

**OSPAR Background Document on the
EcoQO on changes in the proportion of
large fish and evaluation of the size-
based indicators**



**OSPAR Commission
2008**

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.

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 fish communities. 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 "changes in the proportion of large fish and hence the average weight and average maximum length of the fish community".

The justification for this EcoQO is that 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. There is evidence that a change in the size distribution of fish communities in the North Sea has taken place. From a conservation perspective, appropriate EcoQOs would move towards a larger proportion of large fish and would improve fisheries yields.

In 2005, following an initial phase of work, OSPAR concluded that the EcoQ element "proportion of large fish" could be meaningful for the development of an EcoQO but that considerable further development work was needed before an EcoQO for fish communities could be considered for adoption. ICES were invited to continue the development of the EcoQO during 2006 and 2007.

This document, which has been prepared under the leadership of Norway, draws upon the advice delivered by ICES in 2006 and 2007 and proposes that the EcoQO for fish communities in the North Sea should be that the proportion (by weight) of fish greater than 40 cm in length should be greater than 0.3. The evaluation of the EcoQO is based on the ICES International Bottom Trawl Survey (IBTS) for the first quarter of the year. It is calculated for the demersal part of the fish community as sampled in the IBTS survey, excluding the catch of pelagic species like herring, sprat and sandeel.

The EcoQO can be applied on a trial basis but the time frame for achieving it and the scientific justification will need to be further examined.

Récapitulatif

Le présent document de fond est un rapport sur le développement d'un objectif de qualité écologique (EcoQO) pour les communautés halieutiques. Ces travaux ont été entrepris en réponse à l'accord de la Cinquième conférence sur la mer du Nord, en 2002, à savoir qu'il convient de développer un EcoQO pour l'élément de qualité écologique « changements intervenus dans la proportion de gros poisson, et donc du poids moyen et de la longueur moyenne de la communauté halieutique » et de l'appliquer dans le cadre d'OSPAR.

Dans les communautés halieutiques exploitées, en général, le gros poisson souffre d'une mortalité causée par la pêche plus grande que le petit poisson, ce qui justifie cet EcoQO. La distribution des tailles tend donc vers le bas de la gamme des tailles. Il existe des preuves que la distribution des tailles des communautés halieutiques dans la mer du Nord a subi des modifications. Du point de vue de la conservation, des EcoQO appropriés permettraient d'obtenir une plus grande proportion de gros poisson et d'améliorer le rendement de la pêche.

En 2005, à la suite d'une phase préliminaire des travaux, OSPAR a conclu que l'élément de qualité écologique, proportion de gros poisson, pourrait jouer un rôle dans le développement d'un EcoQO mais qu'il était nécessaire d'entreprendre des travaux supplémentaires considérables avant d'envisager l'adoption d'un EcoQO pour les communautés halieutiques. Le CIEM a été invité à poursuivre le développement de l'EcoQO en 2006 et 2007.

Le présent document, qui a été préparé sous le pilotage de la Norvège, s'inspire des conseils du CIEM en 2006 et 2007. Il propose que l'EcoQO pour les communautés halieutiques dans la mer du Nord soit que la proportion (exprimée en poids) de poisson dont la longueur est supérieure à quarante centimètres devra être supérieure à 0,3. L'évaluation de l'EcoQO se fonde sur la Campagne internationale de chalutage de fond (IBTS) du CIEM pour le premier trimestre de l'année. Il est calculé pour la partie démersale de la communauté halieutique échantillonnée dans le cadre de la campagne IBTS, à l'exception des captures d'espèces pélagiques telles que, le hareng, le sprat et le petit lançon.

L'EcoQO peut être appliqué à titre expérimental mais il faudra étudier plus avant le calendrier des travaux et sa justification scientifique.

1. EcoQO Issue

Fish communities. One of the 10 issues considered when developing the EcoQO system for the North Sea.

2. EcoQO Element

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

Two metrics have been suggested for this element: i) proportion of large fish, and ii) mean weight of fish. The first of these (proportion of large fish) is suggested to be used as the basis for the EcoQO.

3. EcoQO Objective

The EcoQO is that the proportion (by weight) of fish greater than 40 cm in length should be greater than 0.3.

