Iceland request for evaluation of a harvest control rule for Atlantic wolffish in Icelandic waters

Advice summary

ICES advises that the proposed harvest control rule with, F_{MGT} = 0.20 and MGT $B_{trigger}$ = 21 000 tonnes is consistent with both the precautionary approach and conforms with the ICES MSY framework.

Request

ICES received the following request from Iceland:

As stipulated in the MoU between Iceland and ICES, plaice and Atlantic wolffish are stocks in which Iceland expects advice on from ICES. (…) the management strategy for plaice and Atlantic wolffish is to maintain the exploitation rate at the rate which is consistent with the precautionary approach and that generates maximum sustainable yield (MSY) in the long term in part with the adoption of a management plan.

The Government of Iceland requests ICES to evaluate whether the proposed harvest control rules are in accordance with its objectives, given current ICES definition of reference points or any re-evaluation of those points that may occur in the process. Additionally, the evaluation should include review of input data and the applied assessment methodology. It is expected that the ICES advice for the 2022/2023 fishing year for ling, tusk, plaice and Atlantic wolfish be based on the above mentioned HCRs.

In further correspondence received by ICES, it was requested that ICES specifically review the following harvest control rule for plaice:

The HCR is applied to calculate the annual total allowable catch (TAC) based on a forecast from the assessment model with a target fishing mortality, calculated as the mean over ages 10 to 15, F_{MGT}, set to 0.20. The TAC for the fishing year y/y+1 (September 1 of year y to August 31 of year y+1) is then calculated from the projected catch for the upcoming fishing year. If the spawning stock biomass (SSB) falls below 21 000 tonnes (MGT $B_{trigger}$), the harvest control rule dictates that F_{MGT} shall be reduced linearly to zero based on the ratio between the SSB estimated and MGT $B_{trigger}$.

Elaboration on the advice

To answer the request ICES conducted a benchmark assessment and calculated biological reference points, and evaluated the proposed HCR.

Benchmark assessment and evaluation of reference points

This stock has not been benchmarked by ICES before, and this is a new species to be assessed by ICES. The reference points are shown in Table 1.

Table 1 ICES reference points for wolffish in Division 5.a following the benchmark. Biomass values in tonnes.

Framework	Reference point	Value	Technical basis
MSY Approach	MSY $B_{trigger}$	21 000	B_{pa}
	F_{MSY}	0.20	Limited by F_{p05}, maximum F at which the probability of SSB falling below B_{lim} is <5%
Precautionary Approach	B_{lim}	18 500	$B_{pa} \times e^{-1.645 * \sigma B}$, using the default $\sigma_B = 0.2$
	B_{pa}	21 000	B_{loss} (SSB in 2002), observed within the recent period of lower productivity (after 2001)
	F_{lim}	0.33	Fishing mortality that in stochastic equilibrium will result in median SSB at B_{lim}
	F_{pa}	0.20	F_{p05}, maximum F at which the probability of SSB falling below B_{lim} is <5%
Management plan	MGT $B_{trigger}$	21 000	No lower than MSY $B_{trigger}$
	F_{MGT}	0.20	No higher than F_{MSY}

Evaluation of the HCR

Long term simulations accounting for potential advice error indicate that an HCR with $F_{MGT} = 0.20$ and MGT $B_{trigger}$ = 21 000 tonnes, is consistent with both the precautionary approach and conforms with the ICES MSY framework. SSB is compared to MGT $B_{trigger}$ at the beginning of the advice year in the forecast. F_{MGT} is based on F_{MSY}, and MGT $B_{trigger}$ is based on MSY $B_{trigger}$. F_{MSY} is constrained by F_{p05}.

Basis of the advice

Background

Under the Memorandum of Understanding between Iceland and ICES, Atlantic wolffish is a stock for which Iceland expects advice from ICES. Atlantic wolffish will be assessed by the ICES Working Group on Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP). A request for evaluation was submitted to ICES from the Icelandic Ministry of Industries and Innovation in the autumn of 2021. An evaluation of input data, methods for assessment and reference points took place in February–April 2022.

A further request to ICES was submitted in April 2022 with more specific details on the proposed HCR. The evaluation ensured that the HCR conforms with the precautionary approach and ICES MSY framework.

The HCR defined in the request is based on the ICES advice rule (ICES, 2021), which applies a target F at or below F_{MGT}. The target F is decreased proportionately according to the ratio of SSB to MGT $B_{trigger}$ when SSB is lower than MGT $B_{trigger}$. There is no additional action below B_{lim}.

