An Introduction to the South African Sardine Resource and Fishery

International Stock Assessment Workshop

Cape Town

1 December 2025

Carryn de Moor and Janet Coetzee

Marine Resource Assessment and Management Group (MARAM)
Department of Mathematics and Applied Mathematics
University of Cape Town

Department of Forestry, Fisheries and the Environment (DFFE)
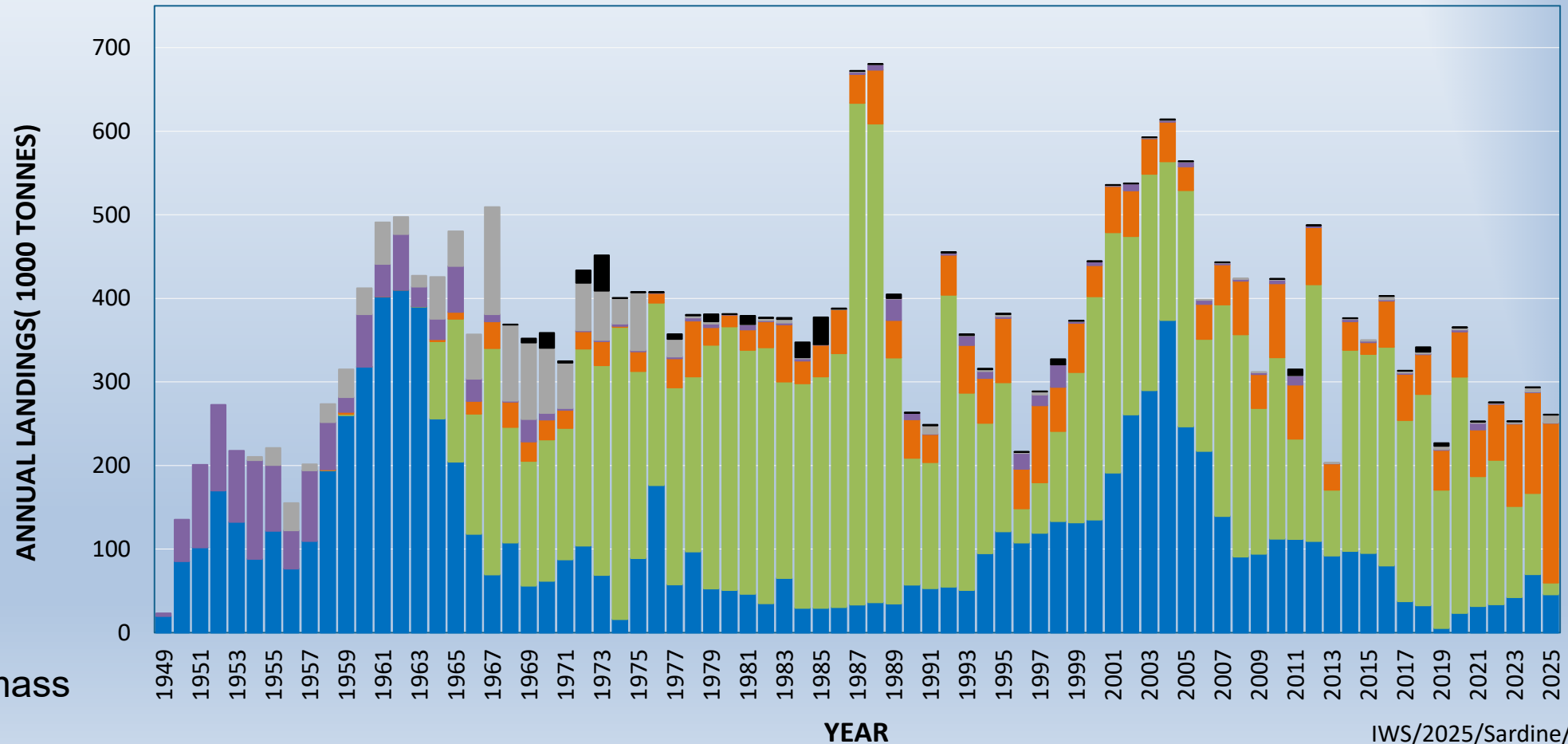Branch: Fisheries Management
Cape Town

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

History of Fishery

Small pelagic purse-seine fishery:
- Mixed fishery
- Largest by landed mass
- 2nd largest by value

IWS/2025/Sardine/BG1

Management Unit

- Commercial management unit is west of Port Alfred
  - data availability
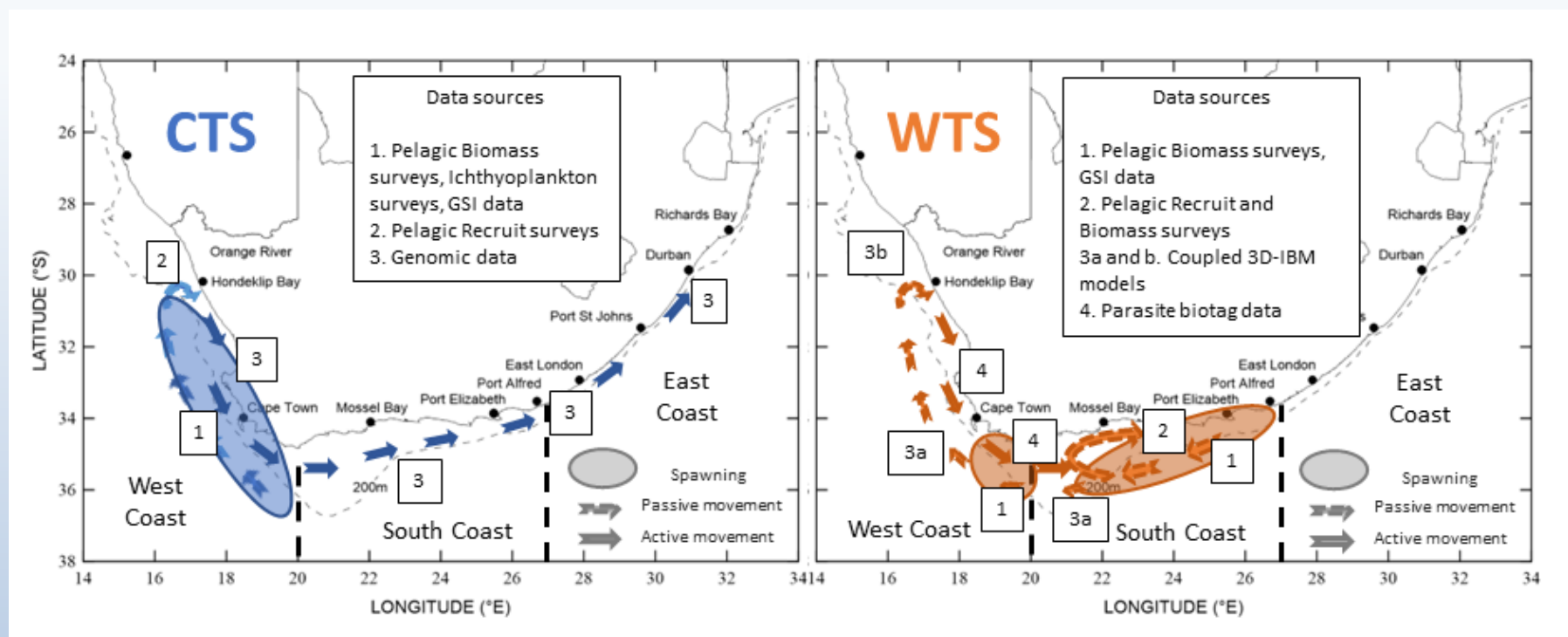 - stock assessments

