ECOREGION	**North Sea**
SUBJECT	**Joint EU–Norway request on the evaluation of the long-term management plan for cod**

Advice summary

ICES advises that the objectives for the North Sea cod EU–Norway long-term management plan, put in place in 2009, have not been met in terms of reductions of fishing mortality (F). There have been continued, though minor, reductions in F and increases in SSB since the introduction of the current plan, but ICES notes that the HCR has not been implemented as stipulated in the plan so far. ICES highlights a number of weaknesses in the design and implementation of the plan, including: 1) discards and unallocated (unaccounted) removals constitute a significant proportion of the total removals and these quantities are difficult to accurately estimate. This has often resulted in underestimating the actual removals; 2) control instruments have been inadequate in that TACs on landings and effort reductions (which are part of the EU plan) have not been effective in reducing fishing mortality as stipulated in the management plan so far, although discards have been reduced. To illustrate the point, recorded landings from 2005–2010 have fluctuated between 35% and 59% of the estimated total removals; and 3) incoherence in some aspects of the EU effort regime (EU plan) are apparent. For example, under Article 13, lower reductions in effort can be allowed given the percentage of cod in the catch, while it would be more appropriate to base these reductions on expected cod catches.

ICES advises that it is appropriate for EU–Norway to continue to use the current values of precautionary reference points as defined by ICES. In response to a similar request in 2008 (ICES, 2008), ICES concluded that F = 0.4 is not necessarily an appropriate proxy for F_{MSY} for North Sea cod. The range of possible fishing mortalities consistent with F_{MSY} for this stock (0.16 to 0.42 as estimated in ICES, 2010a) depends, among other things, on the choice of the appropriate stock–recruitment model, which is uncertain. Since 2010, ICES uses 0.19 as F_{MSY} proxy for this stock, based on the clear peak at F = 0.19 (F_{max}) in the yield-per-recruit curve.

Finally, ICES advises that if the Harvest Control Rule is implemented as stipulated in the plan then there is no need to make any adjustments to the rule to account for low recruitment.

Request

The objectives of the long-term management plan for cod of North Sea origin and allocation of catches agreed between Norway and the European Union is to provide for sustainable fisheries with high and stable yields in conformity with the precautionary approach.

ICES is requested:

1. *To evaluate the performance of the plan in meeting its objectives, identifying any weaknesses in design or implementation that undermine its effectiveness, including the problem of discards and unaccounted mortality.*

2. *To evaluate whether the values assigned to the precautionary reference points remain appropriate;*

3. *To indicate whether the target fishing mortalities rate of 0.4 is consistent with MSY for the stock; and*

4. *To indicate any adjustments that should be made to harvest control rules to take into account recent low levels of recruitment.*

Elaboration on Advice

Request 1. To evaluate the performance of the plan in meeting its objectives, identifying any weaknesses in design or implementation that undermine its effectiveness, including the problem of discards and unaccounted mortality.

   i. Regarding the success of the plan in meeting its objectives:

      Objectives for the North Sea cod current management plan implemented in 2009 have not been met in terms of F. F has declined since 1999 and SSB has increased since 2007, prior to the introduction of the current management plan. There have been continued but minor reductions in F and increases in SSB since the introduction of the current plan.

The current plan specified that F in 2009 should have been 75% of F in 2008 and F in 2010 should have been 65% of F in 2008. As estimated in 2011, F in 2009 was 98% of F in 2008 and F in 2010 was 97% of F in 2008. F in 2010 (ICES, 2011a) was 0.68, but according to the current management plan it should have been 0.45. The SSB in 2011 remains below B_{lim}.

ii. Regarding weaknesses in design or implementation that undermine its effectiveness, including the problem of discards and unaccounted mortality:

Uncertainties related to Forecast and Advice

The proportion of landings, discards, and unallocated (unaccounted) removals is difficult to anticipate and this is a weakness in the estimation of predicted landings, and thus of the TAC advice.

In 2007, ICES provided advice based on total removals. The corresponding value was taken to set the TAC on landings. In 2008–2010, ICES advice for TAC assumed that all unallocated removals were caused by fishing and were partitioned using the proportion of the landings in the catch (landings plus discards). It was expected that there would be no unallocated removals in the TAC year. This assumption proved to be incorrect, and in 2011 ICES gives a forecast for all the components (landings, discards, and unallocated removals) in the TAC year and advice for TAC using the landings value.

Surveys indicate that the year classes are being depleted faster than one would expect from the catches, and point to unallocated removals. There is no documented information on the source of these unallocated removals; while it has been previously assumed that these removals originate mostly from fishing activities, changes in natural mortality may also have an influence. Plausible fishery-based contributions to these unallocated removals are discards (undersized cod, highgrading, and over-quota catches) that do not count against quota, and mis- and under-reporting of landings. Recorded landings from 2005–2010 fluctuated between 35% and 59% of the estimated total removals, indicating that the management system has not been effective in controlling removals.

