# ASPM assessments of the Alfonsino resource in the SIOFA area of the Indian Ocean

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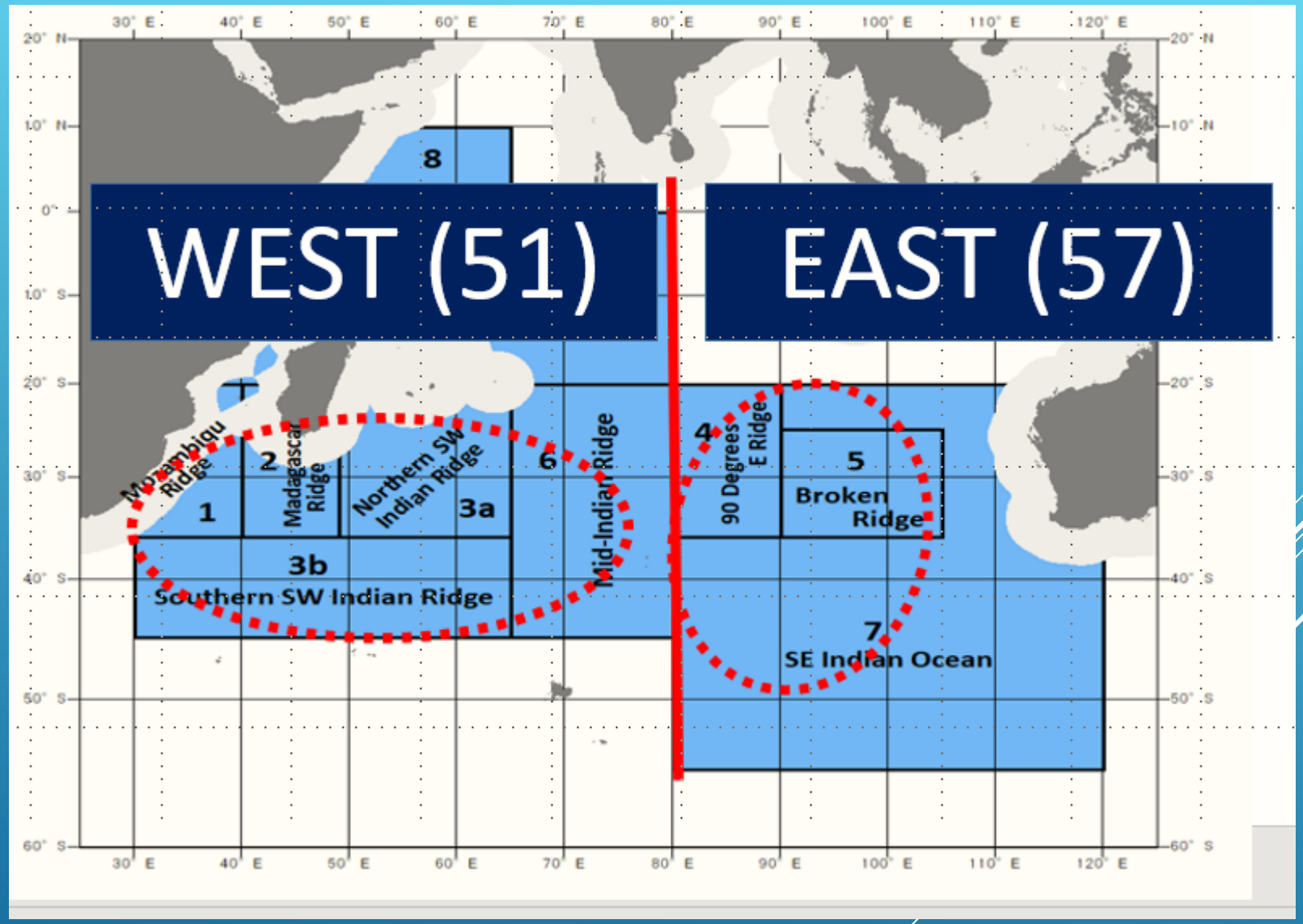
# Management units: (West and East) together with SIOFA statistical areas and FAO fisheries statistical areas (F51 and F57)




Note: Figure extracted from Terms of Reference document

# Data

- **Total catch for each fleet** (for which CPUE data are available), other member countries and non-member countries. Catches start from 1977.
- **Relative abundance indices** obtained from CPUE GLM-standardization:
  - The preferred standardisation models are a Negative Binomial model for series with few zero catches and the Hurdle-Negative Binomial for series with a large number of zero catches.
  - The CPUE series for S2 is not used as those data are very sparse and do not provide reliable trend information.
- **Catch-at-length data** are available for the S1 fleet in 2018 **ONLY**. Used to estimate single overall fishing selectivity curve.

# Assessment model features:

- Assessments are carried out **separately** for the "**West**" and the "**East**" areas
- Conducted on a calendar year basis
- Limited data necessitate a **deterministic** model
- The fishery is comprised of different "fleets", each of which corresponds to a specific country
- CPUE series correspond to those specific countries, with any of the country, fleet or CPUE series referenced by S1, S2 or S3
- The **same selectivity function** is assumed for all of the different fleets

# Base case methodology

- The **paucity of size composition data** (length composition for effectively only one year for a single fishery) severely restricts the assessment model options available, necessitating use of:
  - a **deterministic model** (i.e. no fluctuations in recruitment about a stock-recruitment curve)
  - a **single selectivity function** to apply to all fisheries for all years

**AGE-STRUCTURED PRODUCTION MODEL**

- Chosen to make allowance for time-lags arising from age-structure effects in a relatively long-lived resource
- Key assumptions
  - Beverton-Holt stock-recruitment function
  - **Steepness *h***=0.75
  - **Natural mortality *M*** = 0.2 $yr^{-1}$
  - **Age at maturity** = 6 yr

# Sensitivities to the Base case model

For the **West:**

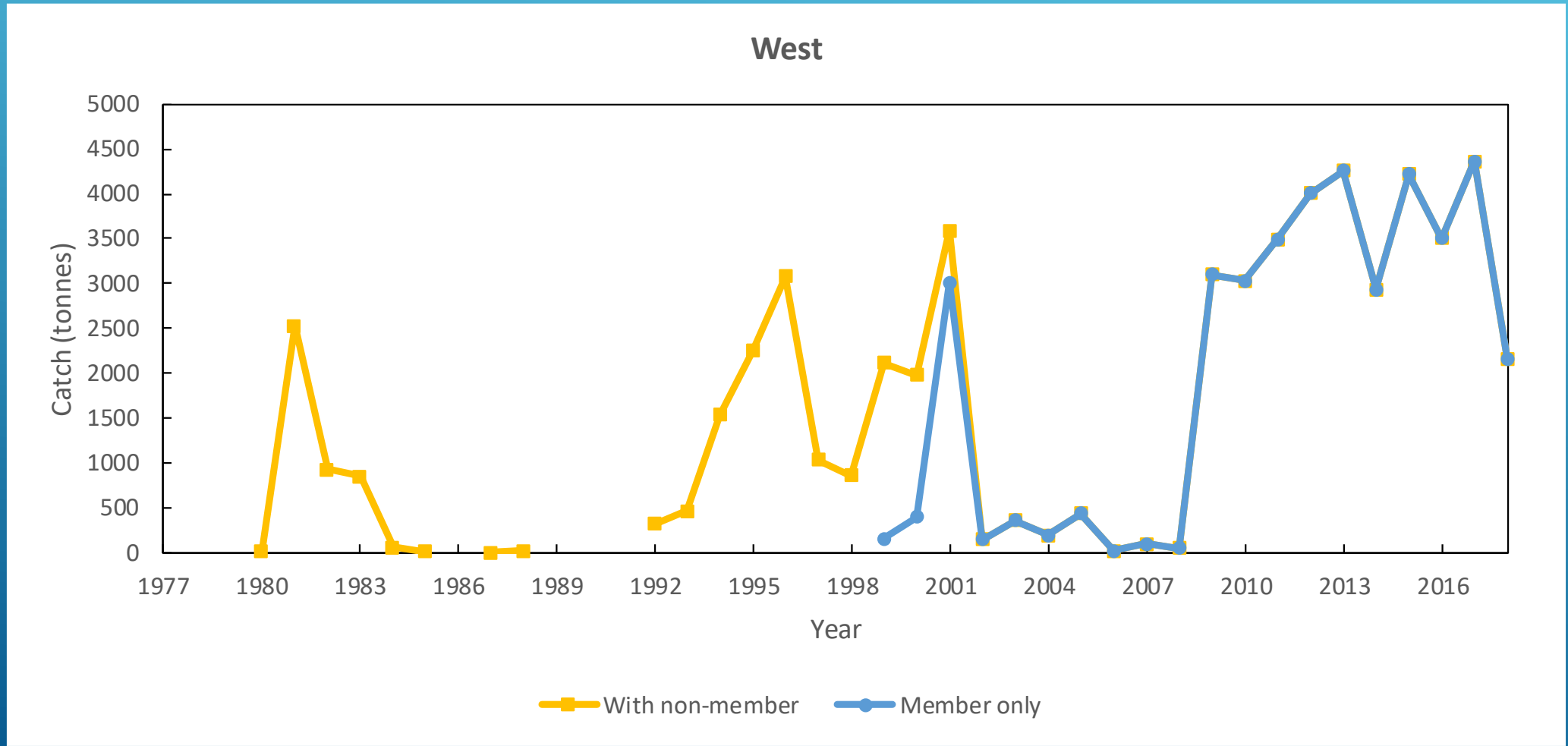
- **Omit the S1 CPUE** as it has a different trend to the other series
- For S3, fit to the standardised CPUE series that takes **bycatch** into account, as this standardised series does not have an unusually high estimated index value in 2011
- **Omit the S1 2011 CPUE** index to exclude the high peak estimated for 2011
- **Omit the non-member catches** as there is uncertainty about their accuracy
- Assume a **natural mortality** (*M*) of 0.15 or of 0.25
- Assume a **steepness** (*h*) of 0.65 or of 0.85
- **Force the spawning biomass depletion** in 2018 to be 0.5, 0.55, 0.65 or 0.7

