

Background document for the EcoQO on plastic particles in stomachs of seabirds



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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

This background document reports on the development of an ecological quality objective (EcoQO) for plastic particles in stomachs of seabirds. This work responds to the agreement at the 5th North Sea Conference in 2002 that an EcoQO should be developed and applied in the framework of OSPAR for the ecological quality element on plastic particles in seabird stomachs.

The occurrence of plastics (and other man-made types of litter) in the marine environment is due solely to human activity and can therefore be controlled by human management. Marine litter, especially plastics, causes ecological damage to a wide range of marine organisms, including at least marine mammals, birds, turtles and fish as a result of the entanglement with, or ingestion of, plastic. The Northern Fulmar is a particularly 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: i) ship's garbage and operational or cargo-related wastes; ii) lost and discarded fisheries materials from vessels and mariculture; iii) land-based wastes from coastal or riverine disposal; and iv) recreational littering.

In 2005, following an initial phase of work in collaboration with ICES, the OSPAR report on the North Sea Pilot Project concluded on the formulation for an EcoQO based upon the number of plastic particles found in the stomachs of fulmars. However, at the same time, OSPAR noted the recommendation from the Save the North Sea Project Fulmar Study for a formulation based upon the weight of plastic particles found. OSPAR asked ICES to consider these recommendations further. This background document has been prepared by Dr J. A. Franker of Wageningen-IMARES under contract to the Netherlands Ministry of Transport, Public Works and Water Management, taking into account the advice prepared by ICES. The document proposes and evaluates the background for the following formulation for the EcoQO:

*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 found in winter (November to April) from each of 4 to 5 areas of the North Sea over a period of at least five years*

The document includes an evaluation of current and historic levels in relation to the EcoQO together with proposals for potential management measures to reach the EcoQO and an estimation of the potential costs of monitoring in relation to the EcoQO.

Récapitulatif

Le présent document de fond contient un rapport sur le développement d'un objectif de qualité écologique (EcoQO) pour les particules de matière plastique dans les estomacs des oiseaux de mer. Ces travaux font suite à l'accord de la Cinquième conférence sur la mer du Nord de 2002, à savoir qu'il y a lieu de développer et d'appliquer un EcoQO dans le cadre d'OSPAR pour l'élément de qualité écologique sur les particules de matière plastique dans l'estomac des oiseaux de mer.

La présence de matières plastiques (et d'autres types de déchets synthétiques) dans le milieu marin provient uniquement de sources anthropiques et peut donc être contrôlée. Les déchets marins, et en particulier les matières plastiques, engendrent des dommages écologiques pour une grande variété d'organismes marins, notamment les mammifères et les oiseaux marins, les tortues et le poisson soit quand ils s'empêtrent dans ces déchets plastiques soit quand ils les ingèrent. Le fulmar boréal est une espèce qui se prête bien à la mesure de la pollution par les matières plastiques lorsque l'on analyse le contenu de son estomac. Il ingère fréquemment des déchets en matière plastique comme tous les autres oiseaux procellariiformes (les albatros et les pétrels). Il abonde en particulier dans la mer du Nord, se nourrit exclusivement en mer (à l'inverse des mouettes), conserve dans son estomac les matières digérées lentement et assimile donc les niveaux de pollution par les déchets en mer. Les déchets en matière plastique dans la mer du Nord proviennent: i) des déchets des navires et de la navigation ou des cargaisons; ii) du matériel de pêche perdu ou jeté de navires et de la mariculture; iii) des déchets telluriques provenant de l'élimination côtière ou fluviale; iv) des déchets provenant des activités récréationnelles.

En 2005, à la suite d'une phase préliminaire de travaux en collaboration avec le CIEM, le rapport OSPAR sur le projet pilote en mer du Nord a abouti à la formulation d'un EcoQO en se fondant sur le nombre de particules de matière plastique présentes dans l'estomac des fulmars. Cependant, OSPAR prend également note en même temps de la recommandation de l'étude intitulée « un fulmar pour sauver la mer du Nord » de formuler un texte se fondant sur le poids des particules plastiques trouvées. OSPAR a demandé au CIEM d'étudier plus avant cette recommandation. Le présent document de fond a été préparé par Dr J. A. Franker

du Wageningen-IMARES mandaté par le Ministère des transports, des travaux publics et de la gestion des eaux des Pays-Bas, en tenant compte des conseils préparés par le CIEM. Le présent document propose et évalue le contexte pour la formulation suivante de l'EcoQO.

