INTERNATIONAL PACIFIC HALIBUT COMMISSION

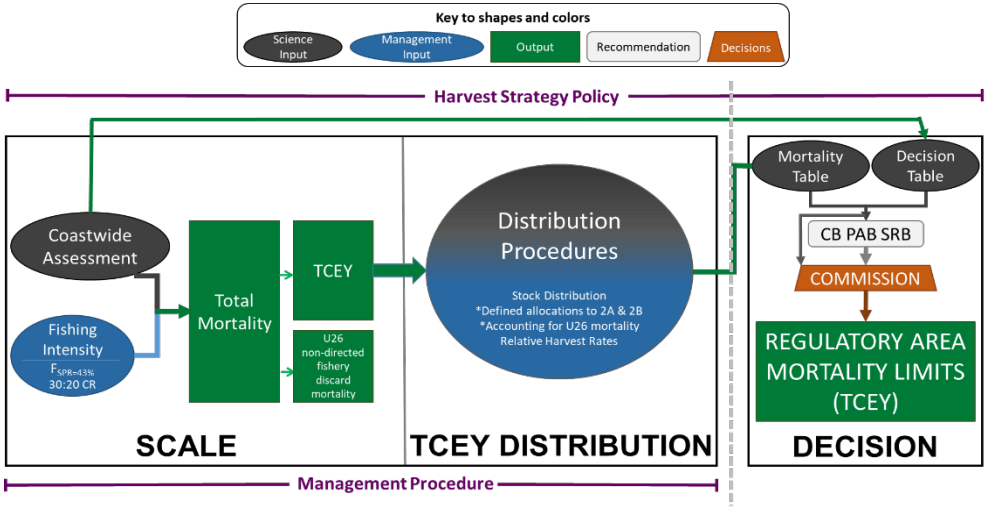
Management Strategy Evaluation Update

Agenda Item 7.1

IPHC-2020-SRB017-09

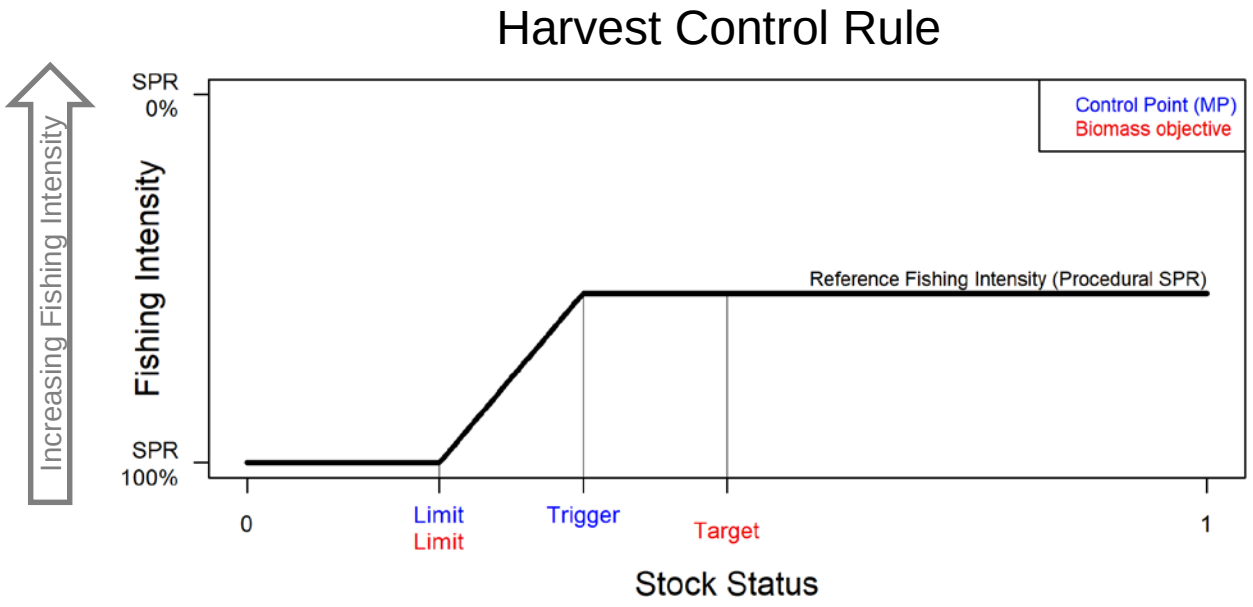
IPHC Harvest Strategy Policy

1. Coastwide target fishing intensity (science-based & management-derived)
2. Regional Stock Distribution (science-based & management-derived)
3. Regulatory Area Allocation (science-based & management-derived)
4. Annual Regulatory Area Adjustment (policy-based)



Coastwide Scale (fishing intensity)

- SPR
  - Various values
- Control rule
  - 30:20
- Constraint
  - Maximum change in TCEY of 15%
  - Slow-up, fast-down

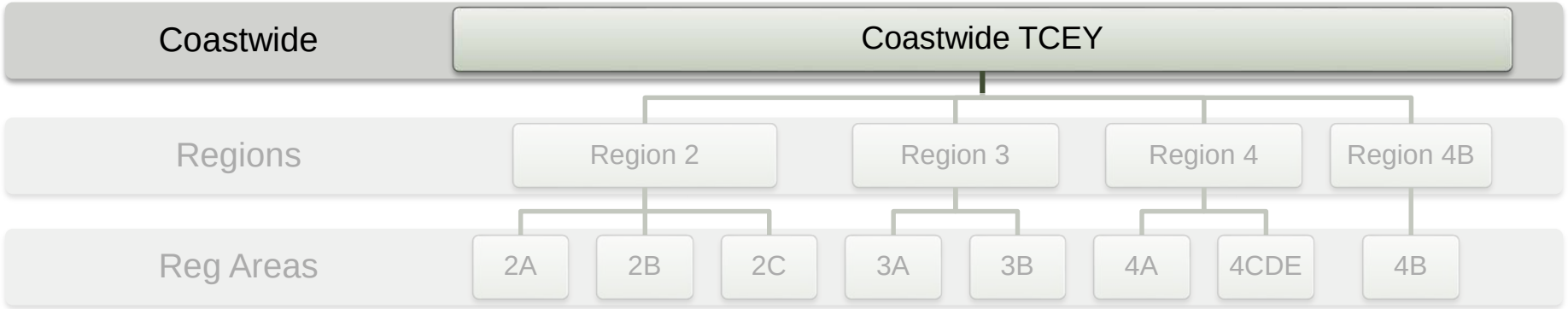


A procedure for distributing the TCEY (2)

1. Coastwide Target Fishing Intensity

Required

- Determine coastwide Total Mortality from Scale MP
- Separate TM into O26 (TCEY) and U26 components

