

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

# Updates to the IPHC MSE Program of Work for 2026 and a Review of Coastwide Management Procedures

Agenda item: 4.1  
IPHC-2026-MSAB022-06  
(A. Hicks & I. Stewart)



# Purpose

To provide the Management Strategy Advisory Board (MSAB) with an overview of work done since the 21<sup>st</sup> meeting of the Management Strategy Advisory Board (MSAB021) 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



# Objectives

Chapter 2, page 10

1. Maintain the long-term coastwide Pacific halibut female relative spawning biomass above a biomass limit reference point where the risk to the stock is regarded as unacceptable ( $RSB_{20\%}$ ) at least 95% of the time;
2. Maintain the long-term coastwide Pacific halibut female relative spawning biomass at or above a threshold reference point that optimises fishing activities ( $RSB_{36\%}$ ) at least 50% of the time;
3. Maximize the short-term coastwide yield while minimising annual changes in the short-term coastwide mortality limit, given the constraints above to ensure a sustainable fishery.

The Commission considered IPHC-2025-MSAB021-R, para 44 when determining the wording of these objectives



# Hierarchical objectives

Chapter 2, page 11

- General objectives: biological (green) or fishery (blue)
- Succinct measurable objectives

## LONG-TERM OVERARCHING OBJECTIVES DEFINING ACCEPTABLE MPs

1. SUSTAINABILITY	
GENERAL OBJECTIVE	MEASURABLE OBJECTIVE
KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES	Maintain the long-term coastwide female relative spawning biomass above a biomass limit reference point ( $RSB_{20\%}$ ) at least 95% of the time



2. OPTIMISE FISHING ACTIVITIES AND OPPORTUNITIES	
GENERAL OBJECTIVE	MEASURABLE OBJECTIVE
MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT SUPPORTS OPTIMAL FISHING ACTIVITIES AND OPPORTUNITIES	Maintain the long-term coastwide female relative spawning biomass at or above a biomass threshold reference point ( $RSB_{36\%}$ ) 50% or more of the time.



## SHORT-TERM MANAGEMENT OBJECTIVES INFORMING A REFERENCE MP

3. OPTIMISE YIELD	
GENERAL OBJECTIVE	MEASURABLE OBJECTIVE
PROVIDE STABLE FISHING OPPORTUNITIES	Maximize the short-term coastwide yield while minimising annual changes in the short-term coastwide mortality limit.



# Overfished and Depleted

- **Overfished:** when the estimated probability that coastwide female relative spawning stock biomass is below the limit reference point (RSB20%) is greater than 50%.
  - The female relative spawning biomass level where the ecological risk to the population and the risk to the health of the fisheries is regarded as unacceptable
- **Depleted:** In development
  - The female absolute spawning biomass level below which the potential for recovery is uncertain



# How are Overfished & Depleted related to environment

Overfished is a relative limit reference point defining an unacceptably low ratio of spawning biomass to dynamic unfished spawning biomass that results from fishing alone rather than the combined effects of fishing and the environment. [...] Therefore, an overfished state may be fully mitigated by management actions.

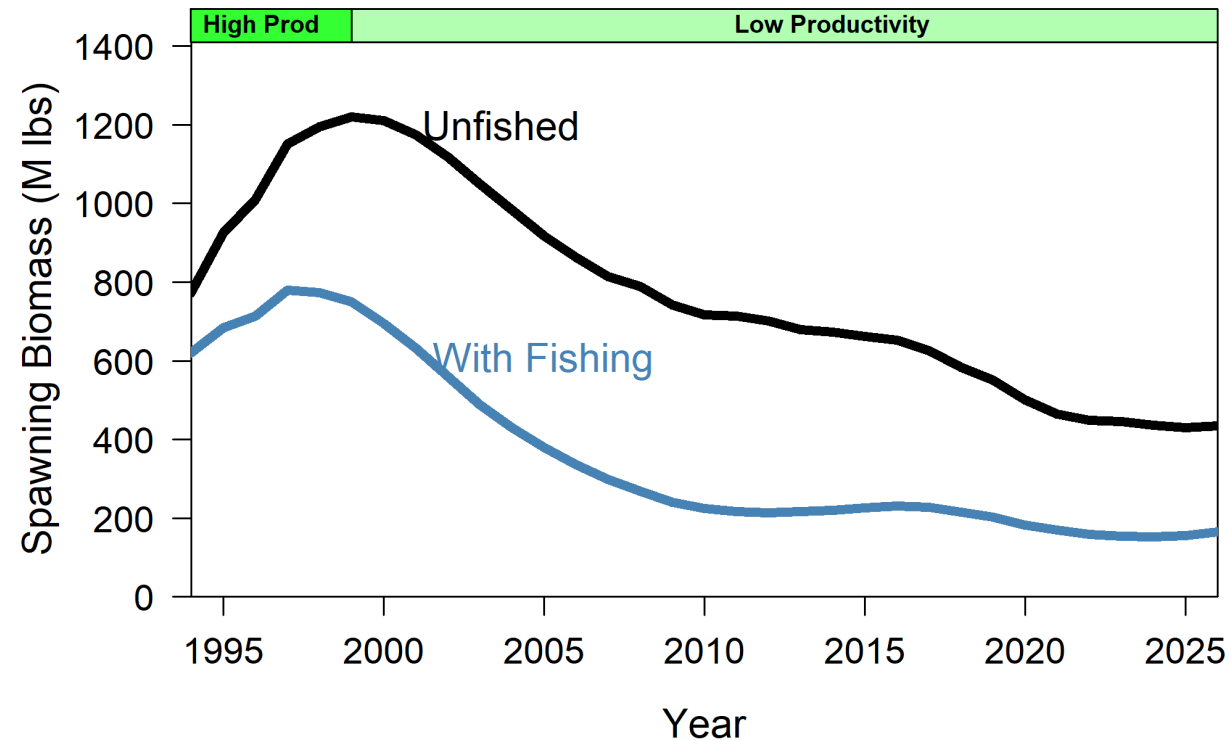
Depleted is an absolute limit reference point defined by a spawning biomass below which the potential for recovery is uncertain. Natural variability affects stock size resulting in fluctuations of the spawning biomass, which along with fishing, may result in a '*depleted*' stock where reductions in fishing mortality may not lead to recovery without a change in the environmental conditions affecting the stock. Therefore, a depleted state may be only partially mitigated by management actions.<sup>1</sup>

<sup>1</sup>The concept of depleted has been added to the Harvest Strategy Policy to recognize it as important while research continues to identify an appropriate threshold and develop management procedures for when the stock approaches or surpasses a depleted state. This research will be considered when updating the HSP following the schedule in Table 2

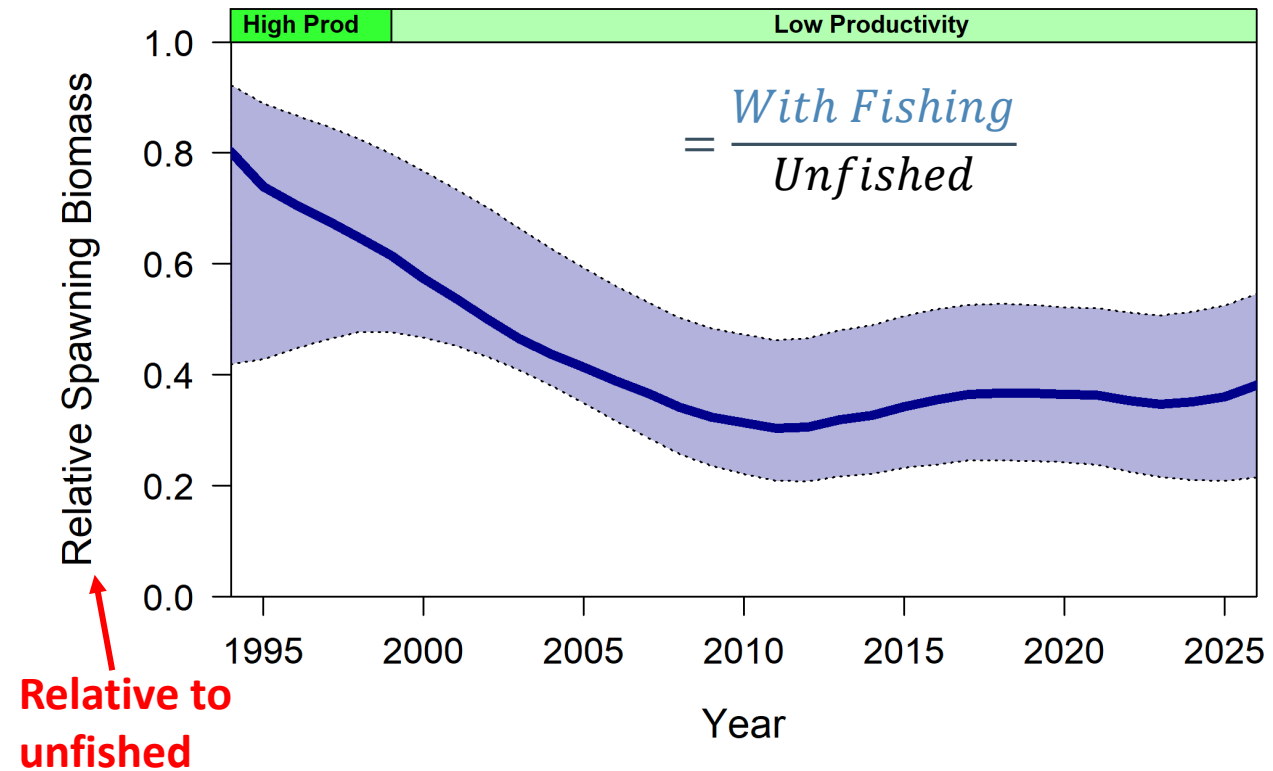


# Comparing Overfished and Depleted

## Absolute Spawning Biomass



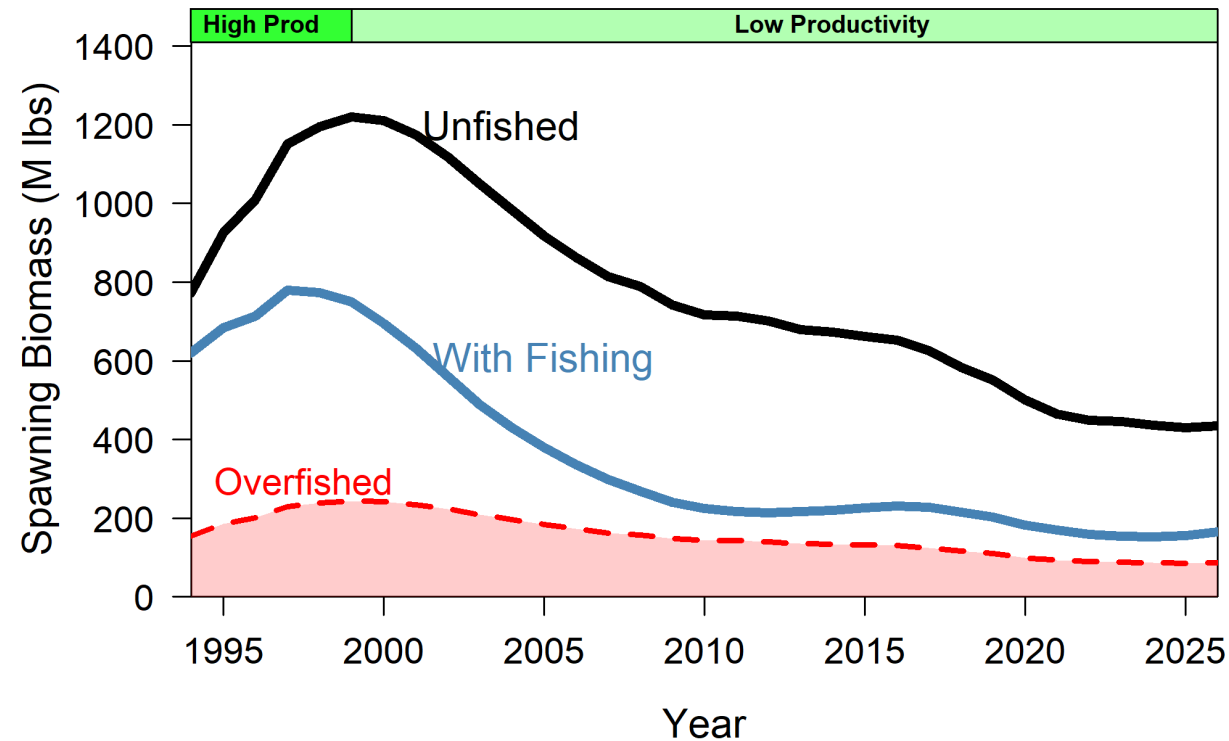
## Relative Spawning Biomass



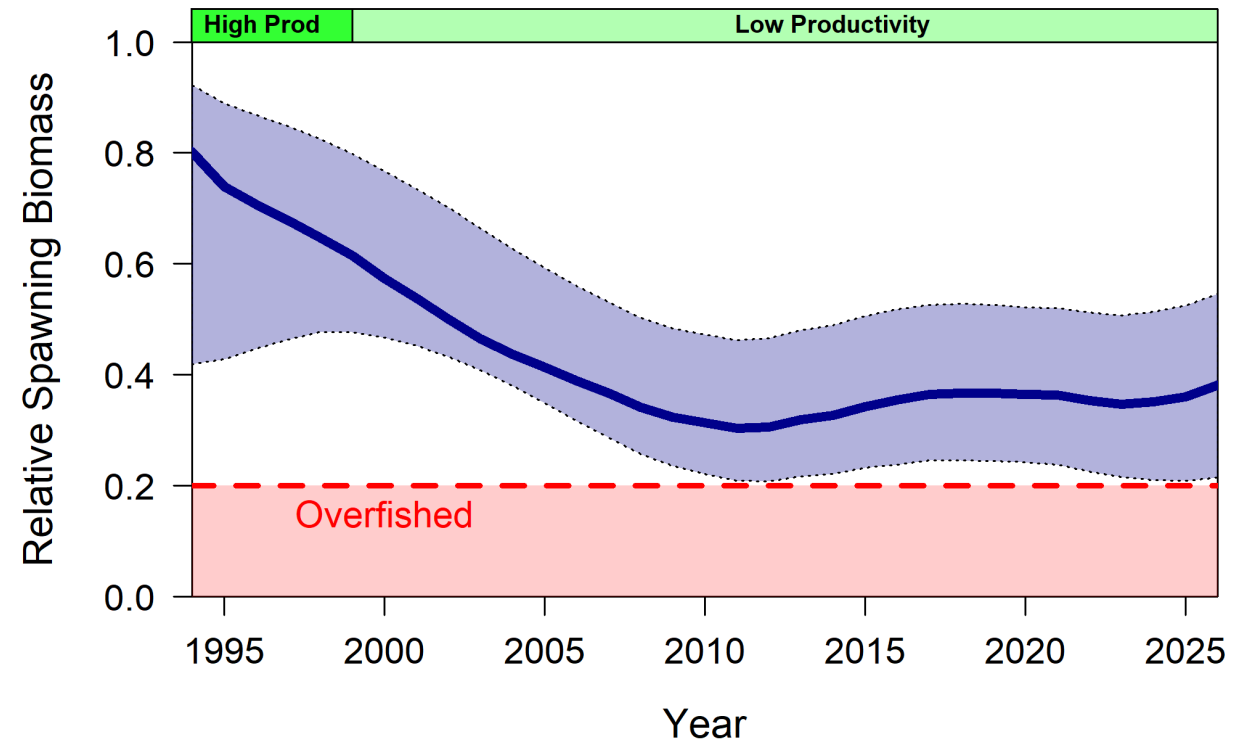
# Comparing Overfished and Depleted

- **Overfished** is a percentage of the dynamic unfished spawning biomass
  - 20% of unfished spawning biomass

