INTERNATIONAL PACIFIC HALIBUT COMMISSION

Development of the 2022 stock assessment

Agenda item 7

IPHC-2022-SRB021-08

(I. Stewart)

Outline

- Response to SRB recommendations and Requests
  - *M* estimation
  - Bootstrapping sample sizes
  - Marine mammal depredation
  - Model weighting
- Additional development
  - Modelling
  - Data
- Final 2022 assessment
  - Remaining data
  - Timeline

SRB recommendation

1) SRB020-Rec.02 (para. 23):

"The SRB NOTED that most models within the ensemble produced reasonable and well-constrained estimates of natural mortality (M) and RECOMMENDED that estimation of M should be adopted in the short AAF assessment model with consideration in other models as part of the stock assessment research program."

Estimation of M will be retained in the final short AAF model for 2022, And explored further in the short coastwide model in 2023.

SRB recommendation

2) SRB020-Rec.03 (para. 24):

"The SRB NOTED that the bootstrapping approach to determining maximum samples sizes for age-composition data improved assessment model performance and stability and, therefore, RECOMMENDED that the bootstrapping approach be adopted for data-weighting in future assessments."

Bootstrapping is now part of standard the data processing steps and will be applied to all new data for the final 2022 assessment. Bootstrapping of the 2021 sex-specific fishery data was easily accommodated.

SRB recommendation

3) SRB020-Rec.04 (para. 25):

"The SRB NOTED apparent discrepancies in marine mammal prevalence among anecdotal reports, FISS observations, and preliminary evaluation of logbook data, and therefore RECOMMENDED further investigation of methods to better estimate marine mammal prevalence and impacts on the fishery."

Next steps:

- Post-season review of logbook fields and collection methods (coordinating with sablefish analysts)
- Explore observer data
- Field research on catch-protection devices (April-May 2023)

Update at SRB022, June 2023.

SRB request

4) SRB020-Req.06 (para. 26):

"The SRB NOTED the proposed new ensemble model weighting scheme using the MASE criterion and REQUESTED investigation of predictive skill on additional quantities such as fishery CPUE and mean age in FISS samples."

More on model weighting

MASE statistic: $$MASE = \frac{\frac{1}{n}\sum_{t=1}^{n}\left|\frac{O_t - E_t}{\sigma_t}\right|}{\frac{1}{n}\sum_{t=1}^{n}\left|\frac{O_t - O_{t-1}}{\sigma_t}\right|}$$

O_t = Observation at time *t*
E_t = Prediction at time *t*
σ_t = standard deviation of O_t

>1: Model skill is worse than the naïve prediction (last year's observation)
1: Equal to the naïve prediction
<1: Better than naïve prediction
0: Perfect prediction

