


Comisión Interamericana del Atún Tropical
Inter-American Tropical Tuna Commission

CIAT
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SOUTH EPO SWORDFISH BENCHMARK ASSESSMENT: Progress report (SAC-13-09)

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Outline

- Motivation
- Data
- Auxiliary analyses
  - Catch estimation
  - Fishery definitions
  - Indices of abundance
- Stock assessment
  - Stock structure hypothesis
  - Reference model assumptions
- Preliminary results
  - Reference model
- Future work

Motivation

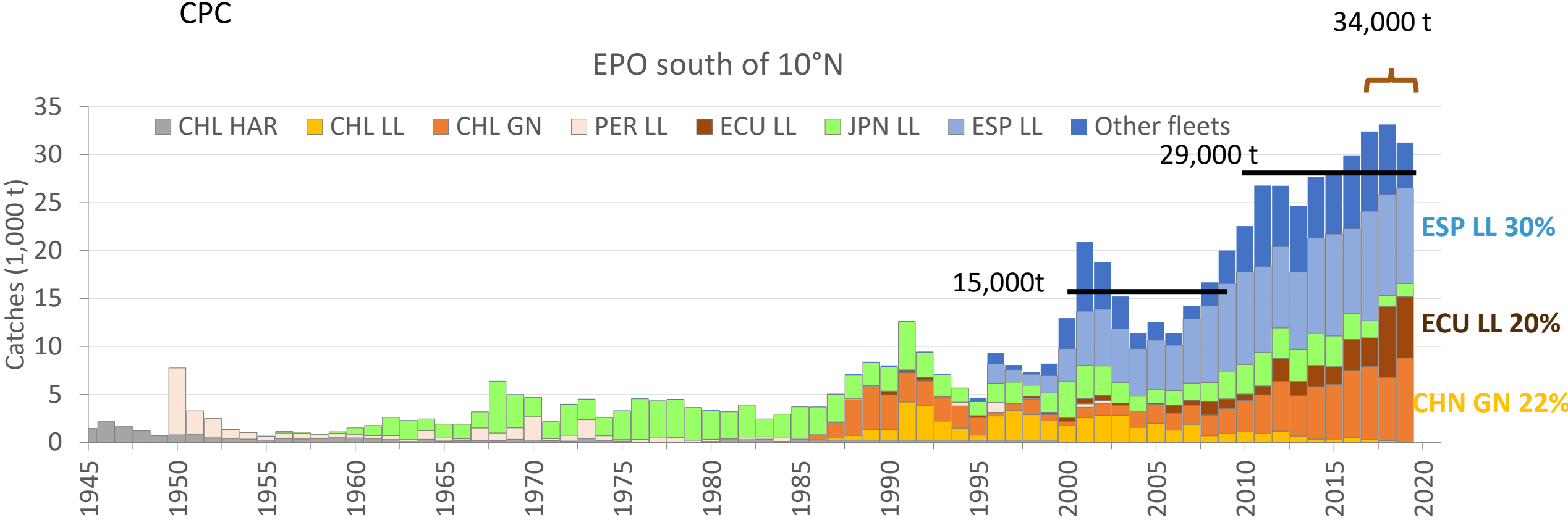
- Last assessment of south EPO swordfish done in 2011
  - SAC-02-07
- The commission requested the staff to work on a new assessment
  - In the workplan since 2018
- The work for the assessment started in Fall 2020
  - Preceded by longline research: collaboration with Japan, Korea, Chinese Taipei and China
  - New collaboration started
  - 1st technical workshop on S EPO swordfish (SWO-01-Report)

Data

- Catches
  - Submission in compliance with Resolution C-03-05
  - Special submission by Chile and Ecuador
  - FAO database/Literature search
- Indices of abundance
  - Collaboration with Japan to analyze set-by-set operational level data (1975-2019)
  - Memorandum of understanding with Korea - set-by-set operational level data (1976-2018)
  - Special submission by Chile of 2° by 2° data and estimation of indices by Chilean colleagues (2000-2019)
  - Special submission by Spain of set-by-set data with positive catches of swordfish (2006 -2019)
  - Submission in compliance with Resolution C-03-05 for Japan (level 2 data)
- Composition data
  - Special submission by data for Chile (2000-2019) and Ecuador (2016-2020)
  - Age composition data by sex for Chile (gillnets and longline) (2000-2019)
  - Length composition for distant water fleets in compliance with Resolution C-03-05
- Standardized average weight
  - Collaboration with Japan to analyse set-by-set catch in weight/catch in numbers

Catch estimation

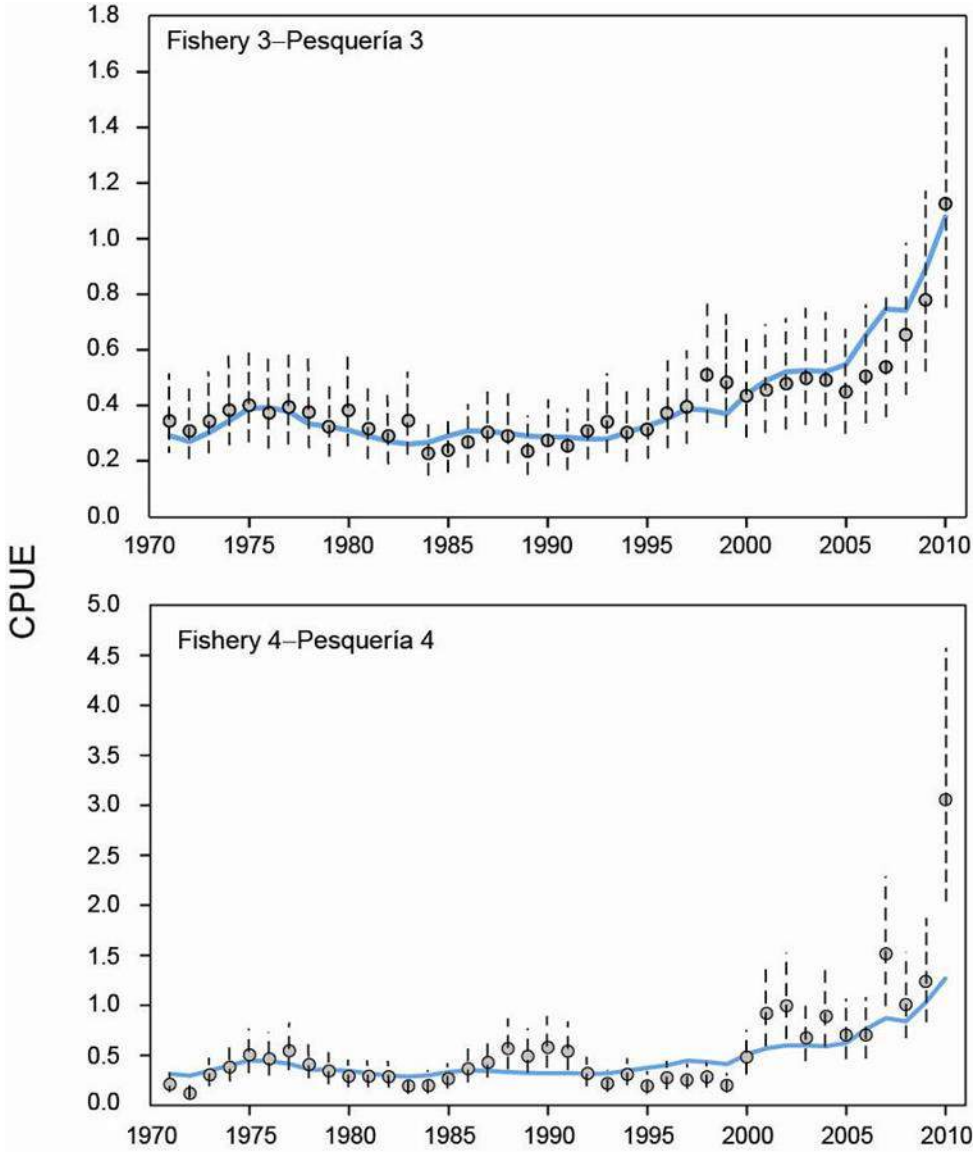
Annual catches of swordfish in the EPO south of 10° N in weight by fishing gear and CPC

