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Notes to the basic framework of the ICES advice on TAC

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Three main issues:

1. ICES Fmsy values are underestimates;
2. ICES Management Strategy Evaluations (MSE) are biased, miss 3 out of 4 density dependent factors;
3. Precautionary considerations should not be mixed into the definition of Fmsy.

We have detailed comments to text of the ICES advise defining documents ("1.2 Advice basis" and "12.4.3.1 ICES fisheries management reference points for category 1 and 2 stocks " - both downloaded 20th December 2019 from the ICES homepage) accordingly, for your considerations.

Ad 1. ICES Fmsy values are underestimates

ICES current Fmsy values are generally underestimates because ICES ignore 3 out of 4 density dependent factors in the calculations. On average Fmsy should be 50% higher. See Fmsy project for new Fmsy values for 53 of ICES data rich stocks that are without any bias known to science. https://www.norden.org/en/publication/global-fisheries-catches-can-be-increased-after-rebuilding-fish-populations.

Why is there no Bmsy in ICES assessment?

Because ICES ignore density dependence in 3 out of 4 important population dynamic factors (in growth, maturity and natural mortality) the obtained biomass estimates are unrealistic. The mechanism is like the one used in your garden for carrots – you get a better yield and more healthy carrots by thinning. ICES has accepted this notion, and therefore ICES normally do not provide Bmsy values, but only Fmsy values. The way of thinking by ICES seems to be that Bmsy is unrealistic, but Fmsy is probably realistic. That Fmsy is realistic is undocumented, and the Fmsy project documents that they are not. They are severe underestimates. Furthermore, it is a problematic modelling practice to select the parameter values you like and discard the parameter values you do not like from a model, especially when the two parameters in question are so strongly (negatively) correlated as Bmsy and Fmsy are.

Three stocks are welcome excepts to this general pattern: Northeast Arctic cod and haddock, and cod around Iceland as their models include all 4 DD factors.

It can also be noted that the few stocks which assessments are based on biomass dynamics models (Tech Guidelines p. 17) have appropriate Fmsy values. They are based on the same approach as used by the Fmsy-project and thus without any bias known to science. It is however unfortunate, that such stocks have higher Fmsy values than they would have had if there were data enough to conduct a "data rick stock" assessment. The remedy is of course not to reduce the Fmsy for these stocks, but rather to correct the approach for data rich stocks.

Way forward

Adopt the Fmsy-project Fmsy values, use ICES default HCR, reduce TAC if SSB surviving the TAC year is lower than Blim with a probability >5%. Develop MSEs that also includes DD in growth, maturity and natural mortality as soon as possible.

Problems resolved: No bias known to science in the Fmsy values used, and foregone sustainable yield avoided.

Ad 2. Most current MSEs are biased

Of the same reason as above, most of ICES MSE are biased because they ignore density dependence in 3 out of 4 important population dynamic factors (in growth, maturity and natural mortality). Again, the Northeast Arctic cod and haddock are welcome exceptions.

Way forward

Develop MSEs that include all four DD factors, either specifically or via MSEs based on biomass dynamic models.

Problems resolved: More sophisticated HCRs than ICES default one can be implemented.

Ad 3. Should precautionary considerations be mixed into the definition of Fmsy?

We prefer that the Fmsy is defined as a "clean" scientific concept of the fishing mortality that gives the maximum sustainable catch independent of precautionary considerations, given the current exploitation pattern (i.e. relative F by age) and the default HCR. To avoid double counting of the precautionary consideration, precautionarity should only be dealt with when considering stock biomass. This is covered well by the current Blim, Bpa, MSY Btrigger and HCRs system.

Way forward

Do not cap Fmsy neither according to Fpa nor to F0.05.

Problems resolved: 1) More transparent what Fmsy is; 2) More comparable with Fmsy used in other areas of the world; 3) Will be consistent with the F that gives maximum sustainable yield in MSE calculations.

Appendix The new Fmsy values.