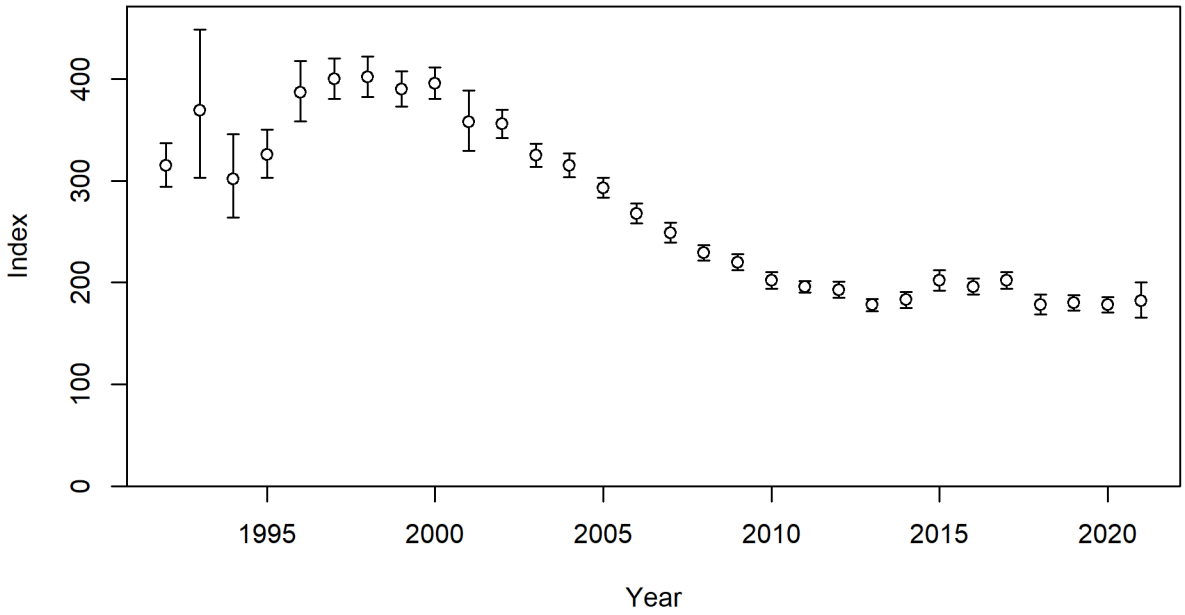
MASE weights

- For models with a MASE of <1:

$$MASE\ weight_m = \frac{1 - MASE_m}{\sum_{m=1}^{M} 1 - MASE_m}$$

- A model with MASE of 1 gets zero weight (unless all models >=1)
- A model with MASE of 0 gets maximum weight

Fishery WPUE



Very little contrast over last 4 years.

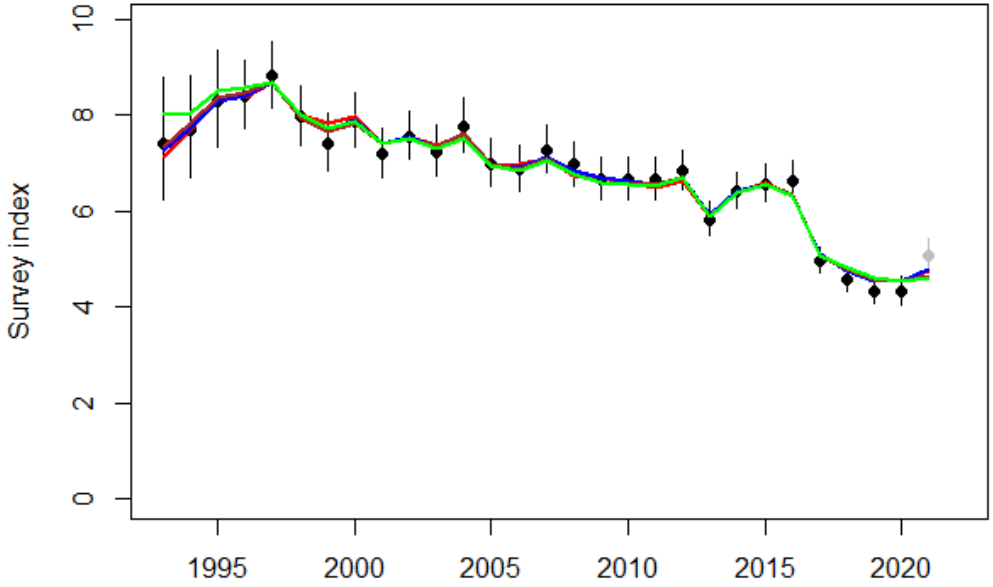
Fishery WPUE

	Model			
Years included	CW short	CW long	AAF short	AAF long
4	0.0%	53.1%	0.0%	46.9%
3	0.0%	27.8%	0.0%	72.2%
2	0.0%	0.0%	0.0%	100.0%
1	25.0%	25.0%	25.0%	25.0%
Status quo weights	25.0%	25.0%	25.0%	25.0%

(All models > 1)