## Absolute Spawning Biomass



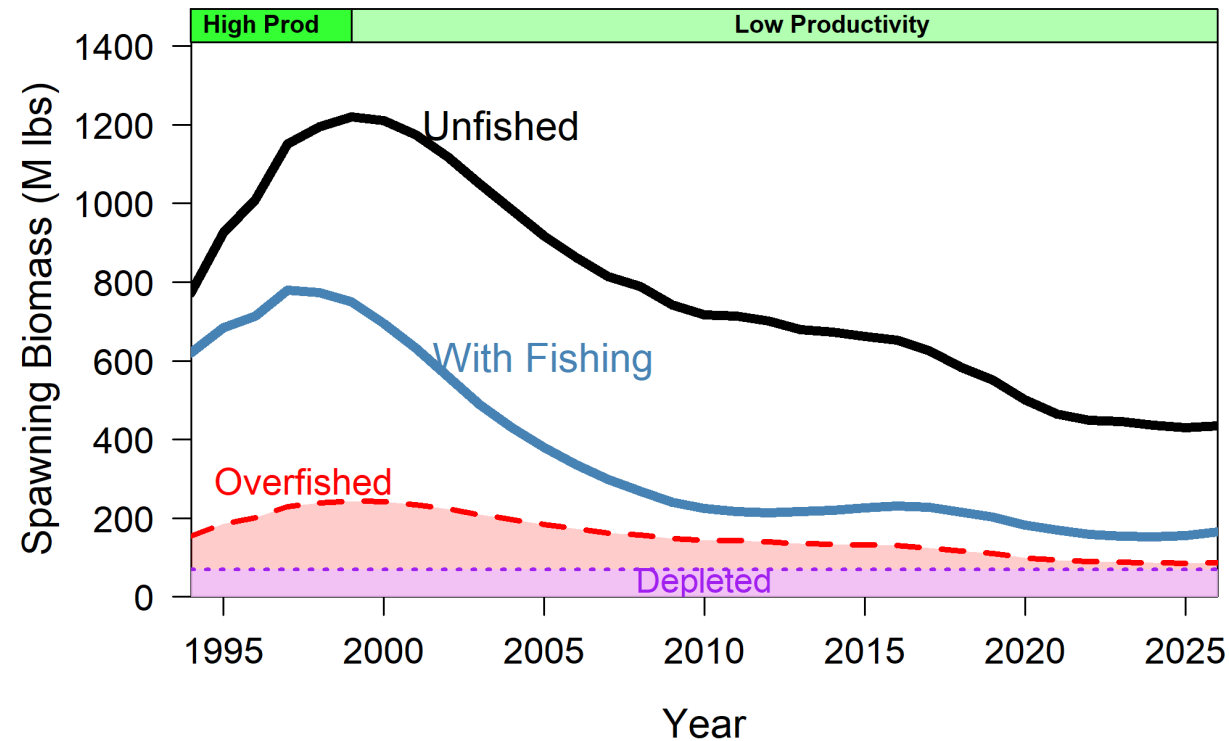
## Relative Spawning Biomass



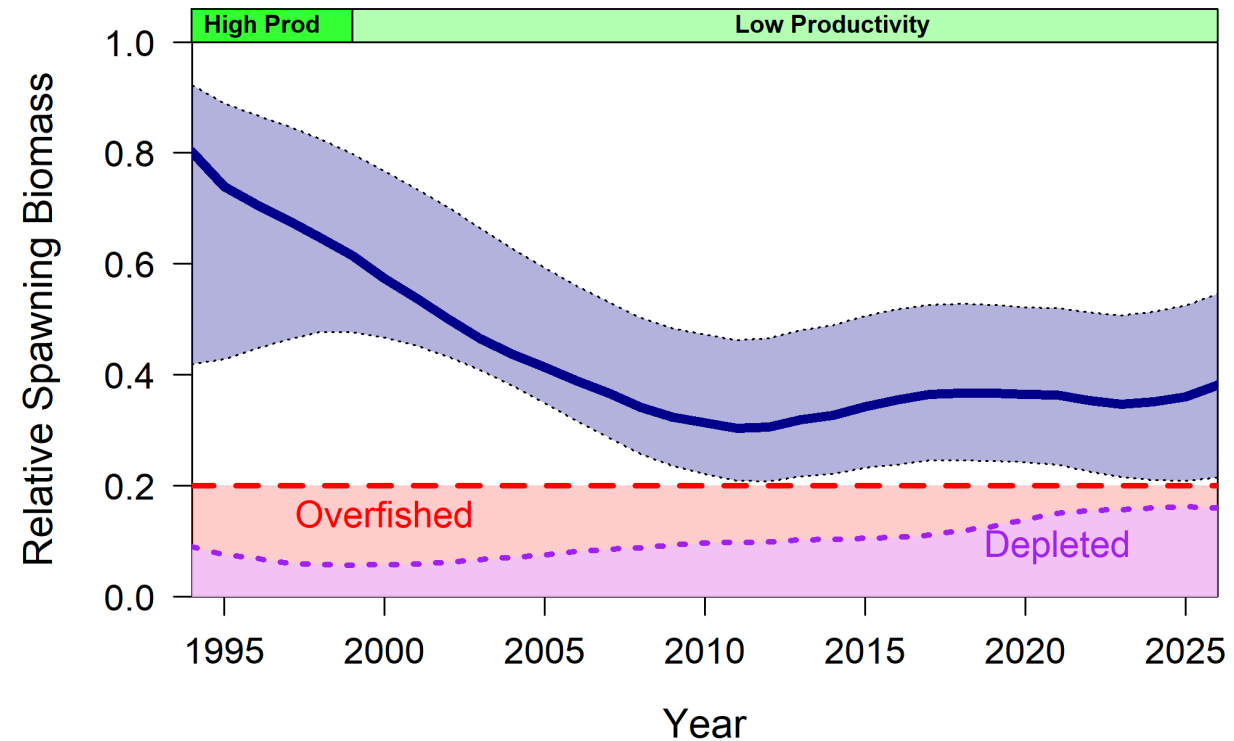
# Comparing Overfished and Depleted

- **Overfished** is a constant ratio limit of the dynamic unfished spawning biomass
- **Depleted** is a constant absolute spawning biomass limit

## Absolute Spawning Biomass



## Relative Spawning Biomass



# Overfishing Reference Point

**Overfishing:** when the annual fishing intensity is higher than the level required to sustain maximum sustainable yield (MSY). The MSY fishing intensity is currently  $F_{SPR=35\%}$  based on current understanding of Pacific halibut population dynamics and fishery characteristics. The MSY fishing intensity may be revised as new information becomes available.

2026 Decision Table

2026 Alternative			<i>Status quo -10%</i>	<i>Status quo -5%</i>	<i>Status quo</i>	<i>Status quo +5%</i>	<i>Status quo +10%</i>	$F_{46\%}$	3-Year Surplus / $F_{43\%}$	MEY proxy	Overfishing limit	Overfishing
Total mortality (M lb)	0.0	21.9	28.6	30.1	31.6	33.1	34.6	37.0	40.8	45.1	53.7	
TCEY (M lb)	0.0	20.0	26.8	28.2	29.7	31.2	32.7	35.1	39.0	43.3	51.9	
2026 fishing intensity	$F_{100\%}$	$F_{62\%}$	$F_{54\%}$	$F_{52\%}$	$F_{51\%}$	$F_{49\%}$	$F_{48\%}$	$F_{46\%}$	$F_{43\%}$	$F_{40\%}$	$F_{35\%}$	
Fishing intensity interval	--	47-77%	39-71%	37-70%	36-69%	34-68%	33-67%	31-65%	28-62%	26-59%	22-54%	



# Determine a Depleted reference point

1. Lowest spawning biomass observed/estimated from the stock assessment
  - 2024: 153 Mlbs
  - May have been at similar levels in the 1970s, but uncertain
  - Scales with updates to the stock assessment
  - Challenging to decide what percentage of this value would define the reference point
2. Simulations using the MSE framework
  - Assume a worst-case scenario with low productivity and extreme depensation
  - Simulate forward with fishing to drive stock to low level
  - Stop fishing and simulate further to determine if stock recovers
  - Determine spawning biomass with a low probability of recovery

Depensation, or the Allee effect, is when recruitment of age-0 fish is further depressed when the spawning biomass is very low