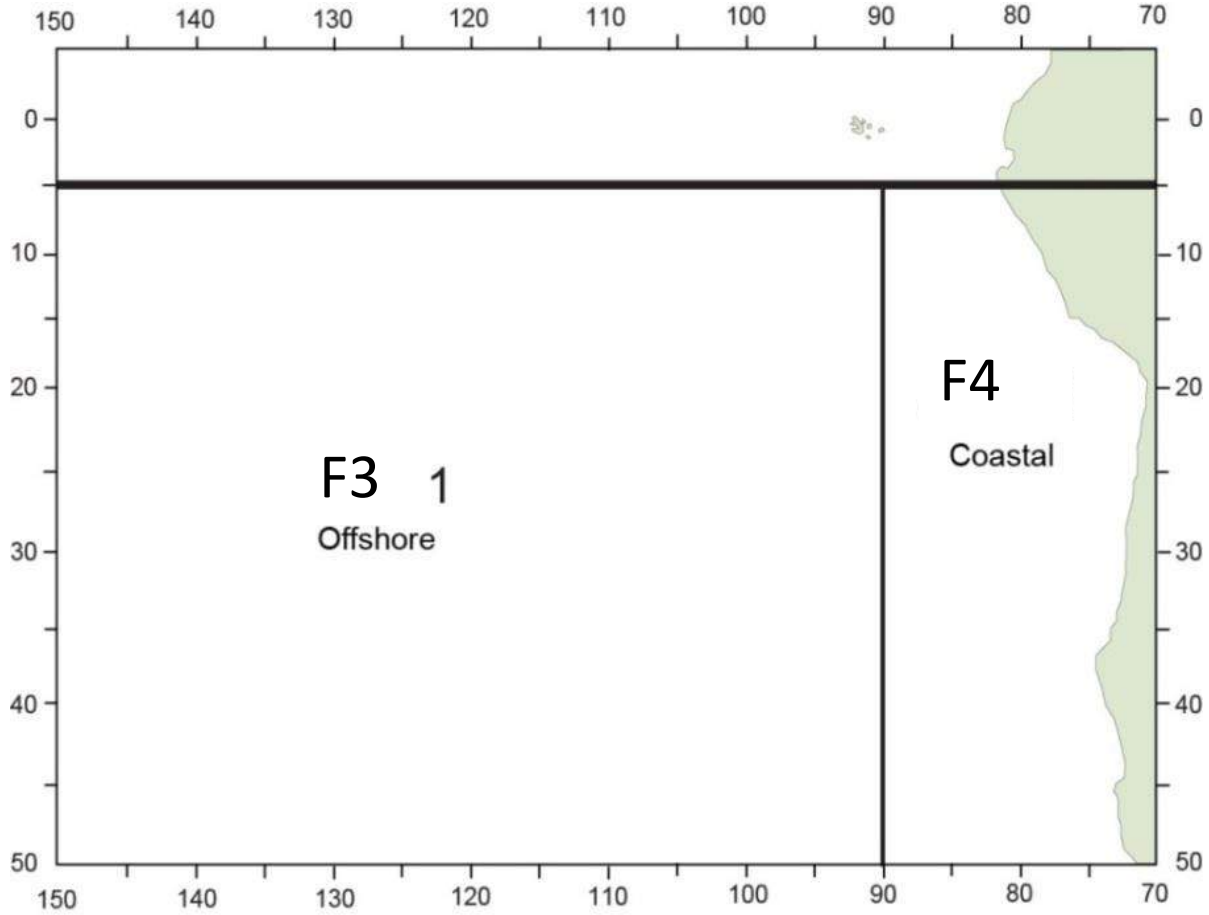


Fishery definitions

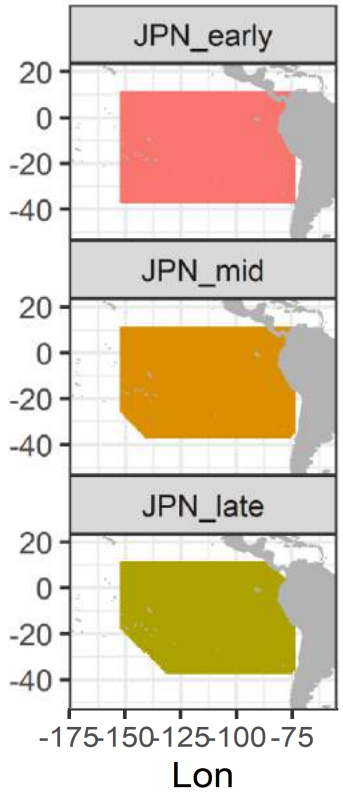
- Analysis
  - Length-composition data from Japan, Spain, Chile, Ecuador of areas south of 10°N
  - Regression tree methods
  - Latitude, longitude, quarter, and cyclic quarter
  - Compromise between explaining data and number of fisheries
- Results
  - First split 100°W
  - Second split at 20°S, east and west of 100 °W
  - 4 areas
  - Fisheries defined by area, gear, fleet origin (coastal, Spain, other distant water fleets)

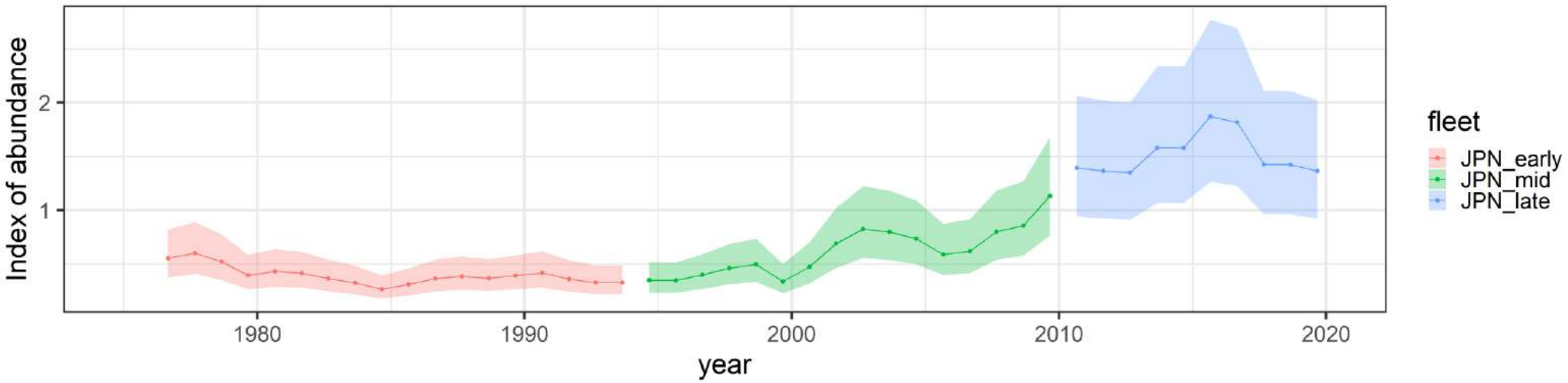
2011 indices: data from JPN fleet



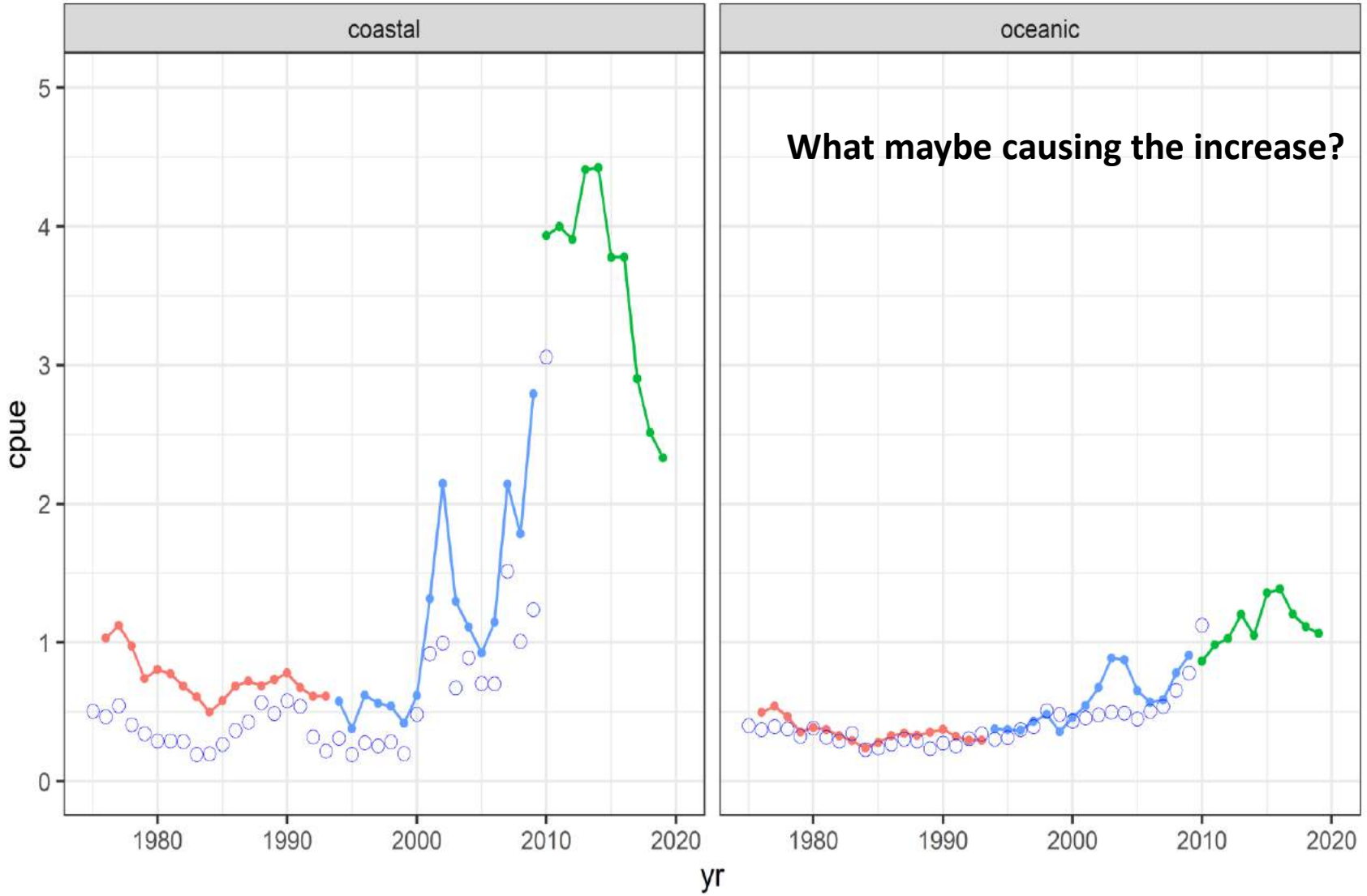


Indices of abundance Japanese fleet





Updated indices from Japanese fleet



New indices:

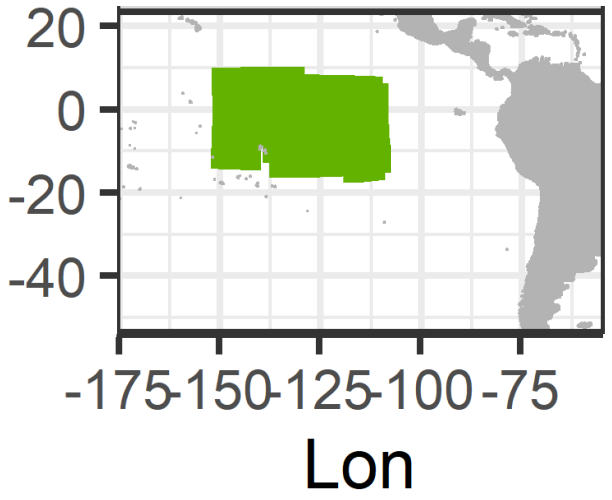
- early
- late
- mid

2011 indices:

