# Successful management of small pelagics within a large international region:

## The case for collaborative assessment work within the recently formed South Pacific Regional Fisheries Management Organization (SPRFMO)

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South Pacific Regional Fisheries Management Organisation

4th Scientific Committee

October 2016

**Acknowledgements:**

Scientific Committee, 52-participants from 13 countries

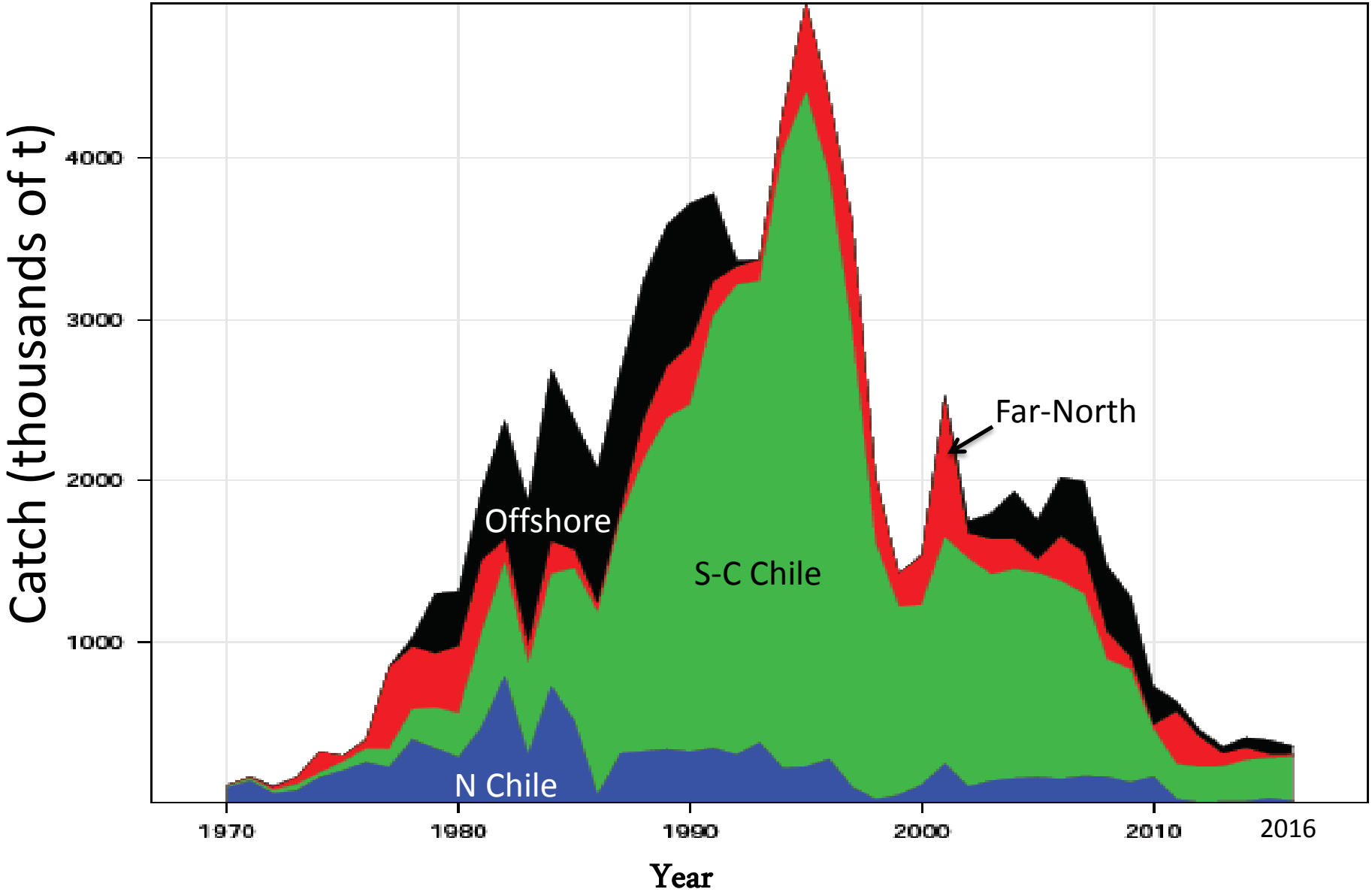
https://www.sprfmo.int/meetings/4th-sc-2016/

# Point #1

Big area, important fisheries

# The South Pacific Regional Fishery Management Organization...

# Jack mackerel fishery



# Point #2

Complex organizational task to create a Commission...

# The South Pacific Regional Fishery Management Organization…

## Science

Assessment and Rebuilding Plan

Assessment methods simulation testing

2008 FAO Jack mackerel workshop Santiago

11 Science working group meetings

SPRFMO 1st Meeting Auckland NZ 2013

2010, 1st "Prep Con" (preparatory conference)

2012, 3rd and last PrepCon

7 more consultations

| | | |
|---|---|---|
| 2 | Hobart, Australia | Nov 2006 |
| 3 | Renaca, Chile | May 2007 |
| 4 | New Caledonia | Sep 2007 |
| 5 | Guayaquil, Ecuador | Mar 2008 |
| 6 | Canberra, Australia | Oct 2008 |
| 7 | Lima, Peru | May 2009 |
| 8 | New Zealand | Nov 2009 |

Feb 2006 1st international consultation in Wellington NZ

## Admin/Organizational

SPRFMO
South Pacific Regional Fisheries Management Organisation

HOME | ABOUT SPRFMO | MEETINGS | CONSERVATION MEASURES | DATA | PARTNERS | NEWS | CONTACTS | OPPORTUNITIES | MEMBER LOGIN

Welcome to South Pacific RFMO

Search

The South Pacific Regional Fisheries Management Organisation is an inter-governmental organisation that is committed to the long-term conservation and sustainable use of the fishery resources of the South Pacific Ocean and in so doing safeguarding the marine ecosystems in which the resources occur. The SPRFMO Convention applies to the high seas of the South Pacific, covering about a fourth of the Earth's high seas areas. Currently, the main commercial resources fished in the SPRFMO Area are Jack mackerel and jumbo flying squid in the Southeast Pacific and, to a much lesser degree, deep-sea species often associated with seamounts in the Southwest Pacific.

## LATEST NEWS

### USA BECOMES A FULL MEMBER OF SPRFMO

*20/01/2017 > The United States of America has become a full member of the SPRFMO*

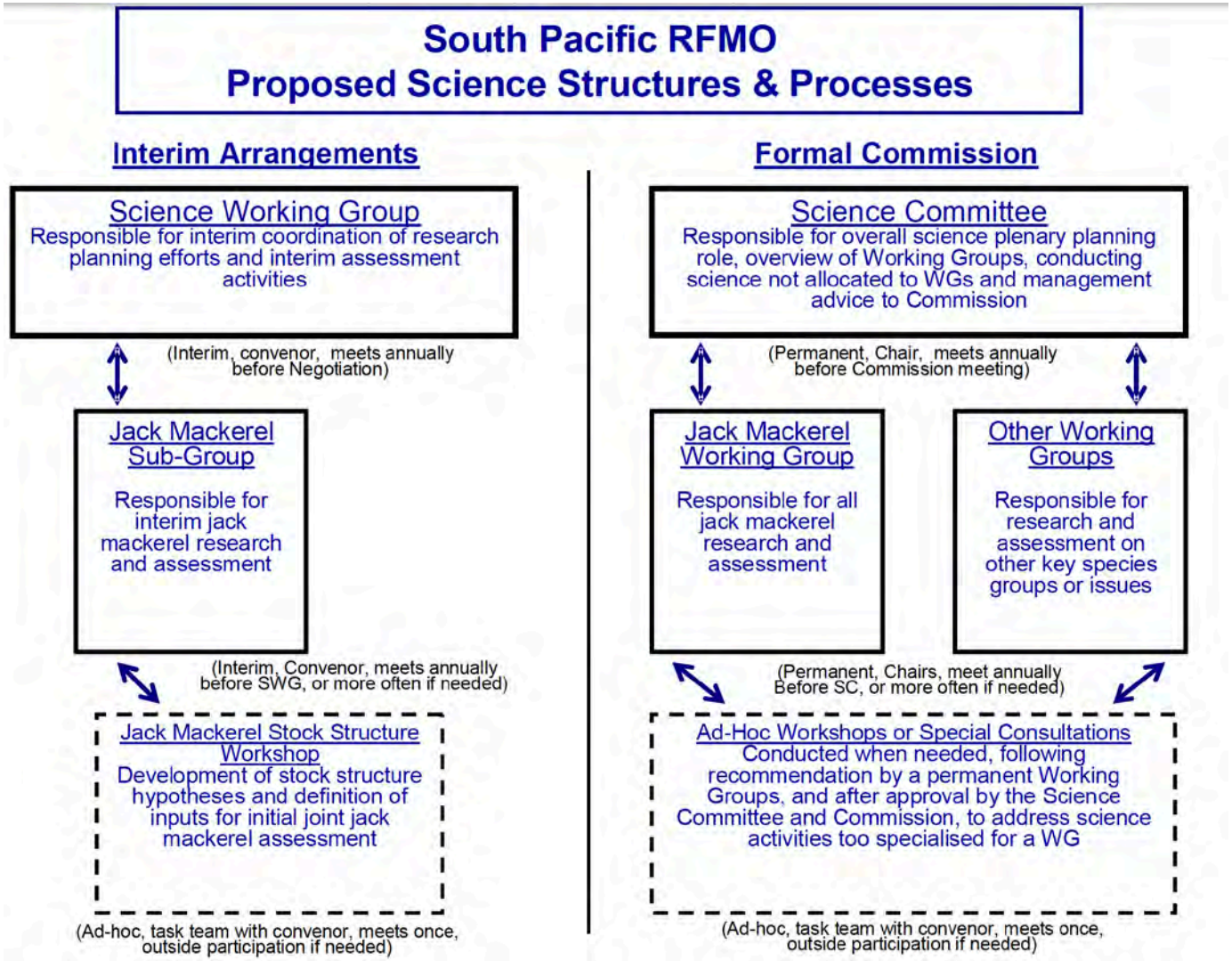
***Read more >>***

Robin Leslie Allen

1943 – 2015

The Commission and Scientific Committee
indebted to his service,
intellect, and motivation

# Complex task…



# Point #3

Science endeavor to manage the region's fisheries

# SPRFMO Science-management interface...

**Article 10 of Convention:**

(a) plan, conduct and review **scientific assessments** of the status of fishery resources

(b) provide **advice** and **recommendations** to the Commission and its subsidiary bodies based on such assessments

(c) provide advice and recommendations to the Commission and its subsidiary bodies on the **impact of fishing on the marine ecosystems** in the Convention Area

(d) encourage and **promote cooperation** in scientific research and

(e) provide such **other scientific advice** to the Commission and its subsidiary bodies as it considers appropriate

# The South Pacific Regional Fishery Management Organization…

## Science

Assessment and Rebuilding Plan

Assessment methods simulation testing

2008 FAO Jack mackerel workshop Santiago

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## Admin/Organizational

# Perceptions…early 2012


## Jack mackerel disappearing in the South Pacific, other species next

**WORLDWIDE**
**Thursday, January 26, 2012, 02:30 (GMT + 9)**

Jack mackerel stocks have plummeted from an estimated 30 million tonnes to less than 3 million in 20 years. An eight-country investigation of the fishing industry in the southern Pacific by the International Consortium of Investigative Journalists (ICIJ) shows that this phenomenon foreshadows progressive collapse of fish populations across the world's oceans.

Daniel Pauly, University of British Columbia oceanographer, considers jack mackerel in the southern Pacific a startling indicator.

"This is the last of the buffaloes", he warned, *iWatch News* reports. "When they're gone, everything will be gone ... This is the closing of the frontier."