*« Des échantillons de 50 à 100 fulmars boréaux (*Fulmarus glacialis*) échoués sur les plages en hiver (de novembre à avril), on ne devrait pas dépasser un maximum de dix pour cent avec plus de 0,1g de particules en matière plastique dans leur estomac dans chacune des 4 ou 5 zones de la mer du Nord, pendant une période de cinq ans. »*

Ce document contient une évaluation des niveaux actuels et historiques par rapport à l'EcoQO ainsi que des propositions de mesures de gestion potentielles permettant de parvenir à l'EcoQO. Il comporte également une estimation des frais potentiels de la surveillance dans le contexte de l'EcoQO.

Introduction

In 2002, the North Sea Ministerial Conference in Bergen decided to adopt a system of Ecological Quality Objectives (EcoQOs) for the North Sea. Ministers asked OSPAR to take on the task of further development and implementation of the EcoQO approach. One of the EcoQO's listed for development was the number of plastic particles in seabird stomachs, representing an ecological indicator of the level of litter in the marine environment. This report describes the background and potential framework of a 'marine litter EcoQO' based on plastic abundance in the stomach contents of a common seabird: the Northern Fulmar.

OSPAR Background Document for the development of the Fulmar-Litter-EcoQO

*Ecological Quality Objective on marine litter in the North Sea based on the amount of plastic ingested by the Northern Fulmar (*Fulmarus glacialis*)*

1. EcoQ Issue: 4. Seabirds

2. EcoQ Element: Plastic particles in stomachs of beached seabirds (Northern Fulmar - *Fulmarus glacialis*)

3. EcoQ Objective

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 found in winter (November to April) from each of 4 to 5 areas of the North Sea over a period of at least five years.

4. Justification for the development of this EcoQO

The occurrence of plastics (and other man-made types of litter) in the marine environment is due solely to human activity, and can therefore be controlled by human management. 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-bycatch, and damage to coastal agriculture (Hall 2000). 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 Northern Fulmar is a particularly 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:

- a) ship's garbage and operational or cargo-related wastes;
- b) lost and discarded fisheries materials from vessels and mariculture;
- c) land-based wastes from coastal or riverine disposal;
- d) recreational littering.

5. Technical evaluation:

5a. ICES criteria

Evaluating comments

<i>Relatively easy to understand by non-scientists and those who will decide on their use</i>	The message of birds having plastic in the stomach (nearly every Fulmar in the North Sea) is easily conveyed to policy-makers as well as stakeholders and general public, stimulating compliance with measures taken. The Fulmar was the symbol of the successful 'Save the North Sea' campaign, receiving two prestigious awards for the way in which it created awareness on the marine litter issue (Environmental Award from the International PR Association 2005; United Nations Department of Public Information Grand Award 2005).
<i>Sensitive to a manageable human activity</i>	All plastics in the (marine) environment are due to human activity, mostly intentional disposal, which can be controlled by management intervention.
<i>Relatively tightly linked in time to that activity</i>	Persistence of plastic materials could suggest long time-lags in response of the metric to changed activities. However, the EcoQO study (regional differences; changes over time) shows good measurable linkage of the metric to the input-rates of litter in the marine environment within the area under consideration.
<i>Easily and accurately measured, with a low error rate</i>	Easily measured from stomach contents of beached birds. Accuracy and low error amongst other shown by interannual consistency and comparability between neighbouring locations.
<i>Responsive primarily to a human activity, with low responsive-ness to other causes of change</i>	Fully responsive to human activity.
<i>Measurable over a large proportion of the area to which the EcoQ metric is to apply</i>	Fulmars are abundant throughout the North Sea area (*), with sufficient spread of locations where beached birds can be collected. (* this species abundant throughout North Atlantic and North Pacific Oceans, with suitable comparable indicator species of tubenosed seabirds occurring worldwide).
<i>Based on an existing body or time-series of data to allow a realistic setting of objectives</i>	The combination of a long time series of data for the Netherlands (since 1980's; Van Franeker 1985) and the wider 'Save the North Sea' study (since 2002) has already led to modification of earlier wording of the EcoQO to a more realistic one as defined in para.3 and slightly modified in para.6) See OSPAR-MASH 2006a,b, and EcoQO reports cited in para.8; in particular the most recent reports no. 5 to 7.