# Sensitivities to the Base case model

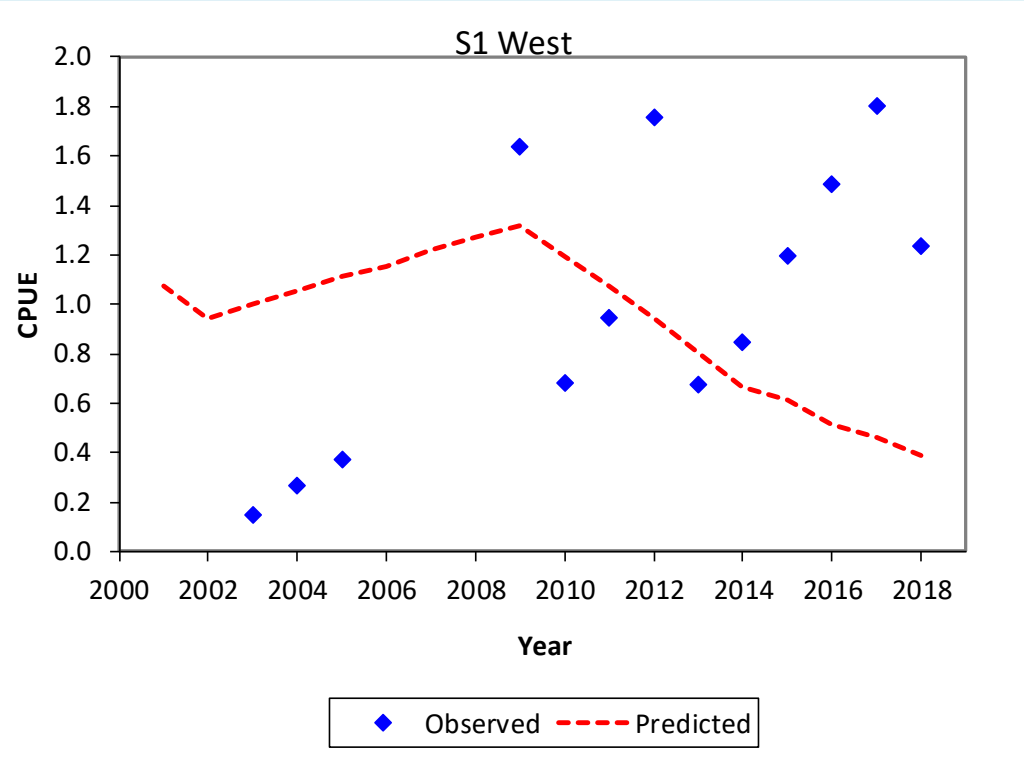
For the **East:**

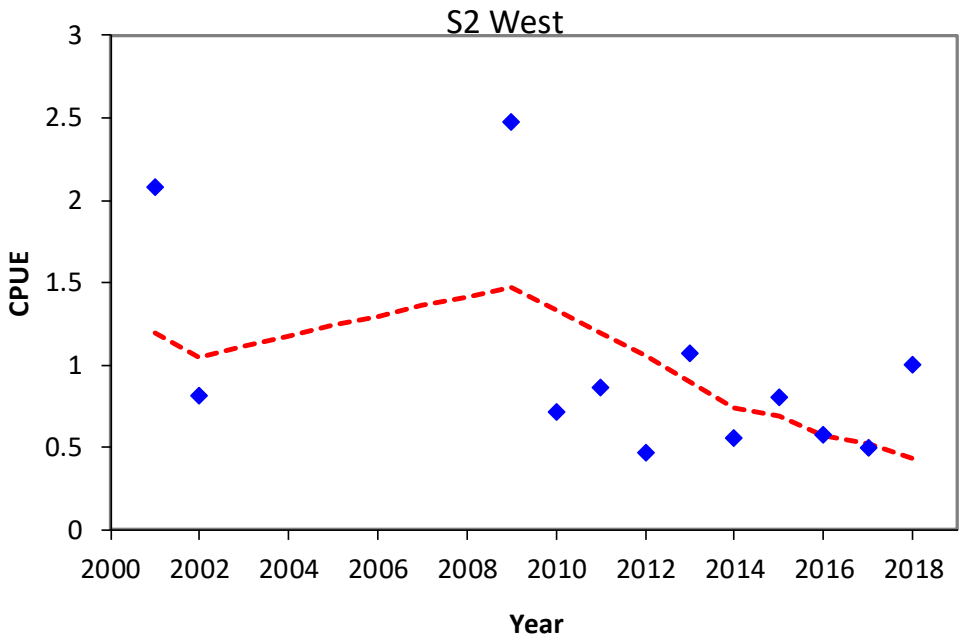
- **Omit the S3 2003 CPUE** index to exclude the high peak estimated for that year
- Assume a **natural mortality** (*M*) of 0.15 or of 0.25
- Assume a **steepness** (*h*) of 0.65 or of 0.85.
- **Force the spawning biomass depletion** in 2018 to be 0.5, 0.55, 0.65 or 0.7

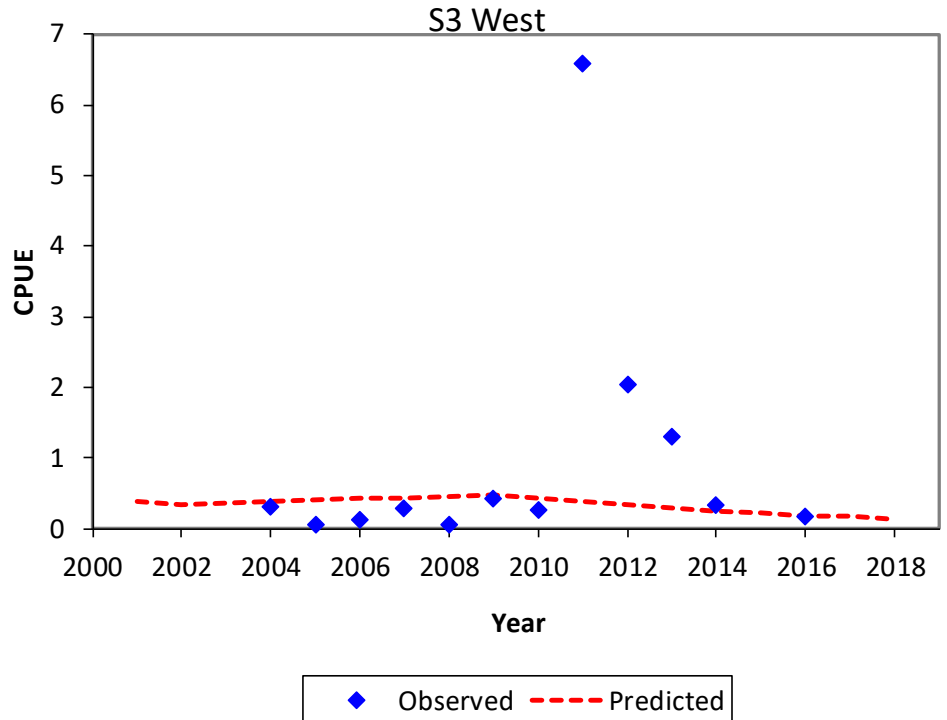
# Alfonsino catches (in tonnes) by year, both with and without non-member catches included, for the West area