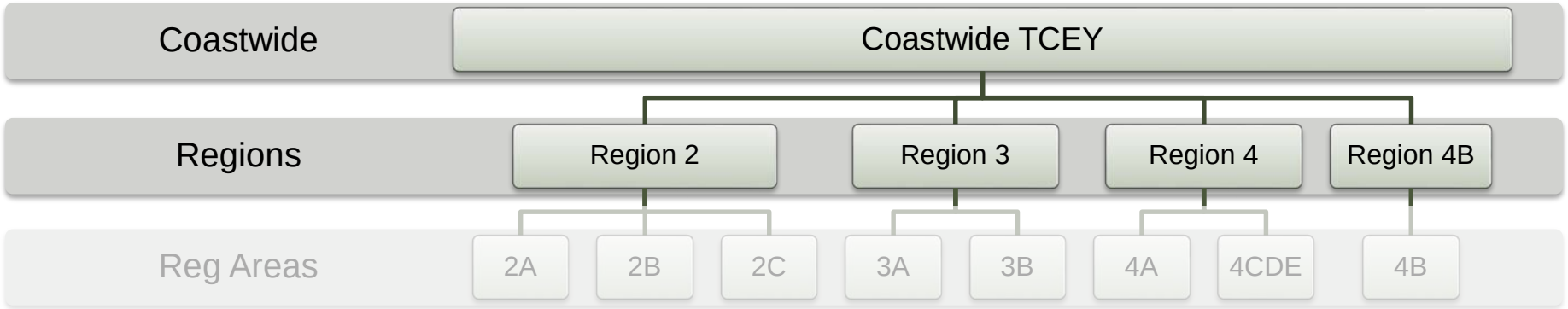


A procedure for distributing the TCEY (3)

2. Regional Stock Distribution

Optional

- Stock distribution using proportion of the stock estimated from the WPUE index.
- Relative fishing intensity to adjust the distribution in account of migration, productivity, etc…
- Regional Allocation adjustment to account for other factors.

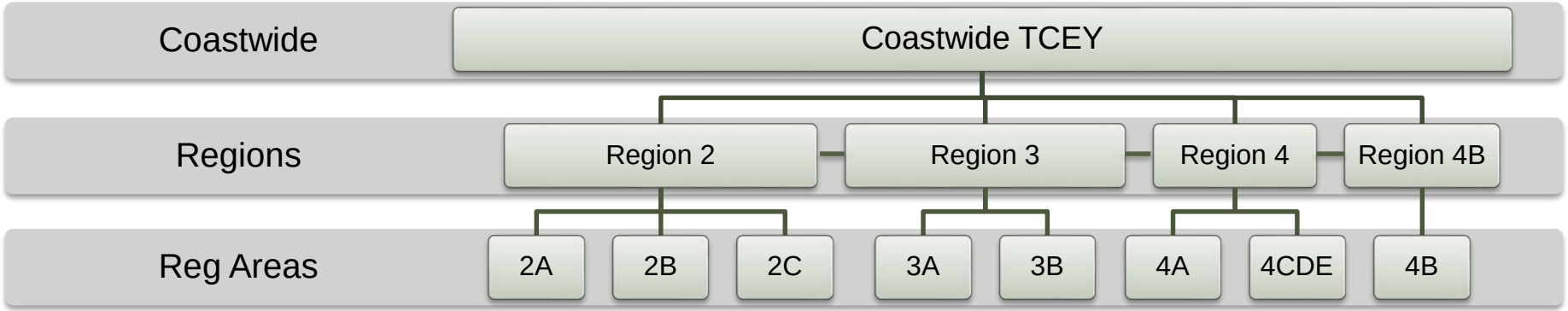


A procedure for distributing the TCEY (4)

3. Regulatory Area Allocation

- Stock distribution using proportion of the stock estimated from the WPUE index.
- Relative harvest rates

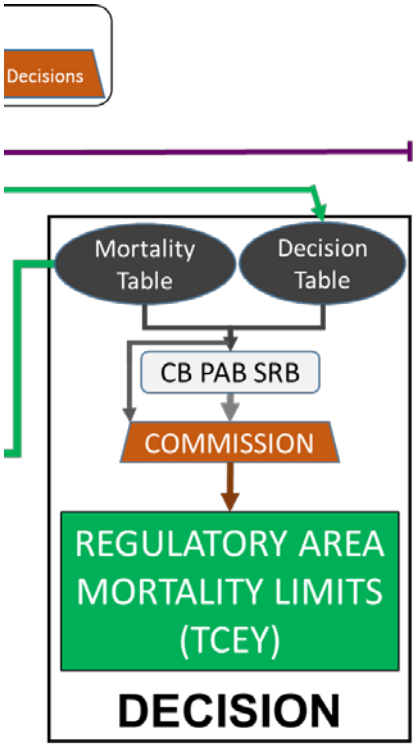
Required



A procedure for distributing the TCEY (5)

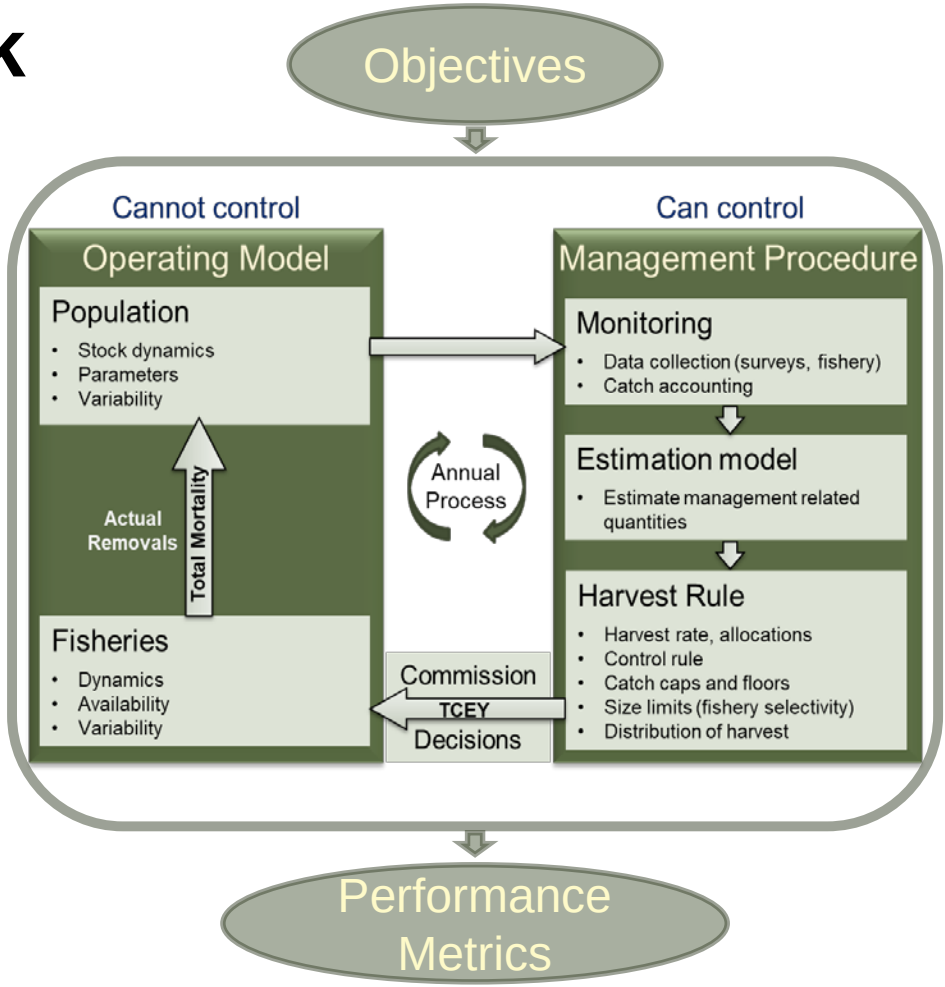
4. Annual Regulatory Area Adjustment

- Adjust Regulatory Area TCEY's to account for other factors as needed
- May deviate from the management procedure
  - Will have unpredictable consequences