# Jack mackerel Conservation and Management Measure

## 1st Commission meeting, 2013

The Commission of the SPRFMO, Noting that despite the efforts that have been made to arrest the depletion of the *Trachurus murphyi* stock, it remains at very low levels;

Concerned in particular with the low levels of the current biomass, high fishing mortality and the high degree of associated uncertainties;

Taking into account the outcomes of the stock assessment carried out in October of 2012 and the advice of the Scientific Working Group (SWG) established by the Preparatory Conference,

Bearing in mind the commitment to apply the precautionary approach and take decisions based on the best scientific and technical information available as set out in Article 3 of the Convention;

# Jack mackerel Conservation and Management Measure

## 1st Commission meeting, 2013

Recognizing that a primary function of the Commission is to adopt conservation and management measures to achieve the objective of the Convention, including, as appropriate, conservation and management measures for particular fish stocks;

Affirming its commitment to rebuilding the stock of *Trachurus murphyi* and ensuring its long term conservation and sustainable management in accordance with the objective of the Convention,

Recognizing the need for effective monitoring and control and surveillance of fishing for *Trachurus murphyi* ...

In 2013 the total catch of *Trachurus murphyi* in the area to which this CMM applies in accordance with paragraph 1 **shall be limited to 360,000 tons.**

# My assertion…

…SPRFMO was the fastest most effective Commission in establishing strict science-based Conservation and Management Measures

# Point #4

Jack mackerel  assessment and application to advice

# Jack mackerel assessment background

2008 Santiago SPRFMO/FAO workshop

2009 SWG 8 call for simulation testing (ASTT)

2010 ASTT Lima

- Simulation testing task team

2011 Preliminary model accepted for advice

SC01 2013
Full assessment and Model revisions

2012 SWG Lima
Alternative stock hypothesis

SC02 2014
Full Assessment and projections

**SC03 2015**
Assessment update only—just new data
**Data compilation focus**

**SC04 2016**
**Full assessment and projections**

# Assessment data

Table A8.18. Years and types of information used in the JJM assessment models.

| Fleet | Catch-at-age | Catch-at-length | Landings | CPUE | Acoustic | DEPM |
|---|---|---|---|---|---|---|
| North Chile purse seine | 1975-2015 | - | 1970-2016 | - | Index: 1984-1988; 1991; 2006-2015 Age comps: 2006-2015 | Index: 1999-2008 Age comps: 2001-2008 |
| South-central Chile purse seine | 1975-2016 | - | 1970-2016 | 1983-2016 | 1997-2009 Age comps: 1997-2009 | - |
| FarNorth | - | 1980-2016 | 1970-2016 | 2002-2009, 2011-2013 | 1988-2013 | - |
| International trawl off Chile | 1979-1991 | 2007-2015* | 1970-2016 | China (2001-2015); EU, Korea & Vanuatu (2003-2016); Russian (1987-1991, 2008-09, 2011) | - | - |

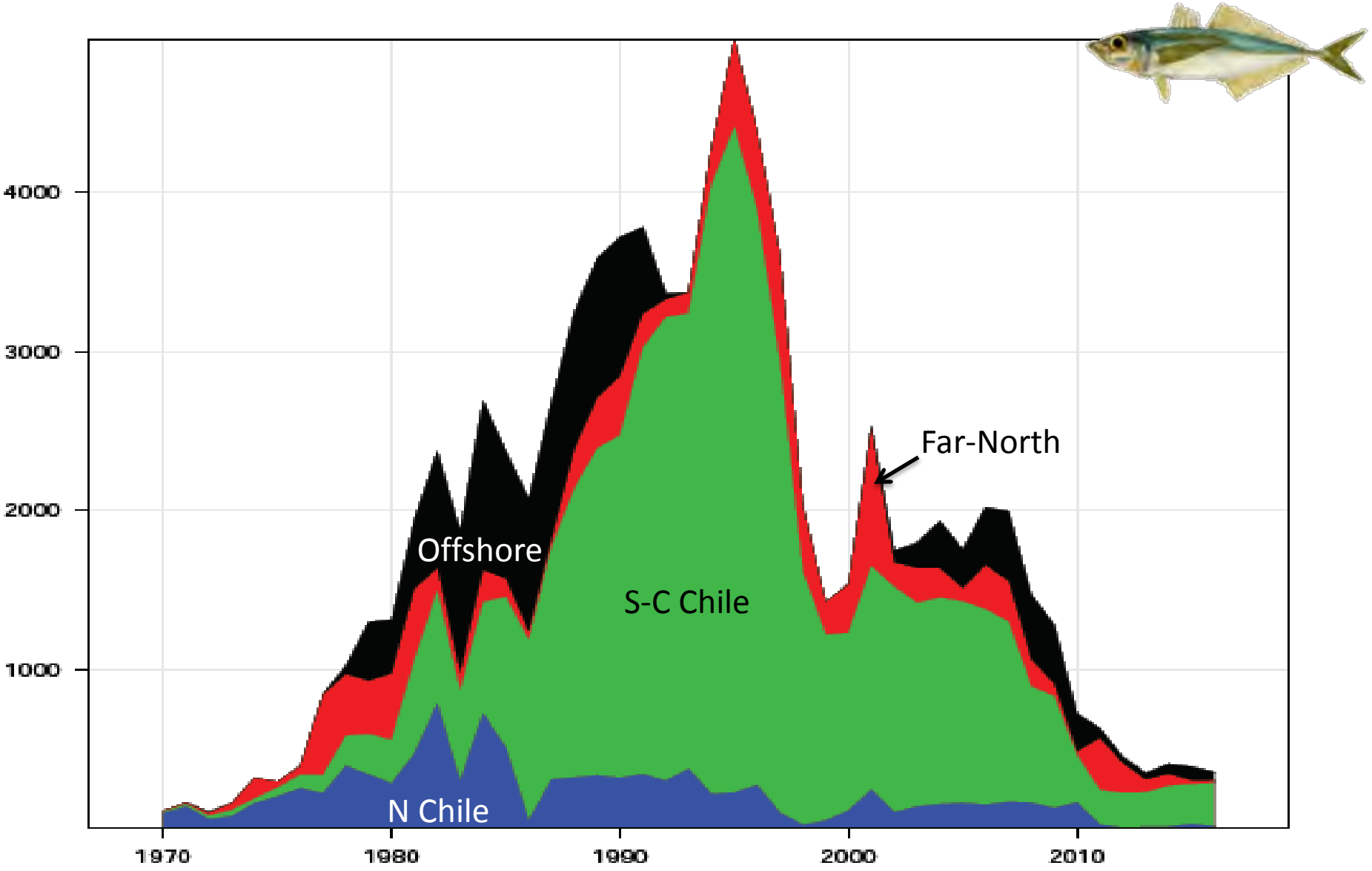
4 "Fleets"