November 2018
Pelagic Spawner Biomass Survey
Africana 295

- East of Port Alfred : sardine run
  - smaller biomass (~30 000t in 3 surveys; '05 most recent)
  - no catch limit for beach-seine fishery
  - controlled with TAE; 20 RHs; many don't exercise their right in some years
  - max catch 700t
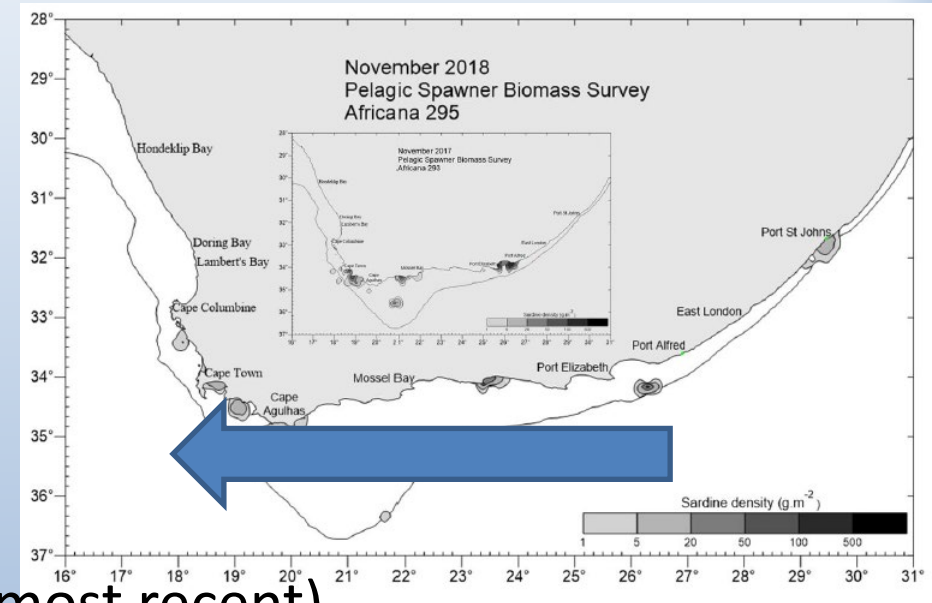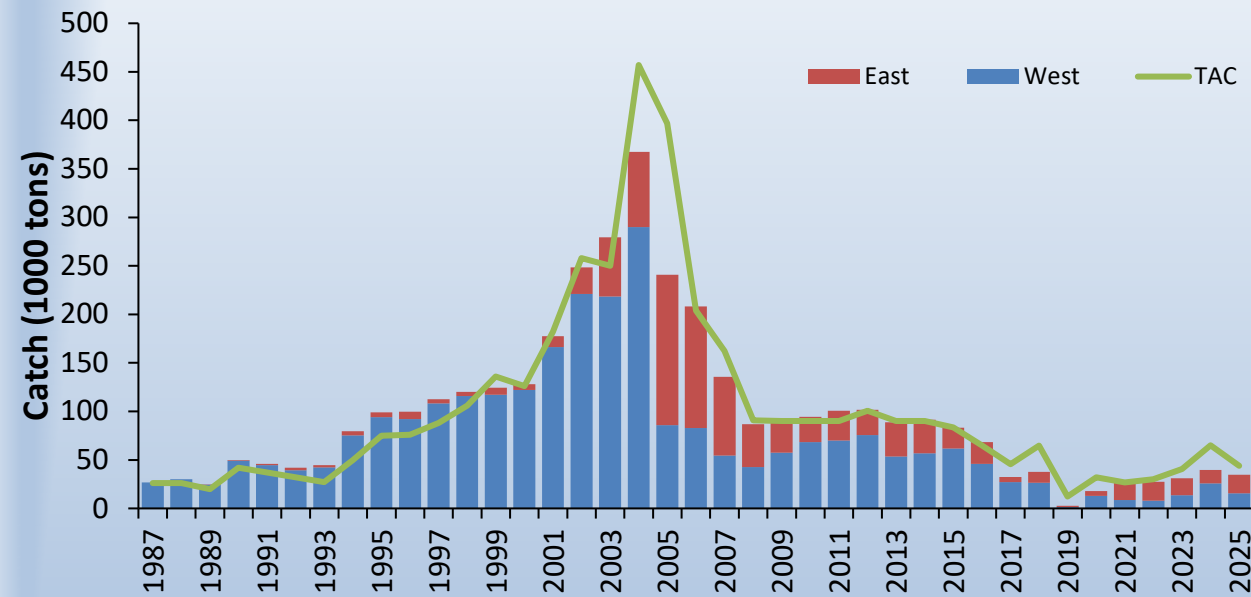
Sardine Stock Structure

- Two stocks (CTS & WTS)

- Active movement (primarily) represents WTS returning back to more favourable SC waters

- WTS spawning products from SC contribute to WC recruitment, but retain their 'genetic heritage'

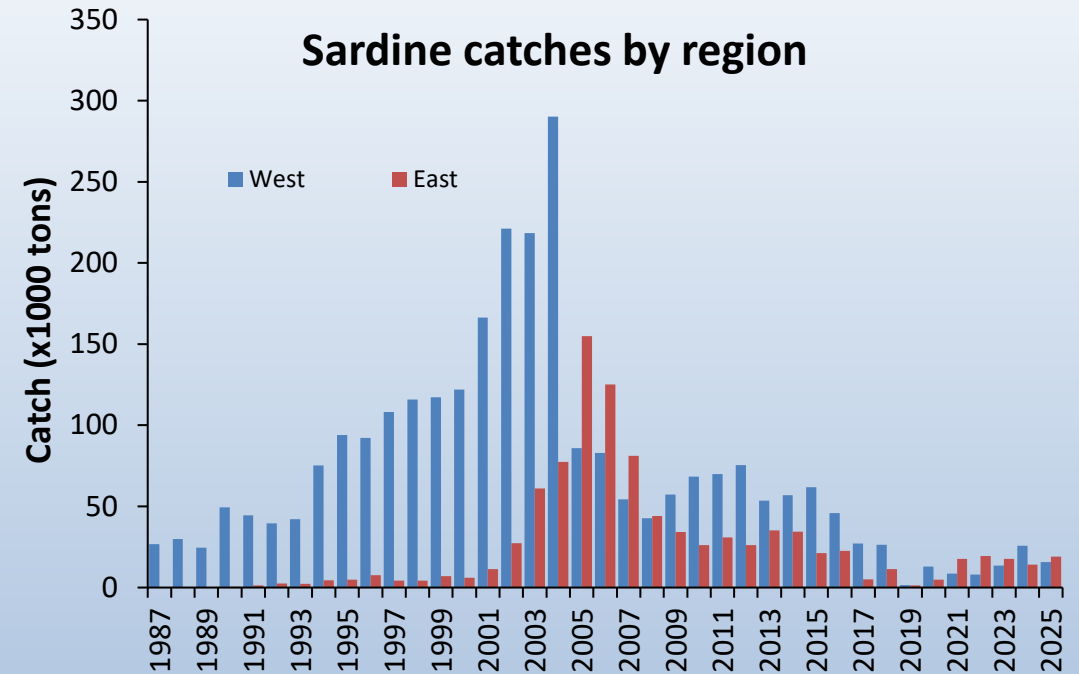- WTS spawn off both coasts

- CTS only spawn off WC

Total Allowable Catches

Sardine catches by region and TAC

Sardine catches by region

- Primarily managed by catch limits (Total Allowable Catches and Total Allowable Bycatches)
- Sardine have also been commercially harvested off the south coast since the 1990s
- In many years catches have been close to the TAC

Management

- Joint sardine-anchovy OMPs since 1994

- TAC/Bs recommended by the start of the year, some updated after the mid-year recruit survey

- Exceptional Circumstances declared for sardine in 2018 (OMP-18 set aside) and catch limits have been set based off short-term projections from annually updated stock assessments since

- (Unlike anchovy) there has been a delay in beginning a new MSE due to finalisation of stock structure

- Given substantial changes to sardine stock structure, a 'Scoping' MSE was undertaken earlier this year with simple candidate MPs.

- Recommendations are requested to be framed both for immediate/urgent use (this MSE) v longer term use (next MSE or later)