In addition, as for other stocks, short-term forecasts for North Sea cod are performed using several assumptions for the intermediate year, mostly on F and recruitment. For example, F in the intermediate year is supposed to follow the management plan (some % reduction compared to F in 2008) but this has consistently not been achieved because discards and unallocated removals have been different than predicted. Recruitment used in the short-term predictions was set in the range of the recent low values. However, recent recruitment estimates have been revised downwards, particularly the relatively abundant 2005 year class which has been revised downwards by 46% from the first estimate in 2007.

ICES stated in 2009 and 2010 that the TAC forecasts would only be valid under the assumption that the management plan is implemented and enforced adequately and that the objectives of the plan during the intermediate year are met (ICES, 2009, 2010c). Although ICES indicated in the advice that this was unlikely to be achieved, the TACs for 2010 and 2011 were set under the assumption that the objectives were met for the intermediate year (i.e. reduction in F during the intermediate year) and that there are no unallocated removals during the TAC year. Both assumptions turned out to be wrong according to the latest assessment, making the successive forecasts too optimistic. This is considered to have contributed to the objectives of the plan not being met.

Inadequate control instruments

TACs on landings and effort reductions have not been effective in reducing fishing mortality as stipulated in the management plan so far, although discards have been reduced.

North Sea single-stock long-term management plans have been designed without taking account of the fishing opportunities for other species. Mixed fisheries simulations (ICES, 2010b; Ulrich *et al.*, 2011) give an indication of the potential implementation error in North Sea cod advice, with actual F being higher than stipulated in the cod long-term management plan if there is continued fishing for other species with higher TACs as well as the potential overshooting or underutilization of TACs.

The implementation of the plan within the EU includes an effort regime (EU management plan) to try to control F on North Sea cod. Even though the allowed effort for each year is based on the same reduction rate in F compared to the previous year, there are several concerns:

- In the first year of the plan (2009), the allowed efforts for the different fleets were set on the basis of the effort calculated over the period 2004–2006 or 2005–2007 (the baseline). This reference period differs from the reference year on which the stipulated F reductions are based on (2008).
- Different methodologies have been used to calculate effort from the reference years compared to those used to report effort usage within the plan. This resulted in higher than intended effort.
- The effort reduction is highly dependent on the estimate of F in the last year; this estimate is uncertain.
- It is generally acknowledged that reductions in effort do not necessarily imply a reduction in F by a similar proportion. Often, the achieved reduction in F is smaller than the effort reduction.

Article 13 of the EU management plan aims to promote the use of highly selective gear and cod-avoidance fishing trips by offering compensation in terms of lower reductions in effort than would otherwise result from direct application of Article 12. The way in which Article 13 is formulated makes it a novel management instrument, as it allows flexibility in the way Member States manage their allocated effort and the mechanisms deployed to achieve cod avoidance. This is left to be devised and decided by Member States and the industry, promoting participatory governance and results-based management, in line with the Green Paper on the reform of the CFP. This may also provide an instrument to help to reconcile different catch objectives for different species in a mixed fishery context. ICES considers that an incentive-based approach may produce real reductions in F, but these have not yet been realized. Potential weaknesses identified in Article 13 are:

- Most of the provisions of Article 13 (excepting Article 13.2 c) do not seem to link the allowed effort with the intended reduction in F according to the HCR of the plan. It is therefore difficult to evaluate the appropriateness of those provisions in achieving the intended F reduction rates.
- In relation to Articles 13.2 a and b, a low percentage of cod catch could be due to local depletion of cod or to increased amounts of catch of other species (while keeping the cod catch constant), in which cases it may not correspond to a low F for cod. Additionally, if the number of vessels or trips with low percentages of cod catch is large, the total amount of cod caught by them may still be high. These points (also affecting to a large extent Article 11) constitute a fundamental flaw in the design of the plan. A system based on the expected cod outtake under these provisions with respect to the whole cod fishery would be more appropriate. Allocating a proportion of the total catch to a fleet, which is then expected to demonstrate it does not exceed that catch seems a better approach.

Article 17 allows Member States to transfer effort allocations between gear groupings in the same geographical area. The catch per unit effort (cpue) of the donor and receiving groups are used to calculate the increase in effort allocated to the receiving group. Two issues require further attention:

- A lower cpue does not necessarily imply a lower exploitation impact on the stock, as the latter is highly dependent on the exploitation pattern (at length or age). A fleet with lower cpue that catches smaller fish may have a stronger impact on the stock than a fleet with higher cpue that catches larger fish or vice-versa, depending on their total catch.
- The measure currently used for effort (and, hence, intervening in the catch per unit effort computation in Article 17) is kW-days, which may not be appropriate for gillnets, trammelnets, and longline gear groupings. This is a general point affecting effort measurement.

