parameters listed in the annexed tables in accordance with the arrangements for the CEMP agreed and updated periodically by OSPAR. ICES is currently the OSPAR data centre for marine environmental monitoring data, and according to the agreements of OSPAR, Contracting Parties are obliged to report their monitoring data to ICES by 1 August in the year following the year of monitoring using the agreed formats and should resolve any data processing issues with the ICES data centre.

The parameters on nutrient enrichment and on direct and indirect eutrophication effects, and general guidance of sampling frequency is shown in the overview of the OSPAR Eutrophication Monitoring Programme in Table 9.2.

Actions needed to achieve harmonised monitoring

There is need to supplement the Eutrophication Monitoring Programme with guidance on frequency and spatial coverage. Work on guidance on the frequency and spatial resolution of monitoring for nutrients and eutrophication effects is still ongoing.

Quality Assurance

Data for the national assessments will have been collected under the Eutrophication Monitoring Programme. Details of the quality assurance procedures applied are set out in the relevant JAMP guidelines compiled under the CEMP monitoring manual. For any other data taken into account in the Common Procedure, Contracting Parties are required to include information on QA procedures followed in their national assessment reports and should follow guidance, prepared by EUC specifically for the application of the Common Procedure in 2007, on the information that Contracting Parties need to include in their reports.

Resource Requirements

The report of the North Sea Pilot Project on EcoQOs concludes in chapter 7 that the monitoring requirements for all the eutrophication EcoQOs are covered by the Eutrophication Monitoring Programme already required for the OSPAR Comprehensive Procedure and the EC Water Framework, Nitrates and Urban Waste Water Directives. Additional assessment work is likely to be very small.

Reporting Requirements for Contracting Parties

The reporting format as in Annex 5 of the Common Procedure should be used.

The timetable for monitoring and reporting is guided by the requirements of the JAMP towards the 2008 assessment of the eutrophication status (EA-6) and the 2009 evaluation of the results of the EcoQO system (BA-2) as a contribution to the QSR 2010 (AA-2).

Method for Evaluation of the data

The evaluation of the EcoQOs-eutro will be carried out in conjunction with the work on the second application of the OSPAR Common Procedure. Contracting Parties national reports on the application of the common Procedure include national reports on the implementation of the EcoQOs-eutro. On the basis of these reports EUC will prepare an evaluation of the results of the EcoQOs eutro.

Consequences of not meeting the EcoQO (target, limit, indicator);

In cases, in which the final classification results in problem areas with regard to eutrophication, and the overall eutrophication EcoQOs are not met, the Eutrophication Strategy requires the OSPAR Commission and Contracting Parties, individually or jointly, to take measures to reduce or to eliminate the anthropogenic causes of eutrophication and to assess, based on implementation reporting, the effectiveness of those measures on the state of the marine ecosystem. In the case of potential problem areas with regard to eutrophication, preventive measures shall be taken in accordance with the precautionary principle and monitoring and research shall be urgently implemented to enable a full assessment of the eutrophication status of each area concerned after five years of its classification.

Measures are in place to combat human induced eutrophication, and the Eutrophication Strategy builds on long-standing work of OSPAR. This includes the commitment of Contracting Parties to achieve a substantial reduction at source, in the order of 50% compared to 1985, in inputs of phosphorus and nitrogen into areas where these inputs are likely, directly or indirectly, to cause pollution.6 These areas are defined as problem areas. The implementation of the Eutrophication Strategy takes place within the framework of the obligations of Contracting Parties in this field. This includes for example the Urban Waste Water Treatment Directive (91/271/EEC) and the Nitrates Directive (91/676/EEC) which requires Member States of the European Community and the European Economic Area to identify “sensitive areas” and nitrate “vulnerable zones”, respectively, as basis for the implementation of targeted measures to reduce nutrient inputs to these areas. Under the WFD (2000/60/EC) an assessment framework, closely linking to the conceptual approach of the Common Procedure, has been set up to assess, classify and monitor the ecological quality of transitional and coastal waters.