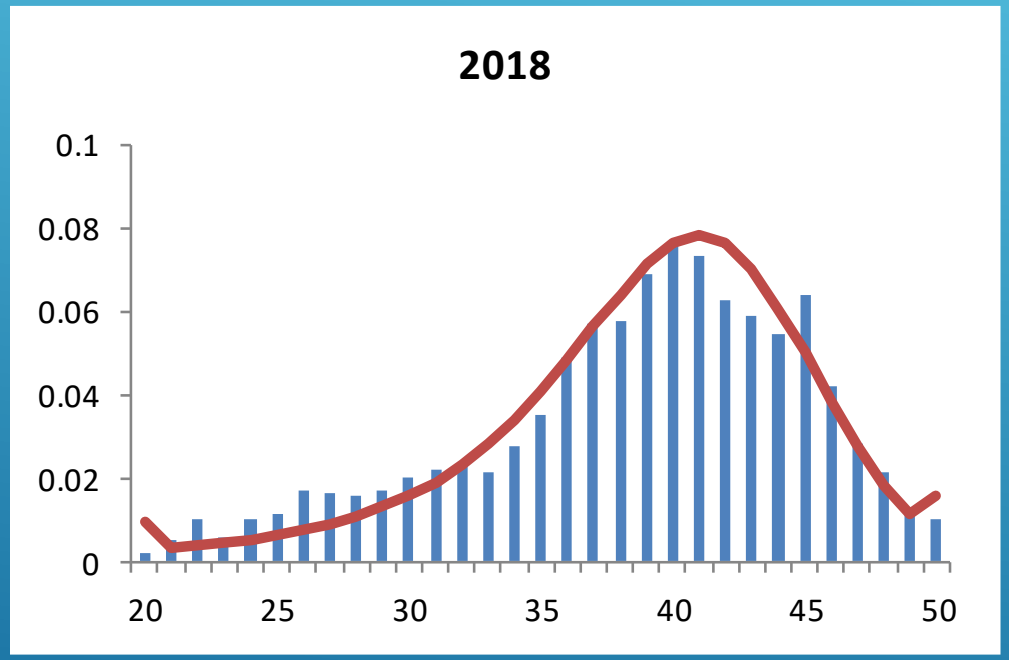
# Base case model fits to the West CPUE series



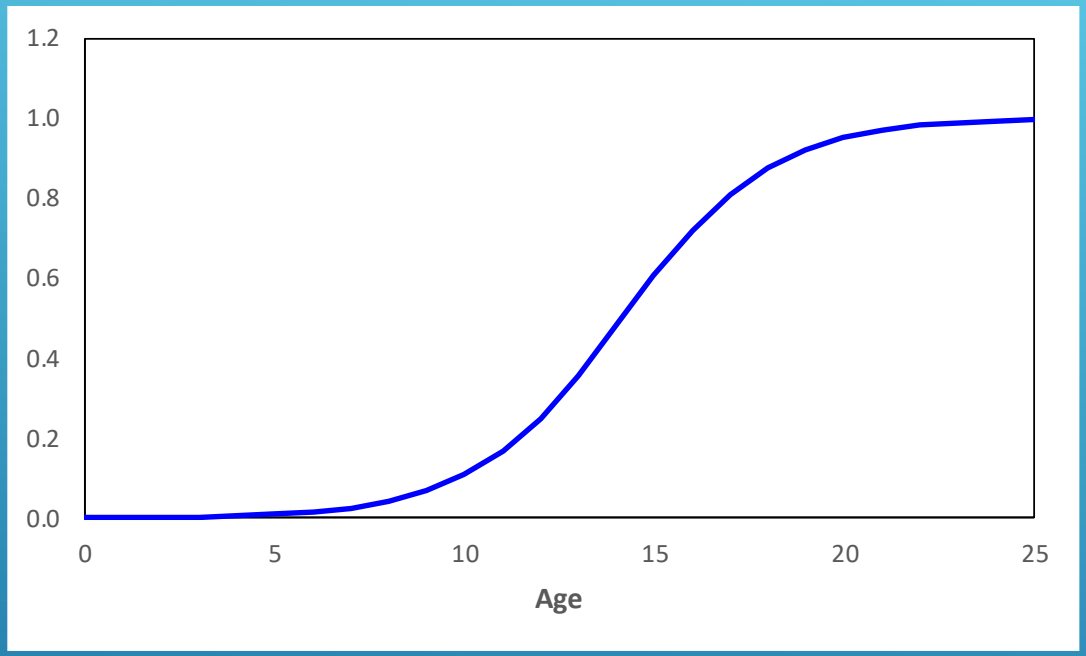



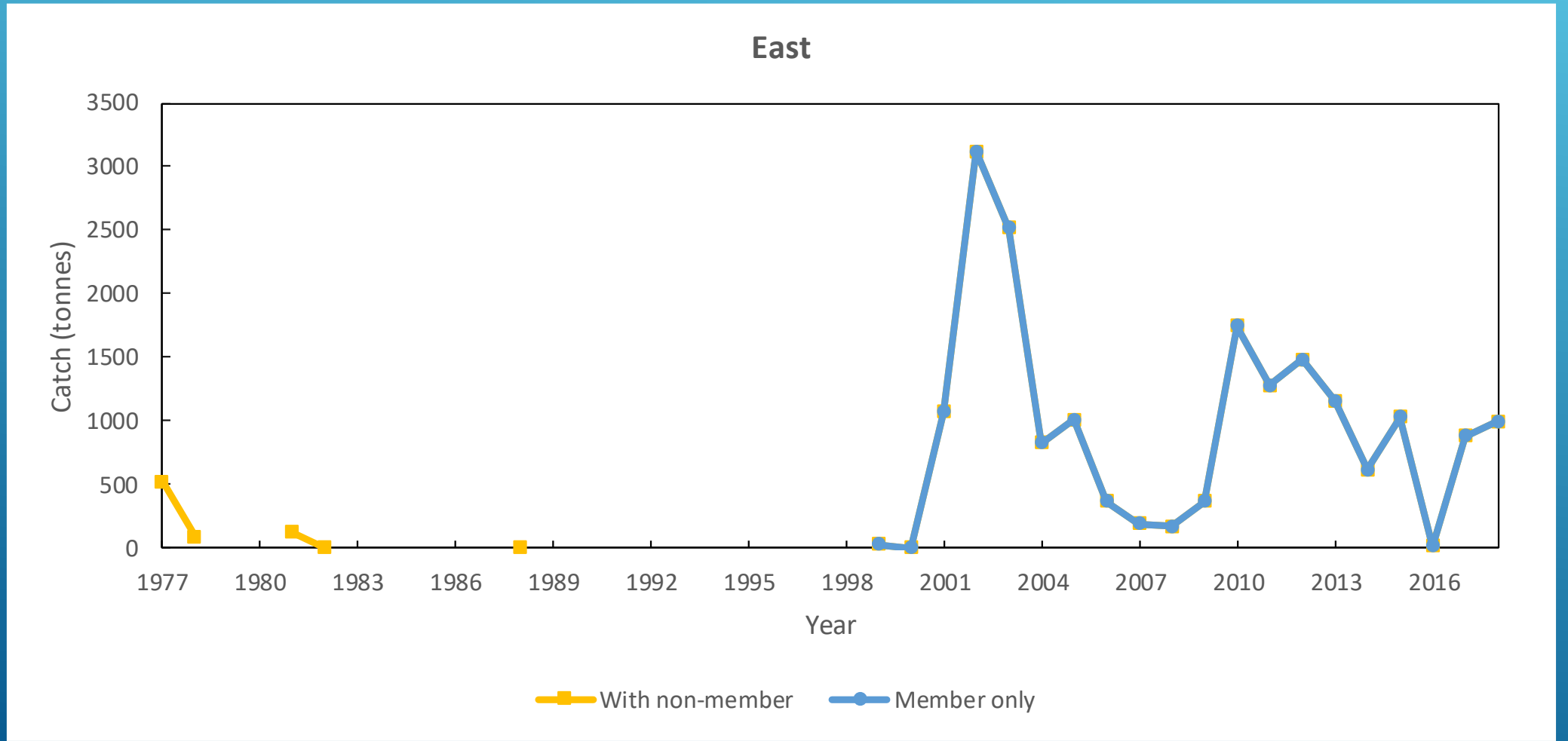
# Base case fits to the West catch-at-length data