Simulation Framework

- The framework contains
  - The elements of the closed-loop simulations
  - The input of objectives and output of performance metrics



General Objectives

- Primary biological sustainability objectives
- Primary fishery objectives
  - Target Spawning Biomass to optimise fishing activities
  - Stability in mortality limits
  - Provide directed fishing yield

MSAB014: https://www.iphc.int/uploads/pdf/msab/msab014/iphc-2019-msab014-r.pdf

Commission: https://iphc.int/uploads/pdf/cir/2020/iphc-2020-cr-007.pdf

Primary Performance Metrics

Biological Sustainability

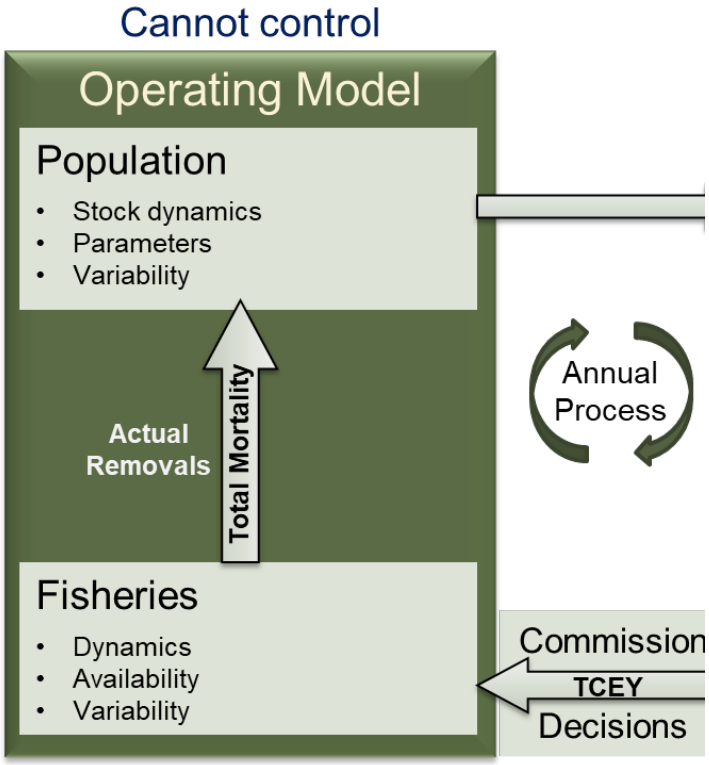
- Probability female SB > 20% of B0
- Probability female SB in R2 > 5% of coastwide SB
- Probability female SB in R3 > 33% of coastwide SB
- Probability female SB in R4 > 10% of coastwide SB
- Probability female SB in R4B > 2% of coastwide SB

Primary Performance Metrics

Fishery

- Probability coastwide female SB > 36% of B0
- Probability Annual Change in TCEY > 15% in any 3 yrs of 10
  - coastwide and by IPHC Regulatory Area
- Median AAV
  - coastwide and by IPHC Regulatory Area
- Median TCEY
  - coastwide and by IPHC Regulatory Area
- Median %TCEY in each IPHC Regulatory Area
- Minimum TCEY in each IPHC Regulatory Area
- Mininum %TCEY in IPHC Regulatory Area

Operating Model (OM)



For technical details, see:

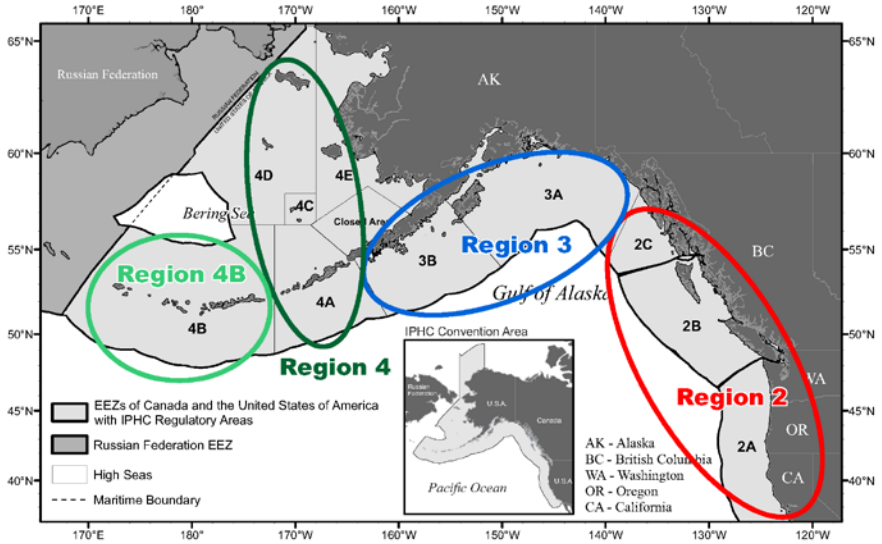
https://www.iphc.int/venues/details/16th-session-of-the-iphc-scientific-review-board-srb016

MSAB015 Report

https://www.iphc.int/uploads/pdf/msab/msab015/iphc-2020-msab015-r.pdf

OM specifications: Regions

- Four Biological Regions to model biological processes
- Eight IPHC Regulatory Areas for fisheries



OM specifications: Fishing Sectors

- Five sectors
  1. Directed commercial fishery
     - O32 mortality from directed fisheries
  2. Directed commercial discard mortality (*directed discards*)
     - U32 mortality from directed fisheries
  3. Non-directed commercial discard mortality (*non-directed*)
     - Mortality from non-directed fisheries
  4. Recreational
     - Mortality from recreational landings and discards
  5. Subsistence
     - Mortality from non-commercial, customary and traditional use

OM specifications: 33 Fisheries

Fishery	IPHC Reg Areas	2019 Mortality
Directed Commercial 2A	2A	0.89
Directed Commercial 2B	2B	5.22
Directed Commercial 2C	2C	3.67
Directed Commercial 3A	3A	8.16
Directed Commercial 3B	3B	2.31
Directed Commercial 4A	4A	1.45
Directed Commercial 4B	4B	1.00
Directed Commercial 4CDE	4CDE	1.65