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. This examination should take into account:

- a. the development of the contribution to the improved evaluation of the EcoQO system (2008-2009);
- b. the development of the relevant implementation guidance for inclusion in the EcoQO Handbook;
- c. work to be commissioned by the European Commission from ICES and other relevant scientific bodies to further develop the indicators the EC has proposed in relation to its communication on the role of the CFP in implementing an ecosystem approach to marine management (SEC(2008) 449), of which this is one.

The metric for the EcoQO is based on the ICES International Bottom Trawl Survey (IBTS) survey series for the first quarter of the year. It is calculated for the demersal part of the fish community as sampled in the IBTS survey, excluding the catch of pelagic species like herring, sprat and sandeel. The decline in the EcoQO metric appears to have stopped for the time being (see Fig. 1), and an increasing trend can be used as a short-term objective.

4. Justification for the development of the EcoQO

In the 2005 review of the EcoQO system for the North Sea, the following justification for development of this EcoQO was given:

"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 be proportional to fishing effort, 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. The dominant activity relevant to this EcoQ is fisheries, to which the remarks under ecological quality element (a) are relevant. There may, however, be less direct influences on the reproductive success and life-cycle of fish from land-based sources of discharges and emissions of chemicals."

OSPAR (2006) concluded that the EcoQ element "proportion of large fish" could be meaningful, but that considerable further development work was needed on the metrics "mean weight" and "mean maximum length of fish". The metrics are closely related to the area fished and the gear used. Reference points that could be developed would therefore also be specific to the surveys and areas. OSPAR requested ICES in 2005 to carry out more work on this EcoQ element.

In response to the OSPAR 2005 request, ICES in 2006 suggested that the goal for the North Sea fish community should be:

- a. to halt as rapidly as possible, and begin to reverse by 2010, both the decline in the mean weight;
- b. and the decline in the proportion of large fish;
- c. and that the short-term operational targets should be:
 - based on survey catches: Halt the decline in the proportion of fish greater than 30 cm in length as rapidly as possible.
 - based on survey estimates: Halt the decline in the mean weight of fish as rapidly as possible.

ICES continued work on this EcoQO in 2007, and determined that the metrics in the form proposed by ICES in 2006 are clearly sensitive to environment-related variations, and trends due to high fishing pressure may be lost or obscured. Based on its work in 2007 ICES therefore recommended:

- the EcoQO for restoration/conservation of the size-structure of the fish community of the North Sea should be: The proportion (by weight) of fish greater than 40 cm in length should be greater than 0.3, based on the ICES Q1 IBTS survey series.
- no EcoQO needs to be set for the Mean Weight of Fish metric in the North Sea.

The metric for the EcoQO (proportion of fish greater than 40 cm) should be calculated for the demersal part of the fish community as sampled in the IBTS survey, excluding the catch of pelagic species like herring, sprat and sandeel.

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

ICES plans to continue work on the 'Proportion of Large Fish' metric in 2008, and will then concentrate on the connection between management action and the time scale required to achieve the target value of 0.3 for this EcoQO metric.

Selection through high fishing pressure over time may have altered the genetic composition of commercial fish species in the North Sea. This may influence the ability of the fish community to recover in terms of size composition as reflected in the proportion of large fish metric. This is one uncertainty that needs to be addressed in follow-up work on the use of this EcoQO.

5. Technical evaluation considering the following elements

		Comments	
a.	ICES criteria		
	Relatively easy to understand by non-scientists and those who will decide on their use	Usually	The public clearly understands the importance of the size of fish as a measure of impact.
	Sensitive to a manageable human activity	Usually	
	Relatively tightly linked in time to that activity	Occasionally	Response time can be slow and the response is often non-linear.
	Easily and accurately measured, with a low error rate	Usually	Measurement is straightforward and well-established protocols and surveys exist, usually with an element of quality control.
	Responsive primarily to a human activity, with low responsiveness to other causes of change	Usually	Of the two metrics suggested, the 'Mean weight of fish' is sensitive to both environmental conditions and fishing effects, while 'The proportion of large fish' has been tailored so that it is primarily sensitive to fishing effects.