New Fmsy values have been estimated by the "Fmsy-project":

Sparholt, Henrik, Bjarte Bogstad, Villy Christensen, Jeremy Collie, Rob van Gemert, Ray Hilborn, Jan Horbowy, Daniel Howell, Michael C. Melnychuk, Søren Anker Pedersen, Claus Reedtz Sparrevohn, Gunnar Stefansson and Petur Steingrund. 2019. Global fisheries catches can be increased after rebuilding of fish populations. Project: Ecosystem Based FMSY Values in Fisheries Management. **TemaNord**, **530**, p1-34. http://norden.diva-portal.org/smash/get/diva2:1316583/FULLTEXT04.pdf

Table. *The new Fmsy values by stock from the Fmsy-project. Also shown are the maximum F observed in the historic time series and the recent 5 years mean F, both from ICES assessments in 2019. From ICES (2019).*

Stock	New Fmsy	Max F in the assessment time series	Recent 5 yr mean F		"Max F" minus "new Fmsy"
reb.27.1-2	0.13	0.05	0.03		-0.08
bli.27.5b67	0.22	0.26	0.05		0.04
whb.27.1-91214	0.44	0.54	0.41		0.10
cod.27.5a	0.51	0.89	0.27		0.38
cod.27.7a	0.76	2.85	0.16		2.09
cod.27.7e-k	0.63	1.05	0.86		0.43
cod.27.47d20	0.71	1.06	0.50		0.35
cod.27.1-2	0.47	1.02	0.35		0.55
cod.27.5b1	0.60	0.73	0.43		0.13
cod.27.22-24	0.51	1.38	0.71		0.87
ldb.27.8c9a	0.44	0.63	0.26		0.19
reg.27.1-2	0.14	0.53	0.22		0.39
reg.27.561214	0.14	0.21	0.11		0.06
had.27.5a	0.38	0.80	0.38		0.42
had.27.5b	0.46	0.53	0.26		0.07
had.27.6b	0.39	1.13	0.26		0.74
had.27.7a	0.43	1.43	0.13		1.00
had.27.7b-k	0.67	1.24	0.60		0.56
had.27.46a20	0.46	0.96	0.32		0.50
had.27.1-2	0.26	0.75	0.28		0.48
hke.27.8c9a	0.65	1.19	0.74		0.54
hke.27.3a46-8abd	0.64	1.19	0.24		0.55
her.27.5a	0.28	0.44	0.19		0.16
her.27.nirs	0.32	0.36	0.16		0.04
her.27.irls	0.40	0.82	0.44		0.42
her.27.3a47d	0.38	1.28	0.19		0.89
her.27.1-24a514a	0.23	0.26	0.11		0.03

her.27.28	0.31	0.71	0.29		0.40
her.27.20-24	0.30	0.63	0.39		0.32
her.27.25-2932	0.25	0.44	0.24		0.19
her.27.3031	0.30	1.85	1.64		1.54
lin.27.5a	0.32	0.56	0.27		0.24
mac.27.nea	0.39	0.40	0.28		0.02
meg.27.7b-k8abd	0.33	0.54	0.24		0.21
meg.27.8c9a	0.34	0.51	0.29		0.17
ple.27.7a	0.29	0.74	0.07		0.45
ple.27.7d	0.29	0.55	0.17		0.26
ple.27.420	0.35	0.67	0.19		0.32
ple.27.21-23	0.28	1.02	0.42		0.74
pok.27.5a	0.31	0.46	0.18		0.15
pok.27.5b	0.34	0.63	0.44		0.29
pok.27.1-2	0.32	0.72	0.24		0.40
pok.27.3a46	0.38	0.74	0.35		0.35
sol.27.7a 1.2	0.36	0.55	0.06		0.19
sol.27.7d	0.34	1.47	0.62		1.13
sol.27.7e	0.33	0.41	0.20		0.08
sol.27.7fg	0.31	0.69	0.30		0.38
sol.27.8ab	0.32	0.83	0.39		0.51
sol.27.4	0.32	0.66	0.24		0.34
sol.27.20-24	0.32	0.53	0.19		0.21
spr.27.22-32	0.39	0.50	0.36		0.11
mon.27.78abd	0.30	0.63	0.33		0.34
mon.27.8c9a	0.30	1.40	0.13		1.10
Mean	0.38	0.80	0.32		0.42

References:

ICES. 2019. Report of the ICES Advisory Committee. ICES Advice 2019. Individual advice sheets available at http://www.ices.dk/community/advisory-process/Pages/Latest-Advice.aspx