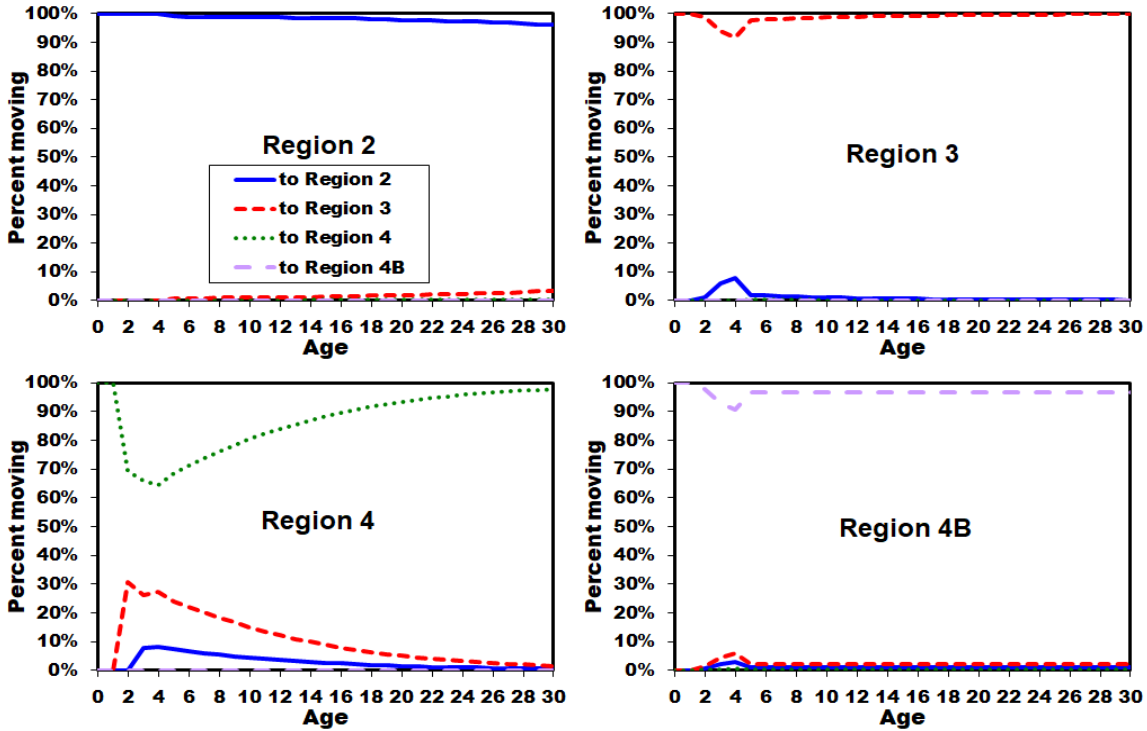
Fishery	IPHC Reg Areas	2019 Mortality
Directed Commercial Discards 2A	2A	0.03
Directed Commercial Discards 2B	2B	0.13
Directed Commercial Discards 2C	2C	0.06
Directed Commercial Discards 3A	3A	0.32
Directed Commercial Discards 3B	3B	0.15
Directed Commercial Discards 4A	4A	0.09
Directed Commercial Discards 4B	4B	0.03
Directed Commercial Discards 4CDE	4CDE	0.07

Fishery	IPHC Reg Areas	2019 Mortality
Non-Directed Comm Discards 2A	2A	0.13
Non-Directed Comm Discards 2B	2B	0.24
Non-Directed Comm Discards 2C	2C	0.09
Non-Directed Comm Discards 3A	3A	1.65
Non-Directed Comm Discards 3B	3B	0.48
Non-Directed Comm Discards 4A	4A	0.35
Non-Directed Comm Discards 4B	4B	0.15
Non-Directed Comm Discards 4CDE	4CDE	3.5

Fishery	IPHC Reg Areas	2019 Mortality
Recreational 2B	2B	0.86
Recreational 2C	2C	1.89
Recreational 3A	3A	3.69
Subsistence 2B	2B	0.41
Subsistence 2C	2C	0.37
Subsistence 3A	3A	0.19
Recreational/Subsistence 2A	2A	0.48
Recreational/Subsistence 3B	3B	0.02
Recreational/Subsistence 4	4A,4CDE	0.06

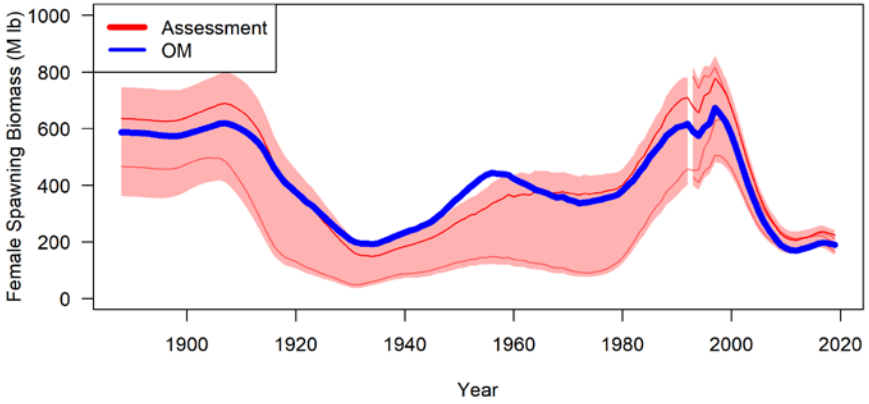
Movement

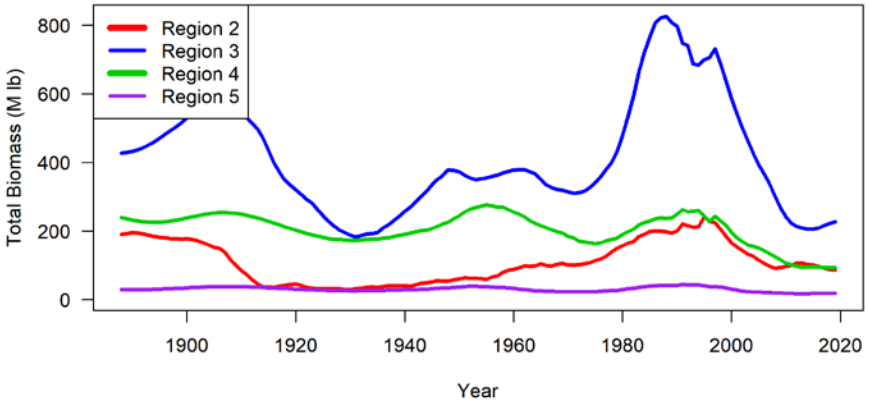
- Integration of information from many sources
  - Recent review of halibut movement
  - Estimated annual movement rates
  - Tuned to observations

