

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

# An Update of the IPHC Secretariat MSE Program of Work

Agenda item: 4.1.3  
IPHC-2026-SRB028-08 Rev\_1  
(A. Hicks & I. Stewart)



# Purpose

To provide the Scientific Review Board (SRB) with the MSE Program of Work for 2026–2027 and an overview of work done since the 27<sup>th</sup> Session of the Scientific Review Board (SRB027) using the IPHC Management Strategy Evaluation (MSE) framework



# Harvest Strategy Policy (HSP) adopted at IM101 in 2025

A framework for applying a consistent and transparent science-based approach to setting mortality limits for Pacific halibut while ensuring sustainability of the Pacific halibut population

- Defines conservation, fishery, and economic objectives of the Commission
- Identifies a management procedure and reference points to achieve these objectives
- Describes management inputs and the decision-making process to determine mortality limits
- Outlines when to develop a rebuilding plan and what it is
- Presents a schedule of annual/triennial processes



# Schedule of events (Chapter 3, page 17)

Y: Task is done  
x: Task may be done

Year	1	2	3	4	5	6	7	8
Example Year	2025	2026	2027	2028	2029	2030	2031	2032
FISS coastwide index	Y	Y	Y	Y	Y	Y	Y	Y
Full stock assessment	Y			Y			Y	
Update stock assessment		Y	Y		Y	Y		Y
Commission TCEY decision	Y	Y	Y	Y	Y	Y	Y	Y
MSE OM updated		Y			X			Y
MP re-evaluated		Y			X			Y
Exceptional circumstances checked	Y		Y	Y	X <sup>1</sup>	Y	Y	
- Consult with SRB and MSAB			X	X	X	X	X	X
- Present to Commission			X	X	X	X	X	X
- Re-evaluate MP due to EC			*	*	Y <sup>2</sup>	X*	X*	
Update HSP			X			X		

<sup>1</sup> The exceptional circumstance would be checked only if a new MSE OM was not updated.

<sup>2</sup> The MP would be re-evaluated as part of the normal three-year cycle due to an exceptional circumstance occurring in two sequential years.

\* An exceptional circumstance can be declared after two sequential instances, thus re-evaluation of an MP would have a delay, unless recommended by the Commission outside of the normal process.



# Conditioning the Operating Model

## Conditioning workflow

1. Outcomes of each individual model of the ensemble stock assessment are summarized.
2. Parameters and assumptions in each individual model of the OM are linked to each individual model of the ensemble stock assessment.
3. Mortality and weight-at-age for each fishery is extended to the most recent year.
4. Weight-at-age for the survey and population is updated and extended.
5. The Pacific Decadal Oscillation (PDO) is updated to the most recent year (and revised for this development cycle based on the new series used in the [2025 stock assessment](#)).
6. An optimized OM executable is compiled and a directory structure for each individual model is created.
7. Parameters for each individual model (e.g. movement, recruitment distribution, average recruitment, initial fishing mortality) are estimated based on fits to regional stock distribution, regional indices of abundance, age compositions, and the estimated spawning biomass from the linked individual stock assessment model.
8. Individual historical trajectories are created for each individual model of the OM using estimated uncertainty and correlations between parameters.



# 2025 stock assessment

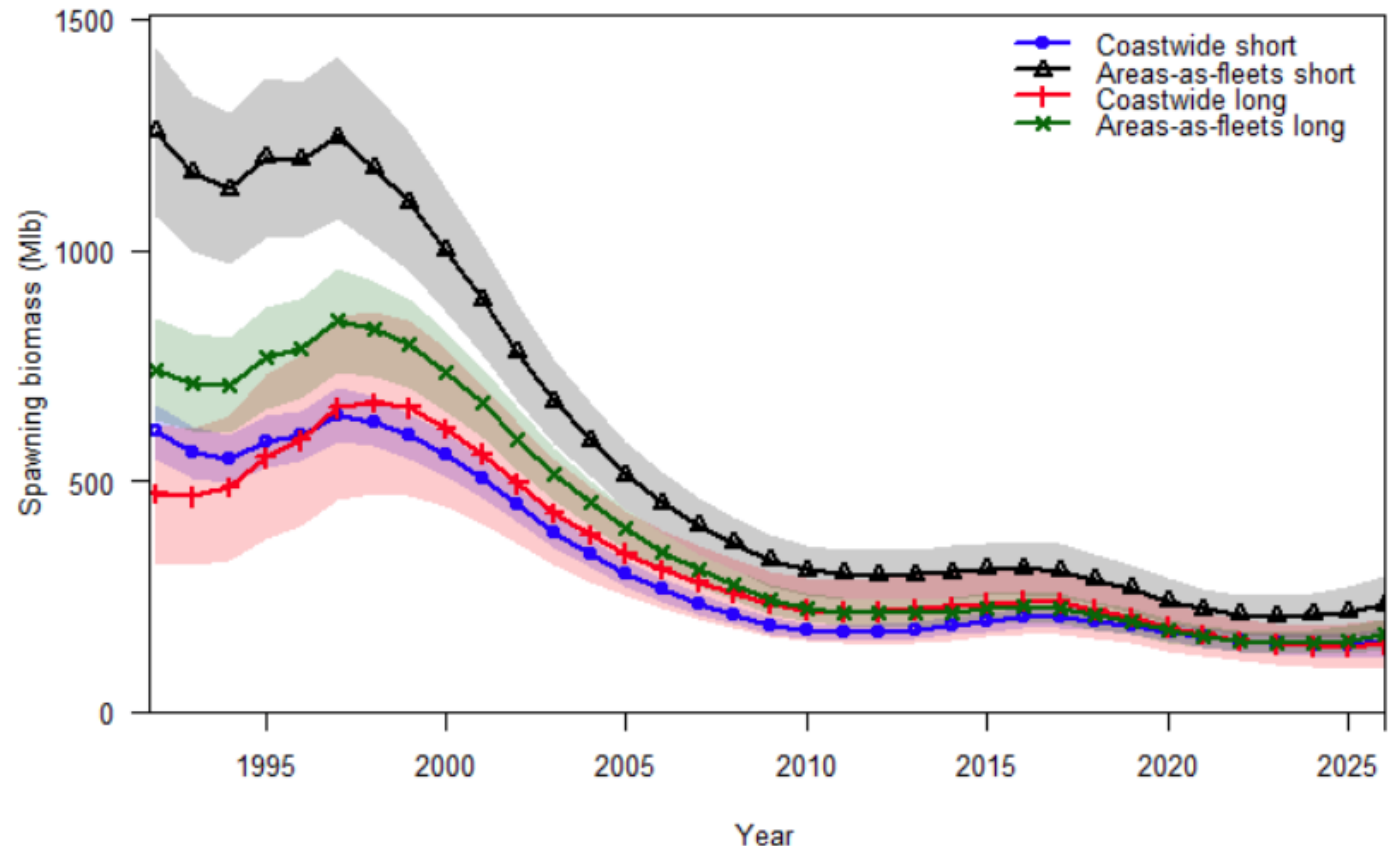
- Full stock assessment
- Revised Pacific Decadal Oscillation (PDO)
- Improved treatment of sample sizes for age data
- Better propagation of uncertainty in selectivity
- Standard updating of process and observation error variances to achieve internal model consistency
- Updates to commercial CPUE time series (1981+) including additional data, revised hook spacing relationship, and extensive error checking
- Updated maturity ogive reflecting histology-based estimates



# 2025 stock assessment models

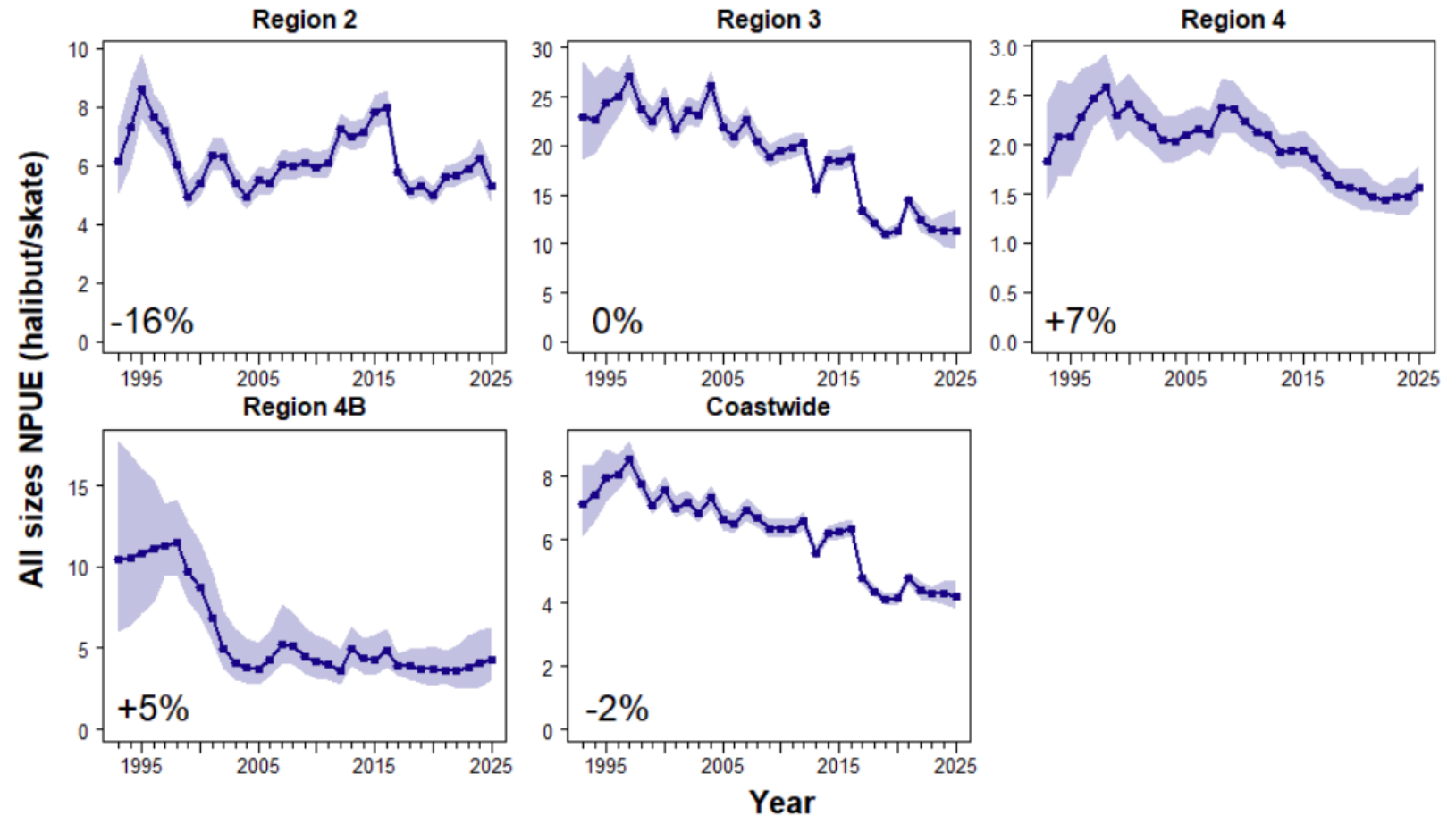
- Same 4 models as in recent assessments
    - Each responds differently to new data and represents a different hypothesis about how the population dynamics and observations are best represented
1. Areas-As-Fleets Long
  2. Areas-As Fleets short
  3. Coastwide long
  4. Coastwide short

The OM is conditioned to these estimated spawning biomass trajectories



# All-sizes Regional FISS NPUE

- FISS NPUE
- pre1993-2025
- OM is conditioned to these data
  - Accounting for changes in catchability before 1993



**FIGURE 2.** Trends in modeled survey NPUE by Biological Region, 1993-2025. Percentages indicate the change from 2024 to 2025. Shaded zones indicate 95% credible intervals.



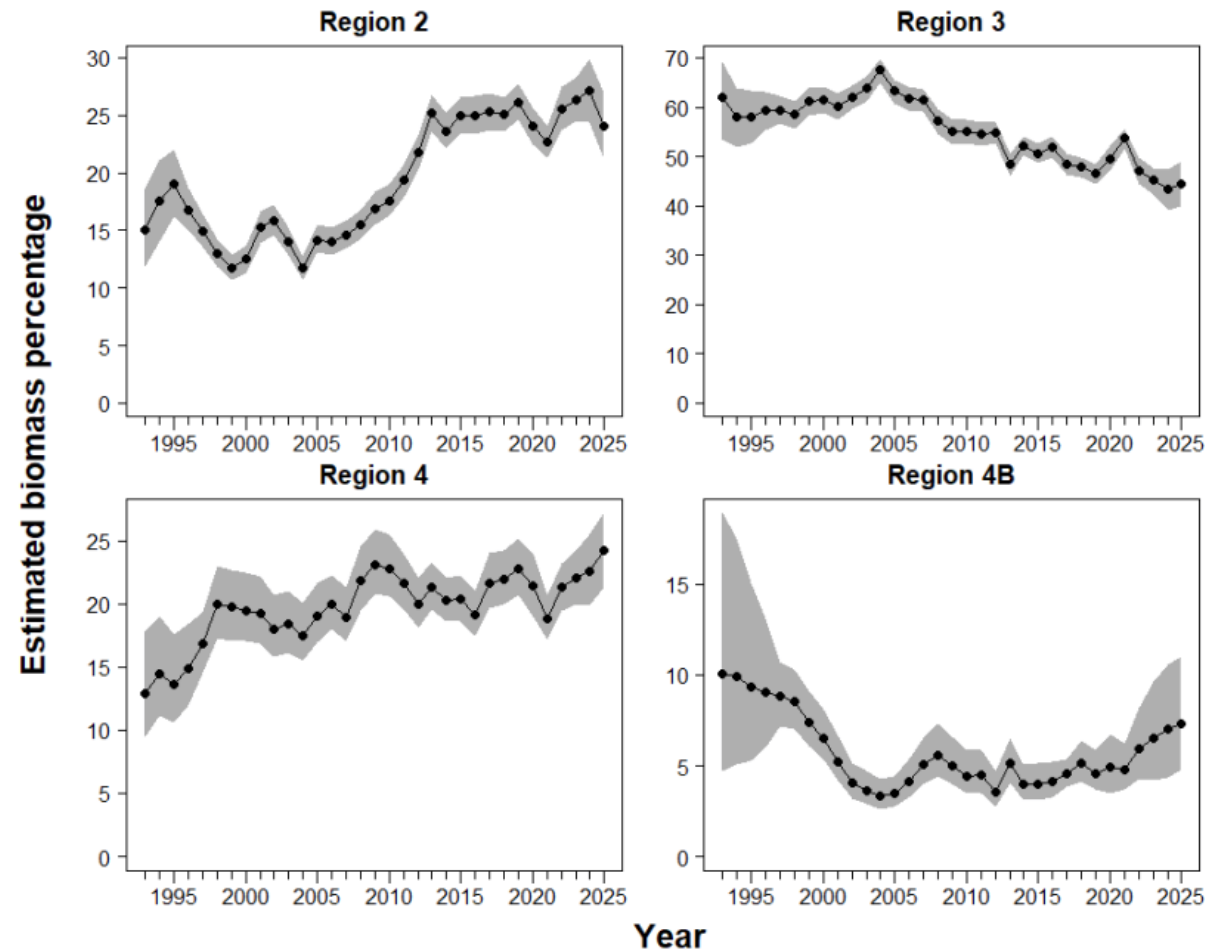
# FISS Regional Age Compositions

- Used to condition the OM
- Given a low weight in the likelihood
  - Down-weighted in the stock assessment
  - Focus on coastwide trends and coastwide management procedures
  - Lots of observations can overwhelm the likelihood



# Regional Stock Distribution

- Determined from all-sizes FISS WPUE
- 1993-2025
- An important source of data for the OM to fit



**FIGURE 8.** Estimated biological stock distribution (1993-2025) calculated from model output of survey WPUE of all sizes of Pacific halibut captured by the FISS. Shaded zones indicate 95% credible intervals.