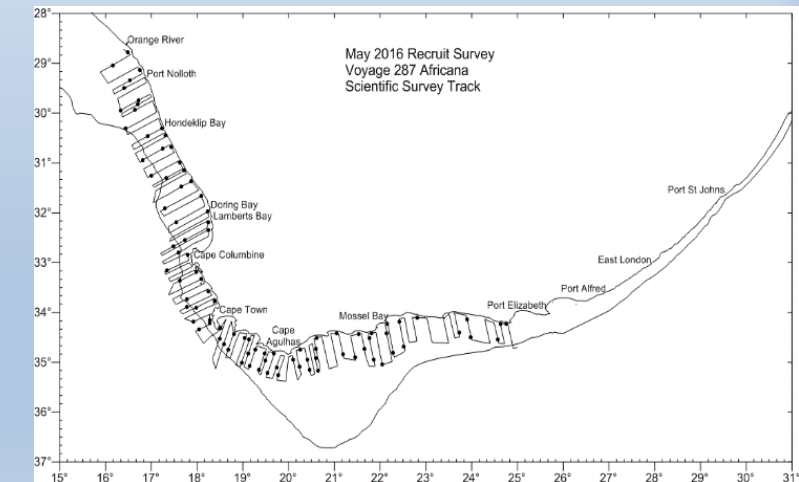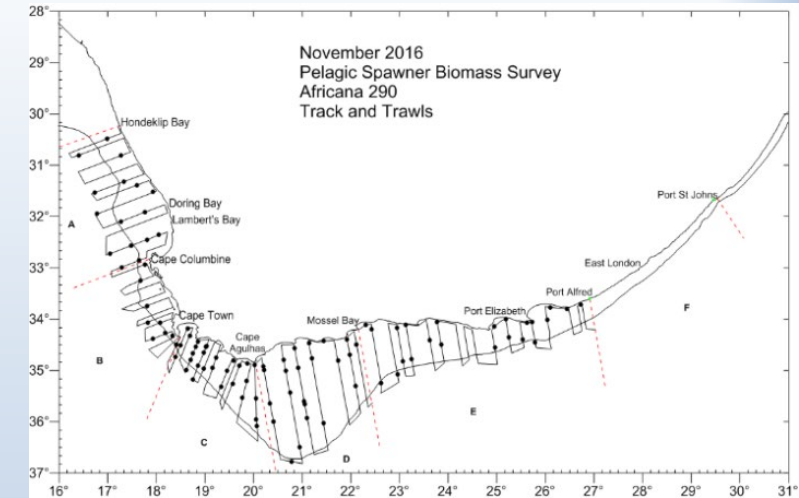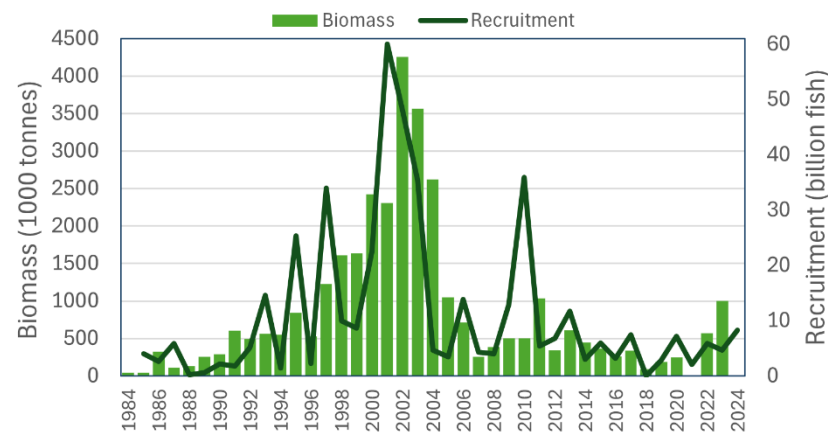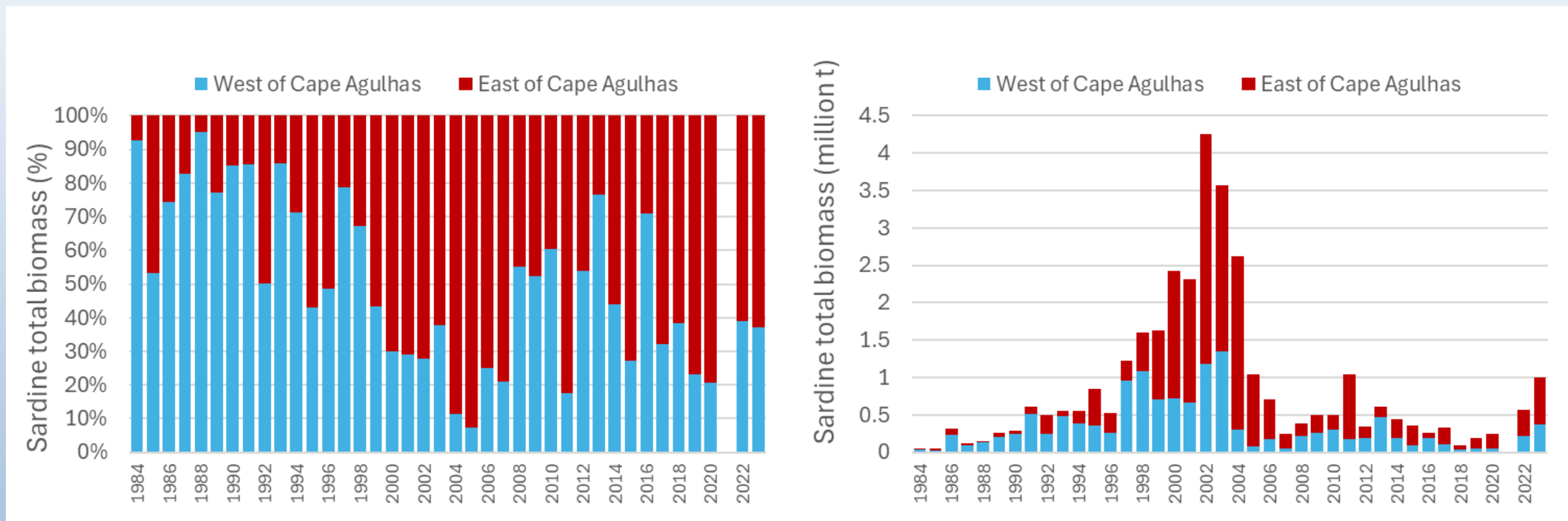# Hydroacoustic Survey Estimates of Abundance
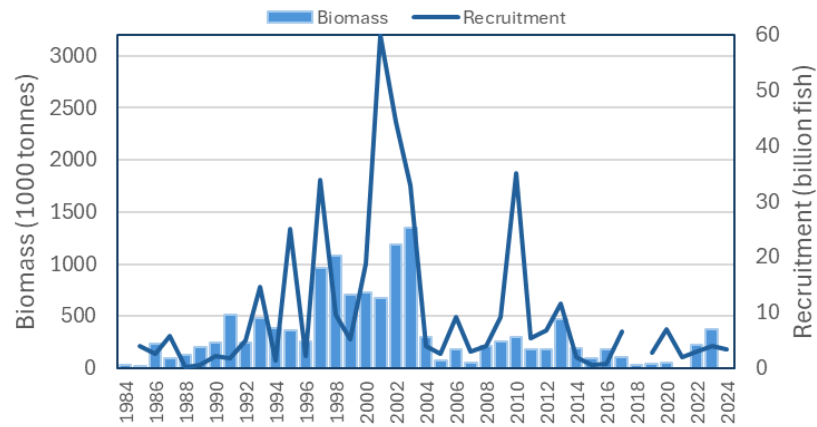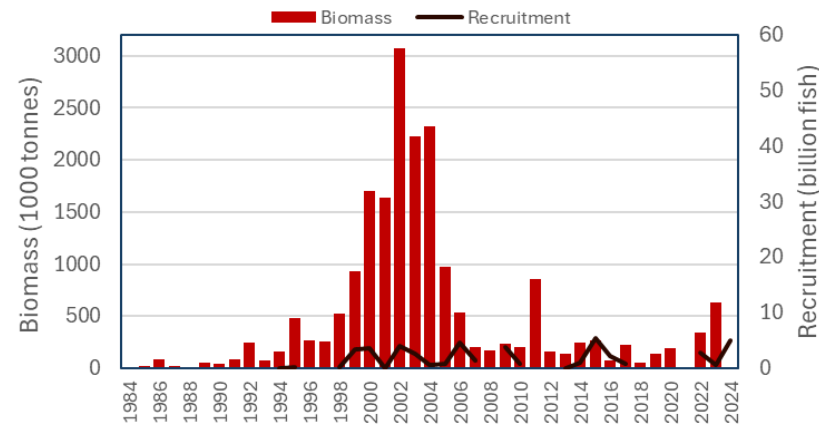
IWS/2025/Sardine/BG1

Hydroacoustic Survey Estimates of Abundance

Stock Assessment Model

- Stock assessment data described in IWS/2025/Sardine/BG2

- Stock assessment model described in IWS/2025/Sardine/BG3

- Stock assessment results (2 models) shown in IWS/2025/Sardine/BG4

Two primary models considered during this workshop

(i) S_{noSR}: historical recruitment estimated independently
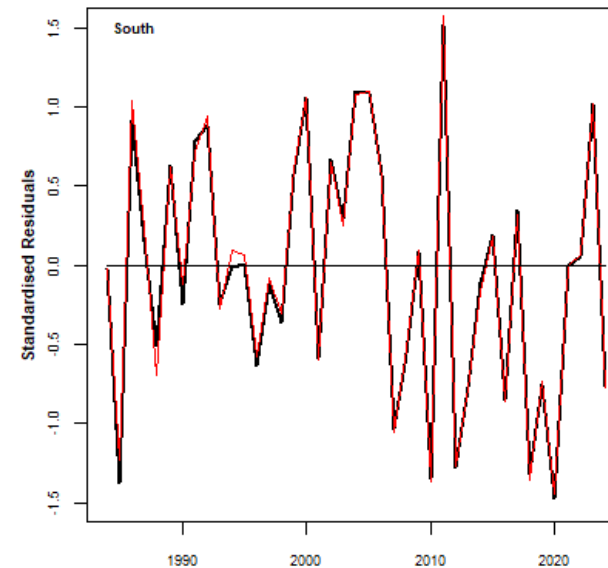
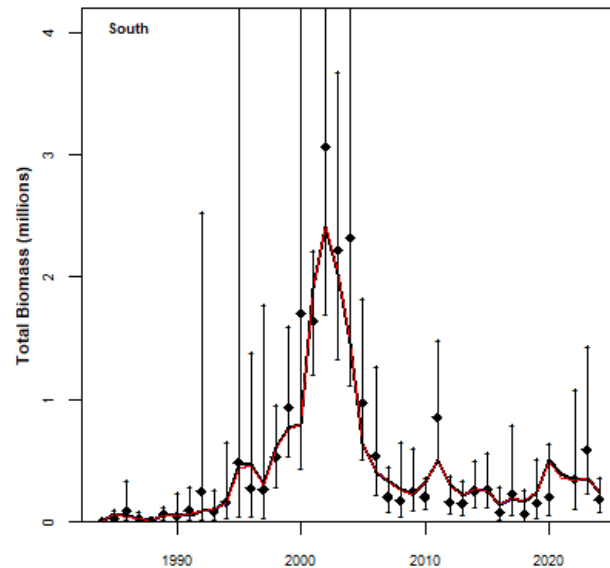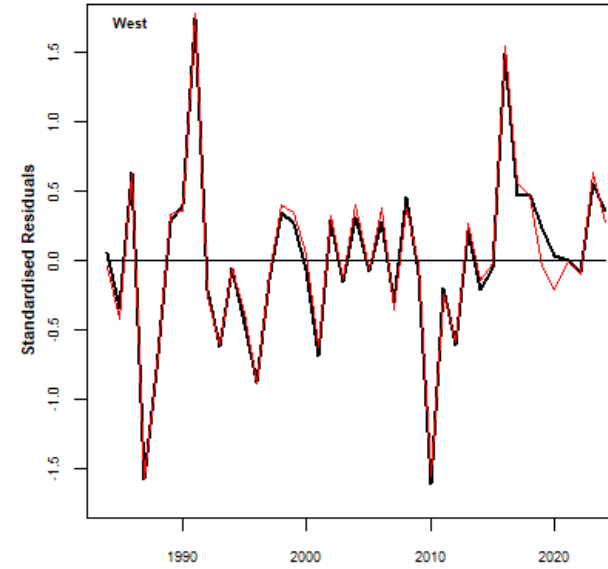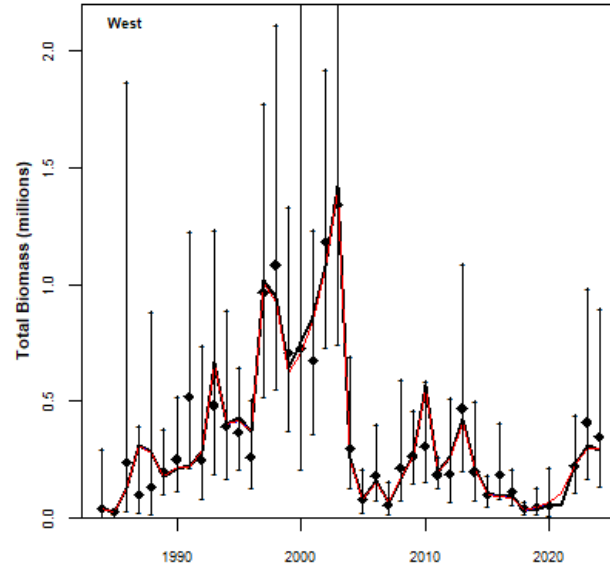$$R_y^{CTS}/10 \sim U(0,50) \,, \; R_{c,y}^{WTS}/10 \sim U(0,50)$$