Request 2. To evaluate whether the values assigned to the precautionary reference points remain appropriate.

The North Sea cod assessment underwent an in-depth review in February 2011 (ICES, 2011b), which resulted in a change of assessment model and exclusion of one survey series. Although the new assessment model and configuration settings are considered the most appropriate that could be fitted in the time available, aspects remain to be investigated. As a result, precautionary reference points have not been re-examined. ICES intends to re-examine precautionary reference points once the new assessment approach is consolidated. For the time being, and given that the historical perception of the stock has not changed markedly with the new assessment model, ICES concludes that the current ICES values of PA reference points should be used.

Request 3. To indicate whether the target fishing mortalities rate of 0.4 is consistent with MSY for the stock.

ICES responded to a similar request in 2008 (ICES, 2008) and concluded that F = 0.4 is not necessarily an appropriate proxy for F_{MSY} for North Sea cod. The range of possible fishing mortalities consistent with F_{MSY} for this

stock (0.16 to 0.42 as estimated in ICES, 2010a) depends, among other things, on the choice of the appropriate stock–recruitment model, which is uncertain. Since 2010, ICES has used 0.19 as F_{MSY} proxy for this stock, based on the clear peak at F = 0.19 (F_{max}) in the yield-per-recruit curve.

Request 4. To indicate any adjustments that should be made to harvest control rules to take into account recent low levels of recruitment.

ICES (ICES, 2011c) has conducted a Management Strategy Evaluation (MSE) study to test the robustness of the harvest control rule in the EU–Norway long-term management plan under a range of assumptions about population dynamics and errors in the input data for assessment. This evaluation assumed that the HCR would be implemented as stipulated in the plan. Starting from the most recent ICES assessment (ICES, 2011a) and assuming low future recruitments, all scenarios considered led to SSB larger than B_{lim} in 2015. For those scenarios, the probability that SSB is larger than B_{pa} in 2015 ranged from 0.44 to 0.98. For the two scenarios most consistent with the way the stock is currently assessed the probabilities of SSB being larger than B_{pa} in 2015 were 0.69 and 0.98, depending on population dynamics assumptions. Therefore, ICES advises that there is no need to make any adjustments to account for low recruitment providing that the Harvest Control Rule is implemented as stipulated.

ICES notes, however, that the HCR has not been implemented as stipulated so far. Consequently, additional projections have been conducted assuming the observed F reductions (about 1.5% per year) since the plan was put in place. The results suggest a high probability of exceeding B_{lim} in 2015, but a very low probability of exceeding B_{pa} if recruitment remains low.

Basis of advice

Background

Cod is widely distributed throughout the North Sea; it is targeted by some fleets, but it is also caught as part of a mixed fisheries catching haddock, whiting, *Nephrops*, plaice, and sole. Cod discards have declined from 45% in 2008 to 20% in 2010 as a proportion of the total cod catches by weight.

There has been a gradual improvement in the status of the stock over the last few years. SSB has increased from the historical low in 2006, but remains below B_{lim}. Fishing mortality declined from 2000, but is estimated to be well above F_{MSY}, and just above F_{pa}. Recruitment since 2000 has been poor.

The EU–Norway agreement management plan was updated in December 2008. The plan aims to be consistent with the precautionary approach and is intended to provide for sustainable fisheries and high yield leading to a target fishing mortality of 0.4 (Annex 6.3.3.3.1). The EU has adopted a long-term plan for this stock with the same aims (Council Regulation (EC) 1342/2008). ICES evaluated both plans in 2009 and concluded they are in accordance with the precautionary approach if implemented and enforced adequately.

In both plans fishing mortality should be reduced to 75% of F_{2008} in 2009 and 65% of F_{2008} in 2010. Until the long-term phase of the management plans has been reached, further annual reductions of 10% must be applied.

In addition to the EU–Norway agreement the EU plan also includes effort restrictions, reducing kW-days available to community vessels in the main metiers catching cod in direct proportion to reductions in fishing mortality until the target F of 0.4 has been reached.

Results and conclusions

There have been many changes in the way the fisheries on North Sea cod have been managed since the introduction of the plan. The intention of most of these changes has been to encourage improvement in fishing practices, with intentional cod avoidance or a reduction of discards being rewarded by measures such as additional days at sea or increased quota. Several countries (principally Scotland, England, Denmark, and Sweden) have implemented catch-quota schemes for cod, which feature discard bans monitored by CCTV systems and associated additional quota. Scotland has also developed a system of real-time closures, intended to move vessels away from cod aggregations.

While there has been some limited progress in reducing the overall F for North Sea cod, and the observed discard rate has been reduced (particularly for older fish), cod avoidance has proved more difficult to achieve, particularly in northern areas where cod abundance would appear to be increasing at a faster rate than elsewhere. Studies (e.g. Needle and Catarino, 2011) have shown that, while vessels will move to areas of lower cod density when impacted by real-time closures, they will move back again when the closed areas reopen and the net effect on mortality is difficult to quantify.