- o

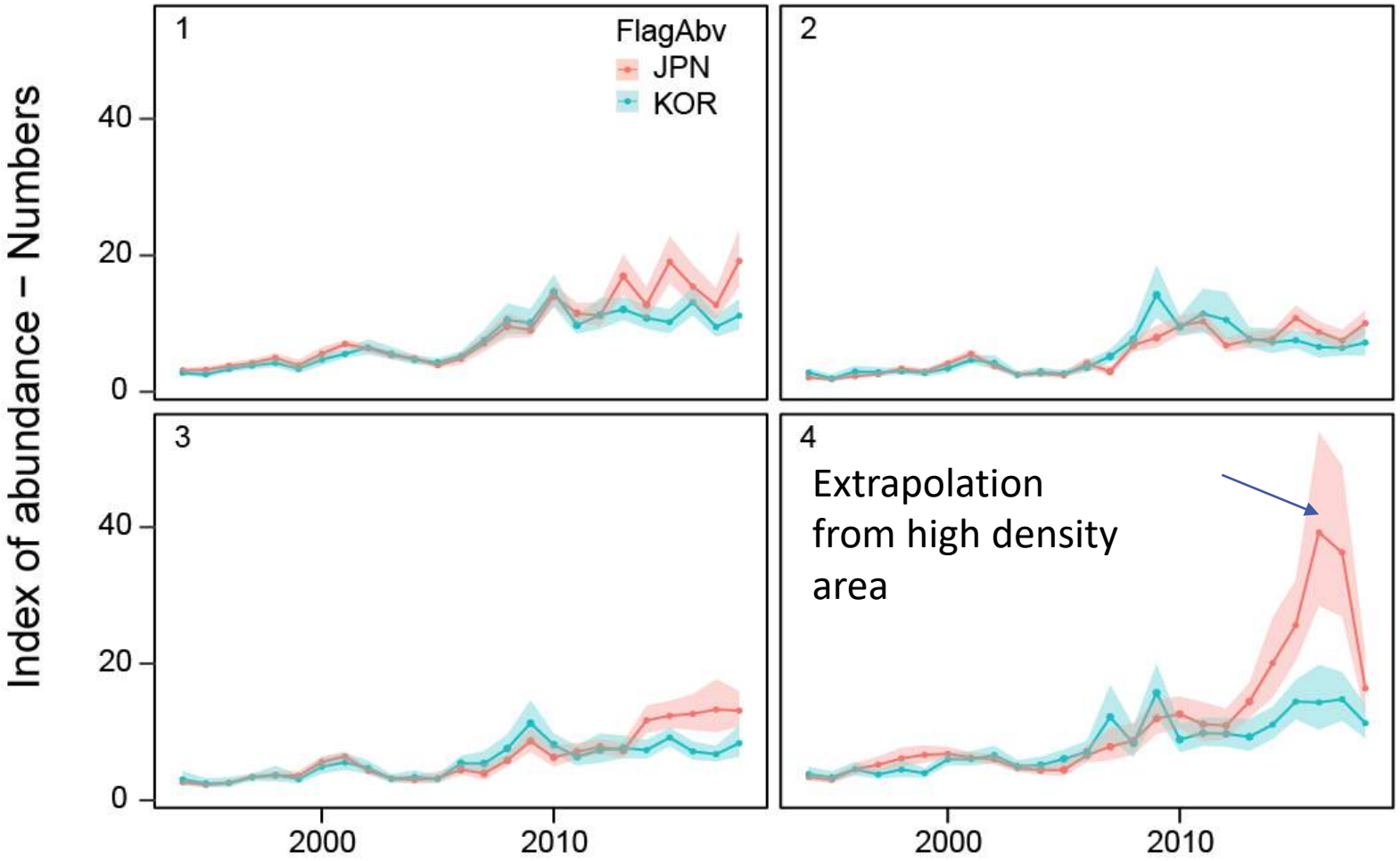
Comparison indices Japanese and Korean fleets SAC-13-Inf-M

Equatorial area:
10°N to 15°S
150°W to 110°W

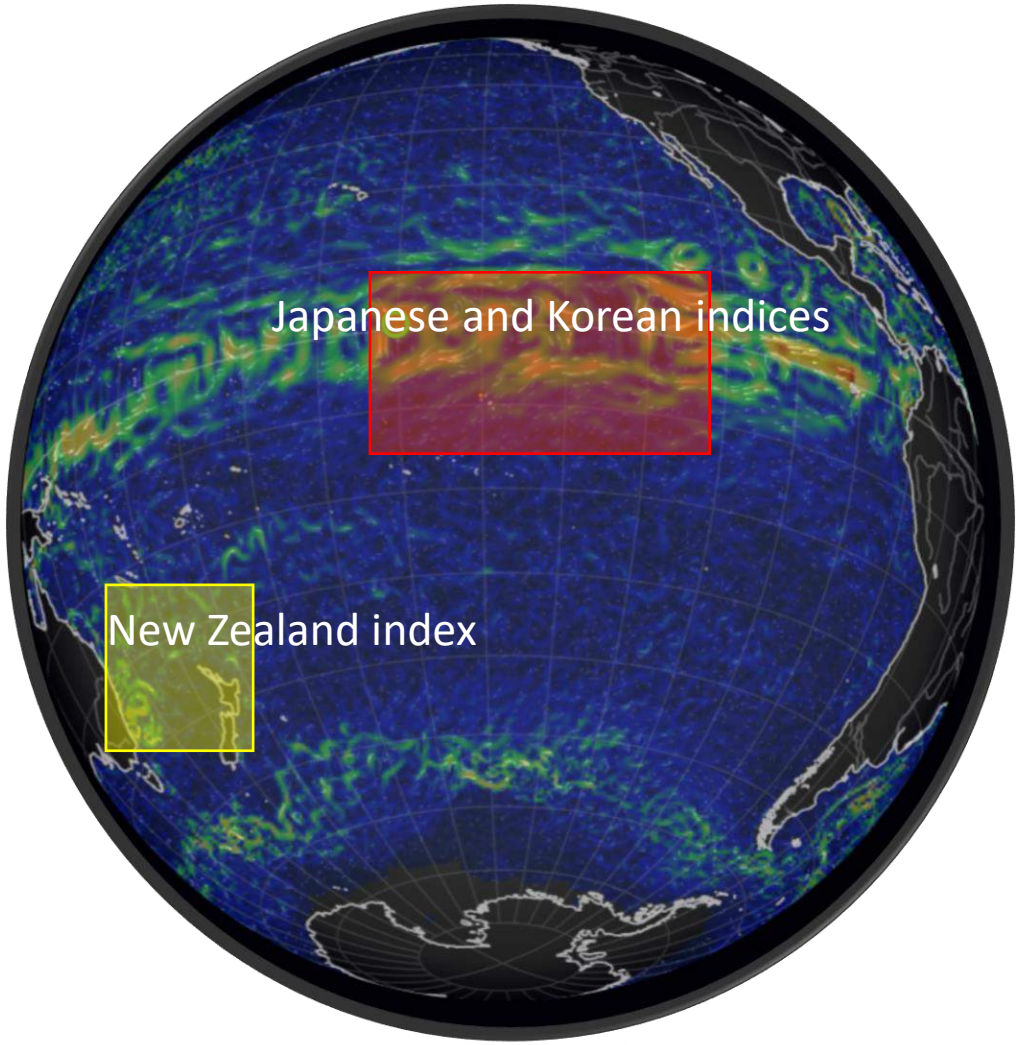


- Increase also seen in the Korean fleet index in the same area
- Increase not related to fishing strategy changes particular to the JPN fleet

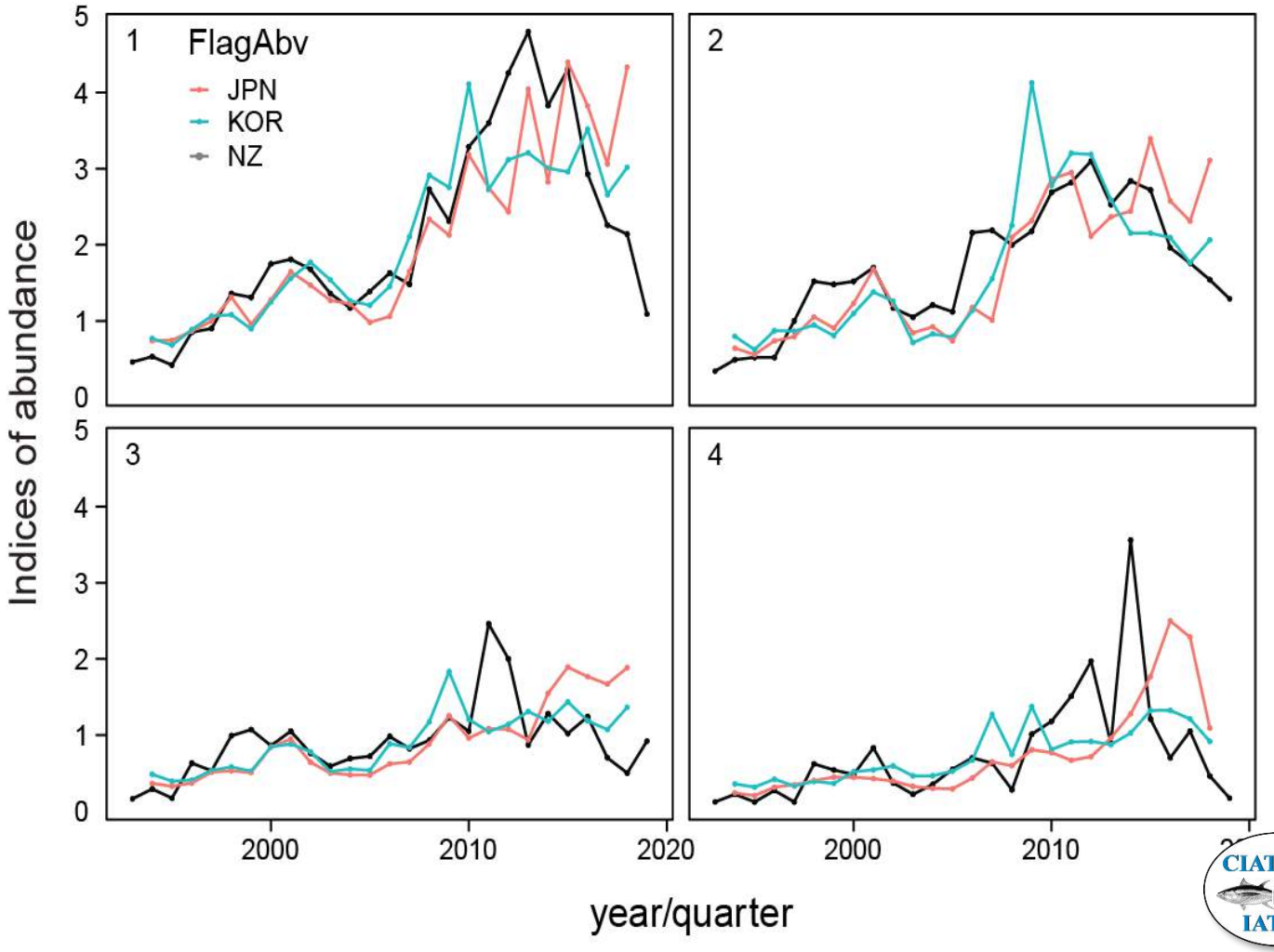
What maybe causing the increase?