Results and conclusions

The results of simulations of the HCR in terms of equilibrium yield and SSB for a range of F values are given in Figure 1.

With a fishing mortality (F) of 0.20, annual probabilities of SSB < B_{lim} are less than 5% in all years. Higher Fs are not possible without the probability of SSB < B_{lim} exceeding 5% (Table 2), but F may range down to 0.15 while maintaining 90% of MSY. Median catch values only increase marginally (1%) at slightly higher F values (F = 0.26), but these correspond with a 24% probability of SSB falling below B_{lim} (see Figure 1). The ranges of SSB, realized Fs, and catches expected to result from HCRs with Fs ranging from 0.15 to 0.20 are shown in Table 2. These ranges should be used in the future to check that realized ranges are compatible with expectations. If future observed values were to go outside the ranges illustrated, this would indicate that there is a need to re-evaluate the assumptions of the simulations.

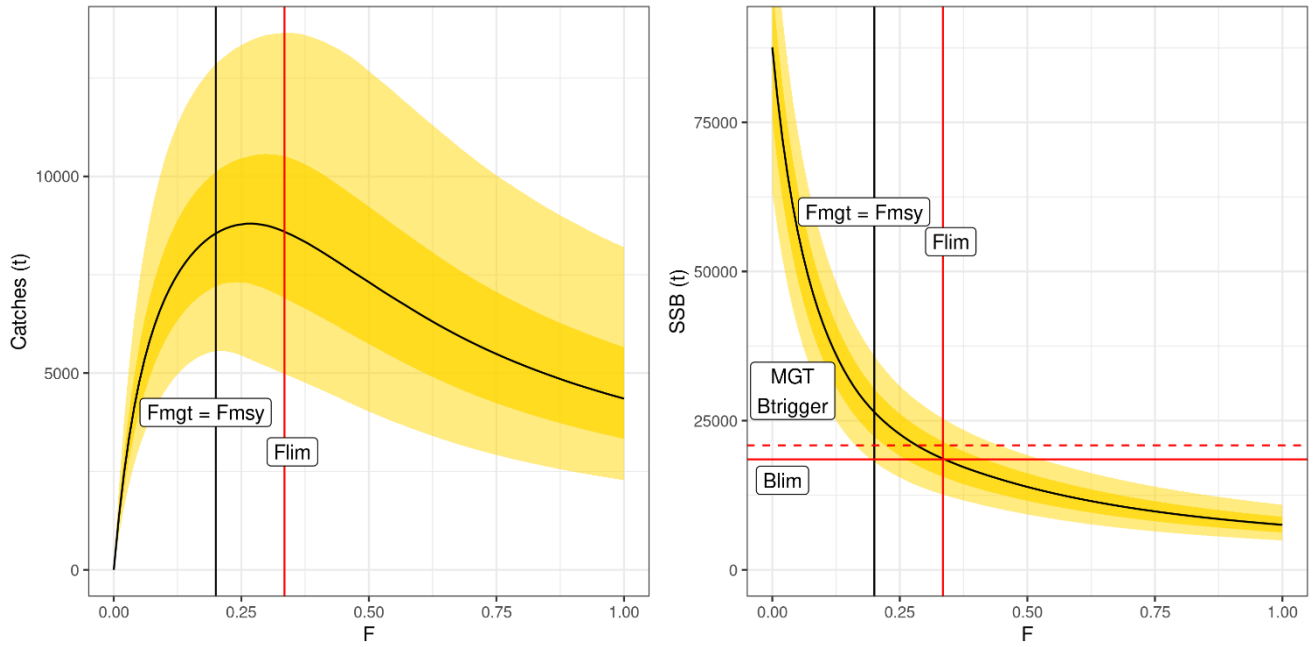

Figure 1 Atlantic wolffish in Division 5.a. Equilibrium catches (in tonnes, left panel) and corresponding SSB (in tonnes, right panel) as a function of fishing mortality implemented in the HCR. In both panels, the solid curves indicate the median of the distribution and the ribbons the 5th and 95th and 25th and 75th percentiles. The black vertical line corresponds with $F_{MGT} = F_{MSY}$ (0.20). The red vertical line corresponds with F_{lim}. The dashed and solid red horizontal lines are MGT $B_{trigger}$ (21 000 tonnes) and B_{lim} (18 500 tonnes), respectively.

Table 2 Atlantic wolffish in Division 5.a. Long-term median values, and 90% confidence intervals, of the projected catches, realized Fs, and SSB for alternative F values (0.15 to 0.20) applied in the HCR with MGT $B_{trigger}$ = 21 000 tonnes.