Catch at age or length

Landings all years

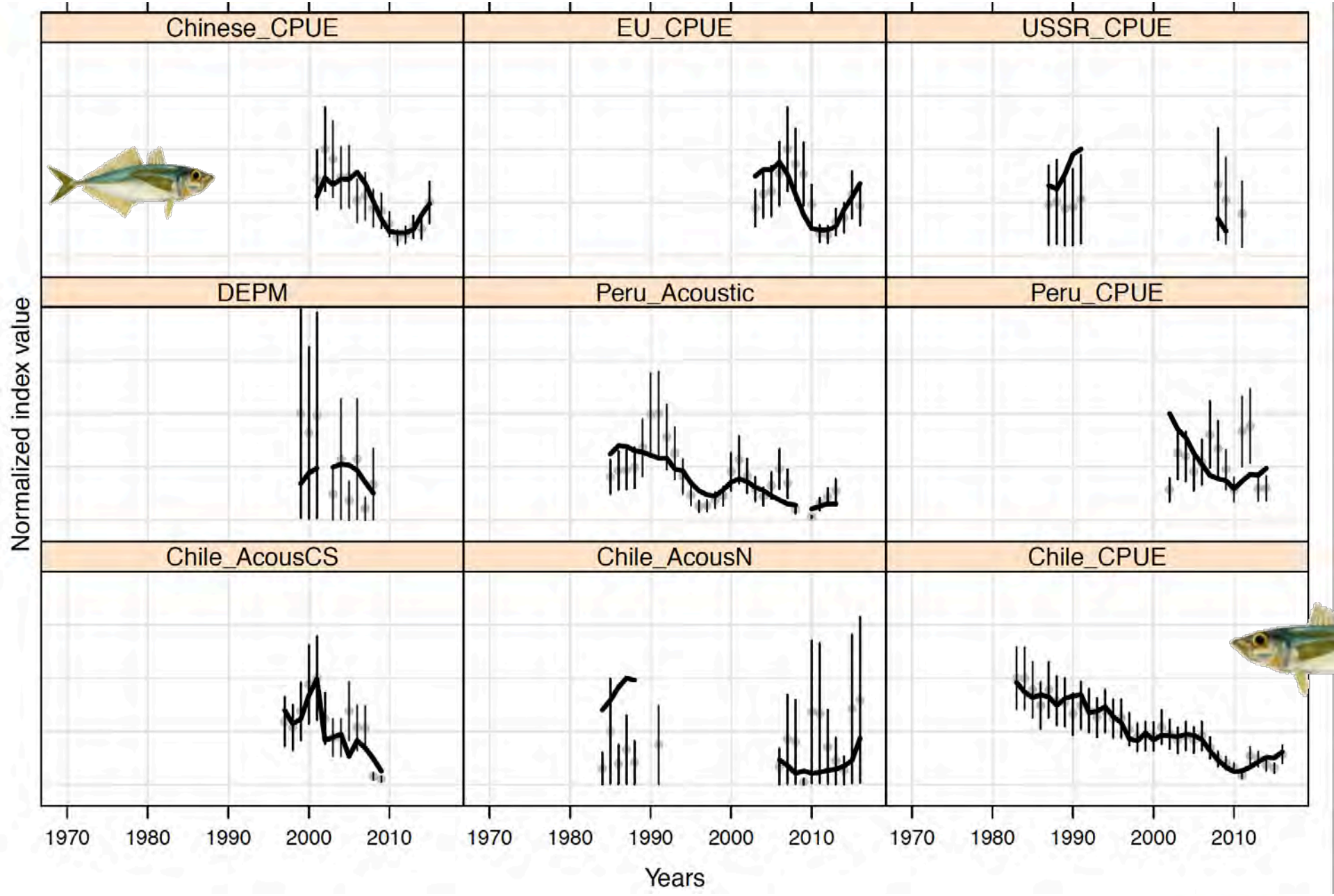
Abundance Indices

# Jack mackerel catches

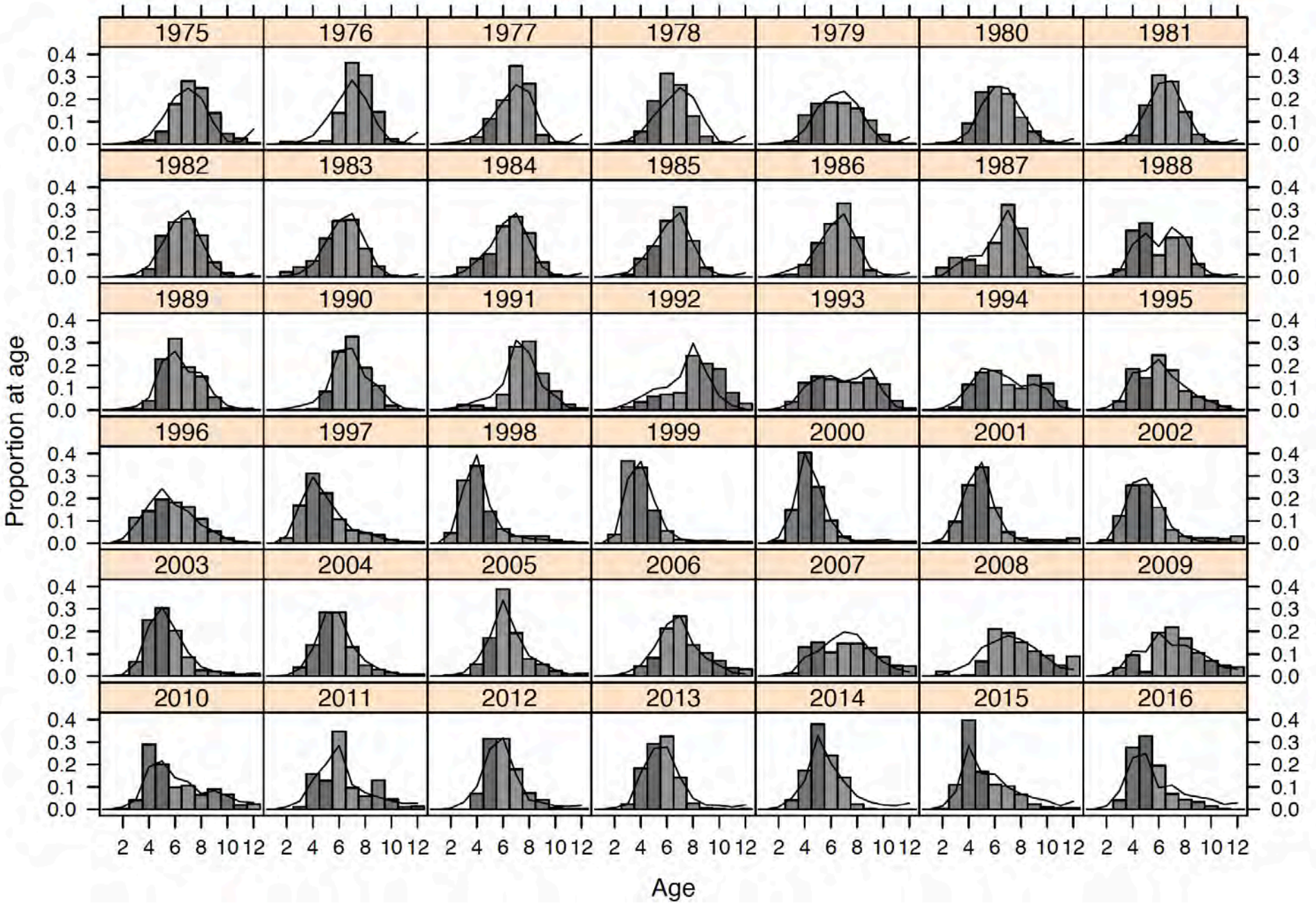



Catch history updated, 2016 projected based on member input historic patterns

# Model fit to CPUE and survey abundance indices



# Fits to age data (S-C Chilean fleet)



# SPRFMO Jack mackerel assessment

Examine effect of new data

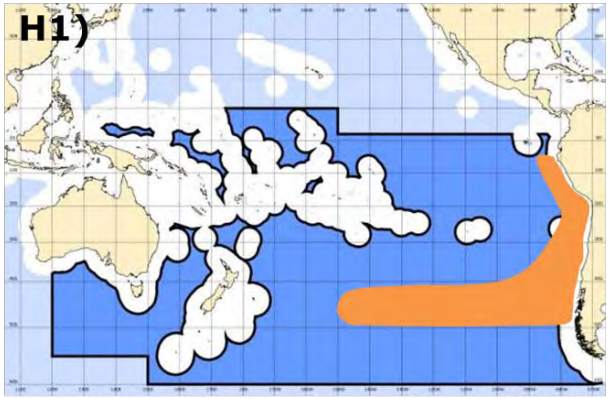
| Model | Description |
|---|---|
| **Models 0.x** | **Data introductions…** |
| mod0.0 | Exact 2015 model and data set through 2015 |
| mod0.1 | Extended to 2016…with revised catches through 2015 and provisional 2016 catch estimates |
| mod0.2 | As 0.1 but with new Chinese CPUE index |
| mod0.3 | As 0.2 but with new Peruvian CPUE index |
| mod0.4 | As 0.3 but with updated Chilean CPUE index |
| mod0.5 | As 0.4 but with 2012 q changed to 2000 on Chilean CPUE index |
| mod0.6 | As 0.5 but with alternative Chilean CPUE index |
| mod0.7 | As 0.5 but with new Offshore nominal CPUE index |
| mod0.8 | As 0.7 but with age composition from all updated |
| mod0.9 | As 0.8 but with selectivity in acoustic N |
| mod0.10 | As 0.9 but with age-error turned off |
| mod0.11 | As 0.10 but with EU only LF for 2015 |
| mod0.12 | As 0.10 but echo-abundance in Far North as an alternative, uses backscatter directly |
| mod0.13 | As 0.12 but Updated Acoustic survey data in N Chile including 2016 biomass estimate |

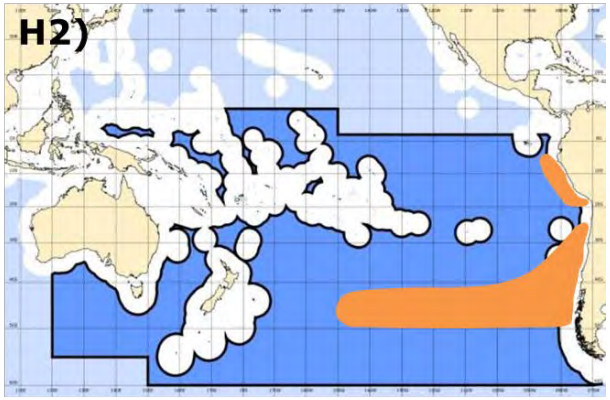
# SPRFMO Jack mackerel assessment

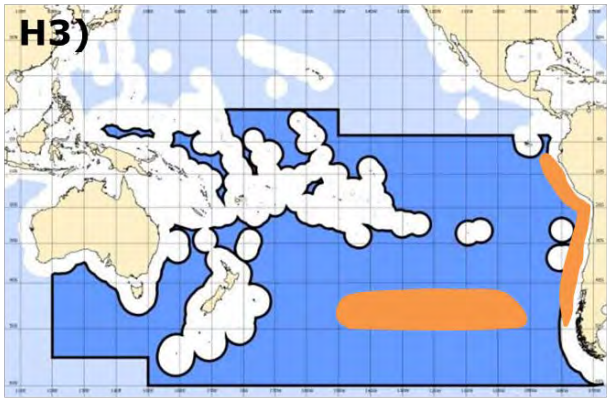
## Model configuration sensitivities

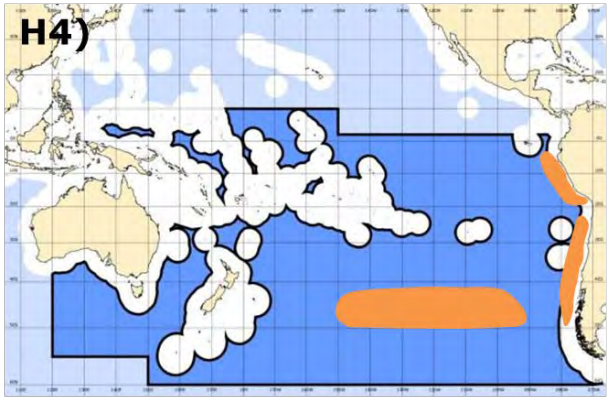
| Model number | Model description |
|---|---|
| 1.0 | 2015 base configurations with all data updated to 2016 |
| 1.1 | As 1.0 but downweighting nominal CPUEs (EU and Russia) |
| 1.2 | As 1.0 but downweighting discontinued surveys (acoustic Peru, DEPM, acoustic Chile Central South) |
| 1.3 | As 1.0 but applying dataset uncertainty (through sample size of the multinomials and the CVs) set according to the estimated uncertainty of these datasets following from the 2015 data workshop |
| 1.4 | As 1.0 but applying dataset uncertainty (CVs) set according to numbers provided in SC04-JM07 |
| 1.5 | As 1.0 but selectivity changes in the fisheries as set according to SC04-JM06 |
| 1.6 | As 1.0 but selectivity changes in the fisheries as set according to SC01 settings |
| 1.7 | As 1.0 but downweighting catch-at-age |
| 1.8 | As 1.0 but rescaling sampling size using the Francis T1.8 method |
| 1.9 | As 1.0 but varying natural mortality between 0.05 and 0.5 in steps of 0.05 |
| 1.10 | As 1.0 but implementing age-varying natural mortality following Lorenzen 1998, scaled to the maximum ages to be 0.23 |
| 1.11 | As 1.0 but including a selectivity change in the Northern Chilean acoustic survey in 2015 and 2016 to reflect changes in availability due to El Nino |
| 1.12 | Combining 1.11 and 1.5 |
| 1.13 | Combining 1.12 and 1.7 |
| 1.14 | Combining 1.11 and 1.3 |
| 1.15 | As 1.11 but including a change in the Northern Chilean acoustic in 2014, 2015 and 2016 |
| 1.16 | As 1.11 but including the natural M following Lorenzen 1998 scaled to the mean of 0.23 (*unsuccessful*) |
| 1.17 | As 1.11 but including ageing-error |
| 1.18 | As 1.11, including time-varying selectivity in the fleets up to 2016 |
| 1.19 | As 1.18 but including provisional age-error matrix |

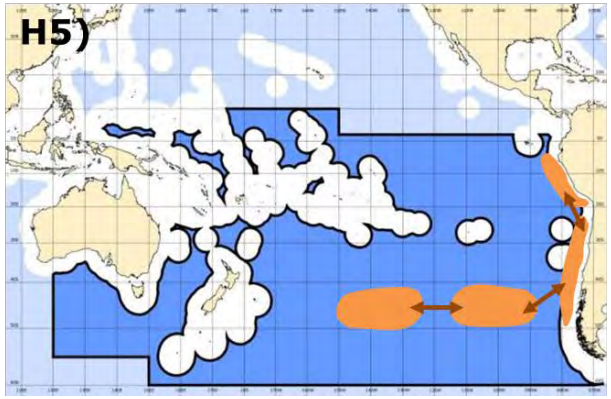
# Working hypotheses on population structure

