INTERNATIONAL PACIFIC HALIBUT COMMISSION

MSE program of work and update

Agenda item 6

IPHC-2021-SRB019-07

(A. Hicks)

Topics

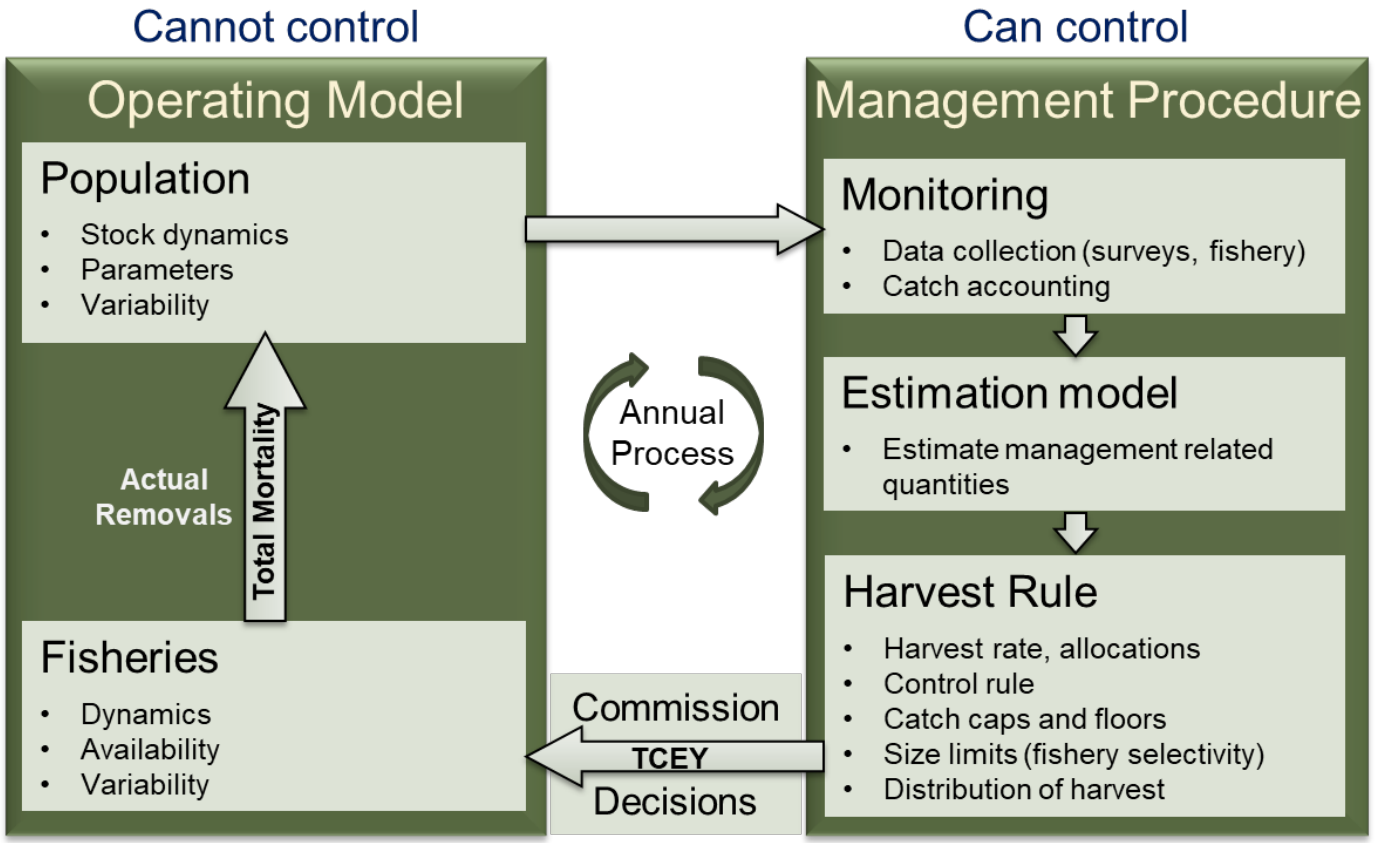
- Variability in the MSE framework
- MSE program of work for 2021-2023
- Preliminary investigation of an MP with multi-year assessments