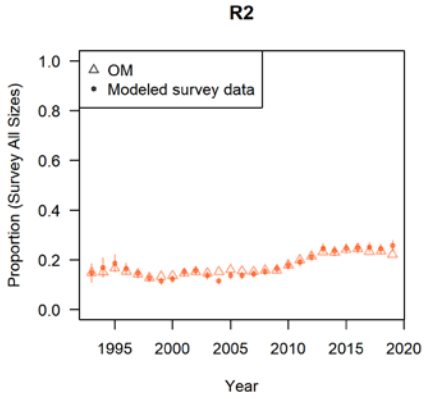


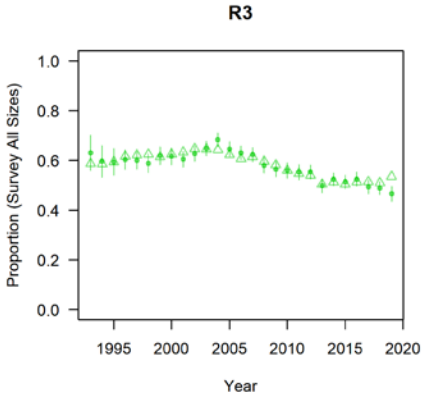
Estimated aggregate annual movement rates by age from Biological Regions (panels) based on currently available data