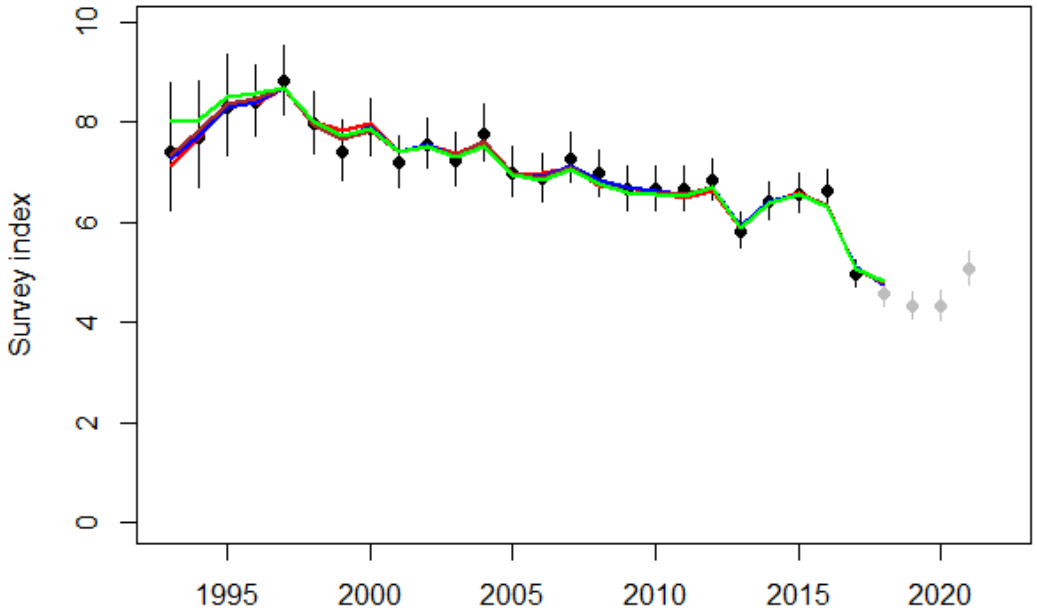
Highly variable MASE weights

Previous MASE results



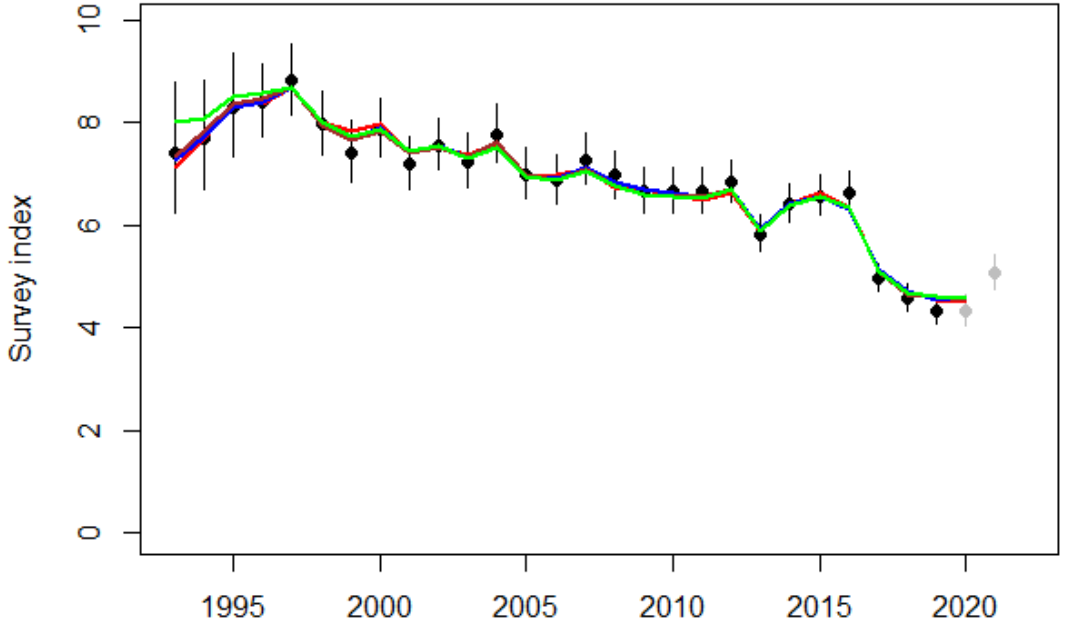
All models preformed better at predicting 2021 than for the 2020 observation. This had a strong effect on all the calculated averages.

