Evaluación de la población de atún aleta amarilla en el Océano Pacífico Oriental: evaluación de referencia de 2025 y análisis auxiliares

Stock assessment of yellowfin tuna in the Eastern Pacific Ocean: 2025 benchmark assessment and auxiliary analyses

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(SAC-16-03 and SAC-16-INF-F)

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Temario–Outline

- Antecedentes
- Modelo conceptual
- Datos Supuestos y parámetros
- Modelos
- Resultados de la evaluación
- Estado de la población
- Direcciones futuras

- Background
- Conceptual model
- Data
- Assumptions and parameters
- Models
- Assessment results
- Stock status
- Future directions

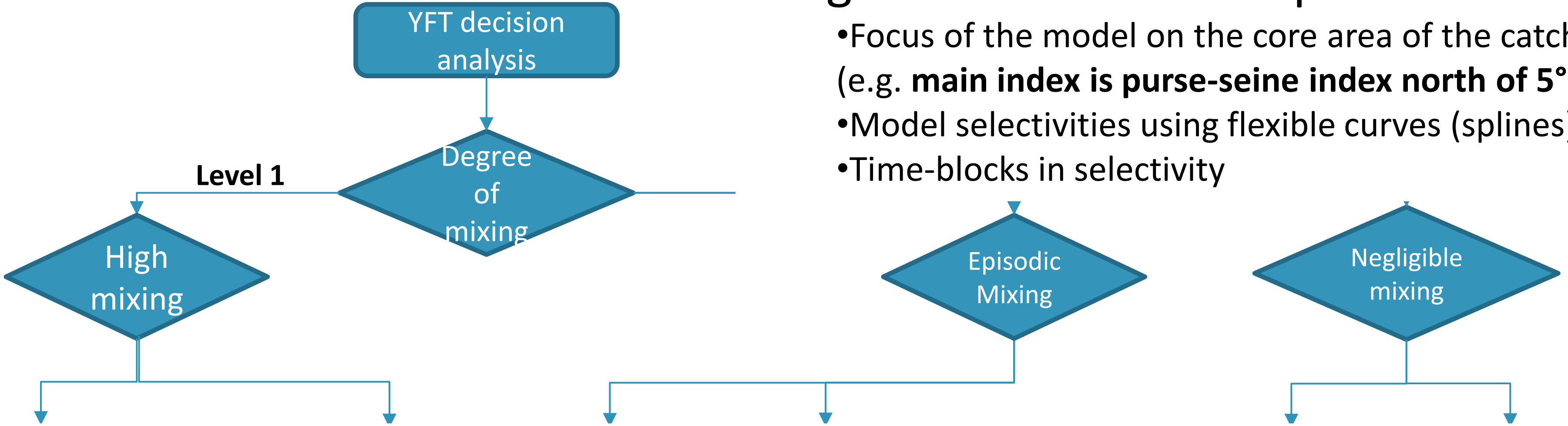
Background: Benchmark Assessment SAC-11-07 2020

Issues that remained:

- Stock structure/spatial structure (explorations on how to “split” stocks inconclusive)
- Bimodal/multimodal patterns in length composition of fisheries and index
- Uncertainty in growth and natural mortalit

Pragmatic solutions adopted:

- Focus of the model on the core area of the catches (e.g. **main index is purse-seine index north of 5°N)**
- Model selectivities using flexible curves (splines)
- Time-blocks in selectivity



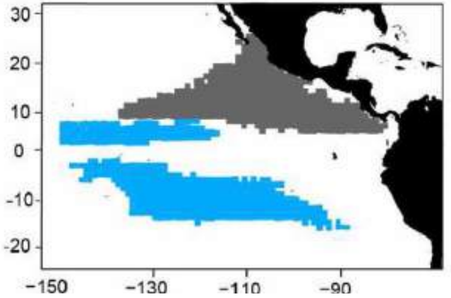
Background: Exploratory analyses SAC-14-06 2023

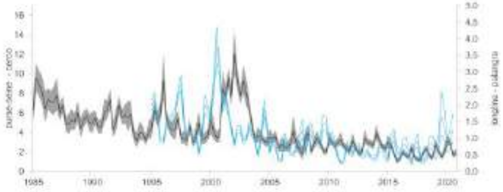
I.Genetic and genomic data is sparse but points towards spatial structure (NE vs SW)

II.Archival tagging data shows limited movement

III.**PS-DEL index** and **LL index**:

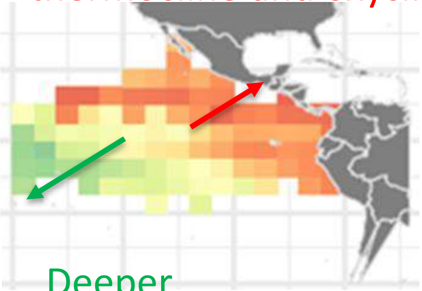
do not overlap in space and are dominated by different cohorts





IV. “Stock” structure may be related to broad oceanographic patterns, and may vary temporally

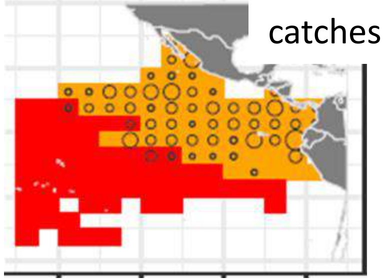
Shallower thermocline and oxycline



Deeper thermocline and oxycline

V. Stocks” may occupy irregular areas, not able to split using latitude and longitude”.

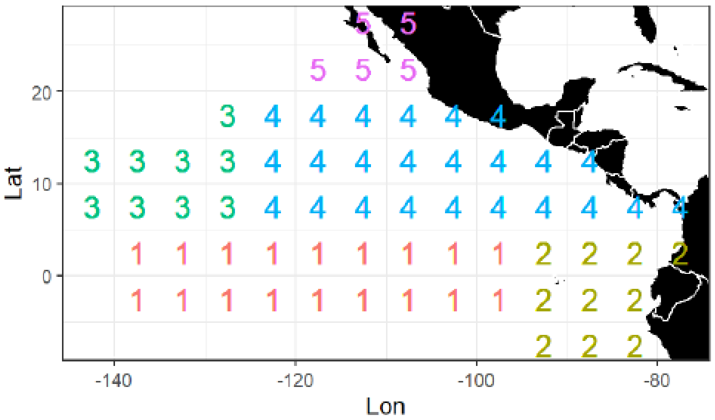
o PS-DEL catches

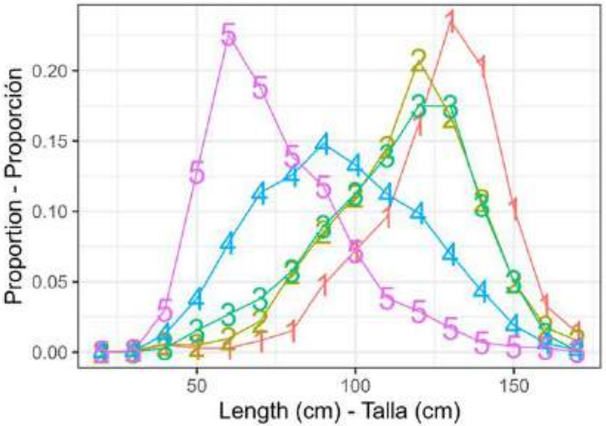


Areas based on habitat and tree analysis of PS-OBJ length frequencies

Background: Exploratory models SAC-15-03 2024

- There is spatial structure even withing PS-DEL area
- May be related to stock structure
- Limitations of the methods to discriminate areas: only along latitude and longitude
- Index associated with multimodal length compositions





Workplan: 2025 benchmark assessment

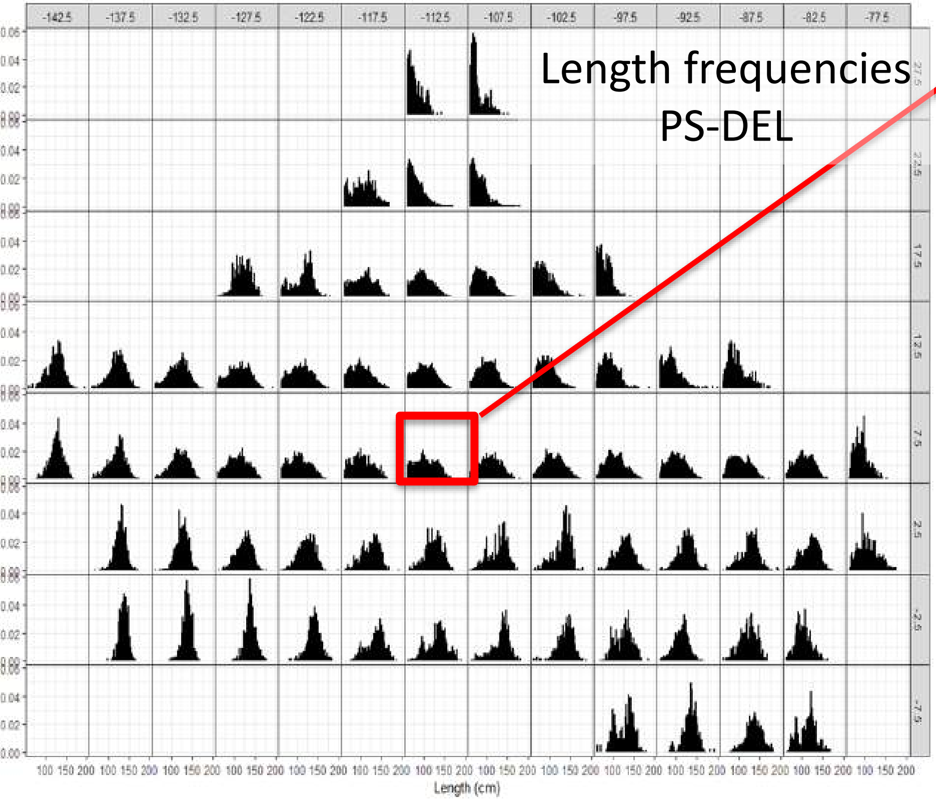
- Cluster analysis for irregular areas
- Flexible well-behaved asymptotic selectivity curves
- Spatio-temporal analysis of tagging data
- Longline CPUE index based on all distant water fleets
- Investigate dolphin associated fishery CPUE index
- Investigate within-year depletion in the DEL index
- Investigate changes in the ecosystem after the 1997-1998 el Niño
- Further develop models of stock structure

2025 benchmark assessment: achievements

- Cluster analysis for irregular areas
- Flexible well-behaved asymptotic selectivity curves
- Spatio-temporal analysis of tagging data
- Longline CPUE index based on all distant water fleets
- Investigate dolphin associated fishery CPUE index
- Investigate within-year depletion in the DEL index
- Investigate changes in the ecosystem after the 1997-1998 el Niño
- Further develop models of stock structure

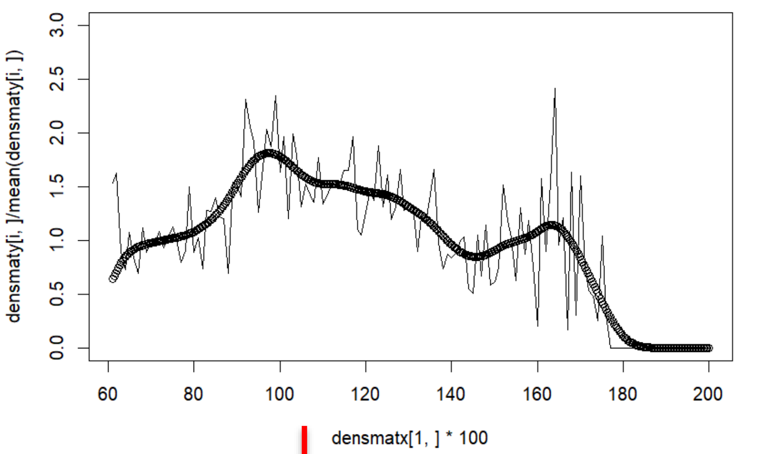
Conceptual model: cluster

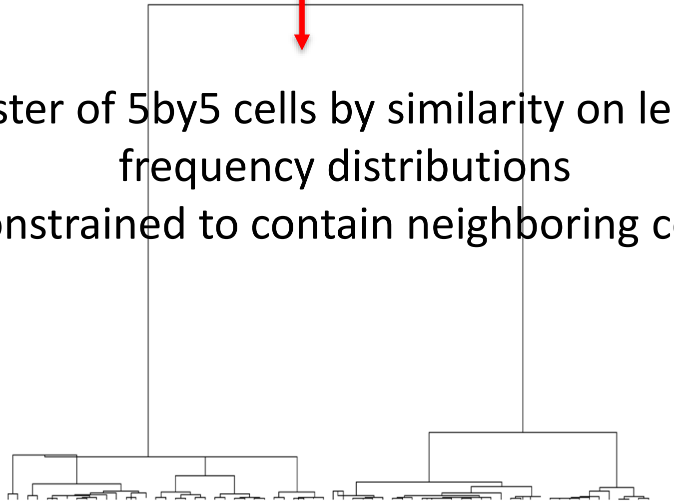
Longitude (5◦)