(ii) S_{SR}: parametric SR relationships assumed with high variance when conditioning the models

$$R_y^{WTS} = \begin{cases} Ce^{\varepsilon_y^{WTS}} & 2000 \le y \le 2002 \\ \alpha^{WTS}e^{\varepsilon_y^{WTS}} & SSB_{c,y}^{WTS} > \beta^{WTS} \\ \dfrac{\alpha^{WTS}\sum_c SSB_{c,y}^{WTS}}{\beta^{WTS}}e^{\varepsilon_y^{WTS}} & SSB_{c,y}^{WTS} \le \beta^{WTS} \end{cases} \qquad R_y^{CTS} = \left\{ \dfrac{\alpha^{CTS}\sum_c SSB_{c,y}^{CTS}}{\beta^{CTS}+\sum_c SSB_{c,y}^{CTS}} \right\} e^{\varepsilon_y^{CTS}}$$

with $\qquad \varepsilon_y^j \sim \begin{cases} 0 & y = y_0 \\ N(0,\sigma_{r,j}^2) & y_1 \le y \le y_n \end{cases}$
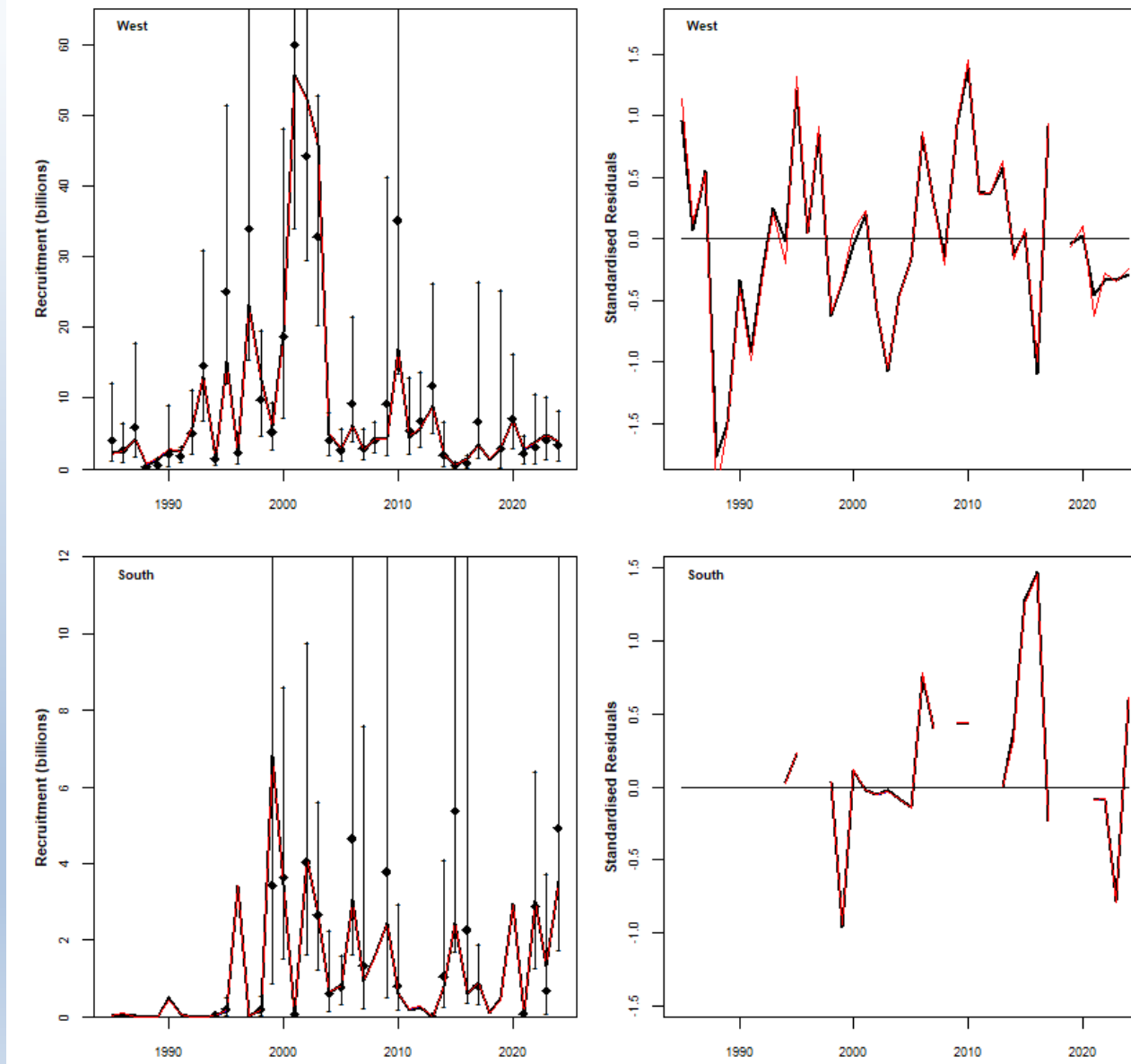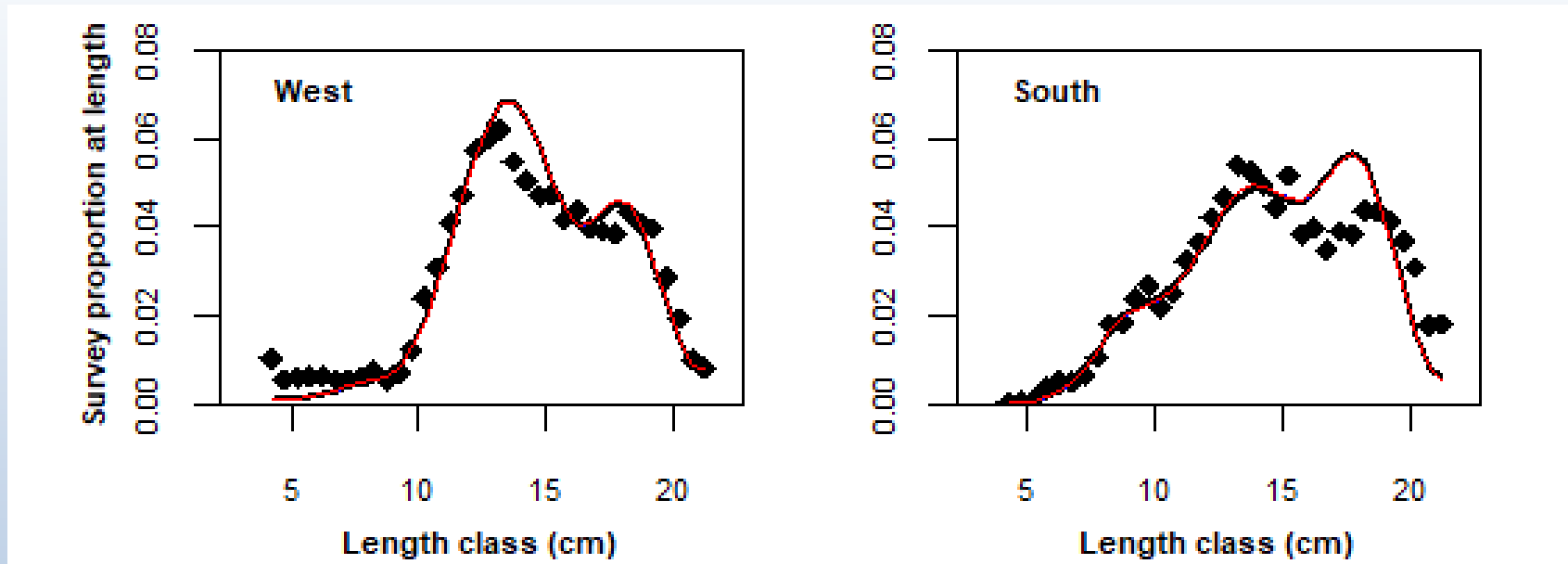
Model Fits to Total Biomass (November)

