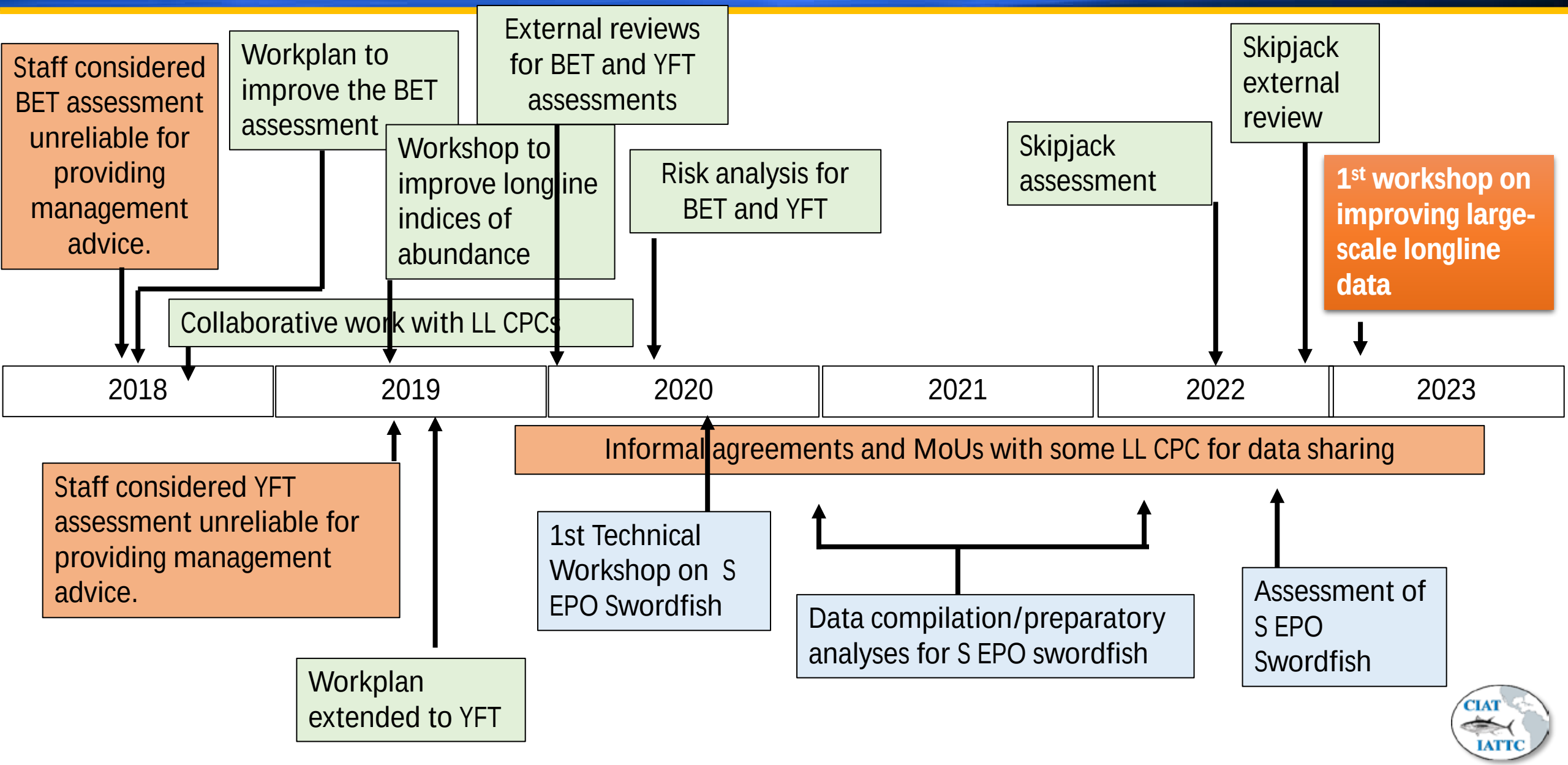
Rationale for revising C-03-05 for target species and benefits of improved large-scale longline data for IATTC stock assessments

1st Workshop on improvements in data collection and provision: Industrial longline fishery
9-11 January 2023

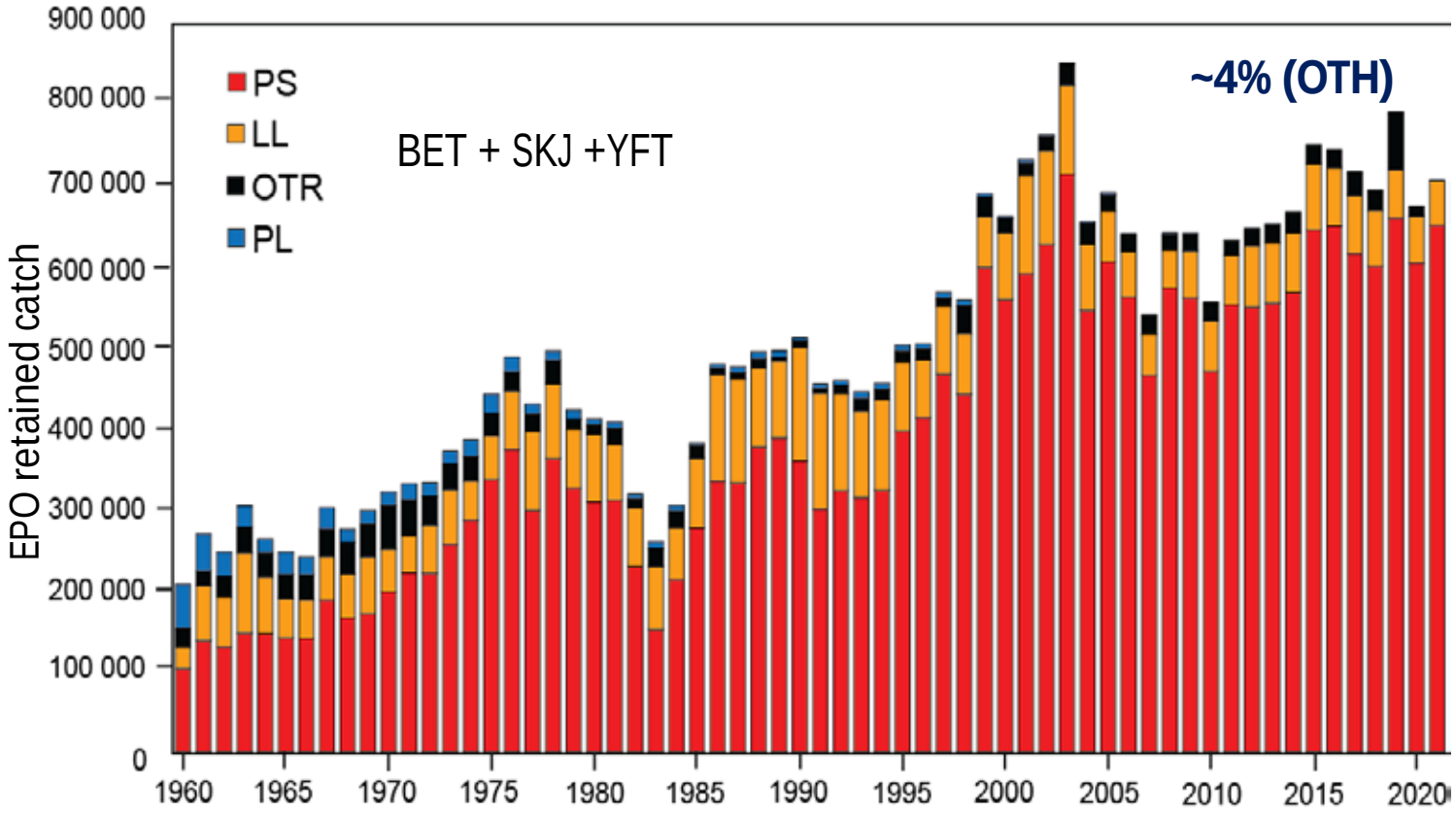
Introduction: Overview of events leading to this workshop



