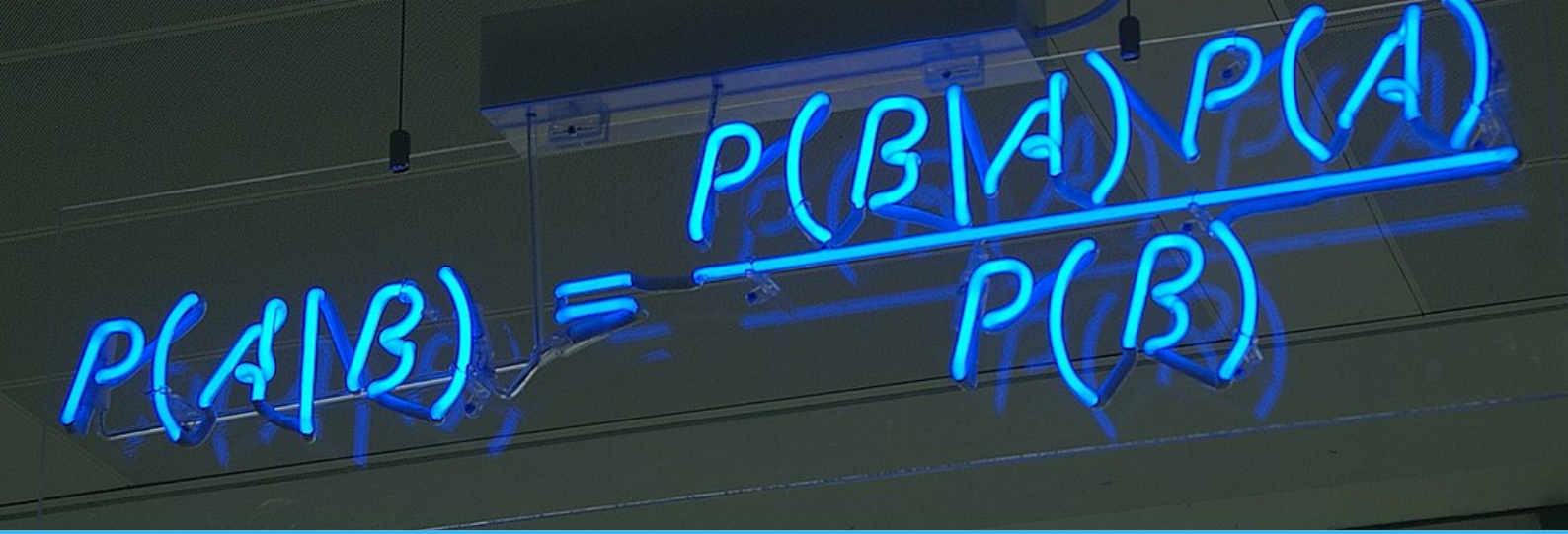

IOTC Albacore OM conditioning

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Background

- Initial development on ABC approach to OM conditioning
- Focussed on IOTC Alabacore
- Integrates LF and CPUE data
- Explores inclusion of stock status priors
- Initial work looks promising

Albacore population model structure

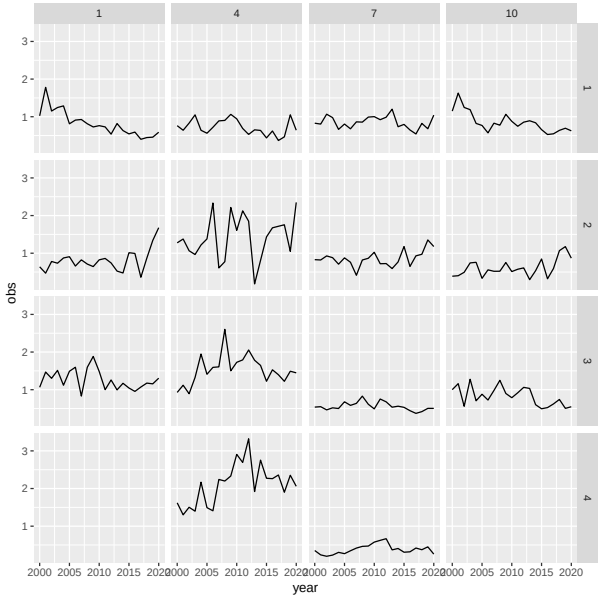
- Mirrors most recent stock assessment (2022):
  - Annual with four seasons
  - Sex structured
  - Annual recruitment (single season)
  - Years: 2000–2020 (all living cohorts)
  - Initial state: exploited equilibrium
- Initial (female) SSB depletion model parameter