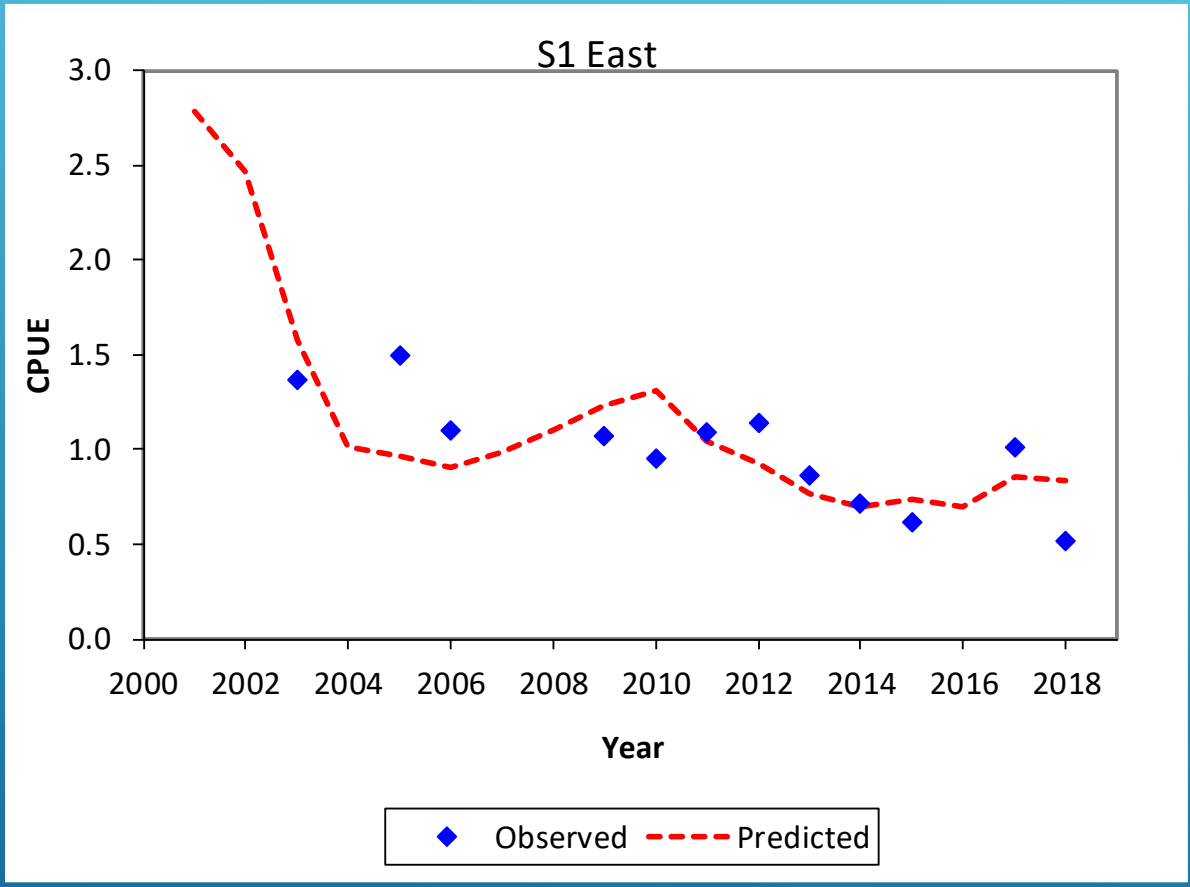

# Base case selectivity curve estimated for the West

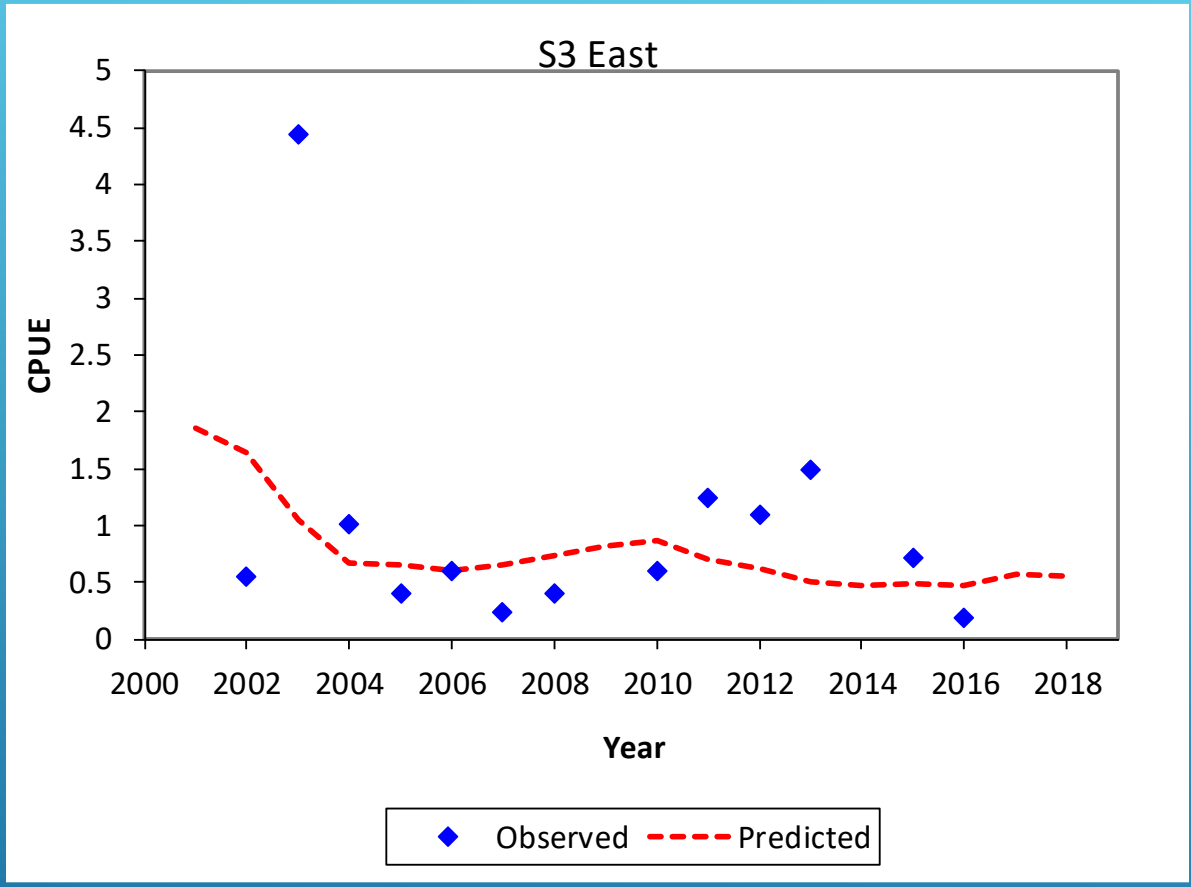


# Alfonsino catches (in tonnes) by year, both with and without non-member catches included, for the East area

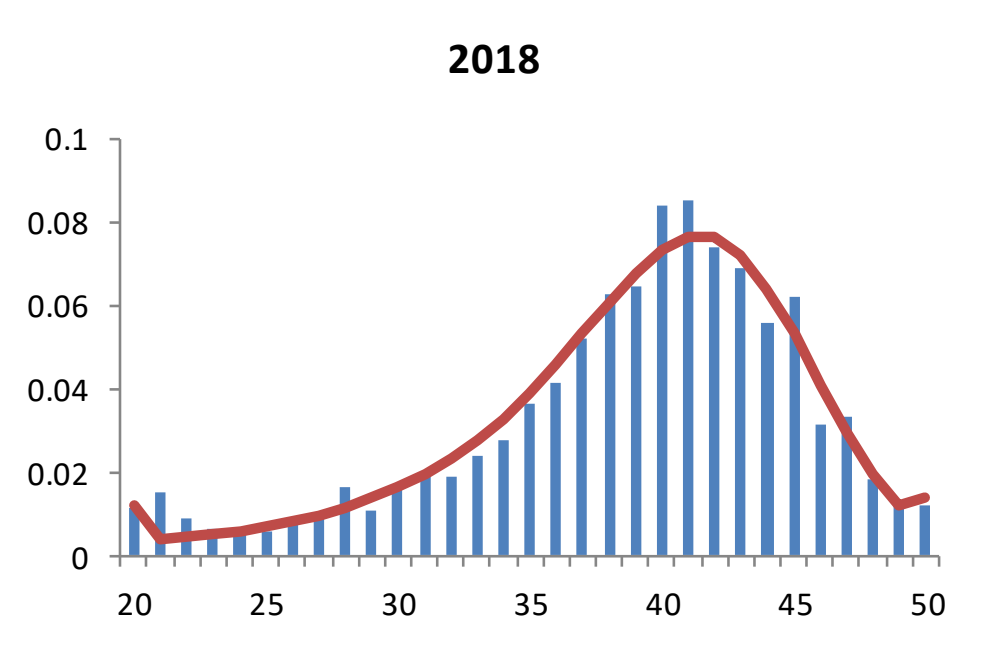