The importance of the longline fishery for assessments

Catches

- Second most important fishery in the EPO for tropical tunas
- Main fishery for some species (e.g. swordfish)



Data

- Information about **asymptotic selectivity**
- **Information about the adult component of the population** (indices of abundance and associated size composition data)
- 2018 BET assessment ,2019 YFT assessment – **overly sensitive** to longline data

~10% (LL)

Larger and older fish

~86% (PS)

Smaller and younger fish

IATTC stock assessments: data sources

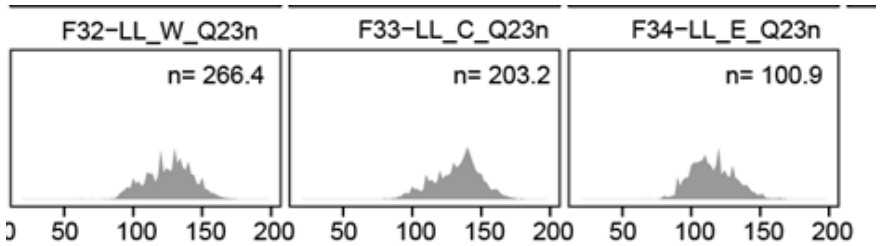
Fishery	Catches	Indices of abundance	Size composition
Purse-seine	*Staff collection and member submission* Best scientific estimate: Unloading, port-sampling, observers, logbooks	*Staff collection and member submission* YFT: large individuals, adult index BET, SKJ: juvenile index Observer data (100% coverage large vessels) Echosounder bouy data (all PS) – index	*Staff collection* Port sampling Observer data (small, medium, large)
Longline	*Member submission* Resolution C-03-05: Task I (total catches) and Task II data (with spatial information)	*Member submission* Resolution C-03-05: Task II data, MoUs: aggregated, with hooks-between-floats information, only Japanese fleet, **adult index** Observer data (5% coverage)	*Member submission* Resolution C-03-05: **Largest fish** Observer data (5% coverage)

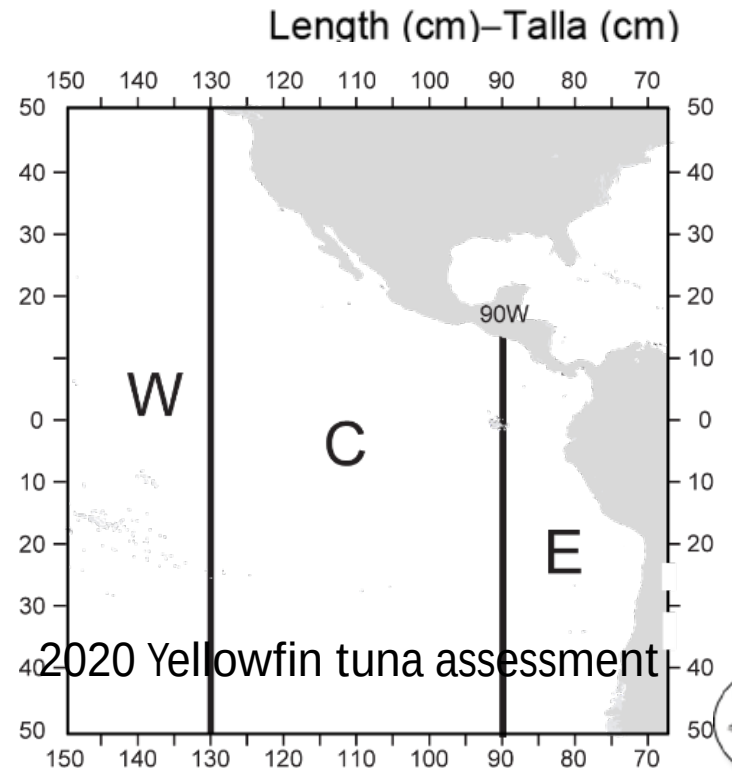
Spatial assumptions for the model

- Stock definition
- Fisheries definitions: need TASK II catches and size composition

Areas as fleets approach:

- Areas defined using size composition
- Catches need to be reported with spatial information to be allocated to each fishery
- Take the catches at the correct sizes





2020 Yellowfin tuna assessment

Longline indices of abundance

- Catch (C) per unit of Effort (E) can be used as an index of abundance (B) of a fish stock:

$$C = q * B * E$$

$$C/E = q * B$$

- if the catchability (q) is constant in space, time and by vessel

- q vary with several factor: fishing gear configuration, fish and fishers' behavior, and oceanographic conditions.

- The effect of these factors should be removed to be able to use CPUE as an index of abundance. This process is done using statistical models and is referred to as "standardization" of the CPUE

Longline indices of abundance: catchability variation

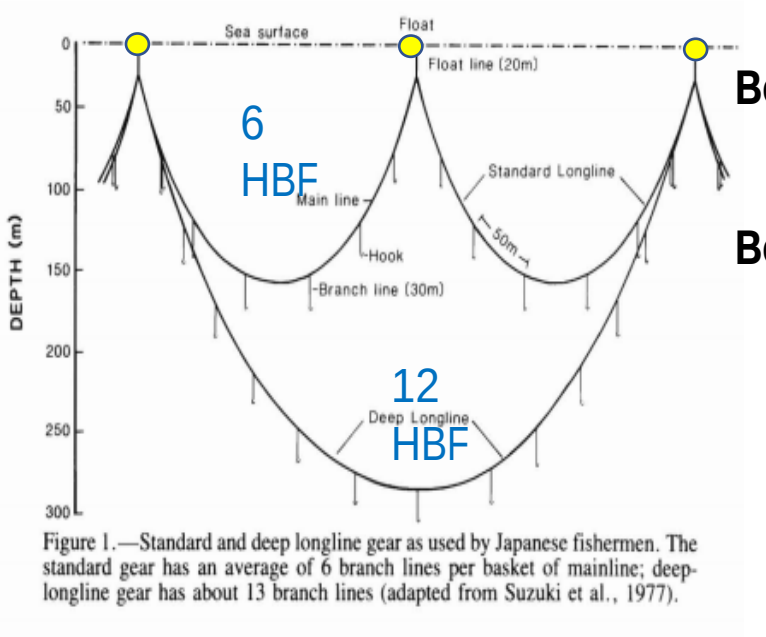


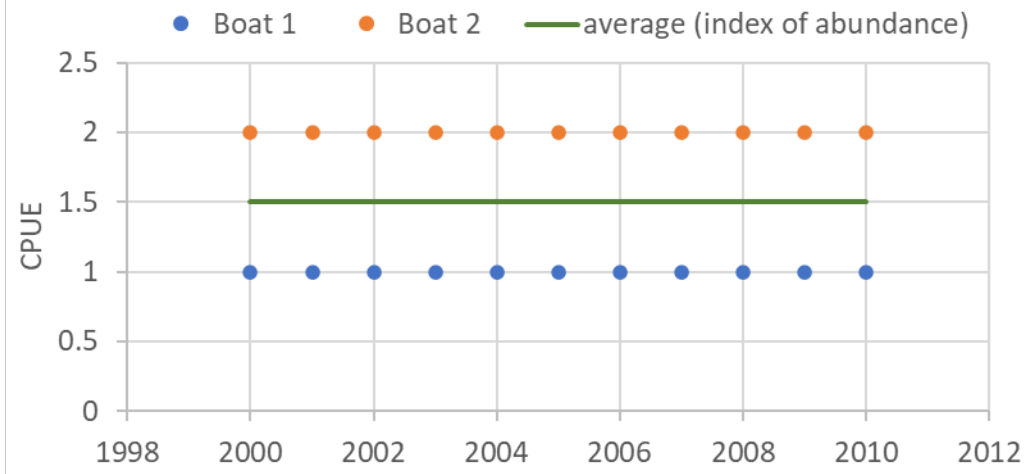
Figure 1.—Standard and deep longline gear as used by Japanese fishermen. The standard gear has an average of 6 branch lines per basket of mainline; deep-longline gear has about 13 branch lines (adapted from Suzuki et al., 1977).