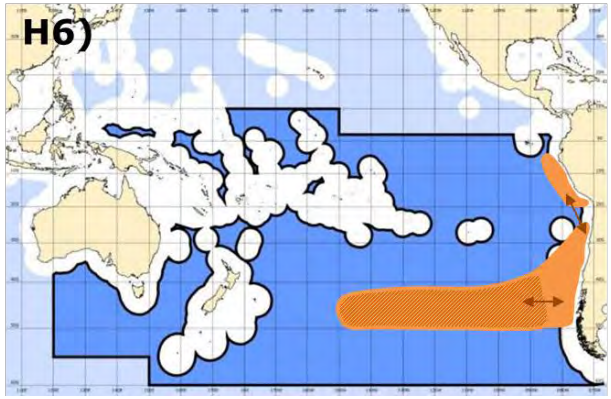


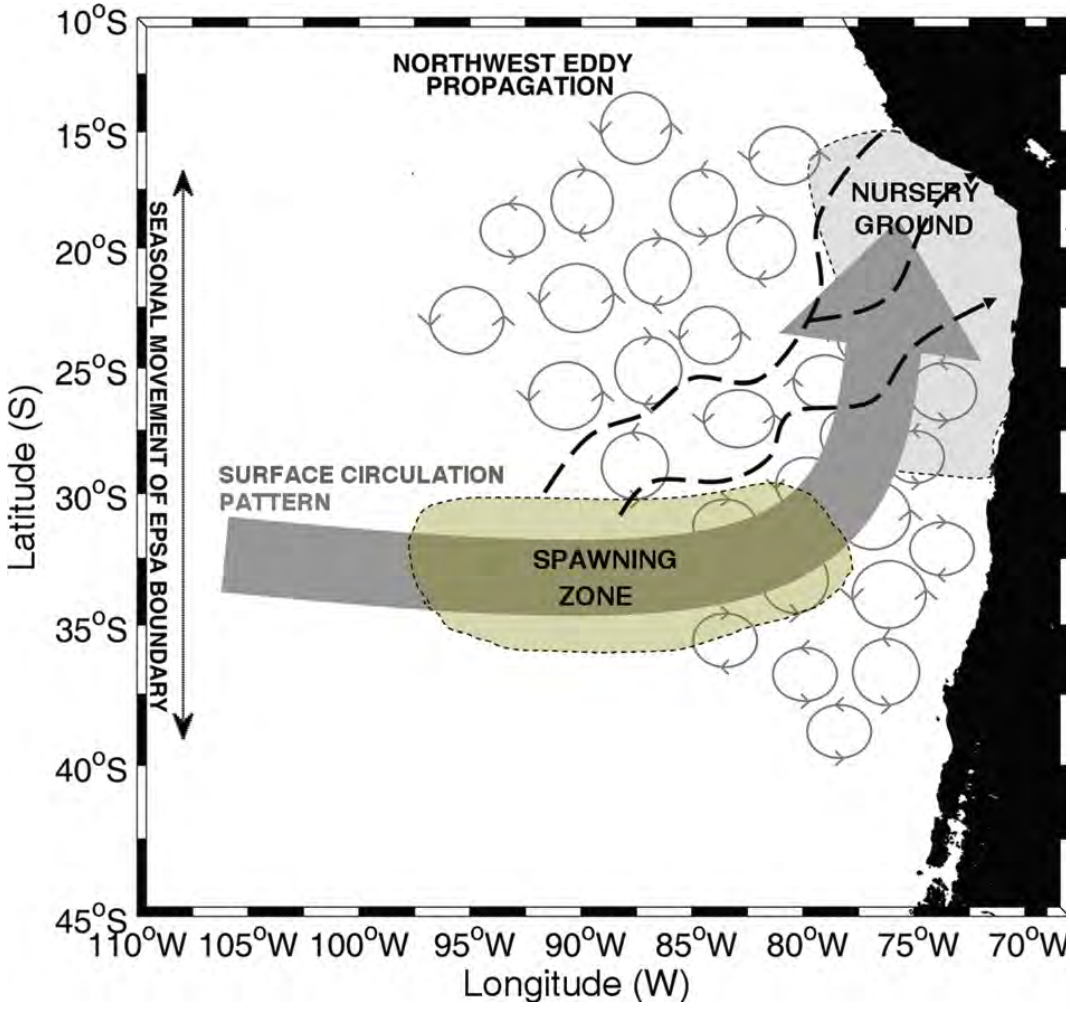
# SPRFMO Jack mackerel assessment

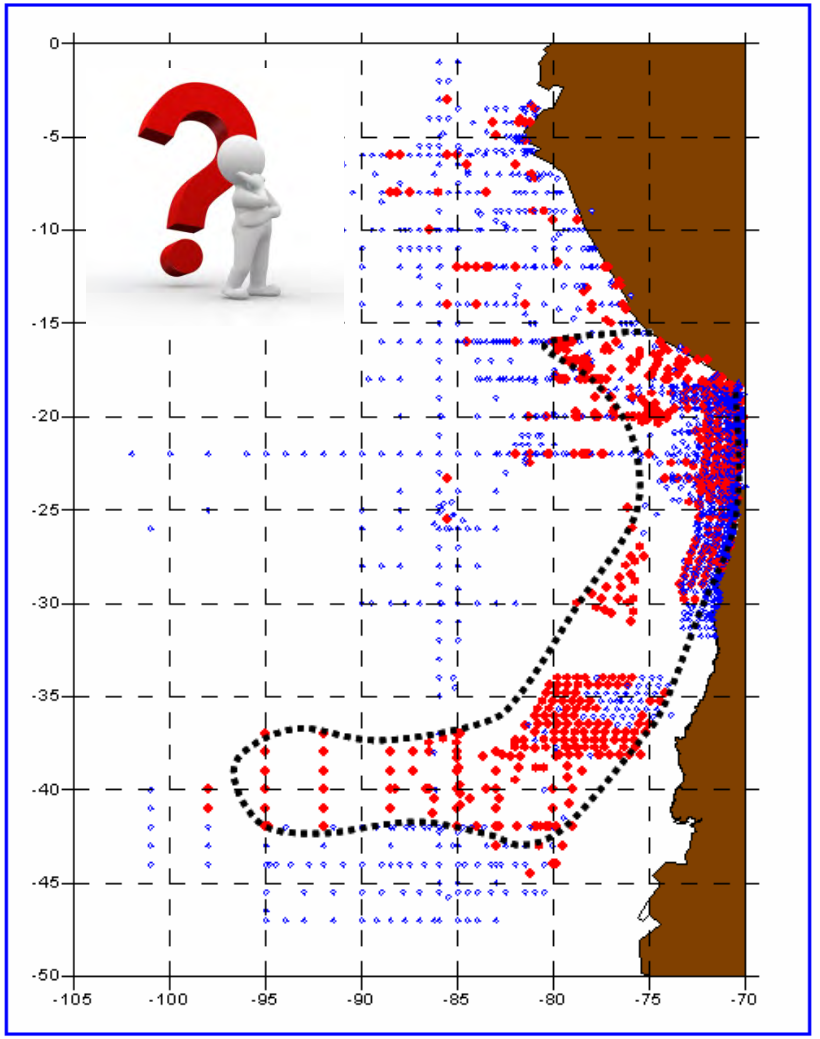
## Stock structure hypotheses

| Hypothesis | Stock | Fleets |
|---|---|---|
| **Hypothesis 1 (multiple stocks)** | Northern Stock | Far north |
| | Southern Stock | Northern<br>Central-South<br>Offshore fleet |
| **Hypothesis 2** | Single stock | Far north<br>Northern Chile<br>Central-South Chile<br>Offshore fleet |

