ECOREGION North Sea
SUBJECT Joint EU–Norway request on a future long-term management plan of North Sea whiting

Advice summary

Recruitment for North Sea whiting is considered to be low (poor) when the geometric mean of the recent 3–5 years falls below 1.25 billion individuals at age 1. ICES considers that 4 years may be an appropriate period to respond to a change in recruitment. When such low recruitment occurs, even a reduction of 33% and 50% in fishing mortality had limited impact on the already low probability (i.e. between 7% and 8%) of the stock going below the lowest observed SSB in the time-series (B_{loss} = 100 000 t). Using a constant F = 0.27 in the long term resulted in around 5% probability of SSB falling below B_{loss}, irrespective of changes in the recruitment regime but providing that recruitment remained within the range of observed values. Removing TAC constraints when the recruitment becomes low reduces the probability of the stock falling below B_{loss}. In all cases examined, the reductions in the probabilities of the stock falling below the lowest SSB observed are small.

Request

The response to the Joint EU-Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel) from ICES in September 2010 stated that "maintaining fishing mortality at its current level of 0.3 would be consistent with long-term stability if recruitment is not poor".

Consequently the EU and Norway have agreed to interim management of whiting at this level of total fishing mortality, conditional on a 15% TAC constraint.

On the basis that the whiting stock exhibits no relationship between spawning biomass and recruitment, ICES is requested to conduct an evaluation of:

1) *The level and number of years for which recruitment is considered poor;*
2) *The lower level to which fishing mortality should be reduced;*
3) *The rate of reduction to the lower level in the event of poor recruitment.*

Elaboration on Advice

Request 1. To conduct an evaluation of the level and number of years for which recruitment is considered poor.

Estimates of low (poor) recruitment that result in a similar risk of SSB falling below the lowest observed value (B_{loss} = 100 000 t), are in the range of 1.25 to 1.5 billion individuals. Using a threshold of 1.5 billion results in a similar risk of SSB falling below B_{loss} but is likely to result in more 'false alarms' (invoking a reduction in F when estimates of recruitment in the next year would reveal that this was not necessary). Thus, the best estimate of low recruitment is when the geometric mean of the recent 3–5 years falls below 1.25 billion individuals at age 1. Noise in recruitment estimation may result in a false reaction for the shorter 3-year period and after 5 years management action may need to be more severe. Therefore, 4 years may be a more appropriate period to respond to a change in recruitment.

Request 2. To conduct an evaluation of the lower level to which fishing mortality should be reduced.

Simulation studies indicate that with a target F = 0.3 and a 15% TAC constraint, a 33% and 50% reduction in fishing mortality rate when recruitment became low had limited impact on the probability (i.e. between 7% and 8%) of the stock going below B_{loss} (Annex 6.3.3.2.1). However, simulations with a constant fishing mortality rate of 0.27 had around 5% probability of SSB falling below B_{loss} in the long term, irrespective of changes in the recruitment regime and providing that the recruitment remained within the range of observed recruitment values. There is some associated loss of yield at lower fishing mortality rate but this strategy would avoid potential false alarms triggered by noise and retrospective bias currently associated with the estimation of North Sea whiting recruitment.

If a target F = 0.3 and 15% TAC constraint are maintained, the approach of reducing fishing mortality when recruitment becomes low would be appropriate. However, the simulation studies suggest that a 50% reduction in F from 0.3 to 0.15 results in some decrease (i.e. from about 8% to 4–5%) in the risk of SSB falling below B_{loss}, but only if the TAC constraint is moved below the trigger recruitment. For other scenarios examined, ICES notes that the probability of SSB falling below B_{loss} is marginally above 5%.

Request 3. To conduct an evaluation of the rate of reduction to the lower level in the event of poor recruitment.