Boat 1: 6 HBF

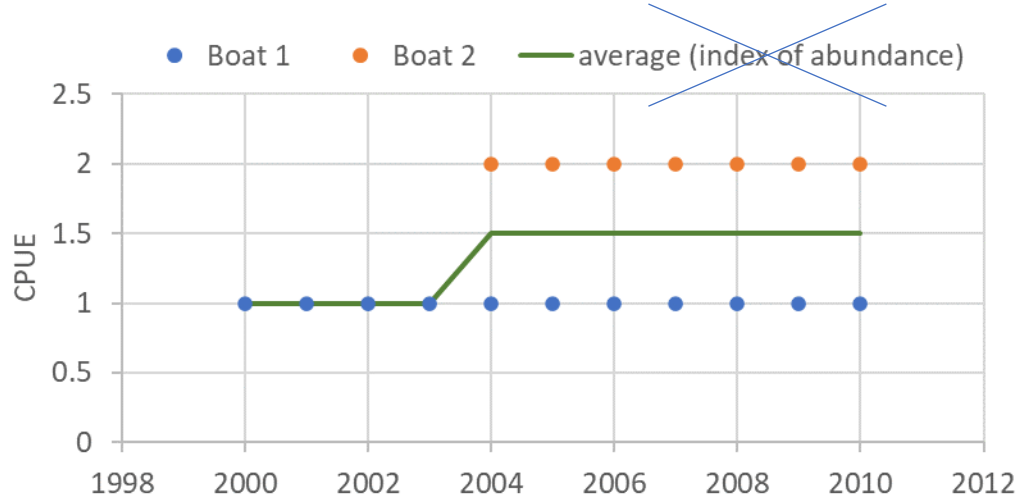
Boat 2: 12 HBF

Hooks between floats

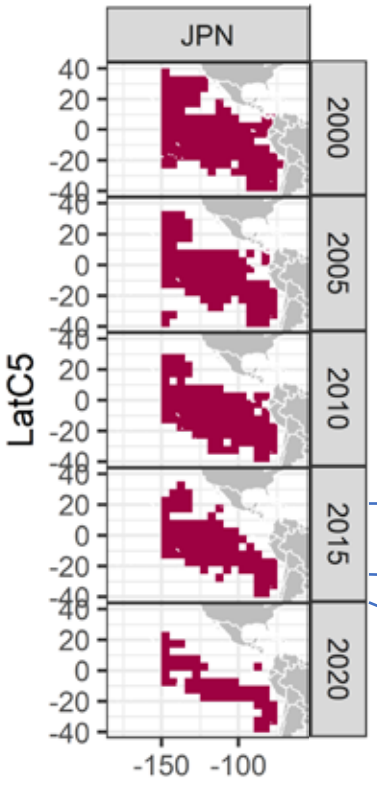
Situation 1



Situation 2



Main indices of abundance for YFT, BET, SKJ, SWO



- First industrial longline fleet to operate in the EPO (1950's)
- Long history of collaboration between Japan and IATTC staff
- The indices were derived using catch and effort data from the Japanese fleet
- Methodology for deriving the indices included one gear variable (hooks between floats) (SAR-07-07)

- The fishing effort has been declining and contracting

SAC-04-05B Analysis of operational-level data: vessel effects are important (2012)

SAC-07-03d; SAC-07-04a Revision of the size composition data (2016)

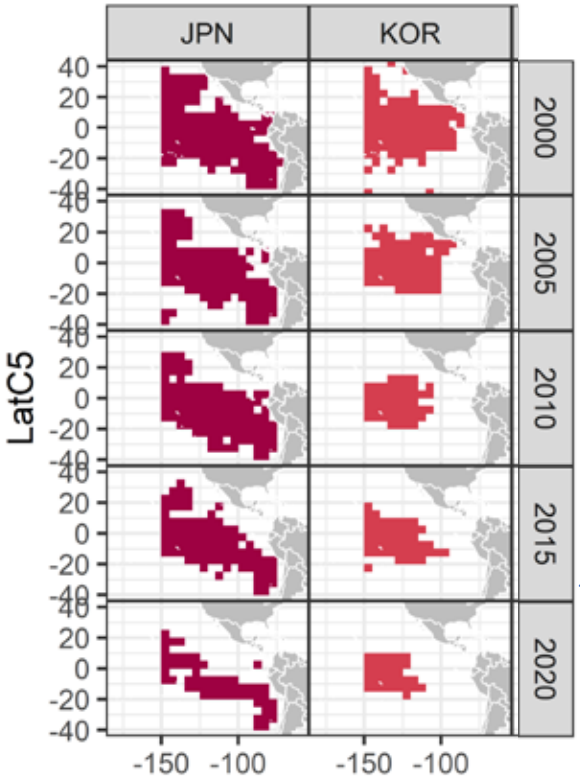
OTH-30 Workshop to improve indices of abundance based on longline CPUE data (2019) and collaborative work

New indices using spatiotemporal models fit to aggregated data 1 by 1 by month by vessel (MoU)

Size-specific spatiotemporal dynamics of bigeye tuna (*Thunnus obesus*) caught by the longline fishery in the eastern Pacific Ocean

Keisuke Satoh [a,*], Haikun Xu [b], Carolina V. Minte-Vera [b], Mark N. Maunder [b], Toshihide Kitakado [c]

Main indices of abundance for YFT, BET, SWO



OTH-30 Workshop to improve indices of abundance based on longline CPUE data:

Operational-level data for JPN, KOR, TWN, CHN

Recommendations to:

- Use spatiotemporal models to standardize CPUE and associated size composition
- investigate changes in target
- Combine data for **Japan and Korea**