Length frequencies
PS-DEL

Latitude (5◦)



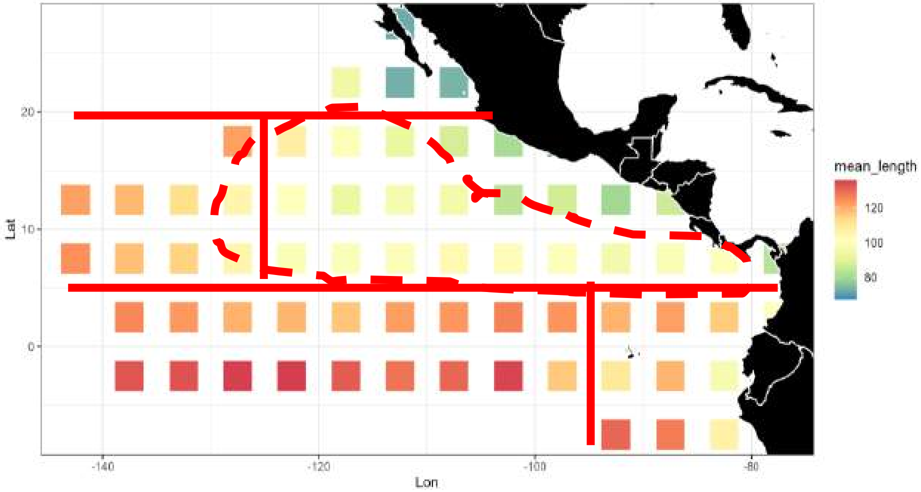


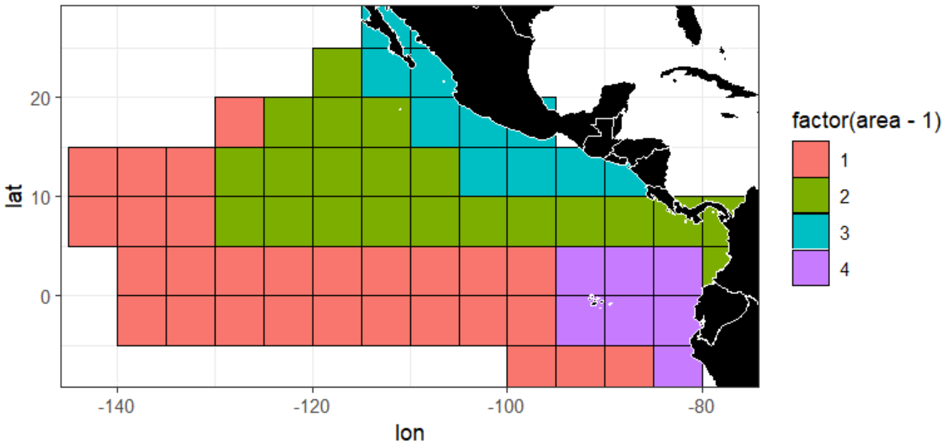
Cluster of 5by5 cells by similarity on length frequency distributions

Constrained to contain neighboring cells

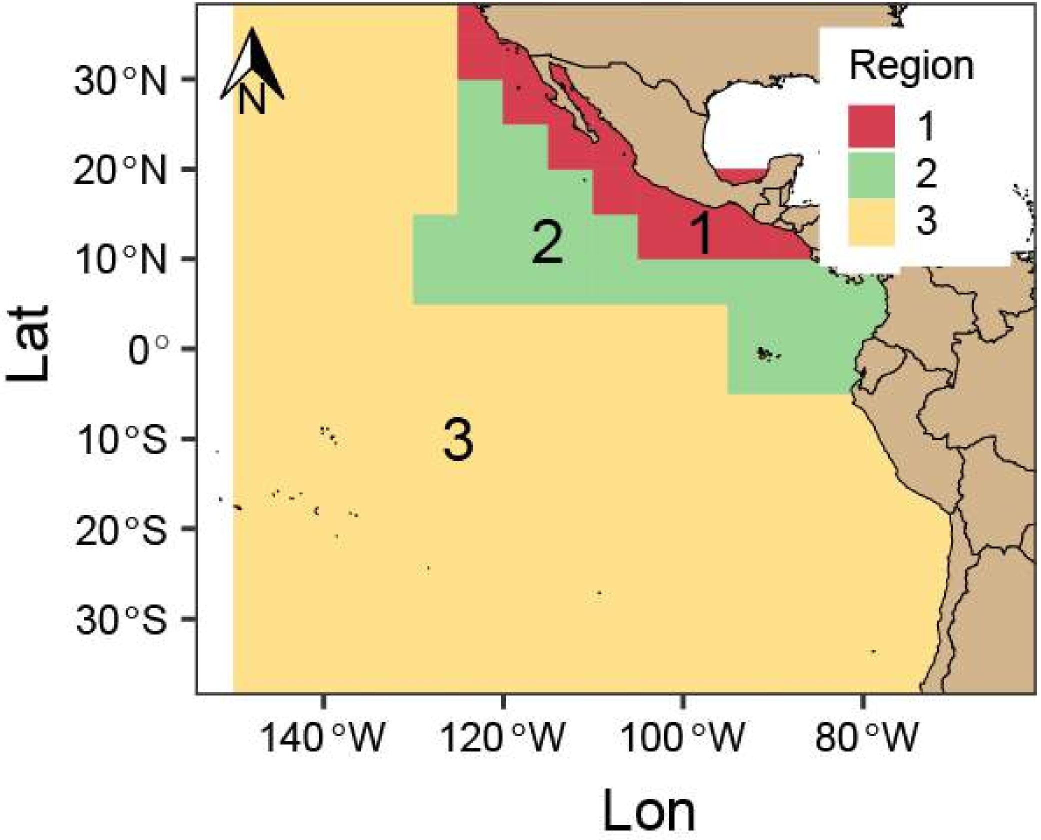
o

Conceptual model





Stock structure hypotheses



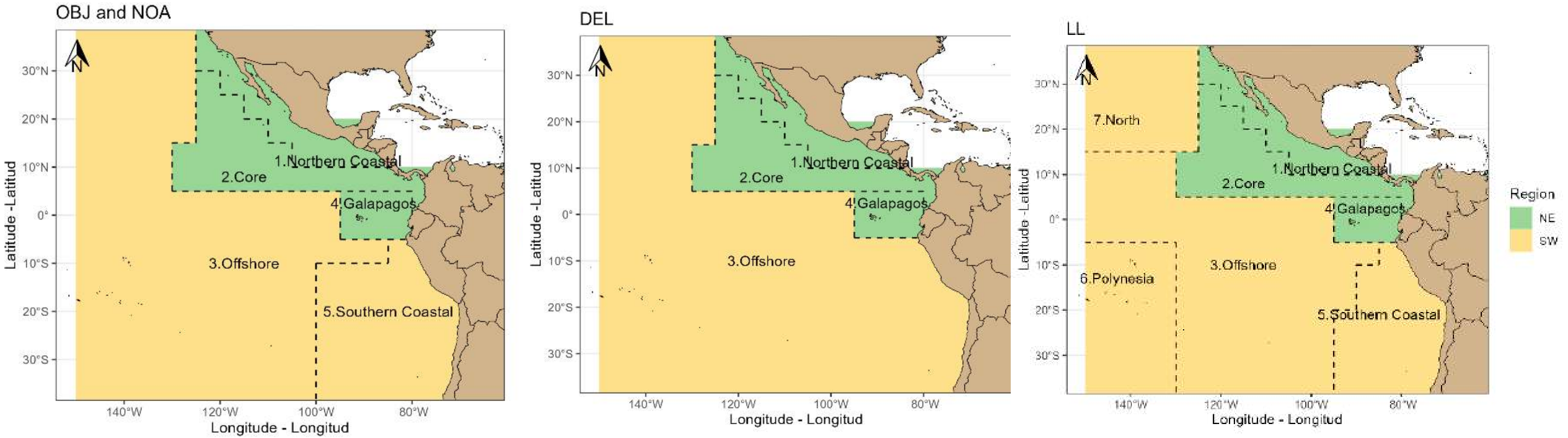
H1: full mixing

H2: Regional dynamics

H3: Independent stocks

Fishery definitions

By gear, purse-seine set type, area of operation



Indices of abundance and corresponding length composition

Purse-seine:

Purse-seine sets on dolphins CPUE and length composition data

ISAM: spatiotemporal model that allows for:

- Sharing of vessel effects between areas
- Variable spatial domain (ENSO)

Indices of abundance and corresponding length composition

Longline:

Collaborative work with Japan, Korea, China and Chinese Taipei

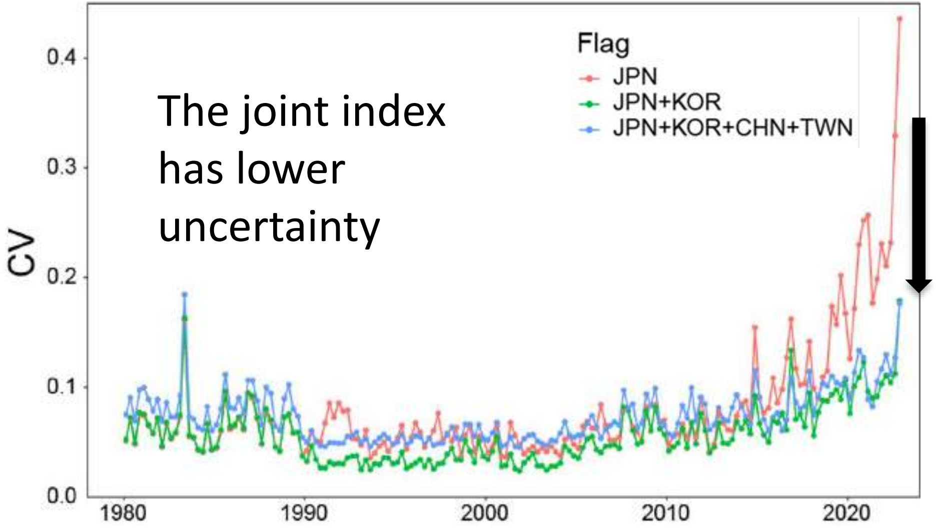
VAST: **Multi-fleet index from standardization of operational level data for Japan and Korea** using spatiotemporal model

Length composition:

Data from fishers (Japan) and obserbvers (Japan and Korea)

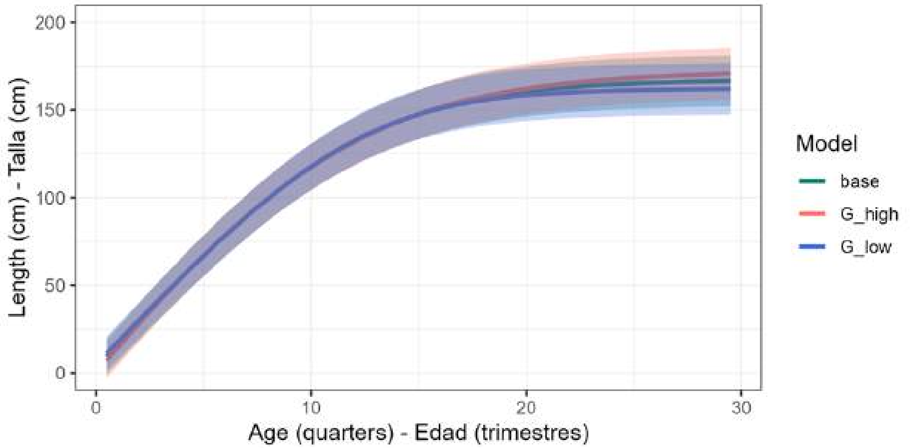
Standardized with spatiotemporal model with correlation parameters fixed at the Index values.