F	Catches (in t)	Realized F	SSB (in t)
0.15	7994 (5286–12 012)	0.15 (0.10–0.22)	32 125 (22 156–43 306)
0.20	8571 (5570–12 869)	0.20 (0.14–0.29)	26 470 (18 128–35 910)

Methods

Benchmark assessment

A statistical catch-at-age model spanning ages 4–16+ was fitted using survey indices from the groundfish trawl surveys Spring IS-SMB [G3239] – Marsrall, and Autumn IS-SMH [G4493] – Haustrall in Iceland (ICES, 2022). The assessment model used is the State space Assessment Model (SAM) described in Nielsen and Berg (2014) and Albertsen and Trijoulet (2020). The model runs from 1979 onwards and ages 4 to 16 are tracked by the model, treating age 16 as a plus group. Observations in SAM are assumed to arise from a multivariate normal process with an expected value derived from the model. Patterns in the residuals were treated by including autocorrelation between ages in autumn and spring survey residuals. Reliable data on catch composition (age and length) are unavailable for years prior to 1997. For those years total catch by weight was used to inform on the catch levels.

HCR simulation

A shortcut Management Strategy Evaluation (MSE) was conducted for Atlantic wolffish in Division 5.a using eqSim software (ICES, 2014, 2015). The operating model, which generates the "true" future populations in the simulations, was conditioned on the ICES stock assessment. Future selection, maturity, and weight patterns were set by resampling values from the last 10 years. Recruitment was projected using a log-normal distribution conditioned on the historical residuals, mean recruitment over the last 20 years, and autocorrelations estimated from the assessment outputs. Recruitment impairment was assumed to occur when SSB fell below the breakpoint of a hockey-stick recruitment function, set as B_{lim}.

A short-cut approach to generating assessment and forecast error was used (ICES, 2013). The advice error of the fishing mortality was assigned a CV = 0.212, based on the default error suggested by ICES (2015). The advice error was auto-correlated to emulate observed sequential periods of over- or under-estimation of stock biomass using the default value of 0.423. F_{MGT} values ranging from 0 to 1 were applied with 2001 simulations per F value to estimate uncertainty of long-term equilibrium results resulting from each F value.

A key assumption of these simulations is that recruitment levels will continue as they have been estimated over the previous 20 years after a shift in productivity. If this assumption is negated in upcoming years, then reference points may need to be re-evaluated.

Sources and references

Albertsen, C. M. and Trijoulet, V. 2020. Model-based estimates of reference points in an age-based state-space stock assessment model. Fisheries Research, 230: 105618. https://doi.org/10.1016/j.fishres.2020.105618

ICES. 2013. Report of the Workshop on Guidelines for Management Strategy Evaluations (WKGMSE), 21–23 January 2013, ICES HQ, Copenhagen, Denmark. ICES CM 2013/ACOM:39. 128 pp. https://doi.org/10.17895/ices.pub.5304

ICES. 2014. Report of the Workshop to consider reference points for all stocks (WKMSYREF2), 8-10 January 2014, ICES Headquarters, Copenhagen, Denmark. ICESCM 2014/ACOM:47. 91 pp. https://doi.org/10.17895/ices.pub.19283177

ICES. 2015. Report of the Joint ICES-MYFISH Workshop to consider the basis for FMSY ranges for all stocks (WKMSYREF3), 17–21 November 2014, Charlottenlund, Denmark. ICES CM 2014/ACOM:64. 156 pp. https://doi.org/10.17895/ices.pub.5661

ICES. 2021. Advice on fishing opportunities. *In* Report of the ICES Advisory Committee, 2021. ICES Advice 2021, Advice on fishing opportunities. https://doi.org/10.17895/ices.advice.7720

ICES. 2022. Workshop on the evaluation of assessments and management plans for ling, tusk, plaice and Atlantic wolffish in Icelandic waters (WKICEMP). ICES Scientific Reports. 4:37. https://doi.org/10.17895/ices.pub.19663971

Nielsen, A. and Berg, C. W. 2014. Estimation of time-varying selectivity in stock assessments using state-space models. Fisheries Research, 158: 96–101. https://doi.org/10.1016/j.fishres.2014.01.014

Recommended citation: ICES. 2022. Iceland request for evaluation of a harvest control rule for Atlantic wolffish in Icelandic waters. *In* Report of the ICES Advisory Committee, 2022. ICES Advice 2022, sr.2022.6a, https://doi.org/10.17895/ices.advice.19625679