SRB018 Request

IPHC-2021-SRB018-R, para. 30:

*"The SRB **REQUESTED** that the IPHC Secretariat present a revised system diagram of the MSE, showing components of variability and their implementation within MSE."*

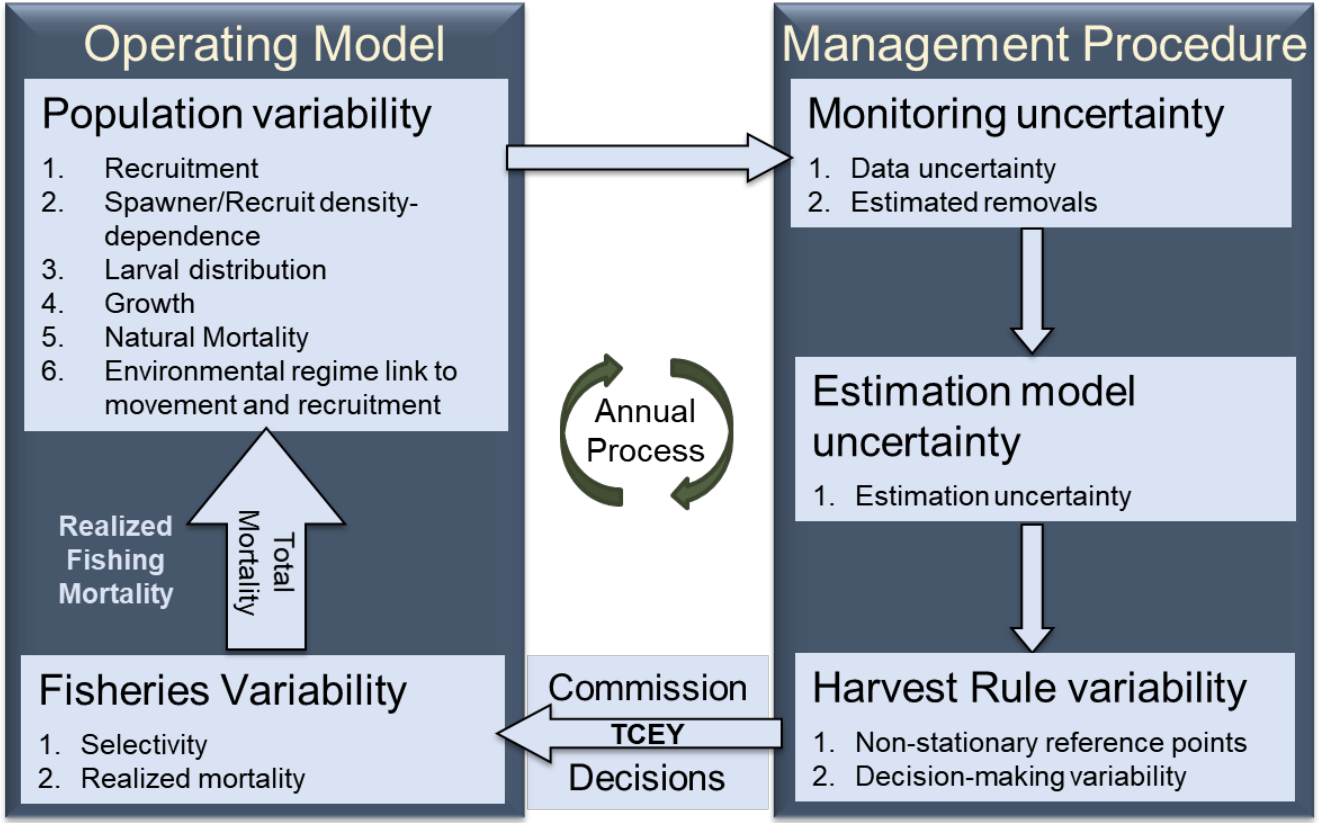
MSE framework



Categories of variability

	MSE Framework Element (Figure 2)				
Leach et al. (2014) Categories	**Population**	**Fisheries**	**Monitoring**	**Estimation Model**	**Harvest Rule**
Reference points					1. Non-stationary
Population structure	1. Recruitment 2. Spawner/Recruit relationship 3. Larval distribution • *Stock structure* • *Annual movement*				
Model	• *Number of bio-regions* • *Density-dependent processes (other than recruitment)*	1. Selectivity • *Number of fisheries* • *Catchability*	• *Data generation processes*	• *Estimation model structure*	
Management		• *Response of fisheries*	1. Uncertain data	1. Estimation uncertainty	2. Decision-making variability
Life History Traits	4. Growth 5. Natural mortality • *Maturation, fecundity, spawning*				