# Base case model fits to the East CPUE series

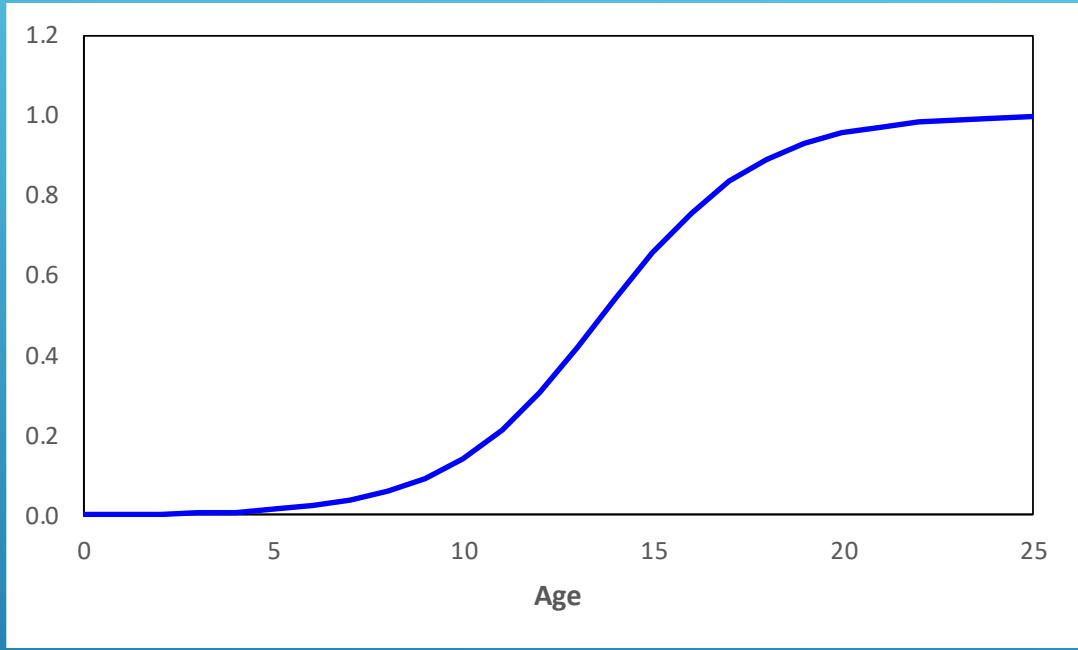


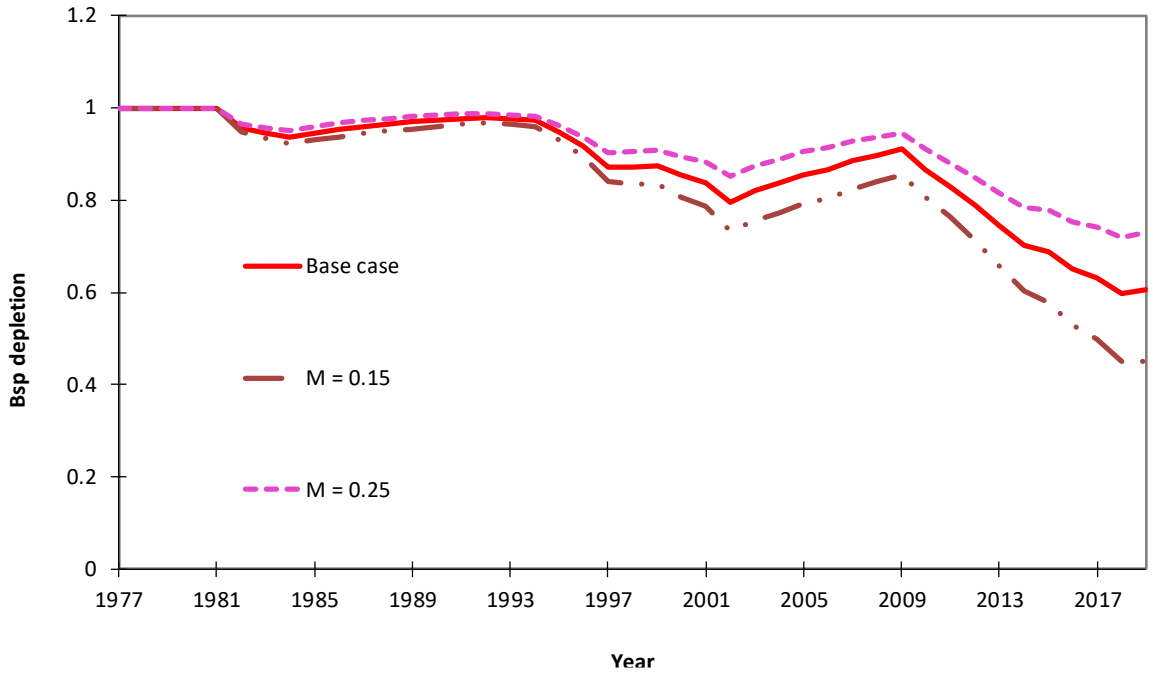



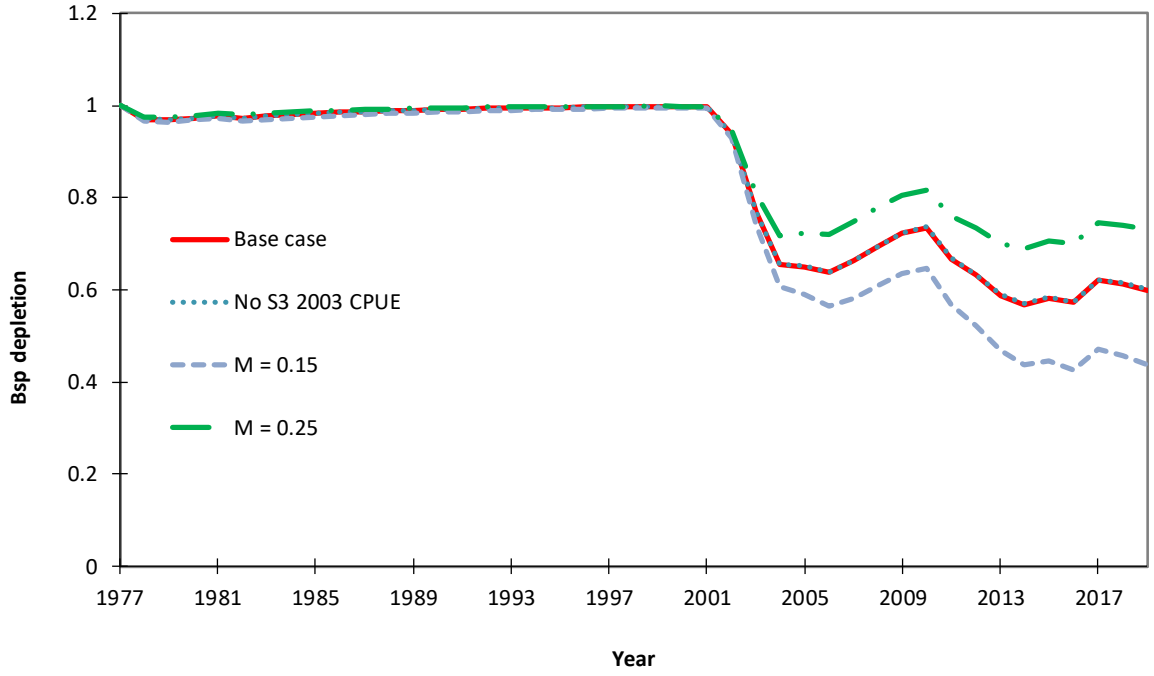
# Base case fits to the East catch-at-length data