[6] PARCOM Recommendation 88/2 on the reduction in inputs of nutrients to the Paris Convention; PARCOM Recommendation 89/4 on a coordinated programme for the reduction of nutrients; and PARCOM Recommendation 92/7 on the reduction of nutrient inputs from agriculture

The 50% nutrient reduction target has been met by most Contracting Parties for phosphorus but, with the exception of Denmark, not for nitrogen. Reductions for nitrogen were less consistent and explicit, ranging from 10% to 48% across OSPAR (OSPAR 2008b). This can partly be explained by a time lag between implementation of nutrient reduction-measures and the actual effects of the measures. It is predicted that nutrient reductions beyond the 50% target are needed for certain areas to achieve the Strategy's objective.

Link with the MSFD

Specific linkages with the MSFD and the WFD and how the EcoQO might be used in relation to the MSFD initial assessment, drawing up programmes and measures and elaborating GES

With respect to the MSFD, the qualitative descriptor of good environmental status covering eutrophication is that "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".

The overall EcoQO for eutrophication as laid down in the corresponding overall objective of the Eutrophication Strategy and applied through the Comprehensive Procedure, is able to provide a good overview of the eutrophication status of the North-East Atlantic and can provide a sufficient indication of the environmental status which takes account of nutrient inputs and eutrophication effects.

For transitional and coastal waters which overlap with the régime of the Water Framework Directive (WFD), the biological and physico-chemical quality elements contributing to determining the ecological quality of water bodies under the WFD provide similarities and synergies with the use of the integrated set of EcoQOs for eutrophication (Figure 9.2) (OSPAR 2005). The 2008 OSPAR integrated report reviews those synergies in the light of progress in the WFD intercalibration process. For eutrophication purposes, the boundary between a 'problem area' and a 'non-problem area' in the coastal region should align with the boundary between the 'good' and the 'moderate' ecological status under the WFD. While for the eutrophication classification the Common Procedure and the integrated set of 5 EcoQOs for eutrophication relate to nutrient enrichment and eutrophication effects, the overall classification of the ecological status under the Water Framework Directive takes into account all kinds of significant human pressures.

Figure 9.2 Relationship between the classification under the Common Procedure, the integrated set of OSPAR EcoQOs for eutrophication and the Water Framework Directive (WFD).