Previous MASE results



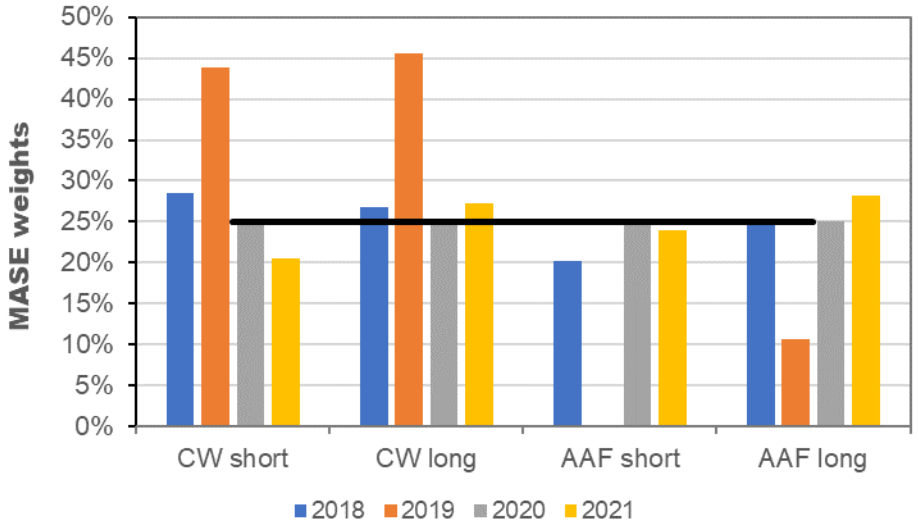
This was similar for 2018.

Previous MASE results



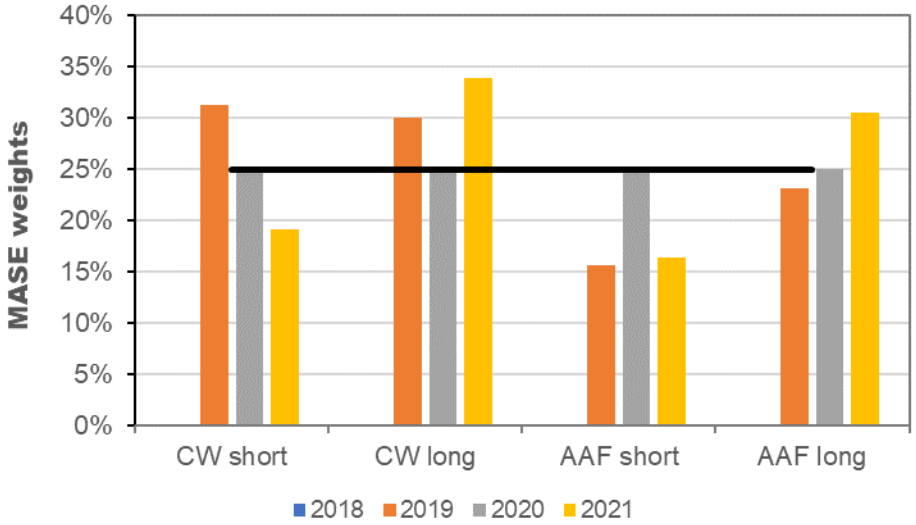
But definitely not 2020.

FISS predictive performance



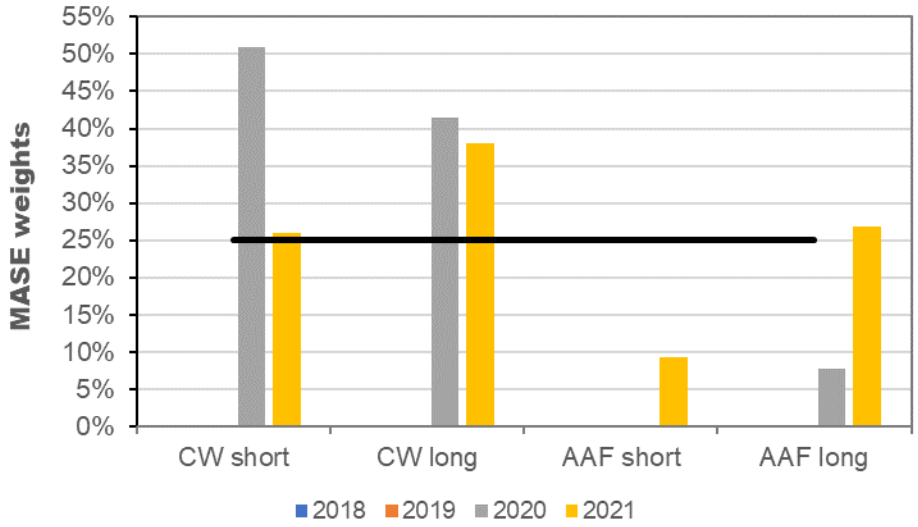
One-year MASE weights, calculated in each sequential year

