Adventures in MSE for IO BET and SBT

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Background

- Talk about successfully implemented MSEs for:
  - Indian Ocean Bigeye Tuna (2022)
  - Southern Bluefin Tuna (2005, 2011, 2019)
- How are they similar/how do they differ?
- What they got right
- What they got wrong...
- What becomes of The Stock Assessment??
- Did it improve assessment and management of the stock

Indian Ocean MSE history

- Began around 2014 for major species (YFT, BET, SKJ)
- SKJ was first with a sort-of-MSE (HCR adopted 2016)
- More complete simulation tested approach taken for YFT/BET
- YFT development stalled (assessment has issues...)
- BET most advanced:
  - Four major rounds of testing and adaptation
  - Final MP adopted from 2 candidates (May 2022)
  - First calculation of TAC (Oct 2022)

SBT MSE history

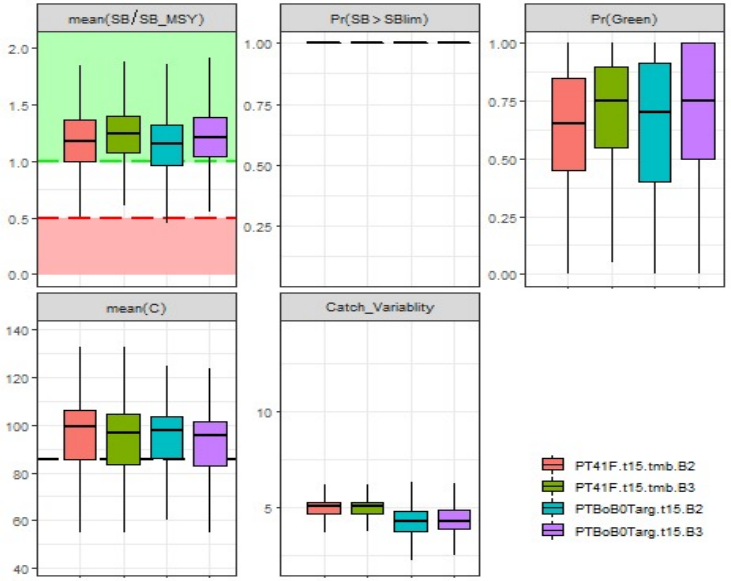
- Process began way back (*ca.* 2003)
- First adopted MP derailed in 2006 by overcatch revelations
- Restart in 2009 and “Bali Procedure” adopted in 2011
- This MP set TAC in 2011, 2013 and 2016
- Key input index ended 2017 - develop a new MP!
- Two years later “Cape Town Procedure” adopted in 2019
- New MP set TAC in 2020 and 2022

Common elements of IO and SBT MSE

- Operating Model (OM) construction:
  - Grid based with a reference/base set
  - Additional suite of alternate hypotheses
  - Robustness tests built into conditioning/projections
- Candidate MPs:
  - Model-based or empirical but far simpler than assessment
  - Pre-agreed **minimum** and **maximum** data inputs
- Agreed performance summaries stakeholders want/understand
- Implementable set of objectives agreed in Commission
- **All** candidate MPs tuned to primary objectives
- Differences were in the details...

Differences in objectives: Indian Ocean

- IOTC committed to Kobe MSY-driven framework
- Main objectives are related to being in Kobe “green zone”
- $\mathbb{P}$(Kobe green 11–15yrs) = 0.6 & 0.7 (B2 & B3)



Differences in objectives: SBT

- **Don't** use MSY or Kobe framework
- Main objectives are relate to adult depletion:
  1. $\mathbb{P}\left(\delta_{2035} \geq 0.3\right) = 0.5$ (primary)
  2. $\mathbb{P}\left(\delta_{2035} \geq 0.2\right) \geq 0.7$ (secondary)
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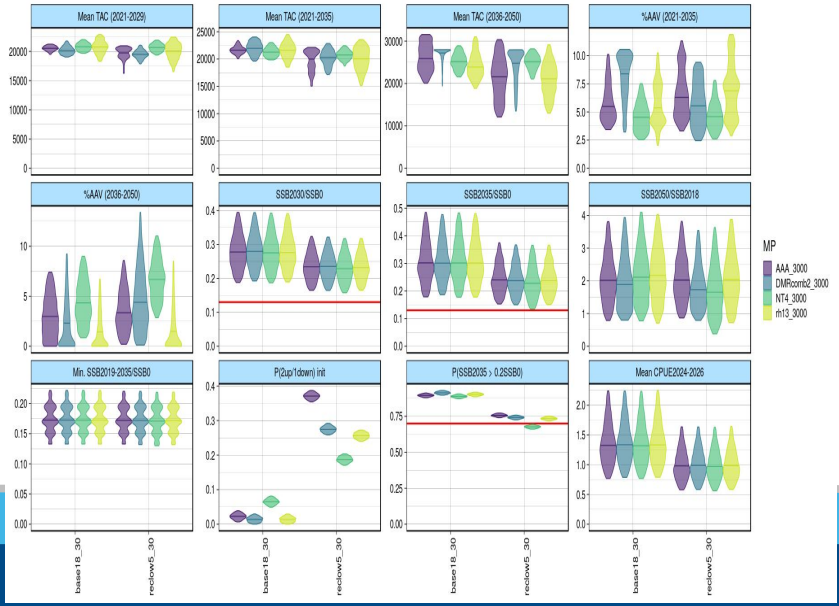
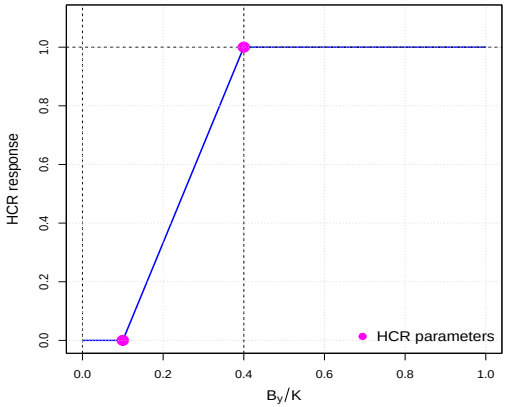