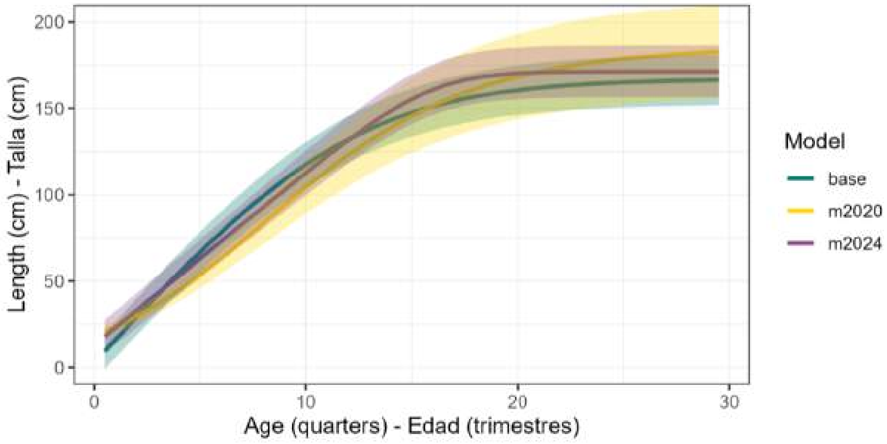
Data raised to the density.



SAC-16-INF-U

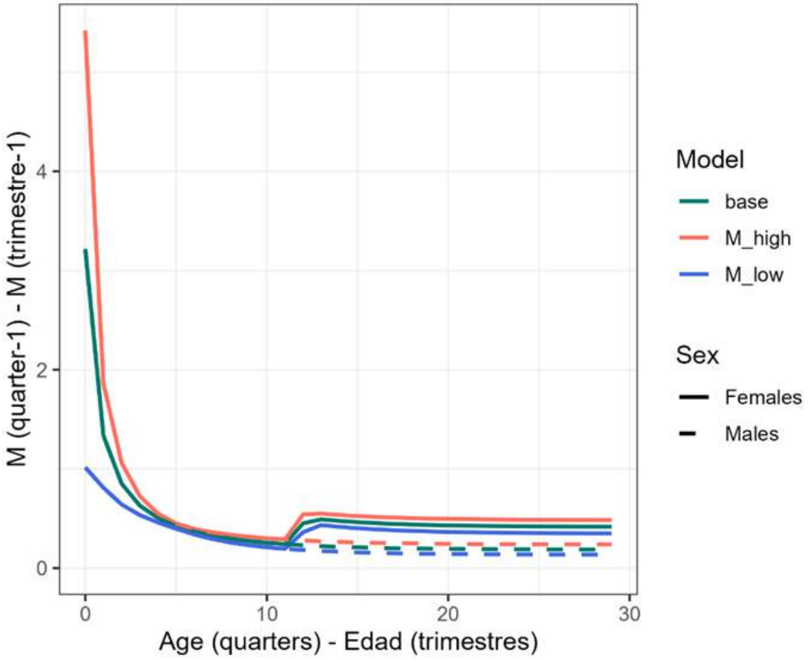
Assumptions and parameters: growth

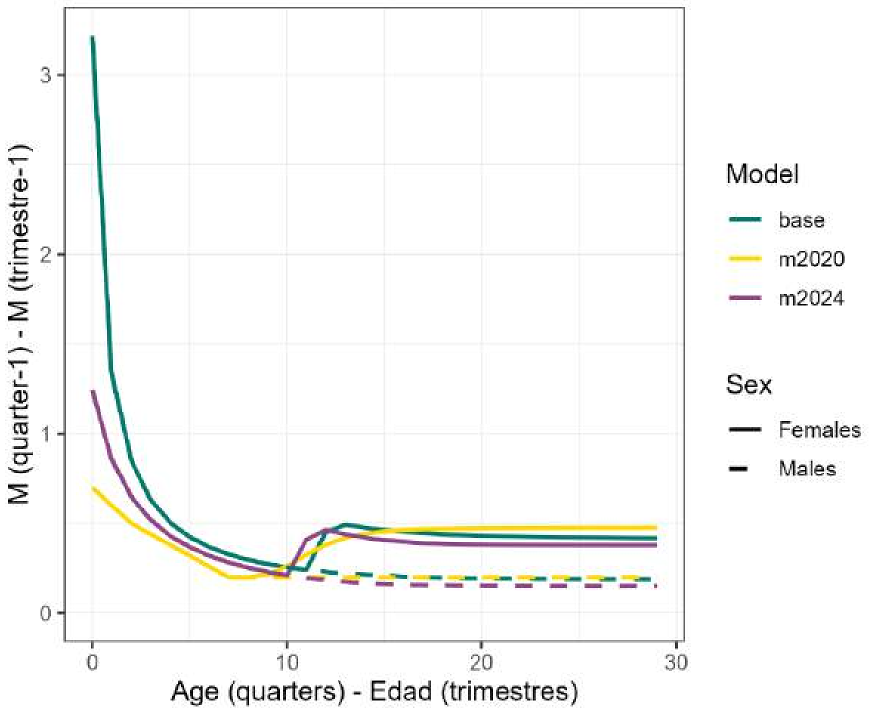




- Growth cessation model
- Fits to recent otoliths data and tagging data

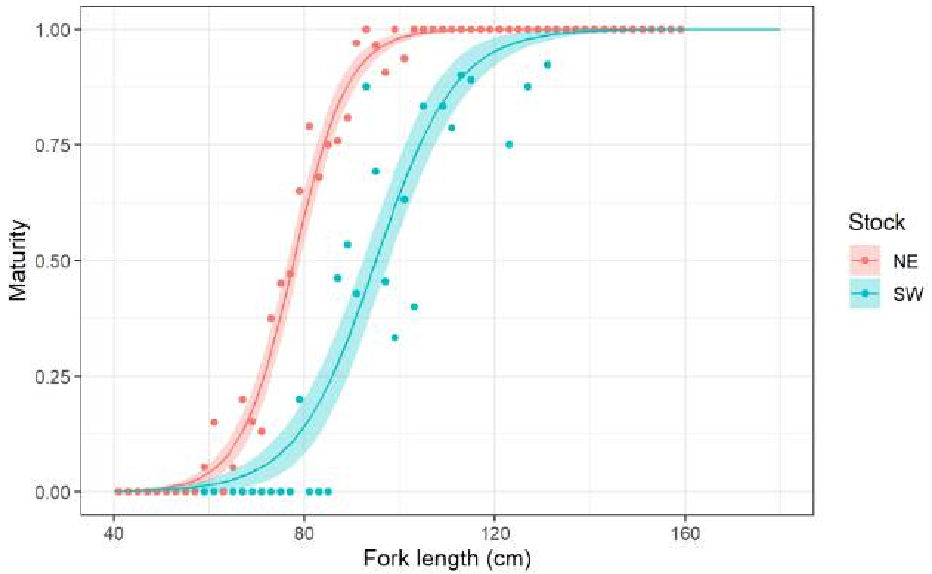
Assumptions and parameters: natural mortality

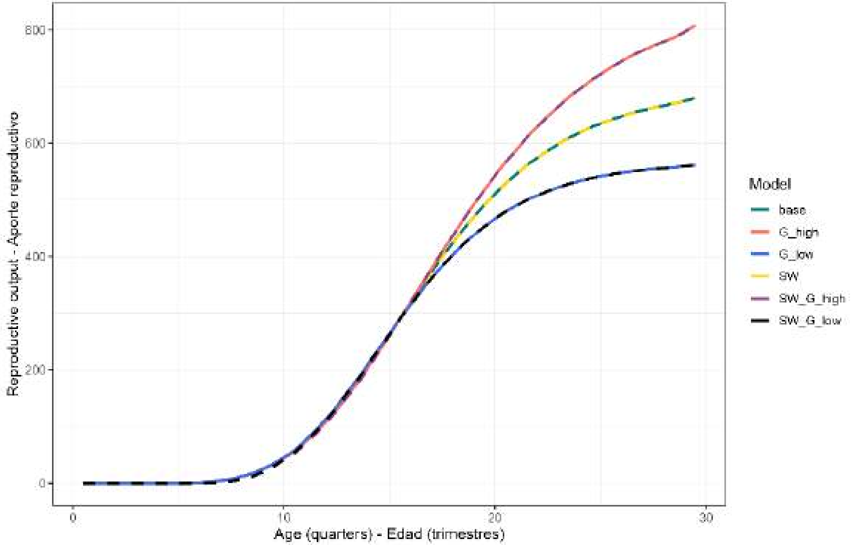




- Lorezen curve with logistic offset
- Cohort analysis
- Fits to tagging data and sex-ratio

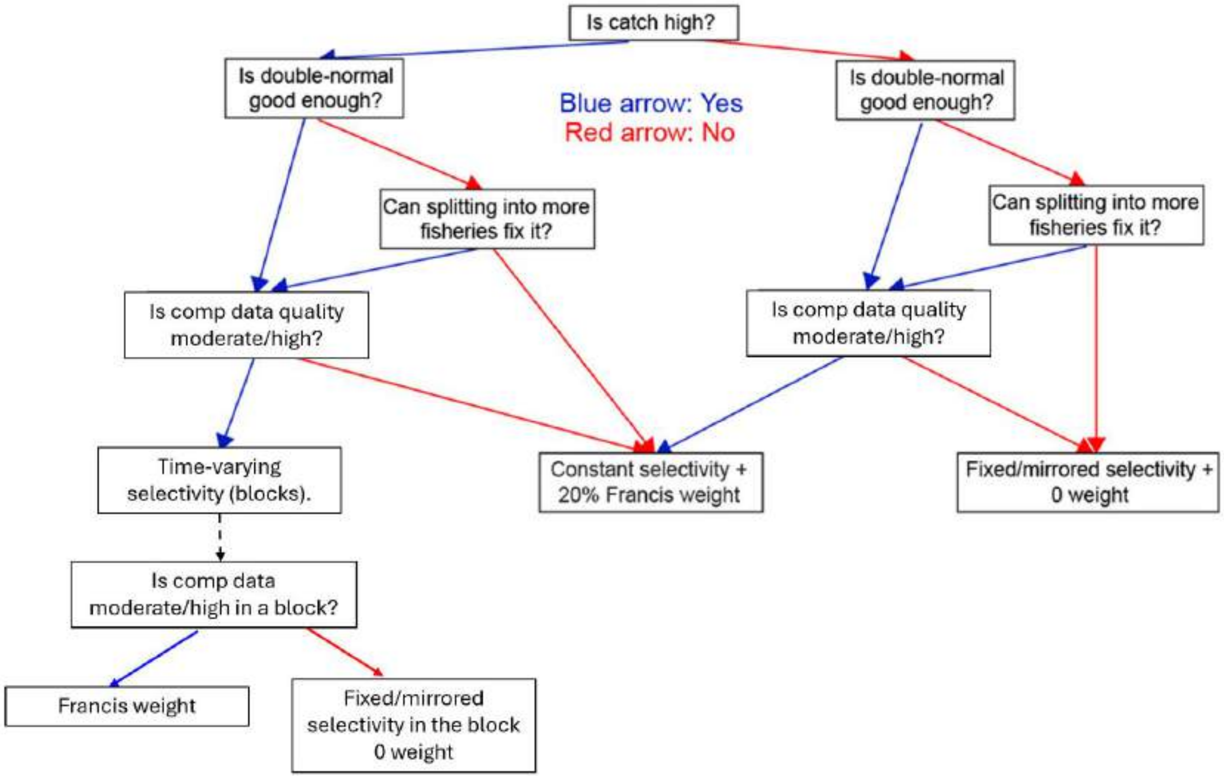
Assumptions and parameters: reproductive biology