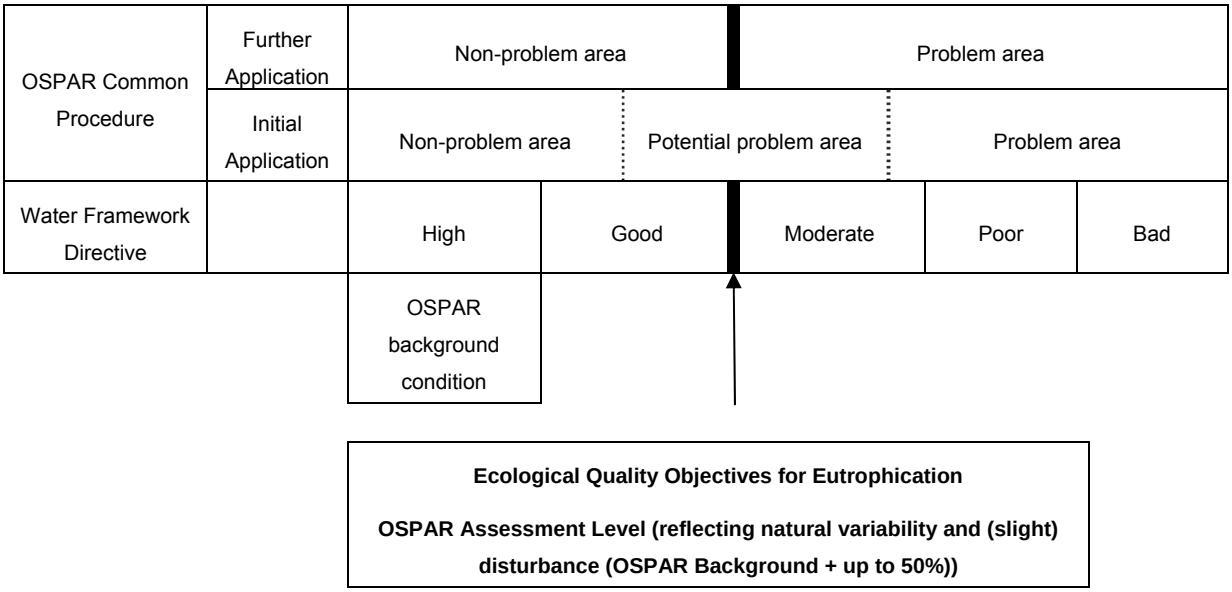

Table 9.2. The OSPAR Eutrophication Monitoring Programme (OSPAR agreement 2005-4) minimum requirements

1. Nutrient enrichment[1]

	Non-problem areas	Potential problem areas	Problem areas
NH_4-N[2,4] (µmol l^{-1})	+	+	+
NO_2-N[2,4] (µmol l^{-1})	+	+	+
NO_3-N[2,4] (µmol l^{-1})	+	+	+
PO_4-P[3,4] µmol l^{-1})	+	+	+
SiO_4-Si[4] (µmol l^{-1})	-	+	+
Salinity	+	+	+
Temperature	+	+	+
Frequency[5]	About every three years during winter	Annually during winter when algal growth is at a minimum and during monitoring of direct and indirect effects	

\+ Action required

\- Action discretionary

1 All parameters should be monitored in conjunction with area-specific ecosystem features.

2 Winter dissolved inorganic nitrogen (DIN) is the sum of NH_4-N, NO_2-N and NO_3-N.

3 Winter dissolved inorganic phosphate (DIP)

4 Monitoring of winter DIN, DIP and Si should be in conjunction with salinity measurements (see Common Procedure, §§ 4.25 and 4.28).

5 Monitoring should include sufficient samples to confirm that the maximum winter nutrient concentration has been determined.

2. Direct and indirect eutrophication effects[1]

	Non-problem areas	Potential problem areas	Problem areas
Phytoplankton chlorophyll *a* (µg l^{-1})	-	+	+
Phytoplankton indicator species (cells l^{-1}; species composition)	-	+ species composition: (genera and nuisance/potentially toxic species)	• + species composition: (genera and nuisance/potentially toxic species) + TOC and POC[2]
Macrophytes, including macroalgae and angiosperms[3]	-	+ biomass	+ biomass + species composition, coverage, and reduced depth distribution
O_2 concentration (mg l^{-1}; including % O_2 saturation)	-	+	+
(zoo) Benthic communities	-	+ biomass and species composition (if time series already exist)	+ biomass, species composition and eutrophication indicator species
Frequency[4]	-	annually during the algal growing season	

\+ Action required

\- Action discretionary

1 All parameters should be monitored in conjunction with area-specific ecosystem features.

2 TOC: Total Organic Carbon; POC: Particulate Organic Carbon.

3 In shallow areas, primarily in estuaries and coastal waters.

4 With adequate frequency and area coverage

C. Guidance on developing EcoQOs

Planning

When a Contracting Party agrees to act as lead country for the development of an EcoQO (or EcoQOs) for one of the less advanced EcoQ elements or issues, they should inform the OSPAR Secretariat of the planned timescale for the development work so that appropriate entries can be made in the OSPAR work programmes when they are next revised.