	Measurable over a large proportion of the area to which the EcoQ metric is to apply	Usually	
	Based on an existing body or time series of data to allow a realistic setting of objectives	Yes	The only research survey series in the North Sea considered suitable for monitoring the development of the 'Proportion of Large Fish' indicator is the ICES Quarter 1 International Bottom Trawl Survey (IBTS), which has been carried out every year since 1983.
b.	Ecological relevance/basis for the metric	Effects of fishing on fish populations may reflect effects of fishing on other ecosystem components.	
c.	Current and historic levels (including geographic areas)	Trends have been reported by ICES (2003a, 2003b) for the whole North Sea and subunits of the North Sea. Trends demonstrate that average weight and mean maximum length have declined over the period studied.	
d.	Reference level	Not available for pristine state (no fishing)	
e.	Limit point	Not available	
f.	Time frames	<i>Detection of change</i>	
		<i>Use in advice</i>	To be developed by ICES.
g.	Advice on EcoQO options (scenarios)	<i>Scenario 1</i>	Not available, but would simply be a value of weight and length.
		<i>Scenario 2</i>	Not available
		<i>Scenario 3</i>	Not available
h.	Monitoring methods and reporting requirements	ICES Quarter 1 International Bottom Trawl Survey (IBTS)	
i.	Management measures to achieve EcoQO	Regulation of the spatial and temporal distribution and intensity of fishing effort.	

5.1 The 'Proportion of Large Fish' metric

Interannual variation around trends in the size-based metrics can reduce the signal-to-noise ratio to the point where trends become non-significant, and can lead to the conclusion that an anthropogenic activity, such as fishing, has not actually impacted the state of the community. In addition, where detrimental changes in size structure have been demonstrated, interannual variation in recruitment can wrongly suggest that remedial management actions have been ineffective or effective. Work by ICES in 2007 identified individual recruitment events as a major source of interannual variation. Specifically, it was demonstrated that a strong year class of haddock in the North Sea had a pronounced effect on both of the size-based metrics previously proposed. These abundant haddock recruits initially drove down the metric (the proportion of large fish in the community decreased) and then subsequently pushed the metric up (the proportion of large fish in the community increased as the fish in the strong year class grew larger). Increasing the large fish threshold to 40 cm addresses this issue to some extent due to the impact of fishing pressure while growing from 30 to 40 cm. The influence of recruitment events on the metric is therefore lessened. Using weight of fish greater than 40 cm rather than number of fish greater than 40 cm makes the metric even less sensitive to environmental effects and more sensitive to fishing effects.

The only research survey series in the North Sea considered suitable for monitoring the development of the 'Proportion of Large Fish' metric is the ICES Quarter 1 IBTS. 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.

The longest time series for bottom trawl surveys in the North Sea is the Scottish Autumn Ground Fish Survey (SAGFS) that was run for many years from the 1920s until it was stopped in 1997. Where the two surveys (SAGFS and IBTS) overlapped from the early 1980s until late 1990s, there was a fair agreement in the value for the 'Proportion of Large Fish' metric. The target of 0.3 corresponds to the average for the SAGFS prior to 1983. Both series showed a marked decline in the metric values after the early 1980s and into the 1990s (Fig. 1).

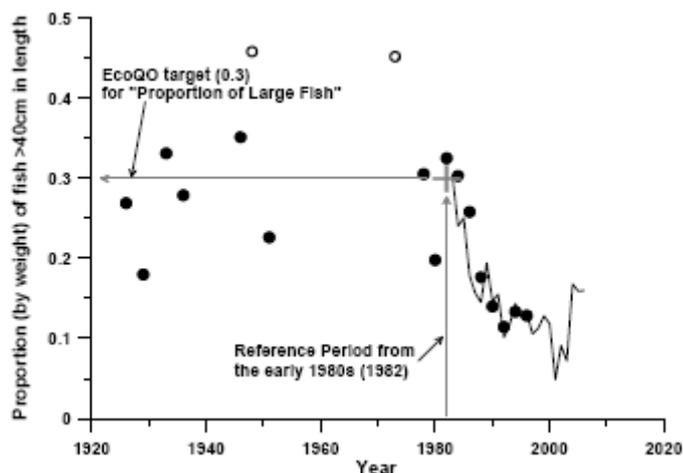


Fig. 1. Plot showing the Scottish Autumn Ground Fish Survey (SAGFS) aggregated year group data (circles, with unfilled circles indicating two outliers related to strong year classes of gadoids). Variation in the IBTS data set is shown (solid line). 1982 was considered to represent the “early 1980’s” reference period and derivation of 0.3 as the target value for the metric is illustrated. (From ICES 2007b).