FISS predictive performance



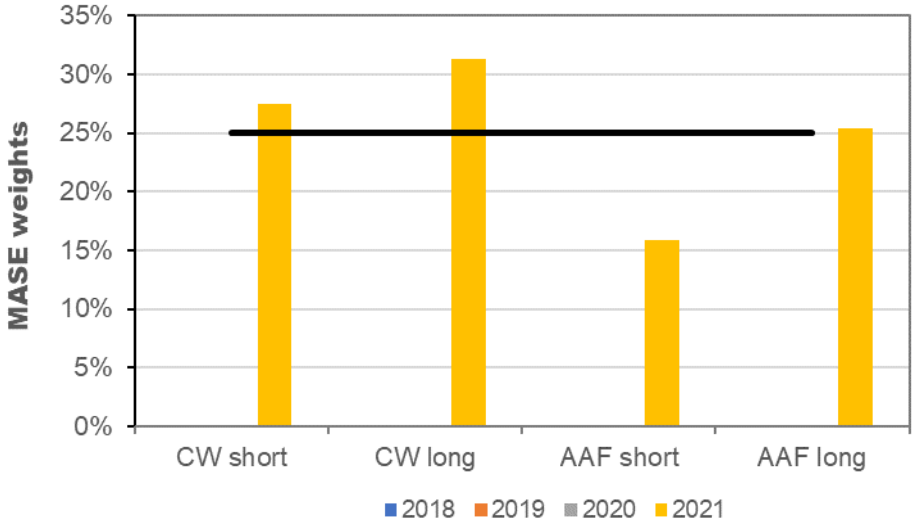
Two-year MASE weights, calculated in each sequential year

FISS predictive performance



Three-year MASE weights, calculated in each sequential year

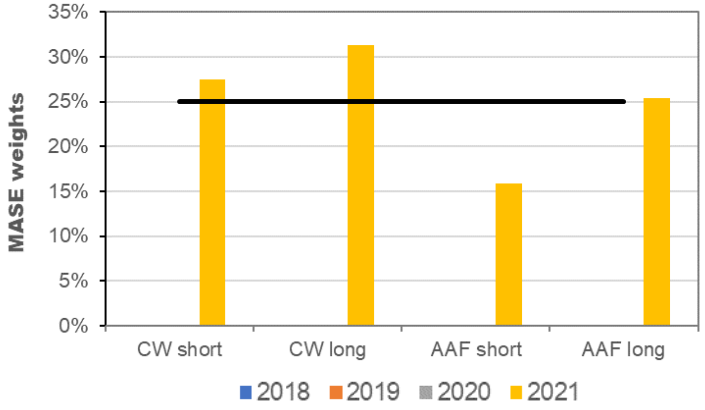
FISS predictive performance

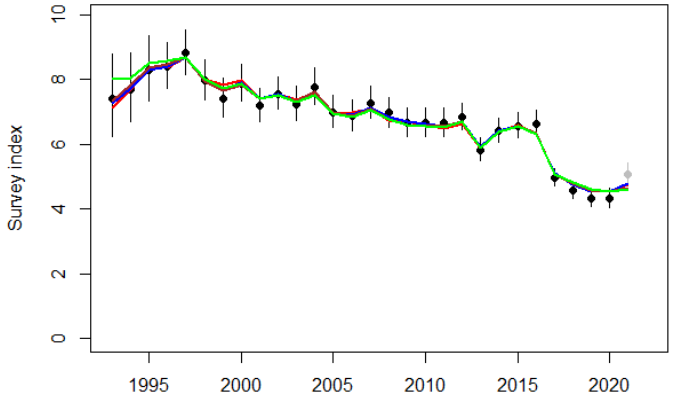


Four-year MASE weights – only one calculation available

FISS predictive performance

- Four-year average for 2022 would include 2019, 2020, 2021 and 2022
- Ensures that the good predictive performance observed in 2021 remains in the average through the next full assessment (2025)
- Allows the method to update weights, but gives us time to generate a slightly longer time-series to better evaluate performance vs. variability over time
- Change from previous recommendation of a one-year MASE statistic