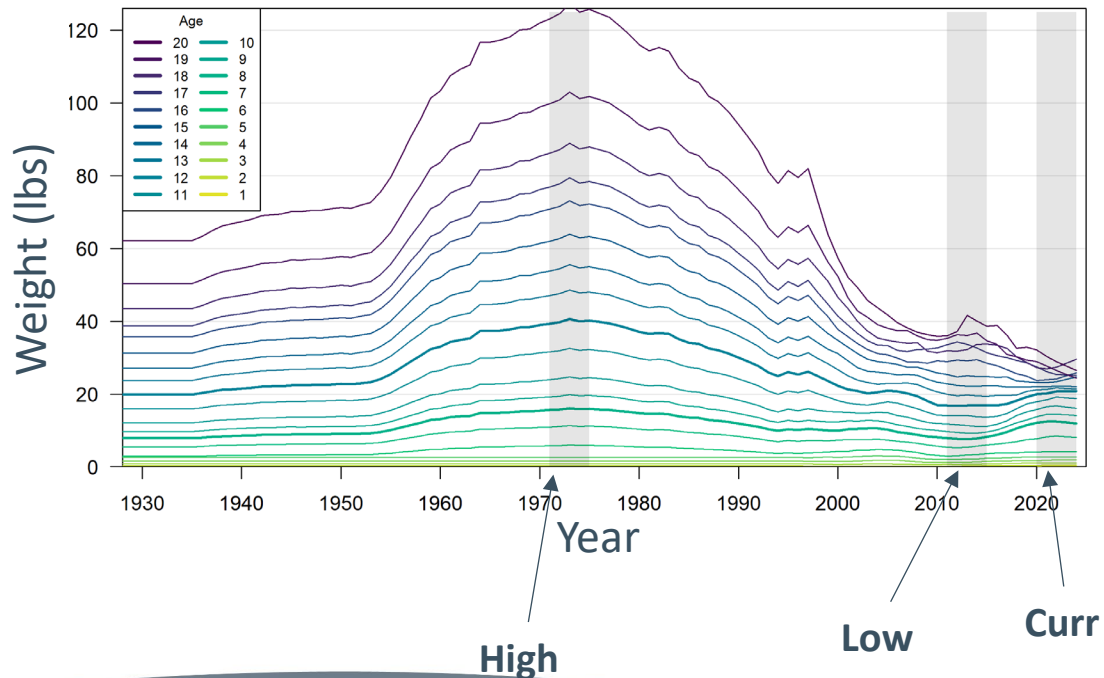


# Productivity Regimes

Two major components of productivity

## Weight-at age

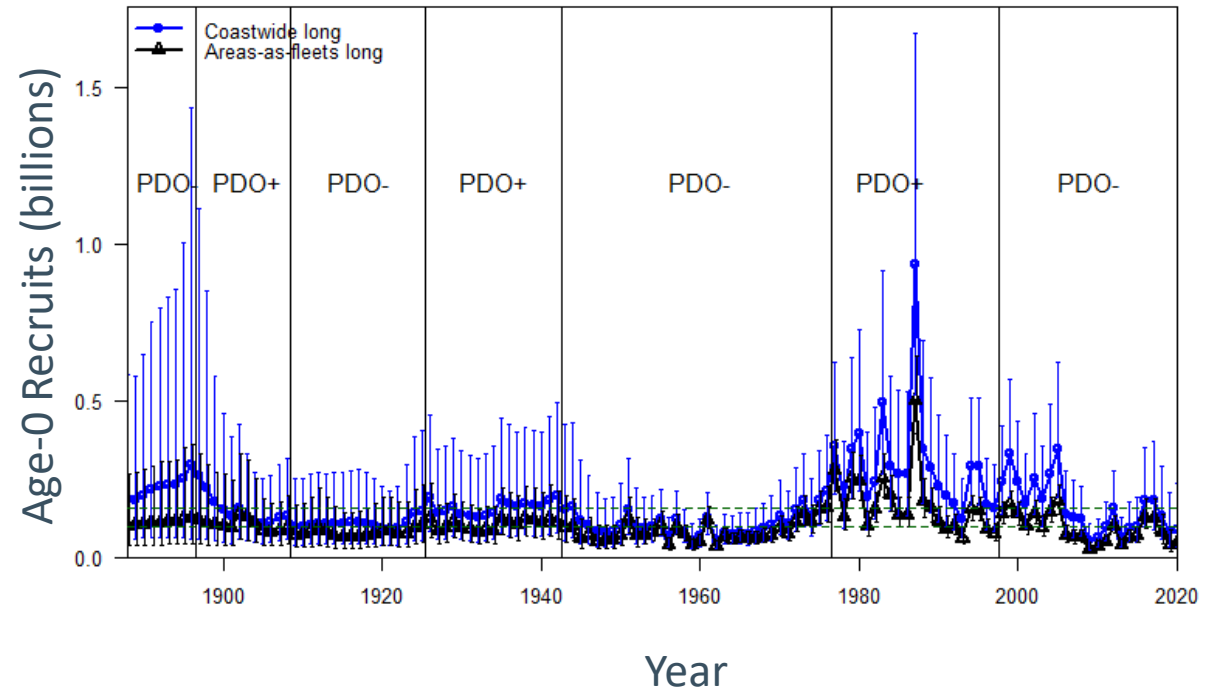
Low, Current, or High



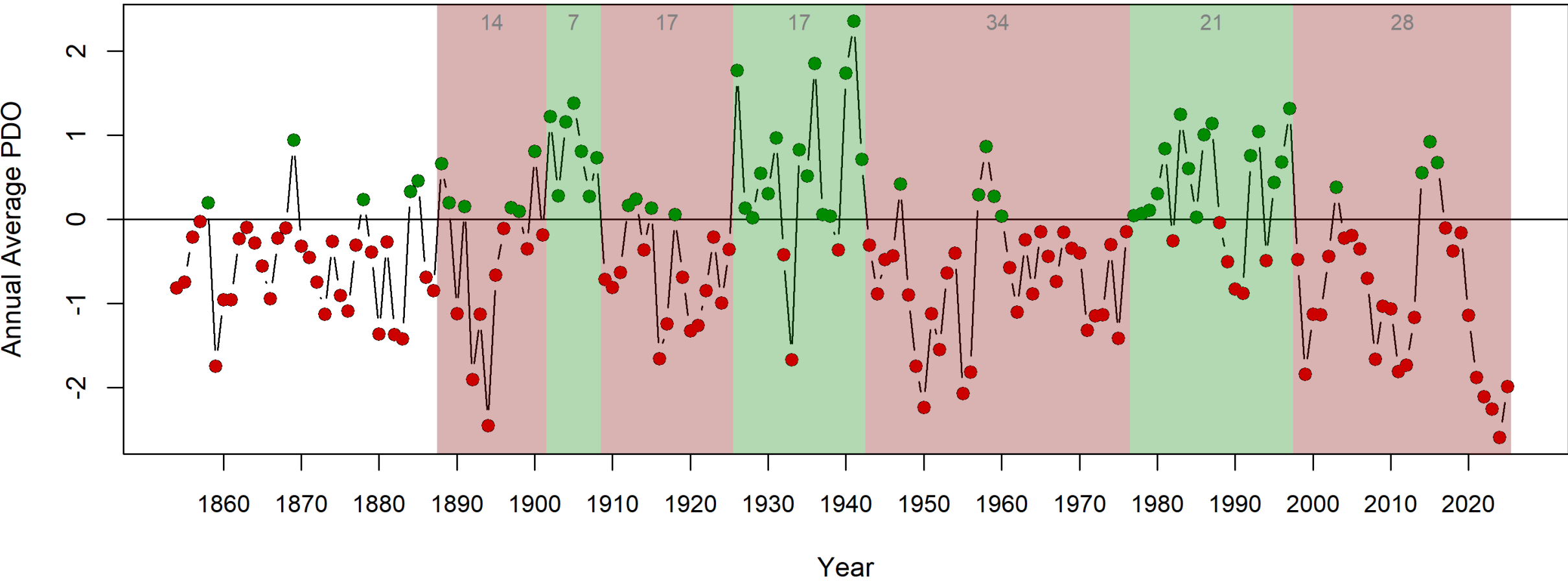
## Average Recruitment

Low or high

related to low or high PDO regime

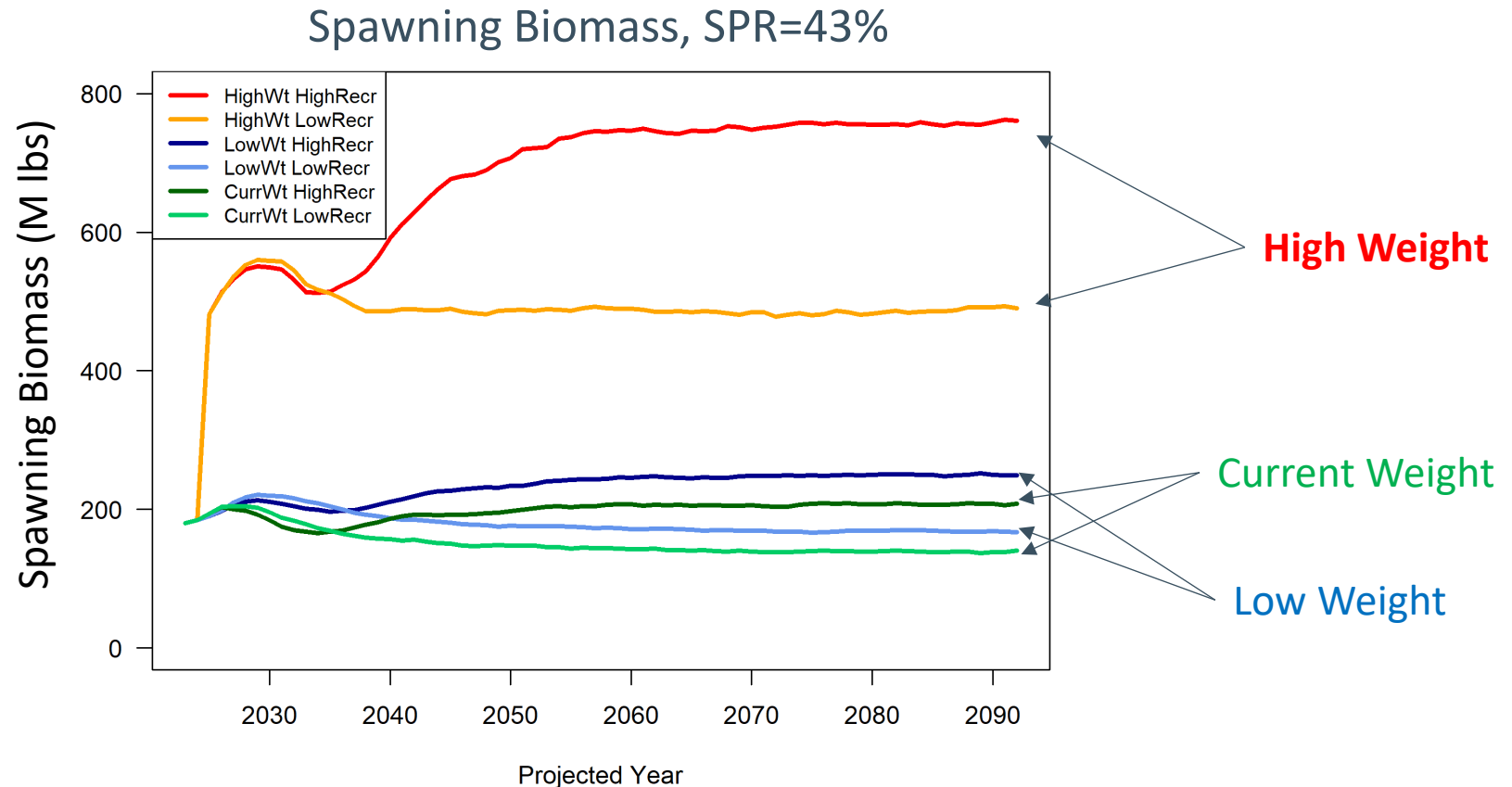


# Pacific Decadal Oscillation (PDO)



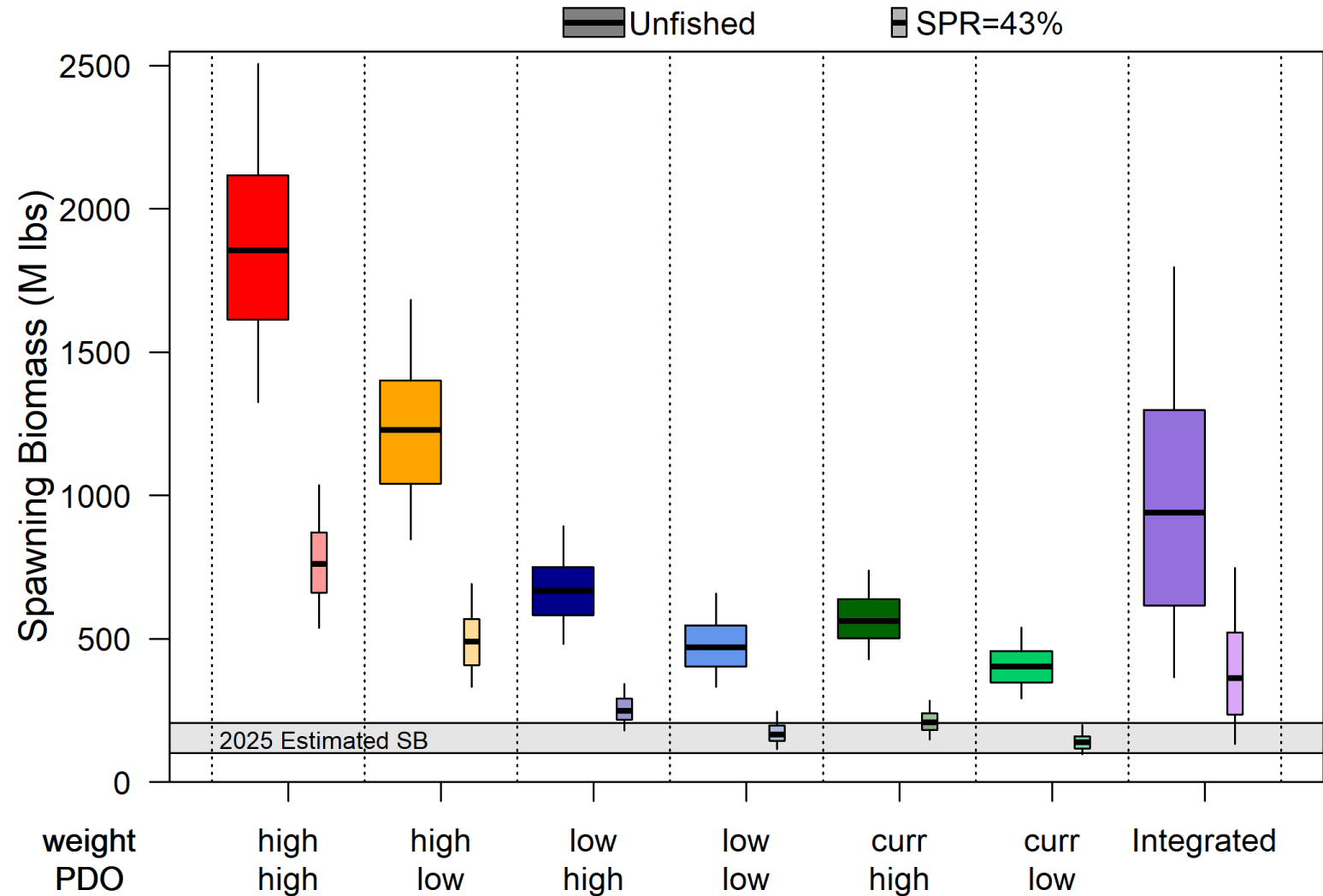
# Spawning Biomass from Simulated Regimes

- Spawning Biomass is greatly affected by weight-at-age and recruitment
- Would not likely see these effects immediately



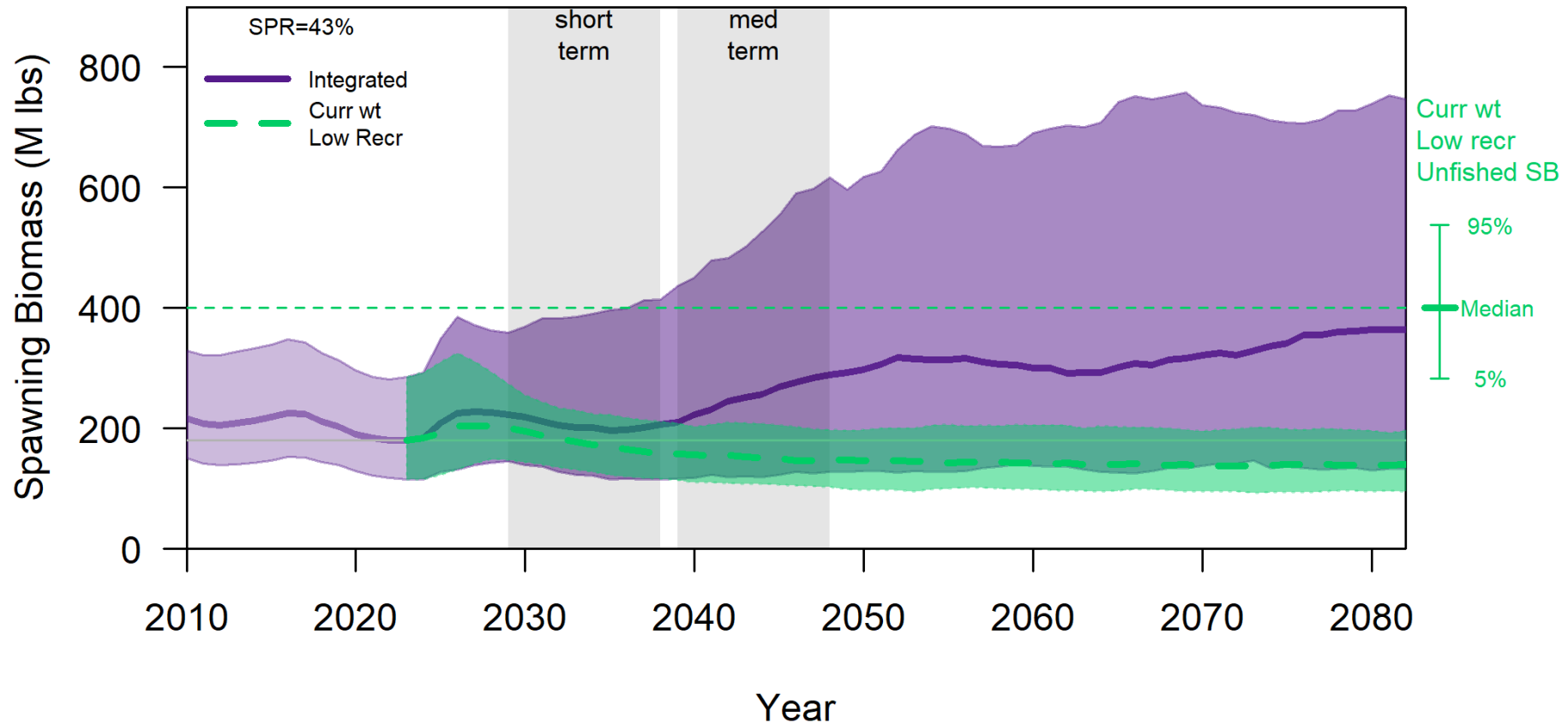
# Differences between productivity regimes

- Weight-at-age and recruitment have a large effect on spawning biomass
- Current estimated spawning biomass is consistent with low productivity regime



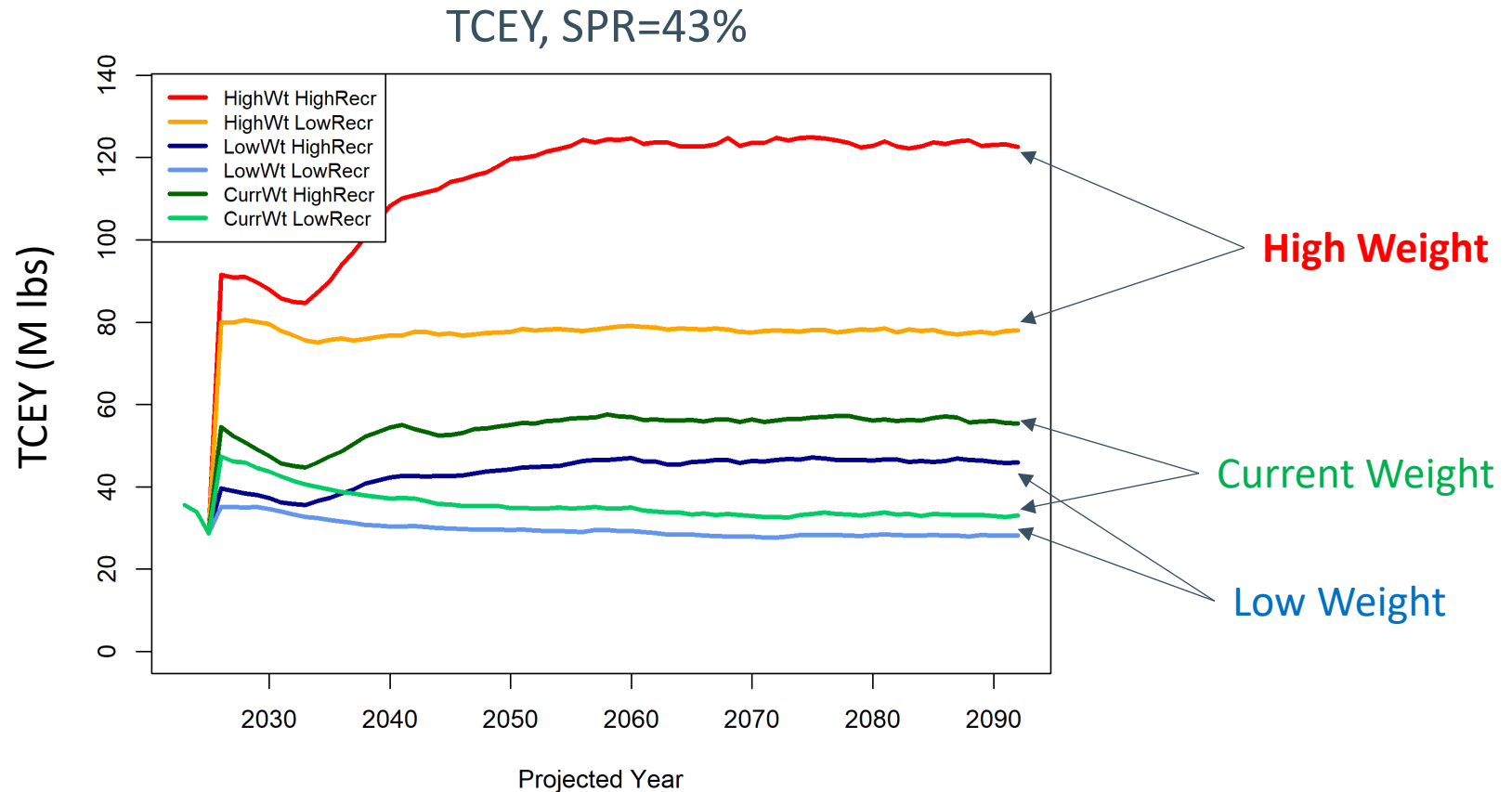
# Low productivity projections

- Pacific halibut have been in a low productivity regime for at least 15 years
- This has influenced the current level of biomass



# TCEY from Simulated Regimes

- TCEY is greatly affected by weight-at-age and recruitment
- Slightly different order than Spawning Biomass (low and current)



# Projection plots for additional SPR values

<https://apps.iphc.int/MSE-Explorer/>

- Choose a pre-specified SPR value
- Make sure to check “Add current weight-at-age...”
- SB and TCEY plots include a low productivity projection in green

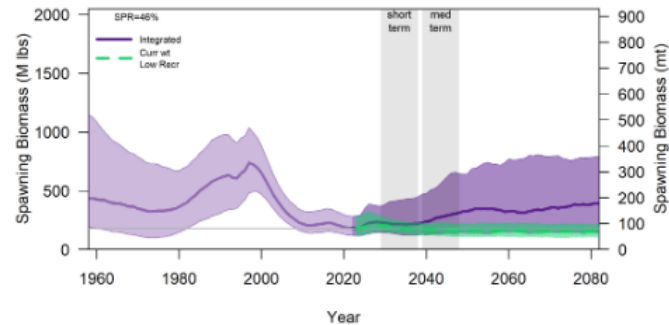
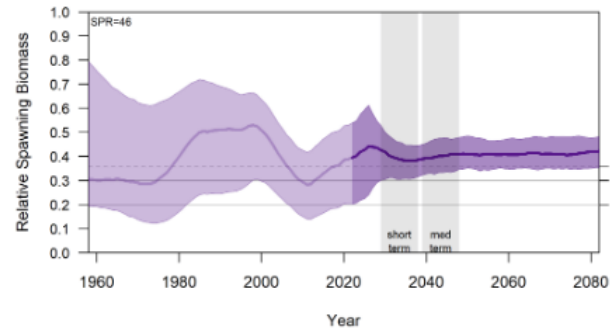
Trace Plots for TCEY, RSB, and SB for selected SPR values

Add Current weight-at-age and low average recruitment scenario simulations (SPR=43, 46, 49, 52)

