Updates on development of MSE analyses for Indian Ocean albacore tuna

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Funded by:

iotc ctoi

Food and Agriculture Organization of the United Nations

Previous albacore Operating Model

- Stock assessment WPTmT 2019, data 1950-2017

- Uncertainty grid including

  - M

  - Steepness

  - recruitment variability

  - Weighting of CPUE / length data

  - Yearly increase catchability LL

  - CPUE (NW, SW)

- Runs selected on various diagnostics

- Resampled with weights based on CPUE prediction skill

- 432 model runs

Previous albacore Operating Model
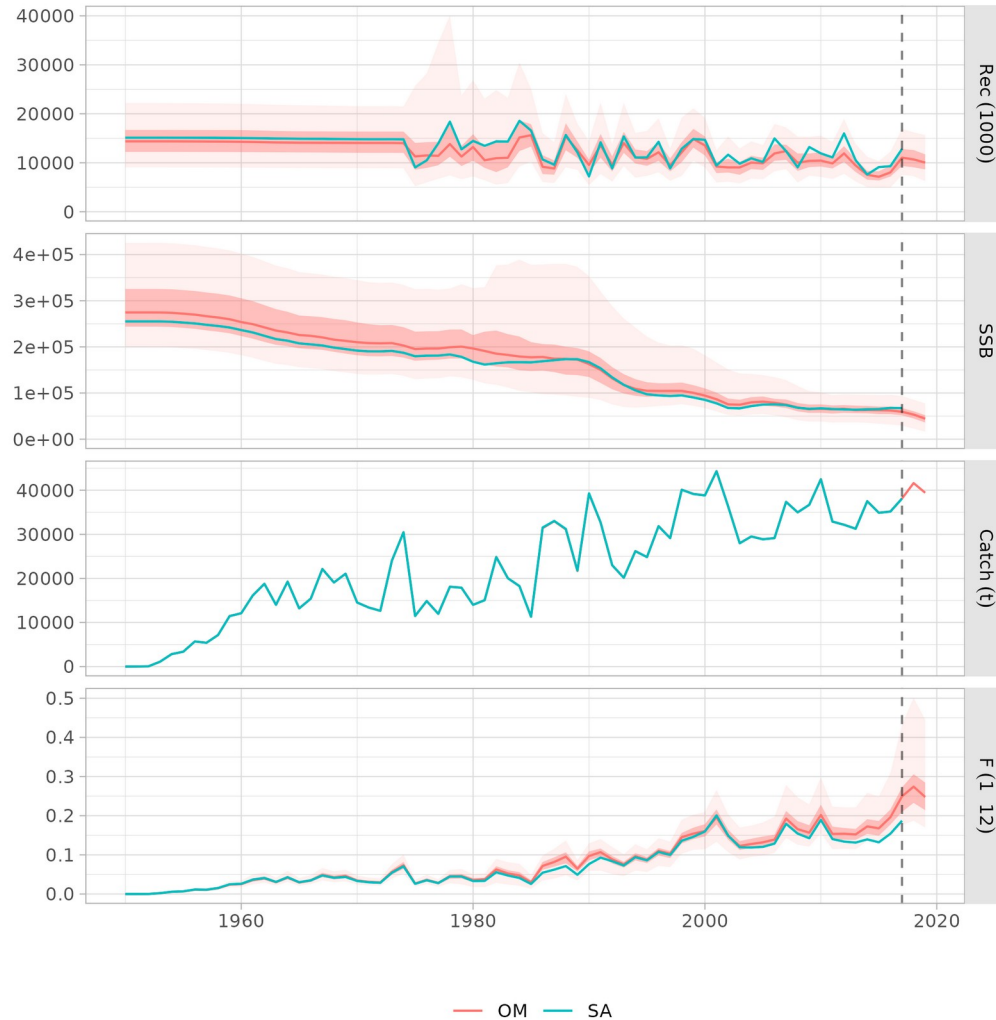
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- 432 model runs

- BUT

  - Runs not accepting catches 2020-2022

  - 3rd iteration of OM grid

Decoupling OM and SA

- Models with different objectives

    - SA: precisely estimate current status.

    - OM: characterize stock productivity, entropy and status, and their uncrtainty.