Environmental	6. Regimes 1. Movement, Recruitment • *Growth* • *Mortality* • *Climate change*	• *Effects on fisheries*	• *Effects on data collection*		• *Response of harvest rule*
Fishing mortality (catch)		2. Realized removals	2. Estimated removals		

Variability in the MSE framework



Movement and recruitment distribution

- Recent OM uses constant proportions of recruitment for each region across all years
- OM conditioned to mostly age 6+ fish from recent data
- Movement rates in current OM depart from rates determined from data
- Confounding between movement and recruitment distribution
- No data to inform recruitment distribution and mostly recent data informs movement
  - Although needs enough fish in early years in Region 2 to support catches

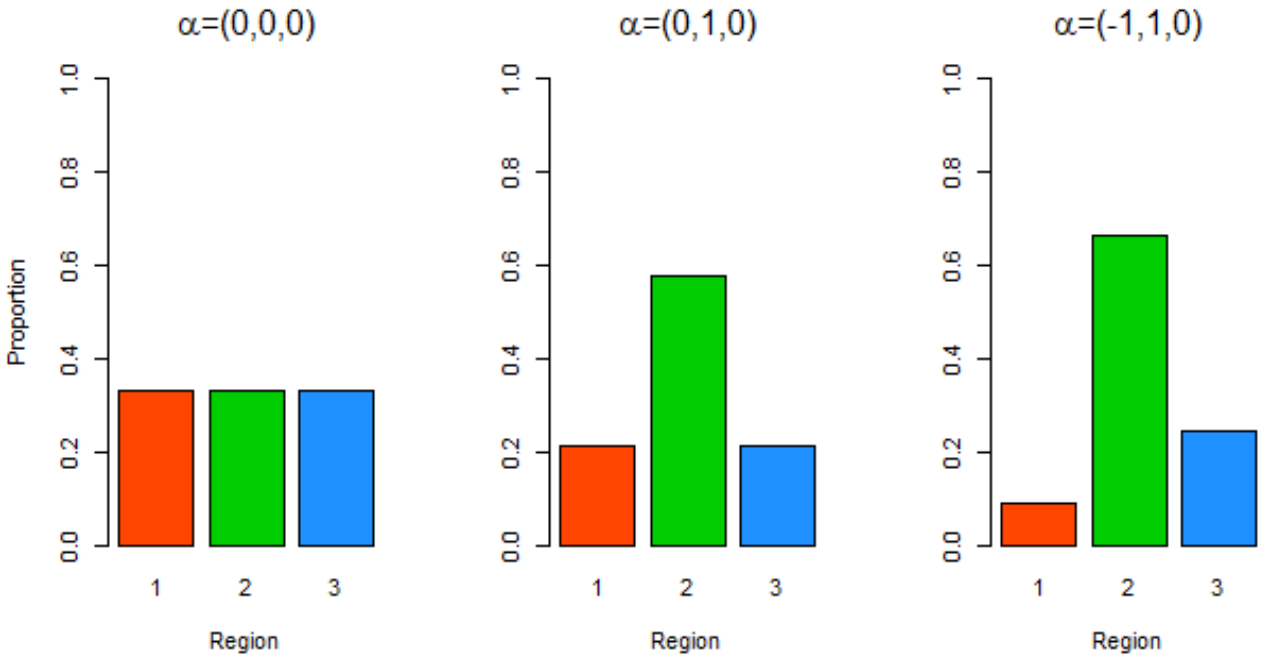
Variability in recruitment distribution

- Parameterize proportion of recruits settling in each region ($p_{t,r}^{R}$)
- $\sum p_{t,r}^{R}$ is 1.0
- Temporal covariate (x_t)
- $\eta_{t,r}^{R}$ in one region fixed at zero