Comparison with New Zealand index

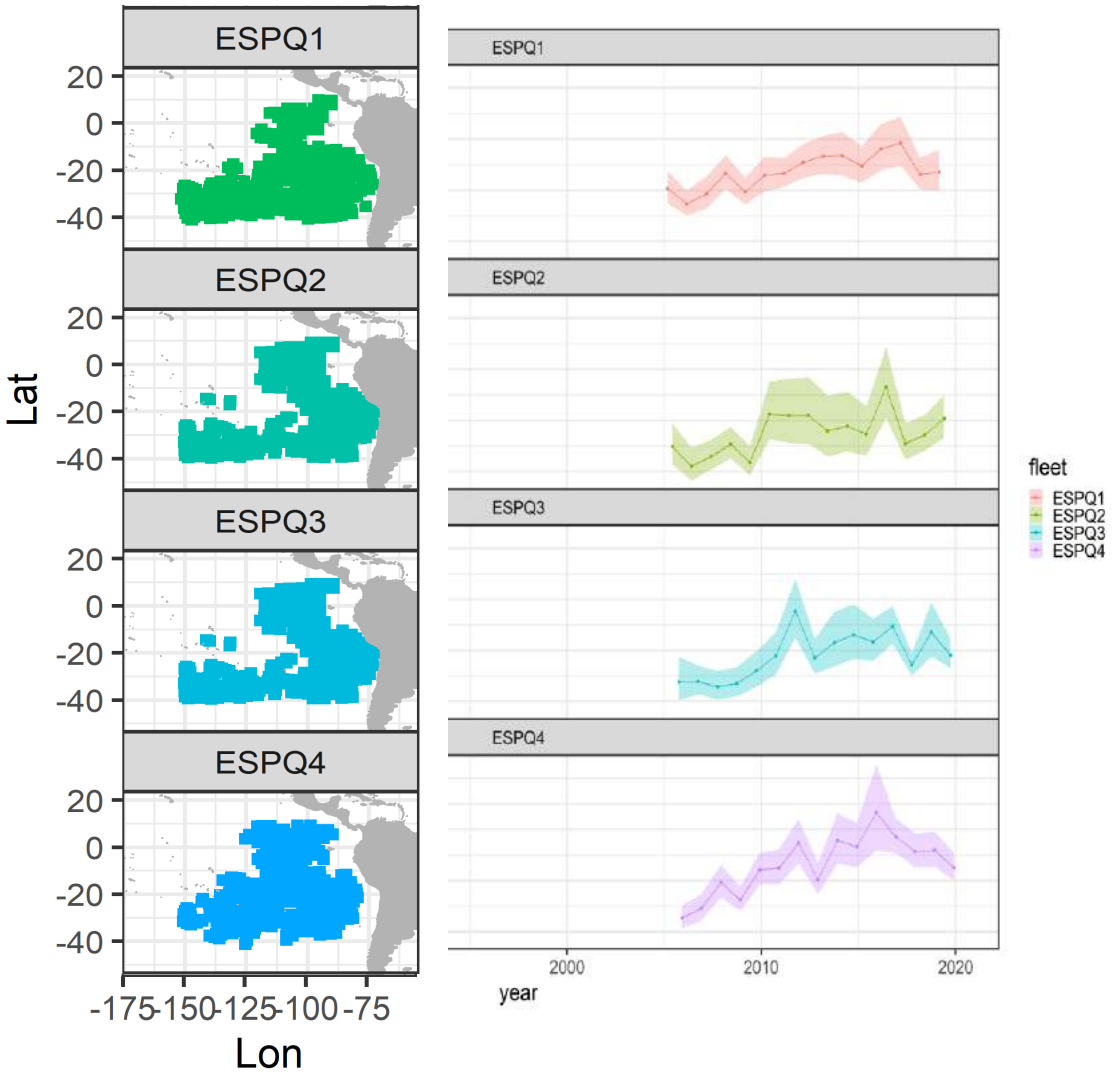


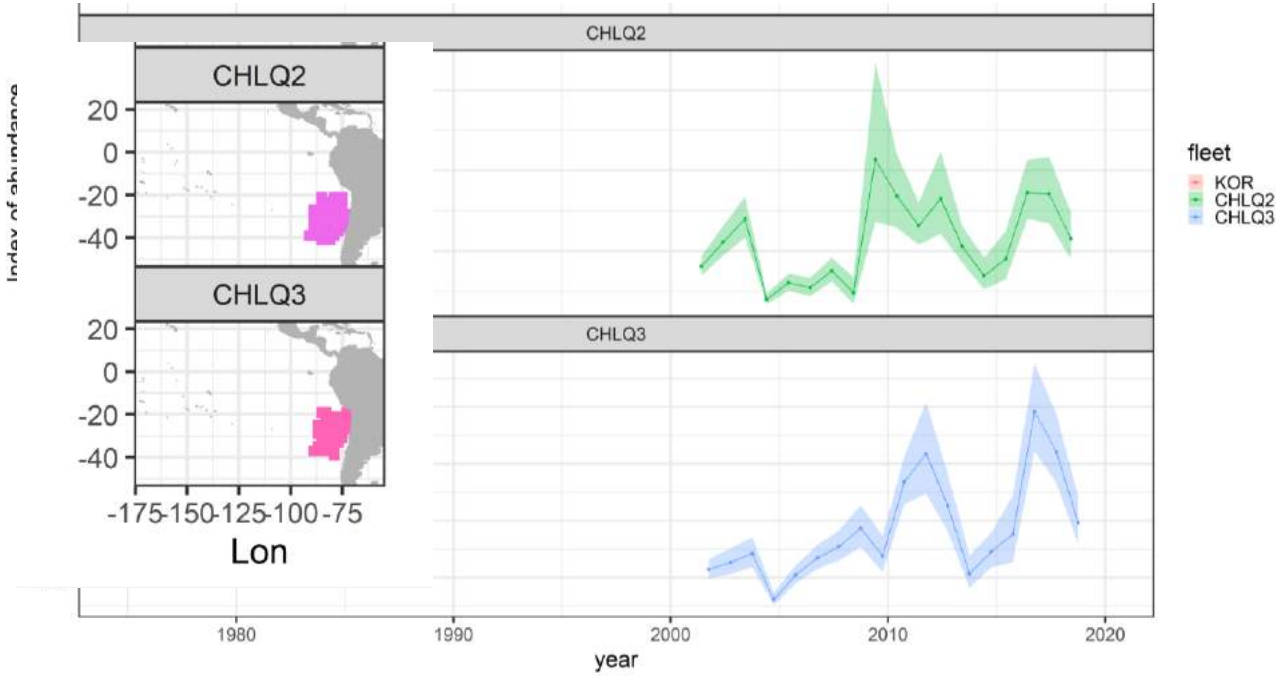
Indices transformed to have the same mean as the NZ index