- Flexibility to incorporate other data and processes

- Keeps assessment and MSE separate

- Reconditioning takes time and resources

    - *The OMs do not need to be reconditioned, even if new information or data sets become available or substantially different models are developed* (IOTC-2022-TCMP05-11)

    - But often requested, or differences are too large

ABC - Approximate Bayesian computation

- Alternative to full statistical model, yields same results

- Similar to method used for previous skipjack OM (feasible trajectories)

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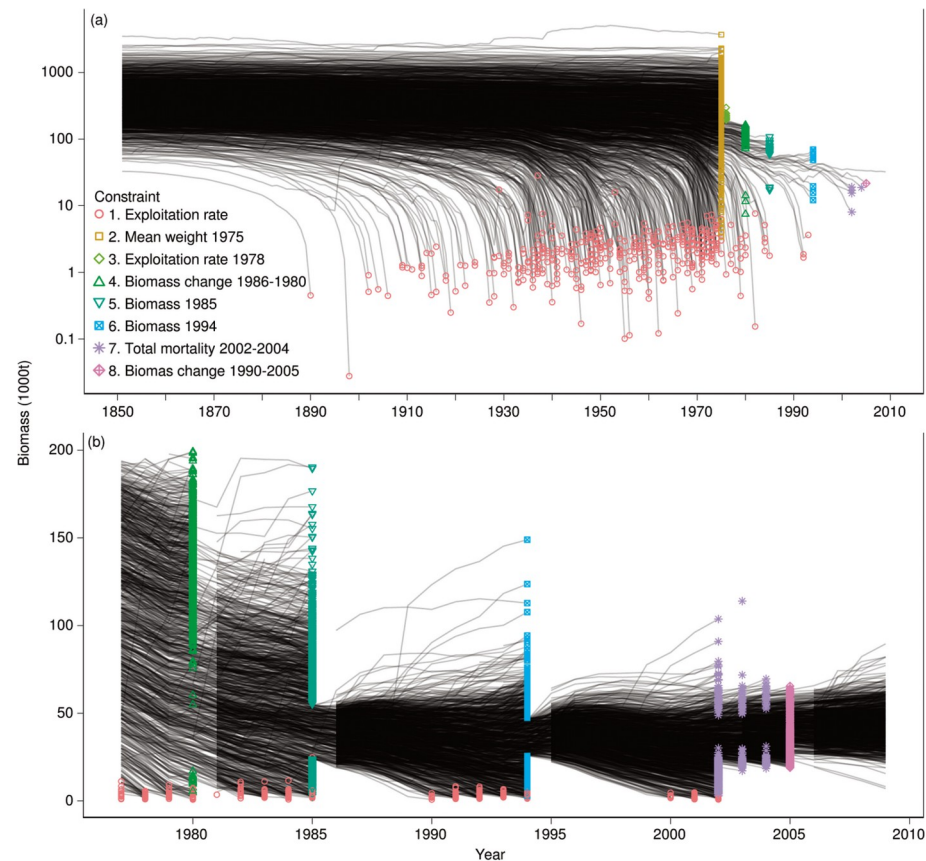
Bentley & Langley, 2012