Albacore fishery model structure

- Modifies year-seasonal structure (6 fleets):
  - 16 longline fleets in assessment
  - Merged in to 4 (seasonal)
  - Purse Seine fleet
  - “Other” fleet (shares PS selectivity)
  - Longline + PS fleet LF data fitted
  - Longline CPUE as abundance index/indices
- MSY variables estimated
- F_{msy} not used directly (SS3 ambiguity)

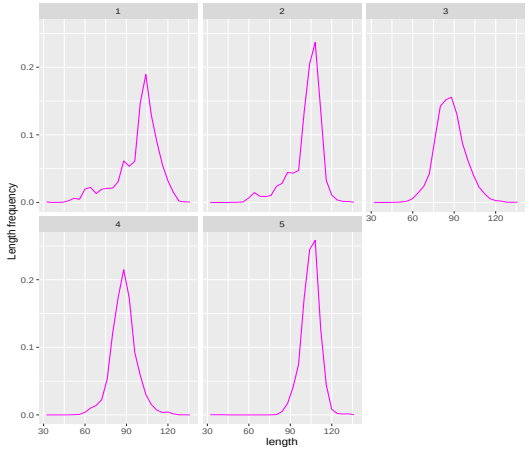
Albacore Longline CPUE indices

- Several options (see below)
- Choose fleet 1 seasons 1–4 (example)



Albacore length frequency data

- Available for five of six fleets
- Model weighted annualy/seasonally averaged data
- Requirements: estimates of selectivity
- Trying to avoid: influence on R_0 and recruitment



Albacore parameters & status priors

- Very simple initial state: fixed at 0.5
- Last two years B_{msy} ratio
- Mean and SD of 2.25, 2 and 0.35, 0.35 resp.
- Estimated parameters:
  1. R_0
  2. recruitment deviations
  3. 3 (double-normal) selectivity parameters per fishery
  4. 36 in total
- Biology: $h = 0.8$, $M = 0.3$ and $\sigma_R = 0.3$

Idea behind Approximate Bayesian Computation

- Classic Bayesian statistics:

$$\pi\left(\boldsymbol{\theta} \mid D\right) = \frac{\ell\left(D \mid \boldsymbol{\theta}\right)\pi(\boldsymbol{\theta})}{\pi(D)}$$

- Approximate Bayesian idea:

$$\pi\left(\boldsymbol{\theta} \mid D\right) \approx \frac{\rho\left(D, X \mid \boldsymbol{\theta}, \boldsymbol{\epsilon}\right)\pi(\boldsymbol{\theta})}{\mathcal{C}}$$

- Good news: Markov chain Monte Carlo to the rescue
- We can construct algorithm to sample approximate posterior
- At this point most of Bayesian analysis applies...

Discrepancy model for ABC algorithm

- CPUE indices:
  - Essentially lognormal
  - Nuisance estimation of q (seasonal/annual)
- Length frequency data:
  - Kullback-Leibler divergence
  - Minimum value of -0.8 (upper CI $N_{\text{eff}} = 20$)

$$\mathcal{D}_{LF} = -\sum_{f}\sum_{l} p_{f,l} \ln\left(\frac{p_{f,l}}{\widehat{p}_{f,l}}\right)$$