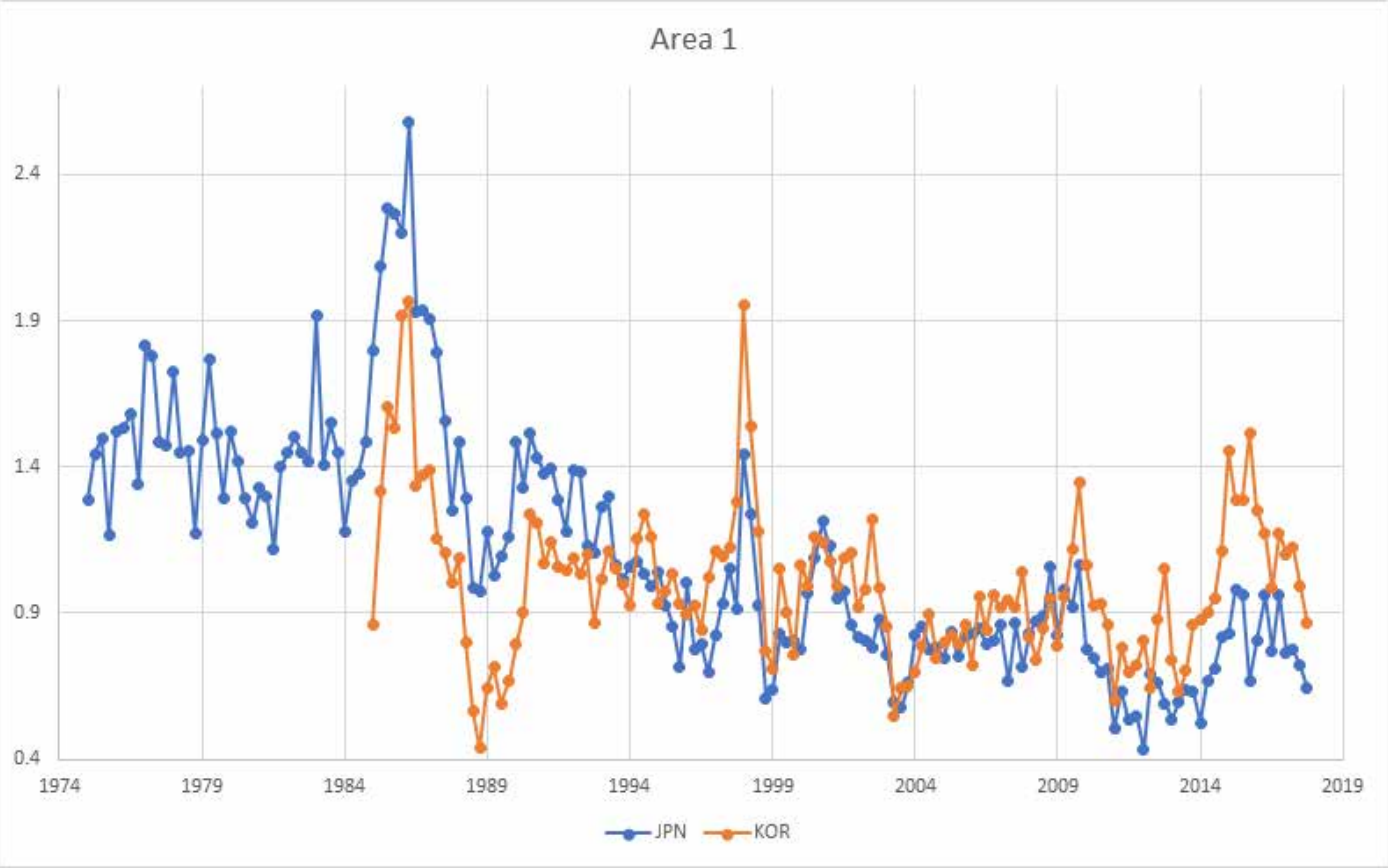
For BET: Comparisons between Korea and Japan showed discrepancies over large areas, similarities over small areas: comparison need to be done is fine-scale resolution

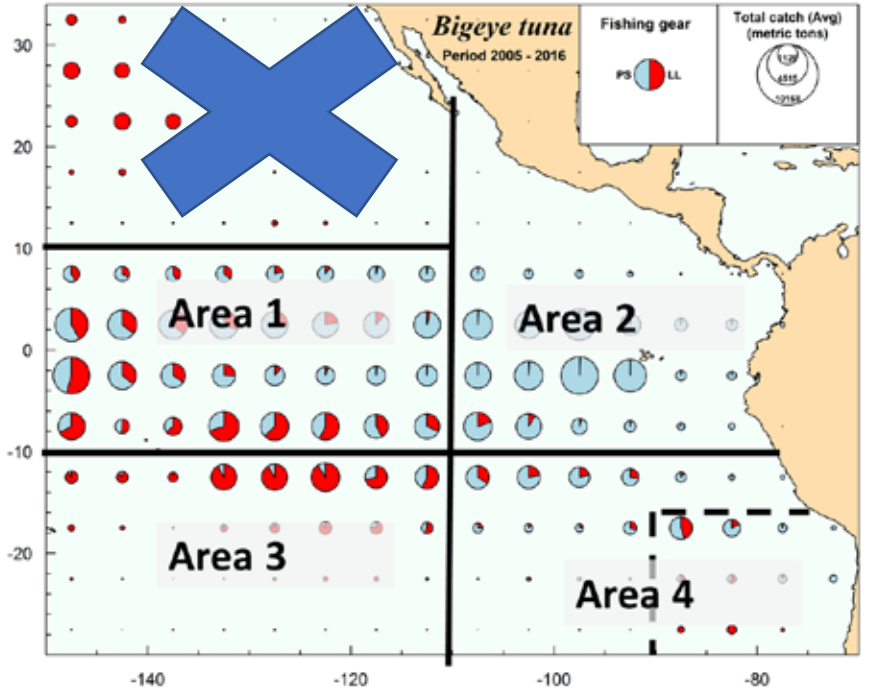
SAC-11-Inf-K SAC-11-Inf-L continued collaboration with Korea

For SWO: data from MoU allowed to do comparisons between Korea and Japan SAC-13-Inf-M