Indices of abundance

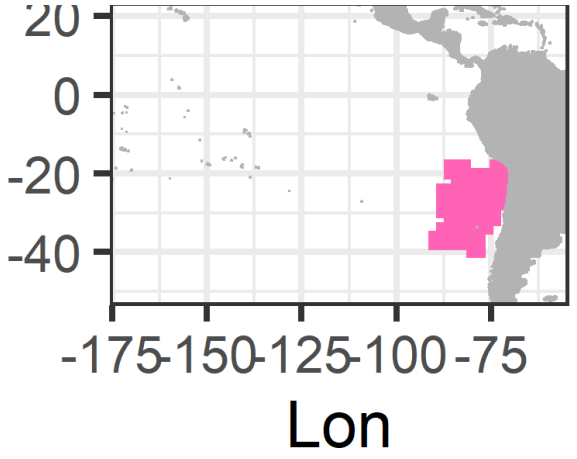
ESP and CHL Longline

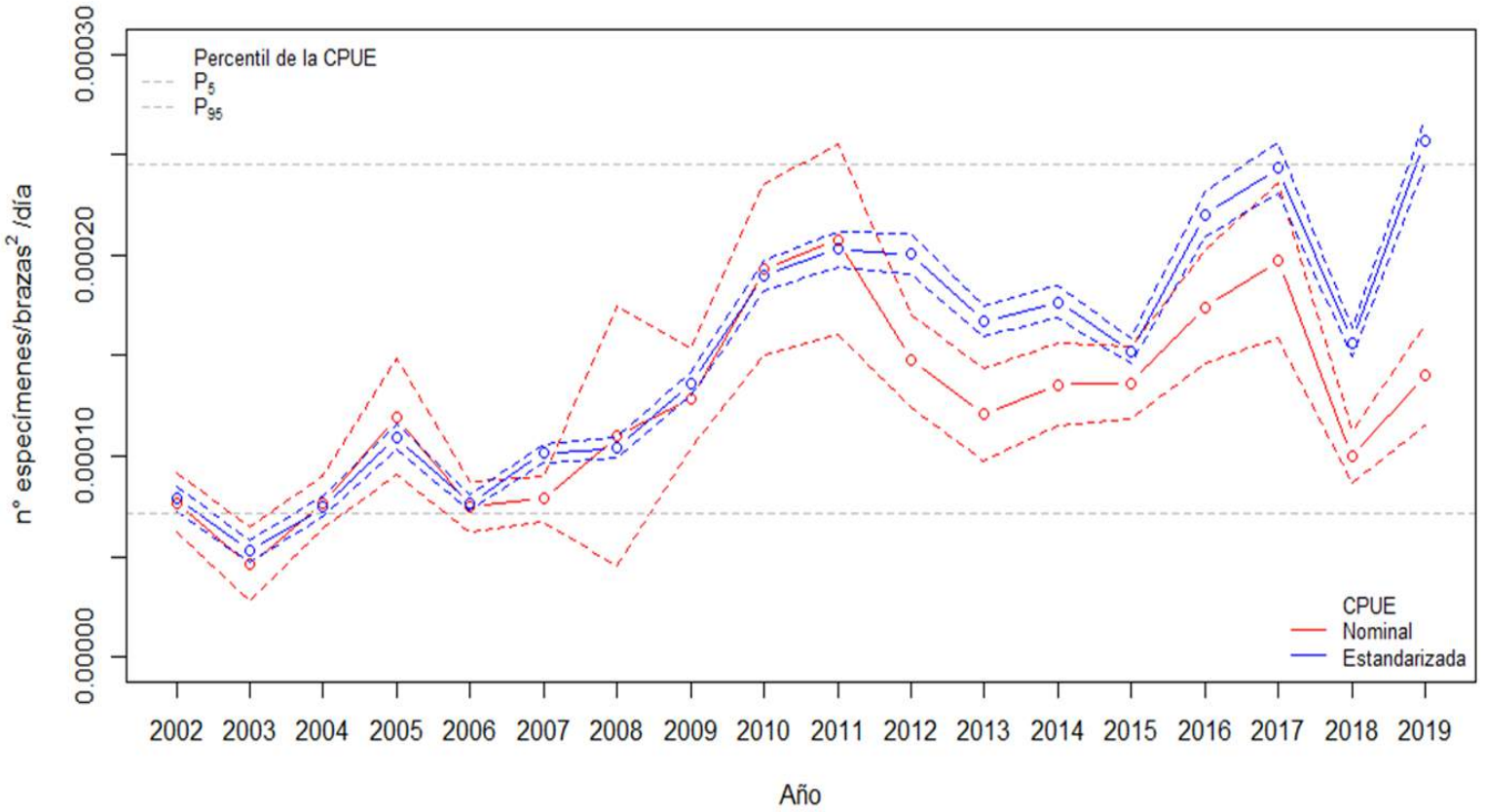




Indices of abundance

CHL Driftnet



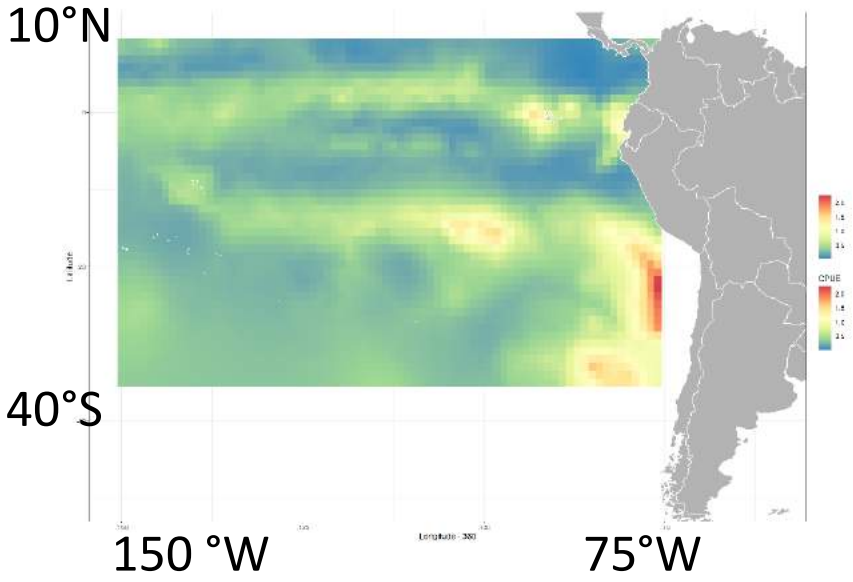


Barraza et al 2020 SWO-01

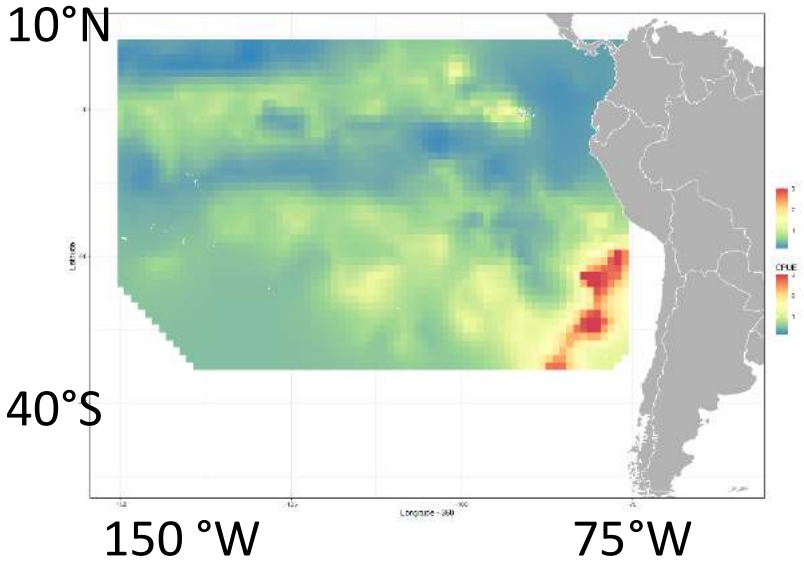
Average density JPN Longline

SAC-13-Inf-N

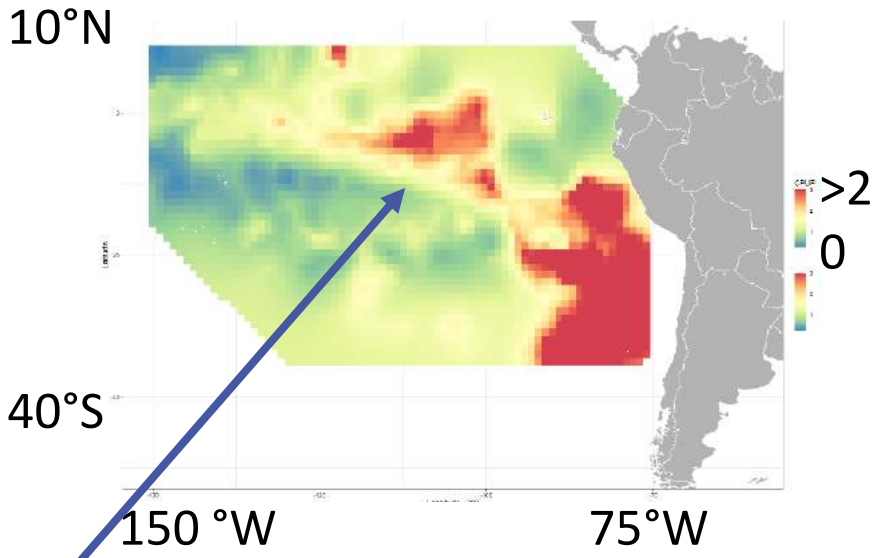
Early: 1975 to 1993



Mid: 1994 – 2009

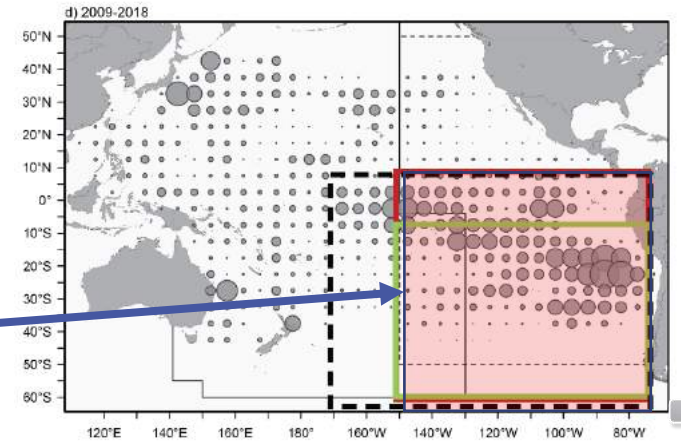


Late: 2010 on

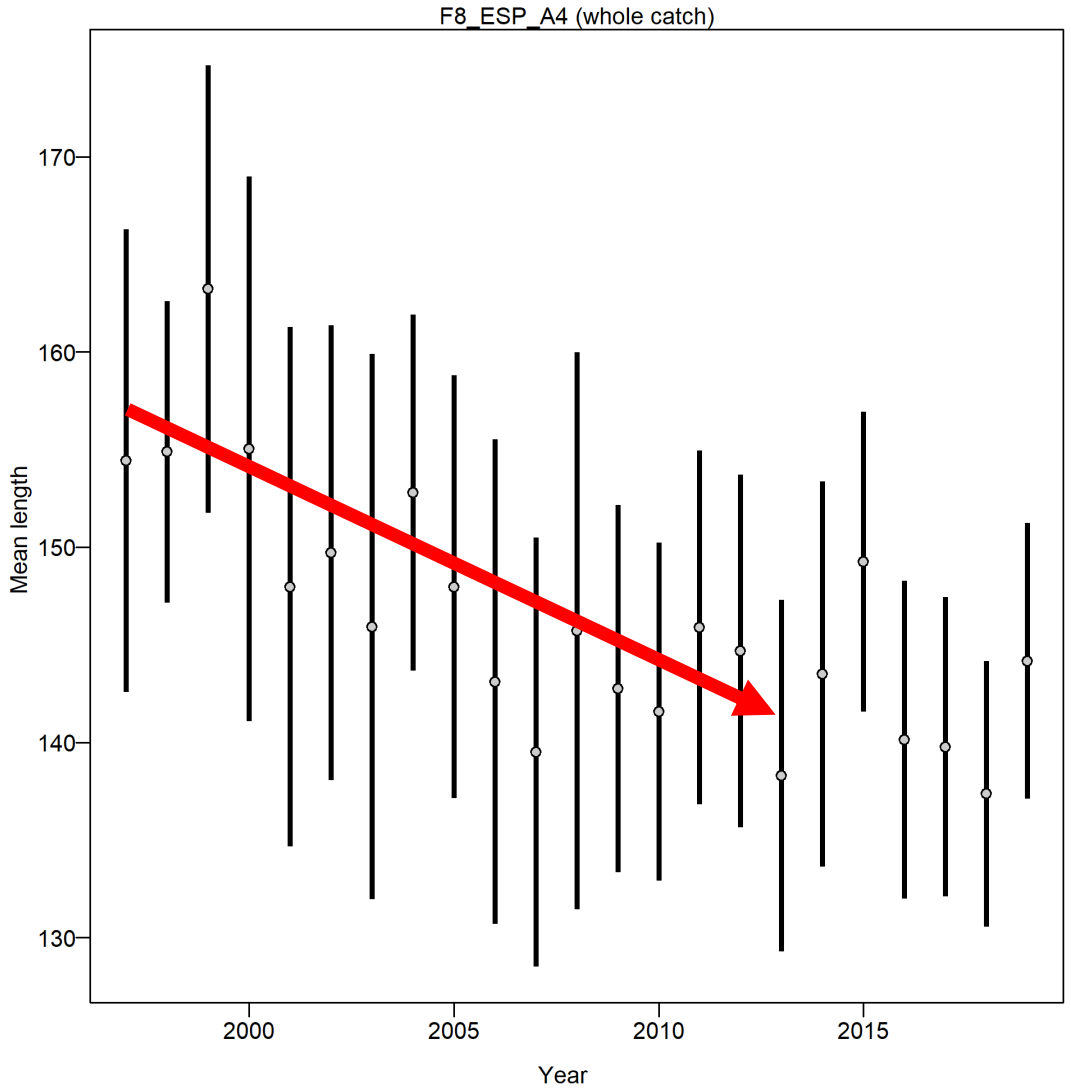


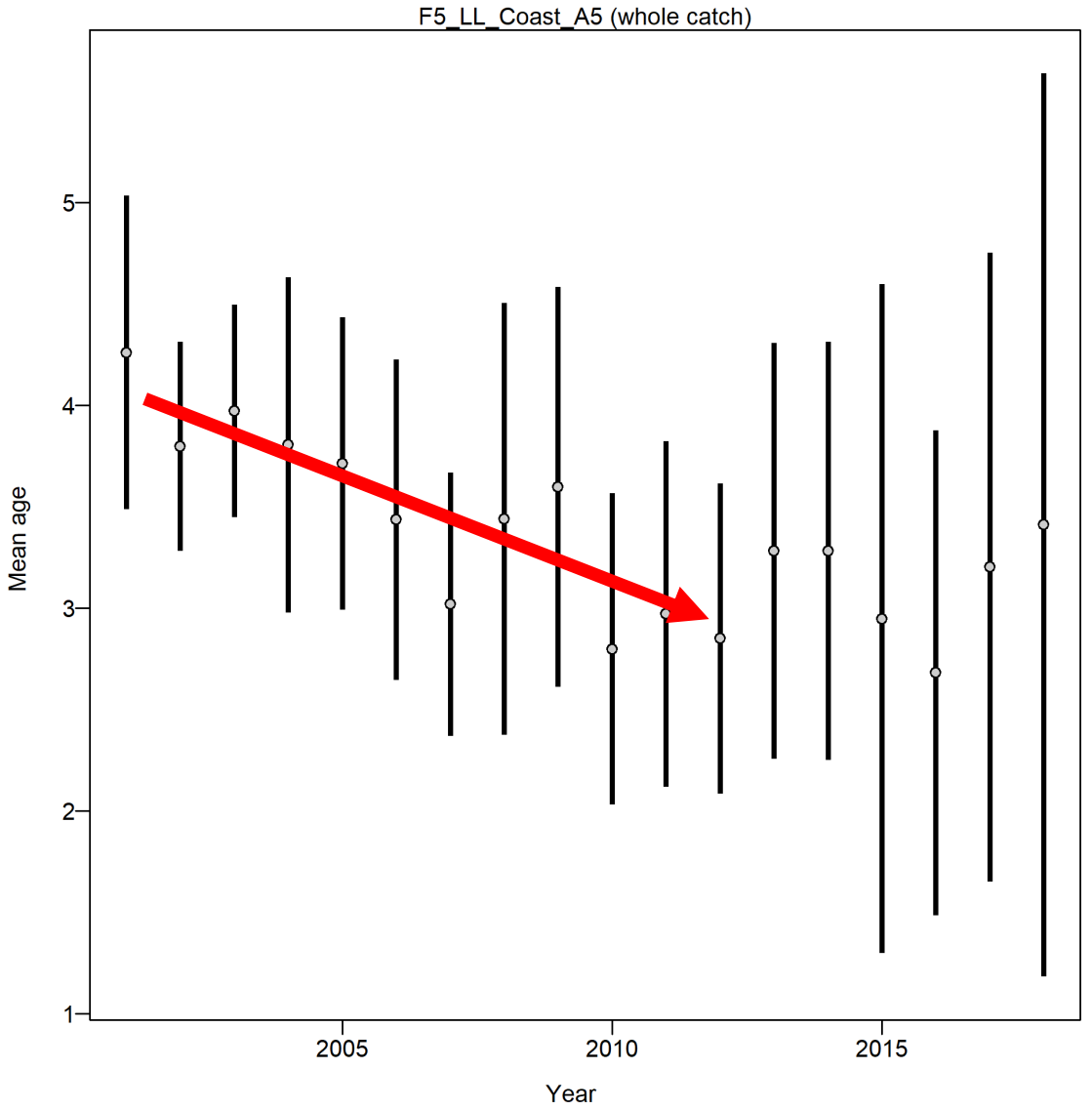
Increase in connectivity between areas of high density

EPO south of 10°N modelled



Composition data



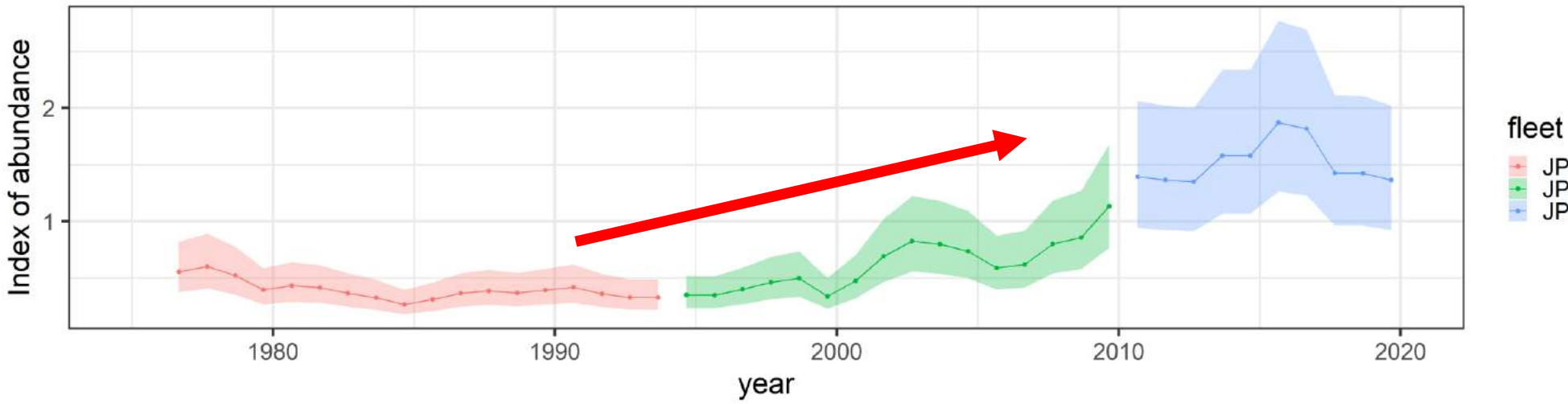


Stock assessment model

