

Where to next with MSEs in ICES

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Agenda

- 01** What is MSE
- 02** Definitions
- 03** MSE in ICES
- 04** MSE elsewhere: Cod in NAFo & Albacore in ICCAT
- 05** Where to next

Management Strategy Evaluation

Simulation approach to evaluate management strategies before they are put in place.

First developed by the international Whale Commission to facilitate the decision-making process

“Best
available
model”

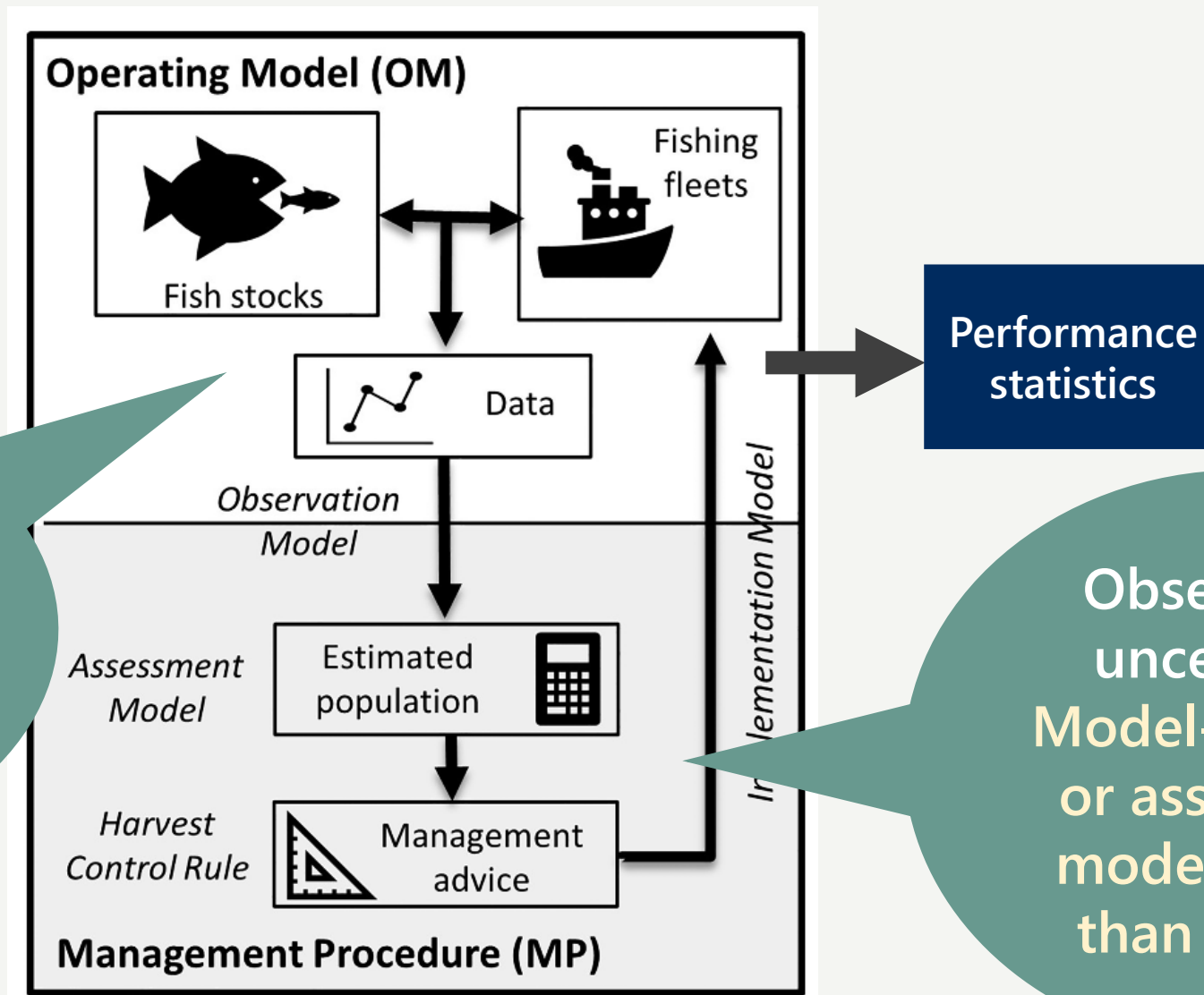


Management procedure
“robust to uncertainty”