Furthermore, the initial reduction in F outlined in the plan was large and therefore likely difficult to attain. Finally, ICES notes that the HCR has not been implemented as stipulated in the plan so far, due to inadequate control on removals which have resulted in actual removals that were considerably higher than forecast removals.

This has led to the advised quota for 2008–2011 being too high, and may have contributed to the lack of a rapid reduction in F. This has been taken into account in the advice for 2012.

Methods

This section provides background on the methods used to answer Request 4. More detail can be found in Annex 13 of the report on the Joint ICES–STECF Workshop on management plan evaluations for roundfish stocks (ICES, 2011c). The simulations method for North Sea cod was developed from the stochastic projection software used to provide catch options advice for North Sea cod (see Annex 2 in ICES, 2011b). This is because the MSE framework used for earlier impact assessments for North Sea cod were designed for B-Adapt, and not for the SAM model now used for North Sea cod, which is structurally different to B-Adapt.

The following scenarios were considered:

Operating Model (OM), reflecting different assumptions about the population and fishery dynamics, considers the existence of unallocated removals, which could arise from 2 different sources:

- Scenario "cat": catch is not correctly reported (this could be due to a variety of misreporting issues with landings or estimation errors, e.g. in discards).
- Scenario "m": natural mortality is changing in ways not known or expected.

Recruitment (SR) scenarios: In the OM, recruitment is simulated randomly with noise around a stock–recruitment relationship and with scenarios as follows:

- Scenario "1": Standard recruitment (the stock–recruitment relationship is fitted to the full time-series of stock and recruitment estimates obtained in the most recent ICES assessment, see ICES, 2011a).
- Scenario "0.5": Low recruitment (same stock–recruitment relationship as in Scenario "1", but halving the slope at the origin).

Observation Error Model (OEM), which captures the way in which the stock assessment is conducted:

- Scenario "cat": the assessment model allows for the existence of unallocated removals and estimates those as part of the fishing mortality.
- Scenario "m": the assessment model allows for the existence of unallocated removals and estimates those as part of the natural mortality.
- Scenario "wg": the assessment model assumes that there are no unallocated removals.

TAC constraints (TAC con):

- Scenario "20%": 20% maximum inter-annual variations permitted in TAC.
- Scenario "-": no TAC constraints.

The catch forecasted for the TAC year by applying the HCR defined in the EU–Norway management plan is subtracted from the population, hence assuming that the HCR is implemented as stipulated in the plan.

Table 1 presents the results of this Management Strategy Evaluation analysis, where each row corresponds to a combination of OM, SR, OEM, and TAC scenarios and columns 6–17 refer to stock status in 2015, as follows:

- Prob≥B_{lim}, Prob≥B_{pa}: probability that SSB at the start of 2015 is at or above precautionary reference points.
- Prob≤F_{msylo}, Prob≤F_{msy}, Prob≤F_{msyhi}: probability that fishing mortality during 2015 is at or below $F_{msylo} = 0.16$, $F_{msy} = 0.19$ or $F_{msyhi} = 0.42$.
- SSB: spawning-stock biomass at the start of 2015, in thousands of tonnes.
- L, D, C: landings, discards, and total catch during 2015, in thousands of tonnes.
- FL, FD, FC: fishing mortality values corresponding to landings, discards, and total catch during 2015.

It is known that the HCR has so far not been implemented in accordance to the plan and only fairly modest reductions in F have taken place during 2009 and 2010. To get an idea of the impact of the implementation problems on future

stock prospects, a further, simpler simulation study was undertaken, considering F reductions of 1.5% each year, without TAC constraints or feedback from the management plan. Hence, only the OM and SR components of the MSE framework were used. Results are presented in Table 2.

The reply to Request 4 is based on the metrics Prob≥B_{lim}, and Prob≥B_{pa}, from Tables 1 and 2. From Table 1, the low recruitment scenarios (SR = 0.5) with 20% TAC constraints (as established in the plan) are considered, with special attention given to rows 7 and 10, which are the most consistent with the way the North Sea cod stock is currently assessed (OEM "cat" scenario).

Sources

ICES. 2008. Answer to Request on appropriateness of F = 0.4 as a proxy for F_{MSY} for certain cod stocks. Report of the ICES Advisory Committee, 2008. ICES Advice, 2008, Book 1:33–34.

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ICES. 2010a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 5–11 May 2010, ICES Headquarters, Copenhagen. ICES CM 2010/ACOM:13.

ICES. 2010b. Report of the Working Group on Mixed Fisheries Advice for the North Sea (WGMIXFISH), 31 August– 3 September 2010, ICES Headquarters, Copenhagen, Denmark. ICES CM 2010/ACOM:35.

