ECOREGION Widely distributed and migratory stocks
SUBJECT NEAFC request for advice regarding the blue whiting stochastic forecast

Advice summary

Answers are provided following the sequence of the request.

1) The value for 2012 recruitment was correct. There was an error in the input recruitment value for 2013. Qualitative information from a series of surveys indicates that the 2012 year class (recruits at age 1 in 2013) is around average such that the long-term geometric mean (GM) should have been applied for forecast. However by mistake, recruitment as estimated for 2012 was used. This error led to a 2% higher TAC advice and a slightly higher SSB than if the GM recruitment had been applied.

2) The distribution of the spawning-stock biomass estimates have not been used to infer precautionary considerations. In 2014 ICES is using a deterministic forecast method for blue whiting.

3) ICES has reviewed the performance of the stochastic forecast model and has determined that there are differences between the stochastic and the deterministic forecast models. The magnitude of the difference depends on the uncertainty in results from the assessment model. For blue whiting catch advice in 2015 the stochastic forecast produces a TAC that is 4 to 5% higher than a deterministic forecast. ICES advises that a deterministic forecast is used as basis for the TAC advice for 2015 in order to be consistent with the assumptions made in both the 2013 (ICES, 2013a, 2013b) and the 2008 (ICES, 2008; Anon., 2008) management strategy evaluations of this stock. A management plan with target F at 0.30 (as suggested by the management plan evaluations carried out in 2013), considered precautionary in combination with a deterministic forecast, may not be precautionary if TACs are set using a stochastic forecast that produces consistently higher TACs relative to the TACs used in the evaluation. ICES uses the deterministic forecast method in its TAC advice – for blue whiting see Section 9.3.5 (ICES, 2014) – to be consistent with the conclusions of its previous evaluations of the various options of the management plan.

Request

The North-East Atlantic Fisheries Commission (NEAFC) has noted that ICES in its blue whiting forecast for 2014, assumed the level of recruitment in 2013 to be the same as that in 2012 rather than the geometric mean of the years 1981-2010, which means the spawning biomass in 2015 might be overestimated.

Furthermore, NEAFC noted that the distribution of spawning biomass estimates using the stochastic forecast model is both wide and skewed, which in its view could lead to an overestimation of the F values that are deemed precautionary.

ICES is requested to review the assumptions and performance of the stochastic forecast model. ICES is also requested to assess whether or not there are any implications with respect to the reliability of its previous evaluations of the various options to revise the management plan, as outlined in special requests 9.3.3.1 and 9.3.3.7 of June and October 2013 respectively.

Background

In the forecast derived with the stochastic model, the distribution of the spawning stock is both wide and skewed and the lower quantiles of the distribution are tight. This leads to the concern that the spawning stock biomass values corresponding to probability levels in the lower tail of the distribution may be overestimated and thus resulting in too high F values being erroneously found to be precautionary.

Basis of ICES advice

Results and conclusions

The value for 2012 recruitment was correct. There was an error in the input recruitment value for 2013. Qualitative information from a series of surveys indicates that the 2012 year class (recruits at age 1 in 2013) is around average such that the long-term geometric mean should have been applied for forecast. However, by mistake, recruitment as estimated for 2012 was used. This error led to a 2% higher TAC advice and a slightly higher SSB than if the GM recruitment had been applied.

The SAM model provides uncertainty of fishing mortality and stock numbers in the final-year estimates that can only be fully applied in a stochastic short-term forecast. The default stochastic projections applied for SAM assessments are carried out by projecting the final year's SAM estimates of stock numbers (log(N)) and fishing mortality (log(F)). Using the variance–covariance matrix of those estimates, a high number (1000) of replicates of the initial stock numbers and fishing mortalities are randomly drawn, such that the variance and covariance between stock N and F are maintained. Due to additional information affecting recruitment (qualitative use of recruitment indices from surveys not used by SAM), the initial stock estimate for ages 1 and 2 and future recruitment can optionally be raised by an input factor. The 1000 replicates are then simulated forward according to the management options. The forecast result presented in the option table is finally derived from the median of the 1000 replicates.

Compared to a deterministic forecast the stochastic forecast gives slightly higher estimates of TAC and SSB. For this year's advice the TAC for 2015 is estimated 4–5% higher and SSB in 2016 8–9% higher than last year's estimate. The difference is due to the assumed log-normal distributed stock number. The median of the projected stock N is unbiased compared to the stock N from a deterministic forecast, but the median of quantities like yield and SSB, which is the sum of several age groups N weighted by e.g. F, mean weight, and proportion mature, will be higher. The difference between the stochastic and deterministic values increases when there is more uncertainty around the stock numbers and fishing mortalities used for the forecast.

In the evaluations carried out to answer special requests 9.3.3.1 and 9.3.3.7 in 2013 the HCS software was used (ICES, 2013a, 2013b). These simulations did not directly run a SAM model for each year. Instead, assessment errors were generated matching the level observed in the most recent (at the time) SAM assessment for the stock. This was done by taking the true stock numbers according to the population model and using an autoregressive model with a combination of a year factor and an age factor noise terms to generate errors in the terminal stock numbers. This is to mimic not only year-to-year uncertainty in the "assessed" stock numbers, but also some retrospective error. As is done in practice, the "assessed" stock numbers are projected forward to the TAC year to get the TAC. This projection is deterministic, based on the point estimates, with specified assumptions for catches or fishing mortalities, according to the harvest rule under study.

At WGWIDE, the default SAM stochastic forecast has been applied for the last three years. For 2014, however, a deterministic version was applied for advice to match that used in the MSE evaluation (Anon., 2008; ICES, 2008, 2013a, 2013b). The conclusion that a HCR with target F = 0.30 is precautionary, is sensitive to the choice of forecast model. This conclusion is dependent on the use of a deterministic forecast, and may no longer be valid should a stochastic forecast, with a TAC estimated 4–5% higher than in the MSE, is applied in reality. Due to time constraints it is not possible to correct the evaluation and re-estimate a precautionary target F. Therefore, ICES uses a deterministic forecast this year which is consistent with the assumptions in the management strategy evaluation.

Sources

Anon. 2008. Report of the Working Group established by the Blue Whiting Coastal States on Blue Whiting Management Strategies, 26–30 May 2008, Charlottenlund Castle, Denmark. 65 pp.

ICES. 2008. EC/Faroe Islands/Iceland/Norway request on long-term management of blue whiting. *In* Report of the ICES Advisory Committee, 2008. ICES Advice 2008, Book 9, Section 9.3.2.9.

ICES. 2013a. NEAFC request to ICES to evaluate the harvest control rule element of the long-term management plan for blue whiting. Special request, Advice May 2013. *In* Report of the ICES Advisory Committee, 2013. ICES Advice 2013, Book 9, Section 9.3.3.1.

ICES. 2013b. NEAFC request on additional management plan evaluation for blue whiting. Special request, Advice October 2013. *In* Report of the ICES Advisory Committee, 2013. ICES Advice 2013, Book 9, Section 9.3.3.7.

ICES. 2014. Blue whiting in Subareas I–IX, XII, and XIV. *In* Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 9, Section 9.3.5.