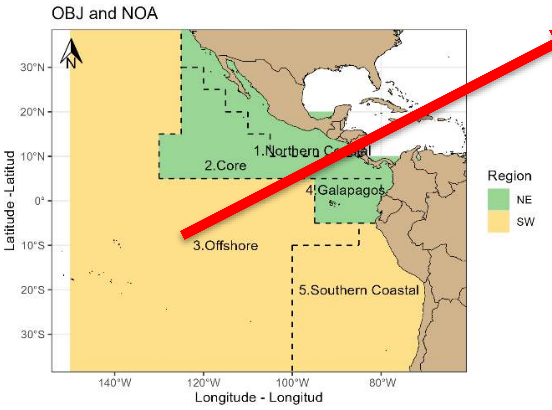


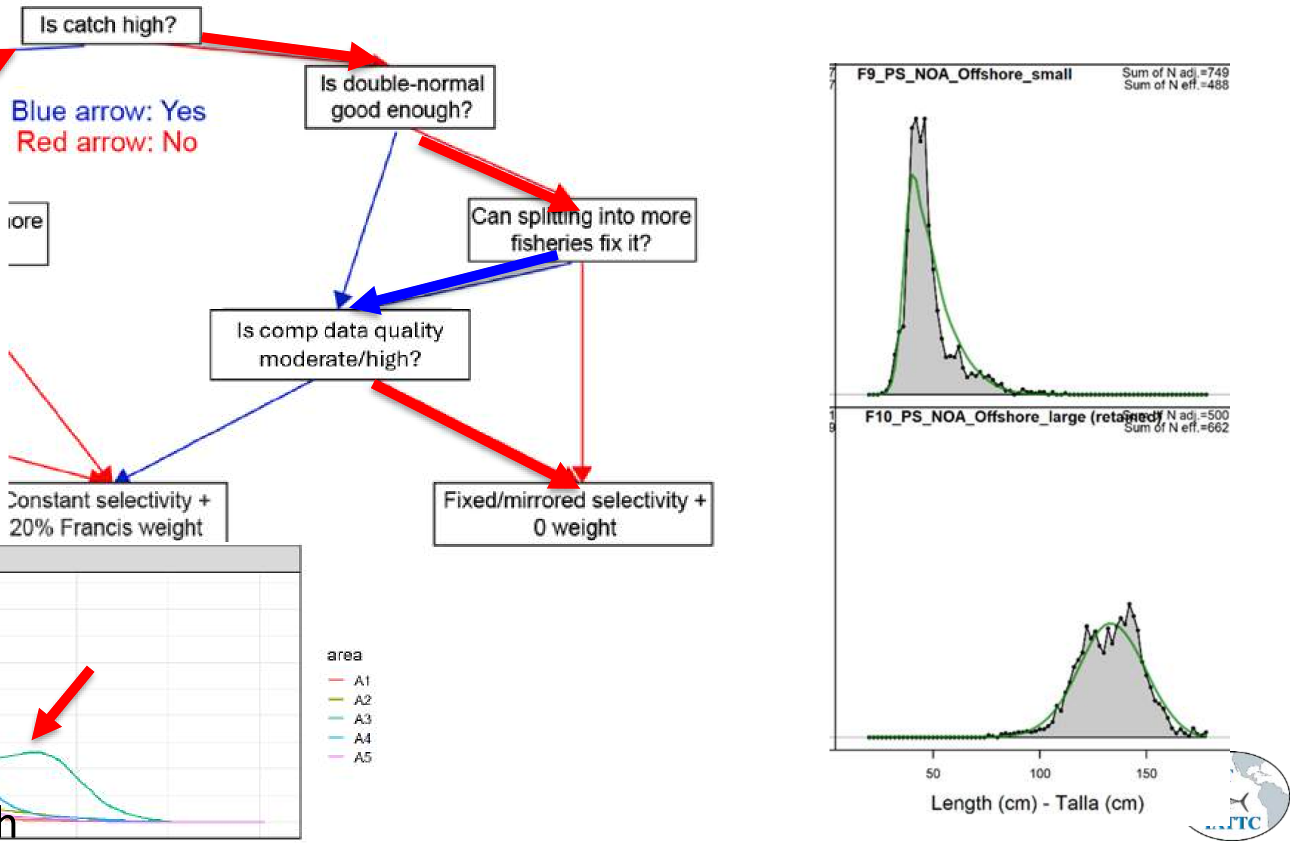
- Recent publication on reproductive biology
- Estimates for two “stocks”

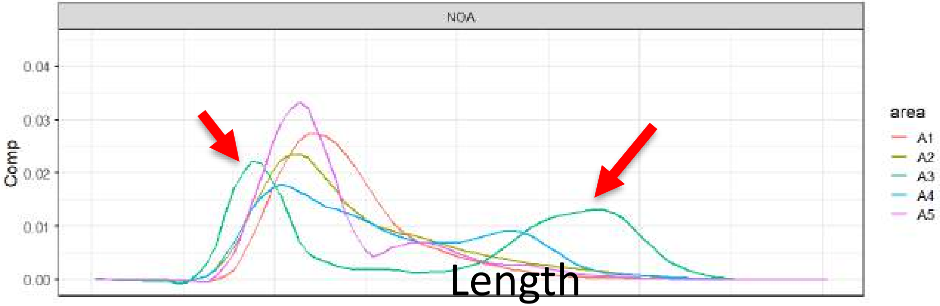
Assumptions and parameters: selectivity and data weighting



Assumptions and parameters: selectivity and data weighting – example NOA offshore



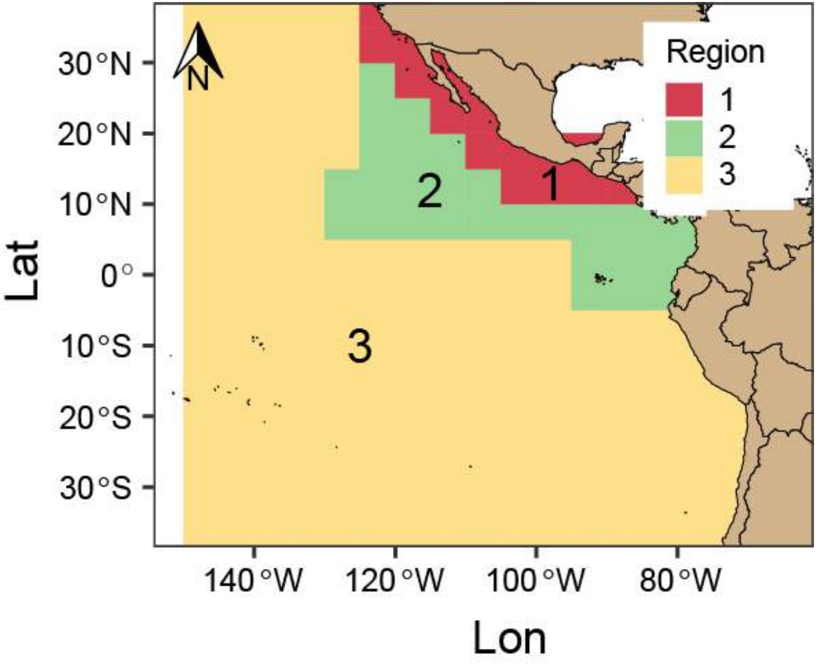




Risk analysis

Level 1 - spatial structure
Level 2 - uncertainty in biological parameters and effort creep
Level 3 - steepness of the stock-recruitment relationship.

Level 1: Spatial structure



EPO:

- spatial model: movement estimated to be near zero
- areas-as-fleet model

NE: Region 1 and 2

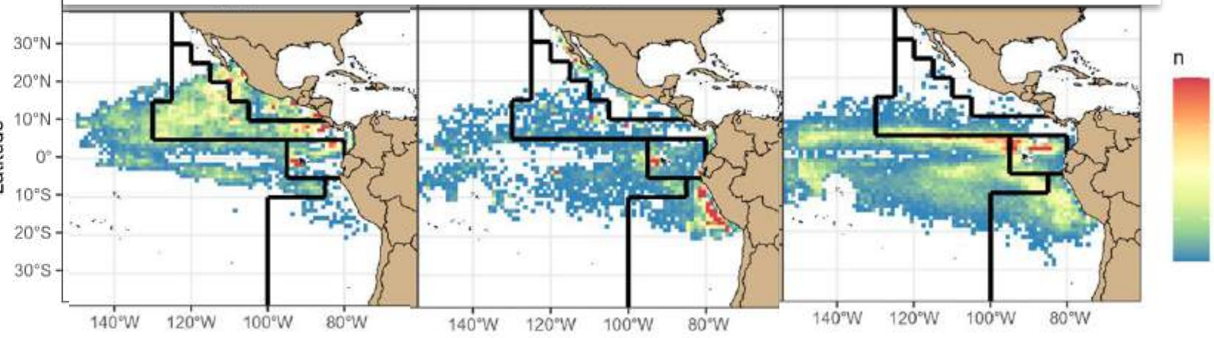
SW: Region 3

Level 1: Spatial structure

Number of sets

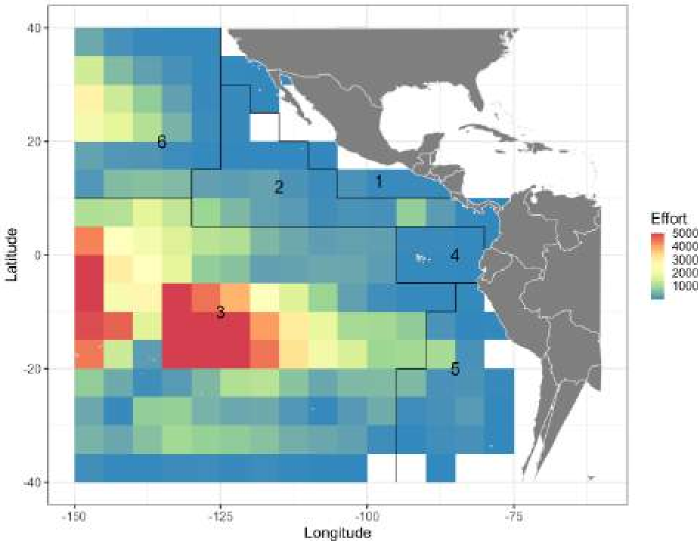
DEL **NOA** **OBJ**

2020-2023



Number of hooks

Longline



Models

Estimation of selectivities for fleets with 0 weight in other models

Basic structure to derive other models

Exploratory spatial model

Ancestral model

Areas-as-fleet models

Period: 1984 to 2023
2006 to 2023 (NE_short)
Start from fished conditions
All models converged