Management
Strategy
Evaluation

Complex models
Several operating
models that
account for main
uncertainties



Observation
uncertainty
Model-free HCR
or assessment
model simpler
than the OM

Management Strategy Evaluation

Model Free Harvest Control Rule

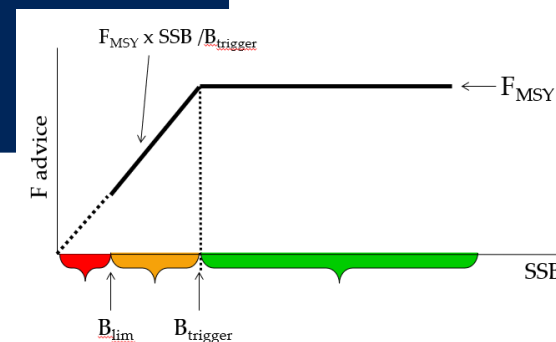
Input: Abundance indices (scientific surveys or CPUES) and additional data

Category 3 harvest control rules

Model Based Harvest Control Rule

Input: Assessment model estimates (SSB, fishing mortality)

The ICES Advice Rule



Empirical approaches* based on life-history traits -- category 3 MSY approach advice		
rfb rule	Biomass ratio, fishing proxy, and biomass safeguard $A_{y+1} = A_y \times r \times f \times b \times m$ biennial advice interval	r : rate of change in the biomass index (I) A_y : recent advised catch f : fishing proxy (length data, target) b : biomass safeguard m : multiplier; tuning parameter Stability clause (-30%: +20% cap)
chr rule	Constant harvest rate $A_{y+1} = I_{y-1} \times F_{proxy,MSY} \times b \times m$ annual advice <i>not for short-lived stocks</i>	I_{y-1} : most recent biomass index value $F_{proxy,MSY}$: target harvest rate b : biomass safeguard m : multiplier; tuning parameter Stability clause (-30%: +20% cap)
chr - MSE rule	Constant harvest rate with MSE $A_{y+1} = I_{current} \times HR_{msy,proxy}$ <i>for short-lived stocks</i>	$I_{current}$: abundance indicator of the stock $HR_{msy,proxy}$: sustainable harvest rate
Empirical approaches* based on life-history traits -- category 3 Precautionary approach advice		
rb rule	Biomass ratio and biomass safeguard	r : rate of change in the biomass index (I)

Management Strategy Evaluation

Full-feedback loop

The assessment model is included in the simulation algorithm in every year and iteration to feed the HCR

Short-cut approach

Fishing mortality and abundance is directly taken from the operating model and some uncertainty is added around the values (*or not*)

Management Strategy Evaluation

Management strategies are assessed against reference points to ensure they fulfill predefined objectives:

- MSY
- Risk (i.e $p(SSB < B_{lim}) < 5\%$)
- Variability in catch
-

MSE in ICES



- Data limited stocks: Model-free generic HCRs.
- Standard assessment model to condition the OM and as assessment model, but MSE tested with a short-cut approach. (*Icelandic stocks*)
- Complex OM and Assessment model, but MSE tested with a short-cut approach (*Pandalus*)
- Standard assessment model to condition the OM and as assessment model, MSE tested with full-feedback approach. (*NS-Herring*)

What happens elsewhere



Model based HCRs, but simpler and multi-annual:

- IWC
- Southern Bluefin Tuna
- North Atlantic Albacore
- ...

Empirical HCRs:

- South African Hake
- Greenland Halibut
- Atlantic Bluefin Tuna
- North Atlantic swordfish
- ...

MSE Greenland Halibut NAFO



- Adopted by the Fisheries Commission in 2010
- First applied to give advice in 2011.
- Survey based harvest control rule (HCR) to set a TAC for an annual basis.
- Exceptional circumstance protocol
- "Update" assessment every 3 years or if "*Exceptional circumstances*" happen.
- In-depth MSE review after 6 years.
- In 2017 and 2024 the MSE was re-assessed.
- In 2017 the HCR used was revised.