ICES. 2010c. Report of the ICES Advisory Committee, 2010. ICES Advice, 2010.

ICES. 2011a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

ICES. 2011b. Report of the Workshop on the Analysis of the Benchmark of Cod in Subarea IV (North Sea), Division VIId (Eastern Channel) and Division IIIa (Skagerrak) (WKCOD 2011), 7–9 February 2011, Copenhagen, Denmark. ICES CM 2011/ACOM:51. 94 pp.

ICES 2011c. Report of the Joint ICES–STECF Workshop on management plan evaluations for roundfish stocks (WKROUNDMP/EWG 11-01), June 20–24, 2011 ICES CM 2011/ACOM:55.

Needle, C. L., and Catarino, R. 2011. Evaluating the effect of real-time closures on cod targeting, ICES Journal of Marine Science. doi:10.1093/icesjms/fsr092.

Ulrich, C., Reeves, S. A., Vermard, Y., Holmes, S. J., and Vanhee, W. 2011. Reconciling single-species TACs in the North Sea demersal fisheries using the Fcube mixed-fisheries advice framework. ICES Journal of Marine Science, 68: 1535–1547.

Annex 6.3.3.3.1

EU–Norway management plan

In 2008 the EU and Norway renewed their initial agreement from 2004 and *"agreed to implement a long-term management plan for the cod stock, which is consistent with the precautionary approach and is intended to provide for sustainable fisheries and high yield."*

Transitional arrangement

F will be reduced as follows: 75% of F in 2008 for the TACs in 2009, 65% of F in 2008 for the TACs in 2010, and applying successive decrements of 10% for the following years.

The transitional phase ends as from the first year in which the long-term management arrangement (paragraphs 3–5) leads to a higher TAC than the transitional arrangement.

Long-term management

1. *If the size of the stock on 1 January of the year prior to the year of application of the TACs is:*

   a. *Above the precautionary spawning biomass level, the TACs shall correspond to a fishing mortality rate of 0.4 on appropriate age groups;*
   b. *Between the minimum spawning biomass level and the precautionary spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate on appropriate age groups equal to the following formula:*

   *0.4 - (0.2 * (Precautionary spawning biomass level - spawning biomass) / (Precautionary spawning biomass level - minimum spawning biomass level))*

   c. *At or below the limit spawning biomass level, the TAC shall not exceed a level corresponding to a fishing mortality rate of 0.2 on appropriate age groups.*

2. *Notwithstanding paragraphs 2 and 3, the TAC for 2010 and subsequent years shall not be set at a level that is more than 20 % below or above the TACs established in the previous year.*
3. *Where the stock has been exploited at a fishing mortality rate close to 0.4 during three successive years, the parameters of this plan shall be reviewed on the basis of advice from ICES in order to ensure exploitation at maximum sustainable yield.*
4. *The TAC shall be calculated by deducting the following quantities from the total removals of cod that are advised by ICES as corresponding to the fishing mortality rates consistent with the management plan:*

   a. *A quantity of fish equivalent to the expected discards of cod from the stock concerned;*
   b. *A quantity corresponding to other relevant sources of cod mortality.*
5. *The Parties agree to adopt values for the minimum spawning biomass level (70,000 tonnes), the precautionary biomass level (150,000 tonnes) and to review these quantities as appropriate in the light of ICES advice.*

Procedure for setting TACs in data-poor circumstances

6. *If, due to a lack of sufficiently precise and representative information, it is not possible to implement the provisions in paragraphs 3 to 6, the TAC will be set according to the following procedure.*

   a. *If the scientific advice recommends that the catches of cod should be reduced to the lowest possible level the TAC shall be reduced by 25% with respect to the TAC for the preceding year;*
   b. *In all other cases the TAC shall be reduced by 15% with respect to the TAC for the previous year, unless the scientific advice recommends otherwise.*

This plan shall be subject to triennial review, the first of which will take place before 31 December 2011. It enters into force on 1 January 2009.

The main changes between this and the plan of 2004 is the phasing (transitional and long-term phase) and the inclusion of an F reduction fraction.

EU management plan

In December 2008 the European Council agreed on a new cod management plan implementing the new system of effort management and a target fishing mortality of 0.4 (EC 1342/2008). The HCR for setting TAC for the North Sea cod stock is copied below.

Articles 7 1(a) and 7.1(b) are required for interpretation of Article 8.

Article 7: Procedure for setting TACs for cod stocks in the Kattegat the west of Scotland and the Irish Sea
1. *Each year, the Council shall decide on the TAC for the following year for each of the cod stocks in the Kattegat, the west of Scotland and the Irish Sea. The TAC shall be calculated by deducting the following quantities from the total removals of cod that are forecast by STECF as corresponding to the fishing mortality rates referred to in paragraphs 2 and 3:*
   (a) a quantity of fish equivalent to the expected discards of cod from the stock concerned;
   (b) as appropriate a quantity corresponding to other sources of cod mortality caused by fishing to be fixed on the basis of a proposal from the Commission. [...]