*Hypotheses as presented from the 2008 SPRFMO/FAO meeting

# Conceptual model of connectivity



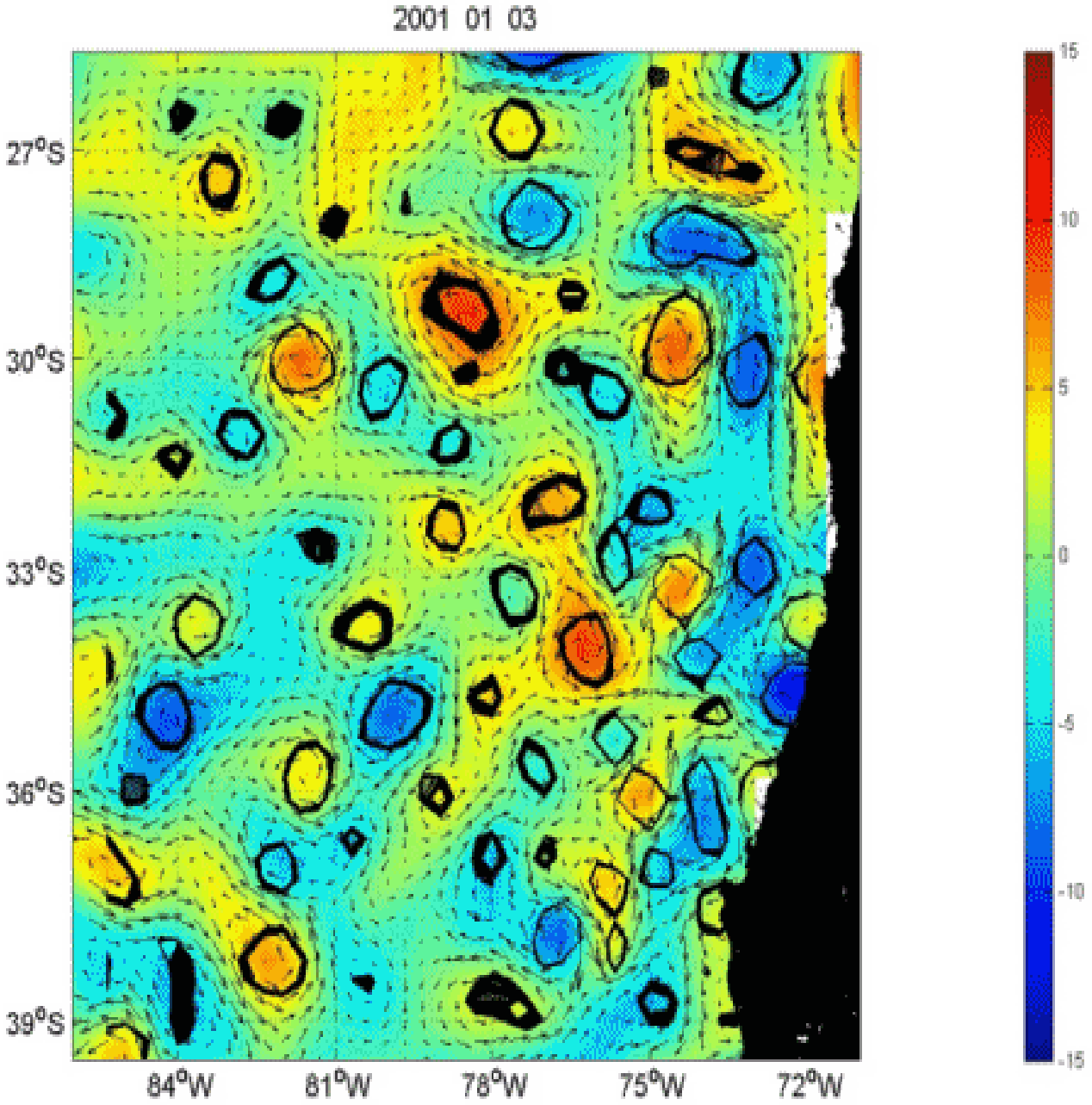
Ocean

Circulation

Model

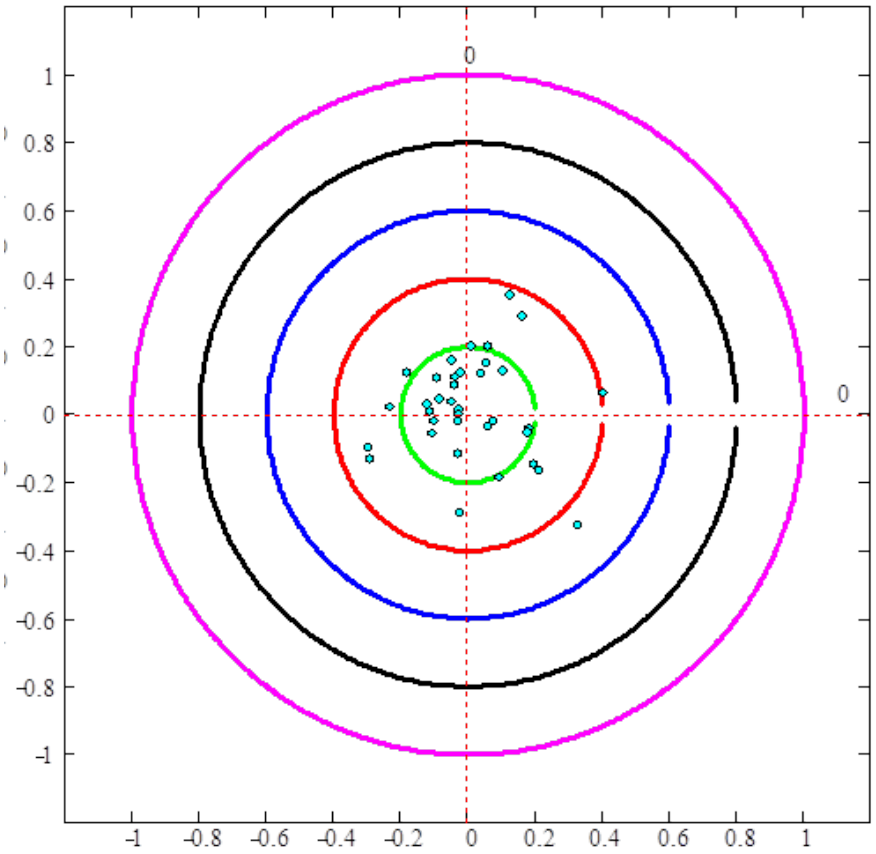
Resolves

eddies




Source: INPESCA

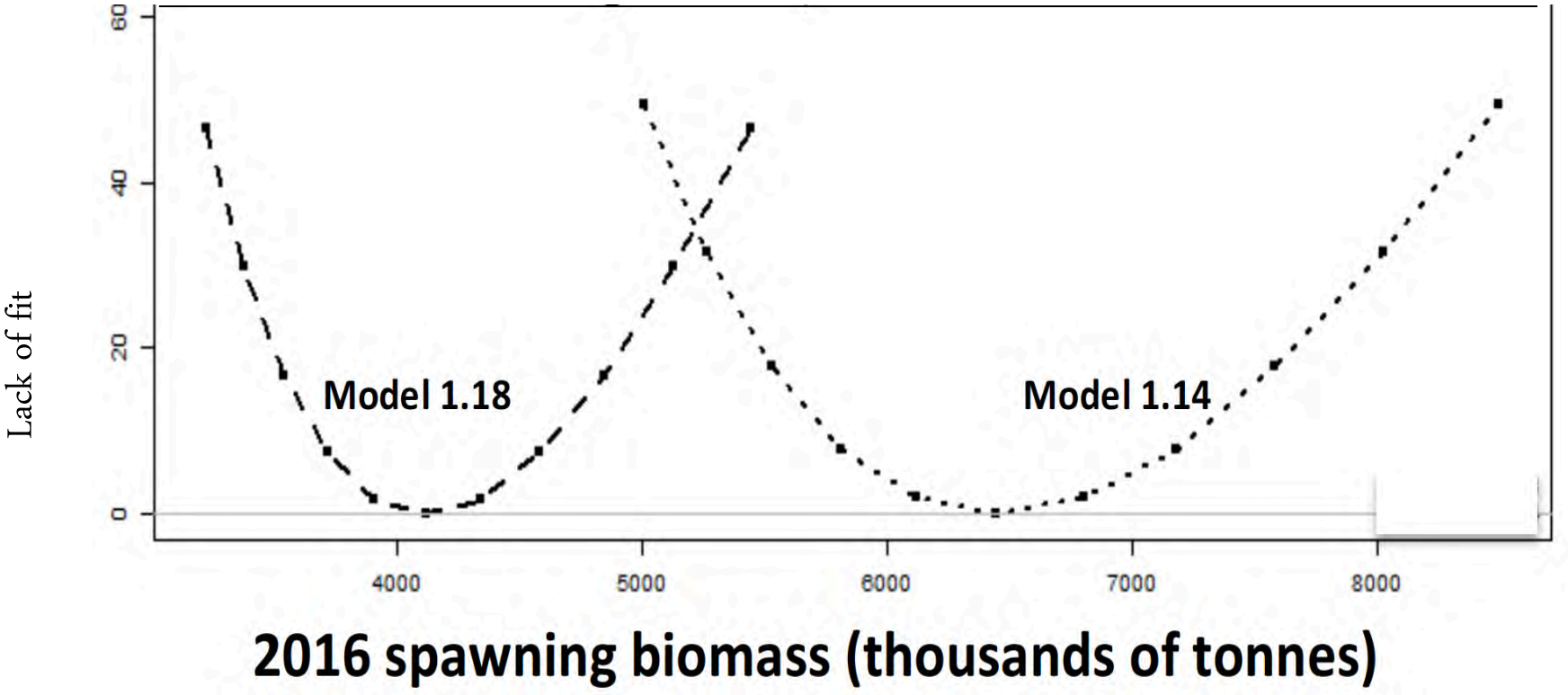
# Sources of uncertainty




- Within model
  - Data precision
- Between models
  - Structural uncertainty
- Projections
  - Environmental effects on recruitment etc.

# SPRFMO Jack mackerel assessment

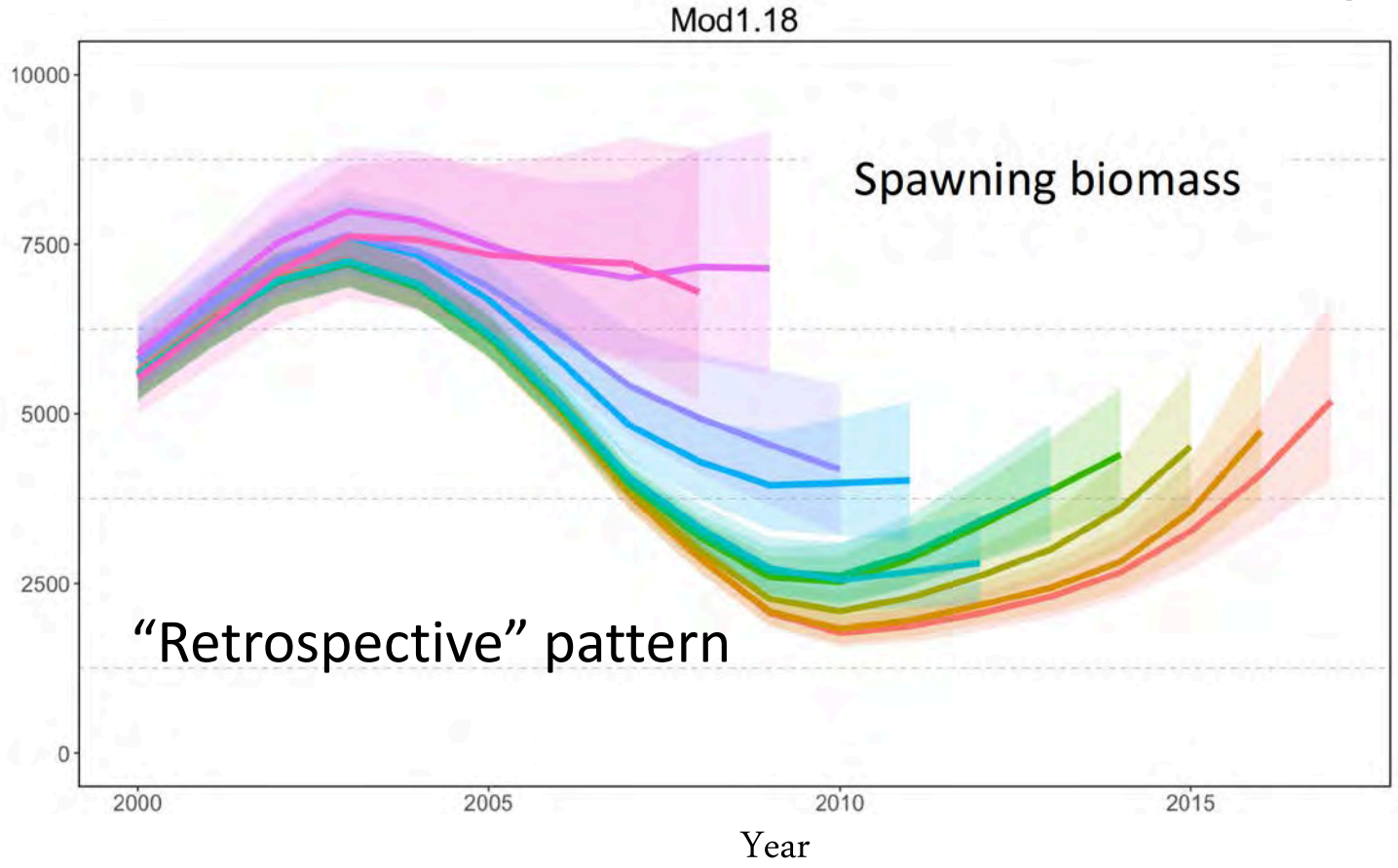
## Diagnostics




Likelihood profiling...