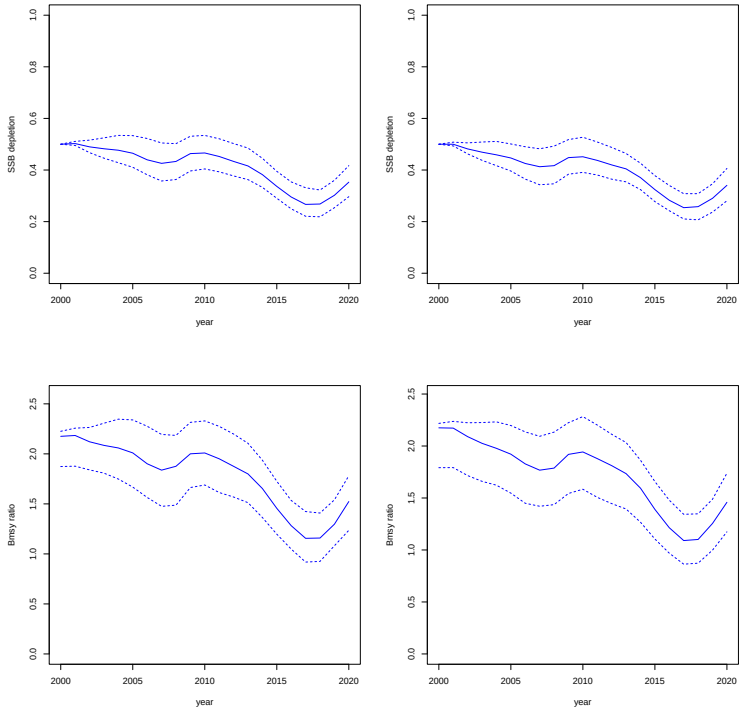
- Parameter priors: log-uniform and normal (ϵ_y^R)
- Stock status priors: normal

Albacore example

- CPUE indices: fleet 1 (1–4) all four seasons
- Catchability: annual and seasonal
- Length data: all five fleets (time-aggregated)
- Initial status: SSB depletion of 0.5
- Final status: last 2 years B_{msy} from assessment
- **Not** trying to replicate assessment
- Example to show utility as “OM hypothesis generator”

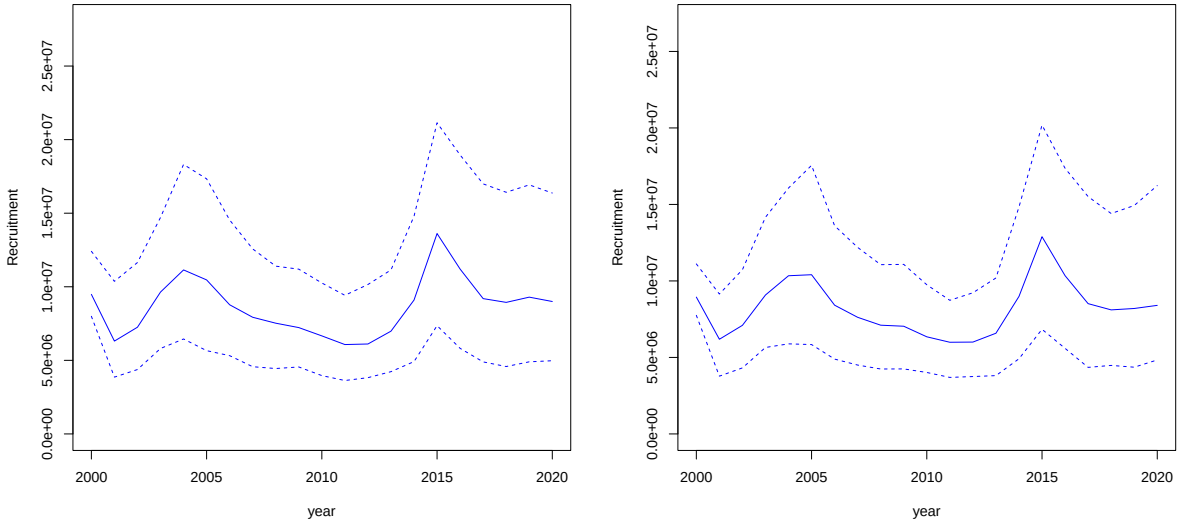
SSB depletion & MSY summaries

- Depletion (T), B_{msy} (B), annual (L) & seasonal (R) q:



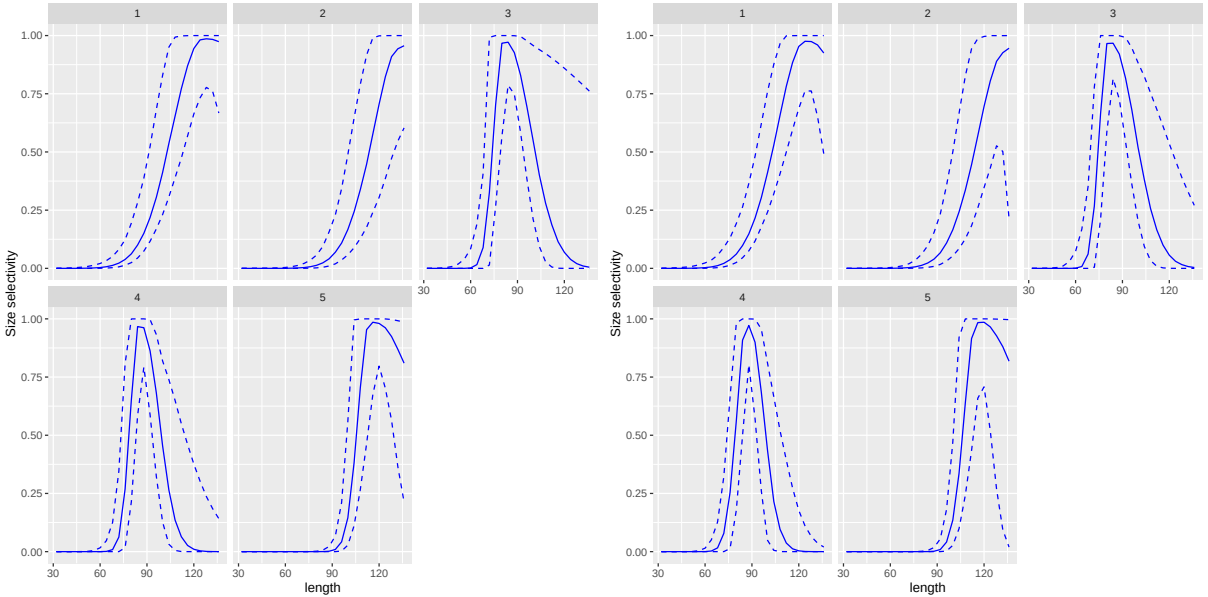
Recruitment summaries

- Overall recruitment for annual (L) & seasonal (R) q:



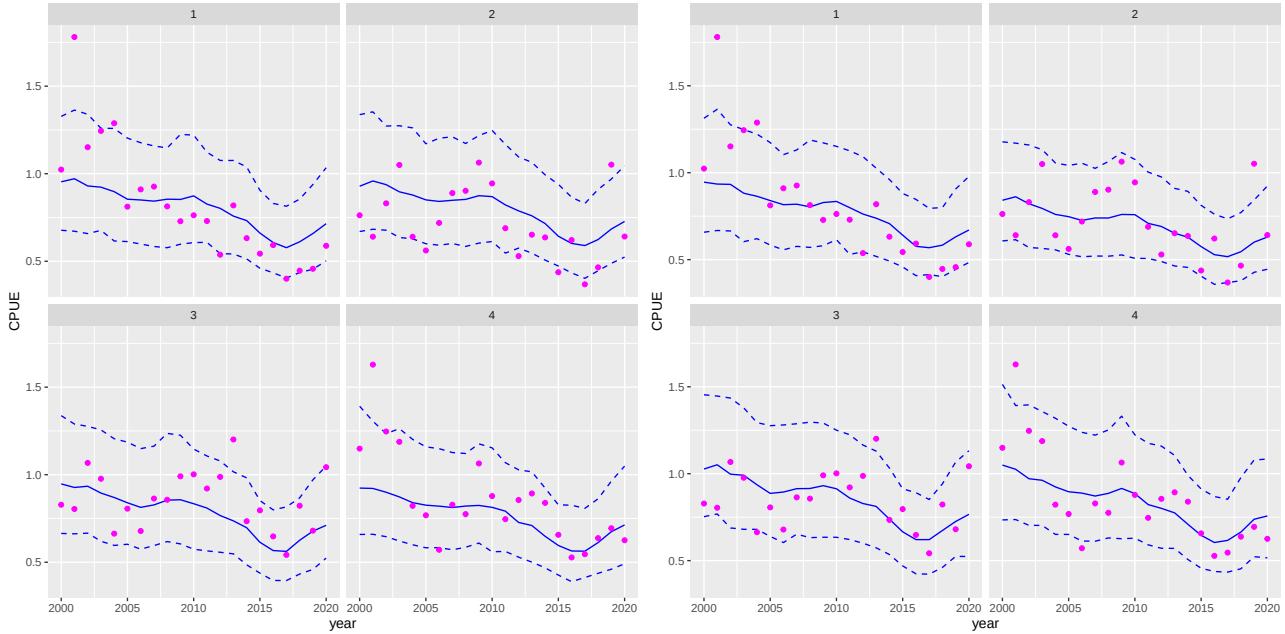
Selectivity summaries

- Size selectivities for annual (L) & seasonal (R) q:



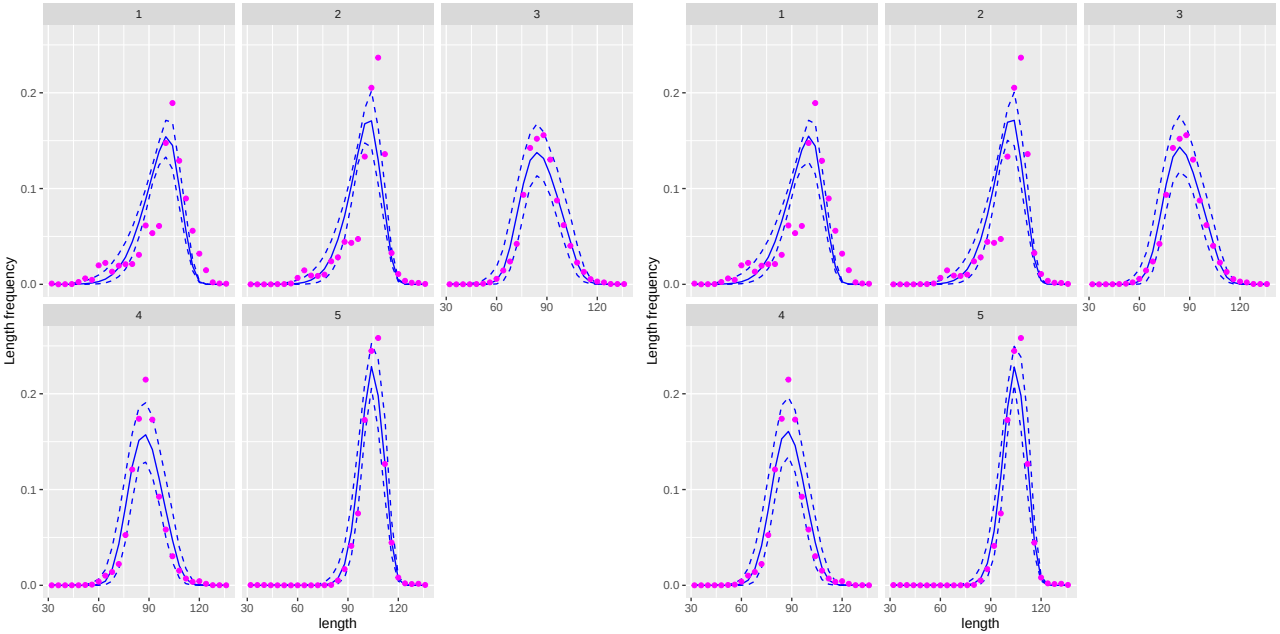
Fits to CPUE series

- Posterior pred. distro. for annual (L) & seasonal (R) q:



Fits to LF data

- Posterior pred. distro. for annual (L) & seasonal (R) q:



Population dynamic summary

- Low evidence for recent MSY ratios given 0.5 initial condition
- Why: using LL1 CPUE more pessimistic trend
- Consistency in absolutes/trends for annual/seasonal q
- Plausible selectivity-at-length relationships
- Similar uncertainty levels to assesment

Data fitting summary

- Fits to CPUE data OK
- Fits to LF data good
- Overall: seasonal q is a “better” model
- Model is consistent with availble “recent” data

Overall summary

- Exploration of alternative methods for OM conditioning
- Combine ABC, custom MCMC and status prior information
- Focus:
  - **Not** about replicating stock assessment
  - Generate plausible OMs consistent with key data
  - Able to simulate data for MP testing
- Initial explorations promising
- Able to include/simulate historic/future data
- Able to generate all key OM population variables
- Future requirements and suggested developments?

Thank You

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