5b. Ecological relevance/basic for the metric

Plastics and related litter are fully anthropogenic and should not occur in the marine environment. These materials have a number of serious negative effects on a wide range of marine organisms, sometimes affecting nearly all individuals in populations, as in the Northern Fulmar. Documentation mainly exists for adverse effects of larger items on larger organisms (e.g. Derraik 2002; Laist 1987; 1997), but plastics degrade to microscopic units occurring throughout the ecosystem with unknown consequences for lower foodweb-levels (Thompson *et al* 2004). The stomach contents of Fulmars are a convenient metric not only for the Fulmar itself, but for the full range of ecological adverse effects.

5c. Current and historic levels (including geographical areas)

The historical level of plastic and similar litter in the marine environment is zero. Plastics usage rapidly increased after the mid 20th century. Already in the 1980's, Fulmars from the North Sea and even polar areas commonly had plastic in the stomach (Van Franeker 1985, 1988). Current data series start with information from the 1980's.

Historic development (Netherlands):

In terms of EcoQ metric, in the 1980s 67% of Dutch Fulmars had more than 0.1 gram of plastic in the stomach. Peak values were reached in 1990s, (84% in 1997), after which decreases have been observed to a minimum of 46% in 2005 (5 year average 2001-2005: 55%). Recent decreases in plastic loads are significant.

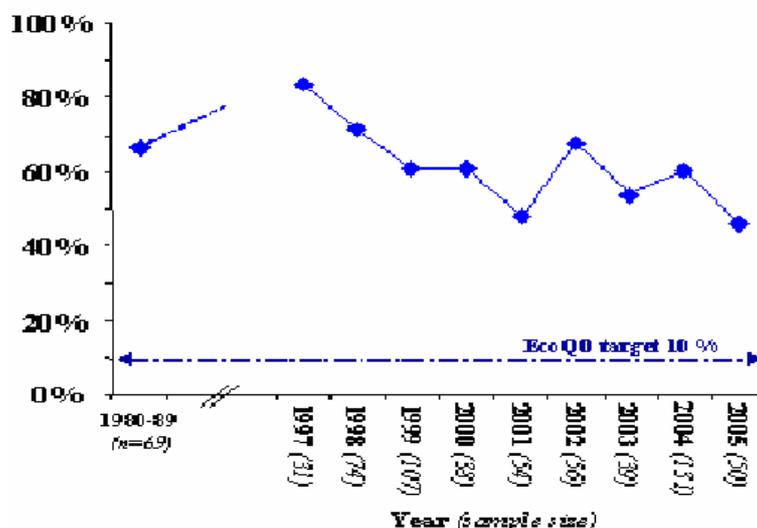


Figure 1. Percentage of Fulmars having ≥ 0.1 g plastic in the stomach, Netherlands 1982-2005

North Sea regional comparison over the period 2002-2004:

In this period, the south-eastern North Sea was most polluted with 60% of Fulmars exceeding 0.1g of plastic in the stomach. During this period, this was 44% for Fulmars from the Scottish Isles, with intermediate levels for East England (56%) and Skagerak (51%). A preliminary sample outside the North Sea, of Fulmars from the Faroe Islands in 2002 showed 26% having more than 0.1g of plastic in the stomach.