A proportional reduction in fishing mortality (i.e. from F = 0.3 to F = 0.2 or 0.15) when recruitment becomes low (see illustration in Annex 6.3.3.2.2) as discussed under request 2, while maintaining the 15% TAC constraint would result in a small (1–2%) reduction in the probability that SSB will fall below the lowest observed value. Reducing the fishing mortality while removing the TAC constraint when recruitment becomes low would reduce this probability by a further 1–2% to about 4–5% (Annex 6.3.3.2.3).

Another option would be to keep F at 0.3 and remove the TAC constraint when recruitment becomes low. In that case, the risk that SSB will decline below the lowest observed value is about 6%, slightly lower than when the TAC constraint is maintained.

ICES concludes that fishing at F = 0.3 with a 15% TAC constraint already has a relatively low probability of SSB declining below the lowest observed value in the time-series, albeit slightly above 5%. Reductions in fishing mortality during periods of low recruitment would be appropriate even though it is not expected to significantly reduce the risk. If F is kept constant at 0.3, relaxing the TAC constraint will lead to very similar results in terms of risk. In all cases examined, the reductions of the risk of the stock falling below the lowest SSB observed are small.

Basis of advice

Background

The dynamics of the whiting stock are heavily dependent on the abundance of recruitment entering the stock. Whiting grow quickly and mature at an early age (11% at age 1 (recruits to the fishery), 92% at age 2, and 100% for ages 3+). Fish at ages 1 and 2 make a substantial contribution to the spawning stock; however, there is no apparent dependence of recruitment on spawning biomass.

A response to the Joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel) from ICES in September 2010 stated that "maintaining fishing mortality at its current level of 0.3 would be consistent with long-term stability if recruitment is not poor" (ICES, 2010). Consequently the EU and Norway agreed to interim management of whiting at this level of total fishing mortality for 2011, conditional on a 15% TAC constraint as follows:

The TAC for whiting for 2011 will be fixed by applying an interim management plan consisting of the following elements:

1. For 2011 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.3 for appropriate age-groups.
2. Where the rule in paragraph 1 would lead to a TAC, which deviates by more than 15% from the TAC of the preceding year, the Parties shall establish a TAC that is no more than 15% greater or 15% less than the TAC of the preceding year.
3. During 2011, after obtaining advice from ICES, the Parties will refine the management plan, in particular to allow for a reduction in the target fishing mortality when recruitment to the stock has been low for a period of years.

Subsequently, a study presented at the EU–Norway negotiations during 2010 determined that fishing at an F = 0.3, with a 15% TAC constraint, would result in increasing spawning biomass with a low risk of decreasing below the lowest observed values in the time-series at the historical average recruitment abundance and variability. However, if recruitment remained for a protracted period at the 2003–2007 level of abundance there is an increasing risk of the stock declining below the lowest recorded biomass.

Due to time constraints on the analysis no information could be provided by the preliminary study as to the extent to which F might need to be reduced following such a protracted period of low recruitment. The parties agreed an interim management plan for whiting in which the total fishing mortality is maintained at 0.3, conditional on a 15% TAC constraint. At the same time, a request was made to ICES to evaluate:

1) the level and number of years for which recruitment is considered poor;
2) the lower level to which fishing mortality should be reduced;
3) the rate of reduction to the lower level in the event of poor recruitment.

This is the request being addressed by this document.

ICES notes that no determination was made to ascertain that F of 0.3 is equivalent to F_{MSY}.

Methods

A standard Management Strategy Evaluation (MSE with FLR) method of evaluating harvest control rules was used, based on an underlying simulated population (operating model) that characterizes the North Sea whiting population and a management system model that simulates the fishery operation. This structure allows errors in sampling of data, the assessment process, and the management implementation to be simulated independently. The analysis included a simulation of the auto-correlated dynamics of North Sea whiting recruitment, with alternating periods of variable duration of three different recruitment regimes (high, medium, and low).