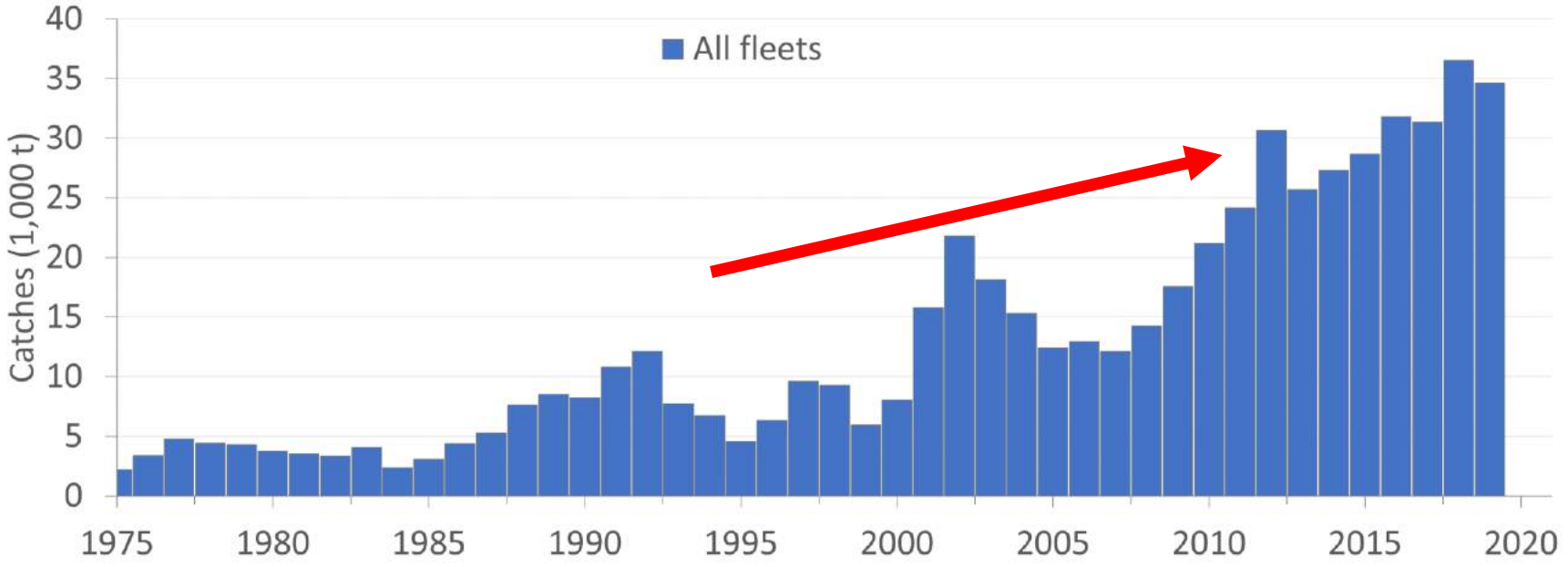
- Stock Synthesis 3.19 model
- Main assumptions
  - Started in a virgin condition (in the 1940's)
  - Annual model with 4 seasons
  - Areas-as-fleet approach
  - 21 Fisheries defined by area, gear, fleet origin (coastal, Spain, other distant water fleets)
  - Splines, double normal selectivities (some asymptotic)
  - Growth (females, males) , recruitment (h=1), natural mortality (M=0.4) as in 2011's assessment
  - Fit to nine indices from Japan, Spain, Chile
  - Fit to age and length composition data
  - Reweighting of composition data after initial run

Summary of the evidence

The indices show increase, and average size/age shows a decrease in some fisheries.