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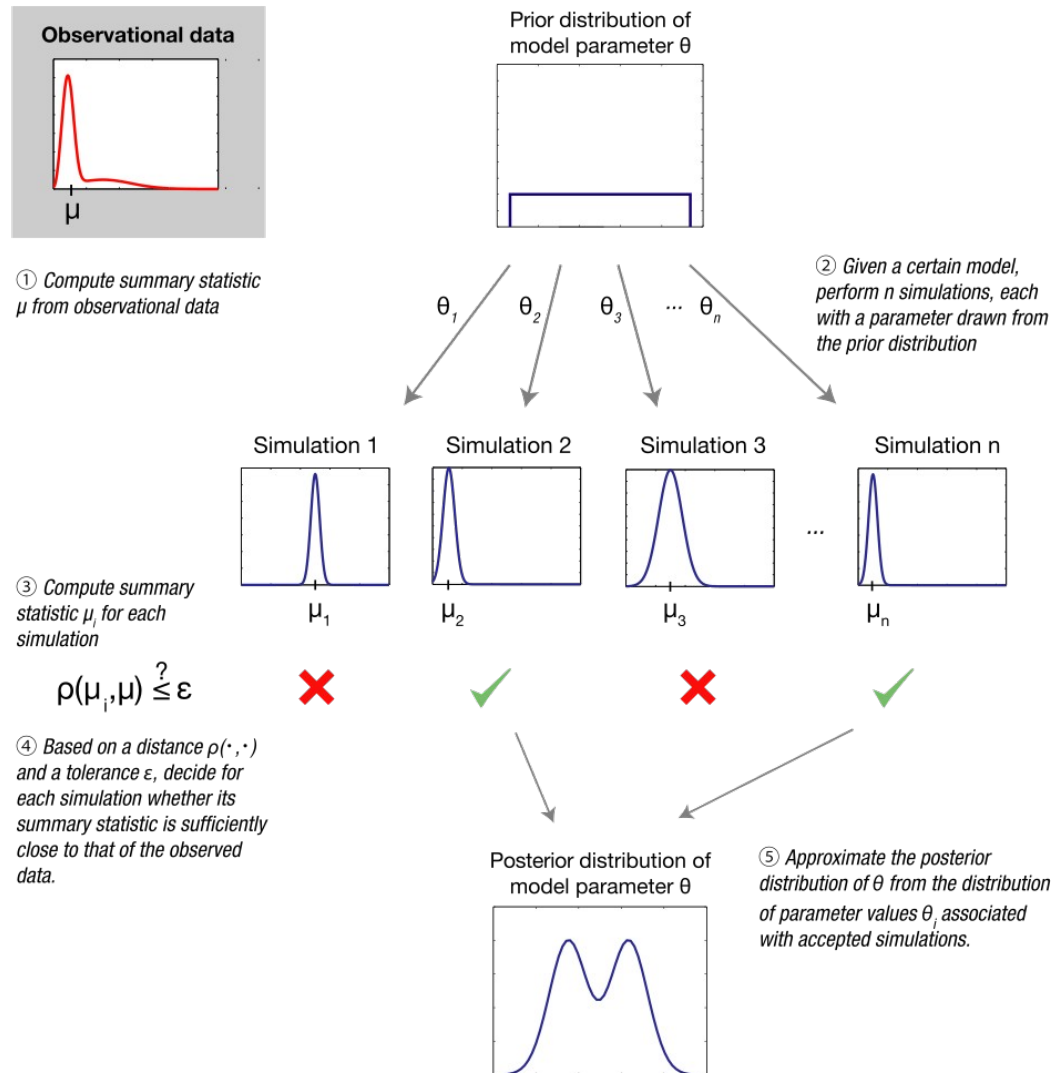
- ABC workflow

  - Set priors for quantities, some informed by assessment

  - Project population

  - Compare generated observations with data

  - Accept or reject based on multiple criteria

  - Repeat until N values are available

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ABC

Observational data

Prior distribution of model parameter θ

① Compute summary statistic μ from observational data

② Given a certain model, perform n simulations, each with a parameter drawn from the prior distribution

θ₁   θ₂   θ₃   ...   θₙ

Simulation 1   Simulation 2   Simulation 3   Simulation n

μ₁   μ₂   μ₃   μₙ

③ Compute summary statistic μᵢ for each simulation

$$\rho(\mu_i,\mu) \overset{?}{\le} \varepsilon$$

④ Based on a distance ρ(·,·) and a tolerance ε, decide for each simulation whether its summary statistic is sufficiently close to that of the observed data.

Posterior distribution of model parameter θ

⑤ Approximate the posterior distribution of θ from the distribution of parameter values θᵢ associated with accepted simulations.