Level 1

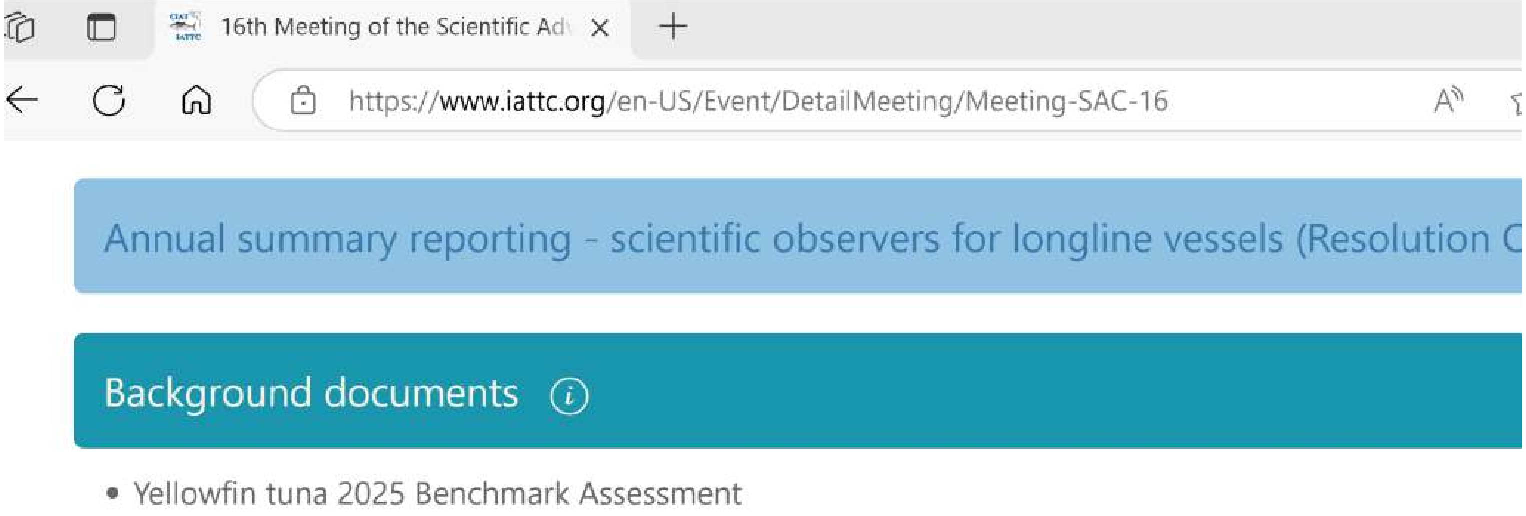
72 models

Level 2

Level 3

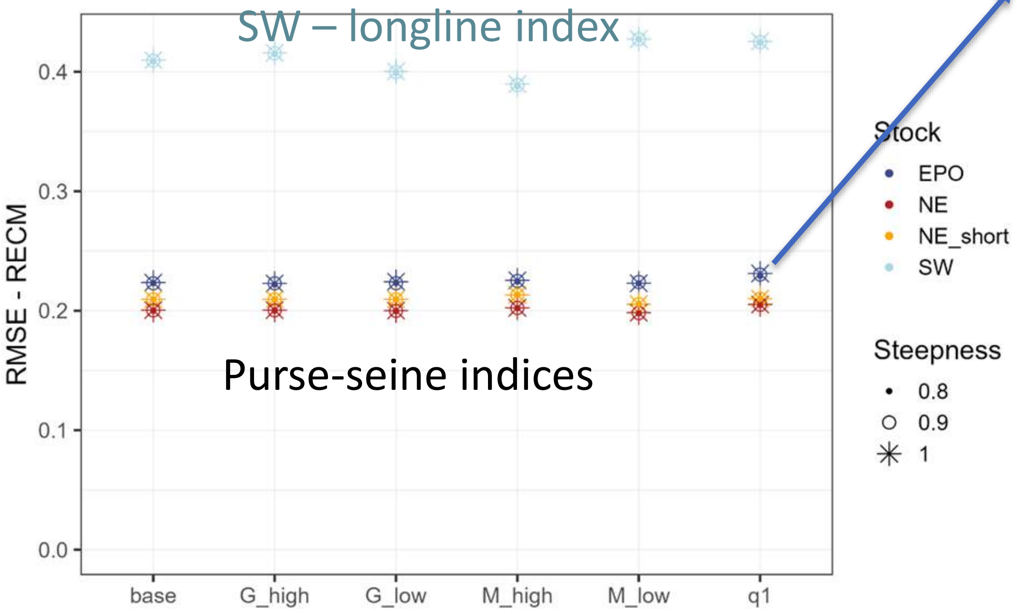
	EPO	NE	NE_short	SW
base	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8
G_high	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8
G_low	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8
M_high	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8
M_low	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8
q1	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8	h=1,0.9, 0.8

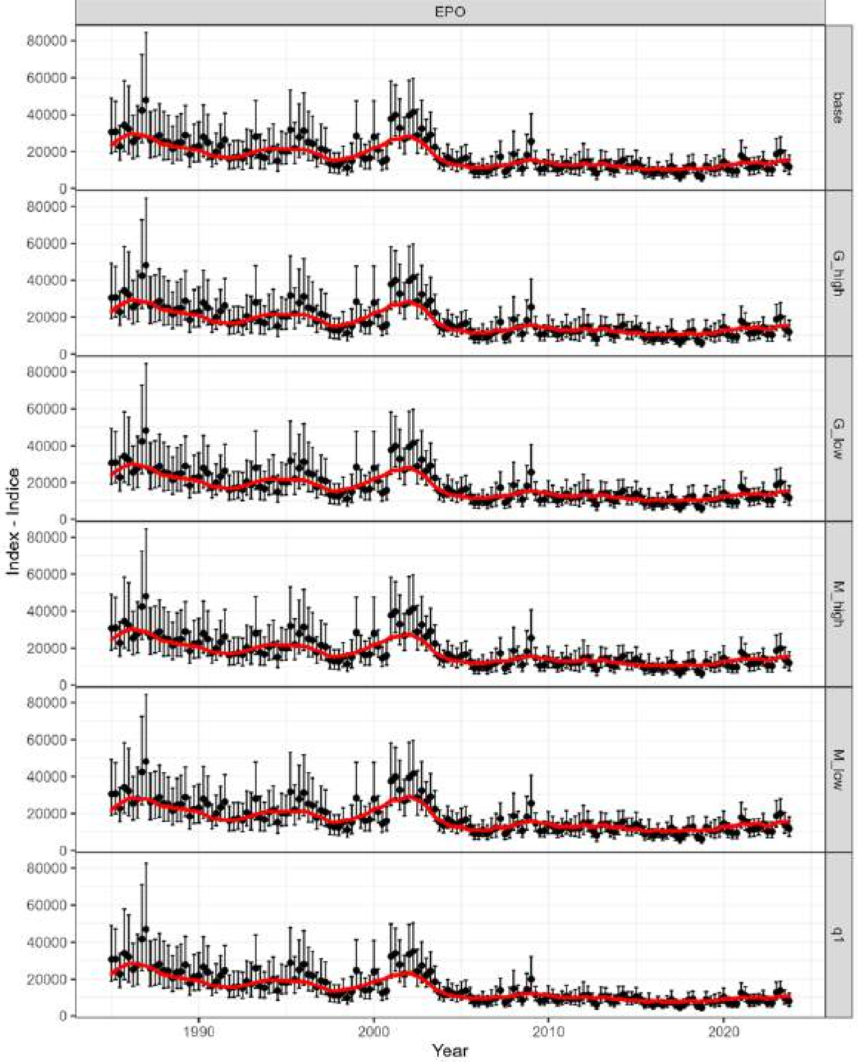
Assessment results:



LINK:
https://www.iattc.org/StockAssessments/2025/YFTWebsite/YFT%202025%20Benchmark%20Stock%20Assessment.htm