Information collection and analysis

An initial information collection stage should include the collection of existing information on, among other things, the monitoring of the ecological quality element, current and historic levels of the EcoQ element in the North Sea, reference levels, sensitivity to human activities and potential sensitivity to management actions. The lead country, at an early stage, should contact other Contracting Parties and observer organisations to obtain information they may have on the EcoQ element concerned. Before developing new EcoQOs there is a need to firstly analyse the objectives (GES descriptors from MSFD Annex 1) and the pressures to establish more clearly what needs to be achieved and what might be preventing it. This would allow a better focus on

what types of indicators (EcoQOs) are needed for MSFD delivery to address the key pressures. The next key question is whether there are already indicators in place (for other policies) that are already doing the job required (or could do the job if adapted or adopted). Another key issue is how many indicators will be needed to determine if GES is being met.

Proposal of an objective

On the basis of the information collected, an objective (EcoQO) should be proposed as the "desired level of an ecological quality" for the EcoQ element. Such a level may be set in relation to a reference level. The definition of an EcoQO should take into account the conceptual description of the EcoQO system in Chapter 3 of the Report on the North Sea Pilot Project on EcoQOs (OSPAR Publication: 2006/239)

Preparation of a Background Document

At the same time, a Background Document should be prepared. The purpose of a Background Document is to set out a justification for the EcoQO and its definition and an analysis of the applicability of the EcoQO. Background Documents should be prepared with a view to publication. They should therefore be reader-friendly, well-structured and concise, and the language used should be clear and unambiguous. Background Documents should contain the following information:

1. EcoQO Issue;
2. EcoQO Element;
3. EcoQO Objective;
4. Justification for the development of the EcoQO;
5. Technical evaluation considering the following elements:
    a. ICES criteria for a good EcoQO:
        (i) Relatively easy to understand by non-scientists and those who will decide on their use
        (ii) Sensitive to a manageable human activity
        (iii) Relatively tightly linked in time to that activity
        (iv) Easily and accurately measured, with a low error rate
        (v) Responsive primarily to a human activity, with low responsiveness to other causes of change
        (vi) Measurable over a large proportion of the area to which the EcoQ metric is to apply
        (vii) Based on an existing body or time-series of data to allow a realistic setting of objectives
    b. Ecological relevance/basis for the metric
        - Spatial and temporal scales

Add a description of the temporal scale of the metric

Add a description of the spatial scale of the metric

- Uncertainty

  Analyse the sources of uncertainty

  Determine confidence level of the metric

  Analyse the statistical power of the metric to detect trends

  Analyse the risk of misclassification

c. Current and historic levels (including geographical areas)

d. Reference level and time frame

- Describe how reference levels have been established
- Describe how the limit point is established
- Define the time frame for the objectives

e. Limit point

f. Advice on EcoQO options (scenarios)

g. Overall classification

- Develop a system to combine metrics in an overall classification

h. Monitoring methods and reporting requirements

i. Quality assurance

Describe through which process quality assurance is organized for

Monitoring issues

Cause-effect relationships

Determination of reference levels and objectives

j. Management measures required to achieve the EcoQO

6. Applicability of the EcoQO in each of the OSPAR Regions

7. Further considerations (including costs);

8. Conclusions;

9. References.

Quality Assurance

The lead country should make proposals during the planning phase for peer review of EcoQOs and background documents by relevant specialists. Where the peer review is proposed to be by ICES, this will need to be included in the OSPAR ICES work programme.

Acceptance of the Background Document and setting the EcoQO

Proposals for EcoQOs and supporting Background Documents should be presented for initial discussion at the relevant BDC working group, with the aim of them being submitted to BDC later in that cycle of meetings for recommendations to the OSPAR Commission meeting at the end of that cycle of meetings for:

a. adoption of the EcoQO;

b. publication of the Background Document.

Follow-up to adoption

When an additional EcoQO has been adopted, the lead country should then make proposals for the entry in section B of the EcoQO Handbook on the basis for its implementation, covering the points mentioned in each of the sections covered by the current guidance. The aim of these proposals is to establish compatible monitoring methods and consistent reporting by all relevant North Sea States. Where appropriate, such proposals can accompany the proposals for the EcoQO and the Background Document.