In terms of average quantities of plastic, Fulmars from the southeastern North Sea over 2002-2004 had an average mass of 0.4g plastic in the stomach, those from the Scottish Isles ± 0.2 , and those from the Faroe Islands ± 0.1 g. Trends over time for other locations than the Netherlands are not possible at the moment as more years of data collection will be required.

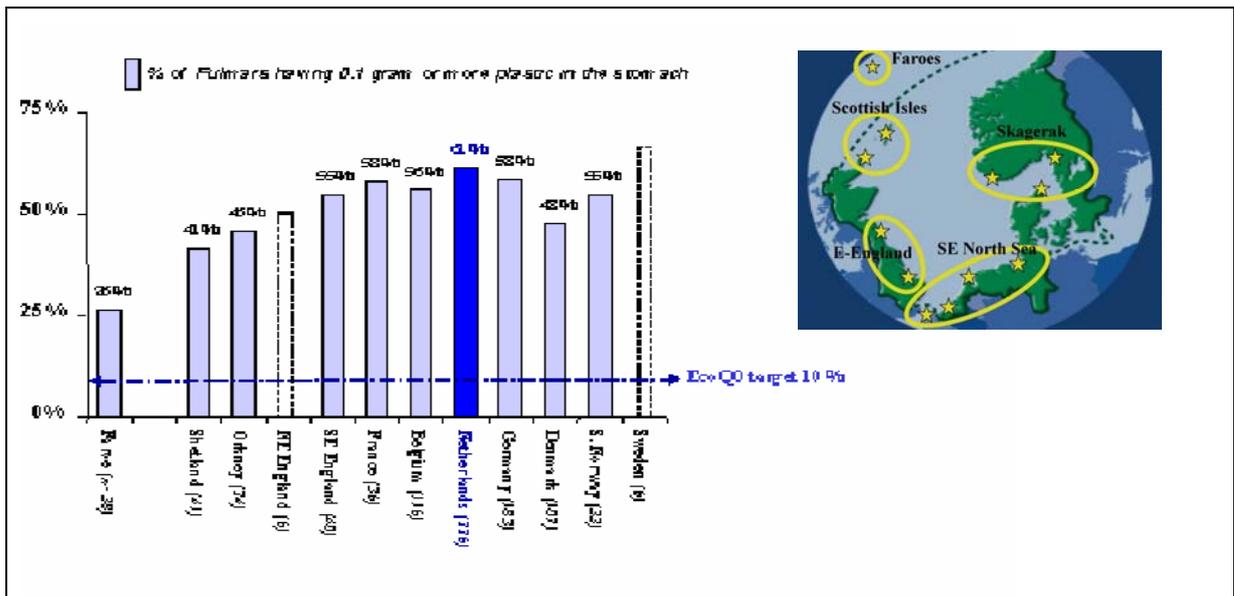


Figure 2. North Sea 2002-2004 - Litter EcoQO situation by location

Graphs shown here are from EcoQO report nr 7. For methodological details, including statistical tests for trends and regional differences, see preceding reports.

5d. Reference level

Zero

5e. Limit point

Unknown

5f. Time frames

In a pilot study (EcoQO report nr 1) it was shown that, using annual samples of ± 40 birds for a location, detection of change would be possible over periods of 4 to 8 years, depending on the type of plastic (*linear regression tests using ln transformed mass data of individual birds against year of collection*). Data analyses in later reports support these findings.

Current regional differences indicate that if all plastic litter discharge ceased, changes would be detectable within very few years.

5g. Advice on EcoQO options (scenarios)

Scenario 1 - No plastic particles in Fulmar stomachs

Unrealistic. It has been shown that most North Sea pollution is of local origin (eg EcoQO report nr 5). Nevertheless, the poor degradability of plastic allows some influx of litter from distant sources ("background noise"). Thus, even in case of total cessation of plastic discharges in our region, some plastics would be found in Fulmar stomachs for many years to come.

Scenario 2: <2% of Fulmars with >10 particles (or >0.1g) in stomach

(=scenario as worded in preliminary EcoQO target).