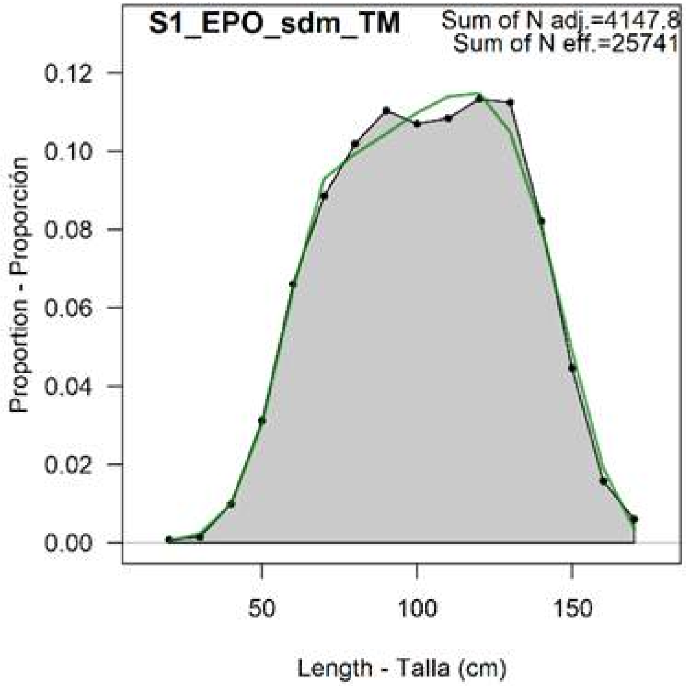
Assessments results: fits



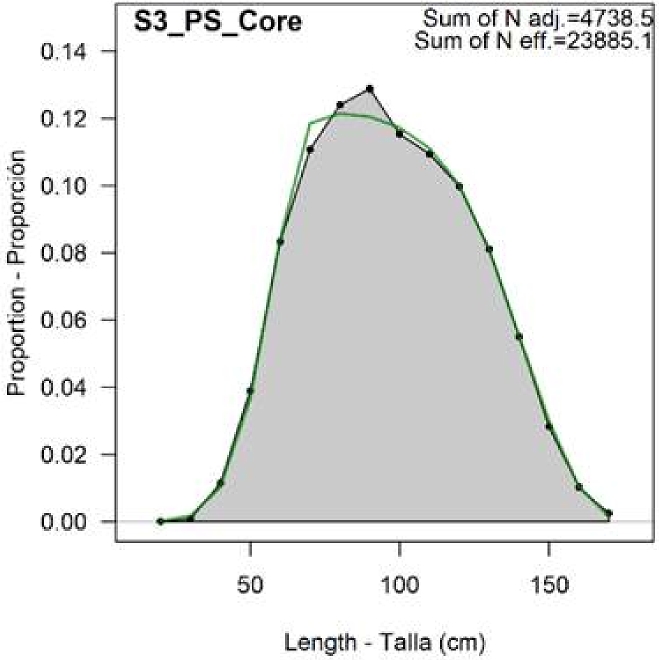


Assessments results: fits to length composition data

EPO

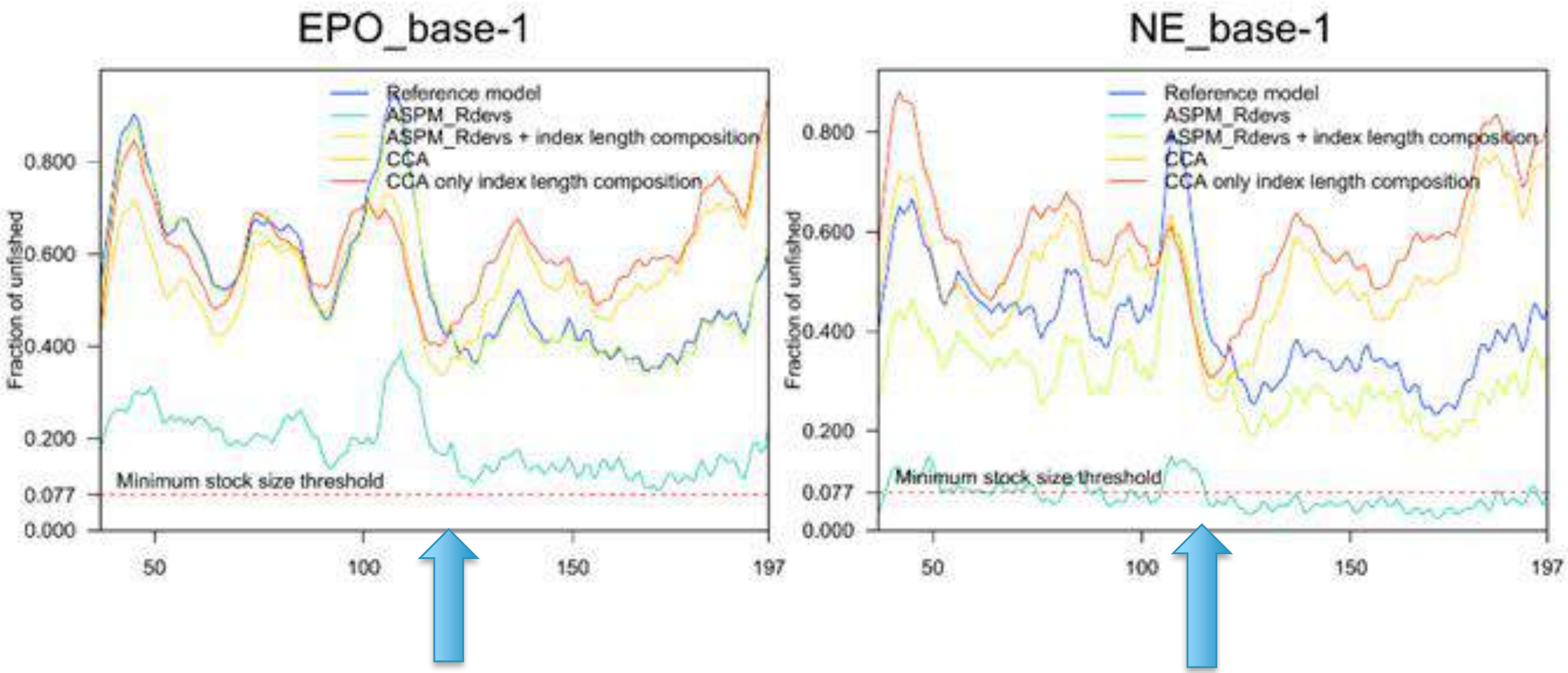


NE



EPO index: Biomodality is improved but not solved

Assessments results: integrated model diagnostics



NE_short: model that starts in 2006

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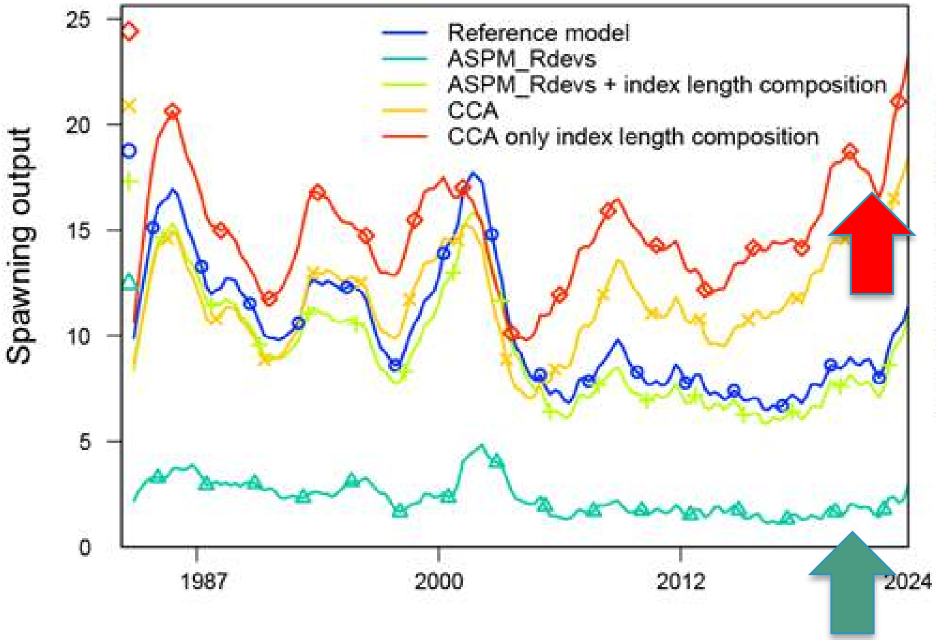
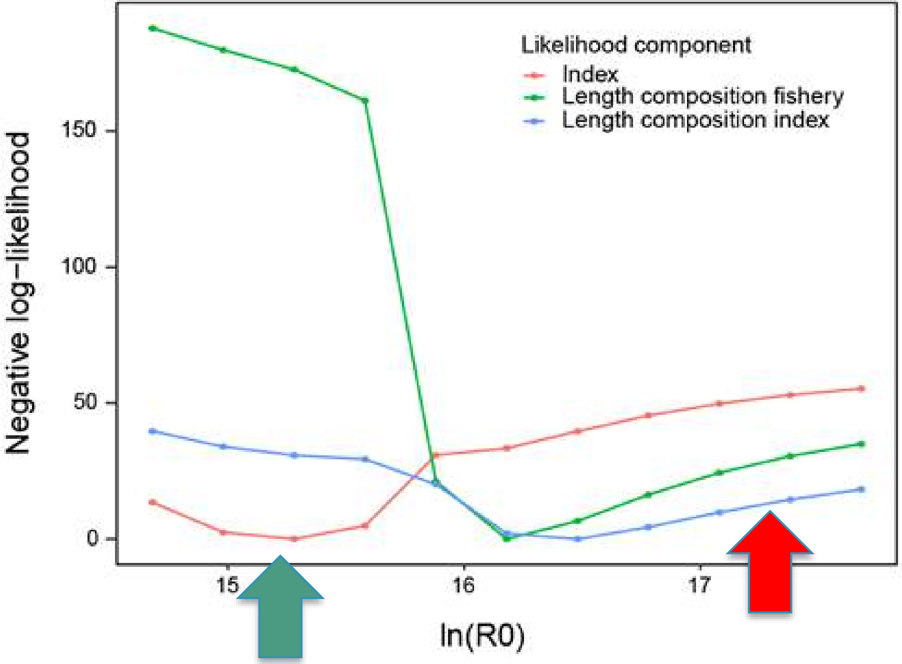
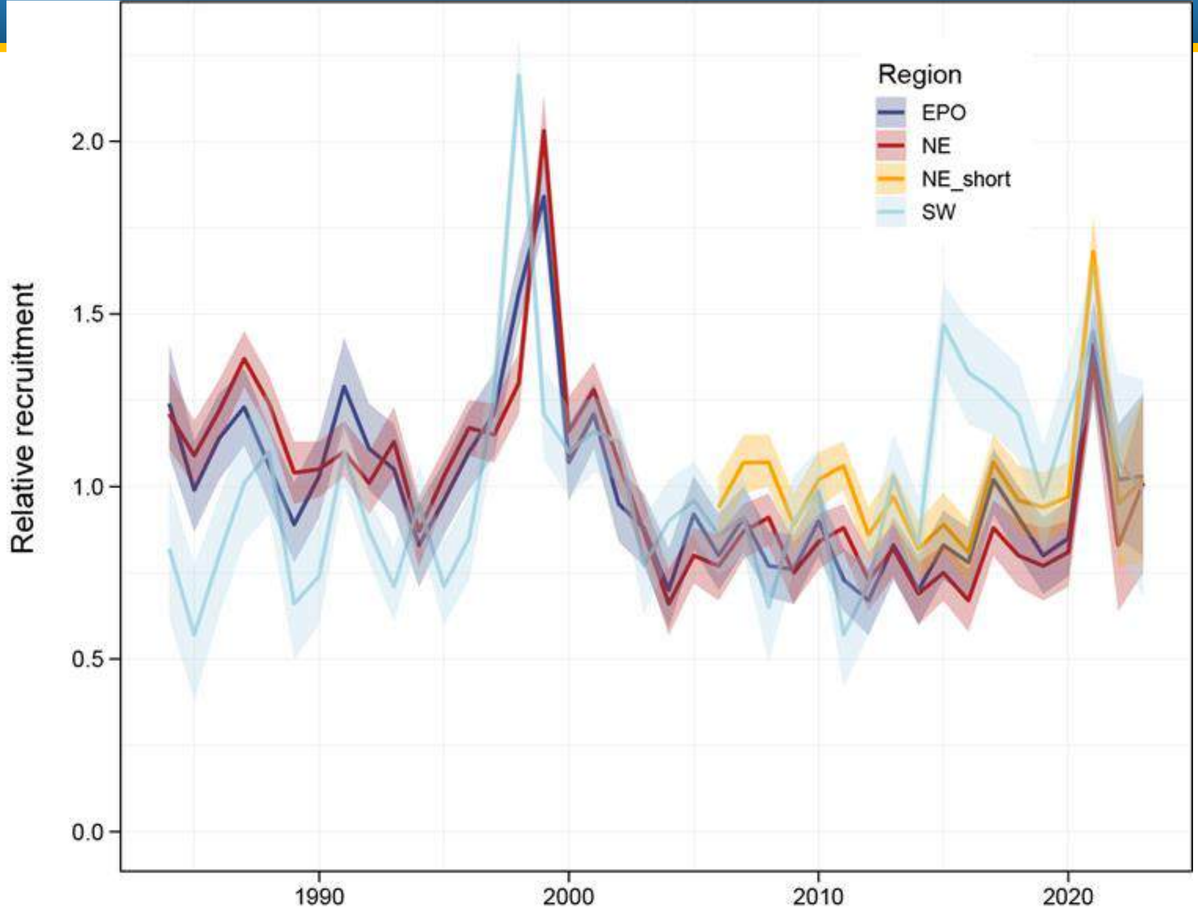
Assessments results: integrated models diagnostics