Methodological considerations

The following guidance on methodological considerations in the development of EcoQOs was endorsed by BDC 2009

Ecological basis of the metric

The suitability of a metric depends on ecological considerations, but also on other factors. ICES (2001) developed a list of criteria for good indicators:

1. Relatively easy to understand by non-scientists and other users
2. Sensitive to a manageable human activity
3. Relatively tightly linked in space and time to that activity
4. Responsive primarily to a human activity, with low responsiveness to other causes of change
5. Easily and accurately measured, with a low error rate
6. Measurable over a large proportion of the area over which the EcoQO element is to apply
7. Based on an existing body or time series of data to allow a realistic setting of objectives

The first criterion is mainly a communication issue, and the second criterion relates mainly to policy development and management of ecosystems.

The other criteria can be applied to evaluate the scientific basis for the metrics.

Tightly linked in time and space

A metric should display a relatively fast response to a pressure, in order to be able to monitor impacts on the marine environment. This seems rather obvious, but in practice poses some difficulties, e.g.:

- What spatial and temporal scale is relevant for the response
  - For example, with transboundary transport of pollutants impacts may occur far from the source
- Slow responses may still be relevant if recovery rates from an impact are also low
  - For example, slowly reproducing fish species may suffer from low fishery related mortality, but the impact is only visible with a long time lag
- Responses may show a time lag

Most of the EcoQOs from the North Sea pilot project (OSPAR, 2006) seem to have relatively short time scales of responses, but a systematic evaluation of this point is lacking in the background documents. The Eutrophication EcoQO elements were reviewed by ICES (2004) and in some cases it was concluded that this link is not always obvious.

These issues should be included in the development of new EcoQOs.

In order to improve the applicability of a metric, the following could be recommended the development of new EcoQOs:

- Evaluate the temporal scale of response of a metric

Example: In an evaluation of the performance of the EcoQO on oiled guillemots it was shown that there is a consistent gradual decline around the North Sea. Evaluations have also been carried out to establish the statistical power of trend tests in this EcoQO (OSPAR 2005 and references therein).

- Evaluate the spatial scale of response of a metric

Example: Some EcoQOs are applicable at North Sea scale (e.g. commercial fish species), other EcoQOs are applicable at a smaller scale (e.g. marine mammals). When the EcoQOs work at a smaller scale (or information is only available at smaller scale) it is not clear how this is aggregated into an overall assessment value for the North Sea environmental status

These recommendations should be taken into account in the "Arrangements for development of EcoQOs", as stated in the Agreement of the application of the EcoQO system (Agreement 2006-4).

Easily and accurately measured

The accuracy of a metric is fundamental if (potentially expensive) measures have to be based on the outcomes of an assessment. A metric should reflect the true value of the ecosystem characteristic that is targeted by this metric.

However, a related issue that is not addressed by this ICES criterion, is the question of precision of the metric and confidence in the final classification of an ecosystem.

This point is extensively discussed in the WFD CIS Guidance on Classification (EC, 2005). Potential sources of error and uncertainty in the value of a metric are *inter alia*

- Apparent random variations on short time scales
- Diurnal patterns
- Seasonal patterns
- Longer term trends, cycles and random influences, including year to year variation
- Step changes (random, regular or permanent)
- Variation with depth of water
- Spatial variation
- Correlations with other physical or biological properties
- Serial correlation, for example, clusters of bad months or bad years
- Bias and random errors from equipment
- Values close to the detection limit
- Human error

The error and uncertainty in the value of a metric can result in misclassification, i.e. a system is assigned a wrong status (worse or better than the true status). Some work has been done in the WFD on the issue of misclassification, and we refer to Annex I in the WFD CIS Guidance on Classification (EC, 2005) that provides several guidelines how to address this issue. This includes determination of monitoring and analytical errors, establishing necessary levels of confidence, limiting the number of metrics that are included in the classification and choosing appropriate methods of combining metrics

in the final classification. Statistical considerations related to the question of confidence in classification were discussed by Carstensen (2007).