Article 8: Procedure for setting TACs for the cod stock in the North Sea
1. *Each year, the Council shall decide on the TACs for the cod stock in the North Sea. The TACs shall be calculated by applying the reduction rules set out in Article 7 paragraph 1(a) and (b).*
2. *The TACs shall initially be calculated in accordance with paragraphs 3 and 5. From the year where the TACs resulting from the application of paragraphs 3 and 5 would be lower than the TACs resulting from the application of paragraphs 4 and 5, the TACs shall be calculated according to the paragraphs 4 and 5.*
3. *Initially, the TACs shall not exceed a level corresponding to a fishing mortality which is a fraction of the estimate of fishing mortality on appropriate age groups in 2008 as follows: 75 % for the TACs in 2009, 65 % for the TACs in 2010, and applying successive decrements of 10 % for the following years.*
4. *Subsequently, if the size of the stock on 1 January of the year prior to the year of application of the TACs is:*
   (a) above the precautionary spawning biomass level, the TACs shall correspond to a fishing mortality rate of 0,4 on appropriate age groups;
   (b) between the minimum spawning biomass level and the precautionary spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate on appropriate age groups equal to the following formula: 0,4 – (0,2 * (Precautionary spawning biomass level – spawning biomass) / (Precautionary spawning biomass level – minimum spawning biomass level))
   (c) at or below the limit spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate of 0,2 on appropriate age groups.
5. *Notwithstanding paragraphs 3 and 4, the Council shall not set the TACs for 2010 and subsequent years at a level that is more than 20 % below or above the TACs established in the previous year.*
6. *Where the cod stock referred to in paragraph 1 has been exploited at a fishing mortality rate close to 0,4 during three successive years, the Commission shall evaluate the application of this Article and, where appropriate, propose relevant measures to amend it in order to ensure exploitation at maximum sustainable yield.*

Article 9: Procedure for setting TACs in poor data conditions
Where, due to lack of sufficiently accurate and representative information, STECF is not able to give advice allowing the Council to set the TACs in accordance with Articles 7 or 8, the Council shall decide as follows:
(a) where STECF advises that the catches of cod should be reduced to the lowest possible level, the TACs shall be set according to a 25 % reduction compared to the TAC in the previous year;
(b) in all other cases the TACs shall be set according to a 15 % reduction compared to the TAC in the previous year, unless STECF advises that this is not appropriate.

Article 10: Adaptation of measures
1. *When the target fishing mortality rate in Article 5(2) has been reached or in the event that STECF advises that this target, or the minimum and precautionary spawning biomass levels in Article 6 or the levels of fishing mortality rates given in Article 7(2) are no longer appropriate in order to maintain a low risk of stock depletion and a maximum sustainable yield, the Council shall decide on new values for these levels.*
2. *In the event that STECF advises that any of the cod stocks is failing to recover properly, the Council shall take a decision which:*
   (a) sets the TAC for the relevant stock at a level lower than that provided for in Articles 7, 8 and 9;
   (b) sets the maximum allowable fishing effort at a level lower than that provided for in Article 12;
   (c) establishes associated conditions as appropriate.

Article 11 Fishing effort regime
1. *The TACs set out in Articles 7, 8 and 9 shall be complemented by a fishing effort regime whereby fishing opportunities in terms of fishing effort are allocated to Member States on an annual basis.*

2. The Council may, acting on a Commission proposal and on the basis of the information provided by Member States and the advice of STECF referred to in paragraph 3, exclude certain groups of vessels from the application of the effort regime provided that:

> *(a) appropriate data on cod catches and discards are available to allow STECF to assess the percentage of cod catches made by each group of vessels concerned;*

> *(b) the percentage of cod catches as assessed by STECF does not exceed 1,5 % of the total catches for each group of vessels concerned; and*

> *(c) the inclusion of these groups of vessels in the effort regime would constitute an administrative burden disproportionate to their overall impact on cod stocks. If STECF is not in position to assess that these conditions remain fulfilled, the Council shall include each group of vessels concerned in the effort regime.*

3. Member States shall provide annually appropriate information to the Commission and STECF to establish that the above conditions are and remain fulfilled in accordance with detailed rules to be adopted by the Commission.