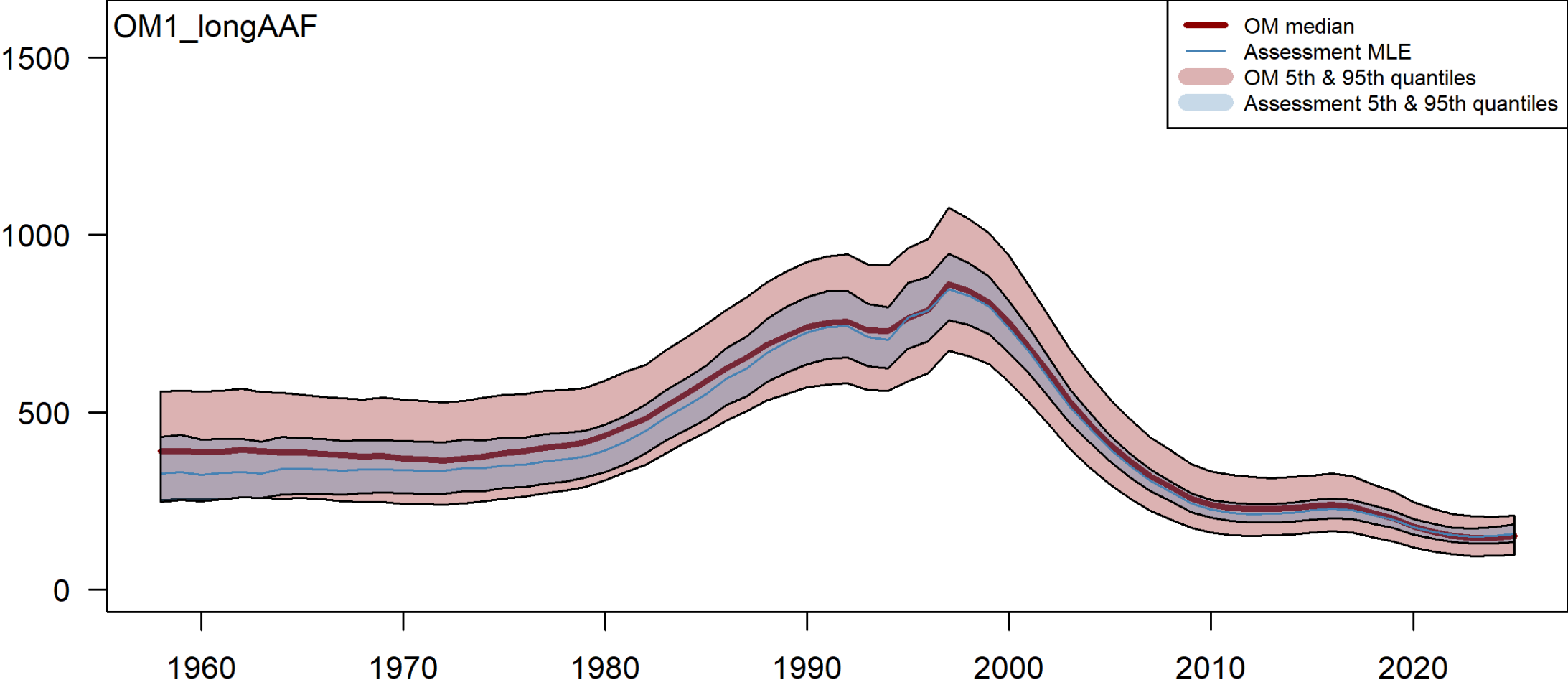


# Four individual models in the OM

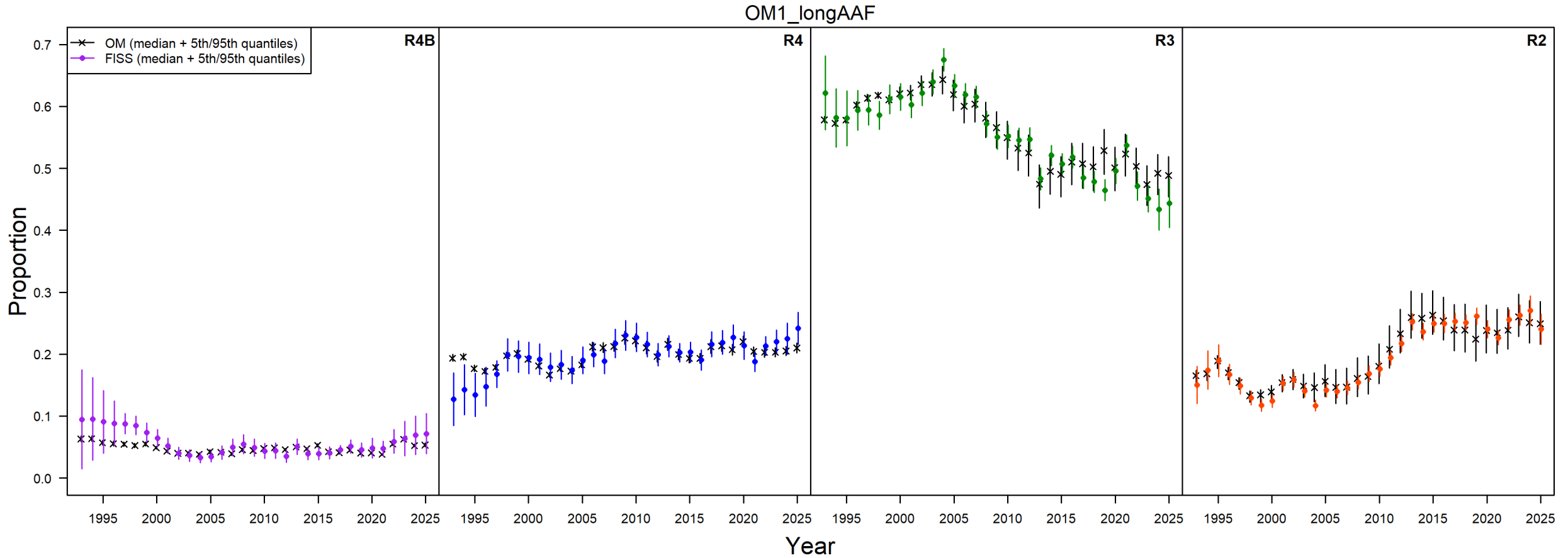
- Conditioned to
  - the estimated spawning biomass from each stock assessment model
  - stock distribution
  - regional indices of abundance
  - age compositions
- Each model starts in 1958
- Estimated movement from Region 4 to 3 and from Region 3 to 2
  - Movement could not occur between non-adjacent regions in an annual time-step
- Estimated the distribution of coastwide recruitment to each Region
- Add uncertainty in steepness