EPO-base-1

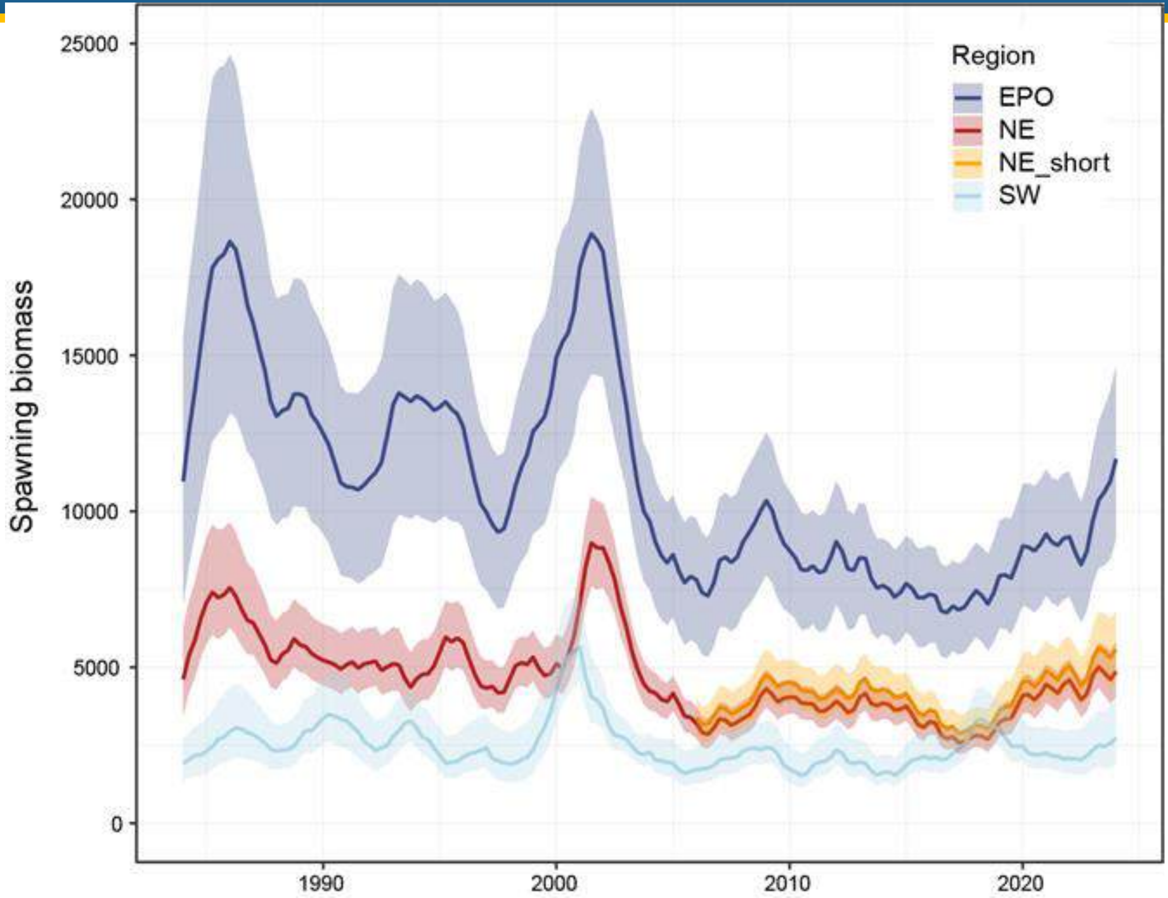




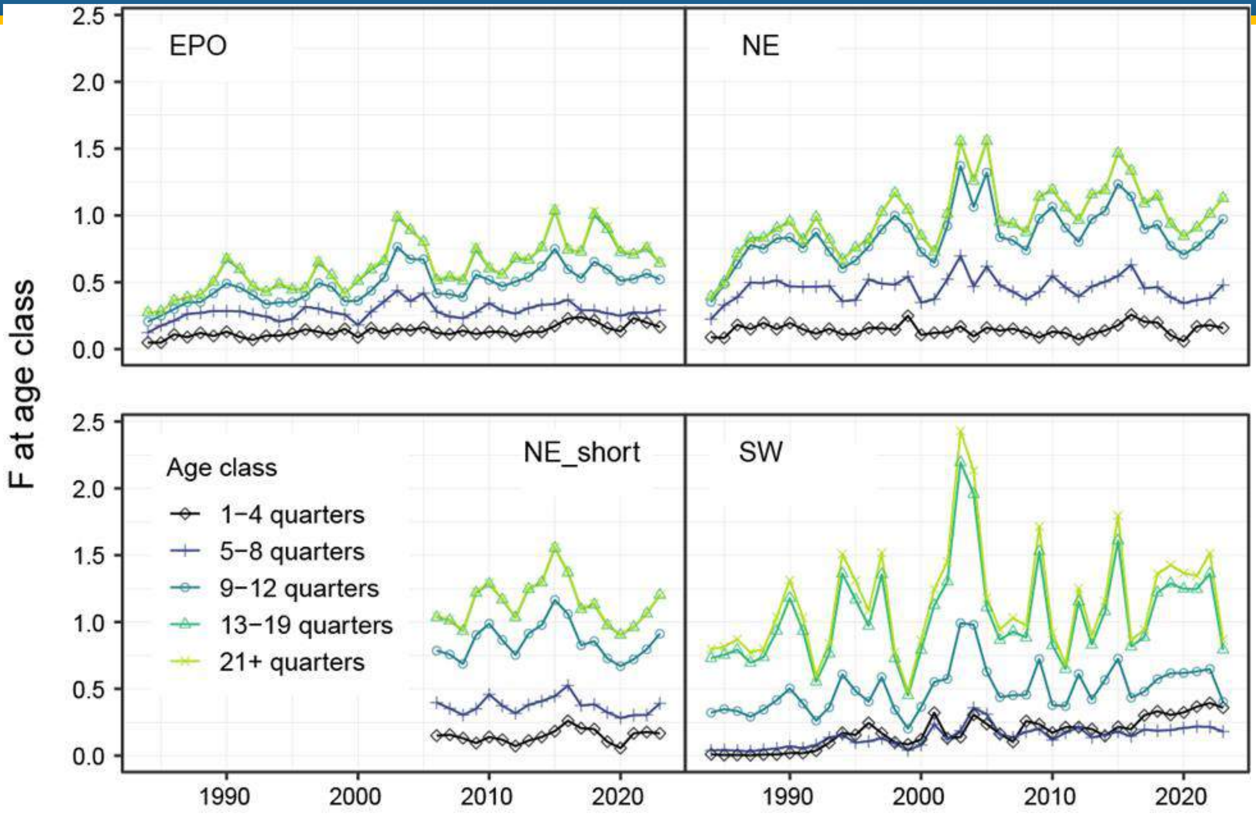
Recruitment: multimodel estimates



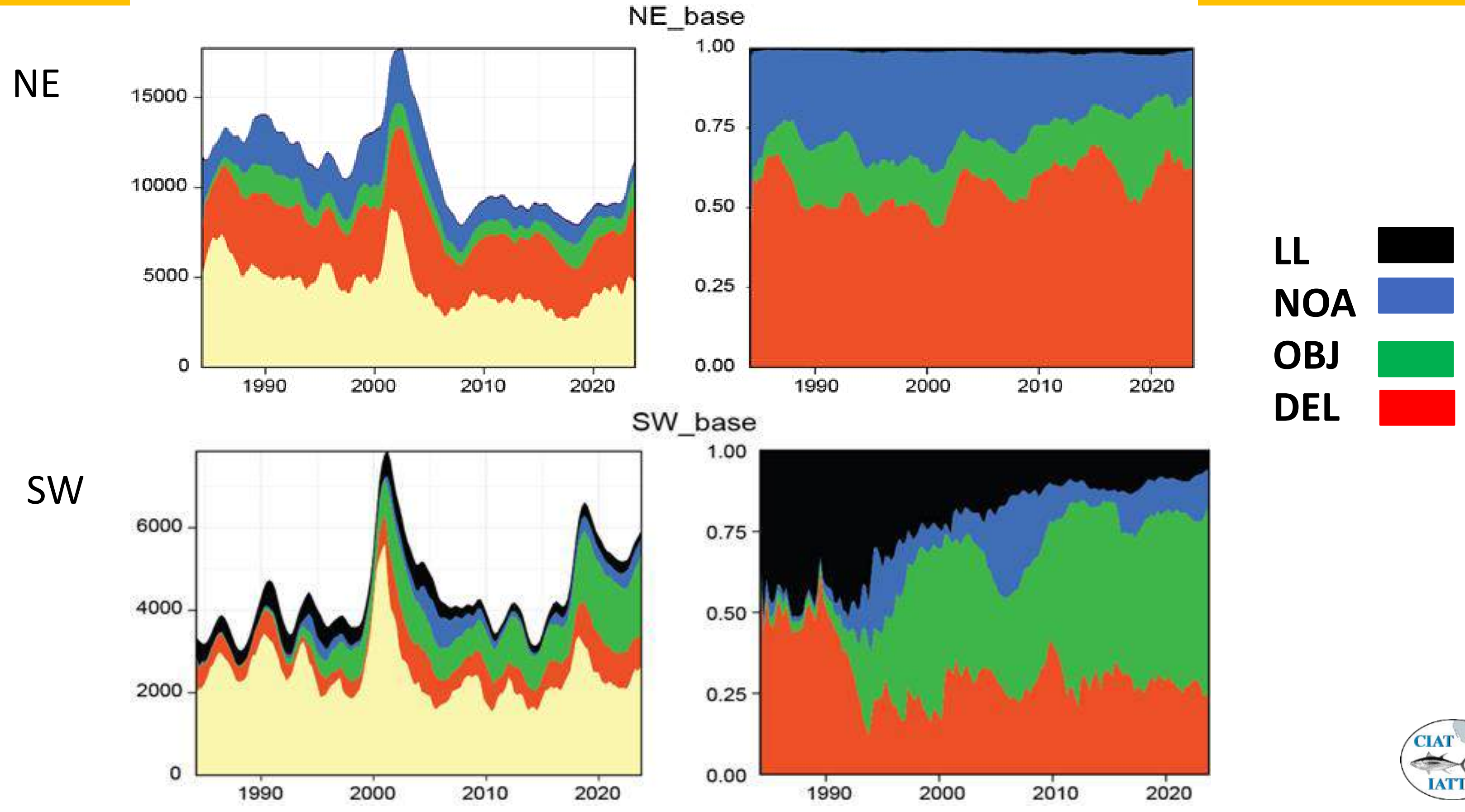
Spawning biomass: multimodel estimates



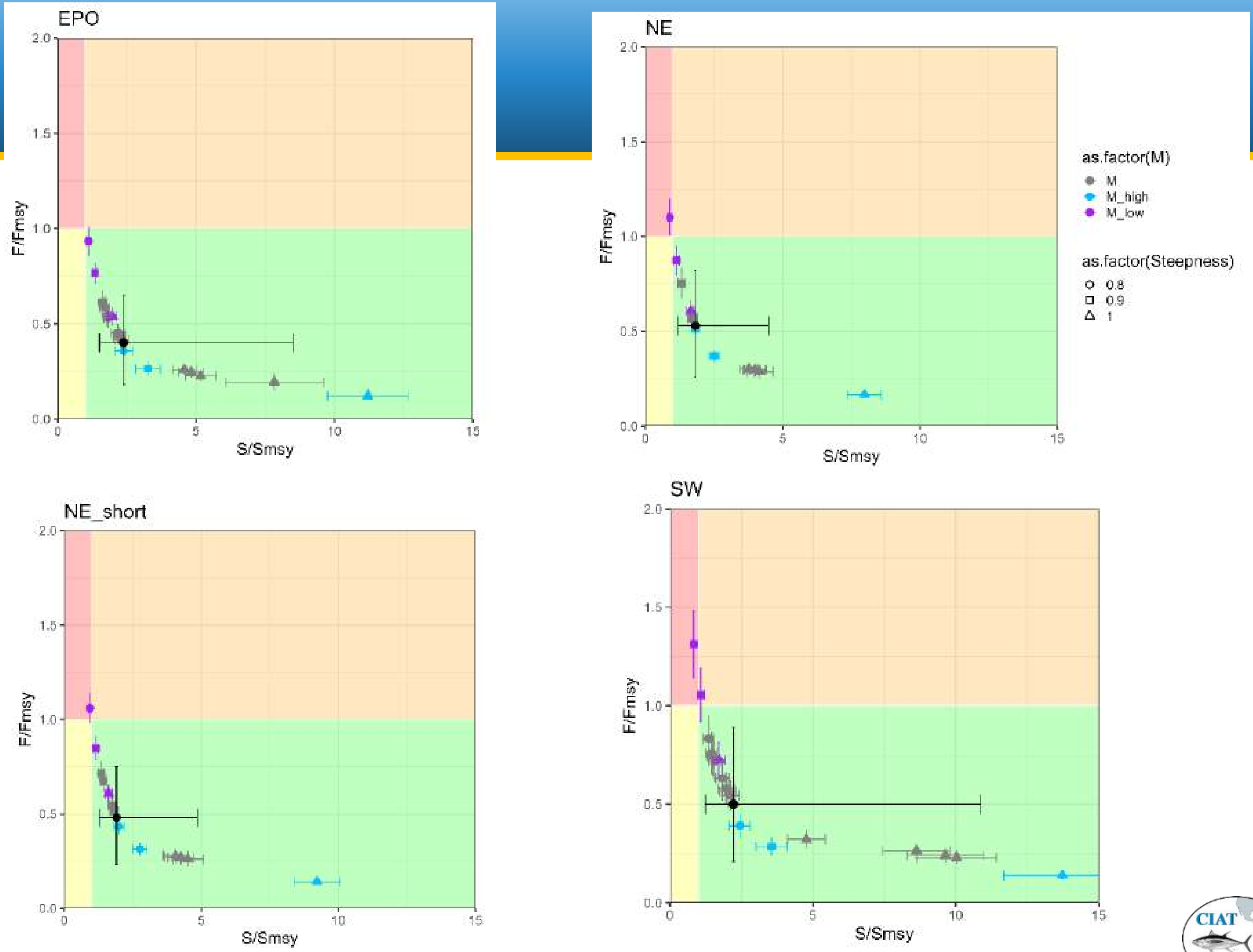
Assessment results: Fishing mortality



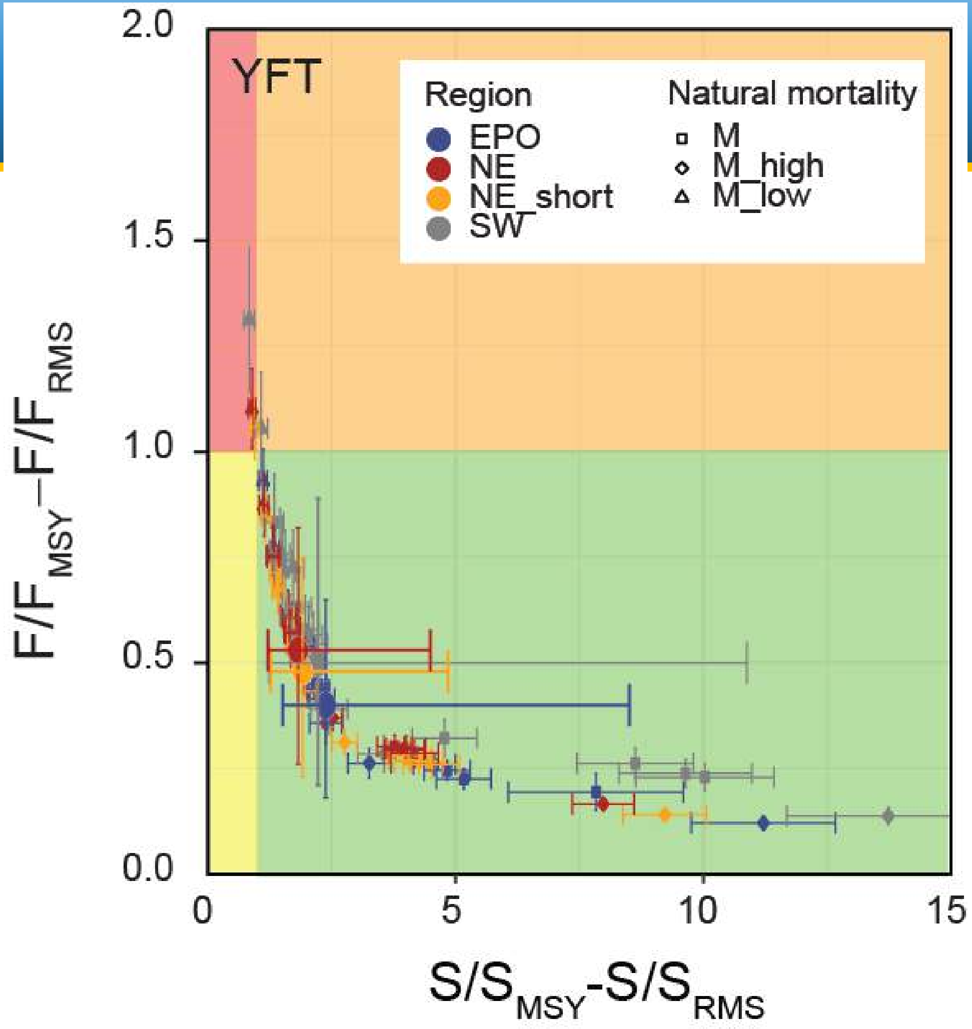
Assessment results: fisheries impact



Stock status



Stock status



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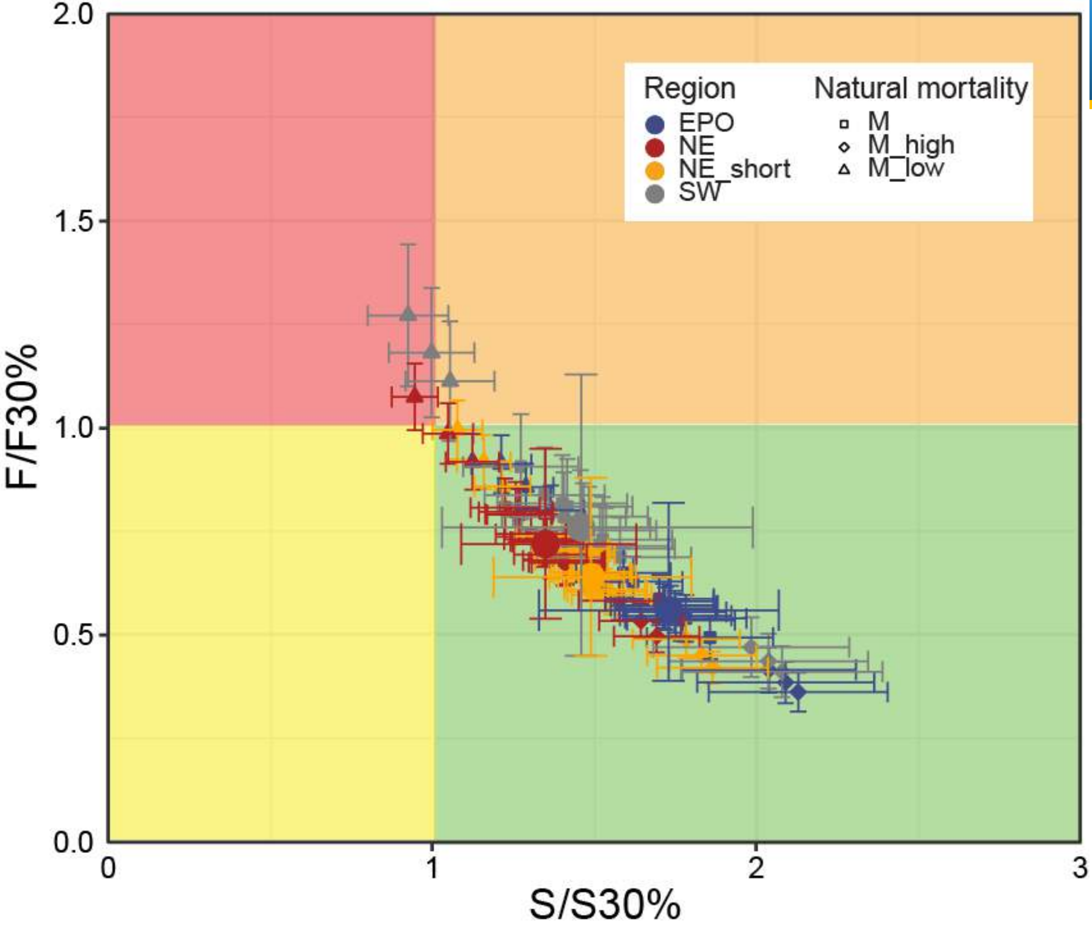
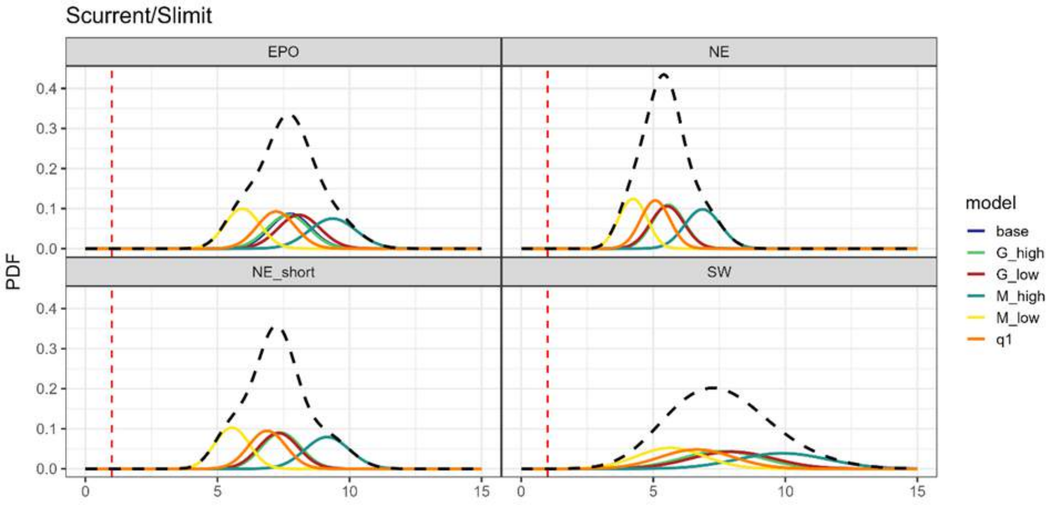
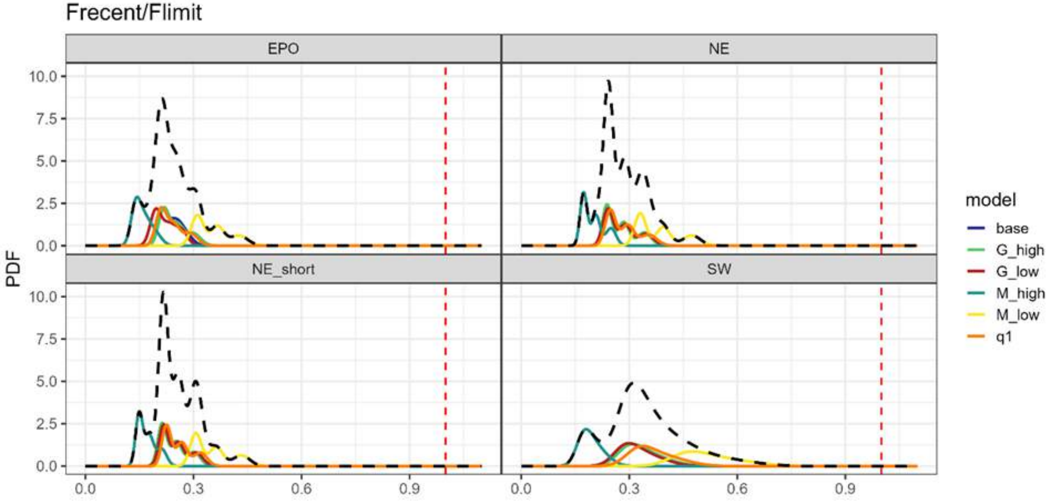
Stock status



Risk analysis





Risk analysis

Median or *Mean

	EPO	NE	NE_short	SW
SMSY/S0 *	0.180	0.189	0.194	0.162
SMSY_d/S0_d *	0.190	0.192	0.201	0.170
$F_{current}/F_{30\%S0\_d}$	0.559	0.718	0.643	0.757
$p(F_{current} > F_{30\%S0\_d})$	0.002	0.059	0.020	0.161
$F_{current}/F_{MSY}$	0.397	0.532	0.484	0.502
$p(F_{current} > F_{MSY})$	0.004	0.034	0.031	0.075
$F_{current}/F_{LIMIT}$	0.232	0.272	0.243	0.330
$p(F_{current} > F_{LIMIT})$	0.000	0.000	0.000	0.000
$S_{current}/30\%S0\_d$	1.73	1.35	1.49	1.46
$p(S_{current} < 30\%S0\_d)$	0.0000588	0.044	0.004	0.081
$S_{current}/S_{MSY\_d}$	2.38	1.82	1.91	2.22
$p(S_{current} < S_{MSY\_d})$	0.000	0.000	0.000	0.000
$S_{current}/S_{LIMIT}$	7.67	5.43	7.23	7.48
$p(S_{current} < S_{LIMIT})$	0.000	0.000	0.000	0.000

- Zero probability of breaching LIMIT RP

Risk analysis

Median or *Mean

	EPO	NE	NE_short	SW
SMSY/S0 *	0.180	0.189	0.194	0.162
SMSY_d/S0_d *	0.190	0.192	0.201	0.170
$F_{current}$/ $F_{30\%S0\_d}$	0.559	0.718	0.643	0.757
p($F_{current}$> $F_{30\%S0\_d}$)	0.002	0.059	0.020	0.161
$F_{current}$/F_{MSY}	0.397	0.532	0.484	0.502
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$S_{current}$/S_{LIMIT}	7.67	5.43	7.23	7.48
p($S_{current}$<S_{LIMIT})	0.000	0.000	0.000	0.000

- Low probability of breaching TARGET RP

Future directions

- A main uncertainty in the stock assessment of yellowfin tuna in the EPO continues to be the **spatial structure.**
- This assessment showed that different areas in the EPO may have different depletion levels.
- The values used for **natural mortality** and the reliance **on size composition data** to inform absolute abundance remain key sources of uncertainty.