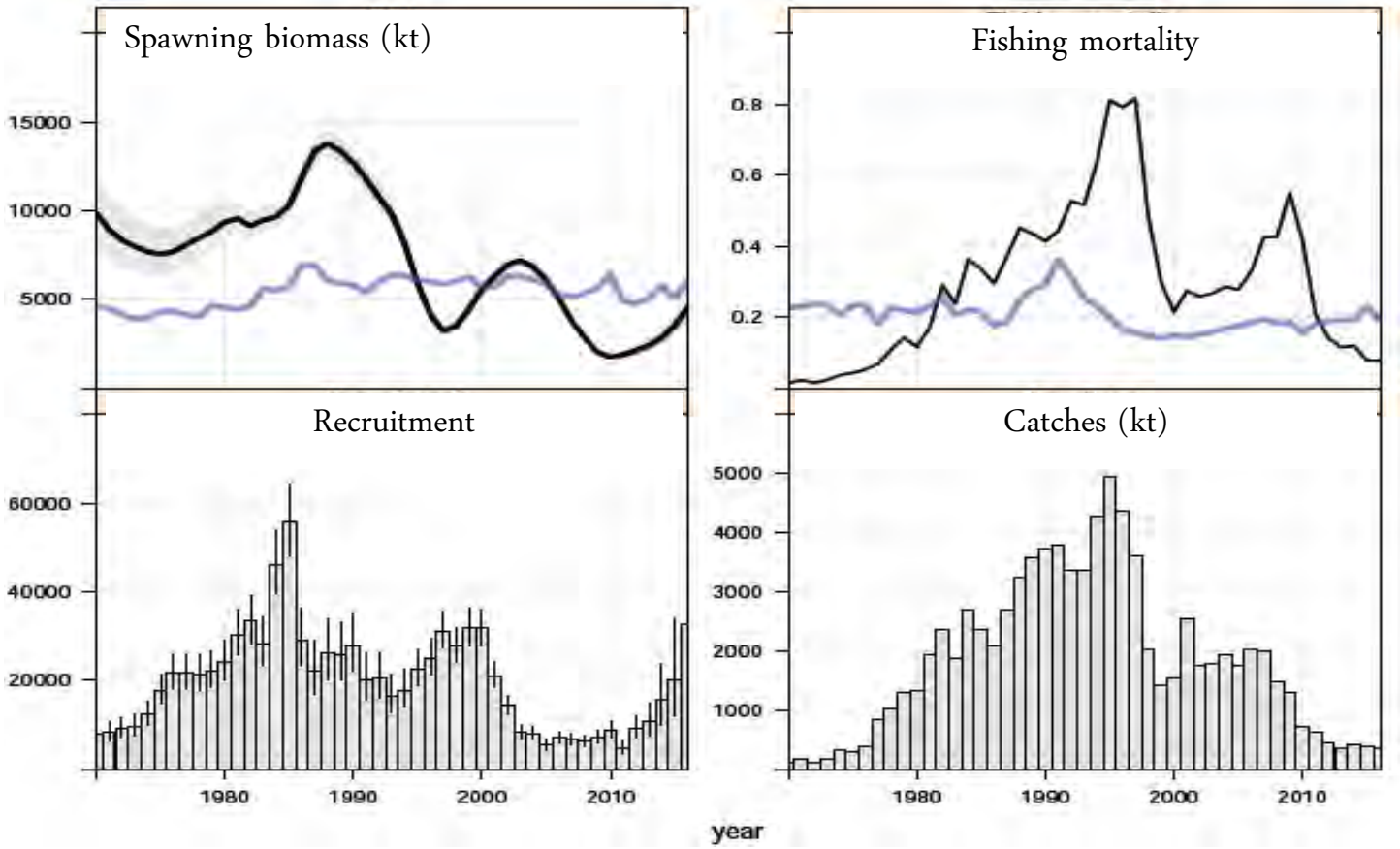
# SPRFMO Jack mackerel assessment

## Diagnostics



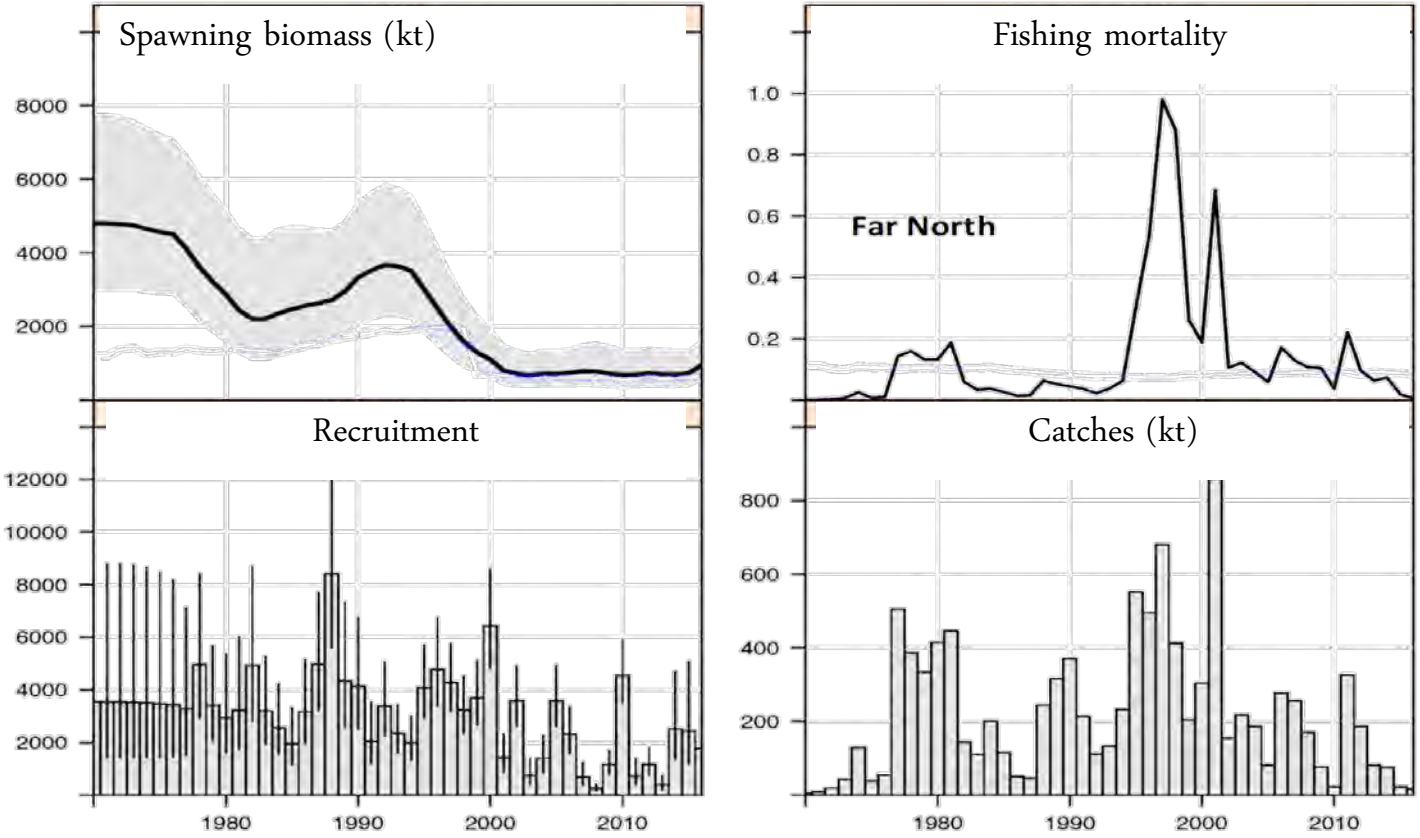
# Stock summary

## Single stock



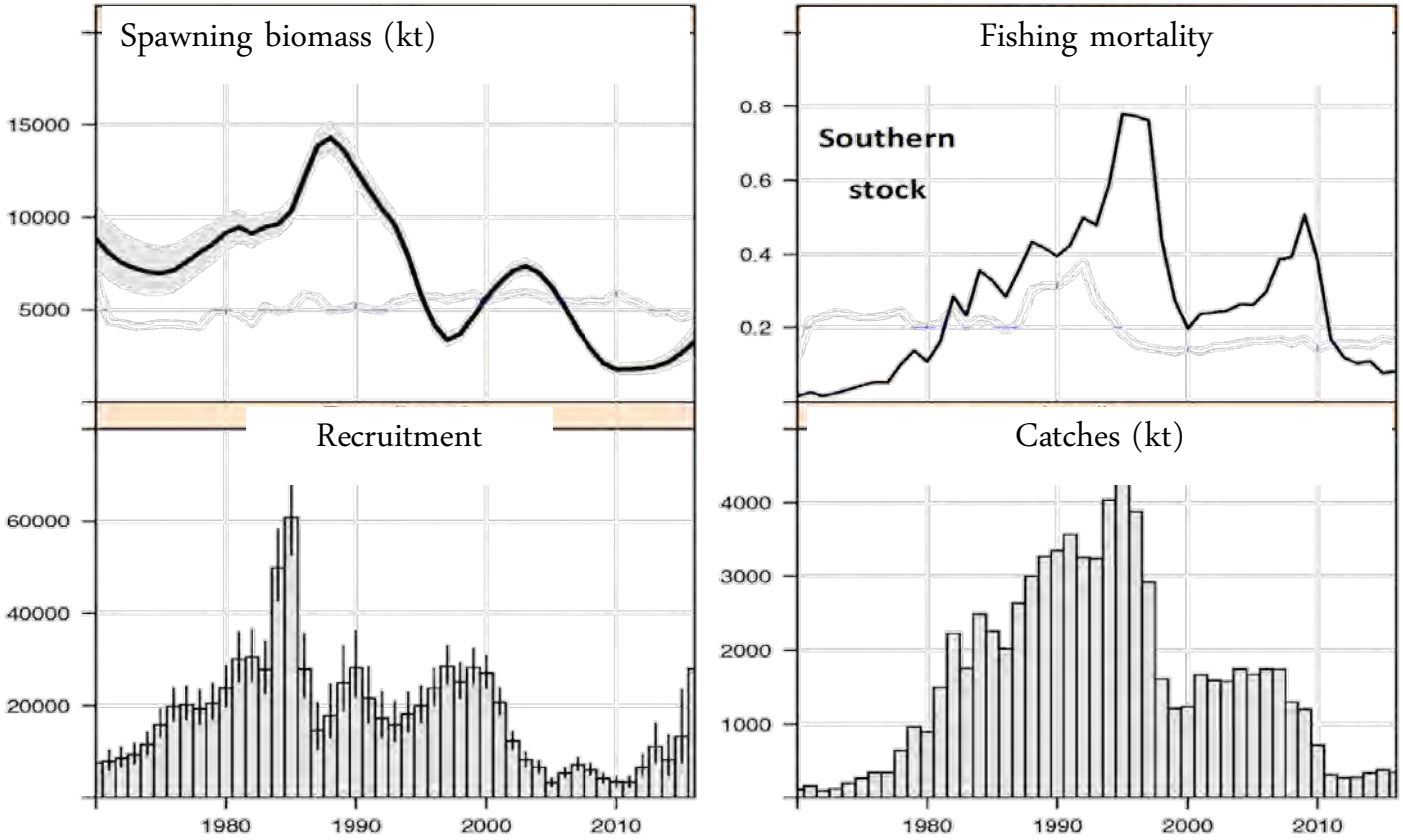
# Stock summary

## Northern stock



# Stock summary

## Southern stock



# Science Advice summary

On the application of the adjusted rebuilding plan adopted by the 2nd Meeting of the Commission as proposed from SC02, **the Commission should aim to maintain 2017 catches for the entire jack mackerel range in the southeast Pacific at or below 493 kt.**

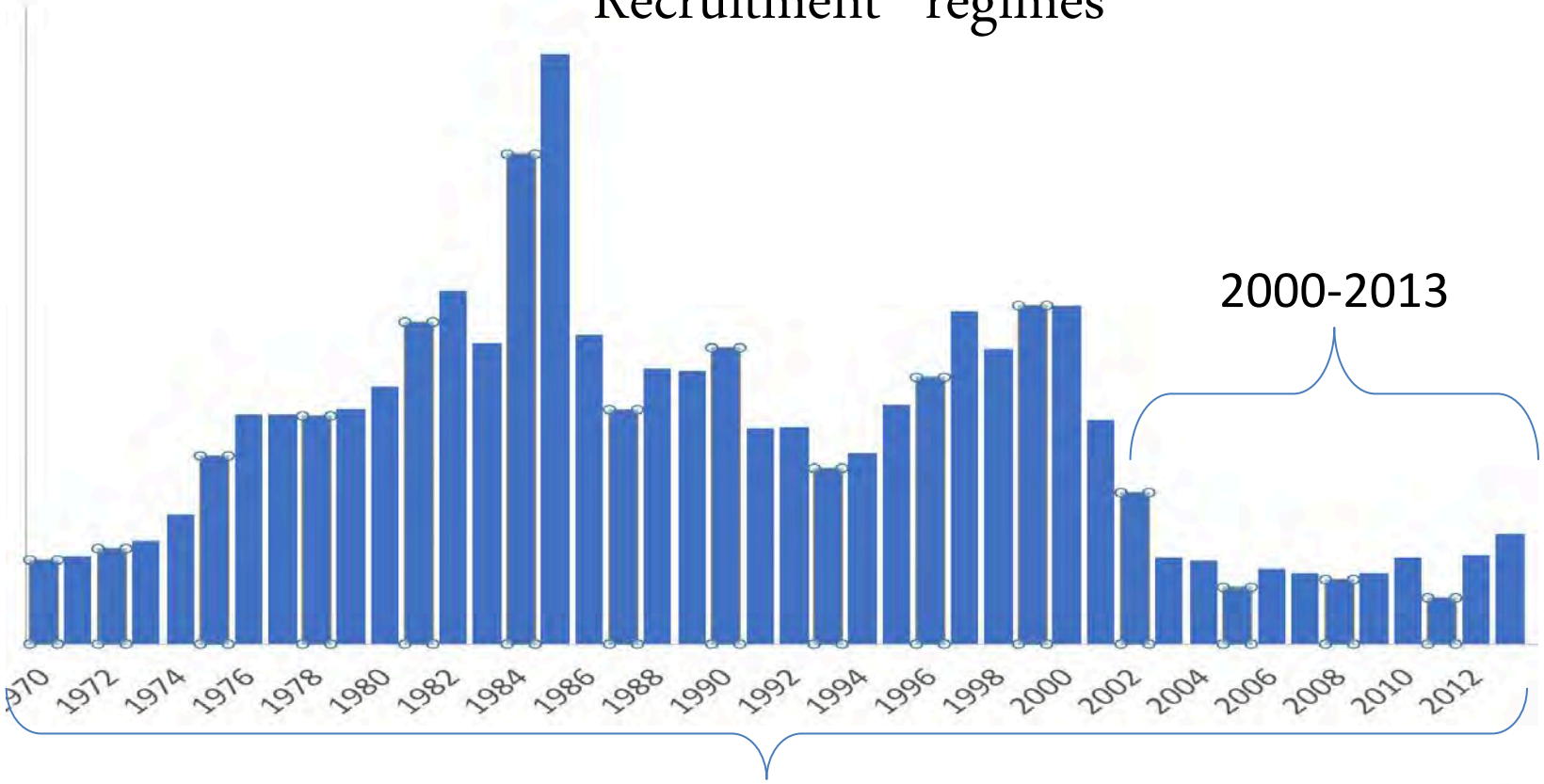
- "Good" probability to continue to increase spawning biomass