S$_{noSR}$
S$_{SR}$

Model Fits to Survey Recruitment (mid-year)
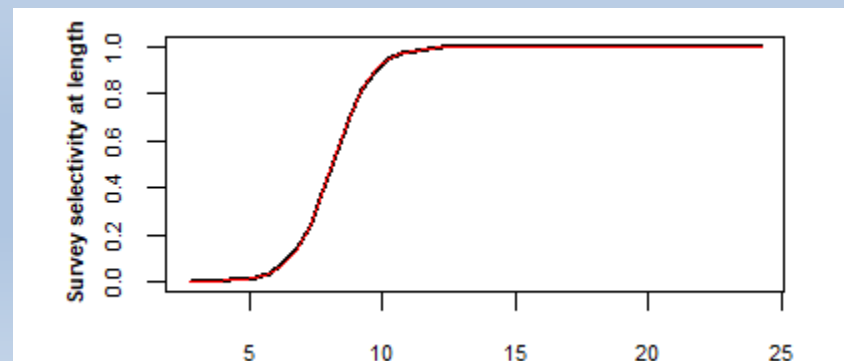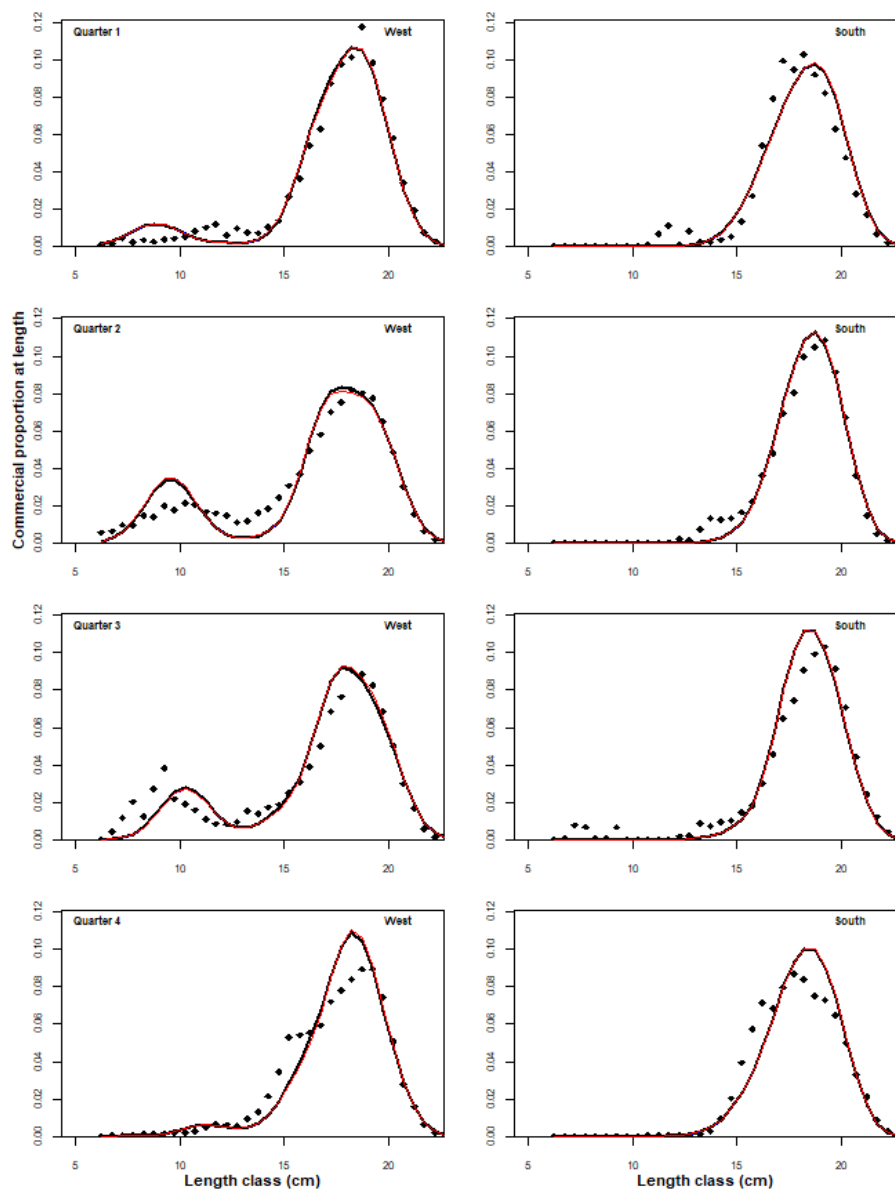
S_{noSR}
S_{SR}
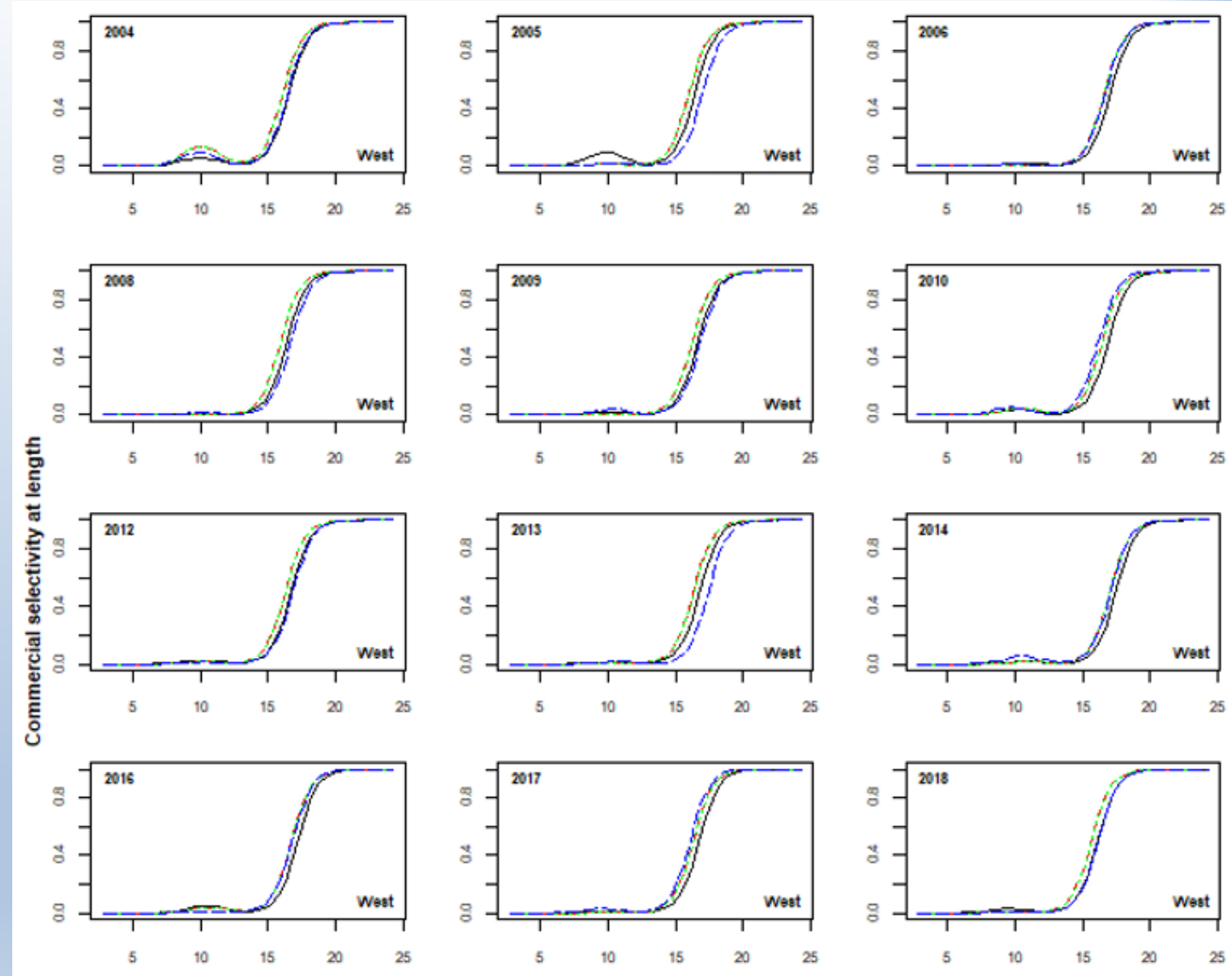
Model Fits to Survey Length Frequencies

S_{noSR}
S_{SR}

Model Fits to Commercial Length Frequencies
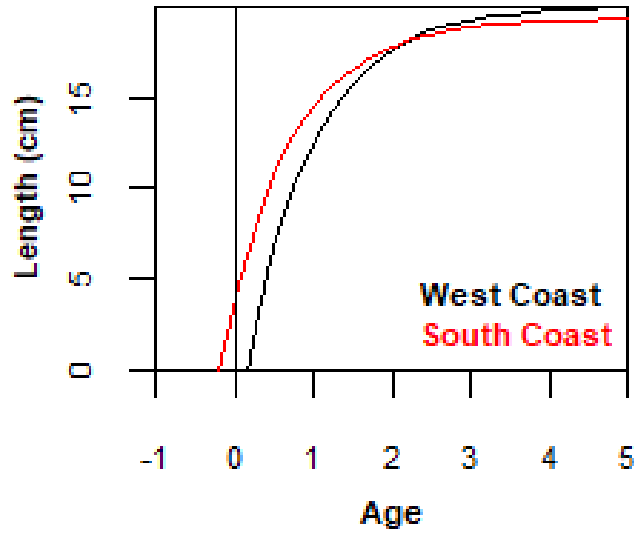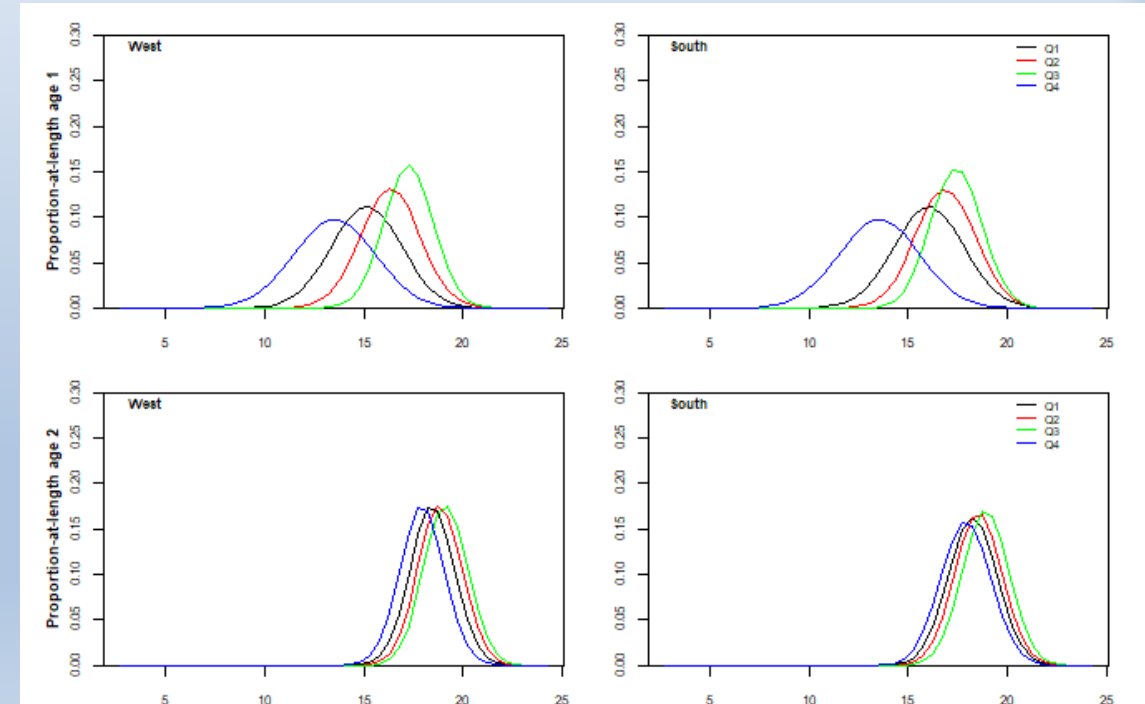