## Left SPR

Choose a value

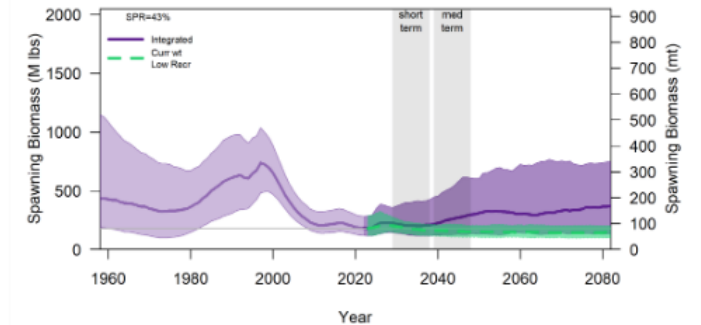
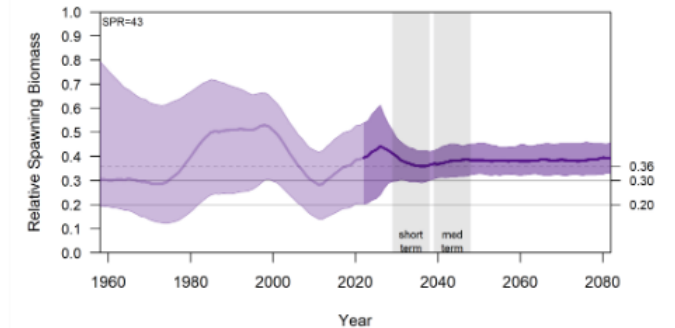
46



## Right SPR

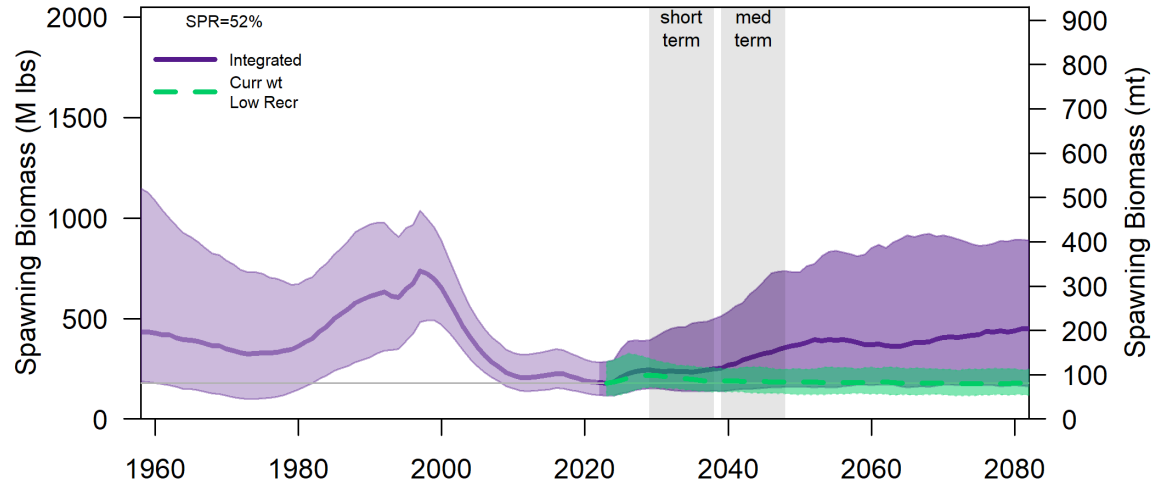
Choose a value

43

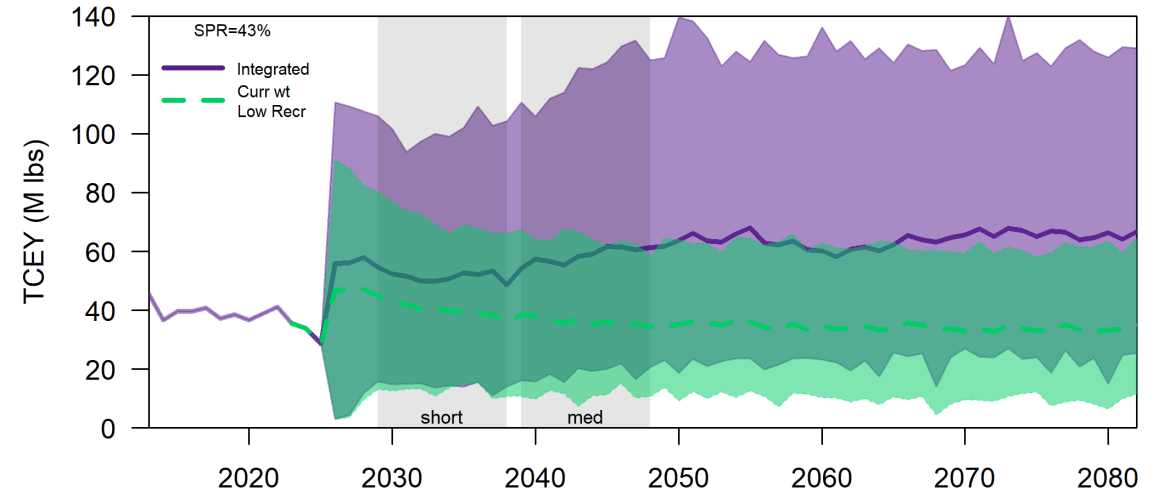
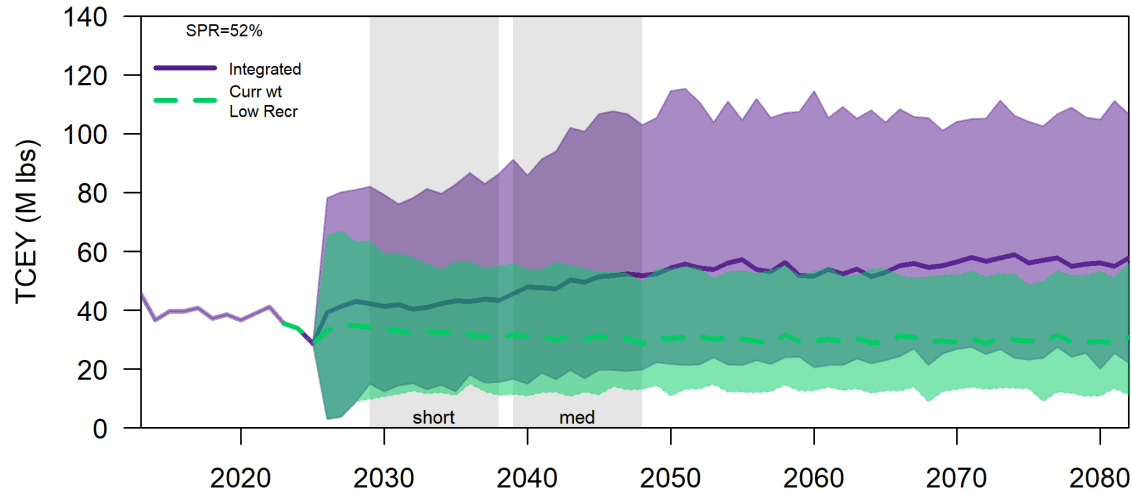
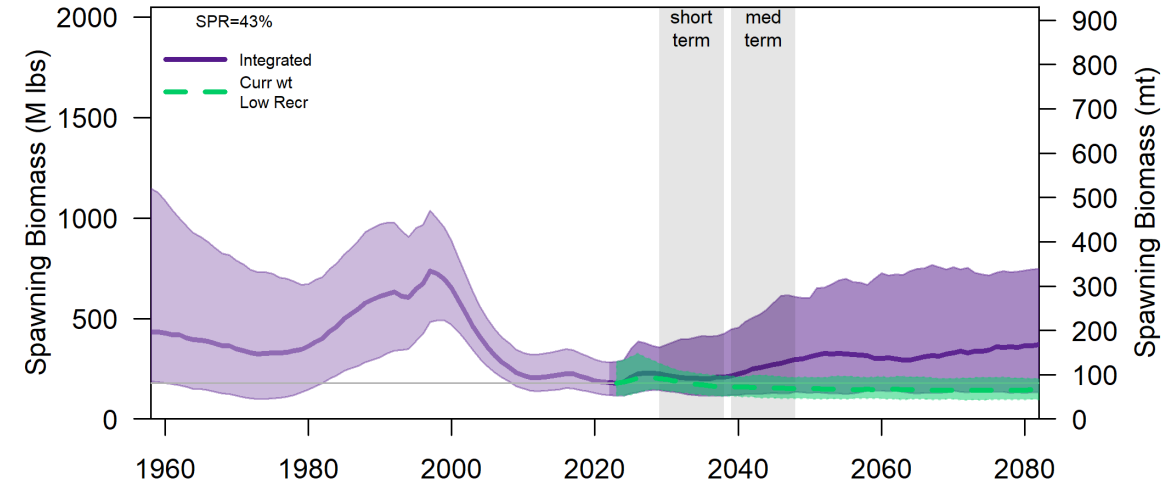


# Projections with low productivity

SPR = 52%



SPR = 43%



Year

Year



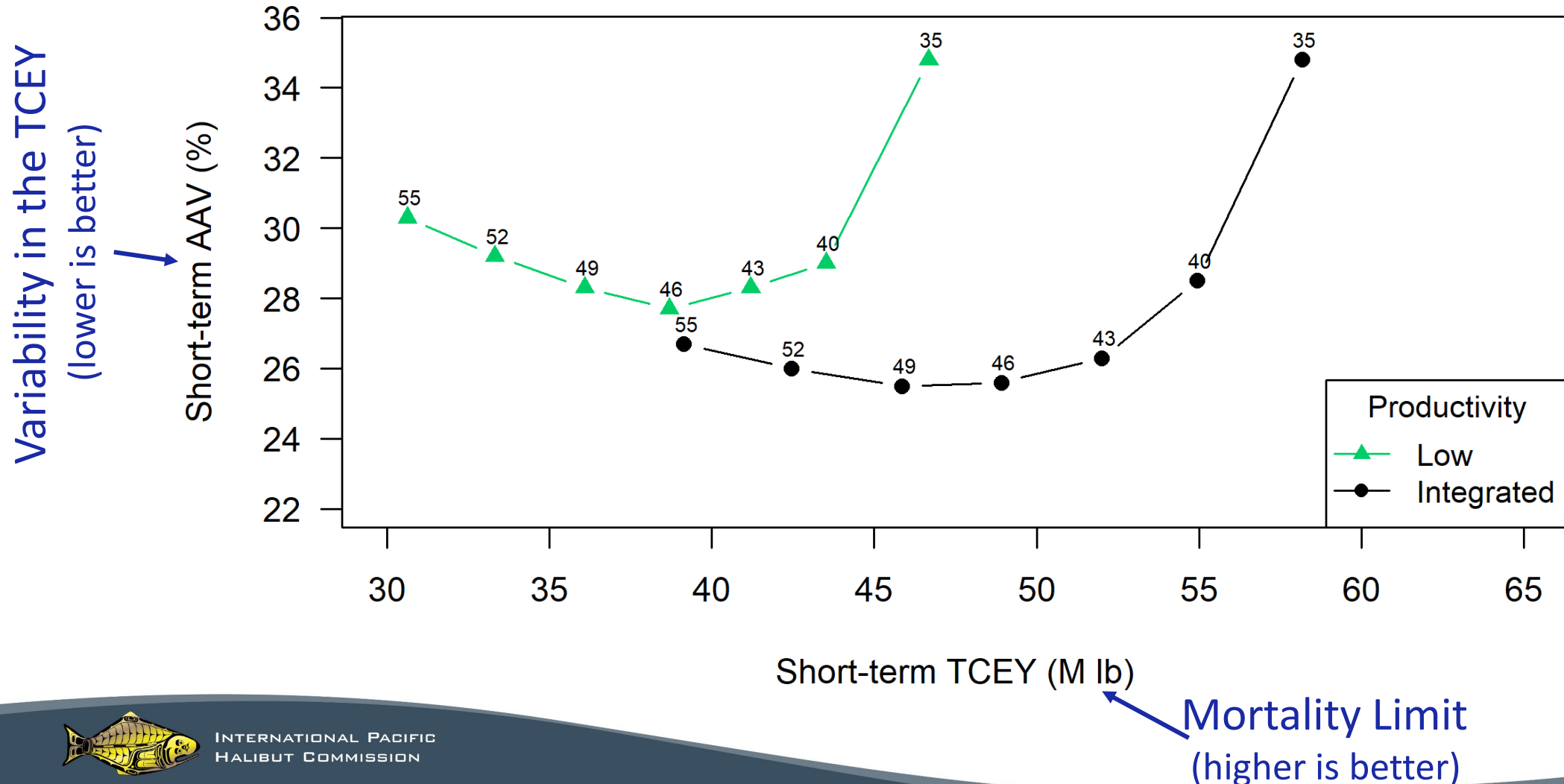
# Coastwide Reference Fishing Intensity

- Harvest Strategy Policy specifies  $SPR=43\%$
- MSAB020 recommended  $SPR=46\%$ 
  - “A lower fishing intensity would also reduce the probability that the spawning biomass is less than the 2023 spawning biomass in the short- and long-term, and result in lower interannual variability”
- Recent mortality limits associated with  $SPRs$  near  $51\%$ .
- Commission expressed interest in learning more about MSE outcomes assuming a “low” productivity scenario



# Trade-off between variability in TCEY and TCEY

- The productivity regime has little effect on the optimal SPR



# MSE Results

- Low Productivity

- Lower TCEYs
  - 9-12 Mlbs lower
- Higher variability
- Greater chance of lower RSB
- Greater chance of lower absolute SB

Integrated (low & high) Productivity							
SPR (%)	35	40	43	46	49	52	55
P(RSB<20%)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
P(RSB<36%)	0.692	0.372	0.195	0.066	0.014	0.001	<0.001
Median TCEY	58.2	55.0	52.0	48.9	45.9	42.5	39.1
AAV	34.8%	28.5%	26.3%	25.6%	25.5%	26.0%	26.7%
Short-term P(SB < SB <sub>2023</sub> )	0.482	0.401	0.350	0.297	0.254	0.214	0.179

~ 1 in 3 chance

Low Productivity							
SPR (%)	35	40	43	46	49	52	55
P(RSB<20%)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
P(RSB<36%)	0.868	0.677	0.462	0.236	0.081	0.016	<0.001
Median TCEY	46.7	43.5	41.2	38.7	36.1	33.3	30.6
AAV	34.8%	29.0%	28.3%	27.7%	28.3%	29.2%	30.3%
Short-term P(SB < SB <sub>2023</sub> )	0.690	0.609	0.543	0.466	0.390	0.312	0.241

~ 1 in 2 chance



# Harvest Strategy Policy (HSP) Table

- Short-term and long-term integrate over low and high productivity
- Uses the columns of the decision table to determine an input SPR
  - Note that the decision table fixes the catch while the HSP uses the input fishing intensity (i.e. SPR) to determine catch (with variability)
- Fills in rows with short-term and long-term performance metrics
  - Ones linked to HSP objectives (in bold)
  - Provides additional performance metrics that may be of interest
  - Short-term is 4-13 years (longer than the decision table)
- Comparisons between consistent applications of a fishing intensity



# Harvest Strategy Policy Table

2026 Alternative	Status quo -10%	Status quo -5%	Status quo	Status quo +5%	Status quo +10%	$F_{46\%}$	3-year surplus/ $F_{43\%}$	MEY proxy	Overfishing limit	
Fixed SPR	100%	54%	52%	51%	49%	48%	46%	43%	40%	35%
<b>Long-term Metrics</b>										
P(RSB < 20%)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
P(RSB < 30%)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.007	0.032	0.161
P(RSB < 36%)	<0.002	<0.002	<0.002	0.002	0.014	0.023	0.066	0.195	0.372	0.692
P(SB<SB2023)	0.002	0.144	0.168	0.176	0.202	0.220	0.232	0.260	0.288	0.334
<b>Short-term Metrics (2029-2038)</b>										
Median TCEY	0.00	40.2	42.5	43.6	45.9	46.9	48.9	52.0	55.0	58.2
Median AAV	0%	26.5%	26.0%	25.9%	25.5%	25.5%	25.6%	26.3%	28.5%	34.8%
P(SB<SB2023)	0.034	0.354	0.378	0.394	0.416	0.434	0.470	0.534	0.576	0.632
TCEY interval	(0-0)	(20-73)	(21-77)	(21-79)	(21-83)	(22-85)	(23-89)	(24-94)	(25-101)	(27-108)



# 2025 Informational Meeting of the MSAB

- 21 October 2025
- 18/22 in attendance

## Outcomes

1. The stock assessment presents 3-year projections, which can be characterized as “immediate-term”. The MSE results are presented as short-term (4-13 years) and long-term.
2. The MSAB noted that the definition of overfishing recently changed, and is now determined annually as opposed to probabilistically based on projections. The existing HSP should be read through for consistency and to avoid unintended consequences.
3. In the current draft HSP, overfishing is defined as exceeding a fishing intensity associated with an SPR of 35%, but the estimated realised SPR in any year is uncertain. Therefore, if this definition is retained, the probability of overfishing should be presented.
4. The MSAB discussed the concept of depleted and how it relates to overfished. They realised that it may have implications as a conservation tool and look forward to future research defining depleted and associated concepts.