MSE Greenland Halibut NAFO



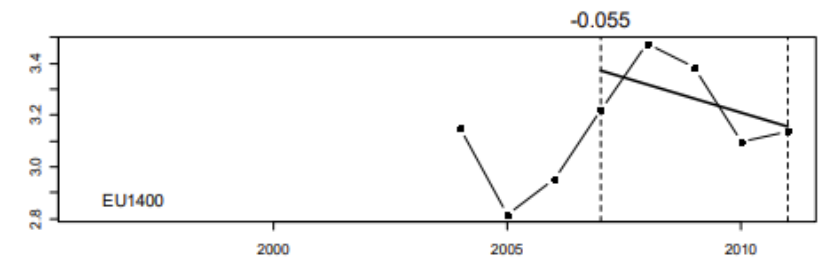
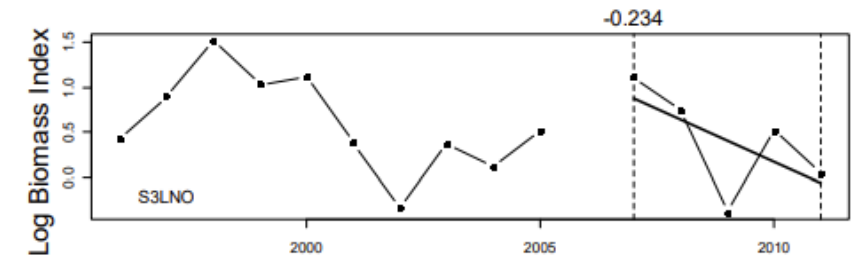
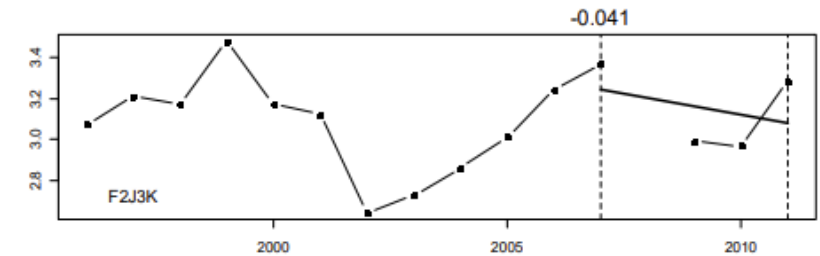
Average of the individual survey slopes: -0.1099.

$TAC_{2012} = 16\,326\text{ t.}$

$Catch_{HCR} = 16326 * [1 + 2 * (-0.1099)] = 12\,739\text{ t}$

5% TAC constraint

$TAC_{2013} = 0.95 * 16326 = 15\,510\text{ t}$



MSE North Atlantic Albacore - ICCAT



- Adopted by the the Commission in 2017
- 3-year constant annual TAC
- Stock assessment, production model, applied every 3 years.
- Stock synthesis used in the OM.
- MSE is being reviewed.
- HCR has been applied in 2018-2020, 2021-2023 and 2024-2026.

MSE North Atlantic Albacore - ICCAT



(a) $B_{\text{THRESH}} = B_{\text{MSY}}$

(b) $B_{\text{LIM}} = 0.4 \cdot B_{\text{MSY}}$

(c) $F_{\text{TAR}} = 0.8 \cdot F_{\text{MSY}}$

(d) $F_{\text{MIN}} = 0.1 \cdot F_{\text{MSY}}$

$$F_{\text{adv}} = \begin{cases} F_{\text{MSY}} \\ F_{\text{MSY}} \cdot \left(a \cdot + b \cdot \frac{B_{\text{cur}}}{B_{\text{MSY}}} \right) \\ F_{\text{min}} \end{cases}$$

$$B_{\text{cur}} \geq B_{\text{thres}}$$

$$B_{\text{lim}} < B_{\text{cur}} < B_{\text{thres}}$$

$$B_{\text{lim}} \geq B_{\text{cur}}$$

$$C_{\text{max}} = 50\,000 \text{ t}$$

Complex models



- NS-Cod: Sub-stocks without enough data to separate them.
- Pandalus: 2 areas, 2 sex, length based, hermaphroditism
- Hakes: 2 sex, length based, several fleets

In complex models usually difficult to discriminate between alternative hypothesis about stock and fleet dynamics, need to select 'the best' one without strong evidence

Where to next with MSEs in ICES

- Overloaded System: the annual cycle to provide advice limits the capacity of the community.
- Increasingly complex assessment models:
Use them to condition operating models!
- Do not use MSE just to add another complexity layer:
Simplify assessment process!

Where to next with MSEs in ICES

When not possible to adjust a model reliably (even in data rich situations!):

- Model-free harvest control rules

When the candidate assessment models are complex:

- Use the model to condition the operating model and a simpler model to feed the ICES advice rule

Don't do an MSE (or call it MSE), if there is a single operating model with the same structure as the assessment model and the advice implementation is perfect.

Where to next with MSEs in ICES

- MSE implementation should continue, even outside special requests.
- MSE should be used to:
 - Increase system robustness.
 - Simplify the advice-provision process.
 - Promote simpler models within the management procedure.
 - Consider empirical HCRs even for Category 1 stocks.
 - Explore multi-annual advice.



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raibh maith agat, paldies, ačiū, dziękuję, obrigada, gracias, gràcies,
grazas, eskerrik asko, mercés, diolch, tapadh leat

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