Additional modelling exploration

- Internal age-length key constants in Stock Synthesis
  - Potential convergence issue
  - Mainly relevant where a growth curve is being internally estimated

Only trivial effects on halibut models

Additional data development

- Raw (unsmoothed) weight-at-age for Biological Region 3 female Pacific halibut
  - Sparse observations in 2019 & 2020
  - Rather than extrapolate trends at oldest ages, constant weight-at-age from the last observation was used

No change to model results

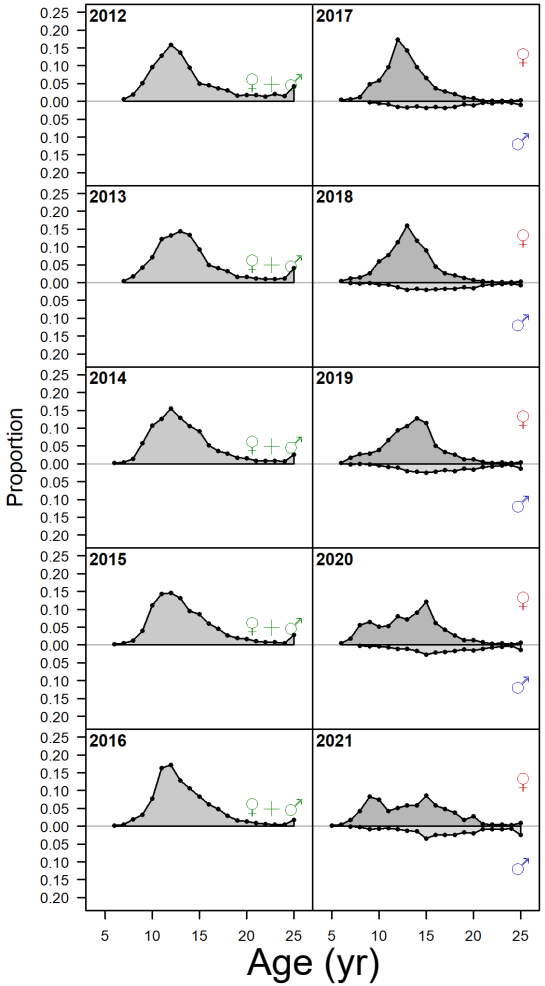
Additional data development

- 2021 Commercial fishery sex-ratios

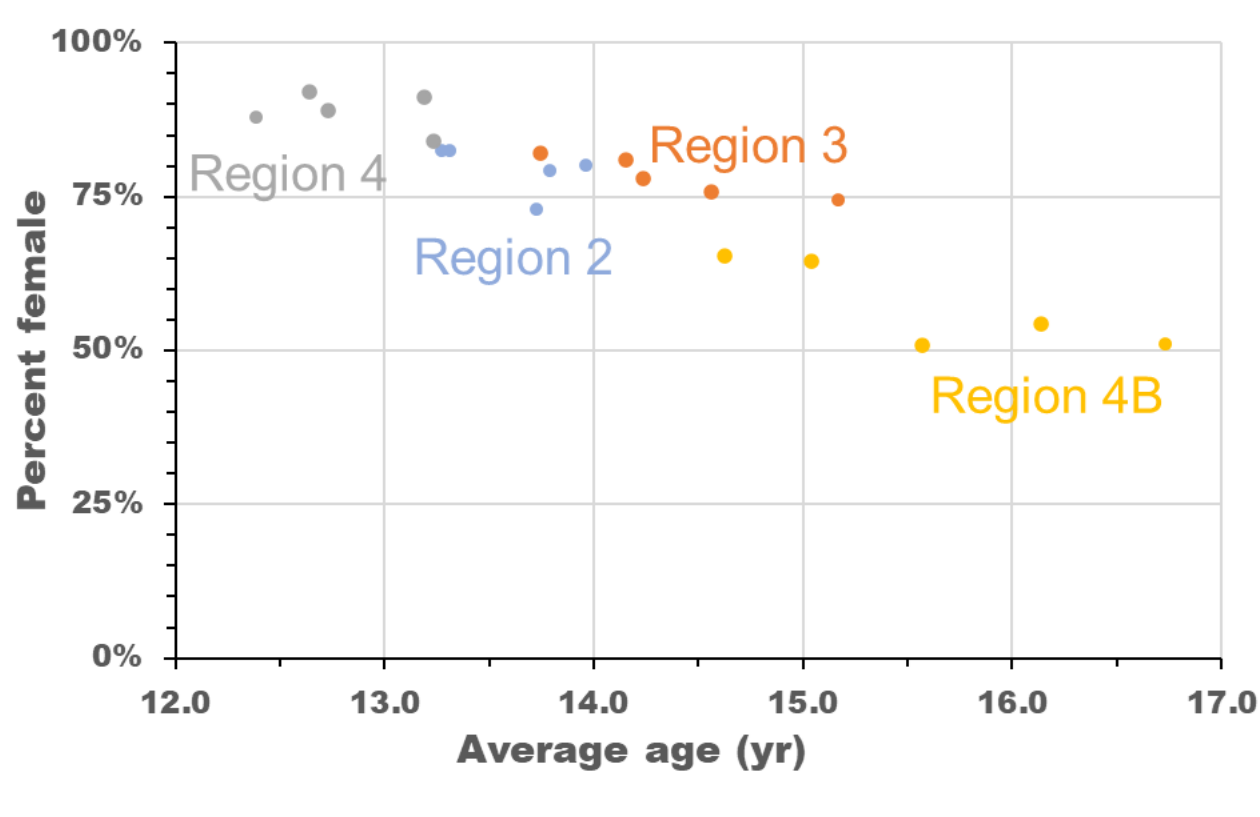
  (5th consecutive year of genetic data!)