# OM1\_longAAF Spawning Biomass

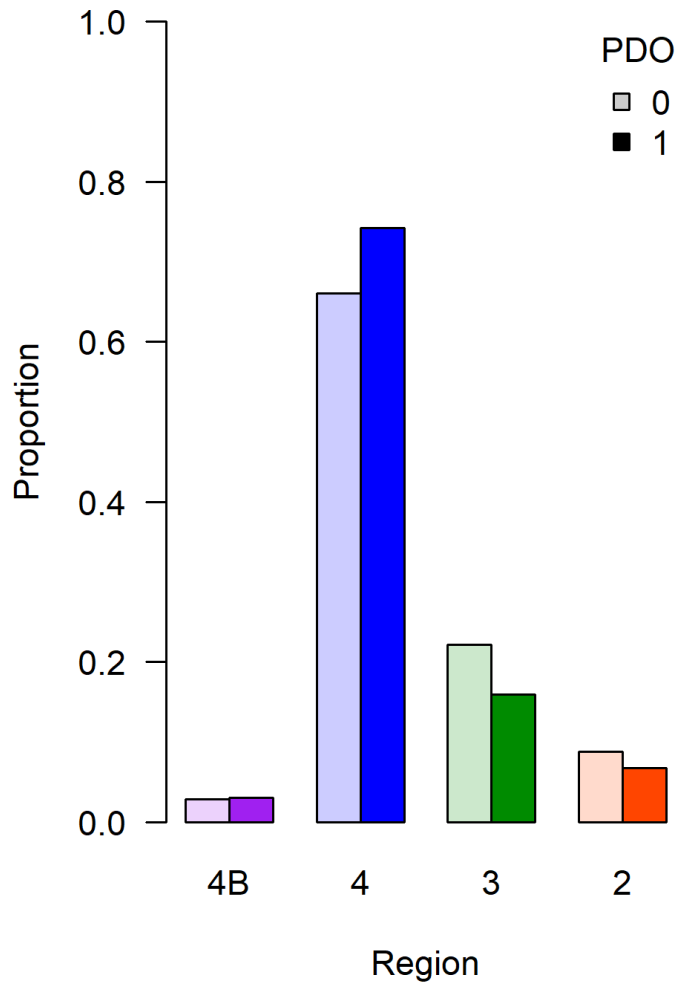


# OM1\_longAAF all-sizes distribution

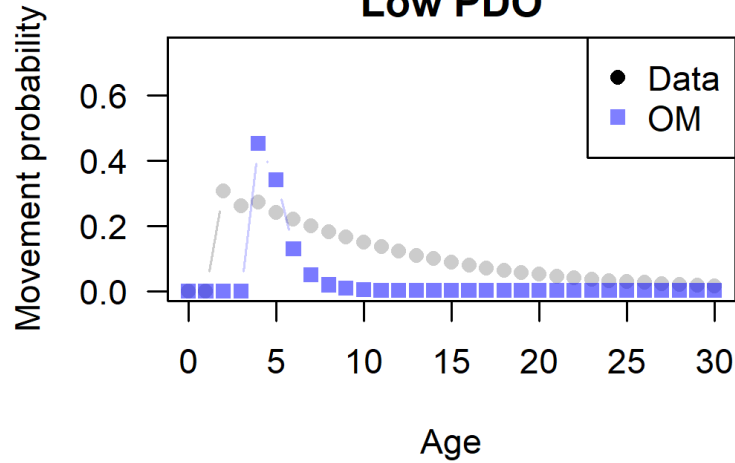


# OM1\_longAAF: Recruitment & Movement

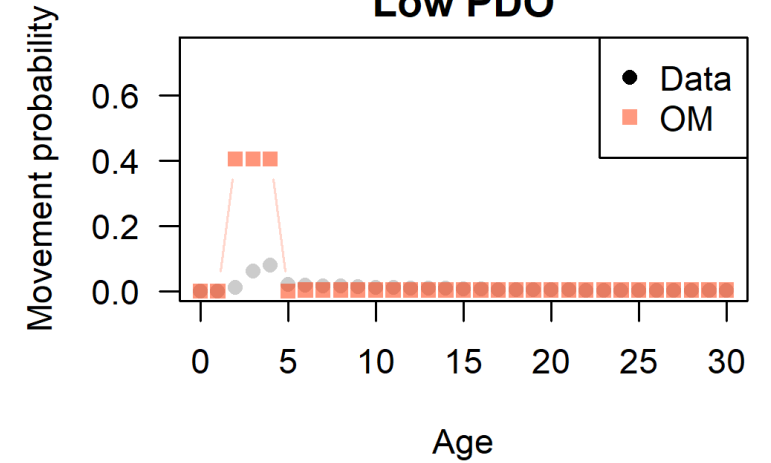
## Recruitment Distribution



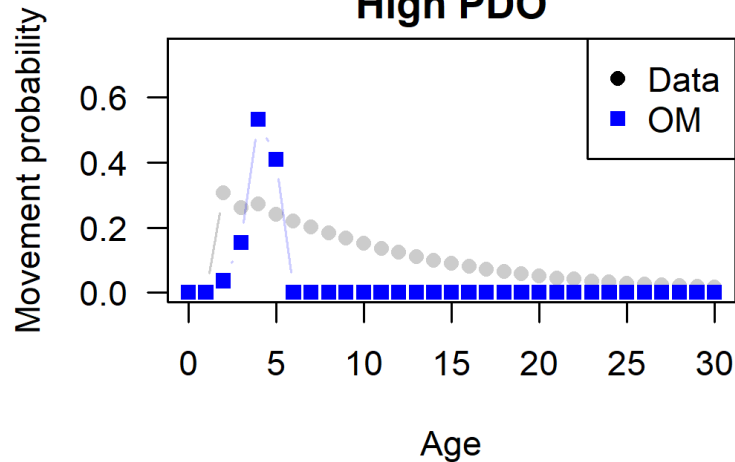
## 4 to 3 Low PDO



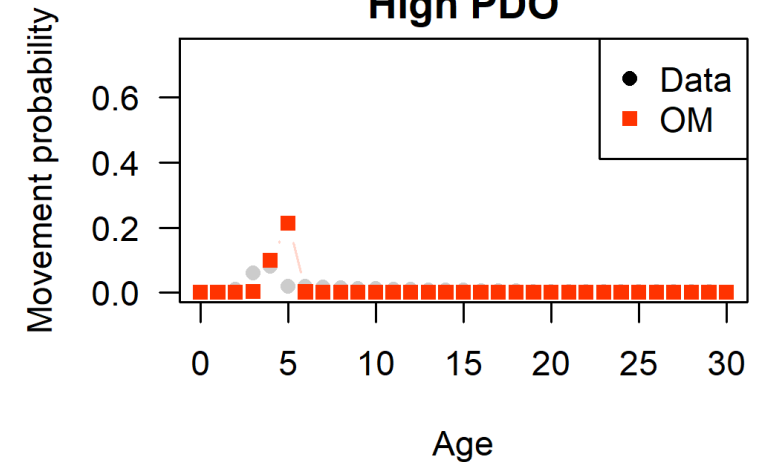
## 3 to 2 Low PDO



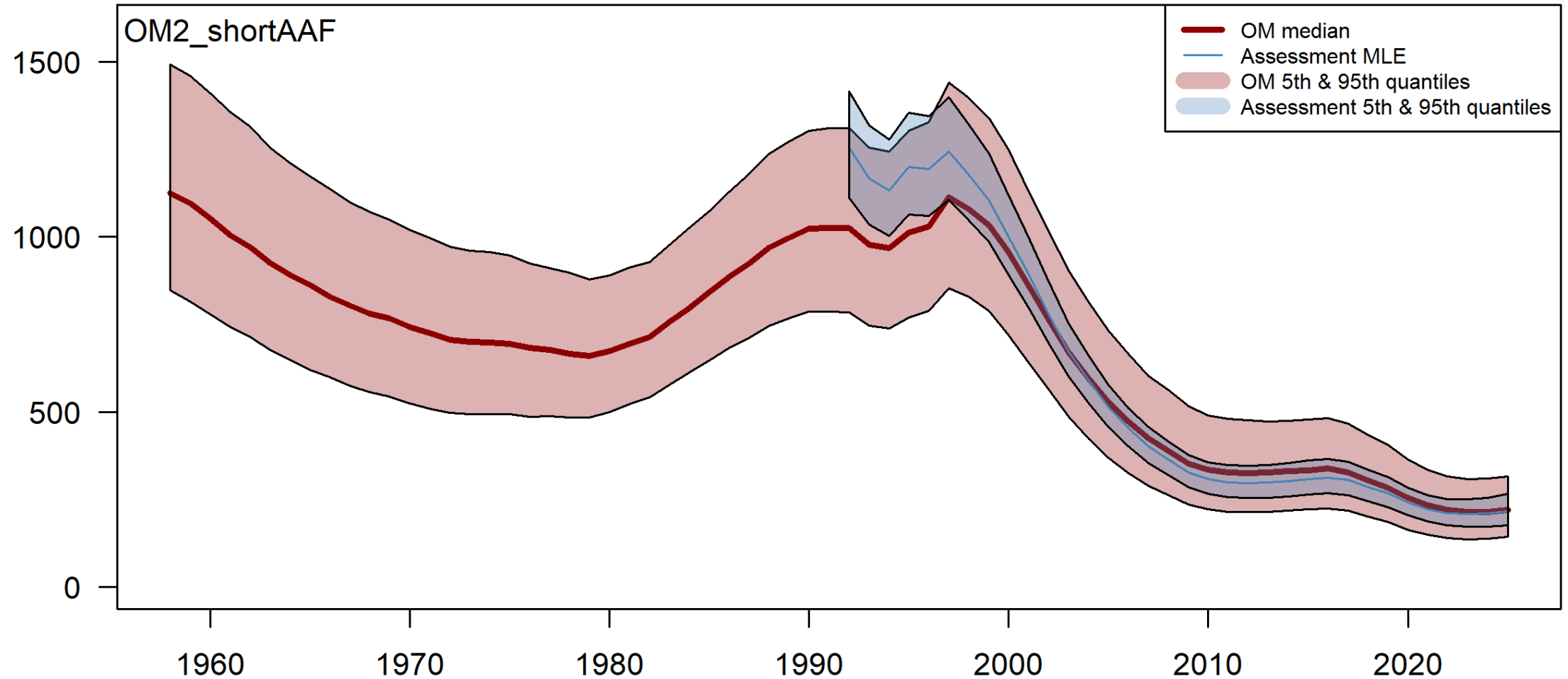
## High PDO



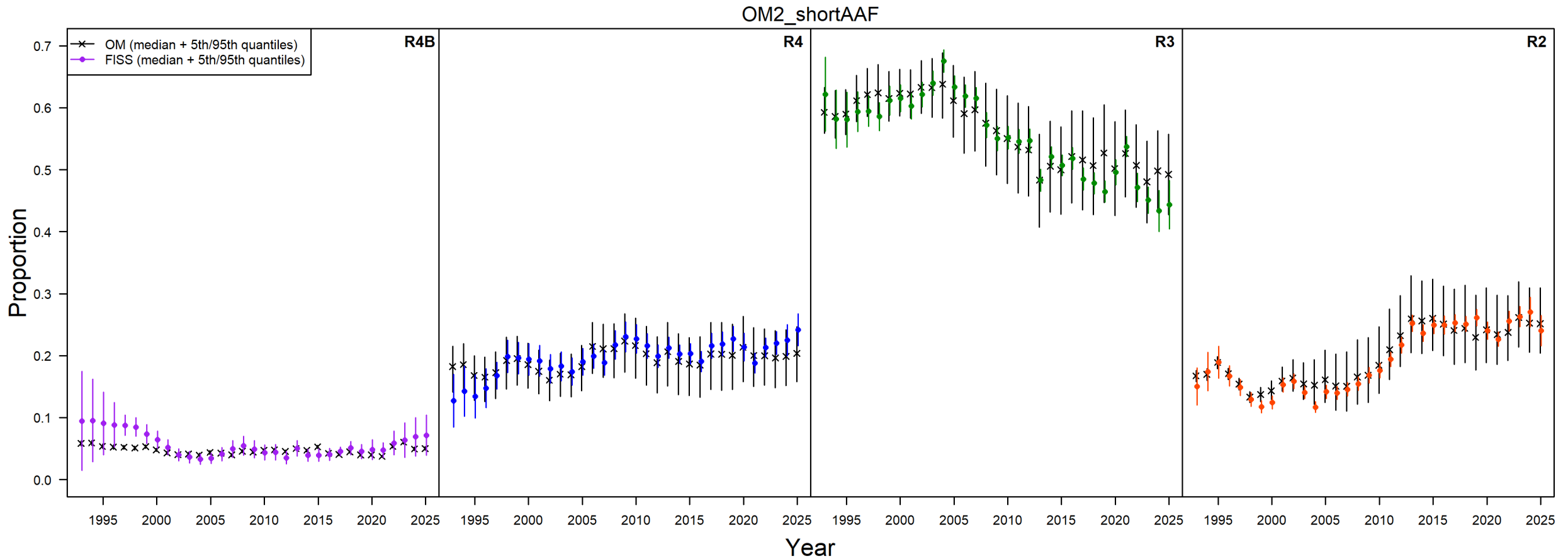
## High PDO



# OM2\_shortAAF Spawning Biomass

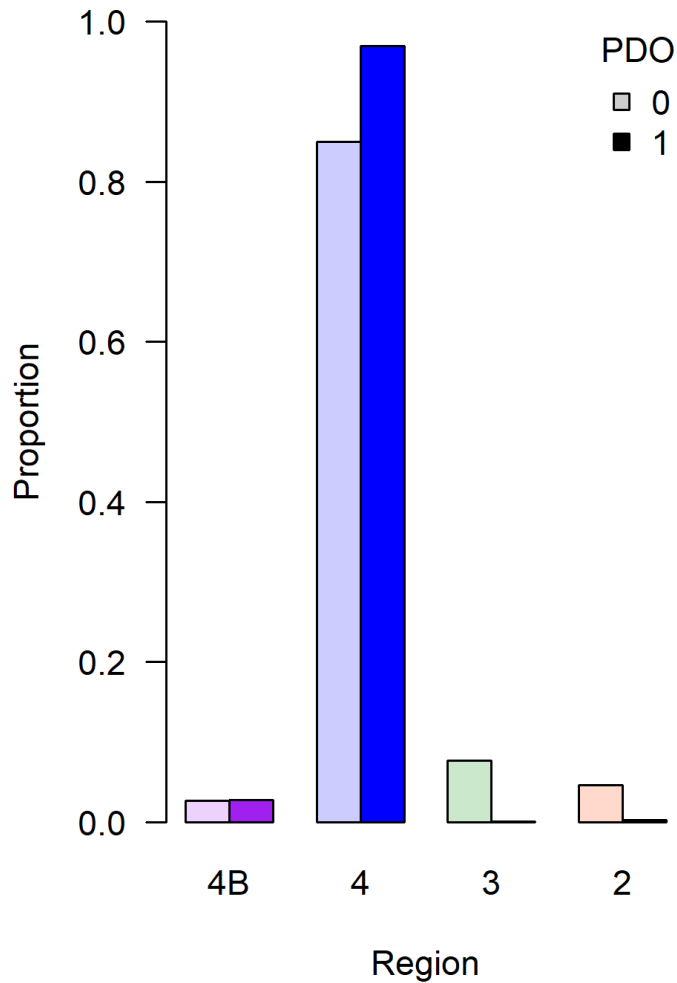


# OM2\_shortAAF all-sizes distribution

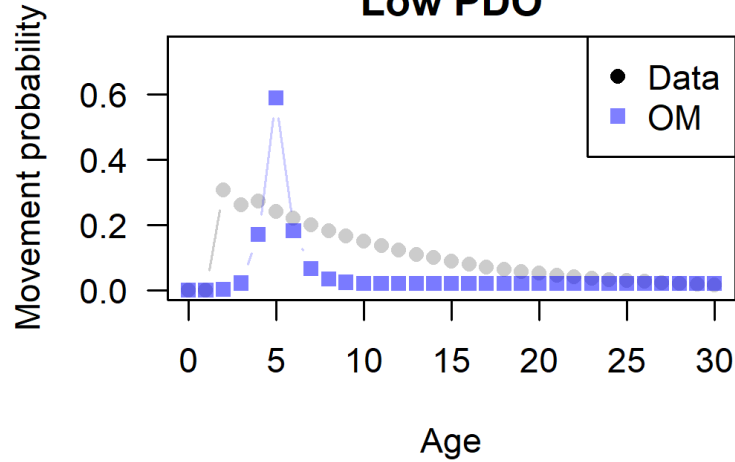


# OM2\_shortAAF: Recruitment & Movement

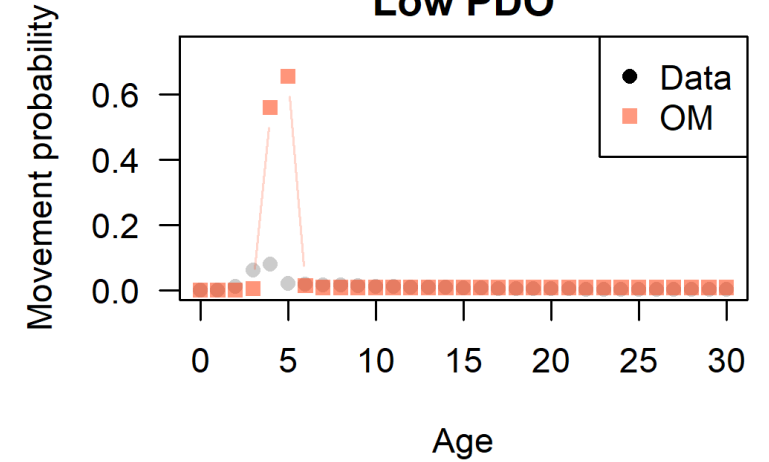