To provide an estimate of the level and number of years for which recruitment is considered poor, simulated fishing at a constant F = 0.3 was used to establish a base run. Each of the 200 simulations were then examined to determine the distribution of the geometric mean recruitment calculated over 3, 4, and 5 years prior to the spawning biomass being reduced to the lowest observed SSB (B_{loss} = 100 000 t) or below. The 95th percentile of the 5- and 3-year geometric mean recruitment were taken as an example of the upper thresholds for recruitment (Rt).

When the geometric mean recruitment calculated over consecutive periods of 3 years is at or below 1.25 billion individuals at age 1, simulations suggest that the SSB has a high probability of being below the lowest observed SSB the following year. When the geometric mean recruitment calculated over consecutive periods of 5 years is at or below 1.5 billion, simulations suggest the SSB has a high probability of being below the lowest observed SSB the following year.

To provide answers to the remainder of the request, two categories of harvest control rules were evaluated using the MSY with FLR method:

1) Constant fishing mortality with no TAC constraint or with TAC constraints of 15%, 20%, and 30%;
2) Fishing mortality constant at a specified target when the recent recruitment average was above a specified upper recruitment abundance threshold (Rt) with a proportional reduction in fishing mortality subject to a 15% TAC constraint below Rt down to a lower constant rate of fishing mortality (F_{low}) at a lower recruitment threshold (R_{low}) (see Annex 6.3.3.2.1 and Annex 6.3.3.2.3).

To allow comparison between harvest control rule evaluations, the same series of 200 simulations of recruitment time-series projections were used with each analysis.

Sources

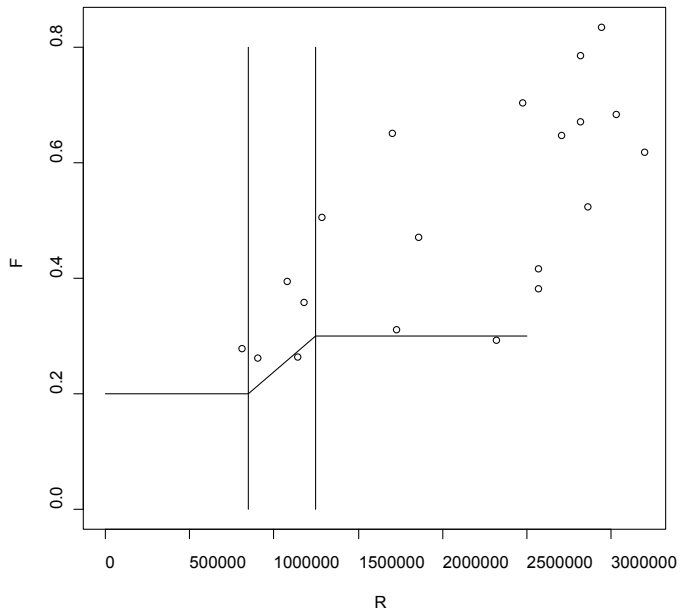
ICES 2010. Joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Report of the ICES Advisory Committee, 2010. ICES Advice, 2010, Book 6: 17–19.

ICES 2011. Report on 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.

Annex 6.3.3.2.1 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Simulation metrics based on fishing a simulated stock at a constant fishing mortality rate or under a harvest control rule in which fishing mortality is adjusted according to the level of recent recruitment. Note: This initial set of scenarios was run with inter-annual TAC constraint applied to the catch rather than landings. This was corrected in the second set of scenarios presented in Annex 6.3.3.2.3. Given that the discard ratio in catch numbers-at-age is constant throughout the simulations (average 2008–2010), this was not considered to affect significantly the medium- and long-term results of the simulations below.