Article 12: Fishing effort allocations

1. Each year, the Council shall decide on the maximum allowable fishing effort for each effort group by Member State.

2. The maximum allowable fishing effort shall be calculated by means of a baseline established as follows:

> *(a) for the first year of application of this Regulation the baseline shall be established for each effort group as the average effort in kW-days spent during the years 2004-2006 or 2005-2007, according to the preference of the Member State concerned, based on the advice of STECF;*

> *(b) for the subsequent years of application of this Regulation the baseline shall be equal to the maximum allowable fishing effort of the previous year.*

3. The effort groups for which an annual adjustment in the maximum allowable fishing effort shall be applied shall be decided on the following basis:

> *(a) the catches of cod taken by vessels in each of the effort groups shall be evaluated on the basis of data submitted by Member States in accordance with Articles 18, 19 and 20 of Council Regulation (EC) No 199/2008 of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy (1);*

> *(b) a list shall be compiled for each of the areas defined in Annex I to this Regulation of the aggregated effort groups and their corresponding cod catches, including discards. This list shall be arranged in ascending order of cod catch in each effort group;*

> *(c) the cumulative catches of cod in the lists established according to point (b) shall be calculated in following way. For each aggregated effort group, the sum shall becalculated of the cod catch by that effort group and the cod catches made by all aggregated effort groups in the preceding entries in the list;*

> *(d) the cumulative catches calculated according to point (c) shall be calculated as a percentage of the total cod catch by all aggregated effort groups in the same area.*

4. For aggregated effort groups where the percentage cumulative catch calculated according to paragraph 3(b) is equal to or exceeds 20 %, annual adjustments shall apply to the effort groups concerned. The maximum allowable fishing effort of the groups concerned shall be calculated as follows:

> *(a) where Articles 7 or 8 applies, by applying to the baseline the same percentage adjustment as that set out in those Articles for fishing mortality;*

> *(b) where Article 9 applies, by applying to the baseline the same percentage adjustment in fishing effort as the reduction of the TAC.*

5. For effort groups other than those referred to in paragraph

4, the maximum allowable fishing effort shall be maintained at the level of the baseline.

Article 13: Allocation of additional fishing effort for highly selective gear and cod-avoiding fishing trips

1. Member States may increase the maximum allowable fishing effort for effort groups for which the effort has been adjusted in accordance with Article 12(4) and subject to the conditions set out in paragraphs 2 to 7.

2. The maximum allowable fishing effort may be increased within effort groups in which the fishing activity of one or more vessels:

> *(a) is carried out having on board only one regulated gear the technical attributes of which result, according to a scientific study evaluated by STECF, in catching less than 1 % cod (highly selective gear);*

> *(b) results in a catch composition of less than 5 % cod per fishing trip (cod-avoiding fishing trips);*

> *(c) is conducted in accordance with a cod avoidance or discard reduction plan which reduces fishing mortality for cod among participating vessels by at least as much as the effort adjustment referred to in Article 12(4); or*

(d) is carried out in the west of Scotland area to the west of a line drawn by sequentially joining with rhumb lines the positions laid down in Annex IV measured according to the WGS84 coordinate system, provided that the participating vessels are equipped with satellite-based vessel monitoring systems (VMS).

3. Vessels referred to in paragraph 2 shall be subject to increased frequency of monitoring, concerning in particular:
  (a) the exclusive use of the highly selective gear during the fishing trips concerned in accordance with paragraph 2(a);
  (b) the amount of discards in compliance with paragraph 2(b);
  (c) the reduction in fishing mortality in accordance with paragraph 2(c);
  (d) the amount of catches and discards occurring to the west of the line specified in paragraph 2(d); and subject to arrangements for the regular provision of data to the Member State concerning the respect of the special conditions laid down in those points.

4. The increase of fishing effort under this Article shall be calculated for each of the vessels in the effort groups concerned that operate under special conditions referred to in paragraph 2, points (a), (b), (c) and (d), and shall be no more than the amount needed to compensate the effort adjustment referred to in Article 12(4) for the gears involved in those actions.

5. Any increases of the fishing effort allocation carried out by the Member States shall be notified to the Commission, by April 30 of the year during which the compensation for the effort adjustment shall take place. The notification shall include details of the vessels operating under the special conditions referred to in points (a), (b), (c) and (d) of paragraph 2, the fishing effort per effort group that the Member State expects to be carried out by those vessels during that year, and the conditions under which the effort of the vessels is being monitored, including control arrangements.

6. Member States shall report to the Commission by 1 March each year at the latest about the amounts of effort used within the actions during the previous year.

7. The Commission shall request STECF to compare annually the reduction in cod mortality which would result from the application of point (c) of paragraph 2 with the reduction it would have expected to occur as a result of the effort adjustment referred to in Article 12(4). In light of this advice the Commission may propose adjustments in effort that may be applied for the relevant gear grouping the following year.

Article 17 Exchange of maximum allowable fishing effort across effort groups

1. A Member State may amend its effort allocations by transferring fishing capacity across effort groups, under the conditions set out in paragraphs 2 to 5.

2. The transfer shall be allowed between gear groupings but not between geographical areas, provided that the Member State concerned provides the Commission with information on the catch per unit effort (cpue) of its donor and receiving gear group, averaged over the last three years.