## Recruitment Distribution



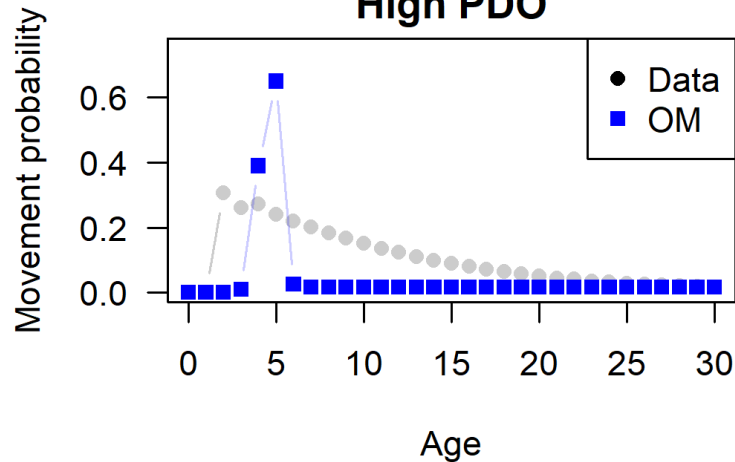
## 4 to 3 Low PDO



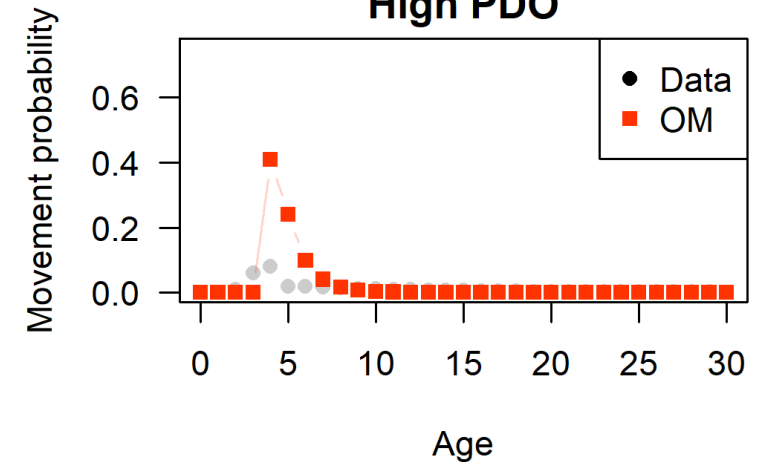
## 3 to 2 Low PDO



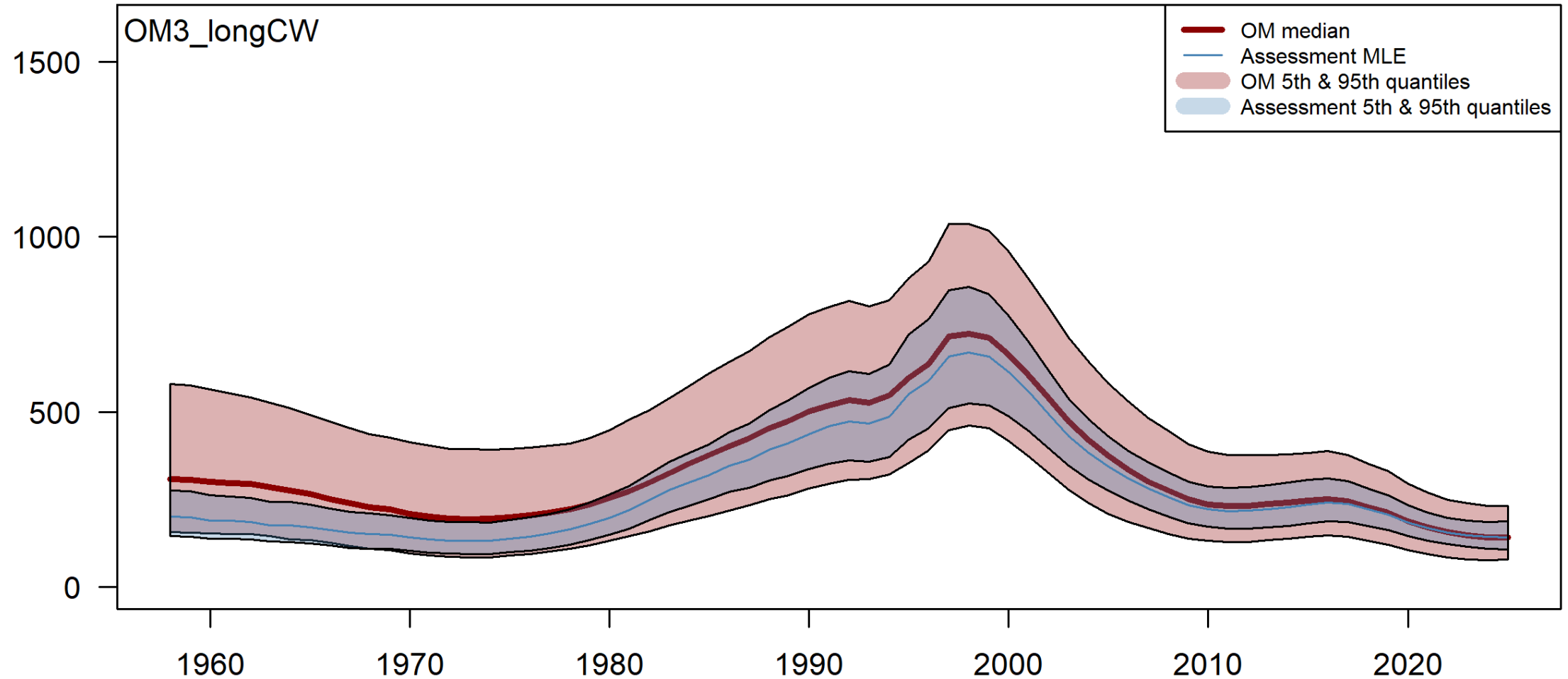
## High PDO



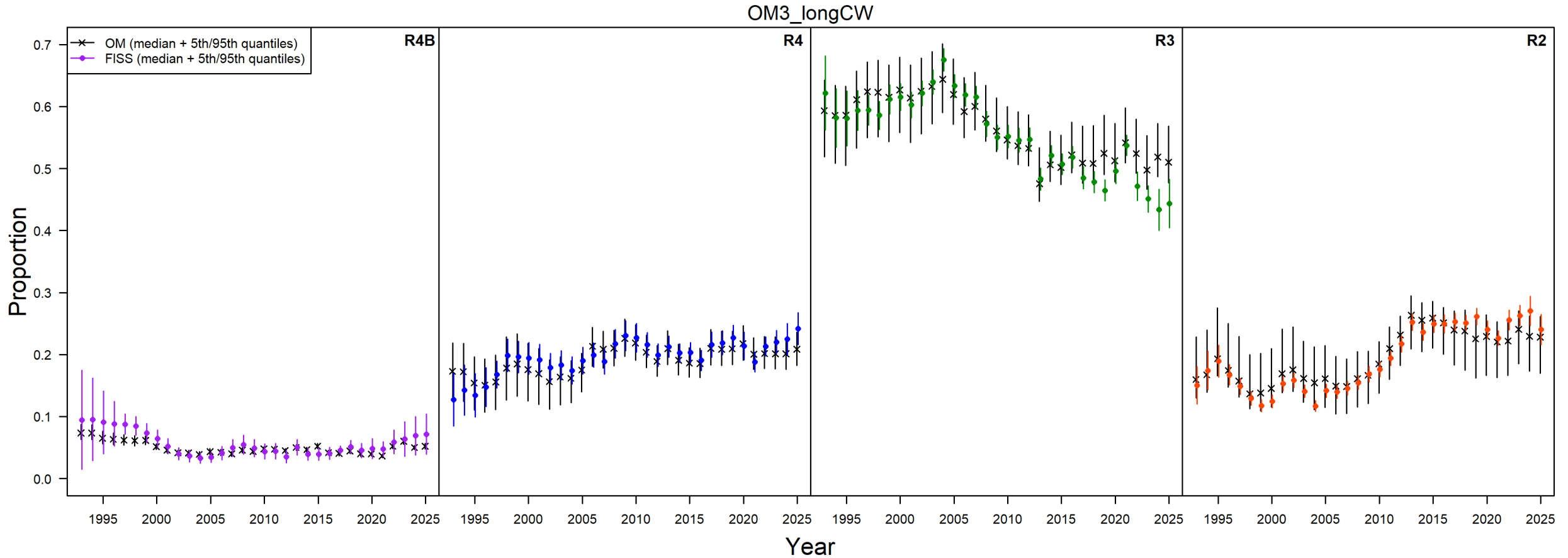
## High PDO



# OM3\_longCW Spawning Biomass

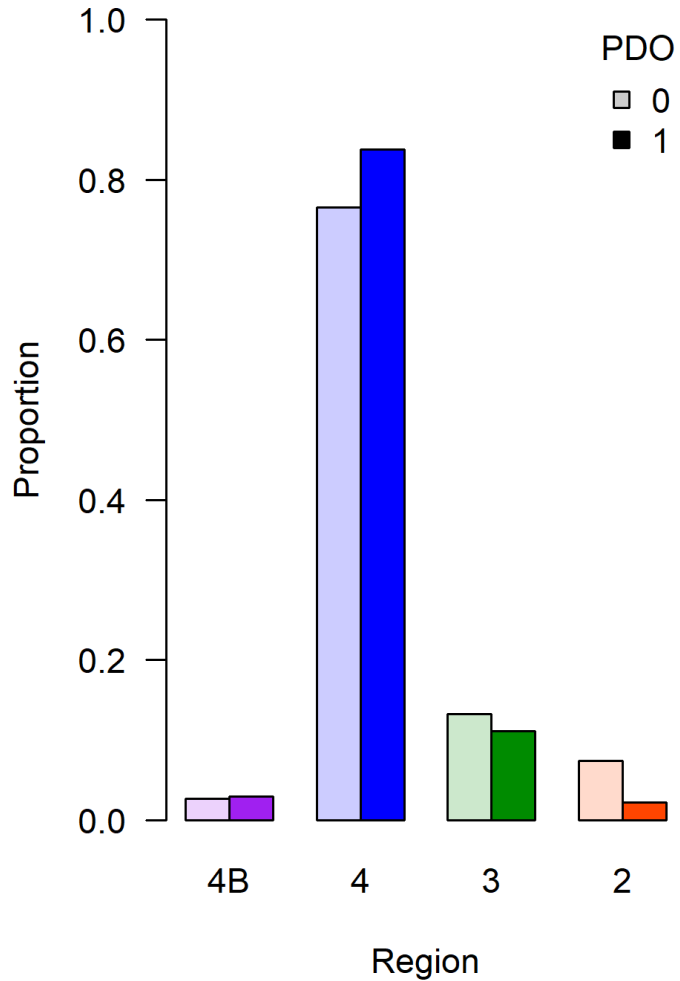


# OM3\_longCW all-sizes distribution

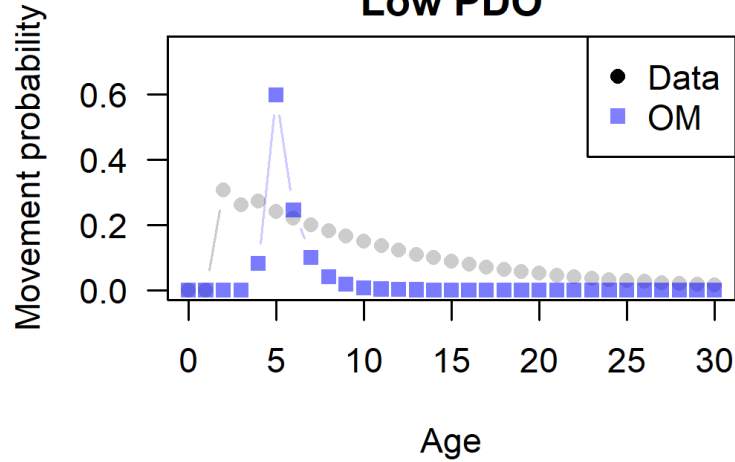


# OM3\_longCW: Recruitment & Movement

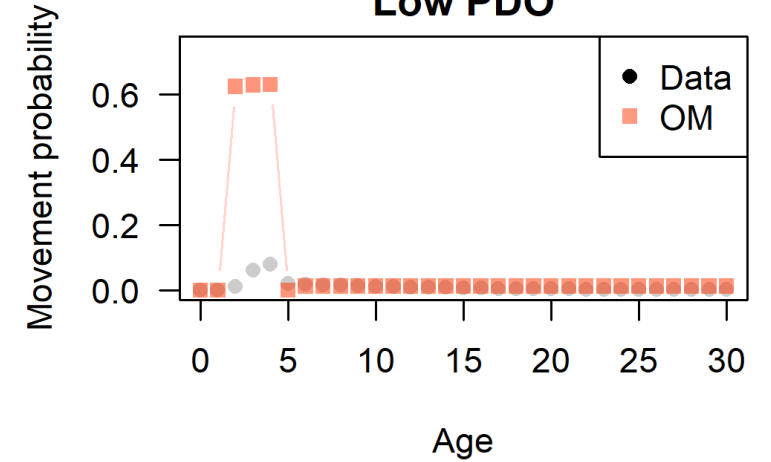
## Recruitment Distribution



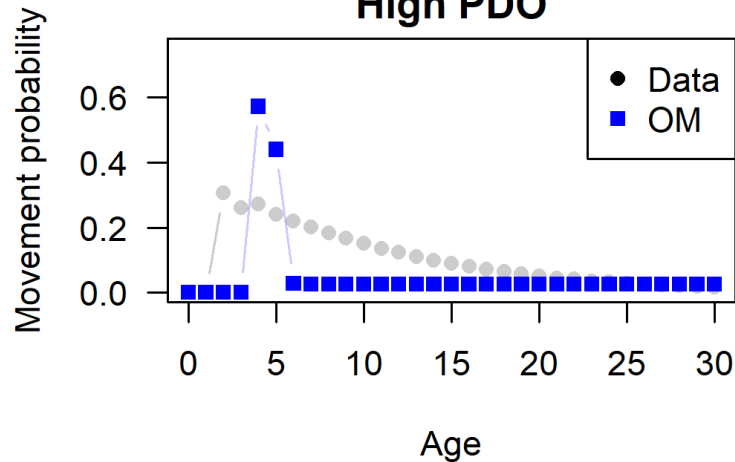
## 4 to 3 Low PDO



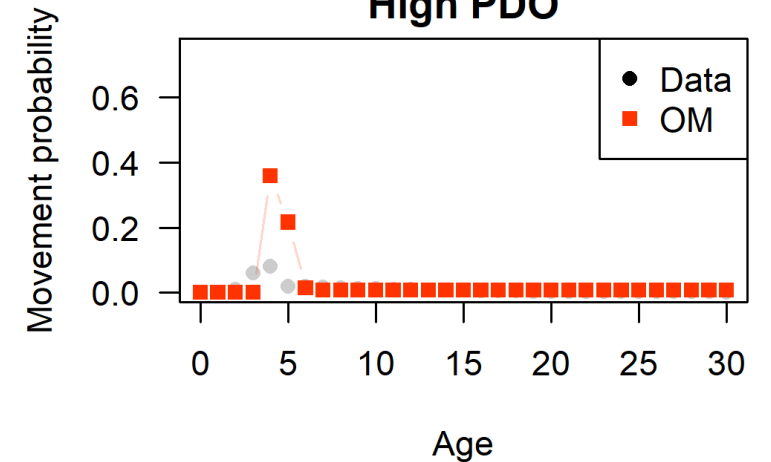
## 3 to 2 Low PDO



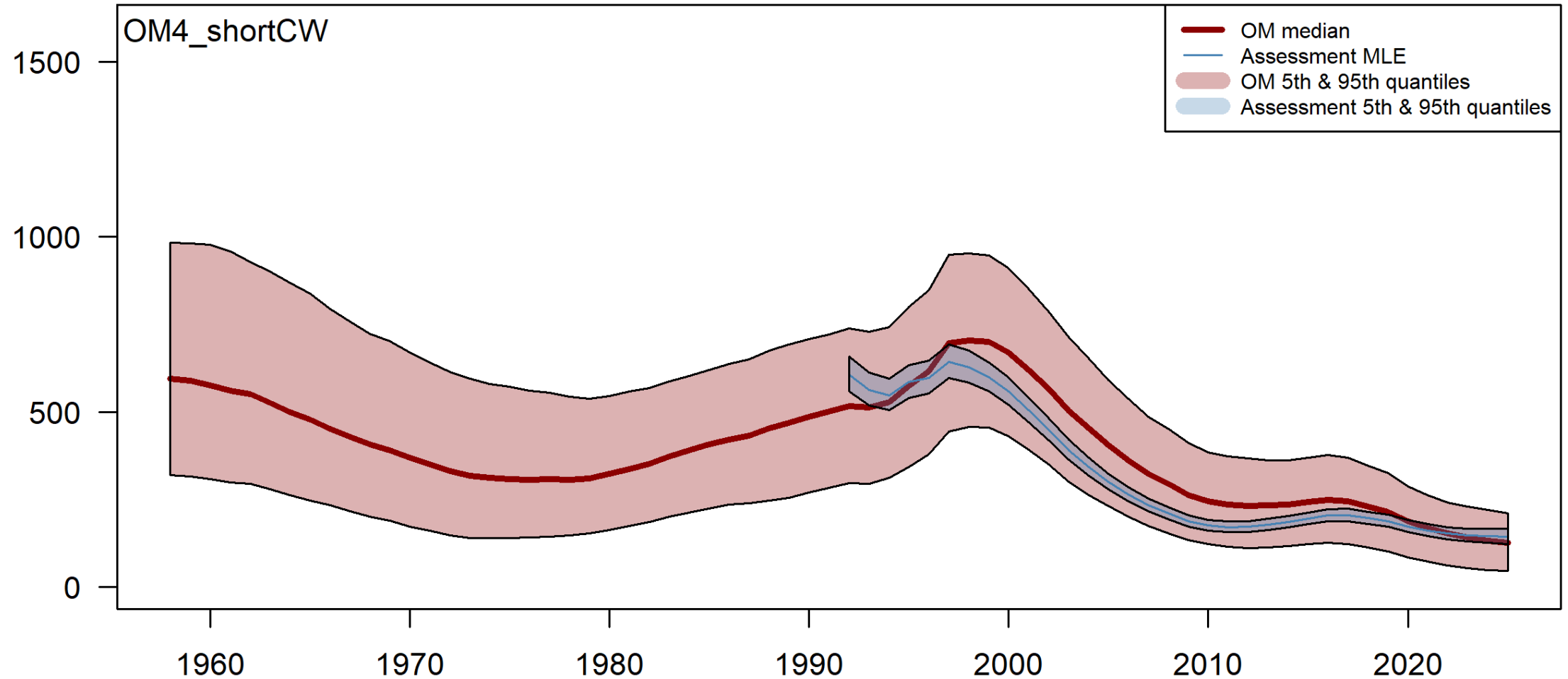