# 2025 Informational Meeting of the MSAB

## Outcomes (continued)

5. The MSAB feels that trace plots (e.g. “purple plots”) are useful for visualizing short- and long-term spawning biomass projections at given SPR values, along with trade-off plots that compare AAV and TCEY values at differing spawning biomass levels. The MSAB thinks that these will be useful to the Commission decision-making process, but suggests that the Commission be given an example and notified that additional plots at differing SPR levels can be produced as requested.
6. The section on the rebuilding plan needs additional specification, including a) ensuring this section and other sections in the HSP are consistent (e.g. clarifications of fishing activities when at an overfished state), b) describing the actions for the directed fishery if the stock is declared overfished before a rebuilding plan is in place and when a rebuilding plan is implemented.
7. The MSAB is in favour of scheduling a Spring 2026 meeting (MSAB022) in April or May of 2026, preferably after the PFMC meeting (7-12 April) and before SRB028 (19-21 May). The week of April 20th should be avoided, as the Seafood Expo Global is taking place that week in Barcelona, Spain.



# 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.



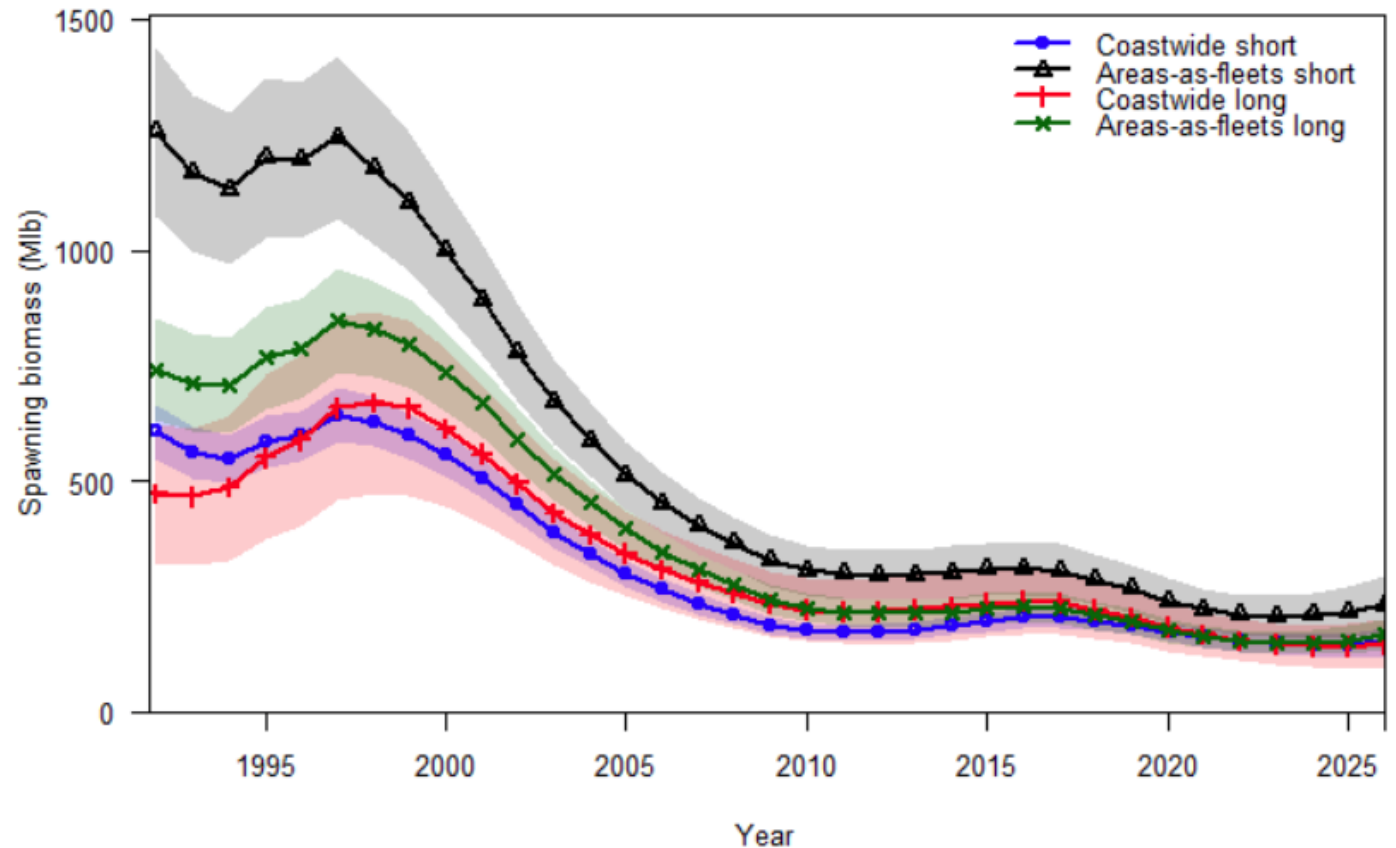
# 2025 stock assessment

- 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

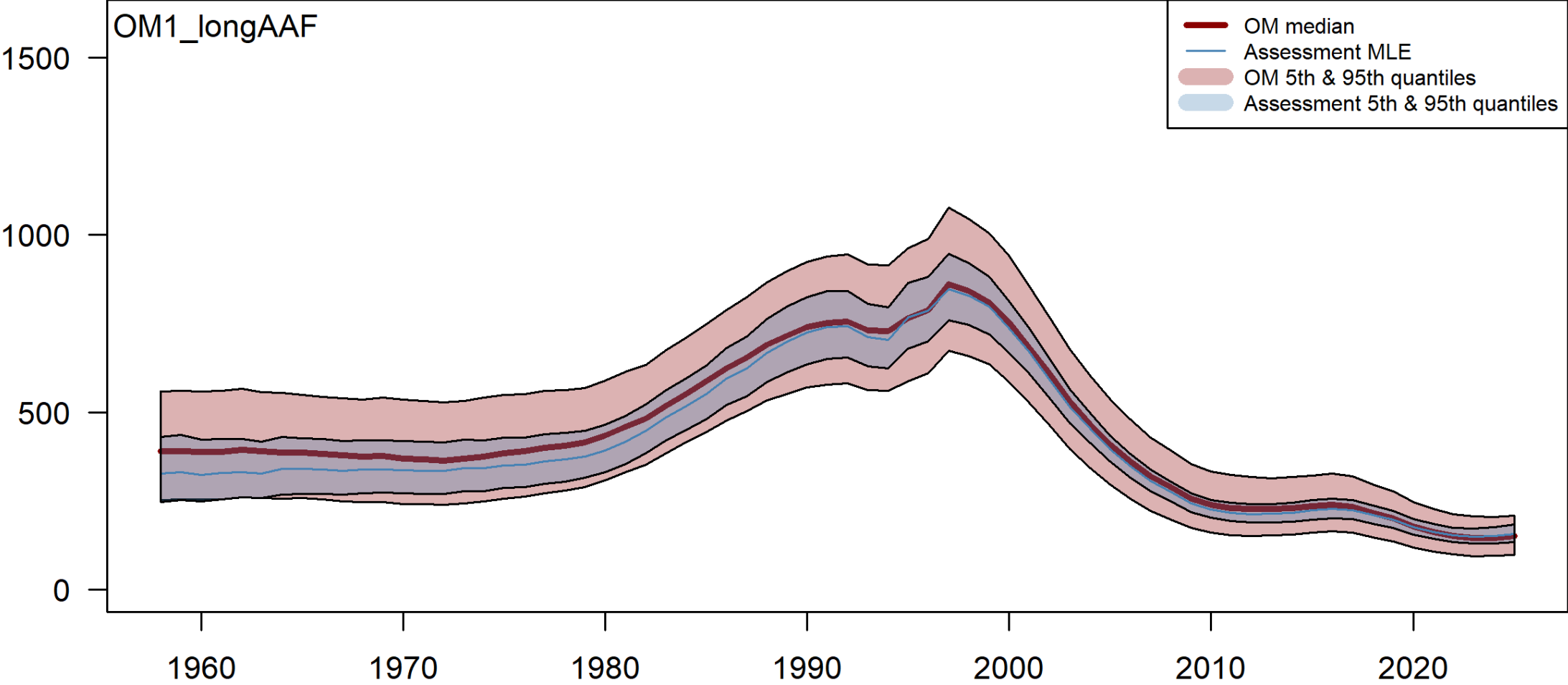


# Four individual models in the OM

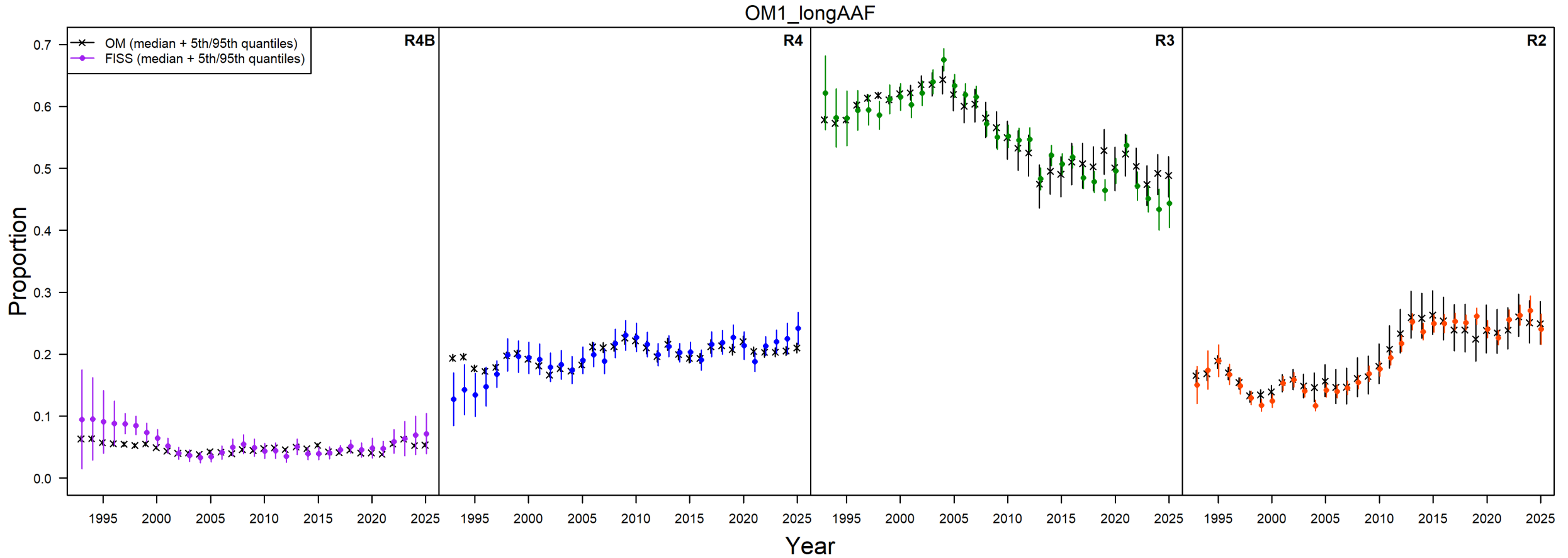
- Conditioned to
  - stock distribution
  - regional indices of abundance
  - age compositions
  - the estimated spawning biomass from the stock assessment
- Each model starts in 1958
- Estimated movement from Region 4 to 3 and from Region 3 to 2
  - Movement could not occur between non-adjacent regions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