This topic is not included in the background documents of the EcoQOs. However, for most current EcoQOs these issues were included during the development phase.

We have the following recommendations to be included in the development of new EcoQOs:

Determine the detection limit, and the analytical and monitoring errors in the metric

Determine the confidence level of the metric necessary to observe changes in environmental status

Determine which metrics are essential to assess environmental status

Determine if and how metrics are combined for the final assessment of environmental status

Response primarily to human activity

A metric can only be used as a diagnostic tool when it is clear how it responds to anthropogenic pressures or other factors, and if the response to anthropogenic pressures is not overshadowed by natural variation. This requires knowledge on the relationship between natural factors, human pressures and the ecological status of the marine environment.

In the marine environment, there is often large uncertainty involved in these cause-effect relationships, *inter alia* due to complex interactions, feedback mechanisms and lacks in knowledge. For the WFD much work was done to enlarge the knowledge base on cause-effect relationships, *inter alia* within the FP6 project Rebecca (http://www.rbm-toolbox.net/rebecca/). Although some work in this project was done in the marine environment, the main focus of this project was on freshwater systems.

The evaluation of the EcoQOs from the North Sea pilot project (OSPAR 2006) indicates that in some cases the link between anthropogenic pressures and response of the metric is uncertain or unclear, and in those cases there is clearly a need for a strengthening of the scientific basis of the cause-effect relationship.

Ideally, only metrics are used that have a clear and unequivocal response to human pressures, and that respond in a known and predictable manner to natural factors.

It is recommended that metrics are subject to scientific review of the quality of the relationship between anthropogenic factors and the response. In cases where this relationship is uncertain, additional research should be done. An example is the EcoQOs on “Seal population trends in the North Sea”.

Measurable over a large proportion of the area

The MSFD asks for the determination of environmental status at the level of a marine region or subregion. It seems obvious that metrics should be applicable at that level as well. As the pilot EcoQOs are all applicable at the scale of the North Sea, it could be concluded that this criterion is met.

Based on existing data to allow realistic setting of objectives

This ICES criterion should not be regarded as essential, as for some biodiversity issues there simply are not the monitoring programmes in place yet to have established time series data - these will need to be developed and trialed to establish suitable indicators, looking to more local research studies wherever possible for potential indicators.

Further, this ICES criterion is somewhat confusing. Obviously without data a metric cannot be developed properly. However, it is questionable whether data always have to be available for a specific region or subregion, before a metric can be developed and objectives can be formulated. In some cases a metric may be developed on the basis of scientific knowledge developed in other

regions. In some other cases a metric may be developed even without previous data sets. For example, the EcoQO Oiled guillemots does not need historic data on the proportion of oiled guillemots to determine a reference level.

Reference level

In the description of the EcoQOs the reference level is defined as “the level where the anthropogenic influence on the ecological system is minimal”. The MSFD does not give a definition of reference conditions or indicate to what extent anthropogenic influence on the ecological characteristics is compatible with “good environmental status”.

In the WFD, reference conditions were defined as a description of biological quality elements at high ecological status (Annex II 1.3 (i)). High ecological status is described as a situation with no or only very minor anthropogenic alterations to quality elements.

Following a similar approach in the MSFD would mean that a reference condition in the MSFD is similar to the reference level in the EcoQOs. It should be noted that this reference level should not be confused with the objective.

It is essential that there is a clear and transparent way to establish references.

For the WFD, several methods have been applied to derive reference conditions, e.g. using data from reference systems in undisturbed conditions or from historical data sets, by modelling, by expert judgment or by a combination of methods (EC 2005).

For the EcoQOs reference conditions and background concentrations are often used interchangeably. For natural substances, in many occasions it will be possible to derive background concentrations from salinity-related concentration gradients or from offshore concentrations.