$$p_{t,r}^{R} = \frac{e^{\eta_{t,r}^{R}}}{\sum_r e^{\eta_{t,r}^{R}}}$$

$$\eta_{t,r}^{R} = \alpha_r^R + \beta_r^R x_t + \gamma_r^R x_t^2$$

Parameterization of recruitment distribution



The parameters for $\boldsymbol{\beta}_r^R \boldsymbol{x}$ and $\boldsymbol{\gamma}_r^R$ are fixed at zero for all examples, therefore $\boldsymbol{\alpha} = \boldsymbol{\eta}$

Time-varying recruitment distribution

- Allow for nonlinear relationship with a temporal covariate
- Estimable parameters when conditioning
- Currently does not allow for random annual parameters over time

- Will experiment with time-varying recruitment distribution to examine effects on movement
- Develop scenarios for OM
  - Examine potential environmental variables or other covariates

SRB018 Request

IPHC-2021-SRB018-R, para. 36:

"The SRB **REQUESTED** that the IPHC Secretariat prioritize tasks for the MSE Program of Work that lead to adoption of a well-defined management procedure, taking into account interdependencies among tasks and presenting tasks as linked sets."

11th Special Session of the IPHC (SS011)

- Presented a list of tasks
- Commission prioritized a smaller set of tasks
  - Further development of operating model
  - Multi-year assessments
  - Size limits (begin development)
  - Communication of results

MSE Program of Work 2021-2023

ID	Category	Task	Deliverable
F.1	Framework	Develop migration scenarios	Develop OMs with alternative migration scenarios
F.2	Framework	Implementation variability	Incorporate additional sources of implementation variability in the framework
F.3	Framework	Develop more realistic simulations of estimation error	Improve the estimation model to more adequately mimic the ensemble stock assessment
F.5	Framework	Develop alternative OMs	Code alternative OMs in addition to the one already under evaluation.
M.1	MPs	Size limits	Identification, evaluation of size limits
M.3	MPs	Multi-year assessments	Evaluation of multi-year assessments
E.3	Evaluation	Presentation of results	Develop methods and outputs that are useful for presenting outcomes to stakeholders and Commissioners