Current levels of the metric are about half (0.16 as an average for 2004-2006) of the advised EcoQO. To develop specific management measures to move the metric from current levels towards the advised EcoQO target, additional modelling is required. ICES in its advice, stresses that progress towards the target requires, as a minimum, a reduction in fishing mortality to below F_{pa} . However, until the appropriate modelling is undertaken, it is not possible to say with any confidence what level of fishing mortality is likely to result in achieving targets for the large fish metric within given time frames.

ICES recommends that when calculating the 'Proportion of Large Fish' metric, significant changes in fish community composition should be reported. Such changes could influence interpretation of the metric (e.g. two very different communities, one dominated by groundfish versus one dominated by elasmobranchs, could have a similar Proportion of Large Fish metric).

The metric for the 'Proportion of Large Fish' is calculated for the demersal component of the fish caught in the IBTS survey (using a standard bottom trawl). The demersal fish community include 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.

5.2 The 'Mean Weight of Fish' metric

Analyses conducted by ICES in 2007 show that this metric is immediately influenced by environmental conditions that give rise to strong recruitment events, and temporal trends in this metric are far more affected by interannual variation than the 'Proportion of Large Fish' metric. There is little that can be done to reduce the sensitivity of this metric to environmental influence.

Considering that the 'Mean Weight of Fish' metric is sensitive to environmental influence, while the 'Proportion of Large Fish' metric can be tailored so that it is primarily sensitive to the anthropogenic activity that is subject to management, an EcoQO target needs only be set for the latter metric. Hence ICES recommends that no EcoQO needs to be set for the 'Mean Weight of Fish' metric in the North Sea. However, the 'Mean Weight of Fish' EcoQ metric reflects important fish community properties such as recruitment events and should be retained as supplementary information. The metric should be monitored over time to reflect the general effect of environmental conditions on the fish community.

6. Management measures required to achieve the EcoQO

In general terms, measures would include regulation of the spatial and temporal distribution and intensity of fishing effort. However, there is need for further exploration of measures that could be taken by the competent authorities for fisheries management.

ICES has planned to continue work in 2008 by modelling management action (range of demersal community average fishing mortality), and associated timescales involved, to achieve the EcoQO target of increasing the proportion of fish larger than 40 cm to 0.3. The modelling will be based on fishing mortality averaged across the seven main demersal species (cod, haddock, whiting, saithe, sole, plaice, Norway pout). The intention is to use the results as a basis for the provision of advice to meet the EcoQO target.

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

The analysis presented to identify the most appropriate length threshold for defining a large fish is specific to the North Sea. The threshold of 40 cm may be entirely inappropriate for fish communities resident in other marine regions and subject to different fisheries regimes and environmental conditions. If a similar metric is required for other fish communities, then an analytical procedure similar to the one followed here will be needed to identify appropriate length thresholds.

8. Conclusions

The "Proportion of large fish" should be chosen as the metric for the EcoQ element for changes in the proportion of large fish, as advised by ICES

This would be a target type EcoQO. There is not as yet a reference level for the pristine state (no fishing), although possibly such a reference could be developed through theoretical modelling. However, a practical reference exists as the early part of the time series for which this metric is constructed. This is also the target value for the EcoQO suggested by ICES (value 0.3 for the proportion of large fish).

The metric for this EcoQO is tied to the ICES IBTS Survey for the 1st quarter. As advised by ICES, this is the only existing survey considered suitable for monitoring changes in the proportion of large fish in the North Sea fish community. This time series needs to be consolidated and if necessary improved to provide the data needed to use this EcoQO.

ICES should be requested to continue work to consider and advise on management measures that could be taken to achieve this EcoQO.

North Sea States and the EU should be invited to implement and use this EcoQO as one of the integrated set of EcoQOs, thereby contributing to the further integration of fisheries and environmental protection, conservation and management measures, and effective implementation of the ecosystem approach to the management of the North Sea.

9. References

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