## High PDO



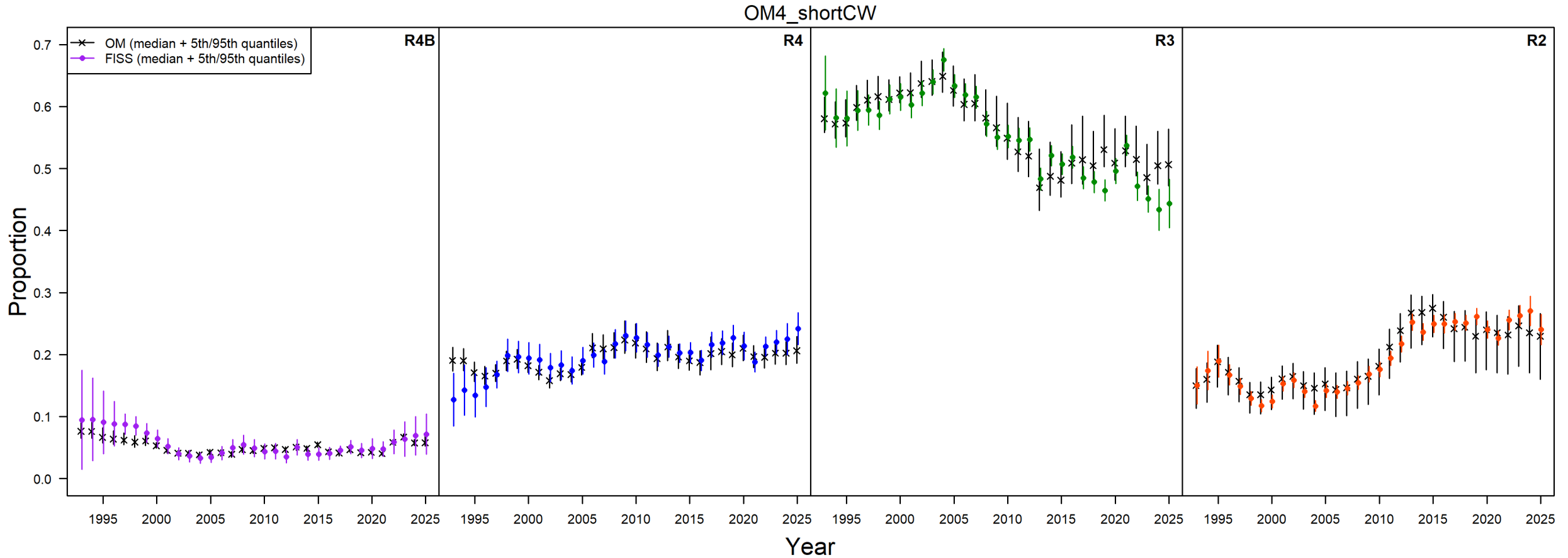
## High PDO



# OM4\_shortCW Spawning Biomass

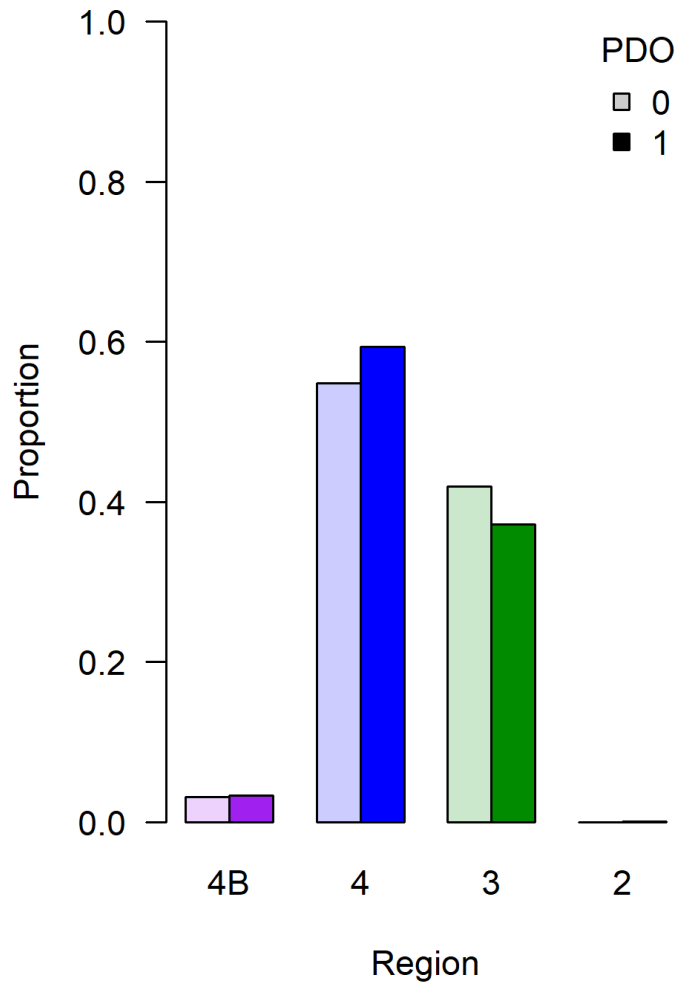


# OM4\_shortCW all-sizes distribution

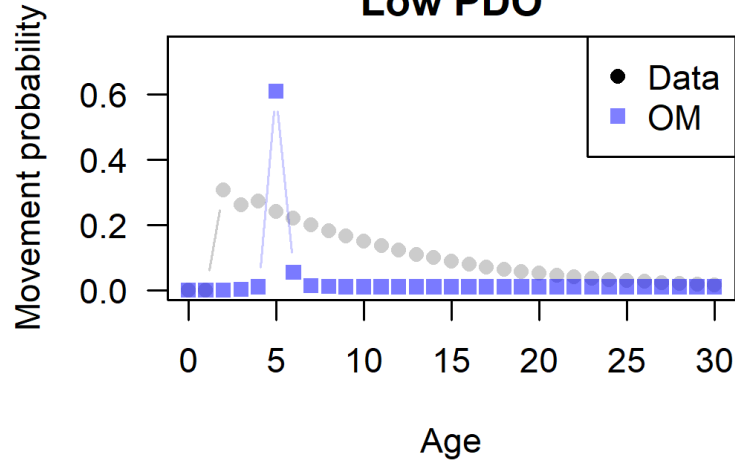


# OM4\_shortCW: Recruitment & Movement

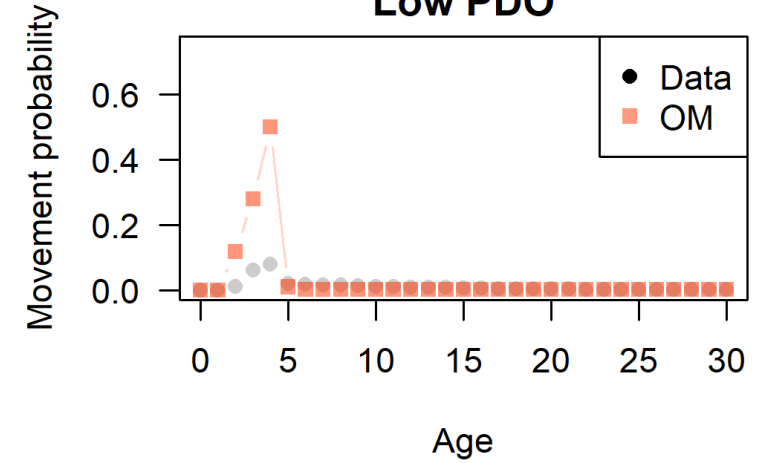
## Recruitment Distribution



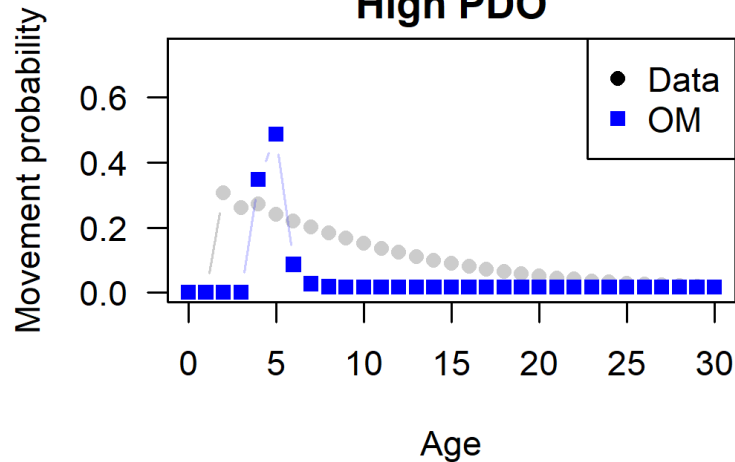
## 4 to 3 Low PDO



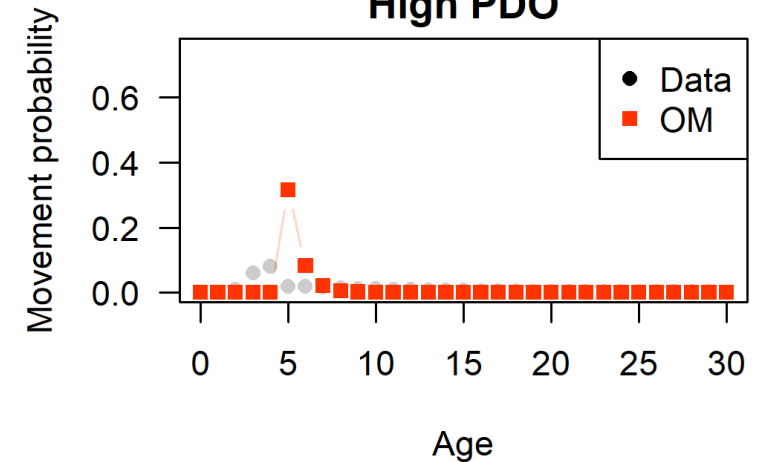
## 3 to 2 Low PDO



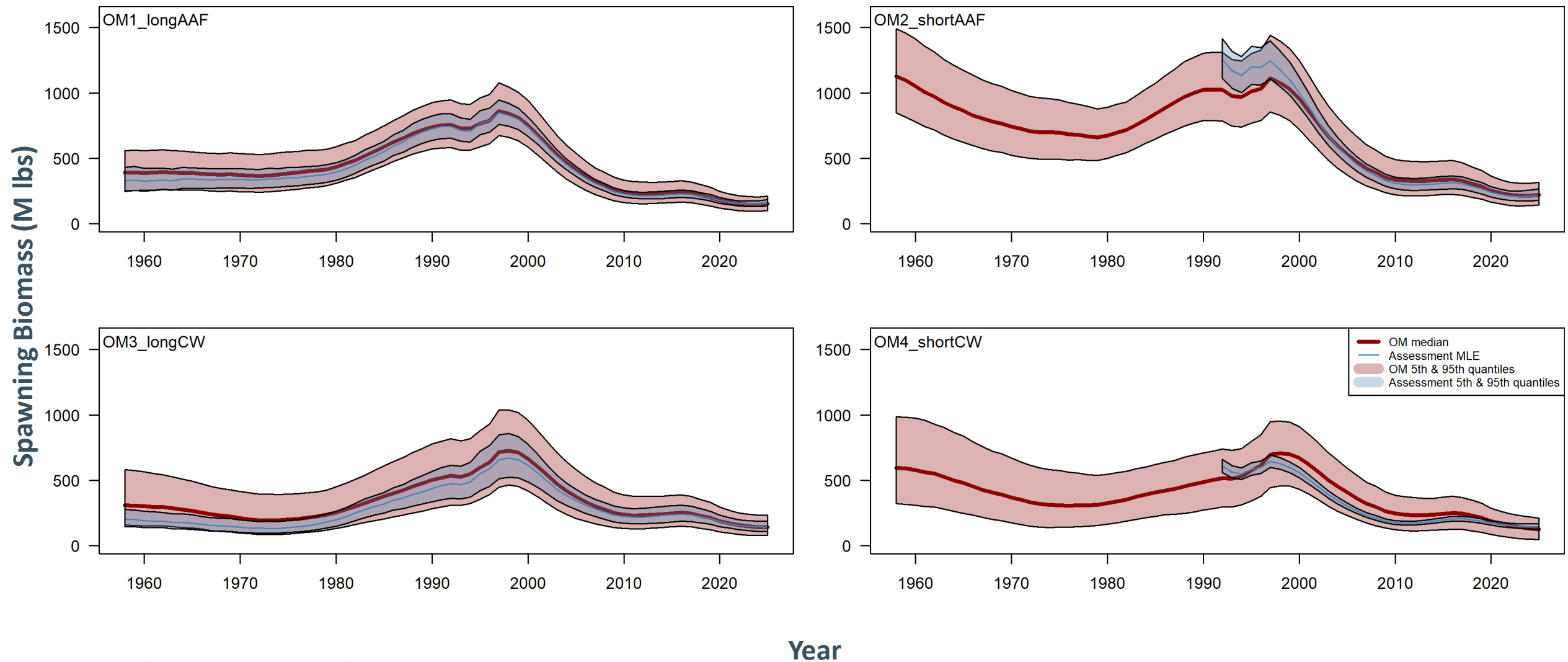
## High PDO



## High PDO

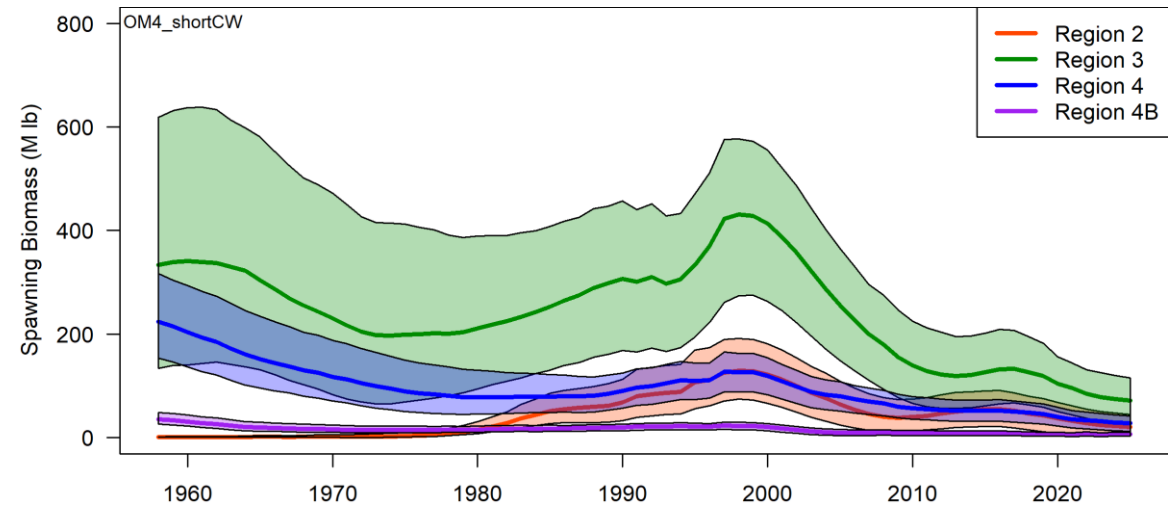
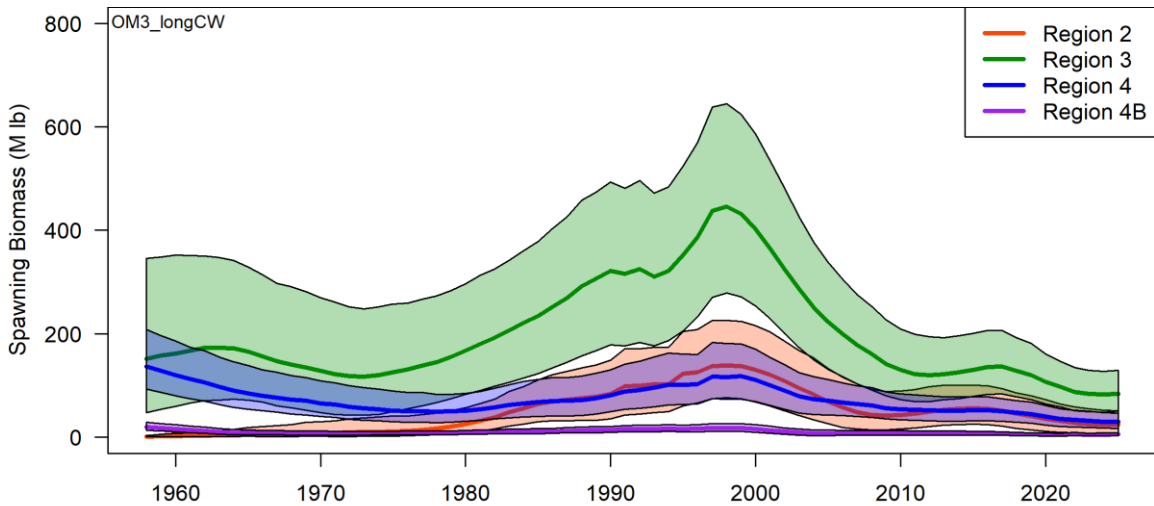
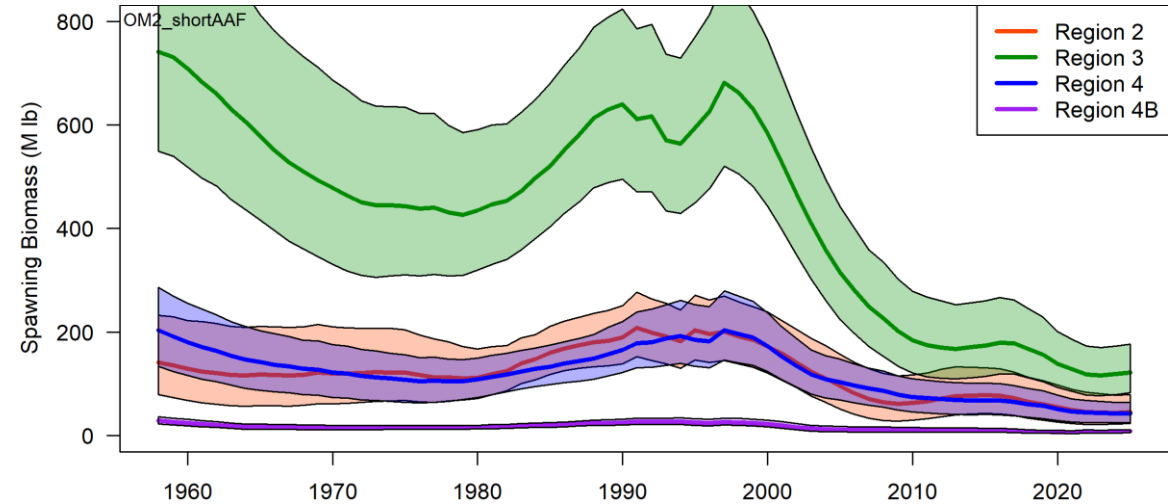
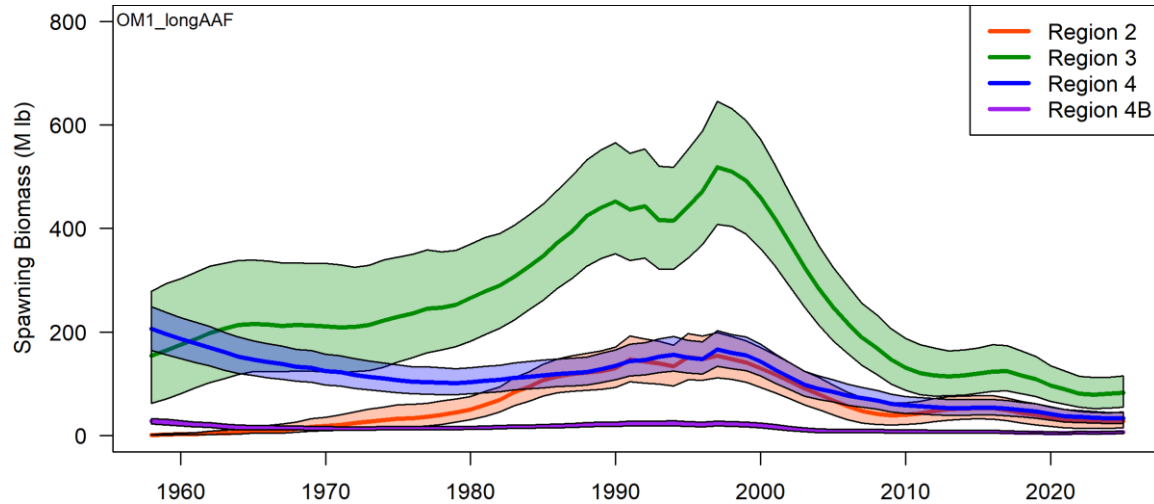