# OM1\_longAAF Spawning Biomass

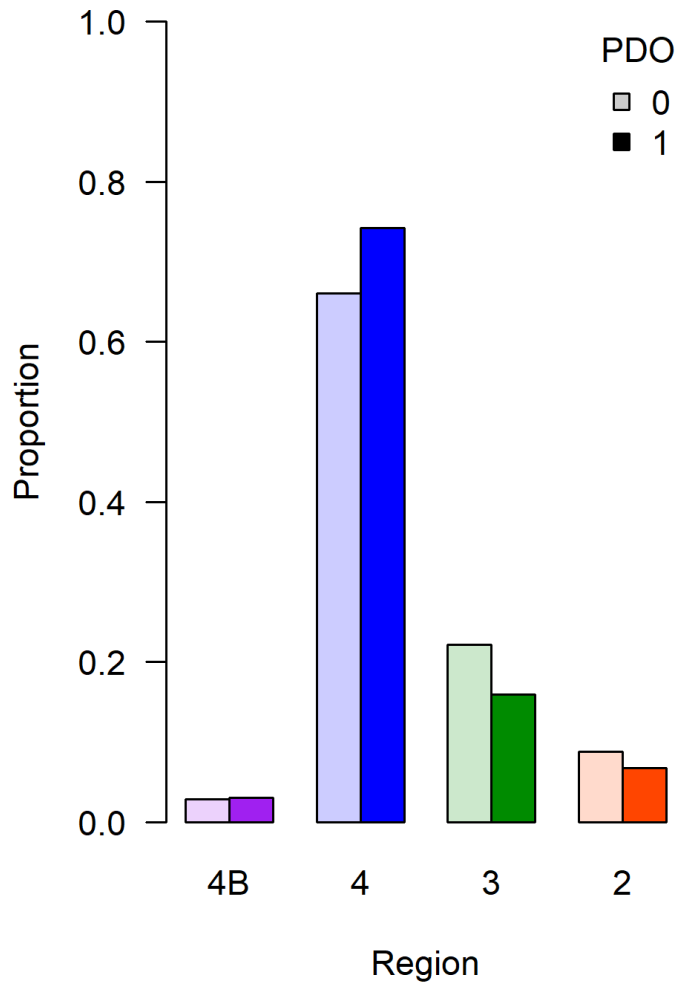


# OM1\_longAAF all-sizes distribution

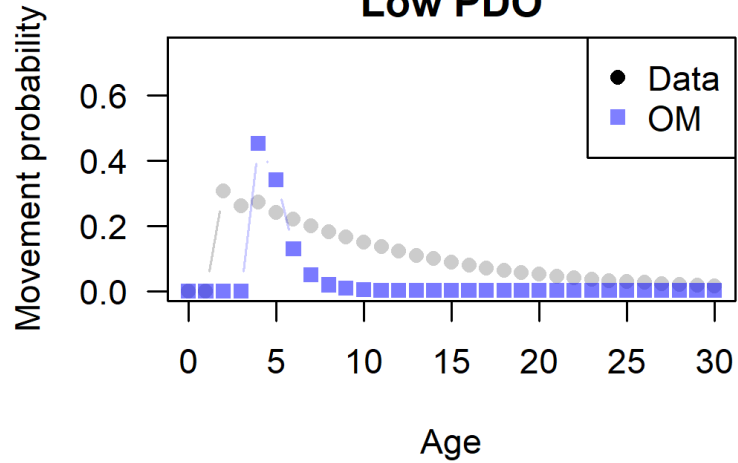


# OM1\_longAAF: Recruitment & Movement

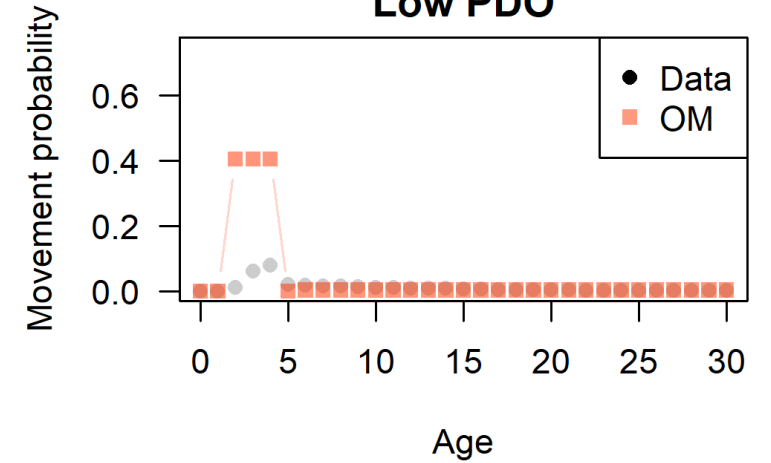
## Recruitment Distribution



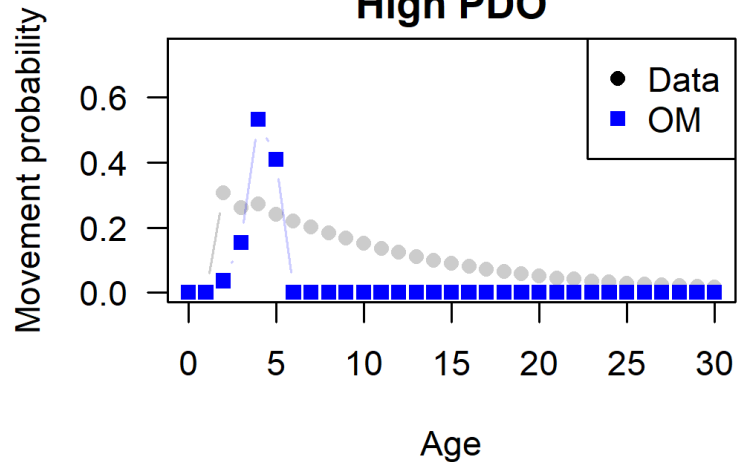
## 4 to 3 Low PDO



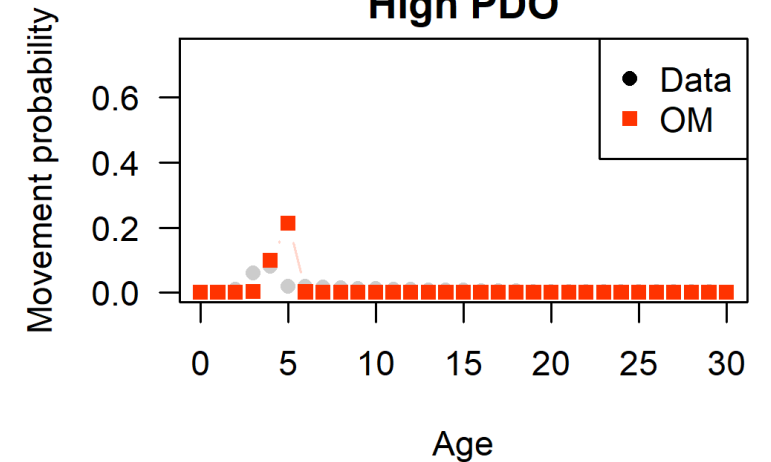
## 3 to 2 Low PDO



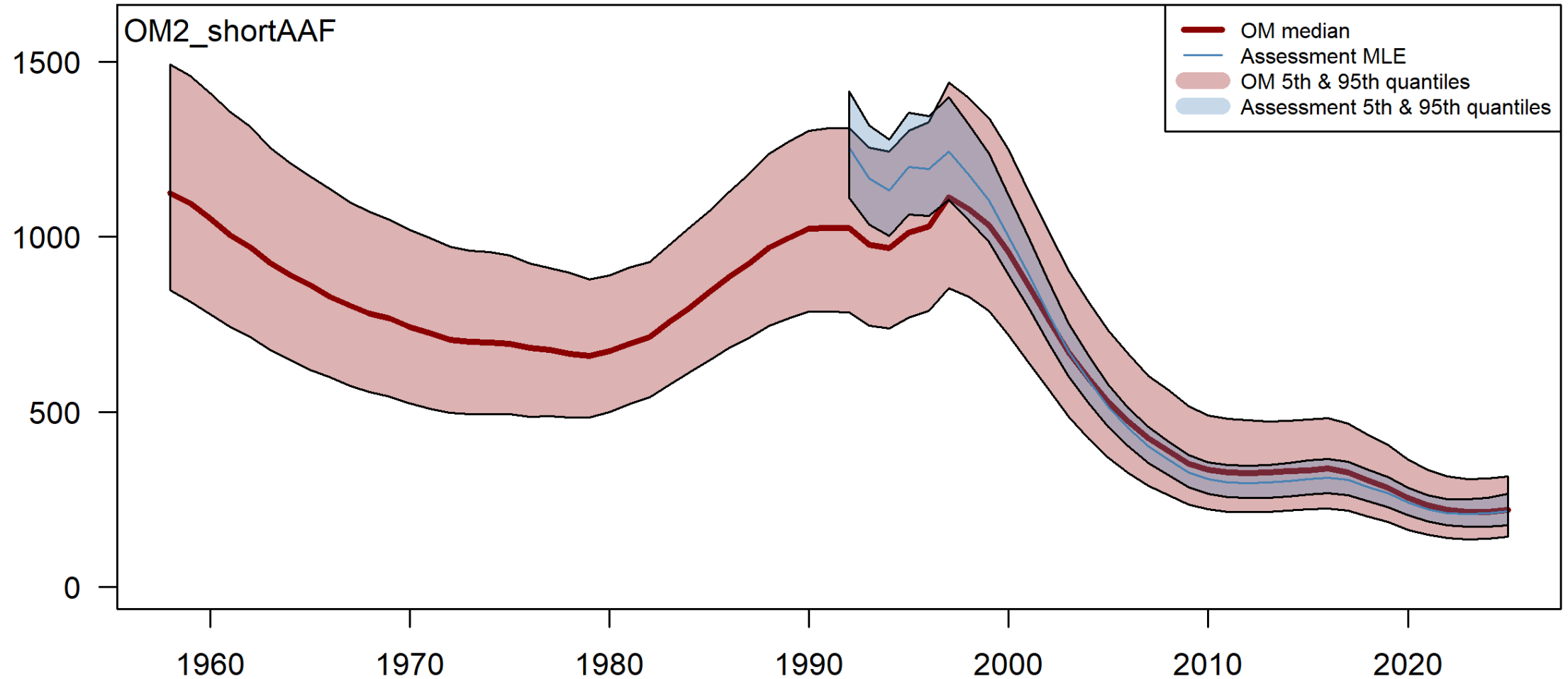
## High PDO



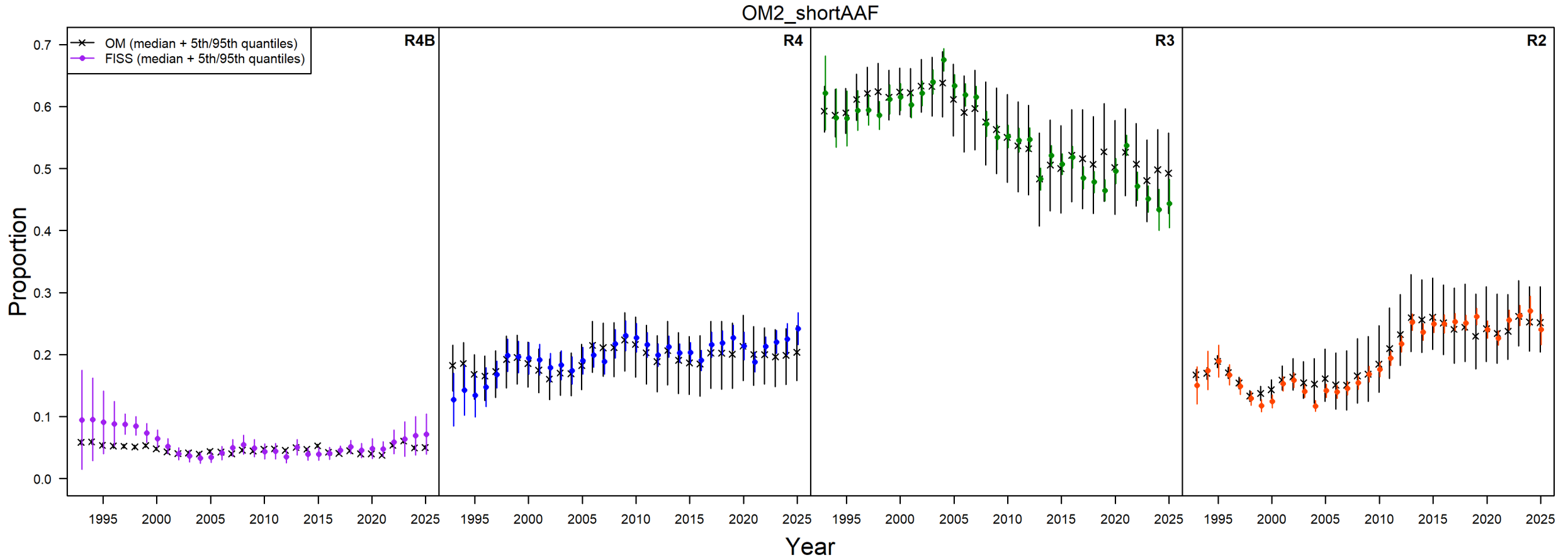
## High PDO



# OM2\_shortAAF Spawning Biomass

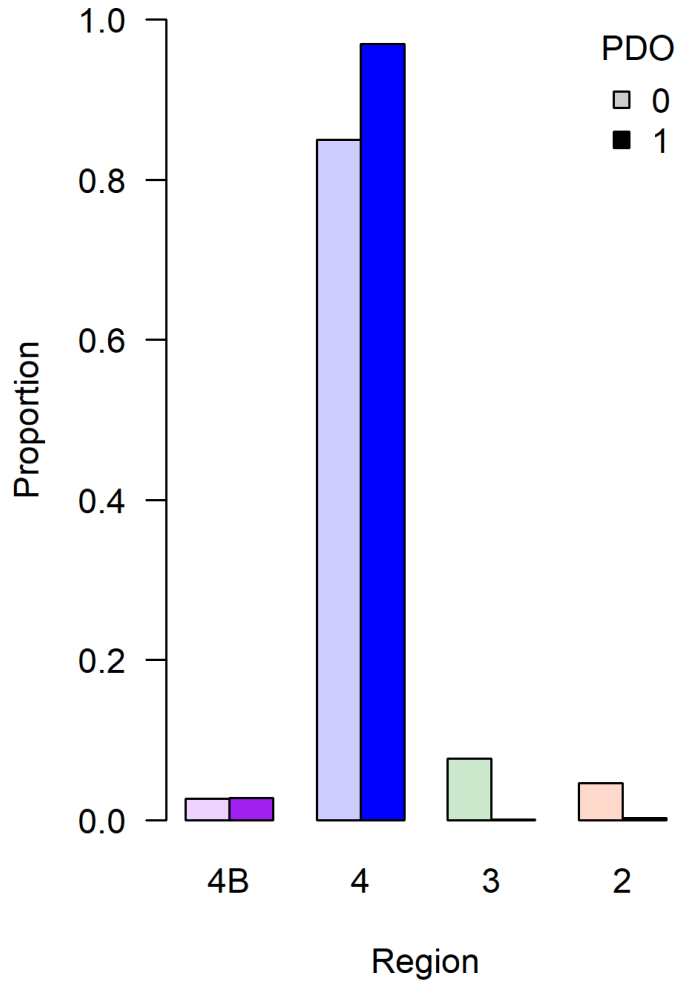


# OM2\_shortAAF all-sizes distribution

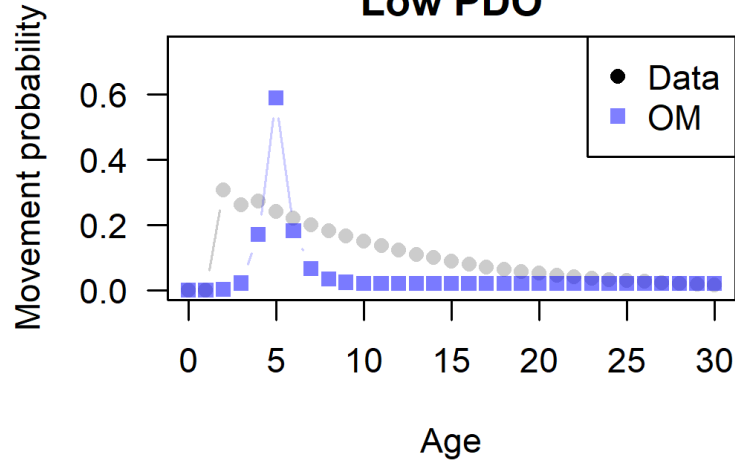


# OM2\_shortAAF: Recruitment & Movement

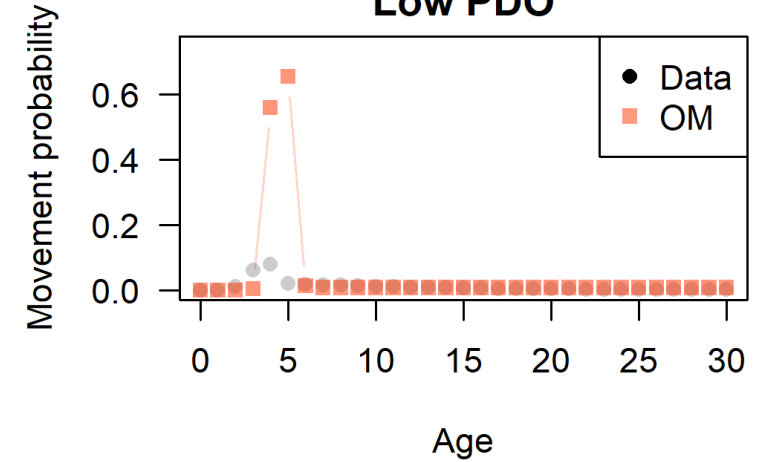
## Recruitment Distribution



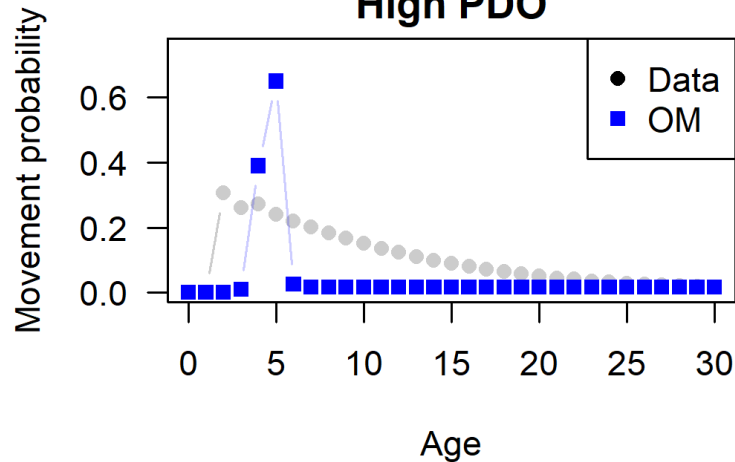
## 4 to 3 Low PDO



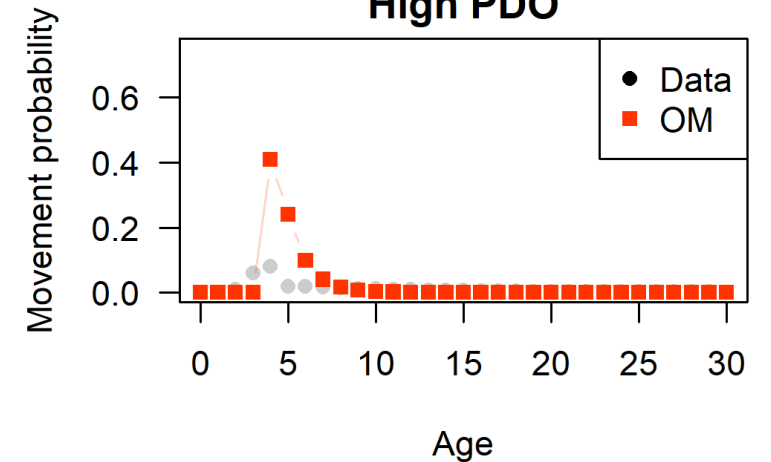
## 3 to 2 Low PDO



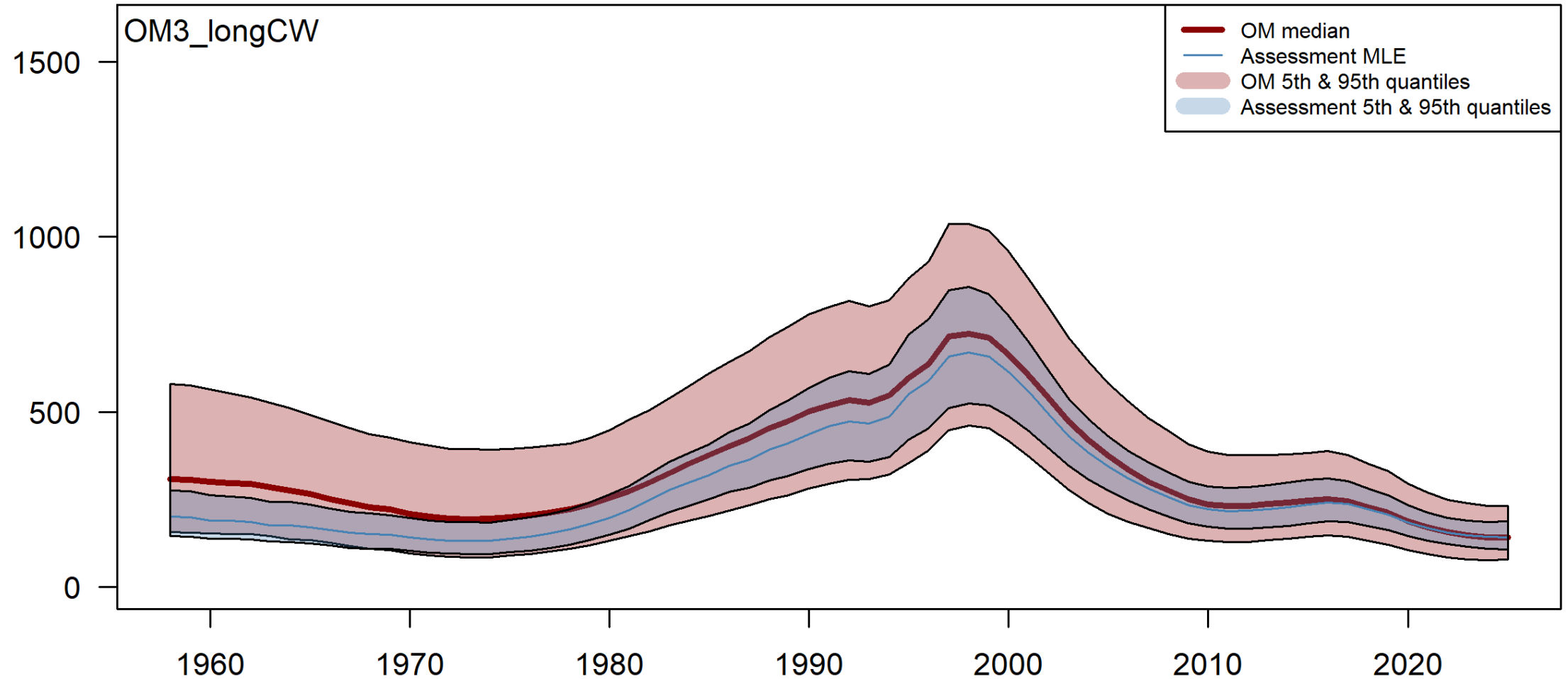
## High PDO



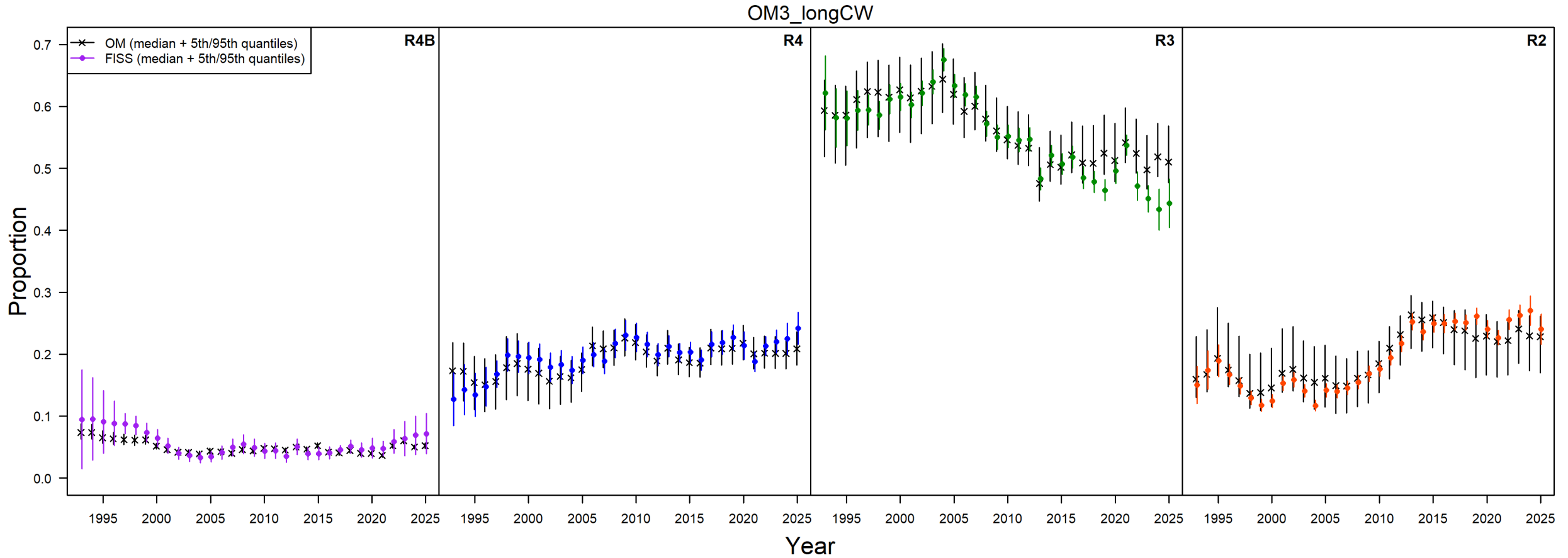