Extract of some years for west coast
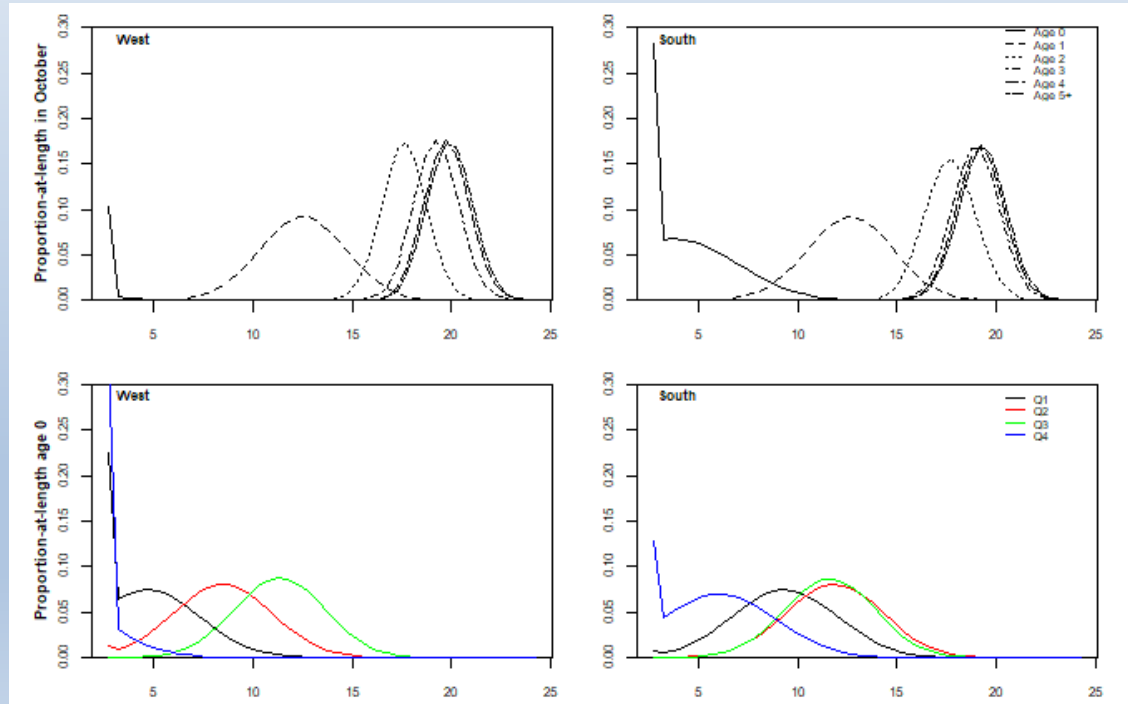
S_{noSR}
S_{SR}

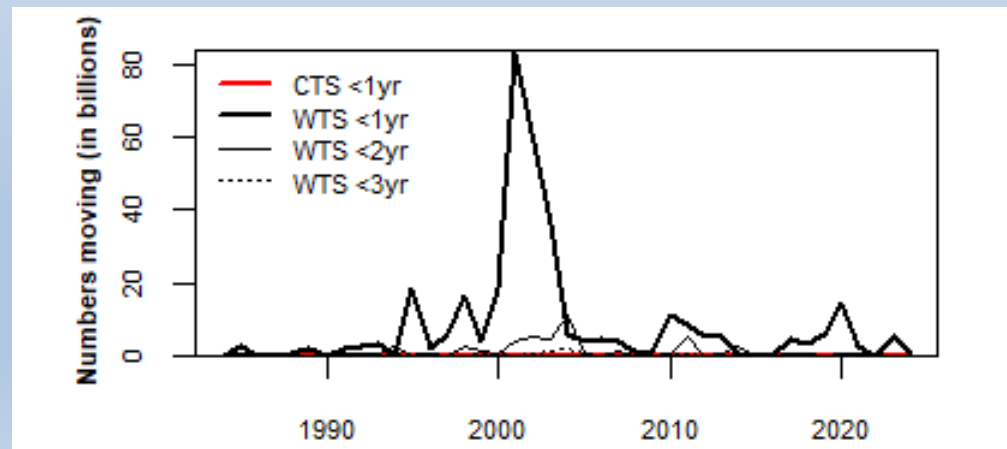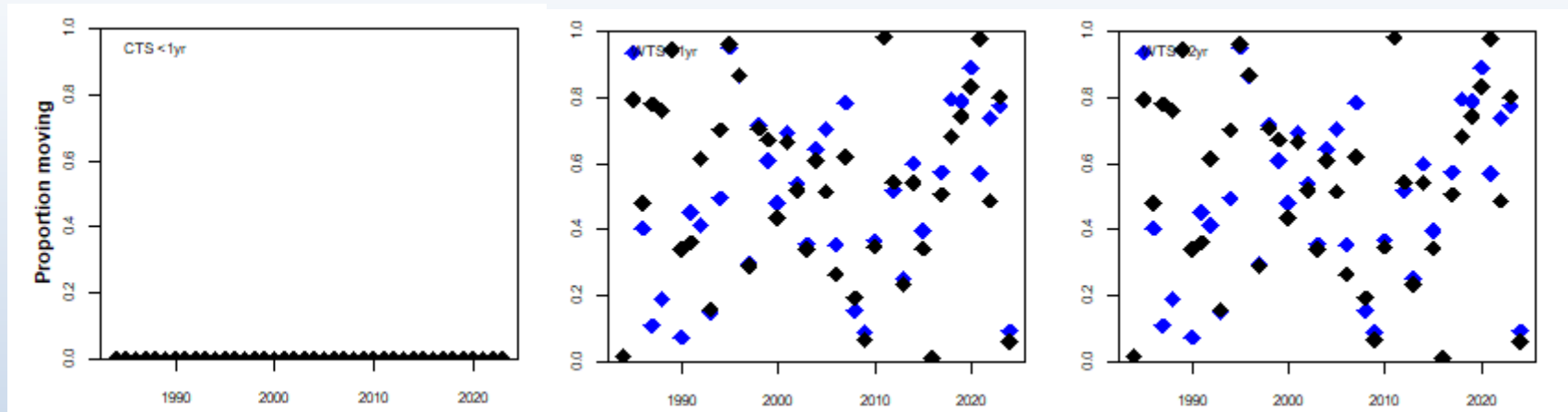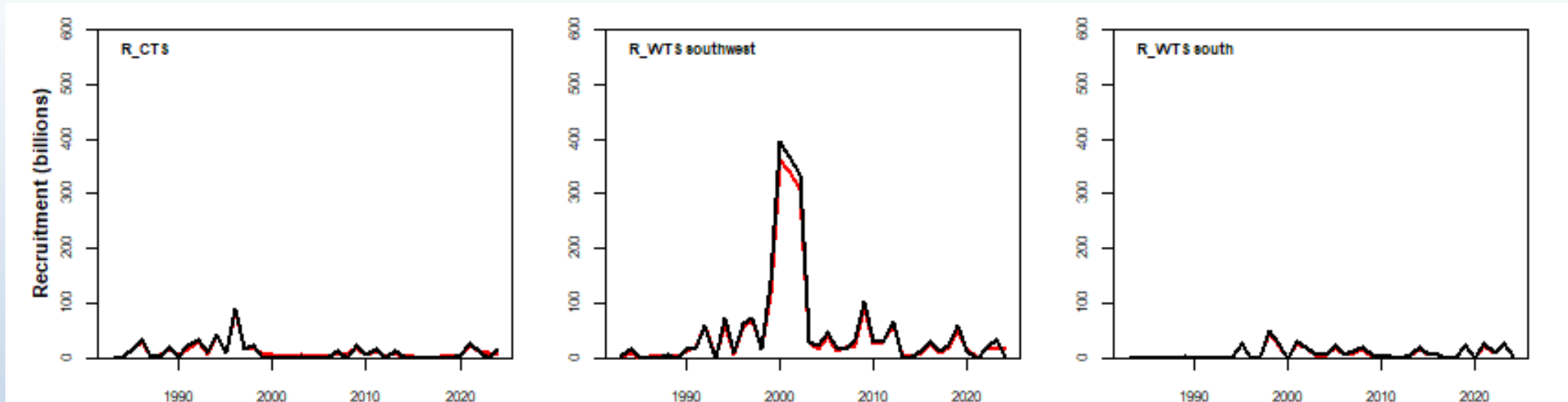Also, see Appendix B of IWS/2025/Sardine/BG4
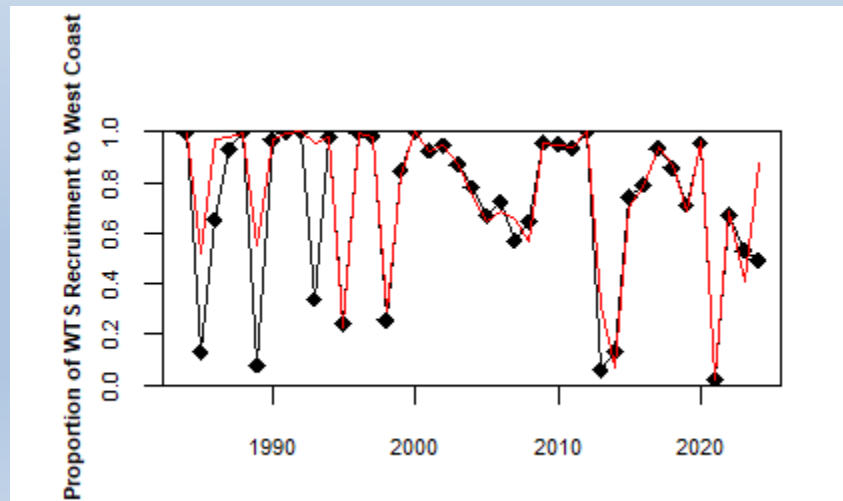
Growth
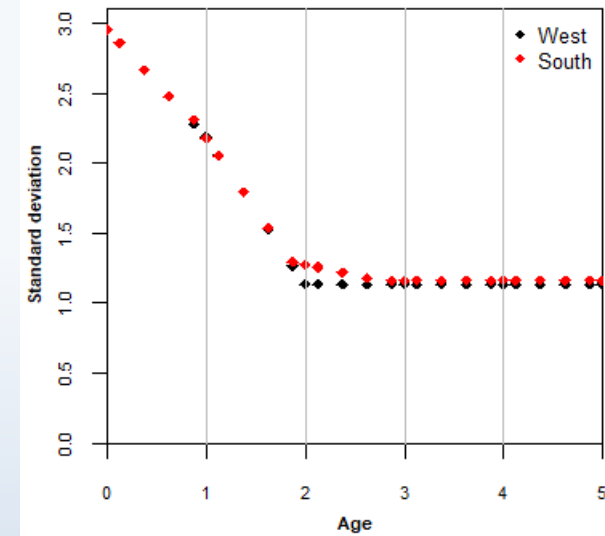
Example Proportion-at-length: 2010