Comparison of nominal BET CPUE: Japan and Korea

Over wide spatial scale the CPUEs **differ**



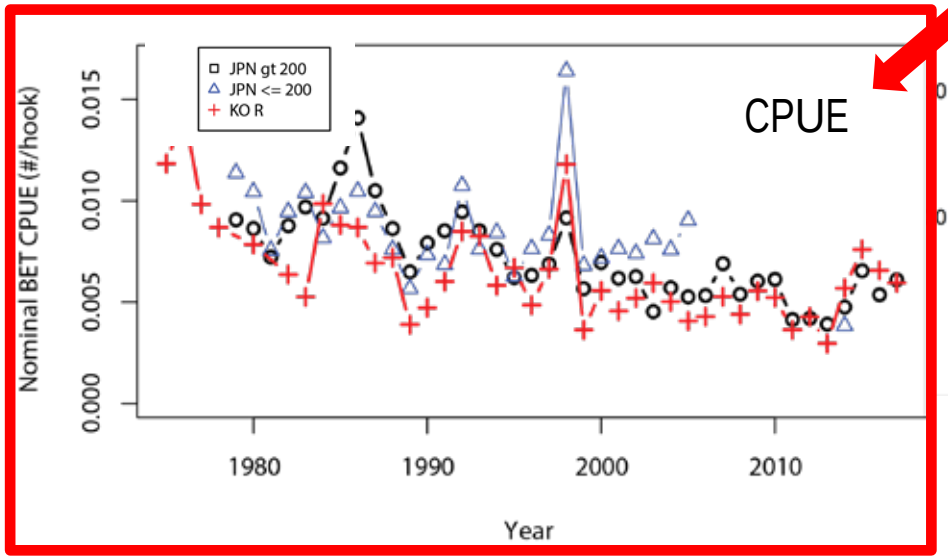


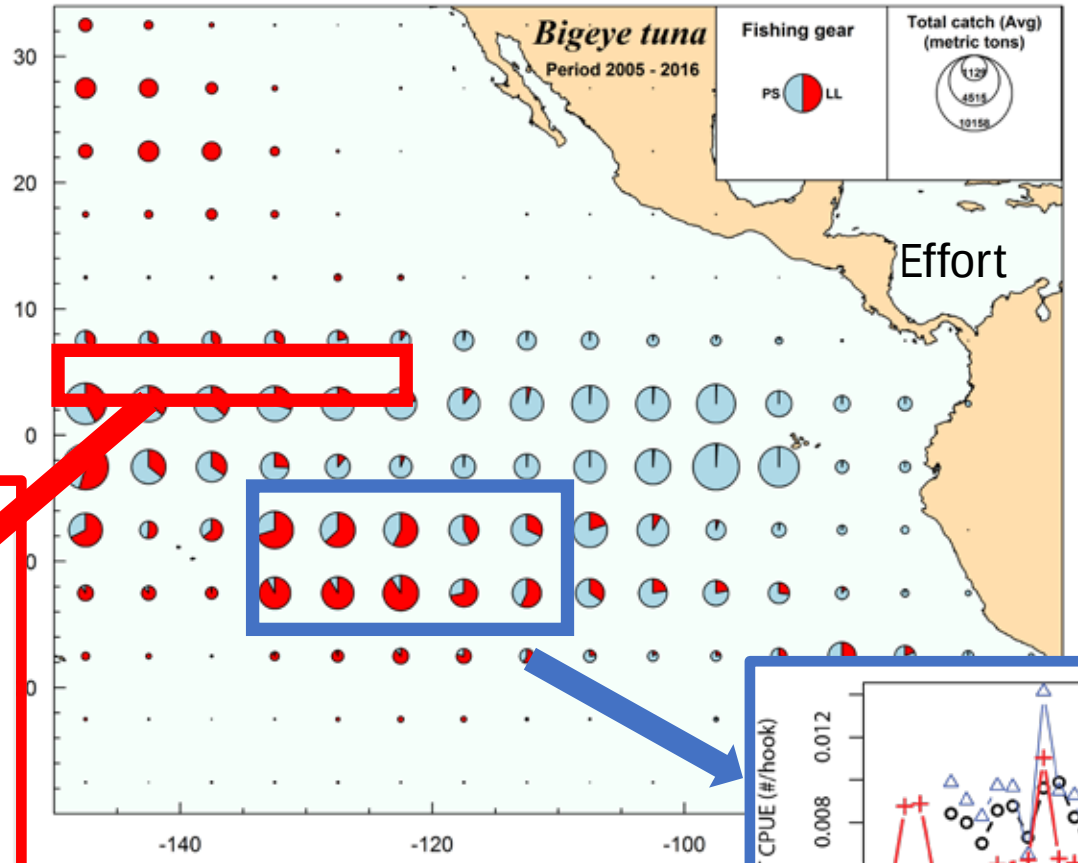
OTH-30

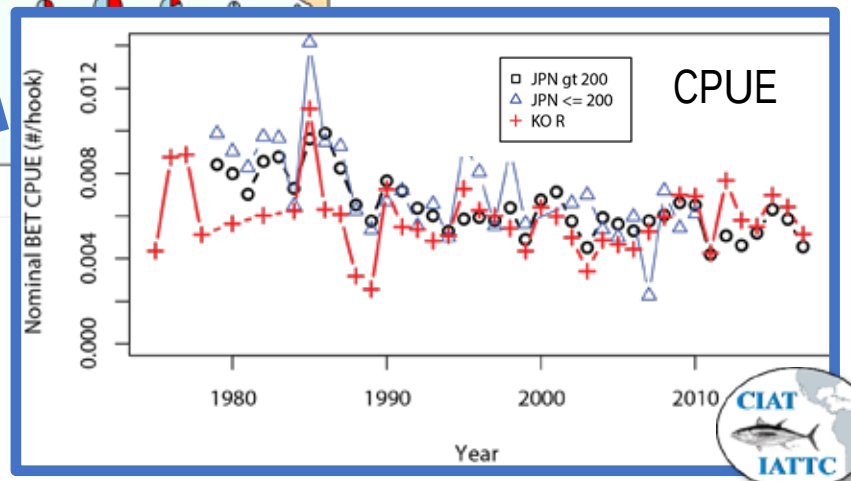
Comparison of nominal BET CPUE: Japan and Korea