# Point #5

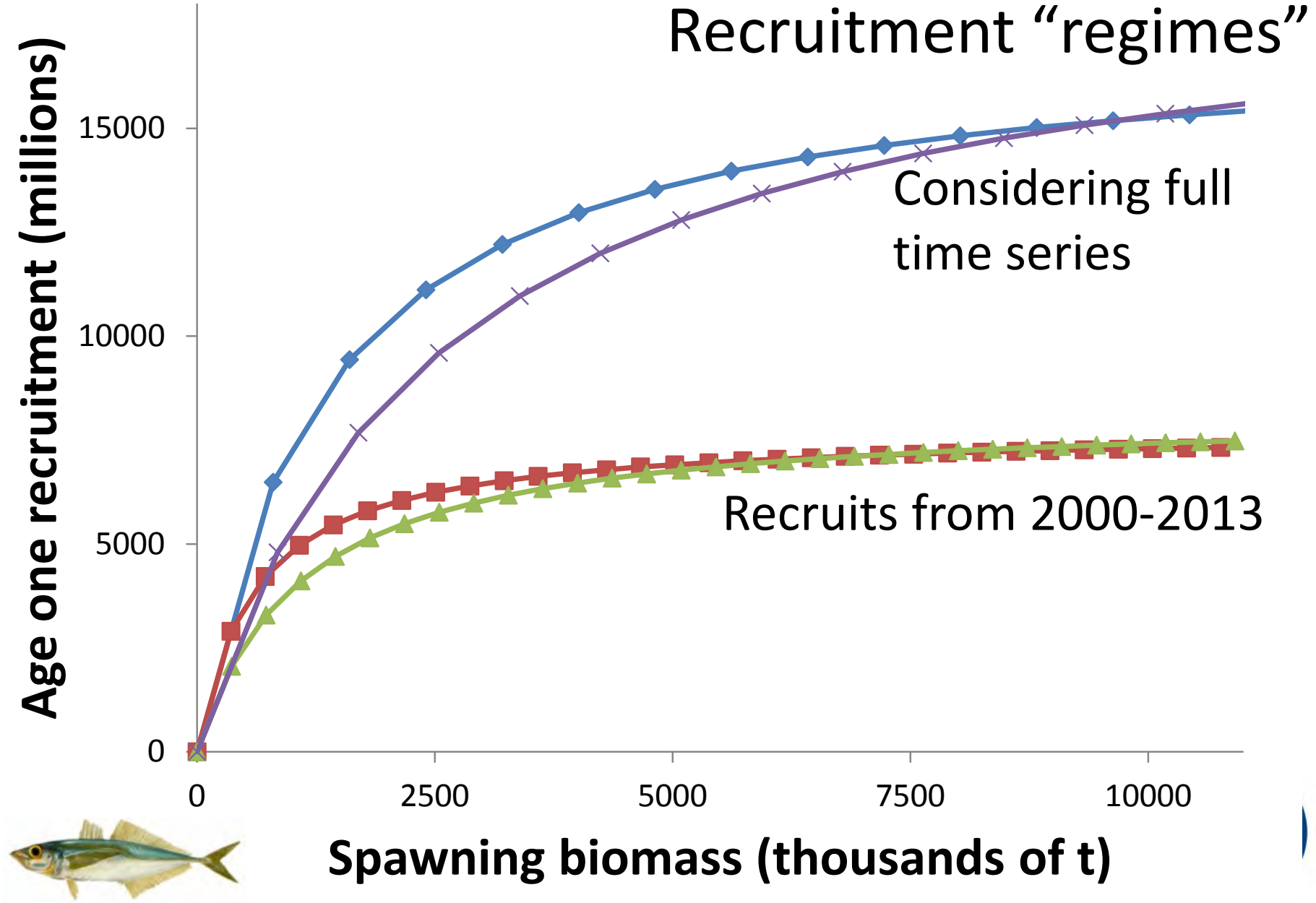
What about environmental drivers of this small pelagic resource?

SC stock status indicators

## Recruitment "regimes"



Stock status considerations



# Communicating to Commission…

# Catch projections

- Table 1…**higher** productivity

**Model 2.0, steepness=0.8, recruitment from 1970-2013**

| Reference $F_{2016}$ | $B_{2018}$ | $P(B_{2018} > B_{MSY})$ | $B_{2022}$ | $P(B_{2022} > B_{MSY})$ | $B_{2026}$ | $P(B_{2026} > B_{MSY})$ | Catch 2017 (kt) | Catch 2018 (kt) |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 7047 | 94% | 11940 | 100% | 15945 | 100% | 0 | 0 |
| 0.50 | 6713 | 89% | 10312 | 100% | 12546 | 100% | 232 | 298 |
| 0.75 | 6555 | 86% | 9619 | 99% | 11247 | 100% | 345 | 435 |
| 1.00 | 6351 | 81% | 8792 | 98% | 9807 | 99% | 493 | 609 |
| 1.25 | 6255 | 79% | 8430 | 97% | 9215 | 98% | 563 | 689 |

kt kt kt kt

**Model 2.1, steepness=0.8, recruitment from 2000-2013**

| Reference $F_{2016}$ | $B_{2018}$ | $P(B_{2018} > B_{MSY})$ | $B_{2022}$ | $P(B_{2022} > B_{MSY})$ | $B_{2026}$ | $P(B_{2026} > B_{MSY})$ | Catch 2017 (kt) | Catch 2018 (kt) |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 6706 | 90% | 9547 | 100% | 10857 | 100% | 0 | 0 |
| 0.50 | 6372 | 82% | 8017 | 97% | 8049 | 96% | 232 | 299 |
| 0.75 | 6214 | 78% | 7372 | 93% | 7010 | 88% | 345 | 437 |
| 1.00 | 6010 | 71% | 6608 | 82% | 5886 | 63% | 493 | 612 |
| 1.25 | 5915 | 67% | 6276 | 74% | 5435 | 48% | 564 | 692 |