## High PDO



# OM3\_longCW Spawning Biomass

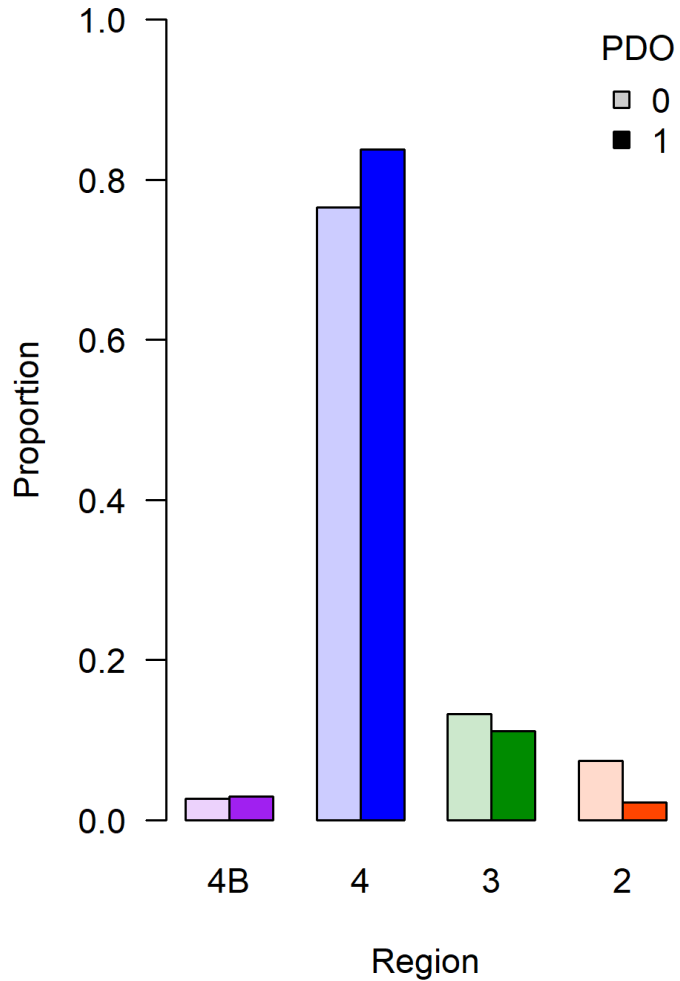


# OM3\_longCW all-sizes distribution

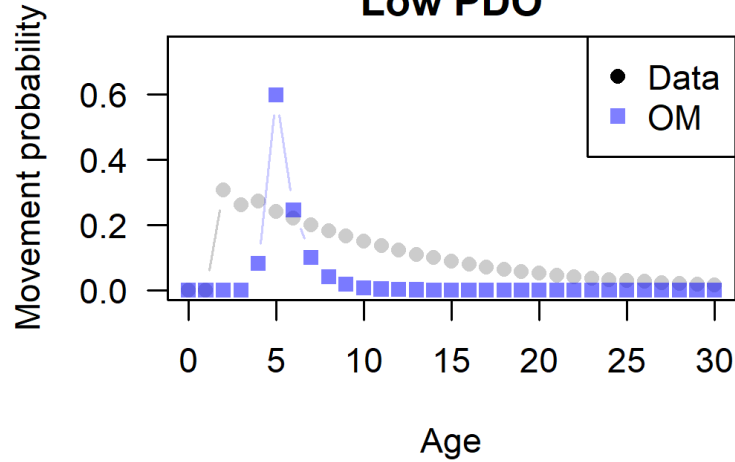


# OM3\_longCW: Recruitment & Movement

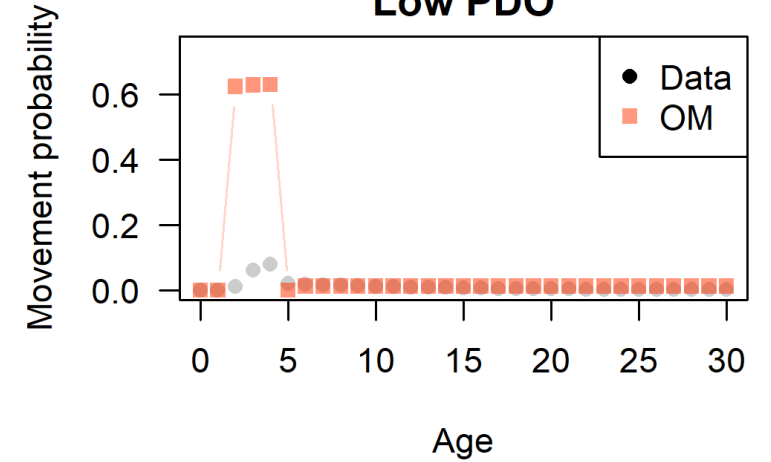
## Recruitment Distribution



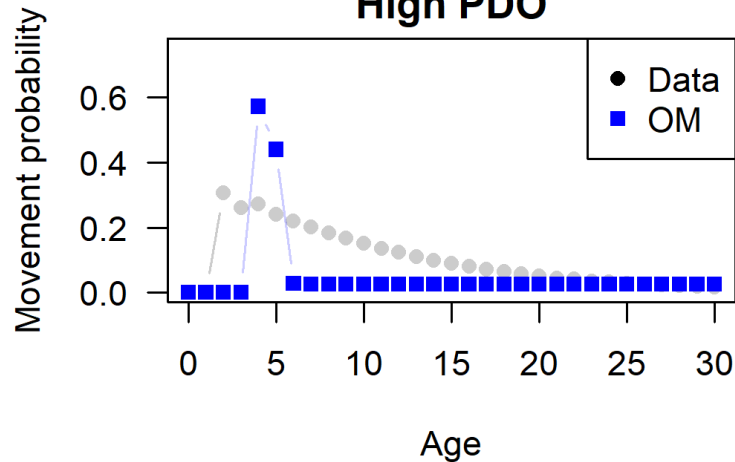
## 4 to 3 Low PDO



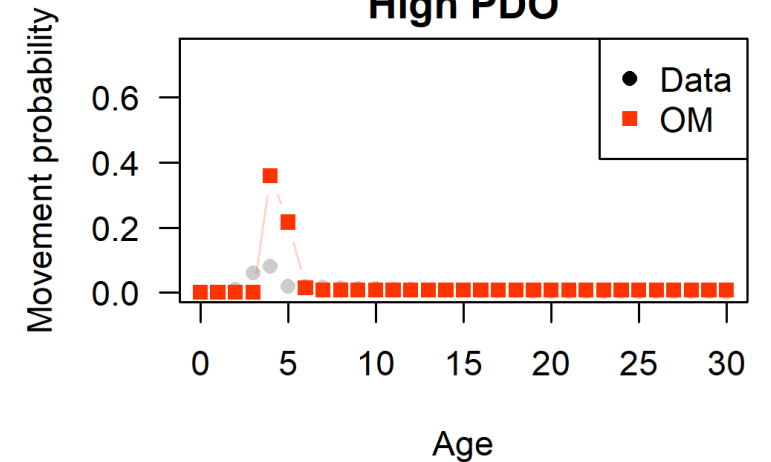
## 3 to 2 Low PDO



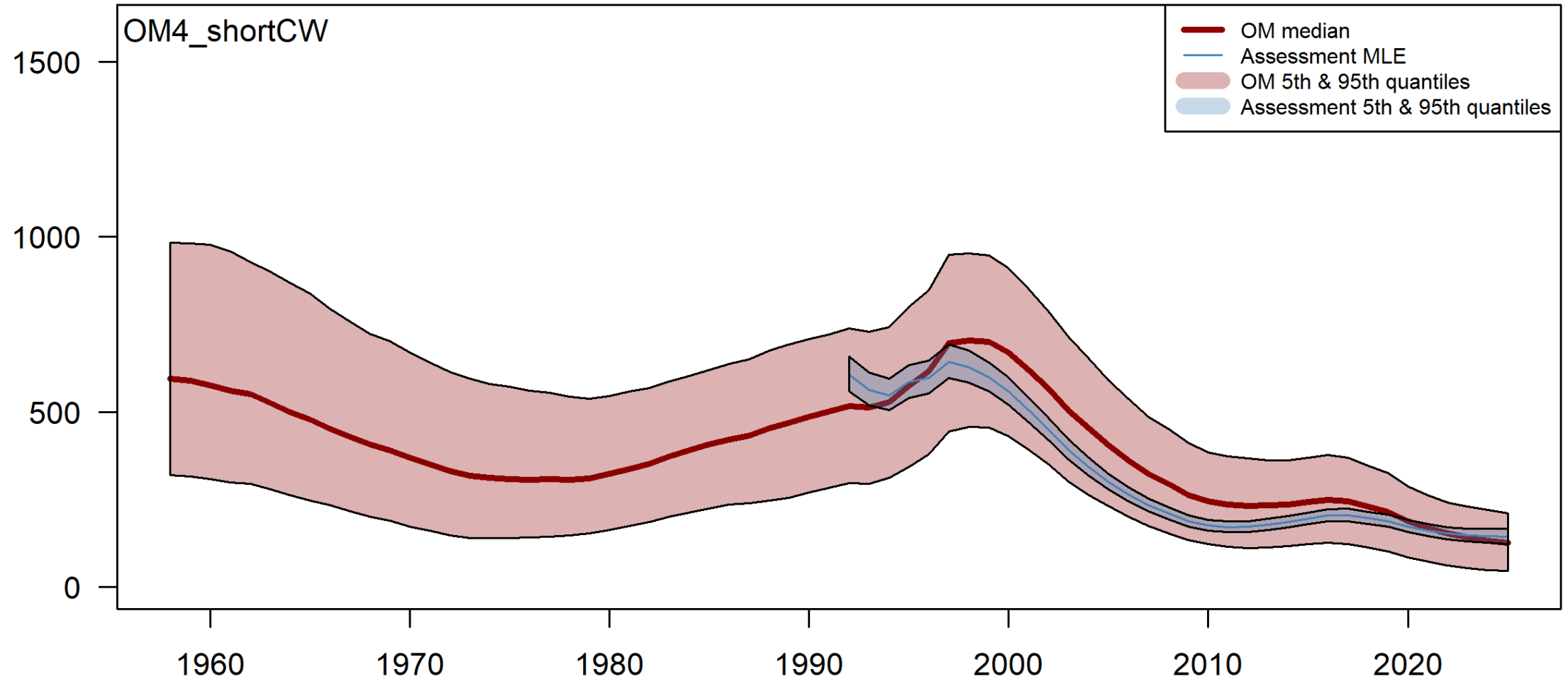
## High PDO



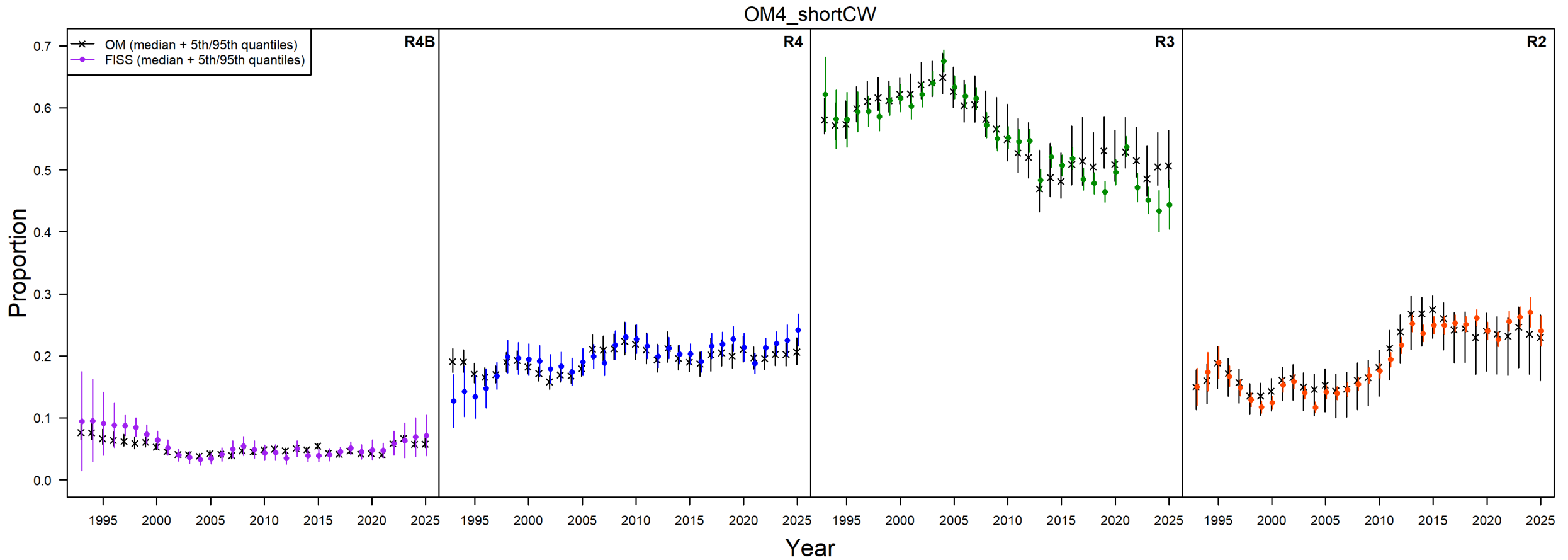
## High PDO



# OM4\_shortCW Spawning Biomass

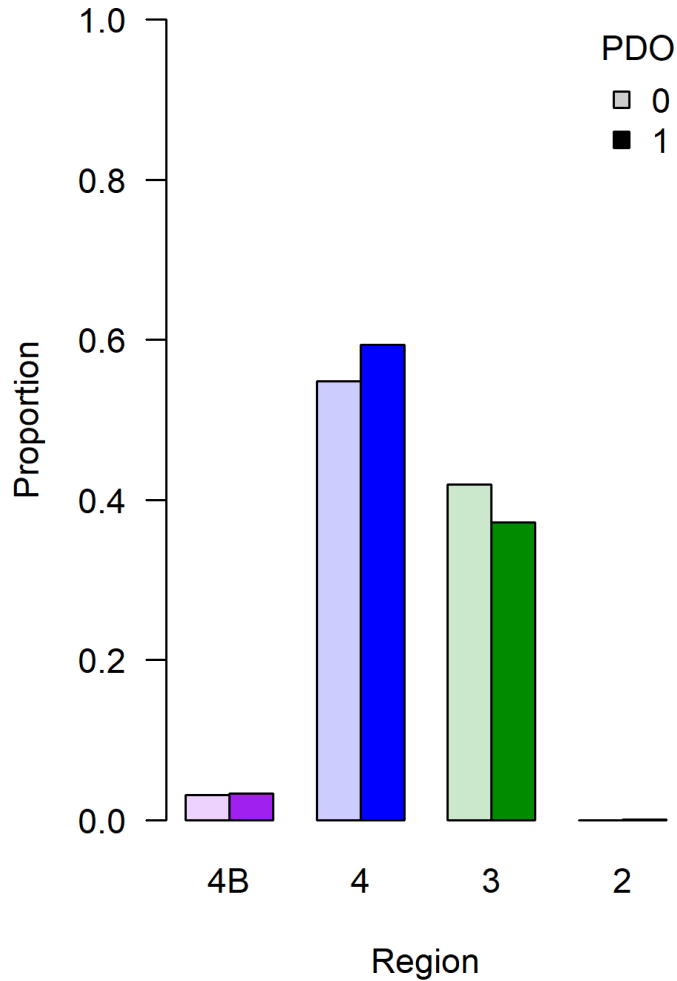


# OM4\_shortCW all-sizes distribution

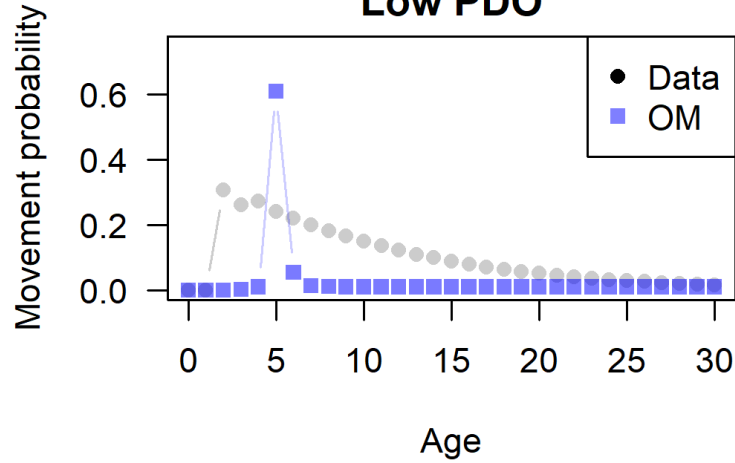


# OM4\_shortCW: Recruitment & Movement

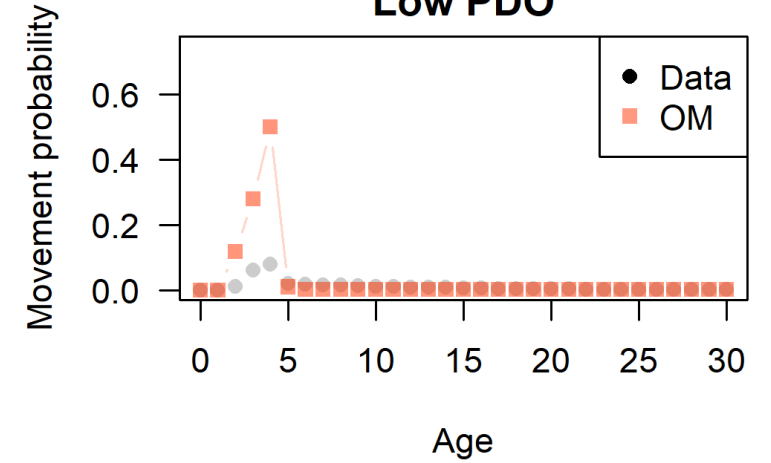
## Recruitment Distribution



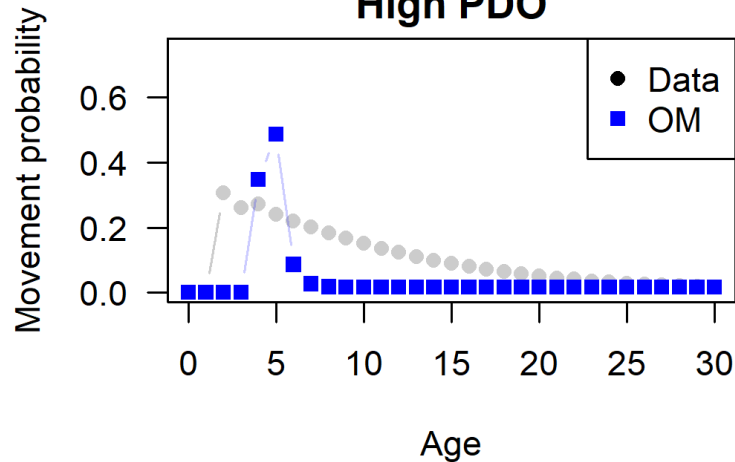
## 4 to 3 Low PDO



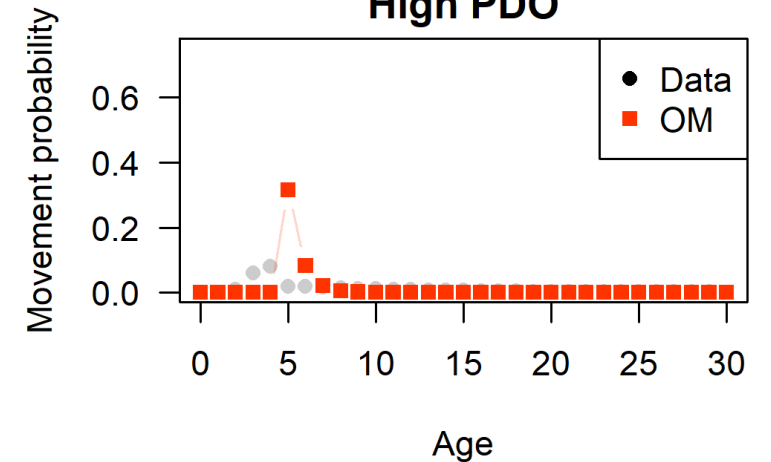
## 3 to 2 Low PDO



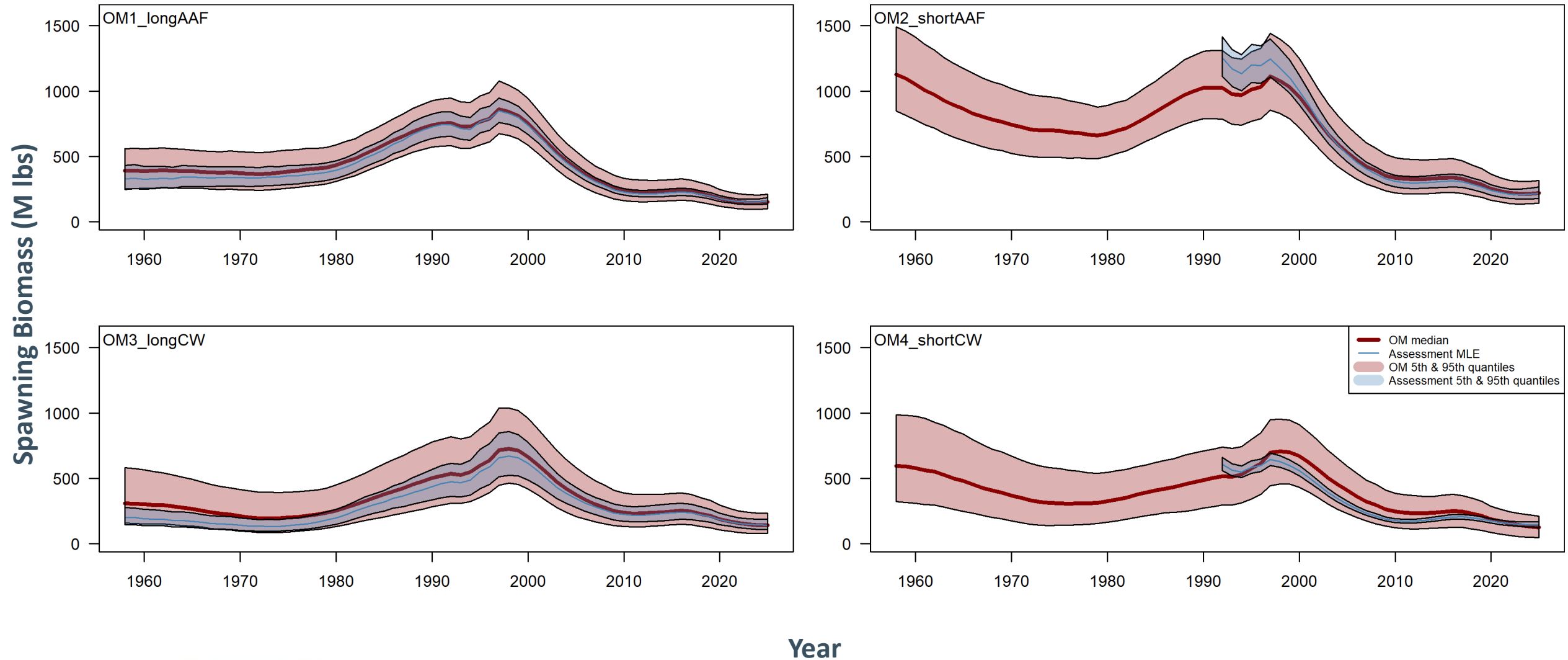
## High PDO



## High PDO



# OM Spawning Biomass

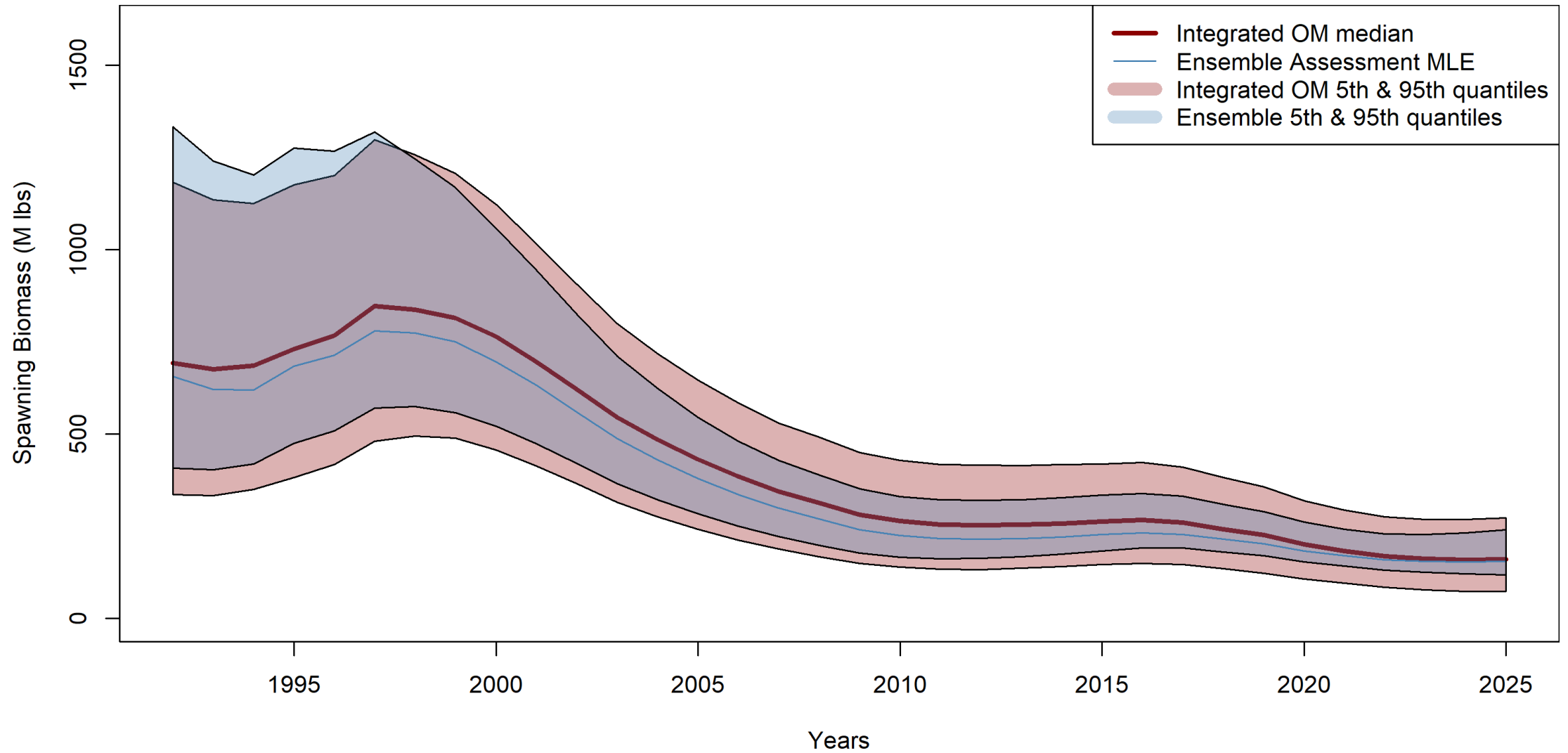