# Base case selectivity curve estimated for the East

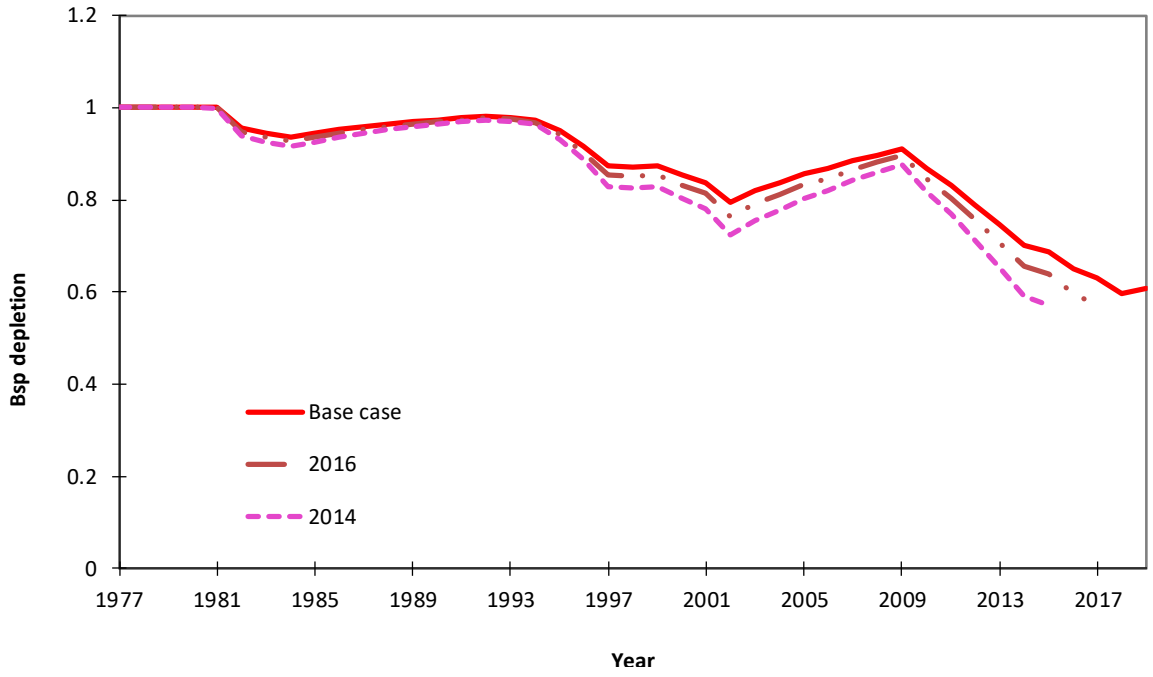


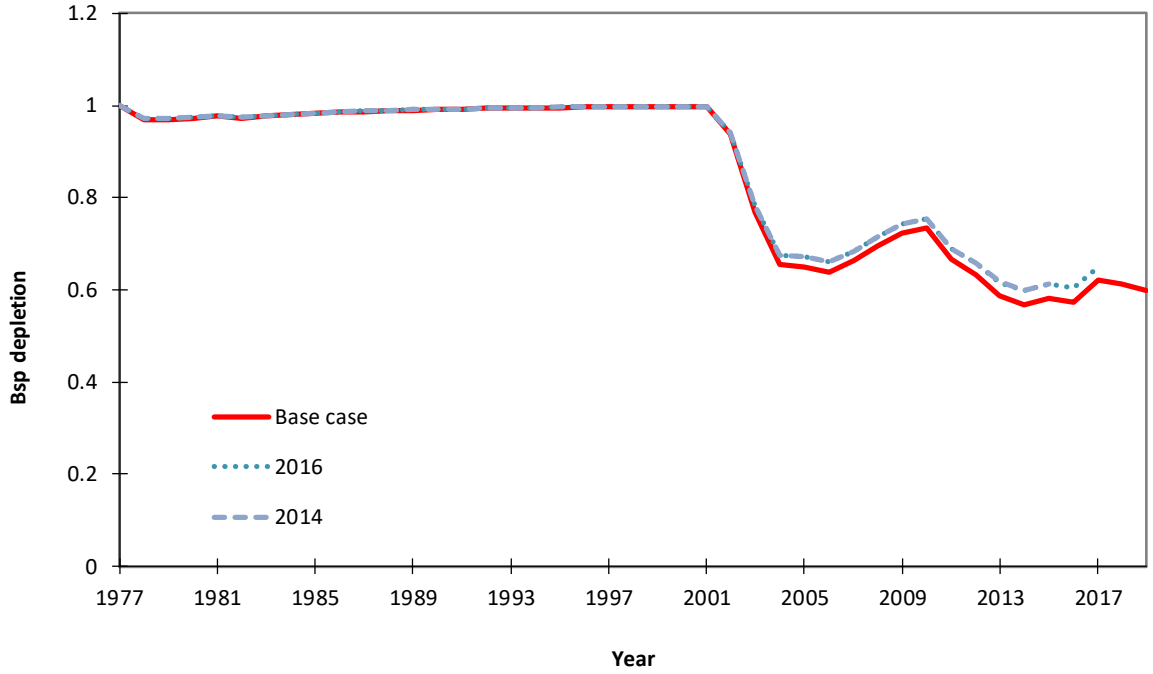



**Spawning biomass depletion for the West (top) and East (bottom) areas for the Base case and sensitivities that assume alternative *M* values**

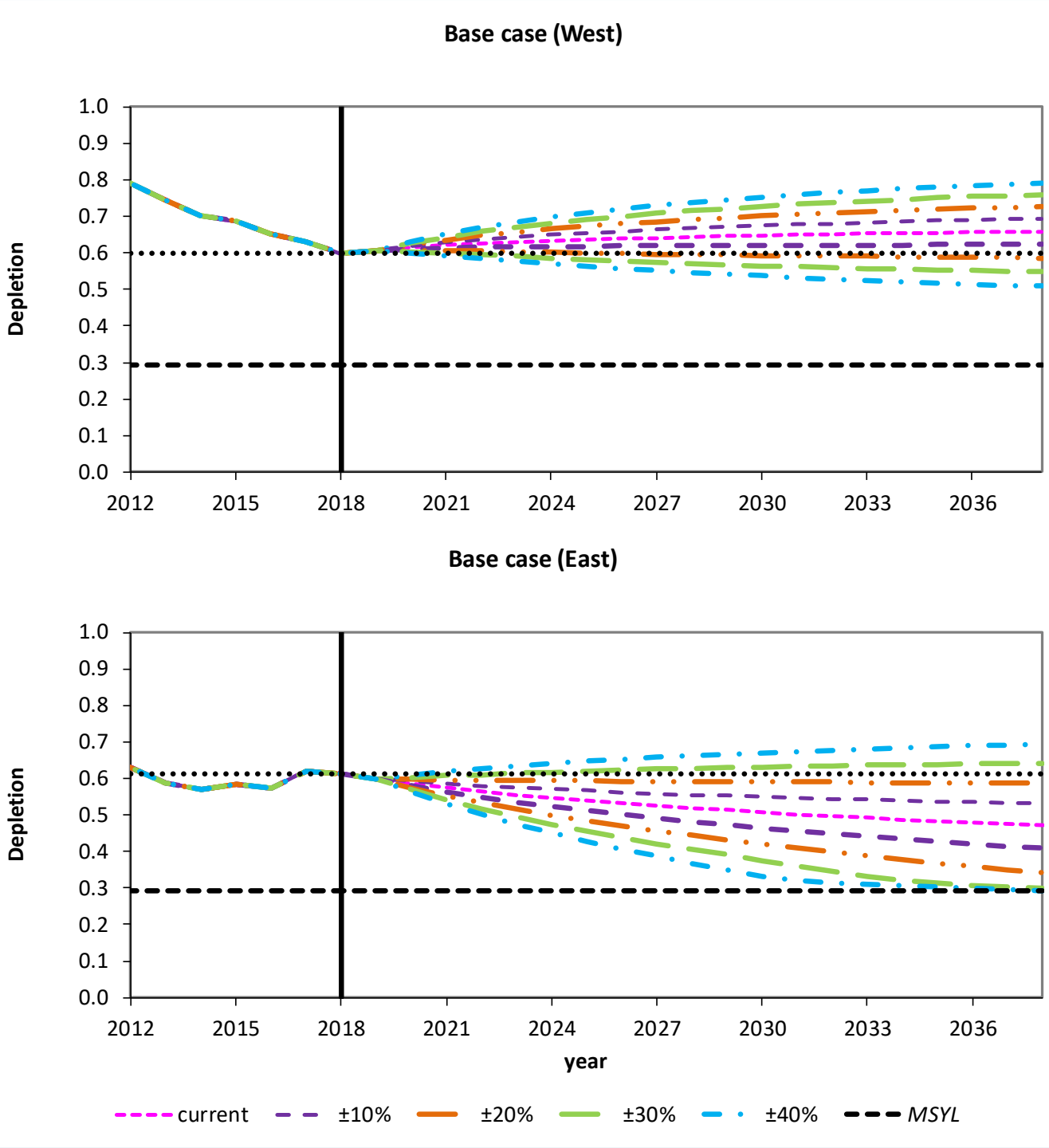
All other sensitivities hardly differ from the Base cases