kt kt kt kt

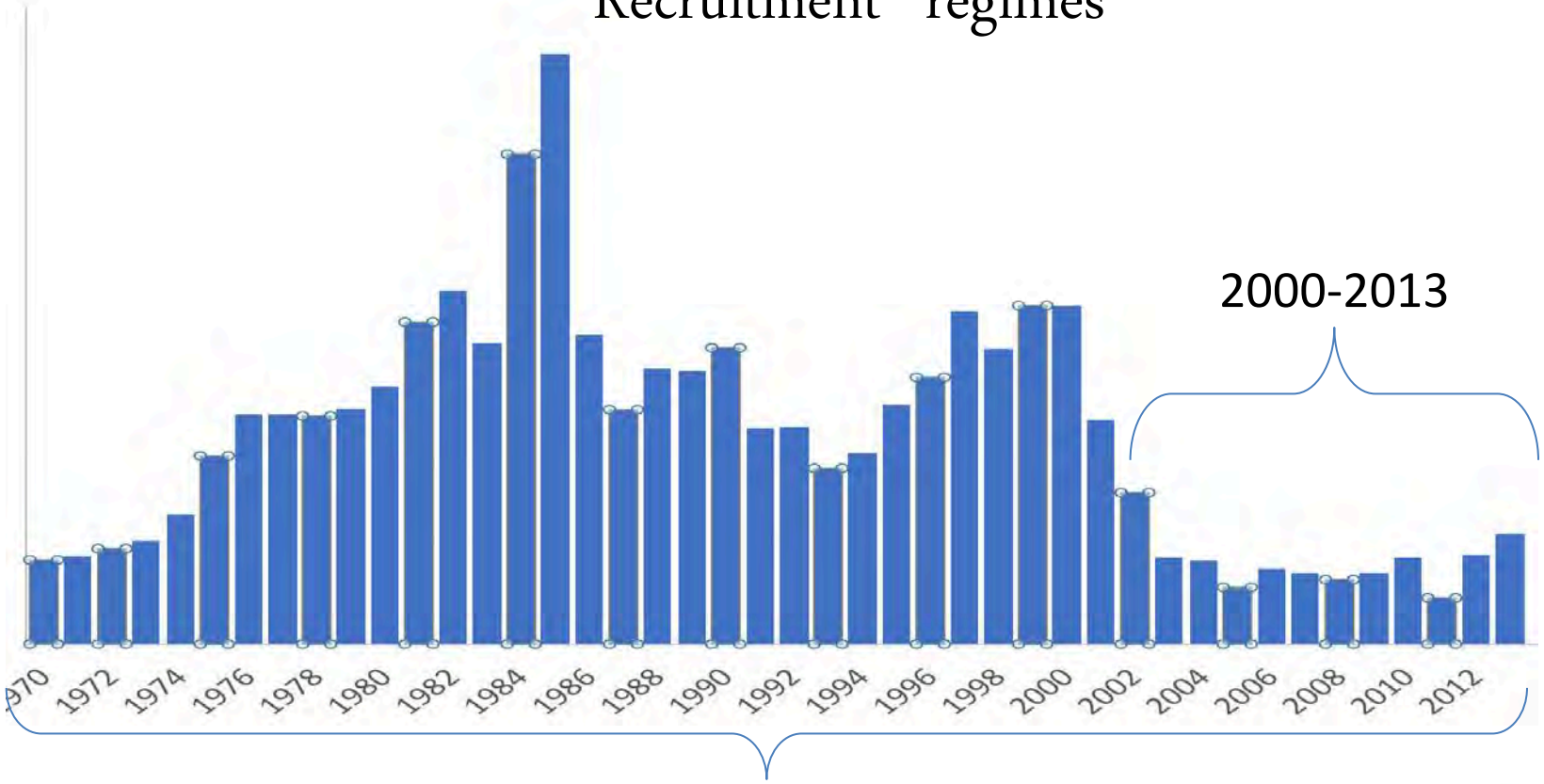
# Catch projections

- Table 1…**lower** productivity

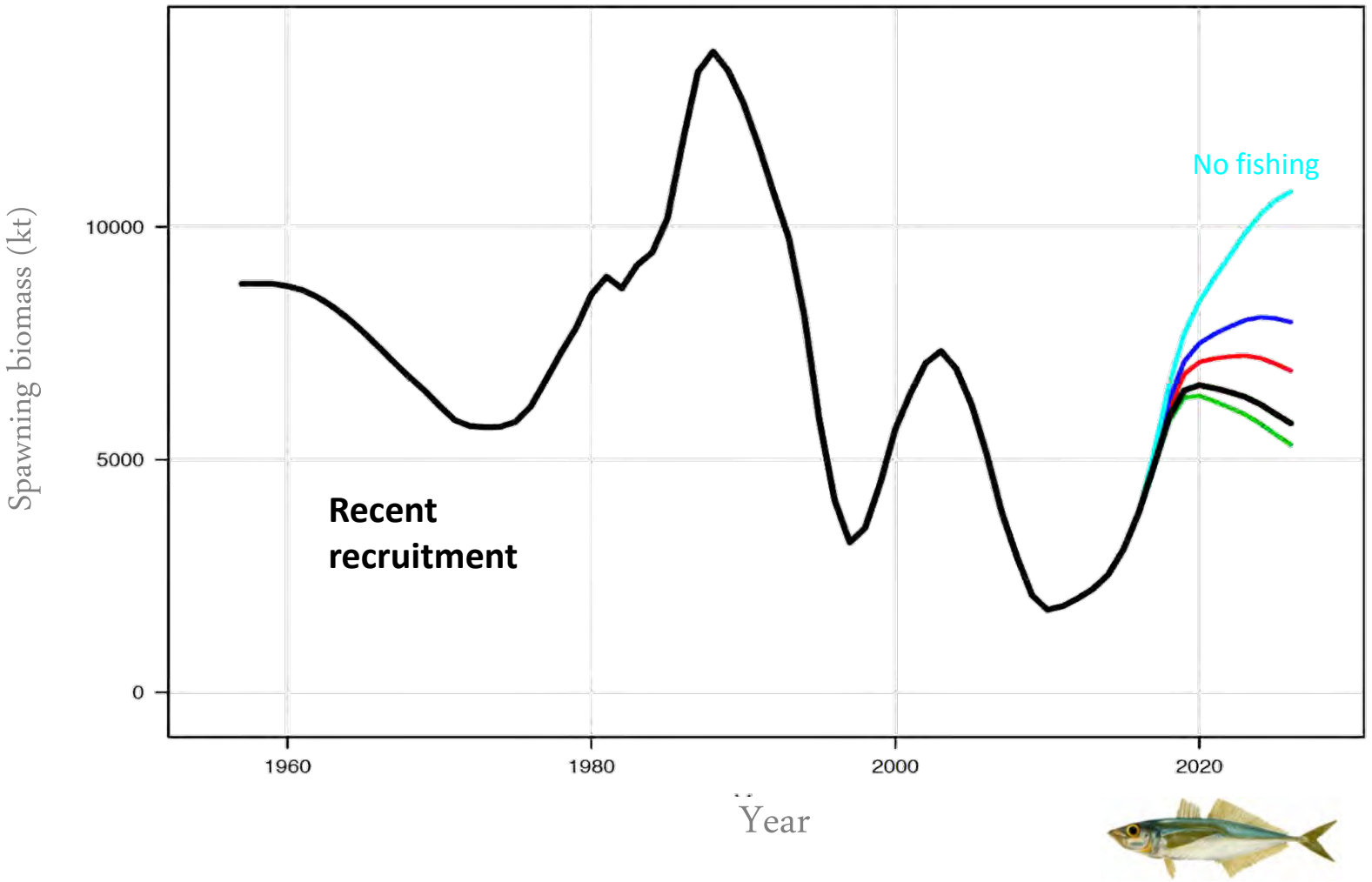
| Model 2.2, steepness=0.65, recruitment from 1970-2013 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reference $F_{2016}$ | $B_{2018}$ | $P(B_{2018} > B_{MSY})$ | $B_{2022}$ | $P(B_{2022} > B_{MSY})$ | $B_{2026}$ | $P(B_{2026} > B_{MSY})$ | Catch 2017 (kt) | Catch 2018 (kt) |
| 0.00 | 6845 | 92% | 11387 | 100% | 15421 | 100% | 0 | 0 |
| 0.50 | 6512 | 86% | 9763 | 99% | 12014 | 100% | 231 | 297 |
| 0.75 | 6355 | 82% | 9071 | 98% | 10704 | 99% | 344 | 434 |
| 1.00 | 6151 | 76% | 8244 | 96% | 9244 | 97% | 492 | 607 |
| 1.25 | 6057 | 72% | 7882 | 94% | 8641 | 96% | 562 | 687 |
| **Model 2.3, steepness=0.65, recruitment from 2000-2013** | | | | | | | | |
| Reference $F_{2016}$ | $B_{2018}$ | $P(B_{2018} > B_{MSY})$ | $B_{2022}$ | $P(B_{2022} > B_{MSY})$ | $B_{2026}$ | $P(B_{2026} > B_{MSY})$ | Catch 2017 (kt) | Catch 2018 (kt) |
| 0.00 | 6603 | 88% | 9383 | 100% | 10756 | 100% | 0 | 0 |
| 0.50 | 6269 | 80% | 7857 | 96% | 7956 | 95% | 232 | 299 |
| 0.75 | 6112 | 75% | 7213 | 91% | 6913 | 86% | 344 | 436 |
| 1.00 | 5909 | 67% | 6449 | 78% | 5780 | 59% | 493 | 611 |
| 1.25 | 5814 | 64% | 6118 | 70% | 5324 | 44% | 563 | 691 |

SC stock status indicators

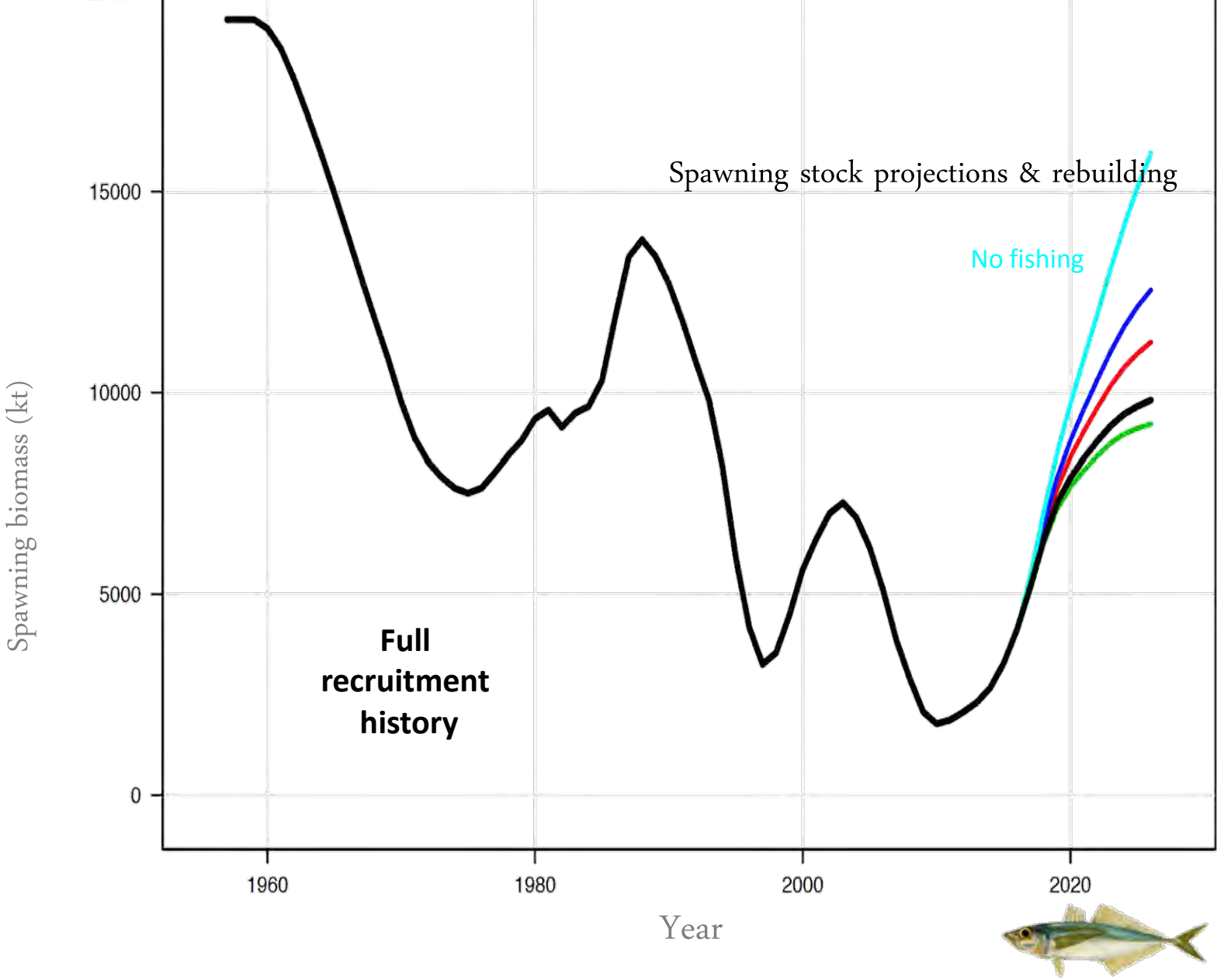
## Recruitment "regimes"



# Spawning stock projections & rebuilding

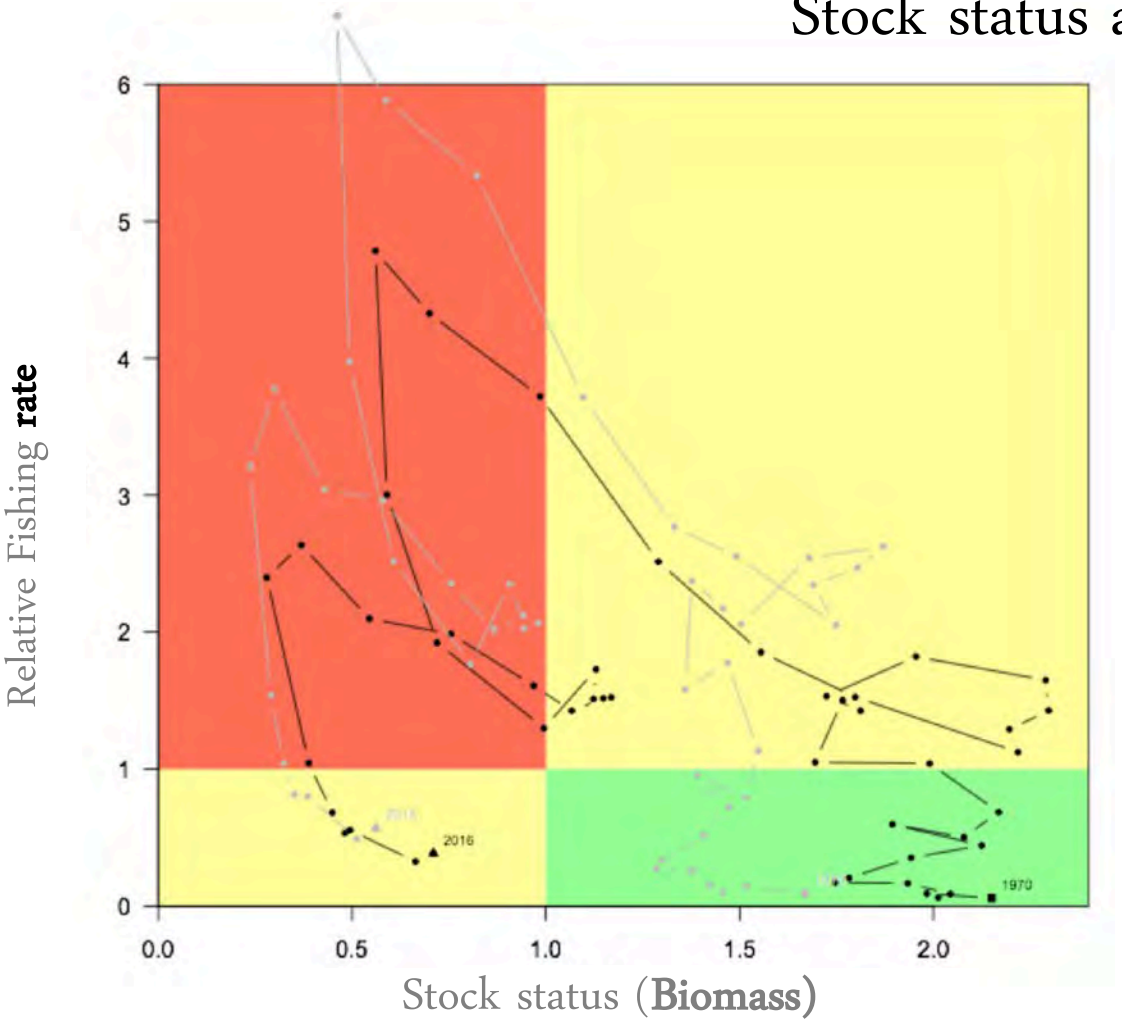



Over different future fishing mortality rates




Over different future fishing mortality rates

# Stock status and history



# SC Advice summary to Commission

Annex 3 – Jack Mackerel advice sheet

South Pacific Regional Fisheries Management Organisation

## Stock status summary for jack mackerel, October 2016

Stock: Jack Mackerel (*Trachurus murphyi*)
Region: Southeast Pacific

### *Advice for 2017*

The SPRFMO Science Committee advises to maintain 2017 catches at or below 493,000t.

### *Stock status*

| | | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| **Fishing mortality in relation to** | $F_{MSY}$ | Below | Below | Below |
| **Spawning stock biomass in relation to** | $B_{MSY}$ | Below | Below | Below |

# Jack mackerel assessment challenges

## Growth

- Large variability between regions
  - And methods for age determination

## Productivity

- Current stock status advice conservative
  - Recent low recruitment for projections
  - Target reference points based on full time series
  - Affects rebuilding plan

## Spatial considerations

- Desire to tie catch limits to relative spatial distributions
- Higher order problem (not to mention politics)

# Review

1. Big area, important fisheries
2. Complex organizational task to create a Commission
3. Science endeavor to manage the region's fisheries
4. Jack mackerel  assessment and application to advice
5. What about environmental drivers of this small pelagic resource?


Thanks!
Courtecy of Tomasz Raczyński and Ad Corten