For biological elements, this approach is not applicable and reference levels have to defined based on expert judgment if reference systems or historic data are lacking. This was done in the case of commercial fish species, but is still lacking for other EcoQOs.

It is recommended that for new EcoQOs the definition of references is documented and done in a transparent way.

Limit point

In addition to reference levels, the desired level of a metric has to be defined. This level would indicate the boundary between “Good environmental status” and the situation where good environmental status is not reached.

In the WFD classification of ecological status 5 classes were used, from High (nearly undisturbed) to Good (slight deviation from reference conditions) and down to Moderate, Poor and Bad. Although this leads to a classification at a detailed scale, in practice the main focus has been on the determination of the class boundary between good and moderate status, as moderate status implies that the objectives of the WFD are not met and measures have to be implemented to achieve good status. This boundary is different from the reference level, as it expresses the point where there is a “moderate deviation” from undisturbed conditions.

The MSFD only speaks of “good environmental status” suggesting a system with only two classes might be sufficient (good status or not). This would be similar to the system used in the EcoQOs, where ‘limit points’ are described as a threshold value that should not be exceeded, and that could be considered as the boundary determining if a marine system is in Good environmental status or not (Figure 1).

For the definition of this threshold value, methods similar to the ones used to derive reference values could be used, e.g. data from reference systems in undisturbed conditions or from historical data sets, by modelling, by expert judgment or by a combination of methods. Again, it is essential that it is done in a transparent way that is subject to scientific review.

The work on the BA-5 and BA-6 assessments of the OSPAR Joint Assessment and Monitoring Programme has indicated that there is a need to assess each pressure and define a suitable threshold value (which might differ for different species and habitats, according to their sensitivity).

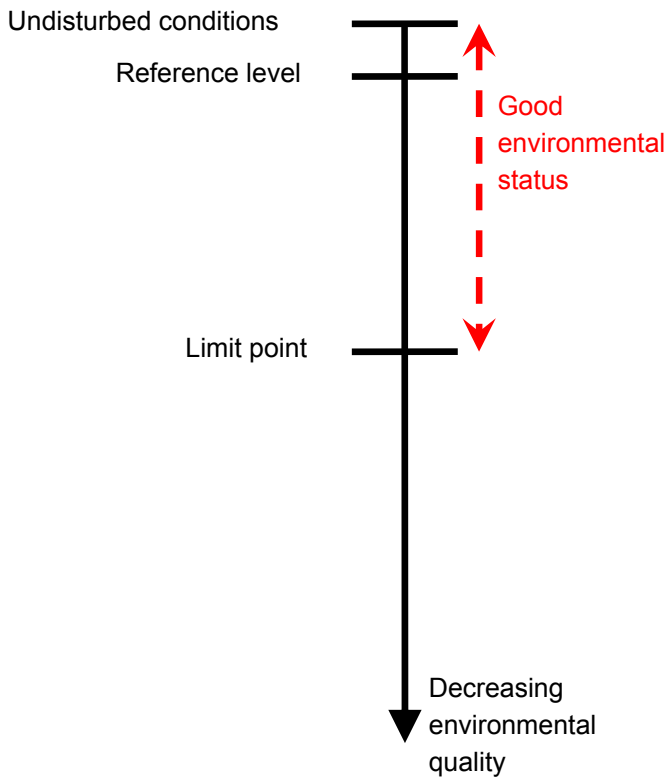

Figure.0.1 Schematic diagram of relation between undisturbed conditions, reference level, limit point and environmental status

The determination of the boundary for good environmental status requires a well-defined dose-response relationship between a pressure and the value of the metric. Moreover, the metric not only has to be sensitive to the pressure, but it should also be possible to measure it with enough confidence and precision.