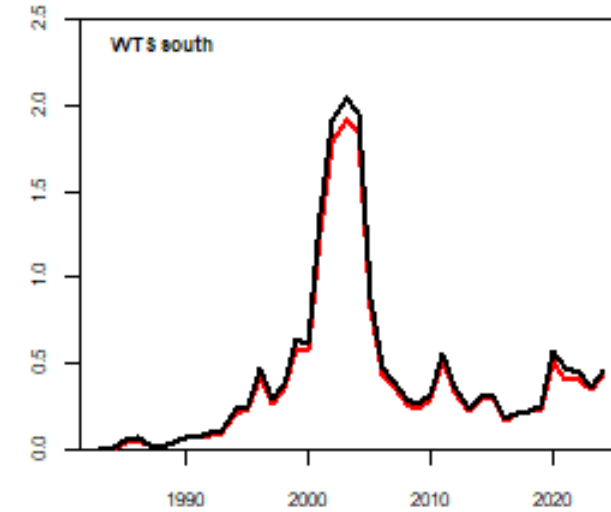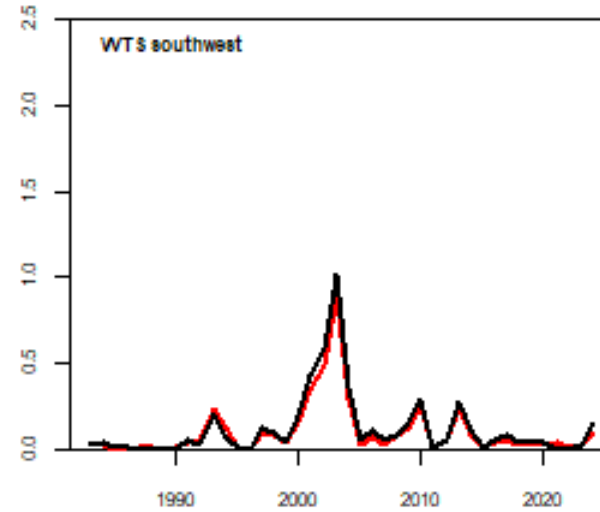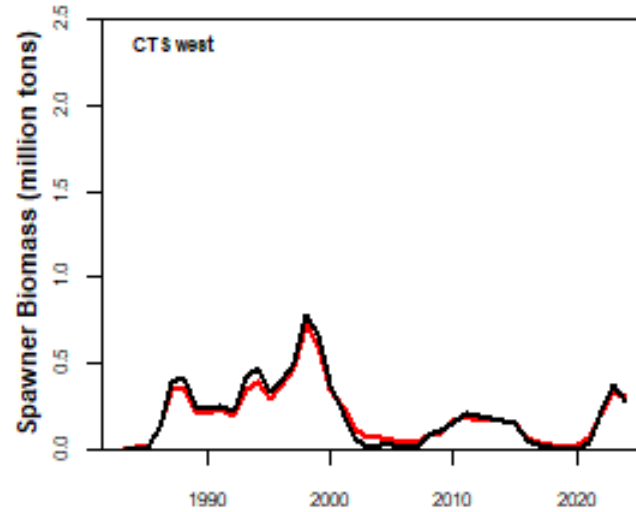# Active Movement (west to south/east)