# OM Spawning Biomass



# OM Regional Spawning Biomass

Spawning Biomass (M lbs)



Year

Year

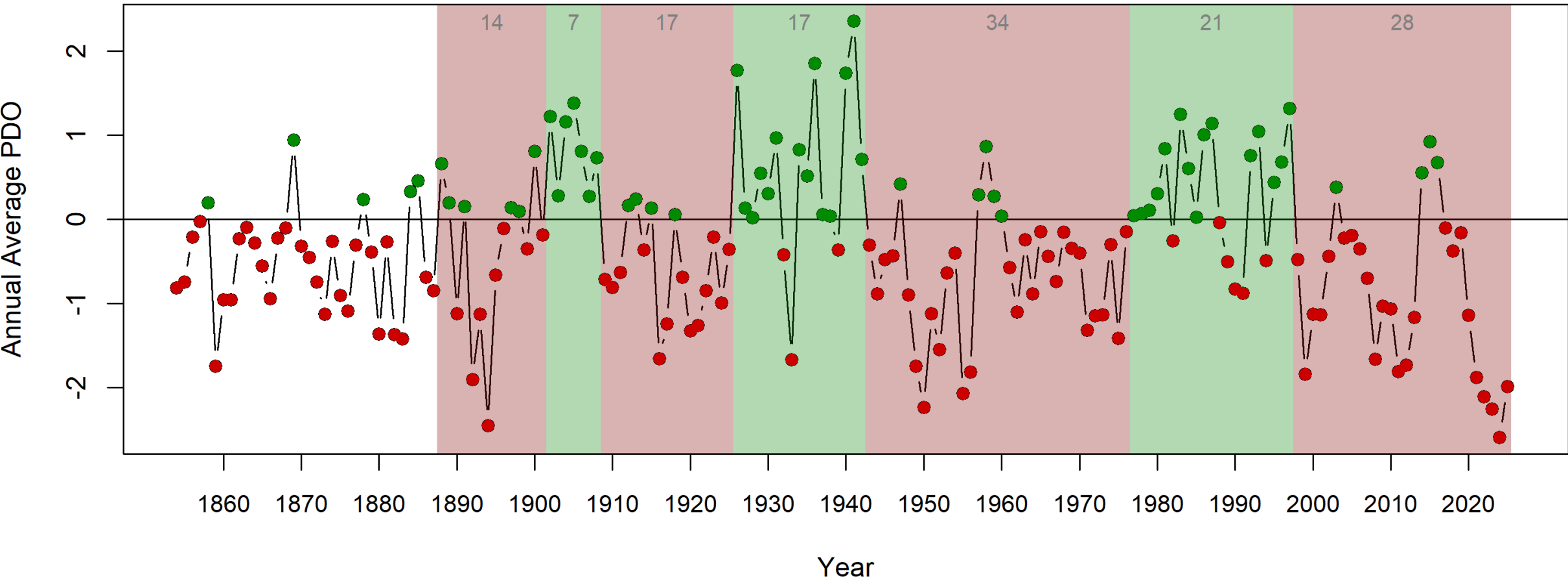


# Discussion of Conditioning

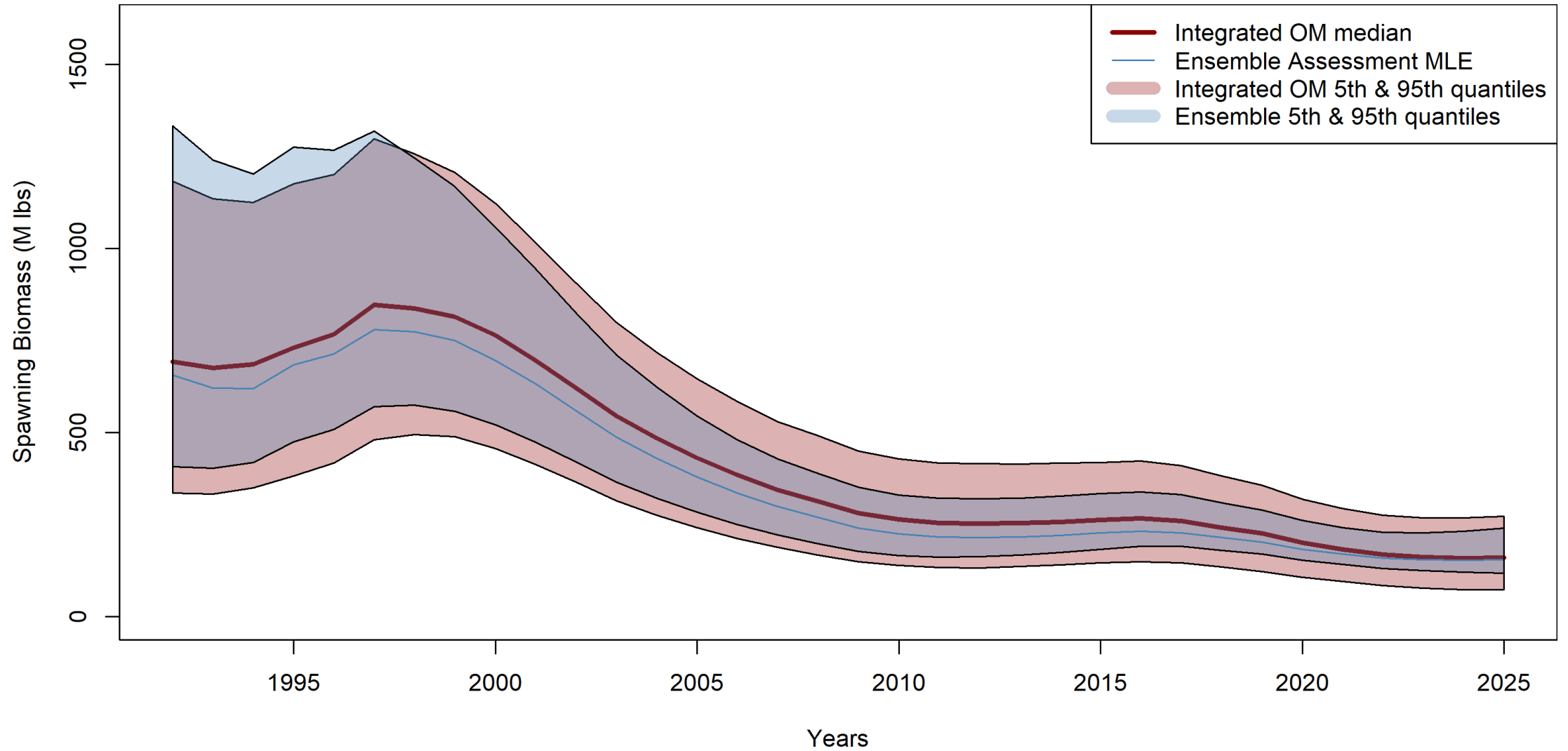
- All models captured the trend in Spawning Biomass
  - OM4 showed some inconsistency, which is the model with low fixed female natural mortality and (thus) low uncertainty in assessment
- All models predicted a higher proportion of all-sizes biomass in Region 3 in the last 4 years
  - Fitting only to distribution could not capture the recent trend
  - Uncertainty does encompass the recent observations
  - This may be an indication that the PDO is no longer related to changes in movement and recruitment distribution
    - The PDO is at the lowest in the entire time-series
    - The North Pacific ocean has experienced high temperatures associated with recent low PDO
    - New/unseen relationships between climate variables and the PDO



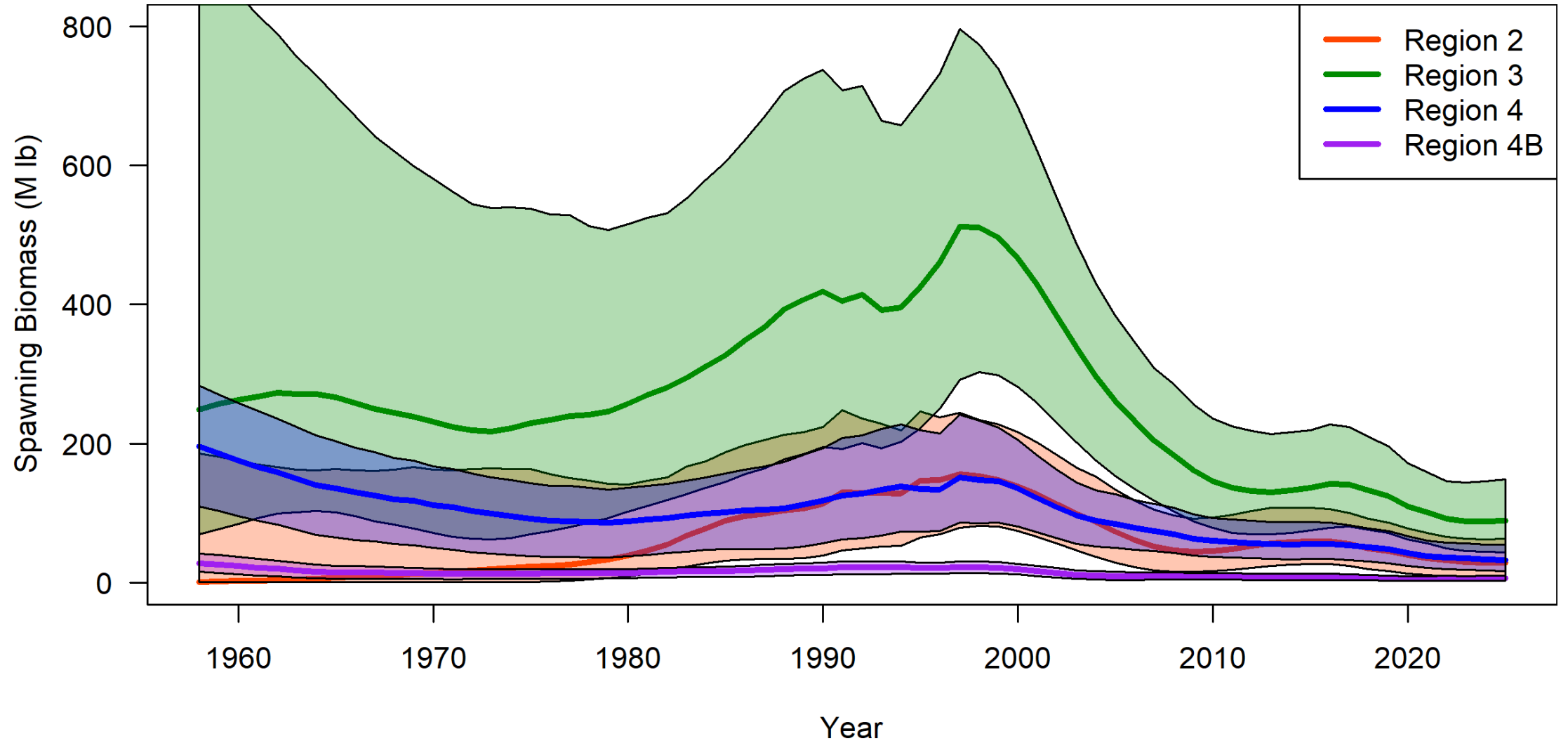
# Pacific Decadal Oscillation (PDO)



# Integrated Spawning Biomass



# Integrated Regional Spawning Biomass



# Next Steps

- Compare the new OM to past simulations/results
  - Project with no fishing
  - Project with different SPRs
  - Compare to past results
- Other items on the 2026-2027 MSE Program of Work
  - Next slides



# AM102: High Priority topics

**IPHC-2026-AM102-R**, para. 56. *The Commission **NOTED** that the 2026 MSE and HSP Program of Work will include the following high priority topics:*