3. Where the cpue of the donor gear group is higher than the cpue of the receiving gear group, the transfer shall in general be made on a 1 kW-day to 1 kW-day basis.

4. Where the cpue of the donor gear group is lower than the cpue of the receiving gear group, the Member State shall apply a correction factor to the amount of effort in the receiving gear group so that the latter⬚fs higher cpue is compensated for.

5. The Commission shall request STECF to develop standard correction factors that might be used to facilitate the transfer of effort across gear groups with different cpue.

Table 1 Results in 2015 from the Management Strategy Evaluation (MSE) assuming HCR in the EU–Norway long-term plan implemented as stipulated in the plan. The highlighted lines correspond to the way the assessment is conducted. OM – Operating Model; SR – Recruitment scenarios; OEM – Observation Error Model; L – Landings; D – Discards; C – Catch; FL – F due to Landings; FD – F due to Discards; FC – F due to Catch. See further details in method section above.

	OM	SR	OEM	TAC con	Prob $\geq B_{lim}$	Prob $\geq B_{pa}$	Prob $\leq F_{MSYlo}$	Prob $\leq F_{MSY}$	Prob $\leq F_{MSYhi}$	SSB	L	D	C	FL	FD	FC
1	**cat**	**1**	**cat**	**20%**	**1.00**	**1.00**	**0.99**	**1.00**	**1.00**	**370**	**53.3**	**14.8**	**68.2**	**0.06**	**0.02**	**0.08**
2	cat	1	m	20%	1.00	1.00	0.98	1.00	1.00	357	56.8	15.7	72.9	0.06	0.02	0.09
3	cat	1	wg	20%	1.00	1.00	0.82	0.94	1.00	330	70.9	20.6	92.0	0.09	0.03	0.12
4	m	1	cat	20%	1.00	0.99	0.99	1.00	1.00	264	39.8	12.0	52.0	0.06	0.02	0.08
5	m	1	m	20%	1.00	0.99	0.98	1.00	1.00	256	42.2	12.7	55.2	0.07	0.02	0.09
6	m	1	wg	20%	1.00	0.95	0.80	0.93	1.00	239	53.0	16.6	69.8	0.09	0.03	0.12
7	**cat**	**0.5**	**cat**	**20%**	**1.00**	**0.98**	**0.65**	**0.84**	**1.00**	**241**	**52.2**	**11.6**	**64.1**	**0.11**	**0.04**	**0.14**
8	cat	0.5	m	20%	1.00	0.96	0.53	0.75	1.00	227	54.1	12.1	66.4	0.12	0.04	0.16
9	cat	0.5	wg	20%	1.00	0.83	0.10	0.25	0.98	197	67.7	16.4	84.7	0.17	0.06	0.23
10	m	0.5	cat	20%	1.00	0.69	0.56	0.79	1.00	170	38.7	9.5	48.3	0.11	0.04	0.15
11	m	0.5	m	20%	1.00	0.64	0.48	0.73	1.00	162	39.1	9.8	49.5	0.12	0.04	0.16
12	m	0.5	wg	20%	1.00	0.44	0.08	0.22	0.98	143	49.5	13.1	63.4	0.17	0.06	0.23
13	cat	1	cat	-	1.00	1.00	0.08	0.17	1.00	324	131.5	40.1	173.8	0.18	0.06	0.24
14	cat	0.5	cat	-	1.00	0.97	0.02	0.05	0.98	219	86.1	20.4	107.8	0.21	0.07	0.28

Weights in ´000 tonnes.

Table 2 Results in 2015 from projections assuming 1.5% reductions in F each year, without TAC constraints or feedback from the management plan and using the Observation Error Model used in the assessment (Catch). OM – Operating Model; SR – Recruitment scenarios; L – Landings; D – Discards; C – Catch; FL – F due to Landings; FD –F due to Discards; FC – F due to Catch.

	OM	SR	Prob $\geq B_{lim}$	Prob $\geq B_{pa}$	Prob $\leq F_{MSYlo}$	Prob $\leq F_{MSY}$	Prob $\leq F_{MSYhi}$	SSB	L	D	C	FL	FD	FC
1	**cat**	**1**	**0.99**	**0.36**	**0.00**	**0.00**	**0.00**	**134**	**128.4**	**46.4**	**176.6**	**0.40**	**0.14**	**0.54**
4	m	1	0.98	0.26	0.00	0.00	0.50	126	93.0	34.1	128.4	0.31	0.11	0.42
7	**cat**	**0.5**	**0.85**	**0.04**	**0.00**	**0.00**	**0.00**	**94**	**74.6**	**21.9**	**96.7**	**0.40**	**0.14**	**0.54**
10	m	0.5	0.78	0.02	0.00	0.00	0.50	87	53.5	16.1	69.9	0.31	0.11	0.42

Weights in ´000 tonnes.