Differences in MPs: inputs, outputs, constraints

- **IO BET**:
  - Data: total catch, spatially aggregated LL CPUE index
  - Constraints: 3 yr blocks; max. change of 10% of TAC
  - Output: single overall TAC (no agreed allocations yet...)
- **SBT**:
  - Data: 2 y.o. GT index, LL CPUE, Close-Kin Mark-Recapture
  - Constraints: 3 yr blocks; min/max change 100t/3,000t
  - Output: TAC allocated by country

Adopted BET MP

- Fits catch biomass+CPUE to Pella-Tomlinson state-space model
- Biomass depletion, B_y/K, input to HCR below (HCR_{mult})
- Tuning parameter, $\tilde{F}$, and $\phi = -\log(1 - MSY/K)$
- $TAC = B_y \left(1 - \exp\left(\tilde{F} \times HCR_{\text{mult}} \times \phi\right)\right)$



Adopted SBT MP

- Mixture of empirical and model-based elements
- Inputs:
  1. **Gene tagging**: 5 year mean age 2 (absolute) abundance
  2. **LL CPUE**: 4 year mean of single abundance index
  3. **CKMR**: adult pop^{n} model $\Rightarrow$ recent trend and relative level
- HCR defined as follows:

$$TAC_{\text{new}} = TAC_{\text{old}} \times \left(1 + \Delta^{\text{cpue}} + \Delta^{\text{ckmr}}\right) \times \Delta^{\text{gt}}$$

What they got right: technical

- Software development:
  - Developers use agreed and open platforms (R, ADMB, TMB)
  - Version control and “well behaved” developers
  - Worth making stakeholder-accessible tools (e.g. Shiny)
- MP design:
  - Efficient testing means MPs must run “unsupervised”
  - Spend time making it robust not “beautiful”
  - Don’t have to choose between empirical and model-based
  - Complexity test: can you explain why it does what it does?

What they got right: process

- Get Commission to define set of objectives first
- Then convince them to reduce the number to one or two...
- Ideally: pre-agree allocations and operational constraints
- Agree on Metarules process:
  1. Are data and stock dynamics within bounds tested?
  2. Are catches exceeding TAC or agreed overcatch limits?
  3. Are there new data available that change things?
- Sensible metarules essential (something weird will happen...)
- Offset the stock assessment and running MP (MP then SA)
- Plan for several rounds of MSE testing and fine tuning

What they got wrong

- **SBT**:
  - Failed to have a plan for overcatch (2005, 2011)
  - Scheduled stock assessment *and* MP for 2020...
  - ...requiring lots of additional communication work
- **IO BET**:
  - No rigorous data and reconditioning “guillotine”
  - Clear dates after which no new data or OM work
  - BET MP could realistically have been adopted in 2019/20
  - Didn’t get allocation/catch control agreed beforehand

What happens to the stock assessment?

- Ideally: run the MP then do the assessment next year...
- Decision made to separate assessment & management
- Even if you use assessment model in MSE, not the same
- Roles of assessment going forward:
  - Exploring hypotheses about stock dynamics
  - Tracking long-term status of stock given MP outcomes
  - Assessing whether Exceptional Circumstances triggered

Having MP improved SBT assessment development

- Very little development work 2005–2011
- Once MP system in place we have:
  1. Incorporated CKMR Parent-Offspring Pair data (2012)
  2. Revised all key life-history processes (2013–2014)
  3. Incorporated CKMR Half-Sibling Pair data (2016)
  4. MSE tested then integrated gene tagging data (2018)
  5. MSE tested impacts of totally revised LL CPUE index (2021)
- None of this work affected outcomes or running of MP
- Develop & MSE test new assessment ideas without “the drama”

Was it worth it?

- Robust MSE is large multi-year project
- Not everyone likes letting go of bargaining process
- Not everyone likes “giving up” the stock assessment
- For SBT bargaining and arguing over assessments failed
- So the answer there is a very clear yes
- For IO BET first TAC through WPTT and now IOTC SC
- Feedback has been “this is a lot easier”
- Nothing is perfect, but I wouldn’t go back :-)

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Thank You

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