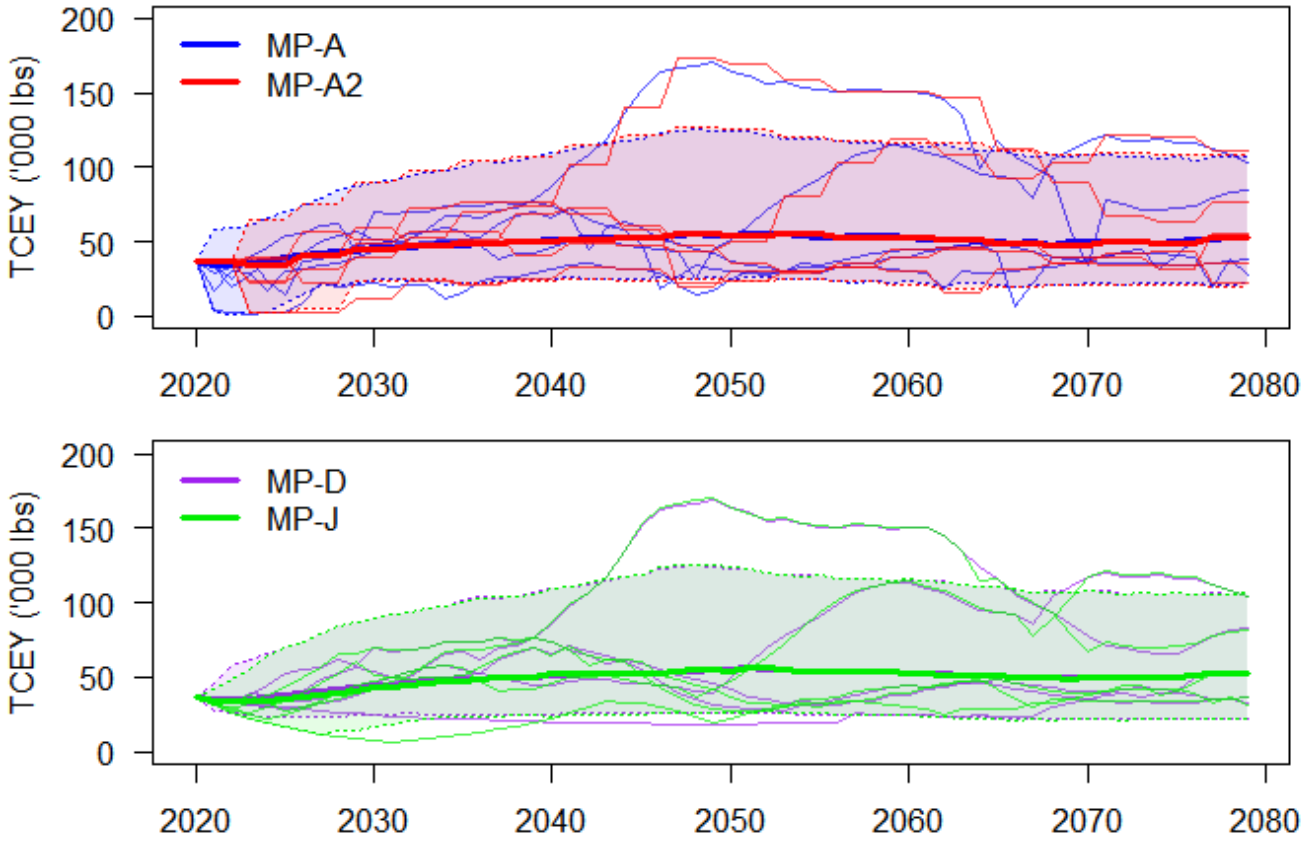
Biennial assessments

Element	MP-A	MP-A2	MP-D	MP-J
Maximum coastwide TCEY change of 15%				
Maximum Fishing Intensity buffer (SPR=36%)				
O32 stock distribution				
O32 stock distribution (5-year moving average)				
All sizes stock distribution				
Fixed shares updated in 5th year from O32 stock distribution				
Relative harvest rates of 1.0 for 2-3A, and 0.75 for 3B-4				
Relative harvest rates of 1.0 for 2-3, 4A, 4CDE, and 0.75 for 4B				
Relative harvest rates by Region: 1.0 for R2-R3, 0.75 for R4-R4B				
1.65 Mlbs fixed TCEY in 2A				
Formula percentage for 2B				
National Shares (2B=20%)				
Frequency of stock assessment & mortality limits (biennial)				

Mortality limits constant between assessments

SPR = 43% for all simulations

Simulated trajectories



Coastwide performance metrics

- Improved stability with a slightly smaller average TCEY
- Different SPR for MP-A2 may make it similar to MP-A