S_{noSR}
S_{SR}

Recruitment

Biomass

S_{noSR}
S_{SR}

IWS/2025/Sardine/BG4
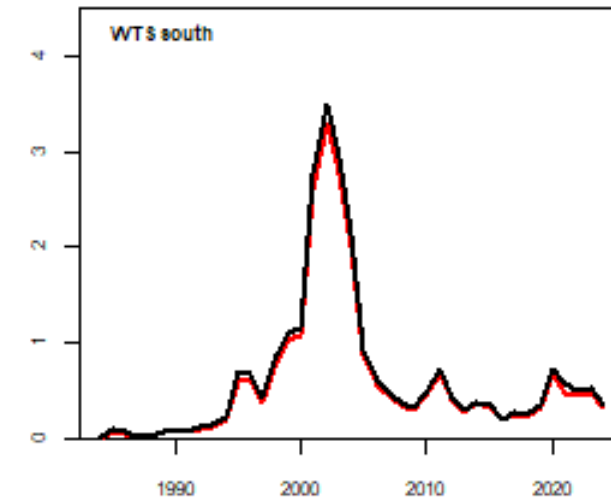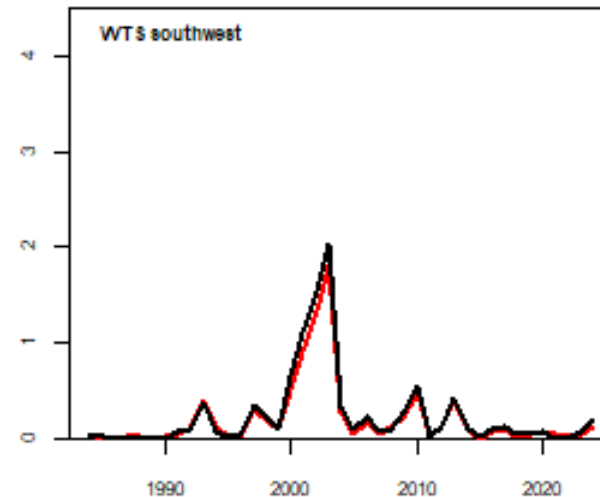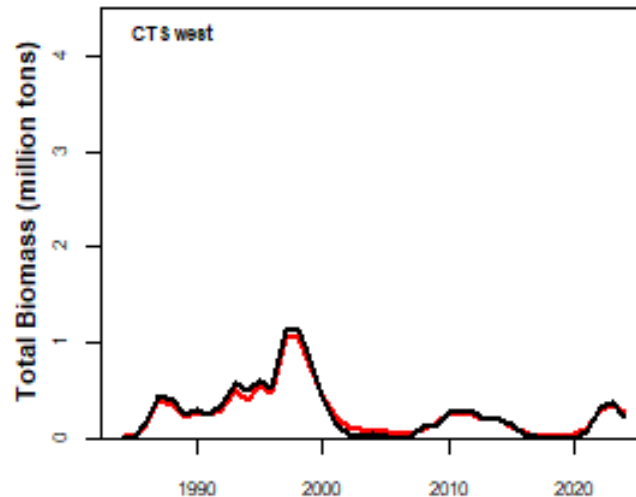
Recruitment v Spawner Biomass
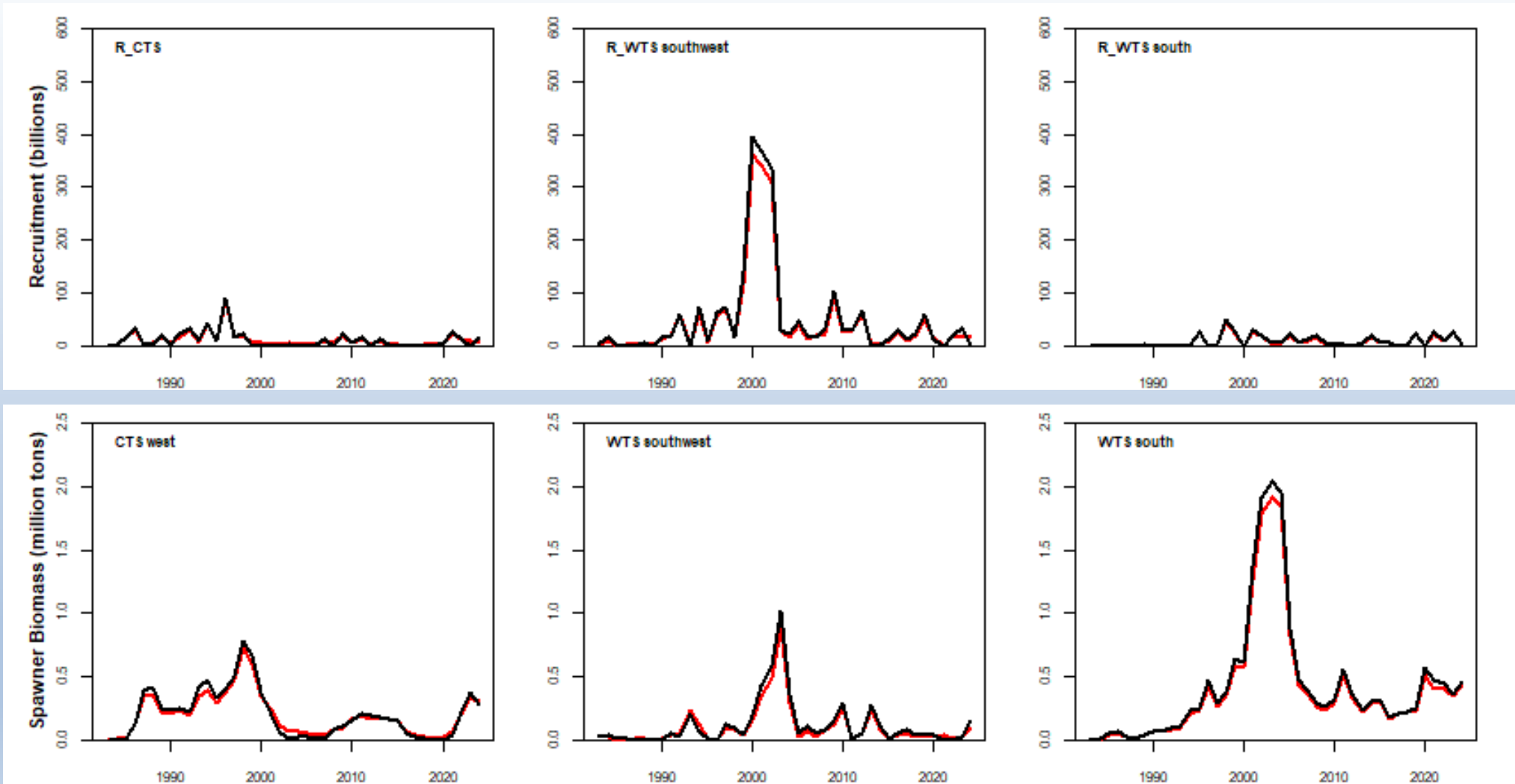
Recruitment v Spawner Biomass
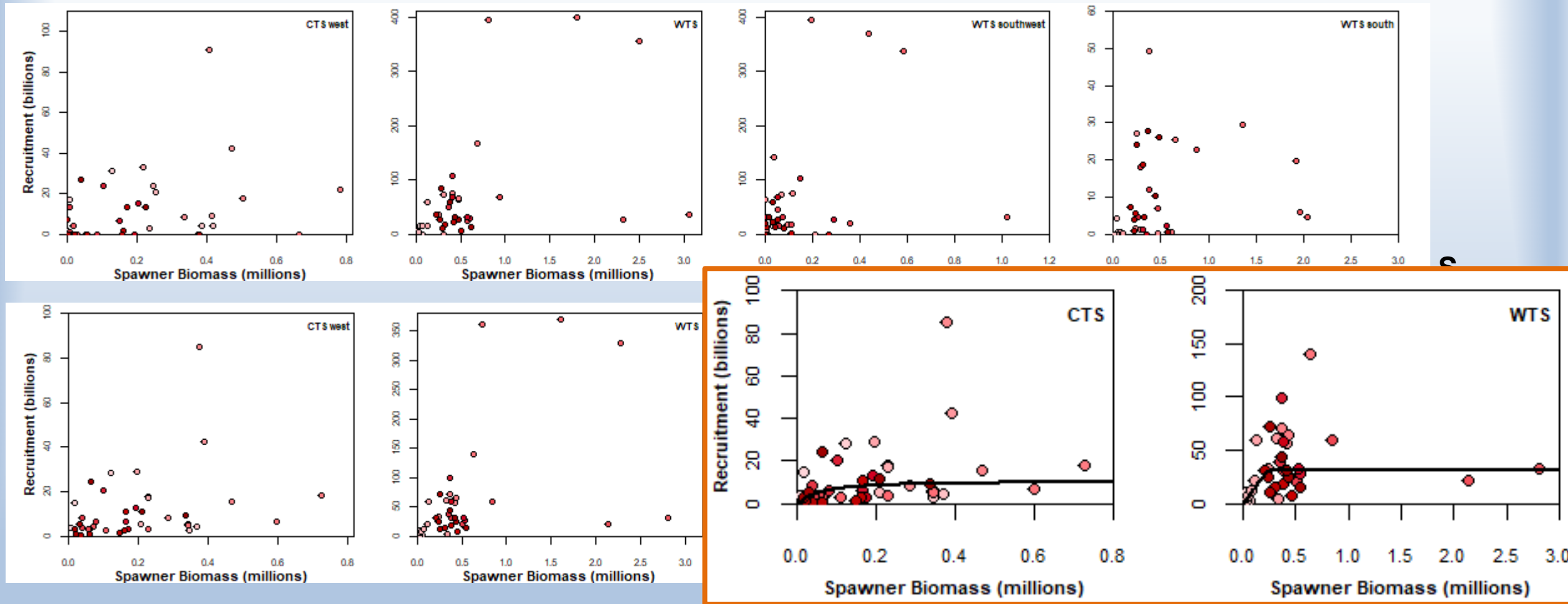
Key Question

1) How should future stock-specific recruitment be generated for sardine for the upcoming MSE?

Key Question

2) Should the future recruitments generated from a parametric stock recruitment relationship include a bias correction?

Key Question

3) Is there likely to be bias in estimates of recruitment process error variance for sardine? If so, is it necessary to correct for this for MSE purposes?

Key Question

4) Should the upcoming MSE assume a time-invariant stock-recruitment relationship for **anchovy**, or should a relationship corresponding to more recent years (for which productivity was lower) be used?

# A Short Detour to Anchovy

- Single stock hypothesis
- Historically, always assumed a time-invariant SR relationship for baseline models for MSEs
- But have considered changes in SR models over time for robustness tests, in particular investigating a less productive 'regime' prior to ~2000, a more productive regime after ~2000, then later the possibility of a 'middle regime' after ~2010
- Three consecutive years of poor recruitment (most recent not included in assessment): is a time-invariant SR relationship still the best choice for the upcoming MSE?
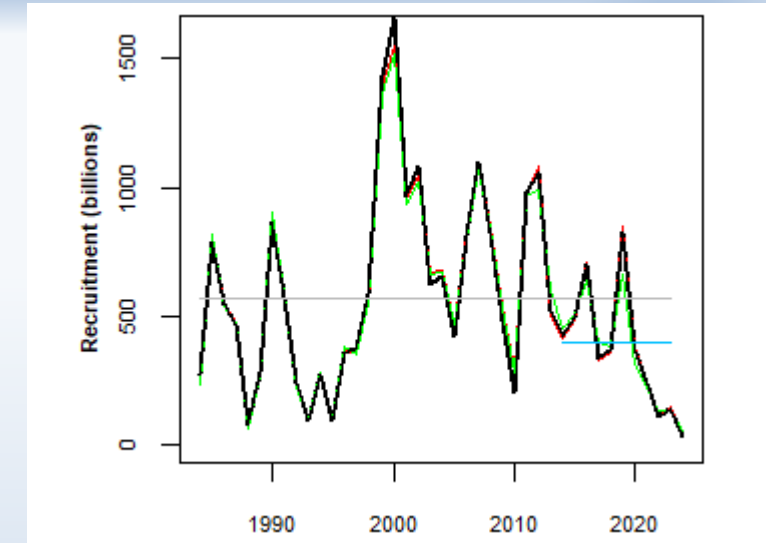
Key Question

5) What is the best approach to follow when there is an indication of more than one local minimum?

6) What is the best approach to follow when the inverse of the Hessian shows some parameters are highly correlated?

7) Is there a problem if the deterministic joint posterior mode of the mean of recruitment estimates falls outside the range of values from a sample of the posterior distribution, and if so how should this be addressed.