	Coastwide % female	Region 2	Region 3	Region 4	Region 4B
2017	82%	82%	82%	92%	65%
2018	80%	82%	78%	91%	65%
2019	78%	80%	76%	89%	51%
2020	80%	79%	81%	84%	54%
2021	74%	73%	74%	88%	51%

Commercial sex-ratios



Commercial sex-ratios



Standard data for the 2022 assessment

1) New modelled trend information from the 2022 FISS for all IPHC Regulatory Areas.
2) Age, length, individual weight, and average weight-at-age estimates from the 2022 FISS.
3) Directed commercial fishery logbook trend information from 2022 (and any earlier logs that were not available for the 2021 assessment) for all IPHC Regulatory Areas.
4) Directed commercial fishery biological sampling from 2022 (age, length, individual weight, and average weight-at-age) from all IPHC Regulatory Areas.
5) Biological information (lengths and/or ages) from non-directed discards (all IPHC Regulatory Areas) and the recreational fishery (IPHC Regulatory Area 3A only) from 2021. The availability of these data routinely lags one year.
6) Updated mortality estimates from all sources for 2021 (where preliminary values were used) and estimates for all sources in 2022.

2022 Assessment timeline

- Post-September SRB
  - No further model changes
- November 1: data sets close
  - Final data + bootstrapping
  - Extend process error vectors
  - Retune data weighting
  - Recalculate model weighting
- November 30: Interim Meeting
  - First public release of results (Executive summary ~2 weeks prior)
- December 2022: Full documents posted
- January 2023: Annual Meeting (Decision making)

Recommendations

a) **NOTE** paper IPHC-2022-SRB021-08 which provides a response to requests from SRB020, and an update on model development for 2022.

b) **RECOMMEND** any changes to be included in the final 2022 stock assessment to be completed for presentation at IM098.

c) **REQUEST** any further analyses to be provided at SRB022, June 2023.

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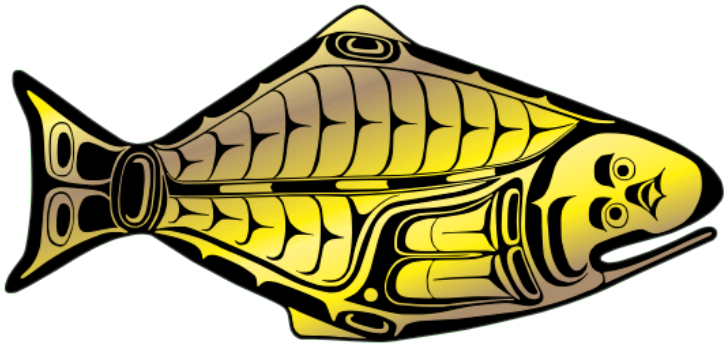

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