- a) Update and recondition the MSE Operating Model in accordance with the schedule defined in the Harvest Strategy Policy;*
- b) Evaluate a range of SPR values to determine if the optimal reference coastwide fishing intensity is different than the current reference fishing intensity (F43%) defined in the HSP;*
- c) Investigate productivity regimes to determine how the Pacific halibut population and fisheries respond to different productivity regimes, if the optimal reference fishing intensity differs across productivity regimes, and how productivity regimes may be incorporated into a Management Procedure;*
- d) Further develop the Depleted concept and identify a limit reference point below which recovery of the Pacific halibut population would be uncertain.*



# AM102: Low priority topics

**IPHC-2026-AM102-R**, para. 57. *The Commission **NOTED** that the 2026 MSE and HSP Program of Work will include the following low priority topics, which may not be completed before AM103:*

- a) Improve the estimation model used in the MSE framework to better characterize the stock assessment in the simulations;*
- b) Evaluate potential management actions to invoke when approaching a depleted limit reference point;*
- c) Evaluate additional elements of Management Procedures which may include a triennial assessment frequency, constraints and smoothers on the interannual change in the TCEY, and empirical rules to determine the reference TCEY in years without a stock assessment;*
- d) Determine reference points using the updated MSE Operating Model (e.g. FMSY and MSY);*
- e) Develop guidance documents for the Harvest Strategy Policy (e.g. specifications of a rebuilding plan).*



# AM102: Other Notes

**IPHC-2026-AM102-R**, para. 58. *The Commission **NOTED** that the 2026 MSE and HSP Program of Work should not include topics related to the distribution of the TCEY, as this is part of the decision-making process and not part of the management procedure, as described in the Harvest Strategy Policy.*

**IPHC-2026-AM102-R**, para. 59. *The Commission **NOTED** that outcomes of the 2026 MSE workplan (e.g. an optimal fishing intensity) may be used to update the Harvest Strategy Policy in the future.*



# High Priority Tasks

- Condition the MSE Operating Model (OM)
- Evaluate a range of SPR values (fishing intensity)
- Investigate productivity regimes
- Further develop the Depleted concept and identify a limit reference point



# Evaluate a range of SPR values (fishing intensity)

- Ensure that the reference fishing intensity continues to be the optimal fishing intensity to meet the Commission priority objectives
- At MSAB021 a recommendation was made to evaluate a range of SPR values

**IPHC-2025-MSAB021-R**, para. 36: *The MSAB REQUESTED further evaluations of the following MP elements, after the OM is conditioned following the full 2025 stock assessment:*

*a) fishing intensities including, but not limited to, SPRs of 40%, 43%, 46%, 52%, 55%, and 100% (no directed fishing); ...*

- This is a reasonable range of values, but can be extended



# Investigate productivity regimes

Three main concepts to explore, relative to productivity:

1. how the Pacific halibut population and fisheries respond to different productivity regimes,
2. if the optimal reference fishing intensity differs across productivity regimes, and
3. how productivity regimes may be incorporated into a Management Procedure



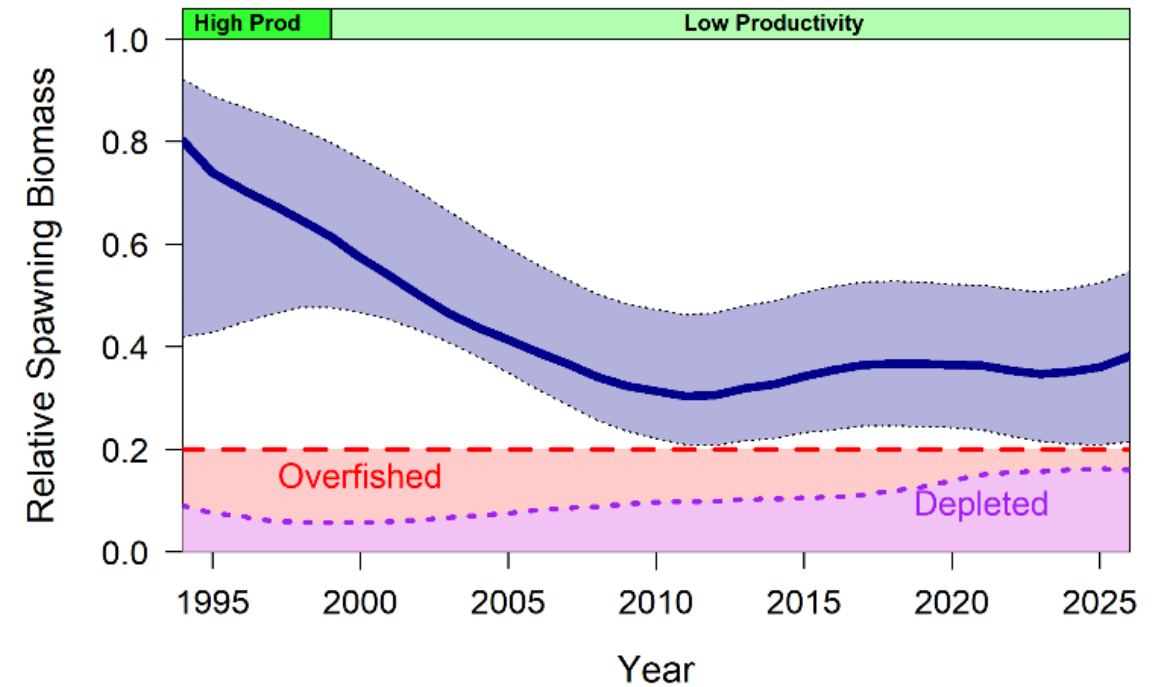
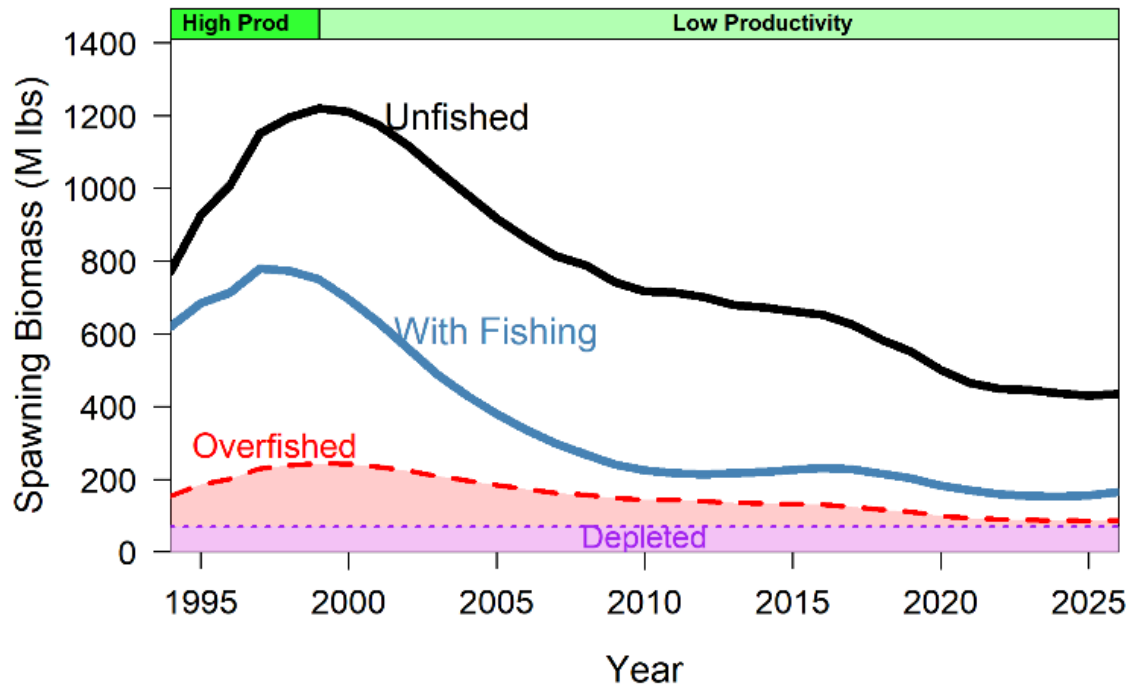
# Steps to investigate productivity

1. Define productivity regimes
2. Use the new OM to conduct simulations assuming different productivity for a range of SPR values
3. Evaluate the effects of productivity on the optimal fishing intensity
4. Identify Management Procedures (MPs) to investigate that incorporate productivity
5. Determine effective methods to present the effects of productivity



# Further develop the Depleted concept and identify a limit reference point

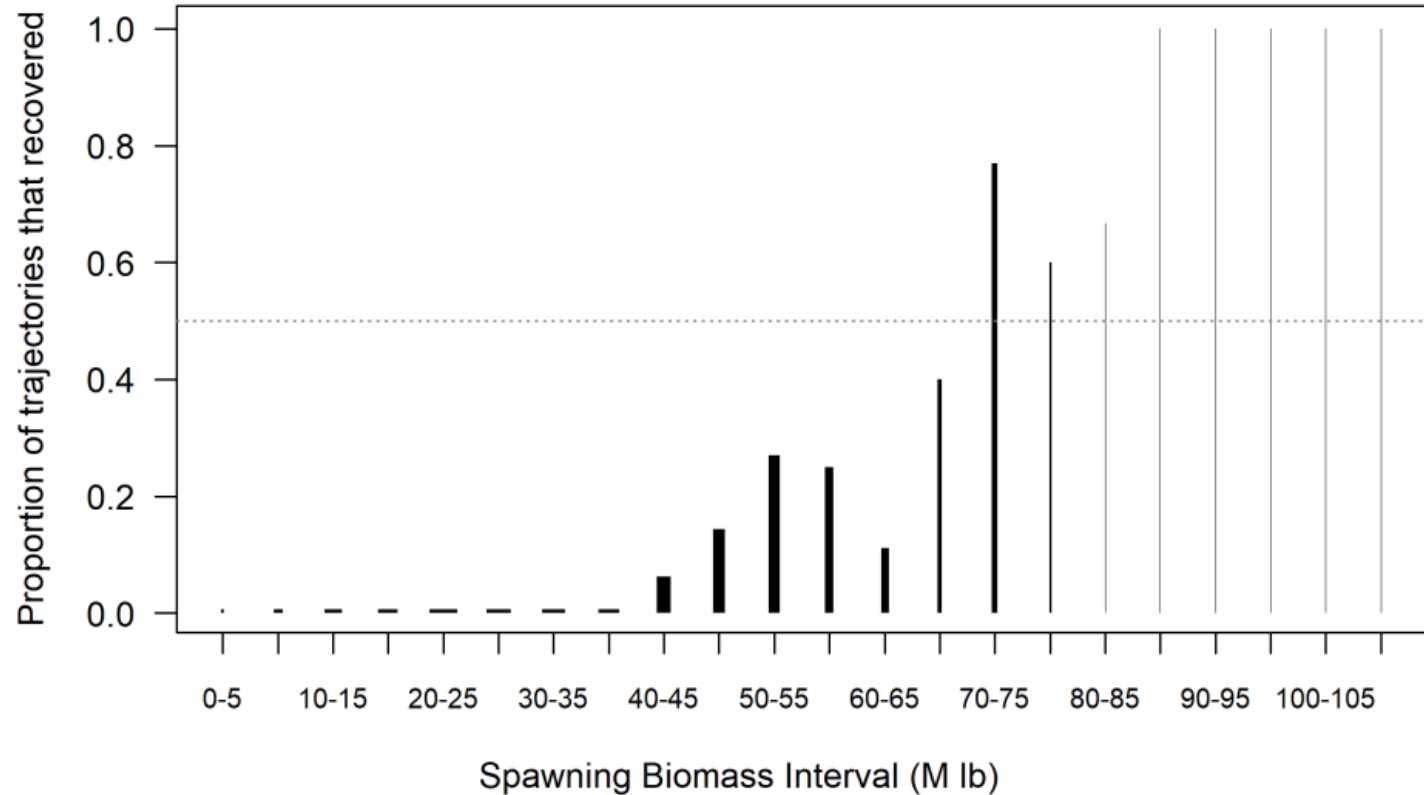
Depleted: The level of female spawning biomass below which the potential for recovery is uncertain



# Simulations to identify a Depleted limit

- Conduct simulations with the new OM to identify a level of female spawning biomass below which the potential for recovery is uncertain
  - Low productivity, but may also investigate other productivity levels
  - Various compensatory spawner-recruit relationships

**IPHC-2025-SRB027-R.** para 23.  
*The SRB **RECOMMENDED** increasing simulation sample sizes to achieve a smooth curve so that a “depleted” threshold can be identified as the lowest spawning stock biomass that results in near 100% probability of recovery.*



# An exceptional circumstance related to Depleted

**IPHC-2025-SRB027-R**. para 21. *The SRB RECOMMENDED defining an “exceptional circumstance” if the stock is determined to be “depleted” as this state is unlikely to occur under the circumstances in which the HSP is implemented and may be indicative of a need for model revision*

Possible language:

- If the stock assessment determines that the stock is depleted in two or more consecutive years, an exceptional circumstance will be triggered



# Low priority tasks

- Improve the estimation model in the MSE framework
- Evaluate potential management actions when approaching the depleted limit reference point
- Evaluate additional elements of Management Procedures
- Update estimates of reference points
- Develop guidance documents for the Harvest Strategy Policy
- *Incorporate autocorrelated recruitment in projections*
- *Update objectives and performance metrics*

*In italics were not noted by Commission at AM102*



# Improve the estimation model

- The estimation model mimics the stock assessment in the simulations

**IPHC-2025-SRB027-R**, para 24. *The SRB **RECOMMENDED** considering the development of an assessment model within the MSE framework. This would have multiple benefits including:*

- a) facilitating analysis of the economic consequences of reduced FISS sampling and the associated increased potential for bias in assessment-relevant metrics such as WPUE, the maturity schedule, size-at-age, and age composition.*
- b) Understanding the impacts of uncertainty in natural mortality on management performance.*