Over fine spatial scale the CPUEs are **similar**

Spatial scale is important



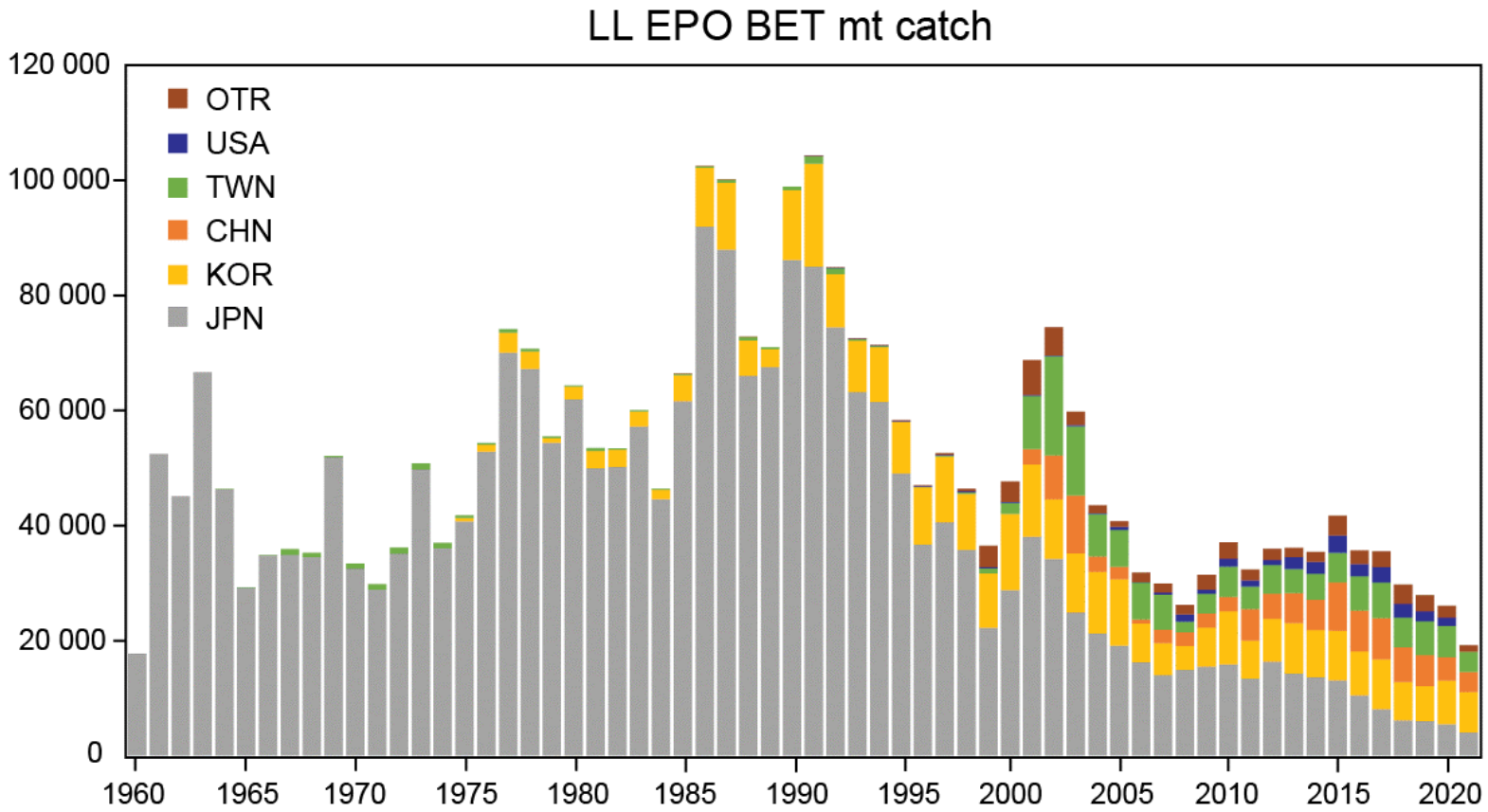




Operational-level data

OTH-30

Challenge to improve the indices

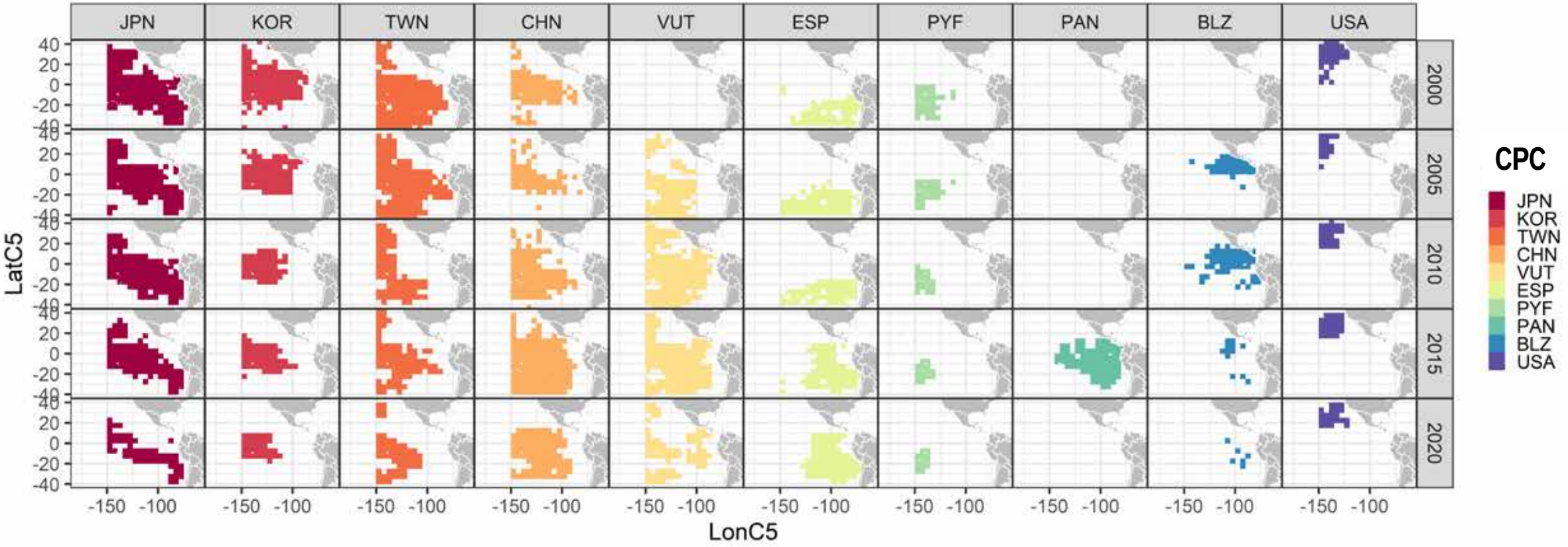


Good data from longline fleets to investigate:

- Produce combine longline indices from data from several fleets
- Changes in target
- Inclusion of size composition data from multiple fleets.

Data from other CPCs could be included in indices

The coverage would be increased, but data needs to be well understood



Longline effort distribution: Data received in compliance with C-03-05: effort in 5° X 5° by month

Benefits of improving longline data: BET Risk Analysis

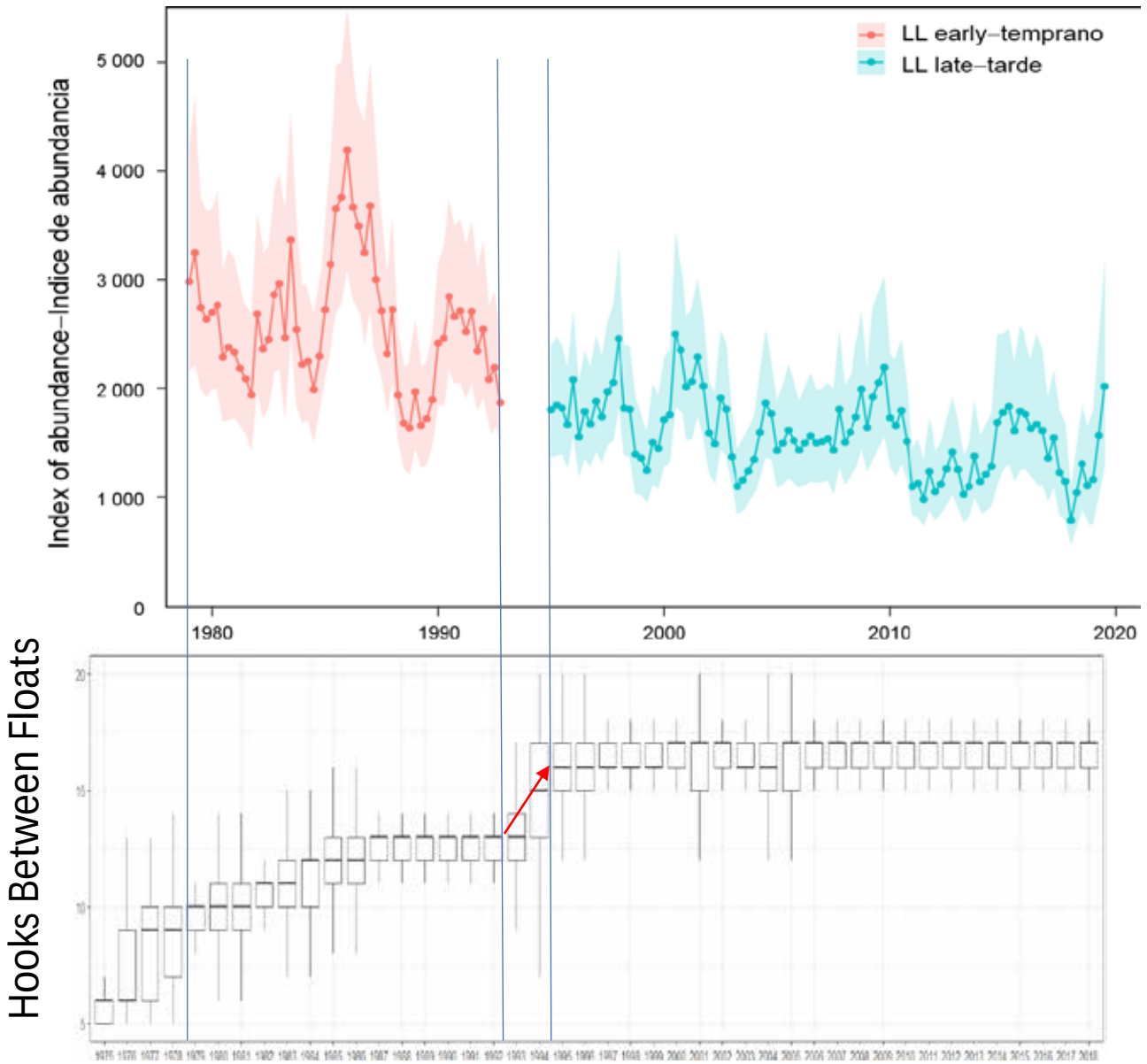
- The transition from the “best assessment approach” to risk analysis to the formulation of management advice for tropical tuna at IATTC:

1. The process resulted in the identification of a set of reference models (alternative *states of nature*) – **patterns in longline data influential to develop models**

2. The approach provides a methodology for assigning relative weights to the plausibility of these alternative hypotheses – **fit to size composition data of longline fleet important (asymptotic selectivity)**