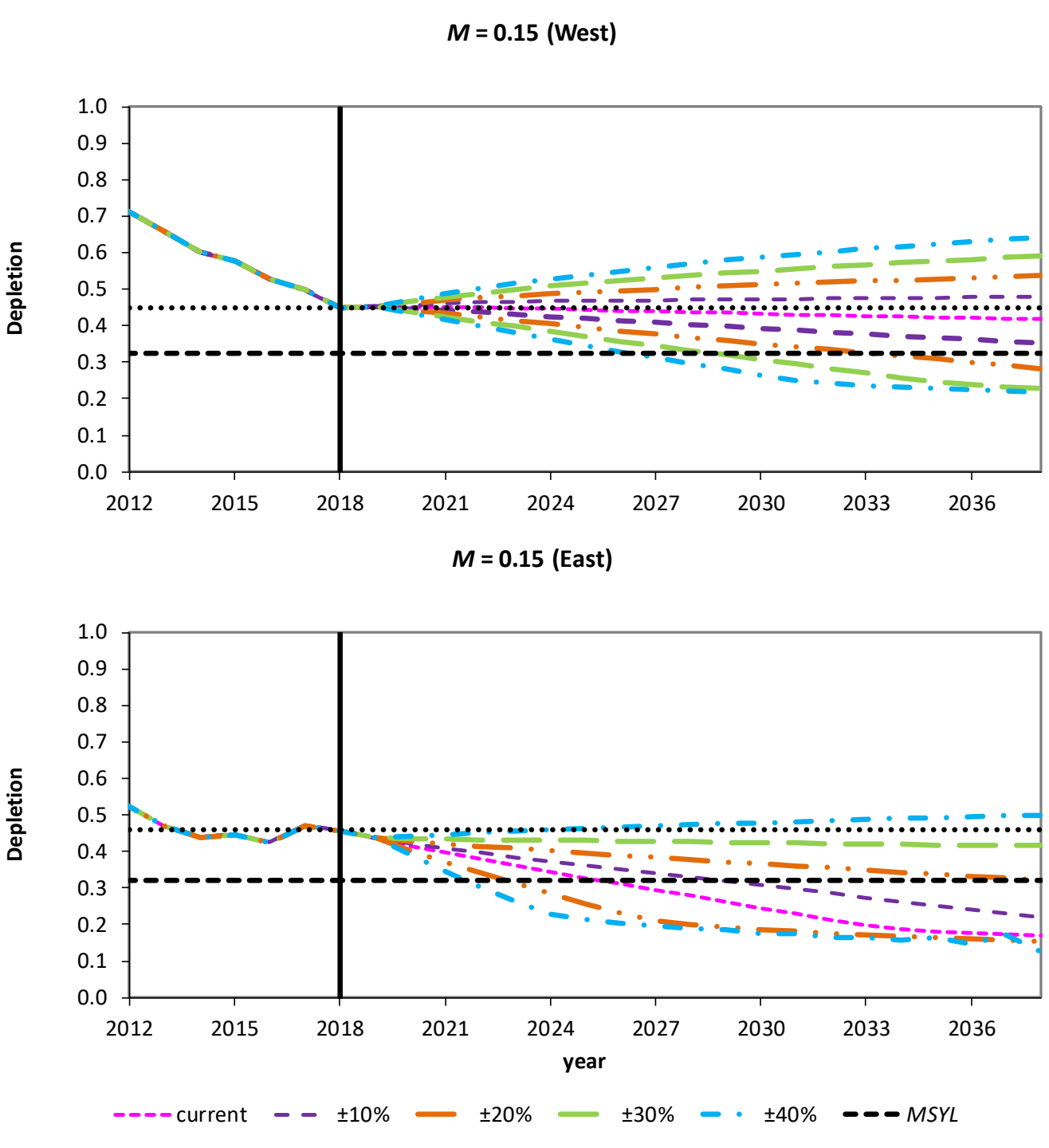

# Comparison of spawning biomass depletion for the West (top) and East (bottom) areas for the Base case and two retrospective analyses

Note that the trajectories for the two retrospective analyses for the East are barely distinguishable from each other



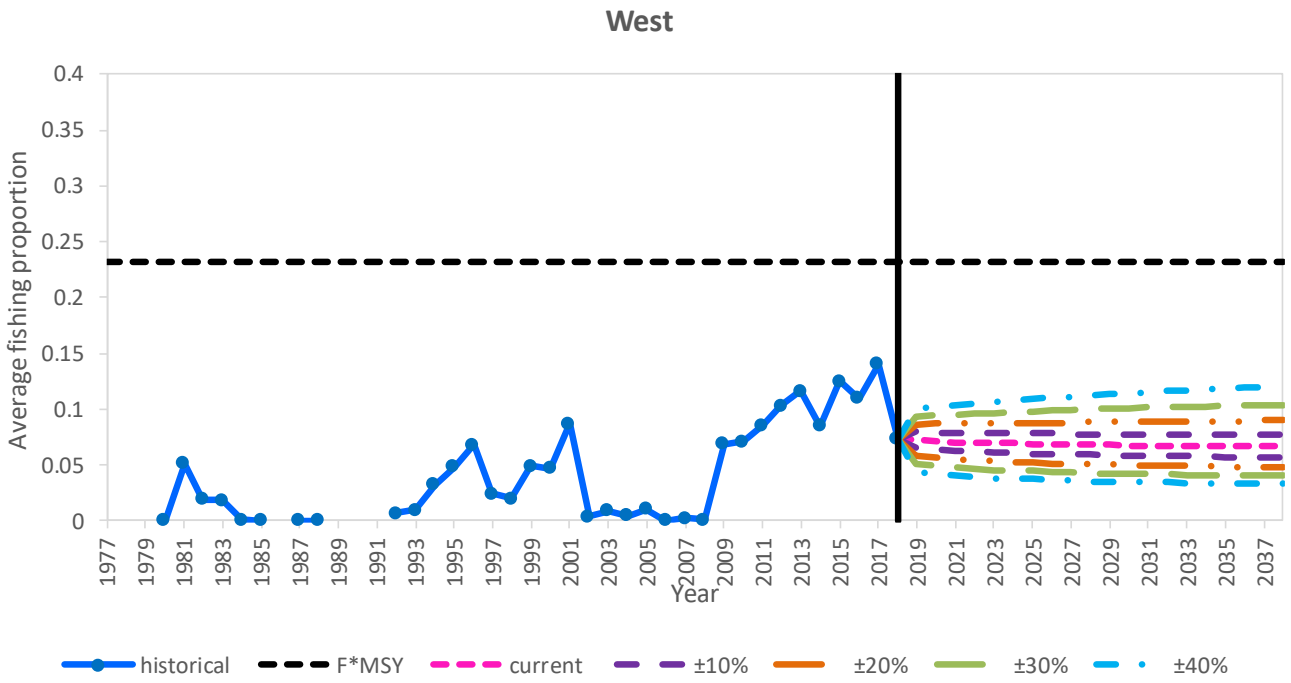

# Spawning biomass depletion projections for the Base case under future annual catches of 2 157 tonnes (as for 2018) for the West (top) and 992 tonnes for the East (bottom), as well as for several variants of these catches: ±10%, ±20%, ±30% and ±40%.

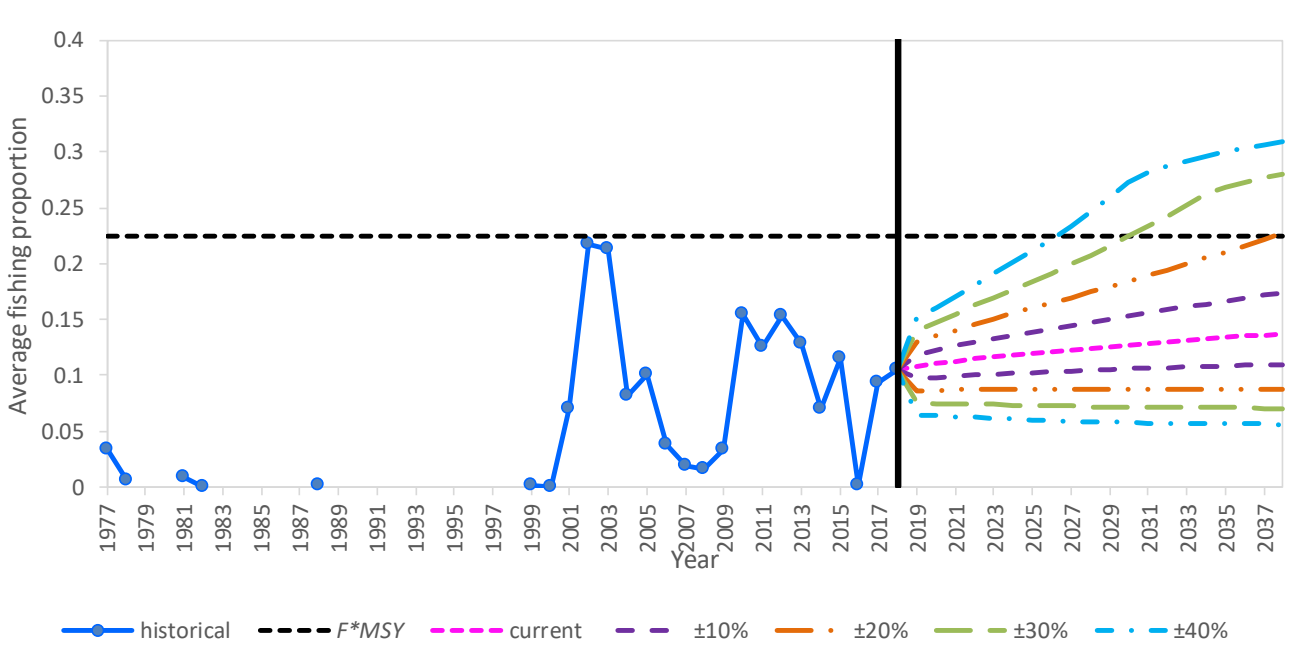
The dotted horizontal lines show the current (2018) depletion values for this assessment model and the dashed horizontal line shows the *MSYL* values.