To decrease the risk of misclassification due these uncertainties in the WFD, it was advised to combine metrics by averaging the values. In the WFD, this can be done as the value of all metrics is expressed on a scale from 0 to 1 (the Ecological Quality Ratio EQR). For EcoQOs this would only be possible if the metrics are related to a similar ecosystem element (EC 2005), and if the metrics are expressed on a common quantitative scale (e.g. similar to the EQR in the WFD). At this moment, the EcoQOs do not meet this requirement. It is recommended to include this requirement in the development of new EcoQOs.

Time frame

The MSFD has the objective to achieve good environmental status by the year 2020, but it is not entirely clear what happens after 2020. For the OSPAR EcoQOs it is not always clearly defined in what year an objective should have been achieved. At least it should be clear in what year an objective has to be met, and whether this objective is an 'interim' target or not.

The definition of the time frame is important also for the definition of the objectives. If objectives cannot be achieved by 2020 (for example due to slow recovery), either objectives for that year have to be lowered or the year when objectives should be achieved has to be postponed. It is not clear at present how the MSFD will deal with the situation where objectives cannot be achieved in 2020, even when all necessary measures have been implemented. However, the MSFD foresees *inter alia* a review of the determination of good environmental status six years after its first establishment, and every six years thereafter.

Use of 'interim' targets implies that the target is below (worse than) the 'limit' level set in Figure 3.1. Use of such interim targets (with dates) may well be desirable to allow for a step-wise improvement in quality (and provide realistic hope that the 'target' can be achieved). Given that GES is to be achieved by 2020, it is not sure whether setting interim targets will be possible for the years leading up to 2020. One possibility is that GES (for certain quality elements) is set at particular levels to be achieved by 2020, but that these are reviewed (after each 6-year reporting cycle, firstly in 2018) and the targets gradually raised over time. This might strike a balance between an ambitious but unrealistic target for GES and one which is challenging but achievable.

It is recommended that the time frame for objectives of new EcoQOs is clearly defined.

Quality assurance

Quality assurance can relate to a number of issues, starting with quality control on monitoring (sampling strategies, analytical methods, etc). This is in many cases covered by monitoring guidelines (e.g. JAMP), cooperation between laboratories (e.g. QUASIMEME, BEQUALM), etc.

Quality assurance can also relate to the general performance of a metric and the development of reference and target levels. The applicability of a metric, and the acceptance of a metric not only by the scientific community but also by policymakers and stakeholders, depends to a great extent on the transparency in the process of developing the metric and determining the associated objectives.

In the OSPAR EcoQO Handbook it is advised to use peer review by relevant specialists (*inter alia* ICES) as quality assurance.

We recommend that peer review is not only part of the initial process of developing metrics, but is also used to evaluate the suitability of metrics on the basis of established results, for example by publications on observed trends and cross-system comparisons.

Overall classification

Another important issue is the way metrics are combined to give an overall assessment of environmental status. In the WFD classification of coastal waters, three biological quality elements (phytoplankton, macro-algae and angiosperms, and macrobenthos) were used to determine ecological status. The value of each quality element could be determined by combining several submetrics (that were averaged or combined in another way to give an overall value for that element). To come to an overall assessment of ecological status, the values of the quality elements were combined using the principle of "one out all out", meaning that the lowest value of the three quality elements determined the ecological status. The "one out all out" principle was also used to determine chemical status of water bodies.

The “one out all out” principle is valid for a pressure on a component. But the failure of one component does not mean that the whole ecosystem has failed (i.e. GES overall has not been met) - this needs a more sophisticated integration of assessments of the components and the functioning of the ecosystem.

The EcoQOs are at present used independently to assess status for that particular element. There is no method to combine these elements into one final assessment of environmental status. It has been recognized that the risk of misclassification (giving a system lower status than its true status) increases with a large number of metrics, especially if the “one out all out” principle is applied (EC, 2005).

The choice for either a system with many EcoQOs individually “telling the story” or a system with a combination of EcoQO scores to give one overall classification requires more elaborate work with attention for the methodological concerns.

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