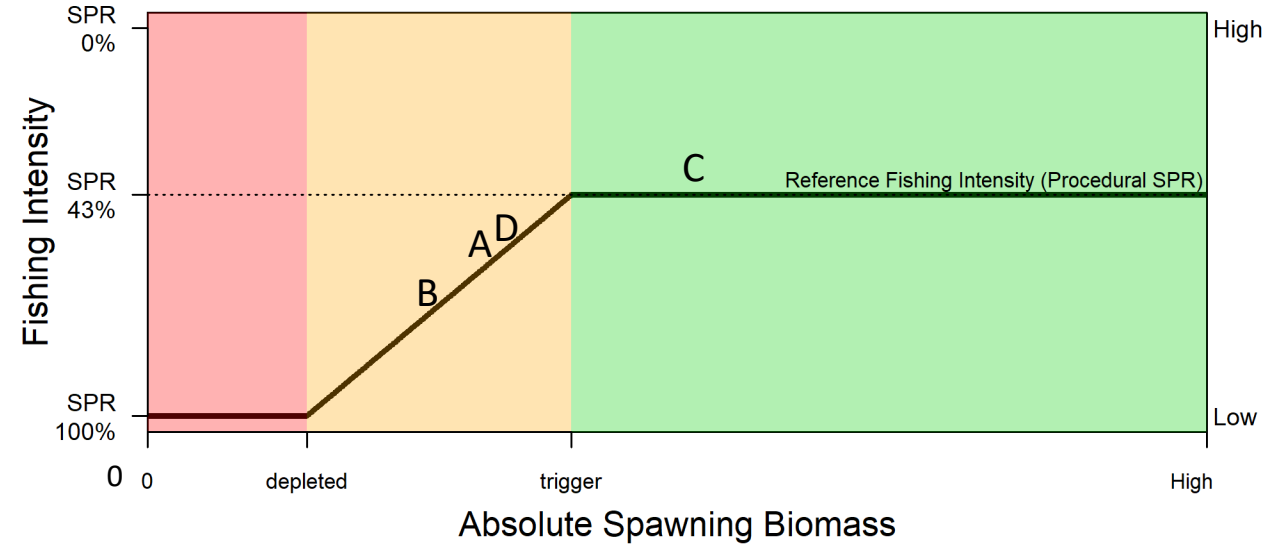
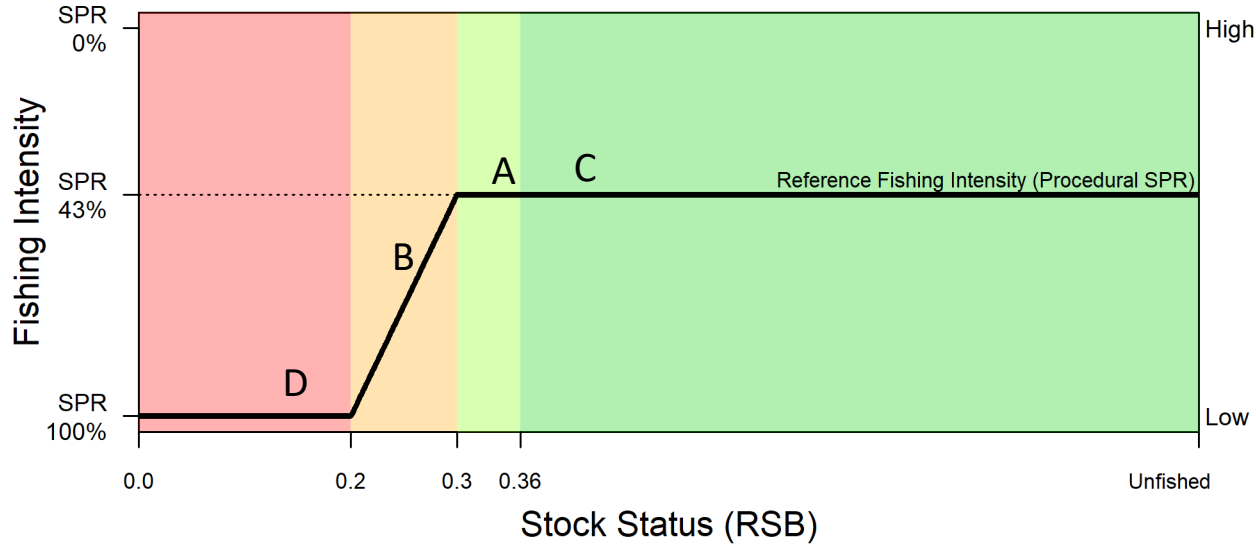
# Evaluate potential management actions when approaching the depleted limit reference point

- Investigate management actions if the stock is approaching the depleted limit reference point
  - Determining this limit reference point is a high priority task
- Management actions could be
  - A control rule that reduces fishing intensity as the absolute spawning biomass approaches the depleted limit reference point
    - Could be used in addition to the current 30:20 control rule
  - Adjusting the reference fishing intensity based on the perceived productivity regime
  - ...



# Example of multiple control rules

- Example: Two control rules determining a reduction in fishing intensity
  - Ex A: CR1 says no reduction, CR2 says a 25% reduction
  - Ex B: CR1 says a 30% reduction, CR2 says a 50% reduction
  - Ex C: Both say no reduction
  - Ex D: CR1 says 100% reduction (no fishing), CR2 says 20% reduction



# Example of multiple control rules

## Some Potential Methods

1. Determine which one results in largest reduction in fishing intensity and use only that one
2. Average them by determining mean proportional reduction
3. Multiply them to combine the reduction

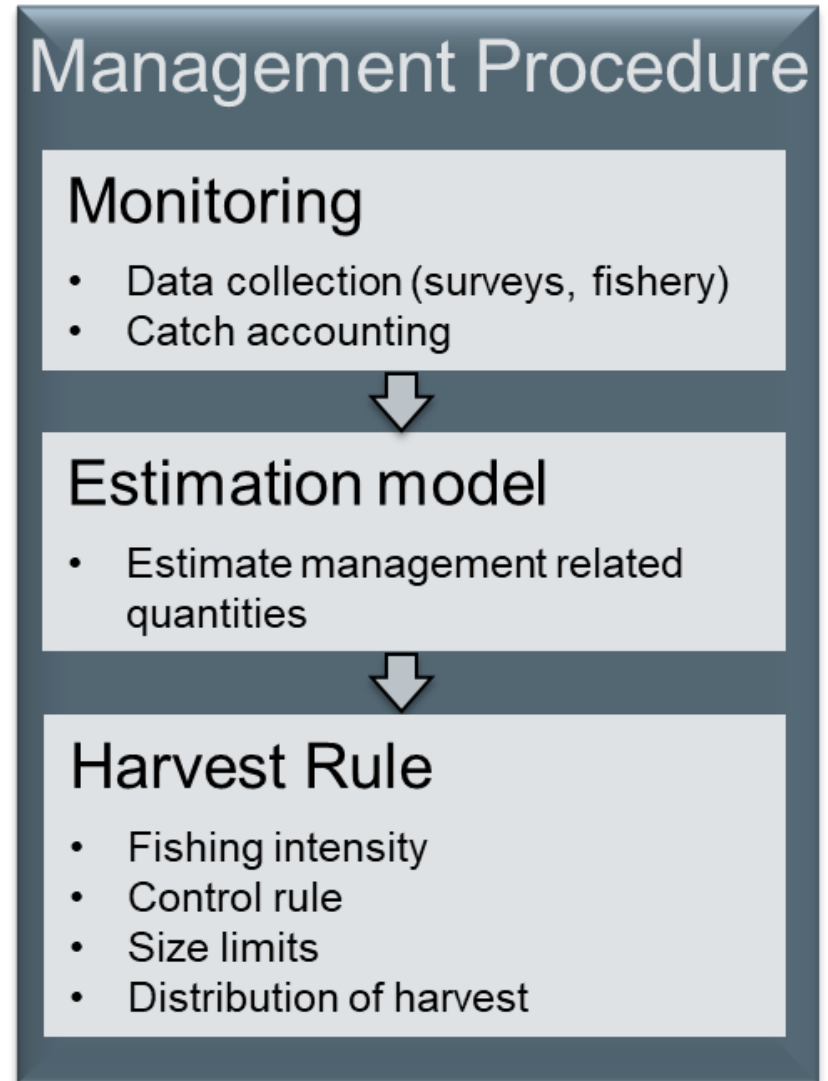
Example	Method 1 (max)	Method 2 (mean)	Method 3 (combine)
A (0% & 25%)	25%	12.5%	25%
B (30% & 50%)	50%	40%	65%
C (0% and 0%)	0% (none)	0% (none)	0% (none)
D (100% & 20%)	100% (no fishing)	60%	100% (no fishing)



# Evaluate additional elements of Management Procedures (MPs)

## Elements of MPs considered in the past

- Fishing Intensity or SPR (many years)
- Constraints (many years)
- Assessment Frequency (many years)
- FISS designs (2024)
- Size limits (2022)
- Distribution procedures (2020, 2021)
- Control rule (2017-2019)



# MP elements of interest to the MSAB

**IPHC-2025-MSAB021-R**, para 36. *The MSAB REQUESTED further evaluations of the following MP elements, after the OM is conditioned following the full 2025 stock assessment:*

- a) ***fishing intensities** including, but not limited to, SPRs of 40%, 43%, 46%, 52%, 55%, and 100% (no directed fishing);*
- b) *a triennial **assessment frequency**;*
- c) *various **empirical rules** to determine the reference coastwide TCEY in non-assessment years;*
- d) ***control rules with triggers** at higher values than  $RSB_{30\%}$  or based on absolute spawning biomass relative to the spawning biomass estimated at the beginning of 2024.*



# Constraints of interest to MSAB

**IPHC-2025-MSAB021-R**, para 37. *The MSAB REQUESTED evaluating **constraints and smoothers**, along with MP elements listed in para. 36, that would potentially reduce the interannual variability in the TCEY, including:*

- a) *a **3-year rolling average** (arithmetic or geometric) on the FISS O32 WPUE used in the empirical rule in a triennial stock assessment frequency;*
- b) *constraints **applied only to** non-assessment years and/or applied only to assessment years;*
- c) *a **phase-in approach** for the change in TCEY in assessment years;*
- d) *using the trends in fishery CPUE and/or FISS WPUE to determine if a bigger reduction should be taken than suggested by the unconstrained reference TCEY to curtail further reductions in the SB.*



# Past work on constraints

- Maximum change (e.g. 15%)
  - Would be worth looking at other percentages
  - When TCEY increases or decreases, or only when increasing
- Slow Up – Fast Down
  - TCEY can increase slowly, but can decrease quickly
  - Restricted change in both directions
- Slow Up – Full Down
  - TCEY can increase slowly, but can decrease quickly
  - Restricted change only when increasing



# Update estimates of reference points

- MSY-based reference points were determined in 2019
  - [IPHC-2019-SRB015-11 Rev 1](#)
- Since then, there have been many updates to the stock assessment, the OM, and the data
- Repeating this analysis will ensure that the Harvest Strategy Policy (HSP) reflects current information



# Develop guidance documents for the HSP

- The Harvest Strategy Policy (HSP) is a high-level document
- Some details are omitted for brevity
- Supplementary guidance documents can provide more detail
  - Guidelines for developing a rebuilding plan for Pacific halibut if it was determined to be overfished
  - Other guidance documents as necessary
- These documents would then be considered by the Commission for adoption



# Incorporate autocorrelated recruitment in projections

- Investigated autocorrelated recruitment in document [IPHC-2025-SRB027-08](#)
- Three-year stock assessment projections are not significantly affected by the modelling of near-term recruitment
- Some evidence that it may be useful to include this in the MSE simulations
  - slight evidence of autocorrelation in the estimated deviates
    - May be a result of ageing error appearing as autocorrelation
  - Simulations with high autocorrelation show small differences
    - Unlikely to result in a different selection of a reference management procedure



# Update objectives and performance metrics

- It is useful to revisit goals and objectives to clarify and/or add new ones
  - For example, objectives related to an absolute spawning biomass or a depleted level
- Also useful to review performance metrics related to objectives
- [IPHC-2025-SRB027-R](#), para 22. *The SRB RECOMMENDED considering some fishery performance indicators that represent metrics directly observable by stakeholders, e.g. fishery CPUE*



# Summary

- High priority tasks
  - Condition the MSE Operating Model
  - Evaluate a range of SPR values
  - Investigate productivity regimes
  - Further develop the depleted concept and identify a limit reference point
- Low priority tasks
  - Improve the estimation model in the MSE framework
  - Evaluate potential management actions when approaching the depleted limit reference point
  - Evaluate additional elements of the Management Procedures
  - Update estimates of reference points
  - Develop guidance documents for the Harvest Strategy Policy
  - *Incorporate autocorrelated recruitment in projections*
  - *Update objectives and performance metrics*



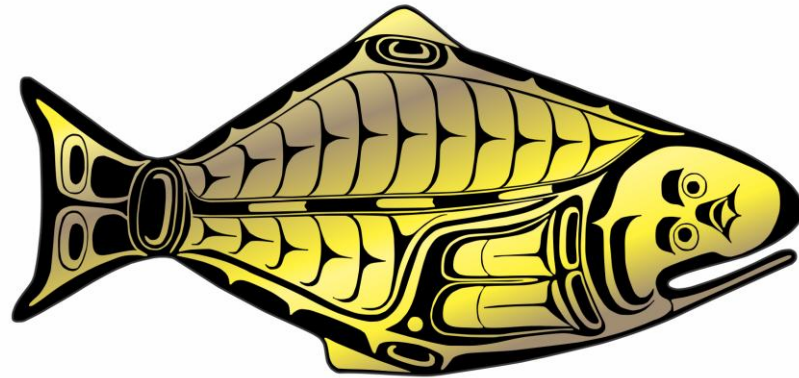
# Recommendations

That the SRB:

- **NOTE** paper IPHC-2026-SRB028-08 Rev\_1 that describes tasks included in the MSE Program of Work for 2026–2027 and work towards completing those tasks.
- **REQUEST** additional tasks to be included in the MSE Program of Work for 2026–2027.



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# Primary goals and objectives

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC
1.1. KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES AND CONSERVE SPATIAL POPULATION STRUCTURE	Maintain the long-term coastwide female relative spawning biomass above a biomass limit reference point ( $RSB_{20\%}$ ) at least 95% of the time	$RSB < Spawning$ Biomass Limit ( $RSB_{Lim}$ )  $RSB_{Lim} = 20\%$ unfished spawning biomass	Long-term	0.05	$P(RSB < RSB_{Lim})$  Fail if greater than 0.05
	Maintain a defined minimum proportion of female spawning biomass in each Biological Region	$p_{SB,2} > 5\%$ $p_{SB,3} > 33\%$ $p_{SB,4} > 10\%$ $p_{SB,4B} > 2\%$	Long-term	0.05	$P(p_{SB,R} < p_{SB,R,min})$



# Primary goals and objectives

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC
2.1 MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT OPTIMIZES FISHING ACTIVITIES	Maintain the long-term coastwide female relative spawning biomass at or above a biomass reference point ( $RSB_{36\%}$ ) 50% or more of the time	$RSB < \text{Spawning Biomass Reference } (RSB_{Thresh})$  $RSB_{Thresh} = RSB_{36\%}$ unfished spawning biomass	Long-term	0.50	$P(RSB < RSB_{Thresh})$  Fail if greater than 0.5



# Primary goals and objectives

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC
<b>2.2. PROVIDE DIRECTED FISHING YIELD</b>	Optimize average coastwide TCEY	Median coastwide TCEY	Short-term		Median $\overline{TCEY}$
	Optimize TCEY among Regulatory Areas	Median $TCEY_A$	Short-term		Median $\overline{TCEY_A}$
	Optimize the percentage of the coastwide TCEY among Regulatory Areas	Median $\%TCEY_A$	Short-term		Median $\left(\frac{TCEY_A}{TCEY}\right)$
	Maintain a minimum TCEY for each Regulatory Area	Minimum $TCEY_A$	Short-term		Median Min(TCEY)
	Maintain a percentage of the coastwide TCEY for each Regulatory Area	Minimum $\%TCEY_A$	Short-term		Median Min(%TCEY)



# Primary goals and objectives

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC
2.3. LIMIT VARIABILITY IN MORTALITY LIMITS	Limit annual changes in the coastwide TCEY	Annual Change (AC) > 15% in any 3 years	Short-term		$P(AC_3 > 15\%)$
		Median coastwide Average Annual Variability (AAV)	Short-term		Median AAV
	Limit annual changes in the Regulatory Area TCEY	Annual Change (AC) > 15% in any 3 years	Short-term		$P(AC_3 > 15\%)$
		Average AAV by Regulatory Area (AAV <sub>A</sub> )	Short-term		Median AAV <sub>A</sub>