# Spawning biomass depletion projections for the *M* = 0.15 sensitivity under future annual catches of 2 157 tonnes (as for 2018) for the West (top) and 992 tonnes for the East (bottom) as well as for several variants of these catches: ±10%, ±20%, ±30% and ±40%.

The dotted horizontal lines show the current (2018) depletion values for this assessment model and the dashed horizontal lines shows the *MSYL* values.



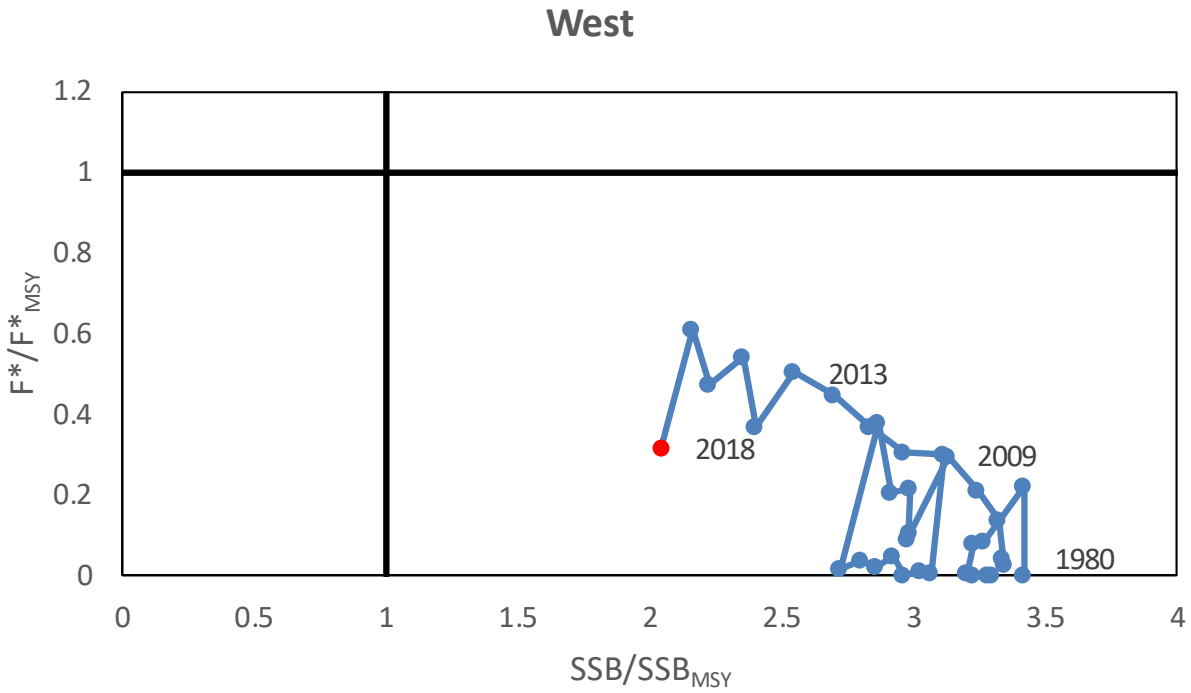

# Average fishing proportion ($F^*$) projections under future annual catches of 2 157 tonnes (as for 2018) for the **Base case** for the **West** (top) and the **East** (bottom), as well as for several variants of this catch: ±10%, ±20%, ±30% and ±40%.

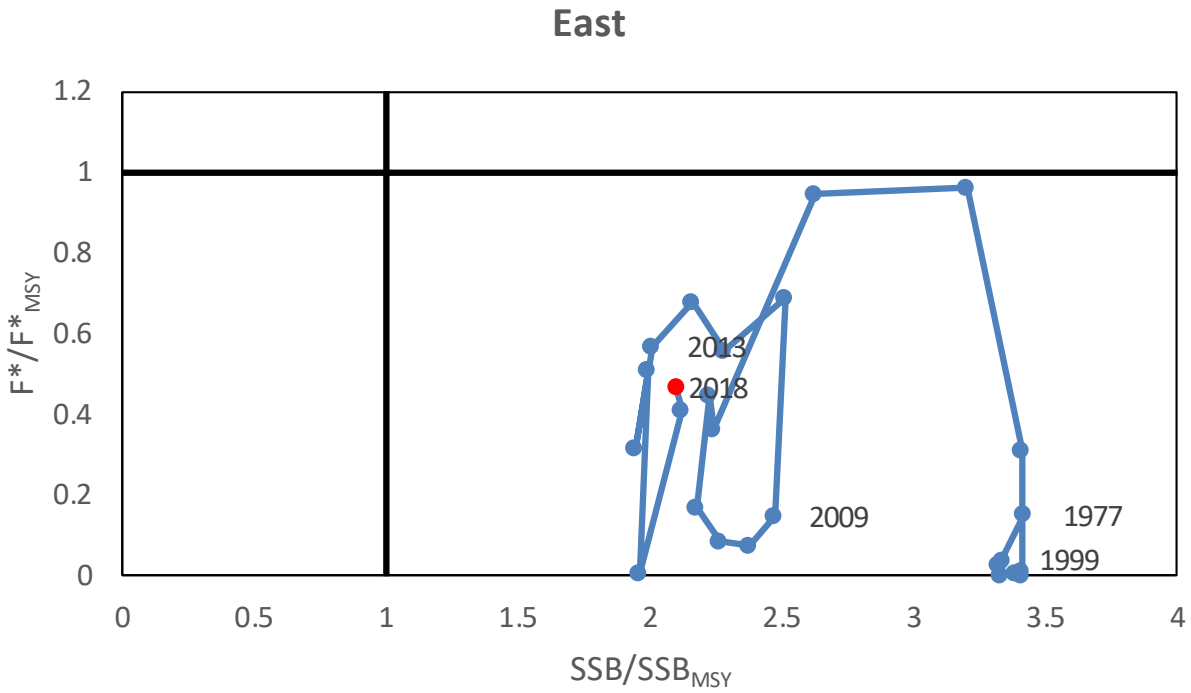
The dashed horizontal lines show $F^*_{MSY}$.

# Summary results for the Base case and the *M* = 0.15 sensitivity (*F** is the fishing proportion)

| Parameter estimates | West | | East | |
|---|---|---|---|---|
| | Base case | M = 0.15 | Base case | M = 0.15 |
| $B^{sp}_{2019}$ (tonnes) | 29 827 | 19 864 | 9 203 | 6 347 |
| $B^{sp}_{2019}/B_{MSY}$ | 2.078 | 1.385 | 2.053 | 1.354 |
| $B^{sp}_{2019}/K^{sp}$ | 0.607 | 0.451 | 0.599 | 0.437 |
| $F^{*}_{2019}$ | 0.072 | 0.109 | 0.108 | 0.156 |
| $F^{*}_{2019}/F^{*}_{MSY}$ | 0.312 | 0.733 | 0.479 | 1.052 |
| MSY (tonnes) | 3 325 | 2 123 | 1 010 | 696 |

# Kobe plots for the Base case for the West and East areas



# Concluding Comments

## KEY OUTCOMES

- Both West and East stocks are at **healthy** levels of about 60% of their pre-exploitation spawning biomasses
- **Neither** stock is **overfished** (i.e. $B>B_{MSY}$), **nor** is **overfishing** taking place (i.e. $F^*<F^*_{MSY}$)
- The only sensitivity test with much impact and importance is that for a **lower value of M**, which indicates poorer stock status and productivity

## LOOKING AHEAD

- Availability of **more catch at length data** for more components of these fisheries is essential
- Estimates of **abundance in absolute terms** (possibly from hydro-acoustic surveys) would assist reduce uncertainties associated with the value of *M*

# Thank you for your attention