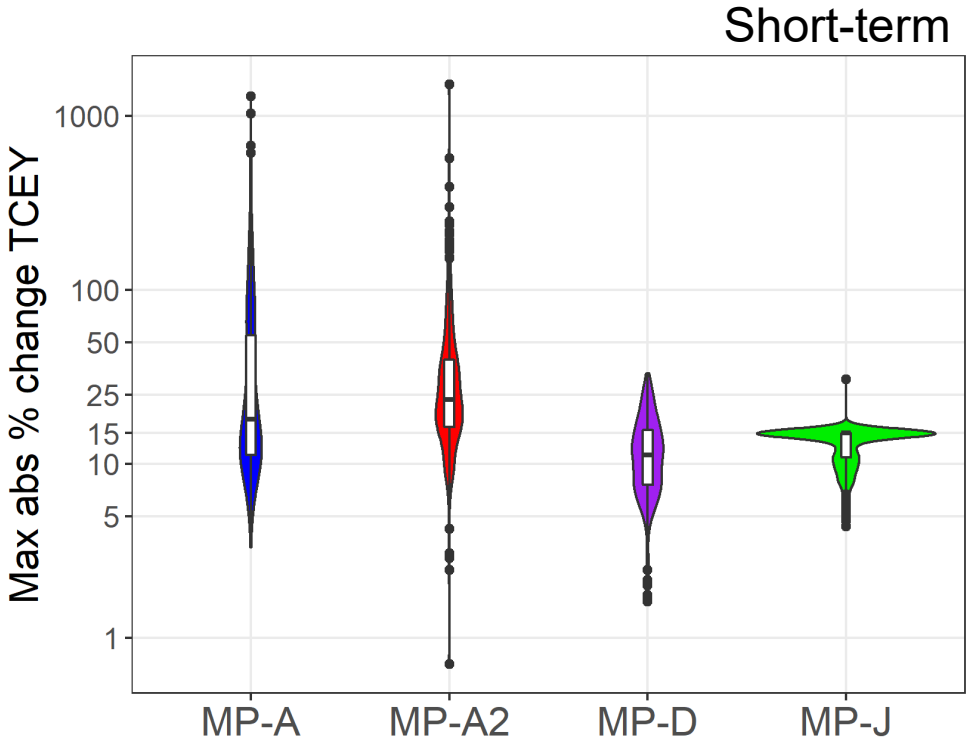
Management Procedure	A	A2	D	J
Biological Sustainability				
P(any RSB_y<20%)	<0.01	<0.01	0.01	<0.01
Fishery Sustainability				
P(all RSB<36%)	0.25	0.28	0.44	0.28
Median average TCEY (Mlbs)	39.92	38.31	40.22	37.90
P(any3 change TCEY > 15%)	0.44	0.36	0.10	0.00
Median AAV TCEY	12.1%	9.0%	5.9%	9.5%

Alternative stability metrics

	Short-term				Long-term			
Management Procedure	A	A2	D	J	A	A2	D	J
Fishery Sustainability								
P(any1 change TCEY > 15%)	0.75	0.93	0.56	0.00	0.46	0.67	0.17	0.00
P(any2 change TCEY > 15%)	0.63	0.74	0.26	0.00	0.31	0.32	0.02	0.00
Median max absolute % change TCEY	18%	23%	11%	15%	13%	21%	9%	14%

Maximum absolute percent change

- Compressed distribution for MP-A2, with higher median
  - more often a higher maximum change in a ten-year period with A2



Note: IPHC-2021-SRB019-07, Figure 5 showed long-term results

Multi-year assessment

- With a constant TCEY for two years
  - Trade-off between annual change and biennial stability
  - Fixing the TCEY or using further projections from stock assessment ignores data
  - Different SPR value may make results more similar
- Stability would increase with constant TCEY longer than two years
  - Would likely result in larger adjustments every 3rd year

Extensions to multi-year assessment MP

- Triennial assessment
- Empirical approaches in non-assessment years
  - Fix coastwide TCEY but update distribution
  - TCEY updated using trend of recent years
  - Use current FISS results to update TCEY and distribution

Recommendation/s

That the SRB:

a) **NOTE** paper IPHC-2021-SRB019-07 describing the MSE Program or Work for 2021–2023, sources of variability in the MSE framework, and results from simulations with a biennial mortality limit specification.

b) **RECOMMEND** MP specifications to investigate multi-year stock assessments or any other elements of interest as part of the MSE program of work for 2021-2023.

c) **REQUEST** any further analyses to be provided at SRB020, June 2022.

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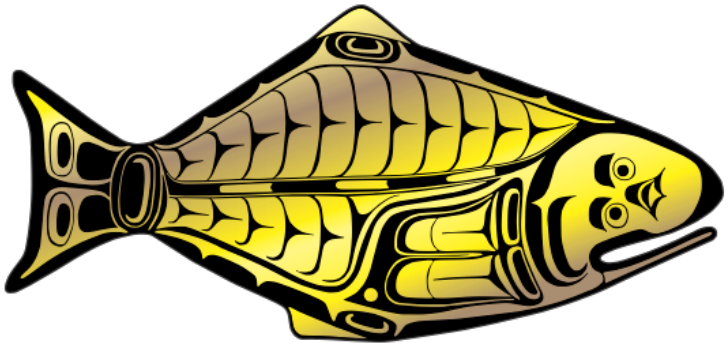

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