- Growth, especially at older ages, relied on a few high-quality tag returns
- All four of these sources of uncertainty could be **reduced by a comprehensive tagging program.**
- This will allow the development of **spatio-temporal analysis of tagging data**

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Preguntas - Questions

Extra slides

Management table: NE

	B			Gh			Gl			Mh			Ml			Q1		
	1	0.9	0.8	1	0.9	0.8	1	0.9	0.8	1	0.9	0.8	1	0.9	0.8	1	0.9	0.8
NE																		
MSY (1,000 t)	226	208	200	225	208	200	226	208	200	276	237	220	200	195	196	236	216	205
MSY_d (1,000 t)	238	213	199	237	212	199	238	213	199	284	245	222	209	195	192	235	209	195
$C_{current}$/MSY_d	0.91	1.01	1.09	0.91	1.02	1.09	0.91	1.01	1.08	0.76	0.88	0.97	1.04	1.11	1.13	0.92	1.03	1.11
S_{MSY}/S_0	0.11	0.23	0.28	0.11	0.23	0.28	0.10	0.23	0.28	0.07	0.20	0.26	0.19	0.26	0.31	0.10	0.23	0.28
$S_{current}/S_0$	0.45	0.42	0.40	0.45	0.43	0.40	0.44	0.42	0.39	0.54	0.53	0.50	0.35	0.32	0.29	0.41	0.39	0.37
$S_{current}/S_{LIMIT}$	5.79	5.51	5.15	5.80	5.53	5.16	5.76	5.48	5.11	7.07	6.83	6.52	4.49	4.17	3.76	5.26	5.04	4.75
p($S_{current}$<S_{LIMIT})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$F_{current}/F_{LIMIT}$	0.24	0.29	0.34	0.24	0.28	0.34	0.24	0.29	0.35	0.17	0.21	0.25	0.33	0.39	0.47	0.25	0.30	0.35
p($F_{current}$>F_{LIMIT})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$S_{current}/S_{MSY\_d}$	3.96	1.71	1.32	3.77	1.70	1.31	4.17	1.71	1.32	7.98	2.52	1.83	1.65	1.13	0.89	4.00	1.71	1.32
p($S_{current}$<S_{MSY_d})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.97	0.00	0.00	0.00
$F_{current}/F_{MSY}$	0.29	0.57	0.75	0.30	0.57	0.75	0.29	0.57	0.75	0.17	0.37	0.51	0.61	0.87	1.10	0.30	0.58	0.75
p($F_{current}$>F_{MSY})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.92	0.00	0.00	0.00
$S_{current}$/30%S_d	1.41	1.35	1.27	1.42	1.35	1.27	1.41	1.34	1.26	1.69	1.64	1.58	1.12	1.05	0.95	1.36	1.30	1.23
p($S_{current}$< 30%S_{MSY_d})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.21	0.83	0.00	0.00	0.00
$F_{current}/F_{30\%S\_d}$	0.68	0.73	0.79	0.67	0.73	0.79	0.68	0.73	0.80	0.50	0.53	0.58	0.92	0.99	1.08	0.69	0.74	0.81
p($F_{current}$>F $F_{30\%S\_d}$)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.41	0.88	0.00	0.00	0.00

Retrospective analysis