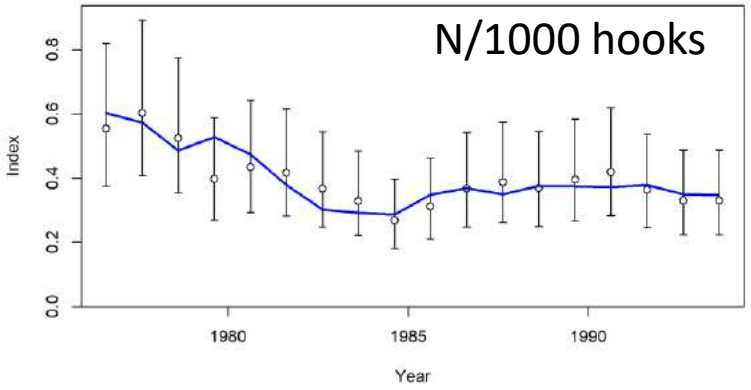


At the same time the catches are increasing

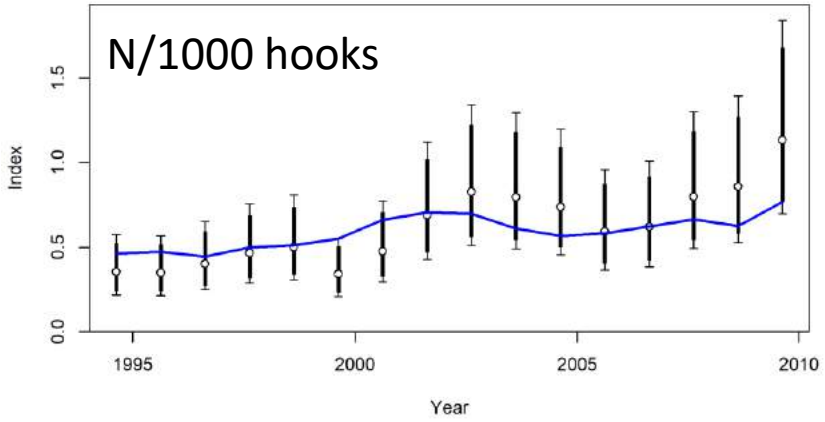


Preliminary results: fits to indices of abundance

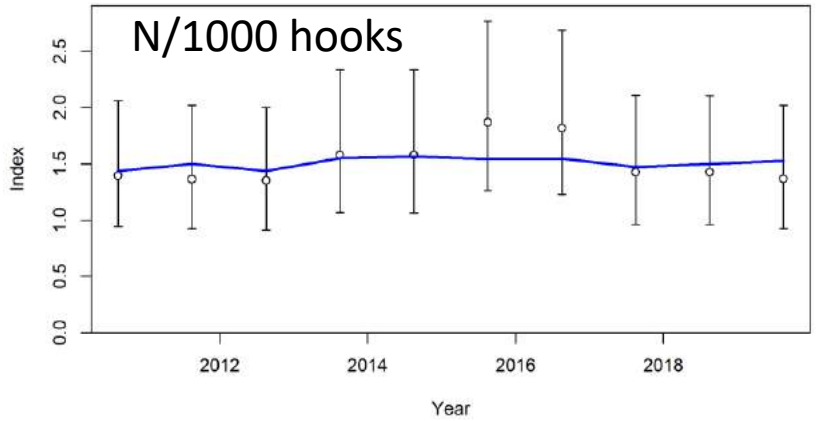
JPN early (1975 to 1993)



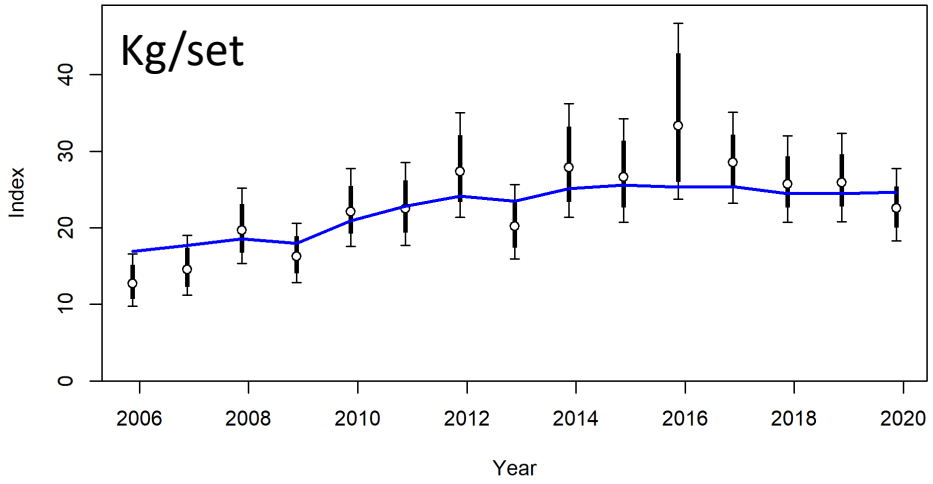
JPN mid (1994 – 2009)



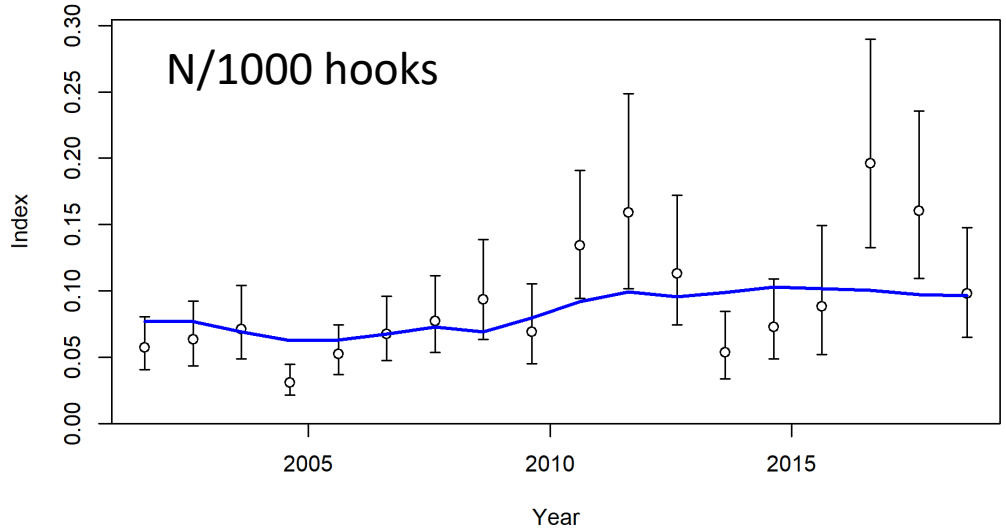
JPN late (2010 on)