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- Commonly used in population genetics, animal and human demography, ecology and epidemiology.
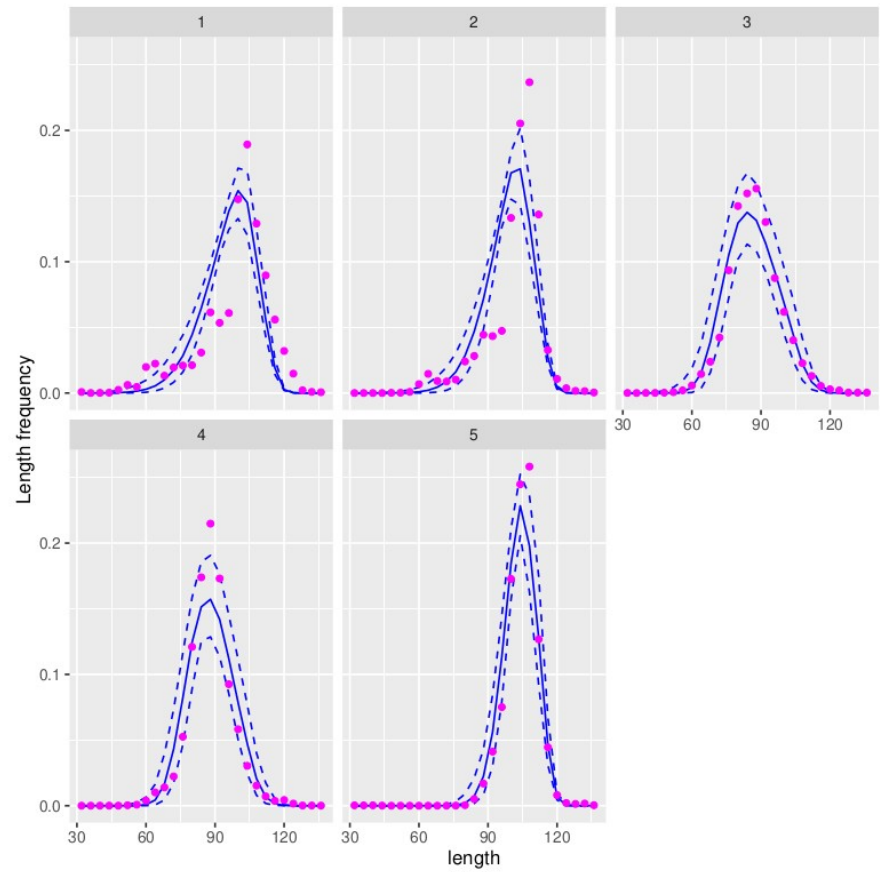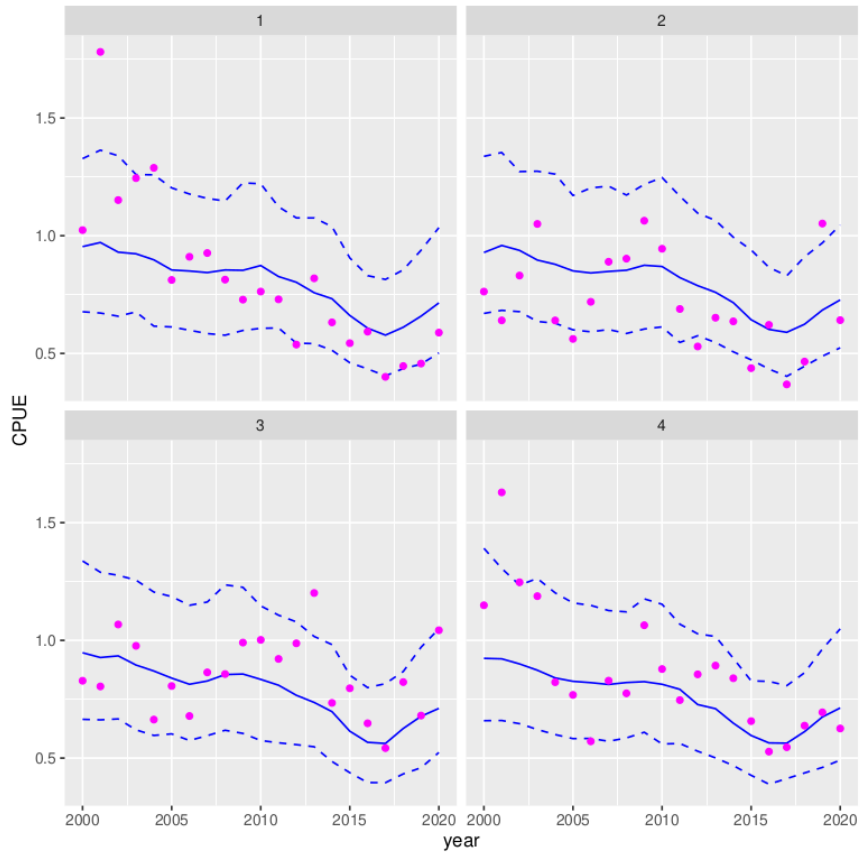
ABC for IOTC albacore