# Discussion of Conditioning

- These results are final for review by the SRB
- All models captured the trend in Spawning Biomass
  - OM4 showed a little inconsistency, which is the model with low 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



# Integrated Spawning Biomass



# Next Steps

- Compare the new OM to past simulations/results
  - Project with no fishing
  - Project with different SPRs
  - Compare to past results
- See 2026-2027 Program of Work



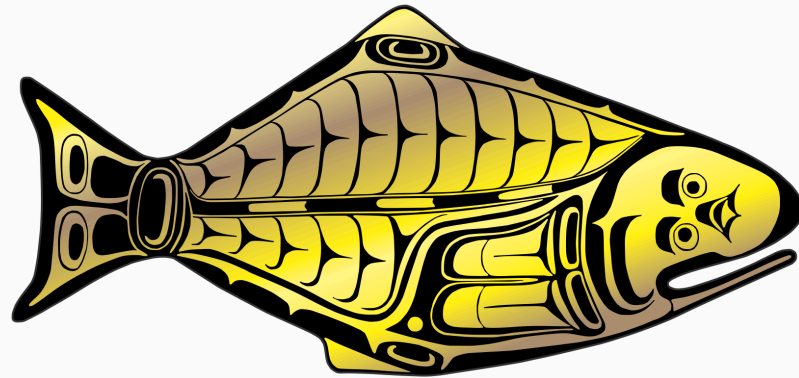
# Recommendations

That the MSAB:

- 1) **NOTE** paper IPHC-2026-MSAB022-06 that describes MSE work completed in 2025 and early 2026, including definitions of overfished and depleted, investigations of effects of productivity regimes on the management of Pacific halibut, evaluations of fishing intensity under low productivity, and conditioning of the OM following the full stock assessment.



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