3. The final product are probability statements for exceeding the reference points established in the Harvest Control Rule

Data – new index of abundance



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The need for spatio-temporal modeling to determine catch-per-unit effort based indices of abundance and associated composition data for inclusion in stock assessment models

Mark N. Maunder[a,b,*], James T. Thorson[c], Haikun Xu[a], Ricardo Oliveros-Ramos[a], Simon D. Hoyle[d], Laura Tremblay-Boyer[e], Hui Hua Lee[f], Mikihiko Kai[g], Shui-Kai Chang[h], Toshihide Kitakado[i], Christoffer M. Albertsen[j], Carolina V. Minte-Vera[a], Cleridy E. Lennert-Cody[a], Alexandre M. Aires-da-Silva[a], Kevin R. Piner[f]

New model and new data source for longline indices of abundance:

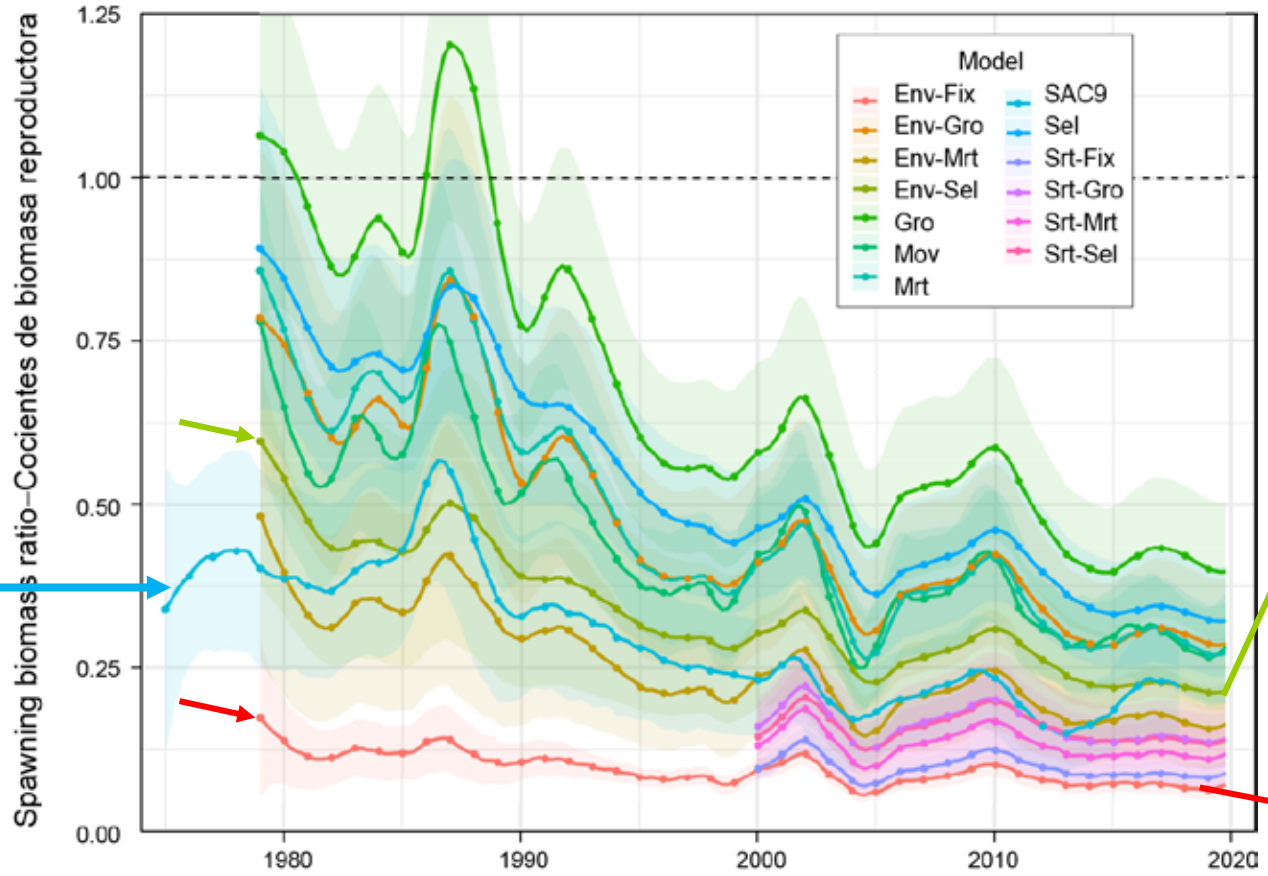
- Standardized using a **spatiotemporal model** (VAST)
- 1° cell x month **x vessel** catch and effort data from the Japanese fleet

What's new in longline indices of abundance:

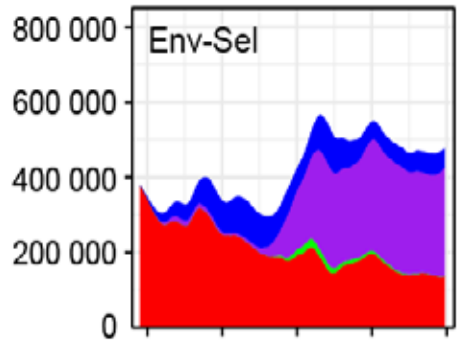
- The longline index is split into **two** indices: 1979-1992 (early) and 1995-2019 (late)
- **Different** catchabilities and selectivities for the two indices due to the change in HBF