- Albacore population model structure, as in SA

  - Four seasons

  - Sex structured

  - Single recruitment season

- Runs 1995-2020, all living cohorts

- 6 fleets

- Priors on initial depletion, current BMSY status

- Measures distance to data

  - Total catch and catch-at-length

  - CPUE trends in biomass

ALB OM: recruitment, SSB
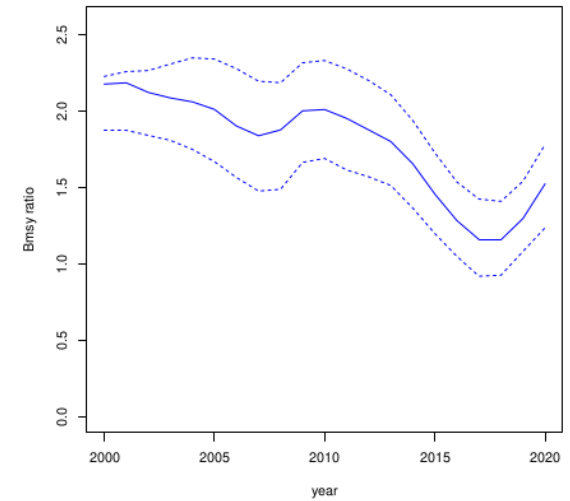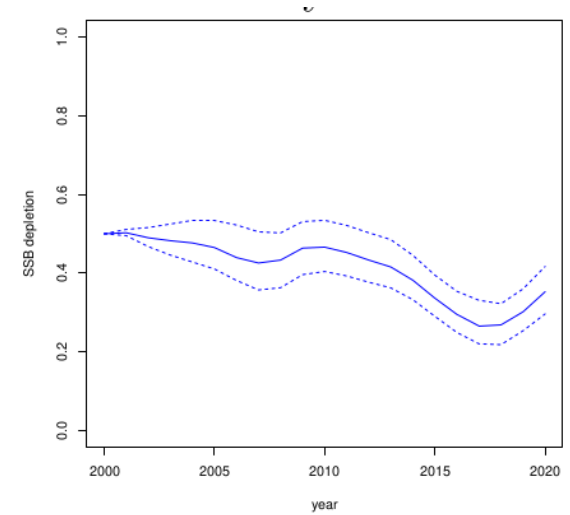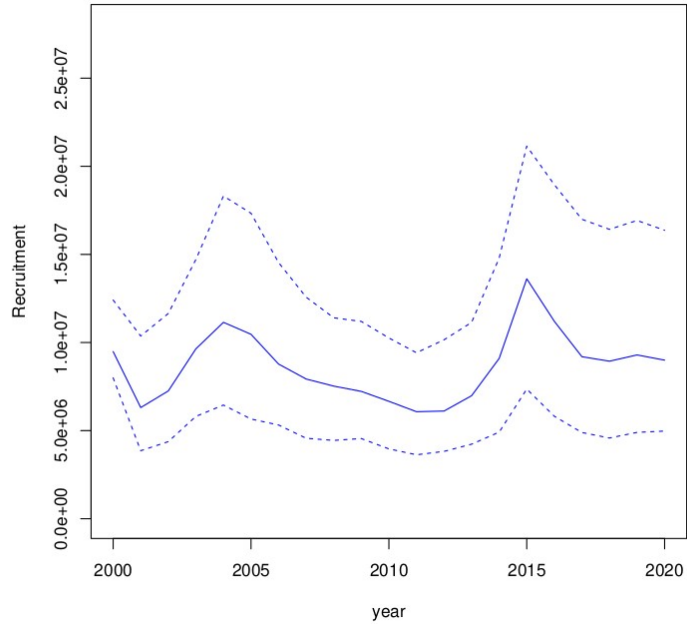
ALB OM: Fit to data

Overall summary

- Viable alternative for OM conditioning

- **Status of work**

  - Presented to WPM, WPTmT and WPM-MSE

  - Endorsed by all, noted by SC

- **Next steps**

  - Full OM to be presented to WPM 2023

  - Ready to use for MP evaluation in 2024

- MP evaluation toolset same as for swordfish

  - JABBA surplus production MP

  - CPUE-based MP

- WMR-CSIRO cross-ocean (and time zones) collaboration

- WMR work under FAO/IOTC contract (DEC 2023)

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