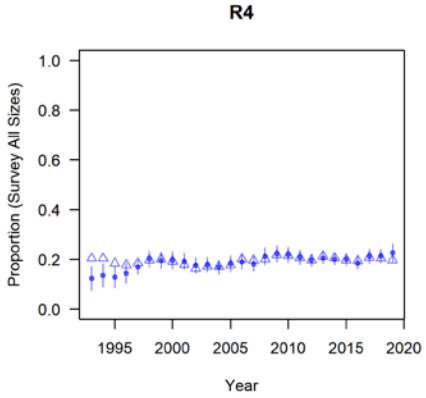
Conditioned model

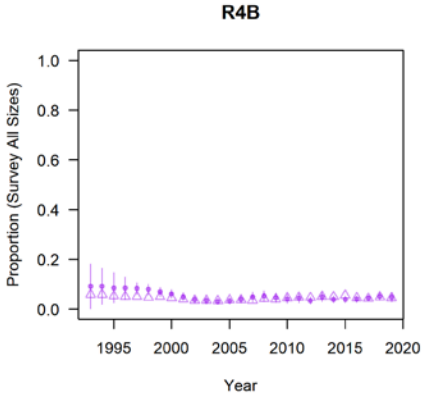




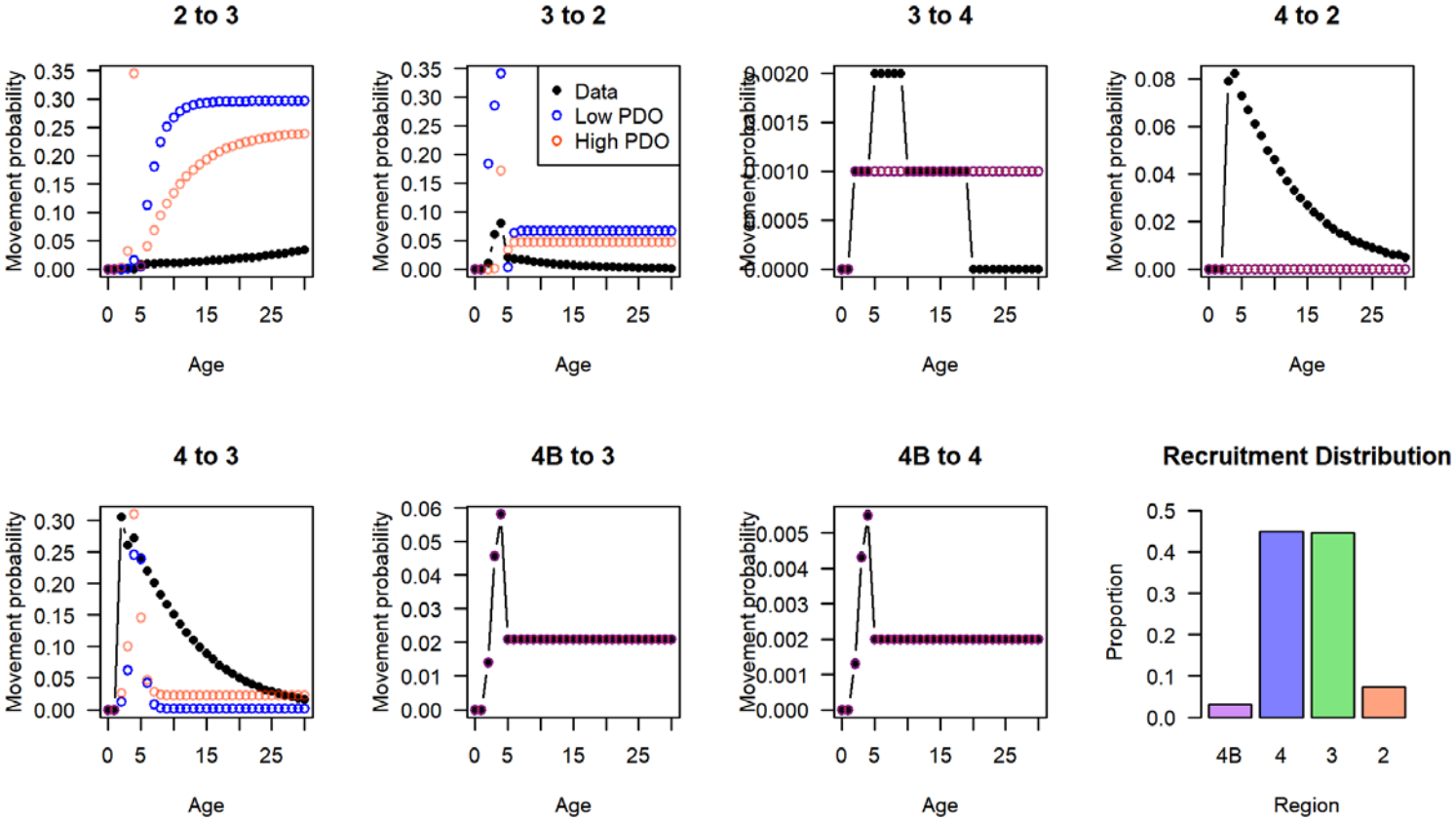








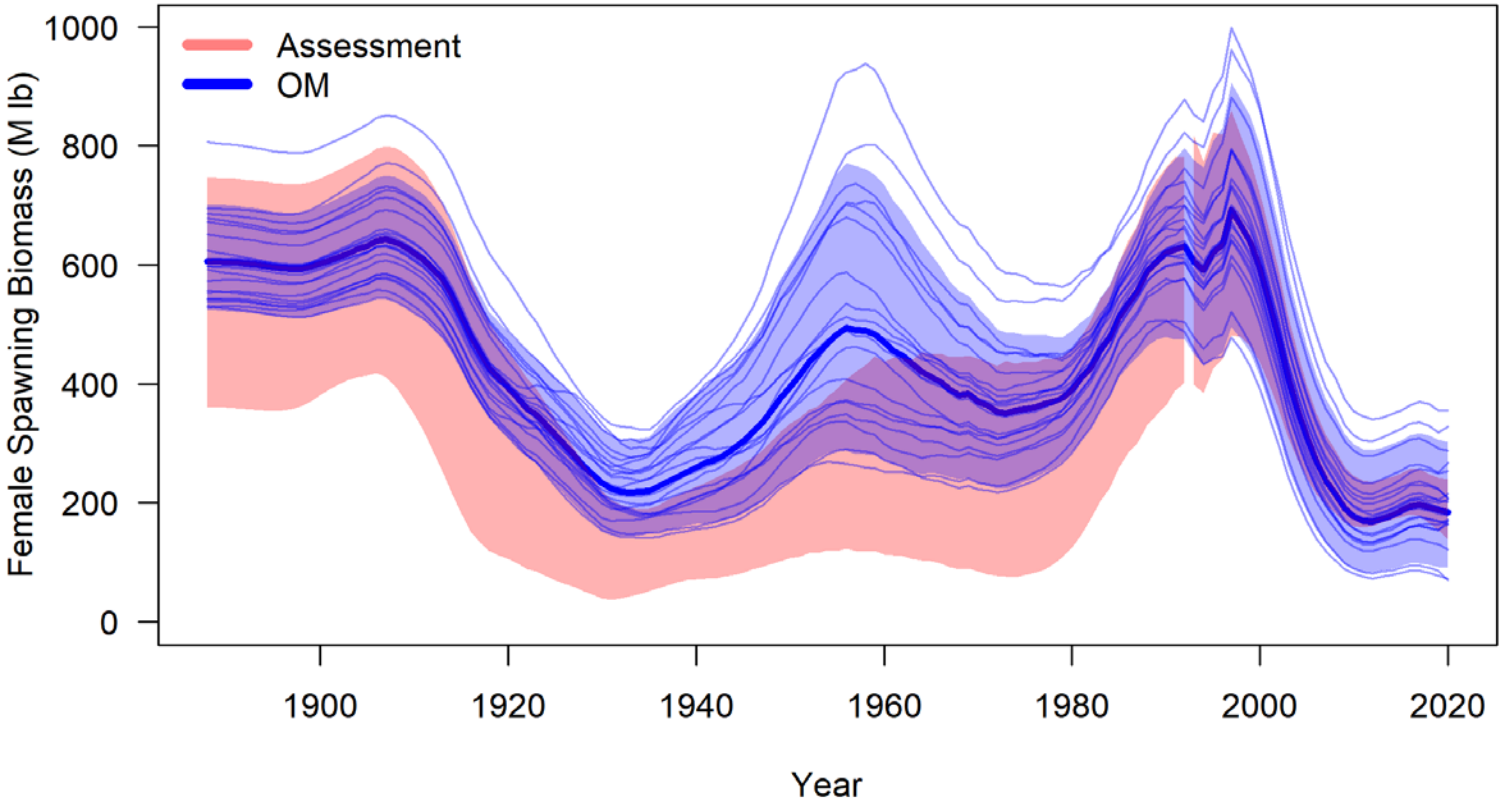
Conditioned Model



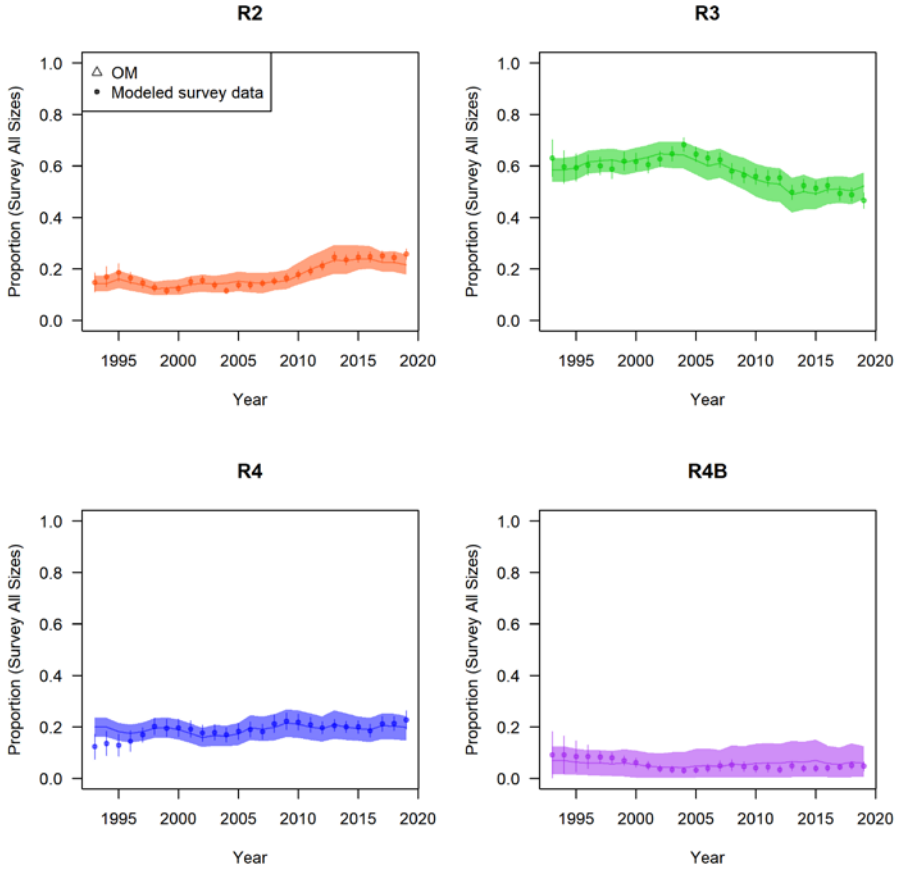
Uncertainty and variability

1. Integrated uncertainty
   - Uncertain parameters
     - M, steepness, R_0, movement, selectivity parameters
   - Variability in projections
     - selectivity, weight-at-age, recruitment, movement
2. Scenarios
   - Specific case to investigate departure in an assumption
     - Weight-at-age at a specified level
     - Non-directed mortality at a specific amount
     - Movement
   - May or may not be integrated into results