Model results - spawning biomass ratio

2018 assessment SAC9

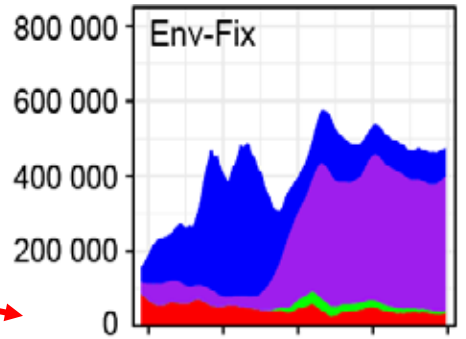


Model that assumes **dome-shaped** selectivity for longline



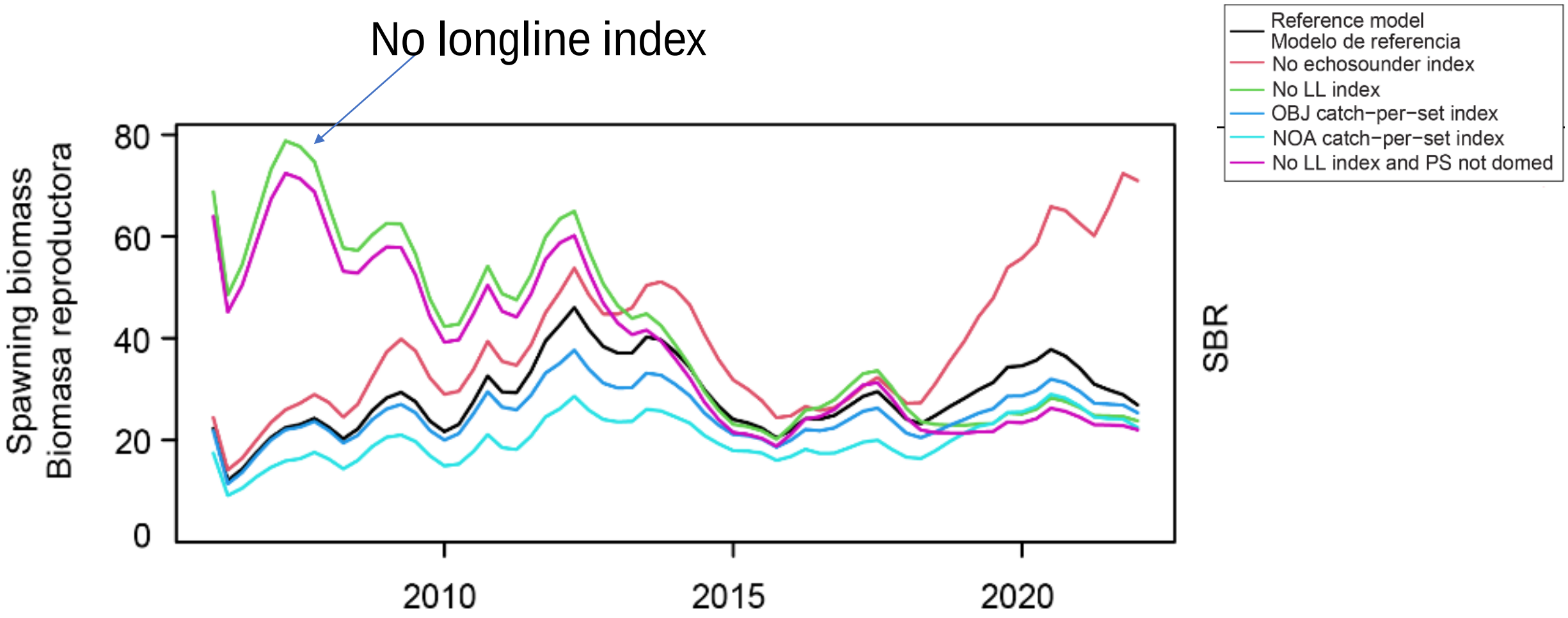
Red: Biomass
Impact of:
Blue: longline
Purple: purse-se
Green: OBJ disca

Model that assumes **asymptotic** selectivity for longline

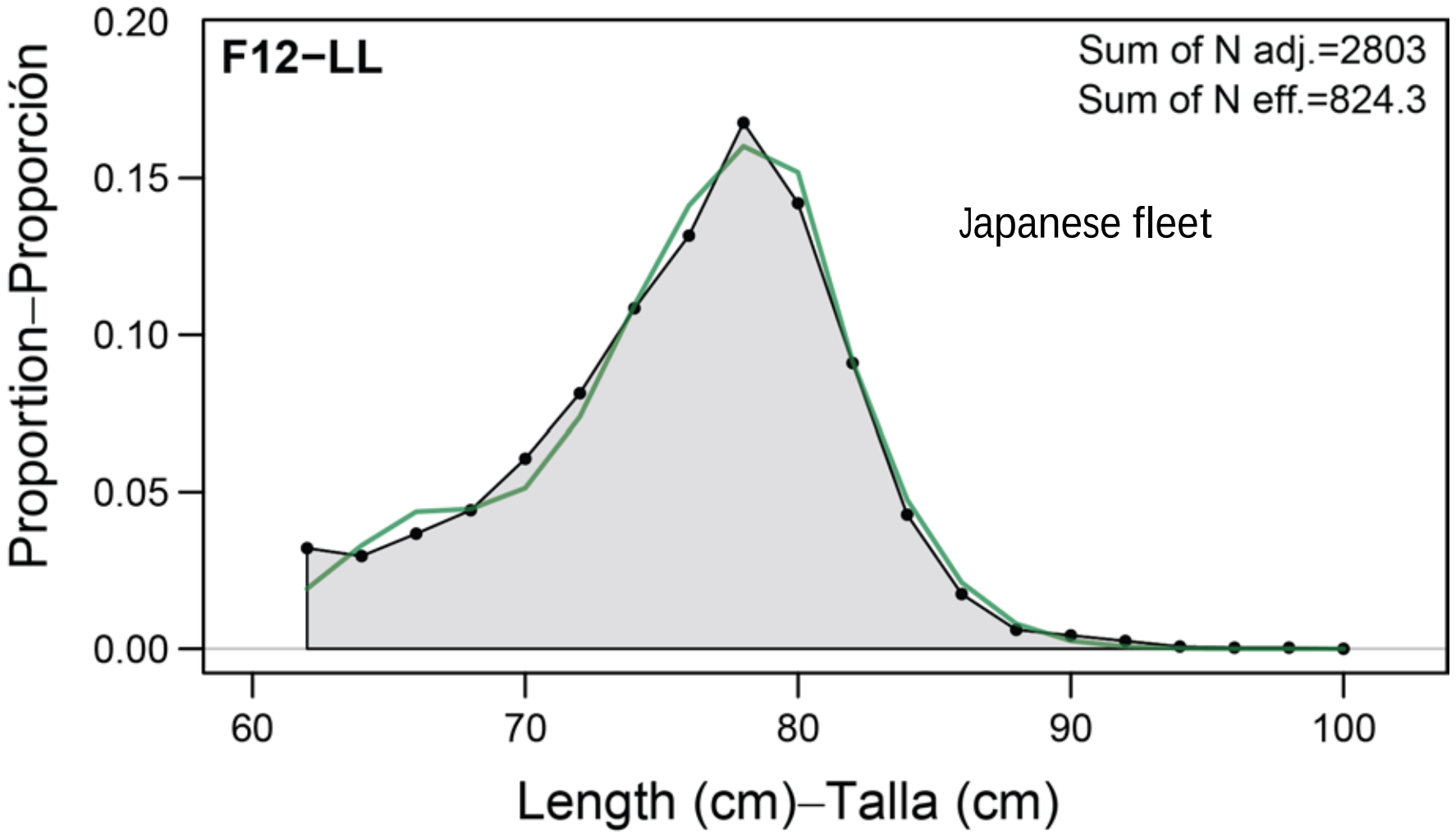


Good size composition data is need to understand whether and where and when the longline selectivity is likely to be asymptotic.

Benefits of improving longline data:SKJ assessment



SKJ: longline length composition



Information on:

- selectivity
- total mortality
- growth

Rationale for revising C-03-05: Target species

- Recent challenges with assessing the stock status of target species
  - 2018 BET and 2019 YFT assessments unreliable
  - Risk analysis
  - Longline data is key to assessment results
  - The assessments need to be further improved for 2024 Benchmark Assessments
- Data sources exist
  - Task I data: annual catch
    - Details on how was estimated and in what units are needed
  - Operational-level LL logbook data only available through MoUs for specific purposes and limited time
    - Data have greater spatial and temporal coverage and may include information on catchability (e.g., gear configuration)
    - Data are not compulsory according to C-03-05
- Collaborative projects with CPCs are invaluable
- Improved data are needed to:
  - analyze current and historical trends of tuna and tuna-like stocks in the EPO
  - assess shifts in target species and effect of factors related to catchability
  - combine data from different fleets to produce better indices of abundance
  - address similar challenges for other tuna and tuna-like species, such as swordfish (SWO-01)

Current gaps in industrial longline data

- TASK I:
  - Need reporting of methodology for estimation
  - Need reporting in original units, conversion factors
- TASK II:
  - Catch and effort data submitted as monthly aggregates mostly at 5°x5° resolution
  - No reports of “Level 1” operational-level logbook data with information on gear configuration and target species
- No information on factors influencing catchability is provided
  - Little to no data on gear configuration and no vessel identifiers provided
- Data submitted are less detailed than for the purse-seine fishery
- A combination of data types are reported
  - Numbers and/or weights of individuals
  - No indication of methods for converting numbers to weights and vice versa
- Option of providing “level 2” (1° x 1°) or “level 3” (5° x 5°) raised or unraised data
  - No indication of whether data were raised
  - No indication of methodology used to raise the data

Questions?