ESP Quarter 4

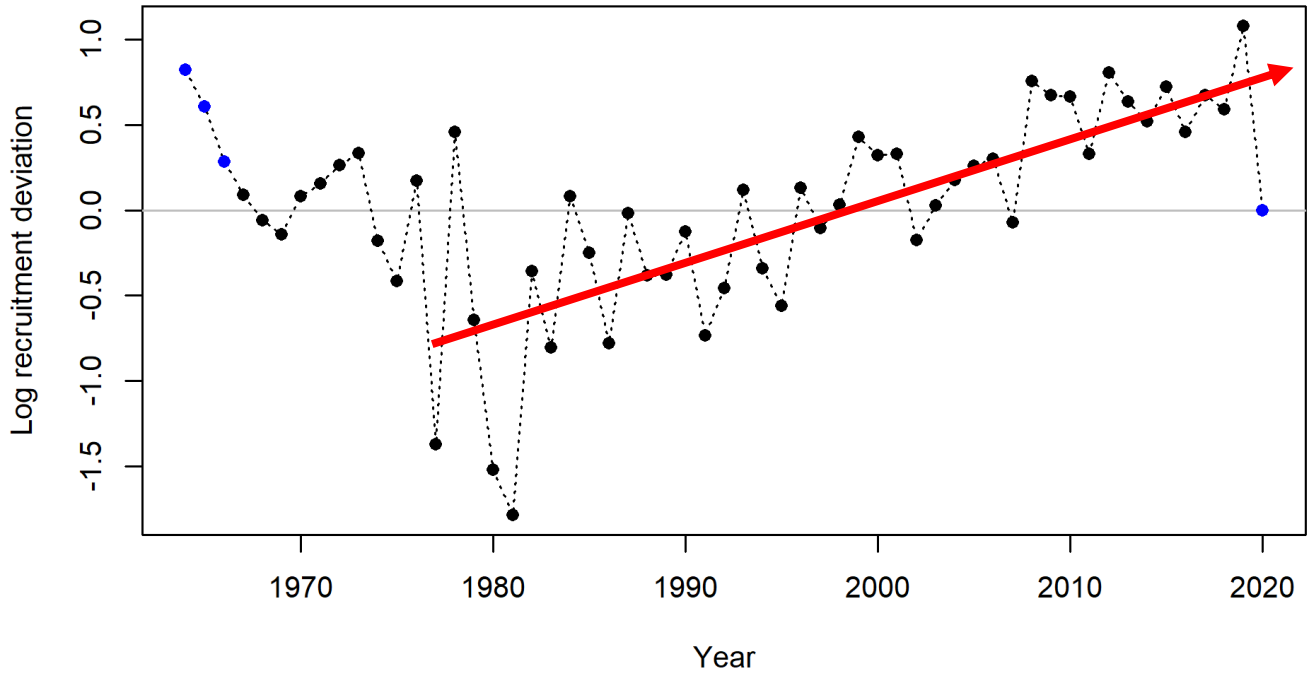


CHL Quarter 3

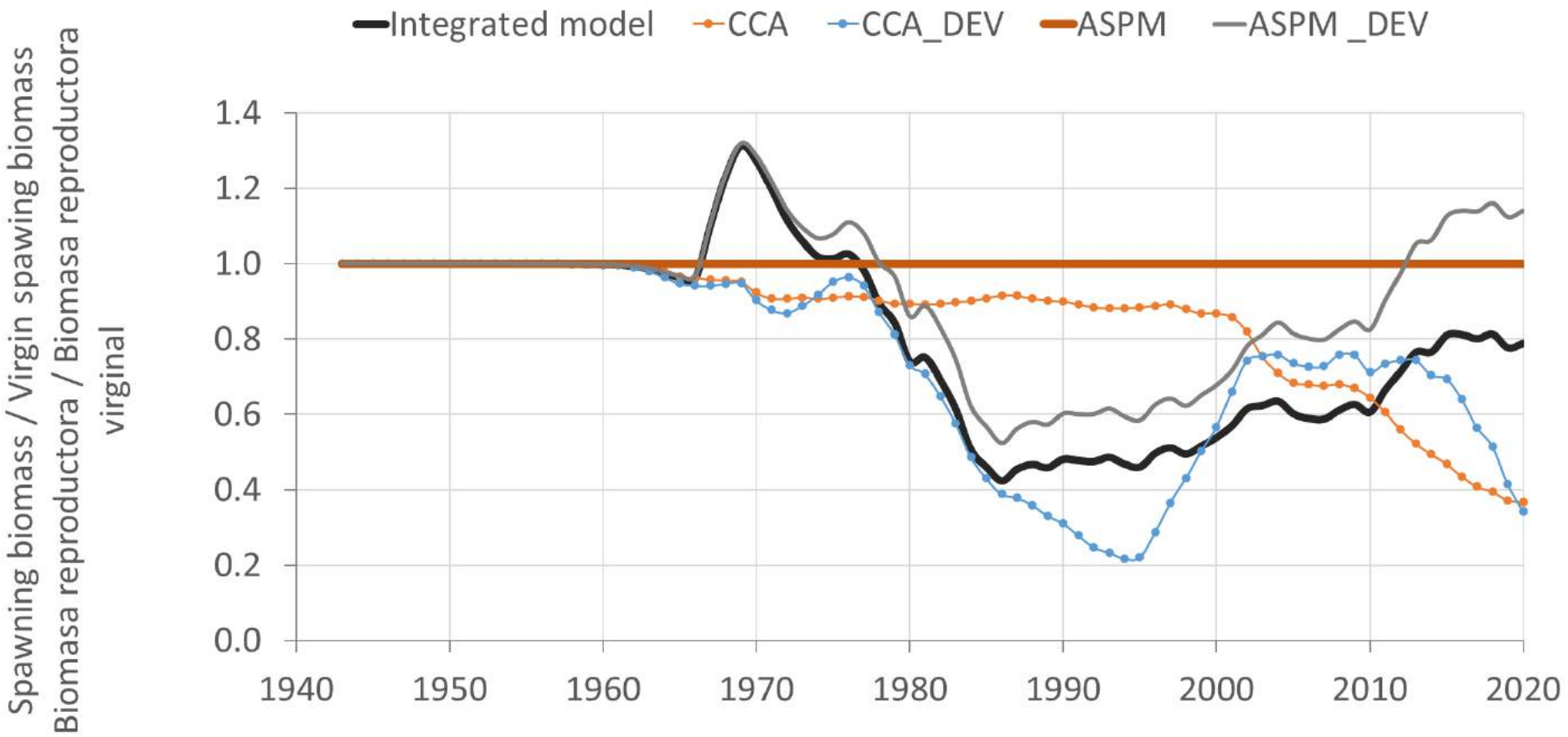


Preliminary results: estimates of recruitment

- The model fits well the indices of abundance and acceptably most of the composition data.
- The solution found by the model is to increase the recruitment



Preliminary results: diagnostics



Preliminary results: interpretation and implications

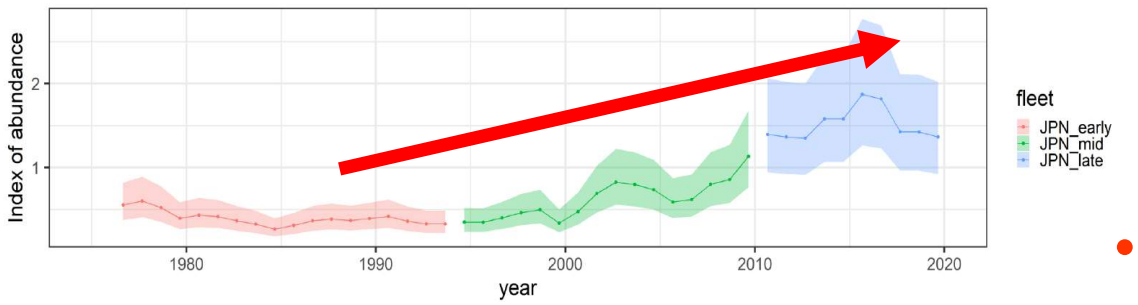
The increases in recruitment and subsequent increase in biomass estimated by the integrated model maybe due to:

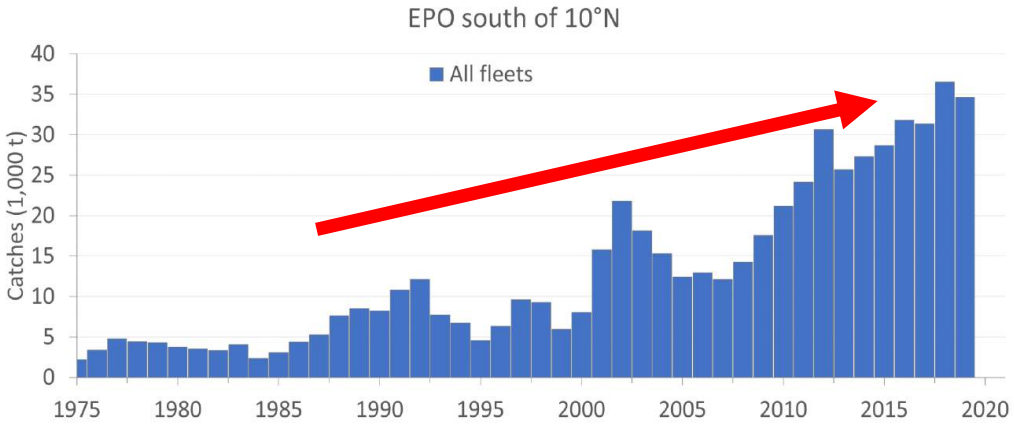
Hypothesis	Interpretation	Implications
Real increase in abundance	Due to increase productivity (increased recruitment) Smaller average sizes in some fisheries are consistent with the hypothesis of a continuous increase in recruitment.	Increase productivity if continued may continue to sustain large catches
Increase in availability	Indices derived from different fleets, gear and locations (e.g. Western PO) show increase in density which maybe because catchability changing due to increase in availability rather than due to technological changes in gear.	Indices should not be used to assess the stock unless trend in availability is considered, if assessment is based on catch-curve analysis type of models, it should be treated as interim until better data is available
Increase both in abundance and availability	Factors that increase availability may also increase abundance	Disentangle the two effects will be difficult as they may be confounded, thus the two extremes should be considered
Stock structure and connectivity	Connectivity from the equatorial area and the southern EPO seems to have increased after 2010, perhaps connectivity between WCPO and EPO also increased.	Stock should be assessed in conjunction with WCPO stock.

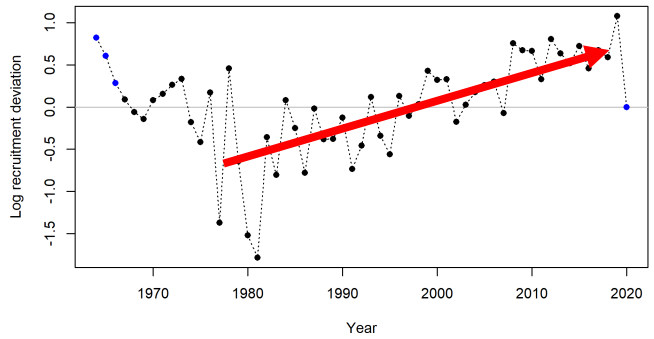
Alternative information may be needed to distinguish among these hypotheses:

- Close-kin analyses and genetic studies; modelling of habitat and effects of oceanography, tagging data

Summary







- The **indices show increase** regardless of fleet and gear, and average size/age shows a decrease in some fisheries.
- The **catches increased** in the EPO south of 10°N, almost doubled in the last decade
- **Model estimates increase in recruitment**
- **Four hypotheses** can explain the preliminary results, including changes in availability
- To distinguish among hypotheses **other data sources may be necessary**
- **Assessment should focus both** on the hypotheses one (**increase in abundance**) and two (**increase in availability**) as the two extremes

Plans for future research

Short -term

- Improve model
  - Model hypotheses of increase in abundance (emphasis on indices) and increase in availability (emphasis on composition data) as two extremes
  - Carefully refine selectivities, including changes in selectivity, due to effect on interpreting composition data
  - Run diagnostic analyses
- Run sensitivities:
  - Stock structure alternative hypotheses
  - Natural mortality (M=0.4 vs M=0.2)
  - Steepness (h=1 vs h=0.75)

Long -term

- Expand modeling of density into the WC Pacific Ocean
- Continue studying changes in longline catch strategies and influence in catchability
- Include oceanography to model catchability
- Study the feasibility of a close-kin mark recapture to estimate abundance
- Study stock structure

Thank you – Gracias

Questions?

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