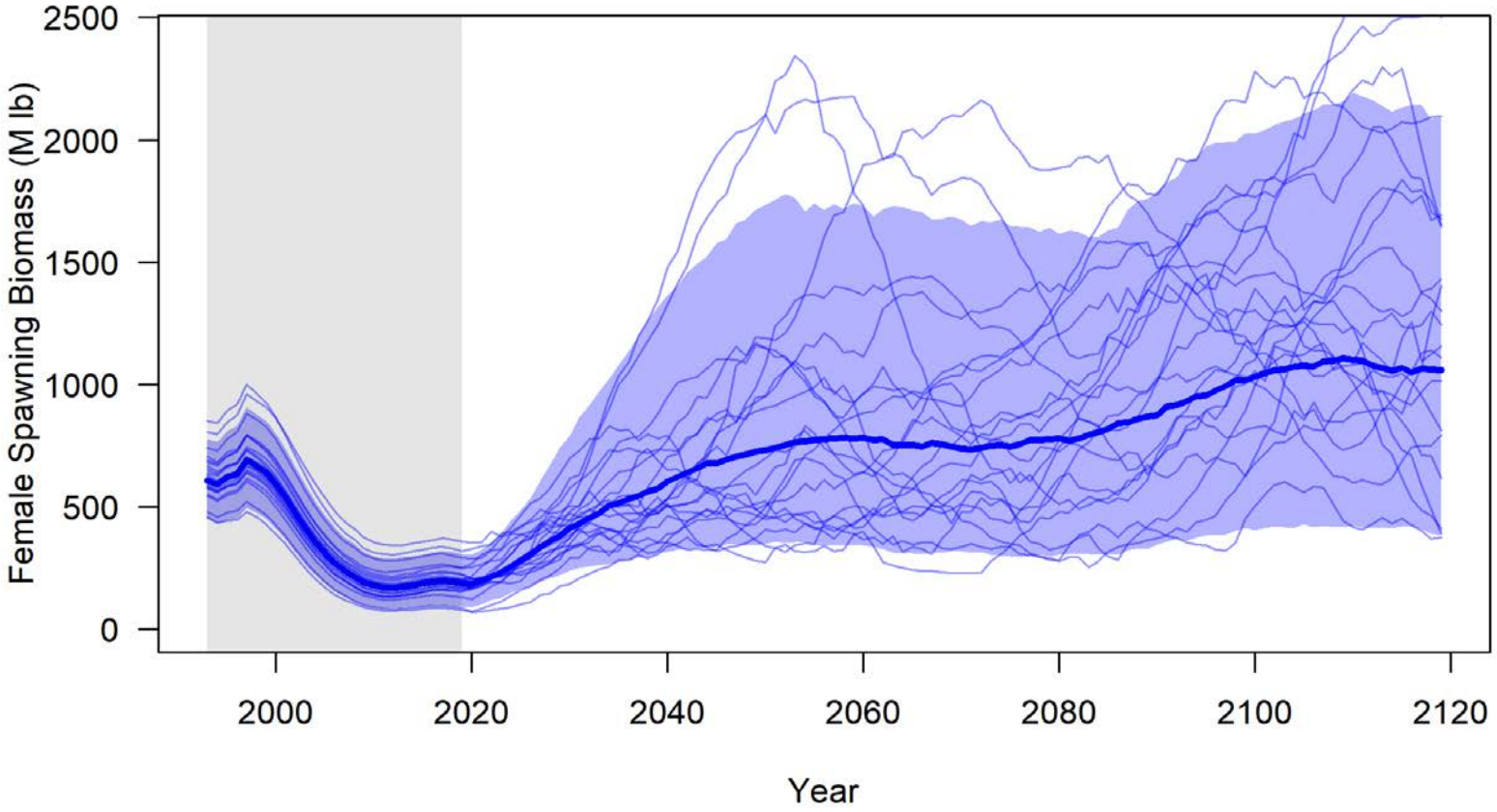
Variability in conditioned model trajectories



Variability in conditioned distribution



Projections without fishing

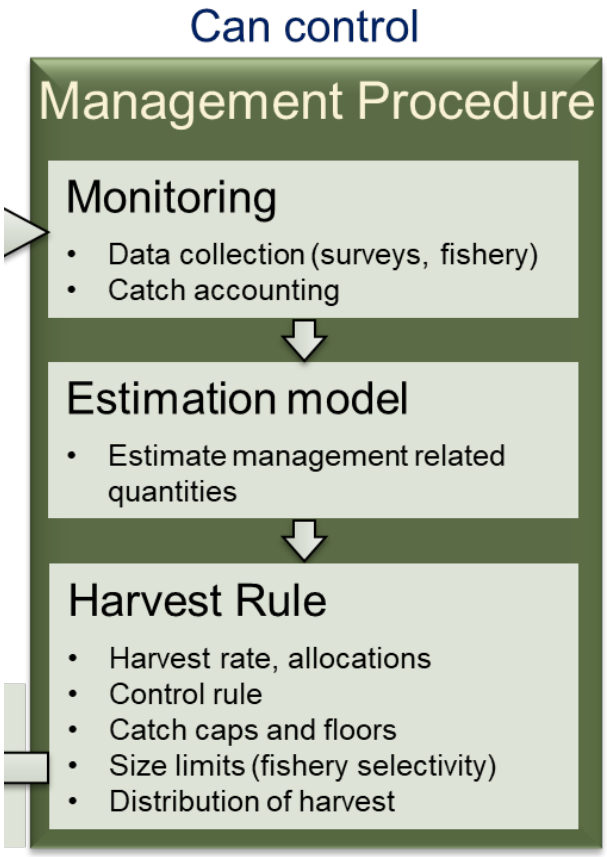


Implementation variability

1. Decision-making
   – Adopted TCEYs may depart from the MP outcomes
2. Actual fishing mortality
   – Fisheries do not exactly catch the set limit
3. Uncertainty in the estimated amount of variability

- Will look at past observations to determine reasonable methods

Management Procedures



MSAB015

- ***IPHC-2020-MSAB015-R, para. 42****.The MSAB* ***AGREED*** *that the following elements of interest for defining constraints on changes in the TCEY, and distribution procedures be considered for the Program of Work in 2020:*
  - *constraints on the change in the TCEY can be applied annually or over multiple years at the coastwide or IPHC Regulatory Area level. Constraints on the change in TCEY currently considered include a maximum annual change in the TCEY of 15%, a slow-up fast down approach, multi-year mortality limits, and multi-year averages on abundance indices;*
  - *indices of abundance in Biological Regions or IPHC Regulatory Area (e.g. O32 or All sizes from modelled survey results);*
  - *a minimum TCEY for an IPHC Regulatory Area;*
  - *defined shares by Biological Region, Management Zone, or IPHC Regulatory Area;*
  - *maximum coastwide fishing intensity (e.g. SPR equal to 36% or 40%) not to be exceeded when distributing the TCEY;*
  - *relative harvest rates between Biological Regions or IPHC Regulatory Areas.*

Monitoring and estimation models

Monitoring

- Simulation of survey and fishery data
  - Indices, age compositions, stock distribution

Three types of estimation error

1. No estimation error
   - RSB, TM, and stock distribution known without error
2. Simulated estimation error
   - RSB and TM simulated from bivariate normal distn
   - Stock distribution determined from generated data
3. SS assessment model
   - RSB and TM estimated from long coastwide SS model
   - Stock distribution determined from generated data

MPs for evaluation in 2020

MP	Coastwide	Regional	IPHC Regulatory Area	Priority
MP 15-A	SPR 30:20		• O32 stock distribution • Proportional relative harvest rates (1.0 for 2-3A, 0.75 for 3B-4) • 1.65 Mlbs floor in 2A • Formula percentage for 2B	1
MP 15-B	SPR 30:20 MaxChange15 %		• O32 stock distribution • Proportional relative harvest rates (1.0 for 2-3A, 0.75 for 3B-4) • 1.65 Mlbs floor in 2A • Formula percentage for 2B	1
MP 15-C	SPR 30:20 MaxChange15 %	O32 stock distn Rel HRs: R2, R3=1, R4, R4B=0.75,	• O32 stock distribution • Relative harvest rates not applied • 1.65 Mlbs floor in 2A • Formula percentage for 2B	2
... K				

https://www.iphc.int/uploads/pdf/msab/msab015/iphc-2020-msab015-r.pdf

MP comparison

Element	MP-A	MP-B	MP-C	MP-D	MP-E	MP-F	MP-G	MP-H	MP-I	MP-J	MP-K
maxChange15%		■	■	■	■	■	■	■	■	■	■
max FI buffer (36%)				■							
O32 stock distribution	■	■	■	■	■	■	■	■			
O32 stock distribution (5-year moving avg)										■	
All sizes stock distribution									■		
5-year shares form O32 stock distribution									■		■
Relative harvest rates 1 for 2-3A, 0.75 for 3B-4	■	■		■	■	■	■		■	■	
Relative harvest rates 1 for 2-3, 4A, 4CDE, 0.75 for 4B								■			
1.65 Mlbs floor in 2A	■	■	■	■	■						
Formula percentage for 2B	■	■	■	■							
National Shares (2B=20%)						■					