Unrealistic. As described in EcoQO reports and para. 5e, current levels at a relatively clean location, the Faroe Islands, are that 26% of birds have more than 0.1g plastic in the stomach. Within policy time frames of maybe 10 to 20 years it is unrealistic to expect that measures could achieve a more than 10-fold reduction of that level in all areas of the North Sea. The 2% level could remain a long term aspirational goal.

Scenario 3: <10% of Fulmars with >0.1g plastic in stomach

(=scenario as proposed by ICES ACE 2006 (OSPAR-MASH 2006a,b) and this document).

In the light of current regional levels of the EcoQ metric, this scenario is ambitious but achievable. A biologically meaningful level in any scenario cannot be really established, because a 'no effect' level for Fulmars could still be harmful to other ecosystem components. Thus, any scenario is primarily a political choice.

5h. Monitoring regimes

Monitoring regimes have already been established in a number of locations around the North Sea. Most of these are conducted as a part of existing long-term Beached Bird Surveys that also contribute to the EcoQO on oil pollution. Some collection programmes of Fulmars are conducted as a part of beach cleanup programmes, or seabird rehabilitation activities. The collection of Fulmars in these programmes involves no or very little additional costs. Subsequent costs for coordination meetings, analysis of stomach samples and report writing are given in para.6.

5i. Management measures to achieve EcoQO

Most litter in the North Sea region comes from shipping including fisheries. In the short term, the most promising measure to reduce litter from these sources is a further refinement of the implementation of the EU Directive on Port Reception Facilities (EU Directive 2000/59/EC). The Directive leaves room for national choices, and competition between harbours occurs. Effectiveness of the Directive can be increased by regional agreements on indirect financing and on uniform implementation with a much higher level of service for ship to shore delivery, combined with strict control and enforcement. In the longer term amendments to MARPOL Annex V (simplifying rules to basically 'no discharge') and support to the 'Clean Ship' concept offer potential to reduce marine littering from ships. Specific measures may be needed with regards to discarded and lost fisheries materials including those from mariculture.

Potential measures to reduce input from other sources are many, including waste recycling and processing instead of landfill, policy measures to reduce single-use packaging and stimulating awareness among public and stakeholders

6. Further considerations (including costs)

6.1 Beached litter surveys

Proposals are made to consider the development of a background document on an EcoQO on **beached** litter quantities. Surveys of beachcast litter are complementary to the Fulmar-Litter-EcoQO having not so much an ecological marine component, but more an coastal environmental one, potentially increasing identification of litter items and sources.

6.2 Costs

Litter EcoQ 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, and the international 'Save the North Sea' project (EU funded under Interreg IIIB). The Dutch monitoring is anticipated to continue, but EU funding ceased after 2004. Collection of beached Fulmars is embedded in existing beached bird surveys or other activities, and requires virtually no additional cost, except for incidental purchases like a freezer. Costs are involved in international co-ordination and mostly laboratory processing of stomach samples. A North Sea wide Fulmar-Litter-EcoQ monitoring programme, on top of the current Dutch effort requires average approximately € 10,000 per Contracting Party.

The costs of Implementing this EcoQO depends on the amount of birds monitored per year. 2-3 stomach contents of birds can be sampled in one hour. The costs per hour in the laboratory is estimated at € 153 and € 94 for an assistant.

6.3 Suggestion for rephrased EcoQ Objective

ICES-ACE 2006 (see OSPAR-MASH 2006a) proposed EcoQO wording that includes a seasonal aspect as used in Beached Bird Surveys and the EcoQO on oil using Guillemots. However, in stomach analyses of Fulmars there is no basis for such seasonal restriction, and it is proposed to shorten EcoQO wording as below:

*"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 ~~found in winter (November to April)~~ from each of 4 to 5 areas of the North Sea over a period of at least five years"*

7. Conclusions

Stomach content analysis of beached Northern Fulmars (*Fulmarus glacialis*) is a reliable scientific monitoring tool for changes in the abundance of plastic (litter) in the sea. The message from the EcoQO is a convincing one and easy to understand for all stakeholders. Data go back to 1982 and an international monitoring network has been operational since 2002.

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