.							Median SSB			Median catch			Realised F	
Rule	Target F	Constraint %	F low	GM Years	Rt (billions)	R low (billions)	All yrs	P(<Bref)	2015<Bref	All yrs	2010 - 2015	2010 - 2030	All yrs	Bias
48	0.3	-	N/A	N/A	N/A	N/A	203	0.07	0.05	42	39	44	0.32	1.07
50	0.3	15	N/A	N/A	N/A	N/A	204	0.08	0.04	42	36	44	0.32	1.07
51	0.3	20	N/A	N/A	N/A	N/A	203	0.07	0.04	42	37	44	0.32	1.07
52	0.3	30	N/A	N/A	N/A	N/A	203	0.07	0.05	42	38	44	0.32	1.07
53	0.3	15	0.2	4	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
54	0.3	15	0.2	4	1.50	0.85	208	0.06	0.03	41	35	44	0.31	1.03
55	0.3	15	0.2	3	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
56	0.3	15	0.2	3	1.50	0.85	209	0.06	0.03	41	36	44	0.31	1.03
57	0.3	15	0.2	5	1.25	0.85	207	0.07	0.04	41	36	44	0.32	1.07
58	0.3	15	0.2	5	1.50	0.85	208	0.06	0.04	41	35	44	0.31	1.03
59	0.3	15	0.15	4	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
60	0.3	15	0.15	4	1.50	0.85	210	0.06	0.03	41	35	44	0.30	1.00
61	0.3	15	0.15	3	1.25	0.85	208	0.06	0.04	41	36	44	0.31	1.03
62	0.3	15	0.15	3	1.50	0.85	211	0.06	0.03	41	36	44	0.30	1.00
63	0.3	15	0.15	5	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
64	0.3	15	0.15	5	1.50	0.85	210	0.06	0.03	41	35	44	0.30	1.00
71	0.25	15	N/A	N/A	N/A	N/A	225	0.03	0.03	39	33	41	0.26	1.04
72	0.25	20	N/A	N/A	N/A	N/A	224	0.03	0.03	39	33	41	0.26	1.04
73	0.25	30	N/A	N/A	N/A	N/A	224	0.03	0.03	39	34	41	0.26	1.04
74	0.25	-	N/A	N/A	N/A	N/A	223	0.03	0.03	39	35	41	0.26	1.04
65	0.25	15	0.15	4	1.25	0.85	228	0.03	0.03	39	32	41	0.26	1.04
66	0.25	15	0.15	4	1.50	0.85	229	0.02	0.03	38	32	41	0.25	1.00
67	0.25	15	0.15	3	1.25	0.85	228	0.03	0.03	39	33	41	0.25	1.00
68	0.25	15	0.15	3	1.50	0.85	230	0.02	0.02	38	32	41	0.25	1.00
69	0.25	15	0.15	5	1.25	0.85	228	0.03	0.03	39	33	41	0.26	1.04
70	0.25	15	0.15	5	1.50	0.85	229	0.03	0.02	38	32	41	0.25	1.00

Annex 6.3.3.2.2 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). An illustration of a harvest control rule in which fishing mortality is adjusted according to the level of recruitment, with the historical recruitment and fishing mortality pairs for the years 1990–2009.



Annex 6.3.3.2.3 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Additional simulation metrics based on a simulated stock exploited at a constant fishing mortality rate or under a harvest control rule in which fishing mortality is adjusted according to the level of recent recruitment. Note: constraint applied to the landings.

Rule	Target F	TAC Constraint above Rt (%)	TAC Constraint below Rt (%)	F Low	Recruitment trigger (Rt) (billions)	Mean SSB (kt)	Probability (SSB<Bloss)	Mean catch (kt)	Mean F
50	0.3	15	N/A*	N/A	N/A	204	0.070	41	0.32
59_2	0.3	15	None	0.3	1.25	206	0.066	41	0.32
60_2	0.3	15	None	0.3	1.5	205	0.062	42	0.31
53_1	0.3	15	None	0.2	1.25	207	0.057	41	0.31
54_1	0.3	15	None	0.2	1.5	209	0.046	41	0.3
59_1	0.3	15	None	0.15	1.25	209	0.052	41	0.31
60_1	0.3	15	None	0.15	1.5	211	0,040	41	0.3
75	0.27	15	N/A*	N/A	N/A	217	0.042	40	0.28

* No recruitment trigger is used.