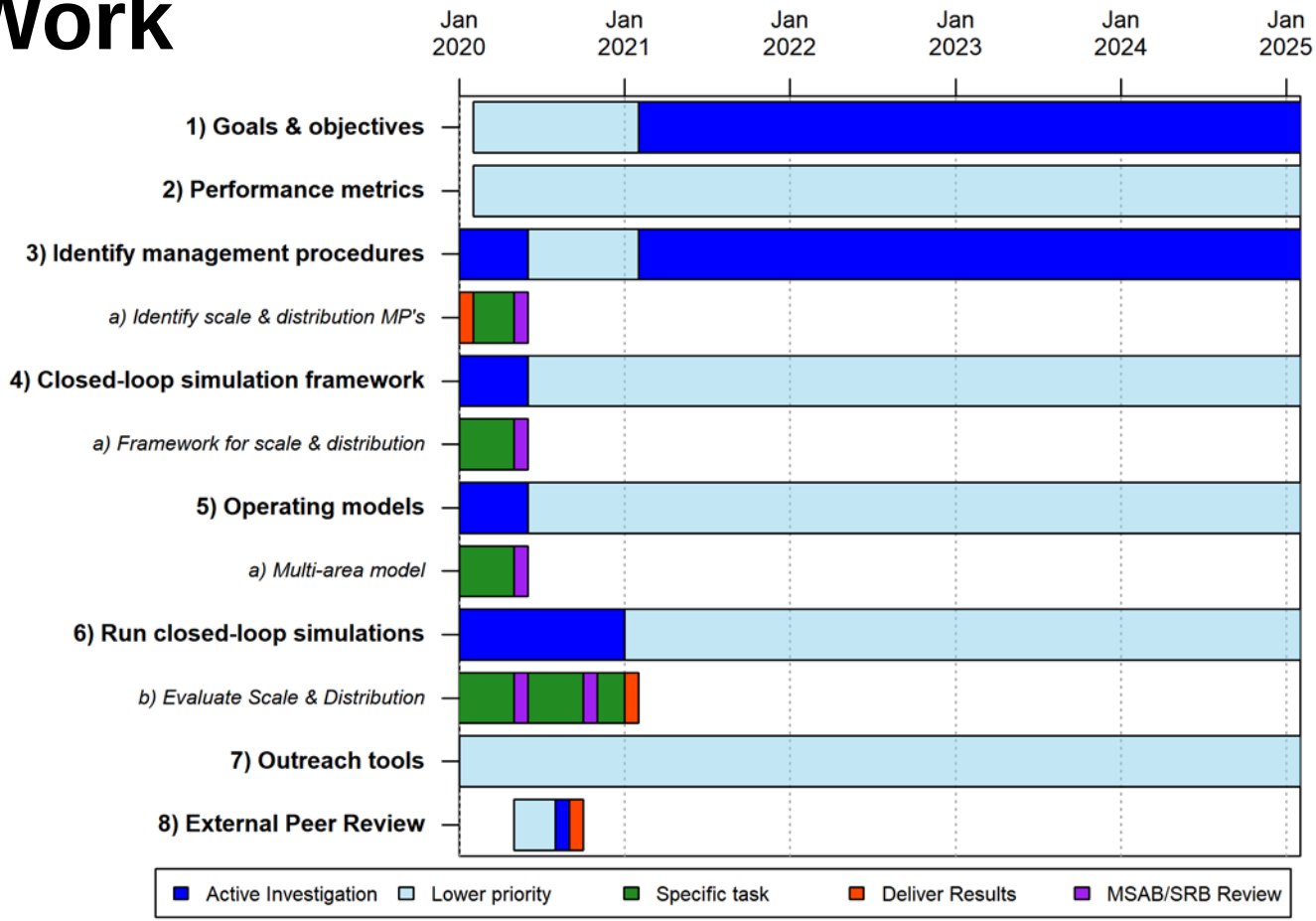
Simulations and Results

- Three assumptions about estimation error
  1. No estimation error
  2. Simulated estimation error (as with coastwide MSE)
  3. Modelled estimation error (a stock assessment model)

http://shiny.westus.cloudapp.azure.com/shiny/sample-apps/MSE-Explorer/

Program of Work

- Eight tasks



Program of Work

May 2020 MSAB Meeting (MSAB015)	Progress
Review Goals and Objectives (Distribution & Scale)	Completed
Review simulation framework	Completed
Review multi-area model	Completed
Review preliminary results	
Identify MPs (Distribution & Scale)	Completed
June 2020 SRB Meeting (SRB016)	
Review simulation framework	Completed
Review multi-area model	Completed
Review preliminary results	
August 2020 MSAB Special Session	
Examine preliminary results	Completed
September 2020 SRB Meeting (SRB017)	
Review penultimate results	On schedule
October 2020 MSAB Meeting (MSAB016)	
Review final results	On schedule
Provide recommendations on MPs for scale and distribution	
Annual Meeting 2021	
Presentation of first complete MSE product to the Commission Recommendations on Scale and Distribution MP	

Recommendations

a) **NOTE** paper IPHC-2020-SRB017-09 which provides a description of the IPHC MSE framework, a description of the specifications of the multi-area operating model, results from conditioning the multi-area operating model, and an overview of the implementation of management procedures.

b) **RECOMMEND** the use of the MSE framework to evaluate management procedures incorporating scale and distribution elements.

c) **RECOMMEND** improvements for the MSE framework including data generation, estimation models, multi-region operating models, and methods to simulate processes.

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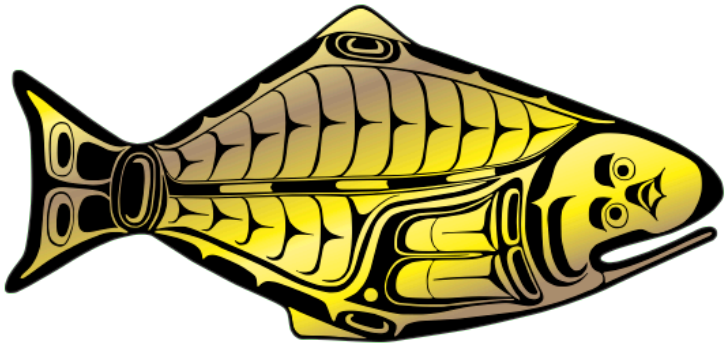

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