2020 Pacific halibut (*Hippoglossus stenolepis*) stock assessment: Development

Agenda item: 5.1

IPHC-2020-SRB016-07

L. Boitor

Summary

- 2020 is an update assessment
- SRB requests addressed:
  - Steepness and likelihood profiles
  - Fleet 'impacts'
  - Data weighting: annual and general
- Data for 2020:
  - new recreational sex-ratio at age
  - Updates to standard data sets: fishery and survey

Introduction

- 2019: Full assessment with Independent and SRB review (links in document)
- Biggest changes:
  - Sex-ratios at age for commercial landings
    - Higher fraction of females than previously understood
  - Modelled survey including complete expansion data
    - More precise indices (particularly from Region 3)

Stock assessment

- Ensemble of 4 equally weighted models capturing uncertainty in fleet structure, data aggregation, natural mortality, environmental effects, …

- Each model represents an internally consistent hypothesis about stock and fishery dynamics and how these are best modelled
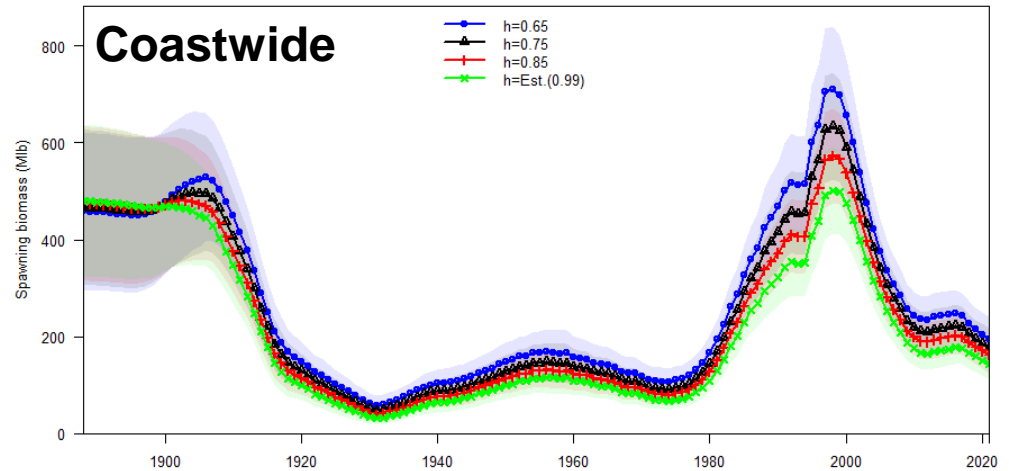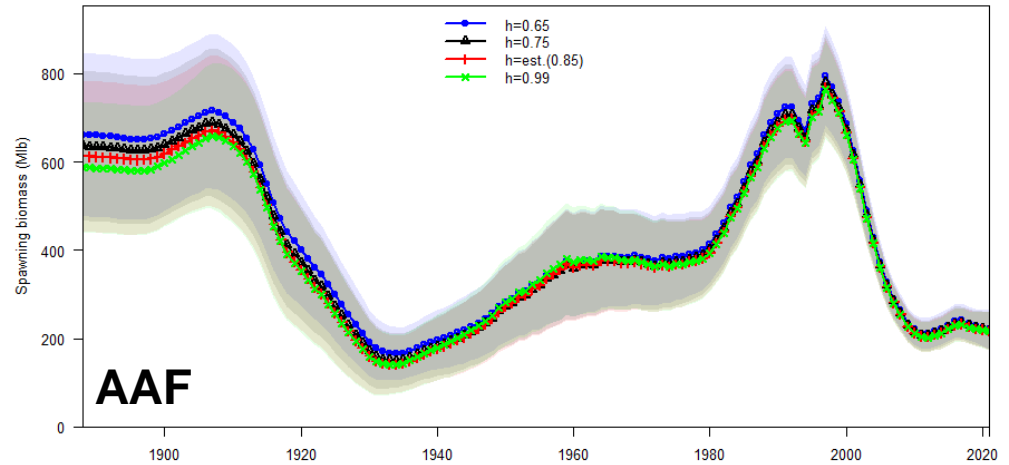
SRB Requests (1)

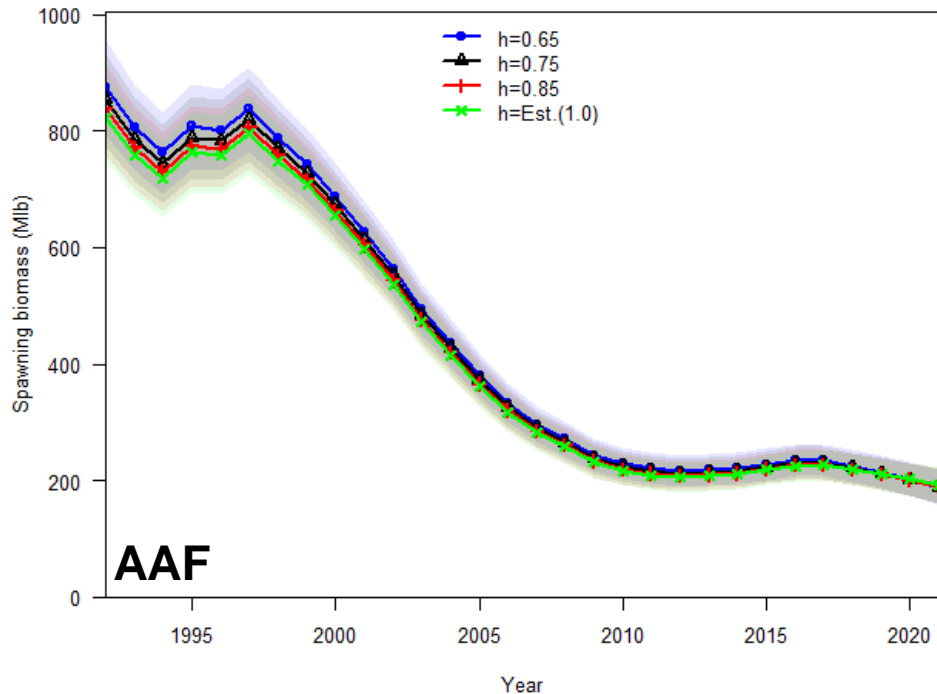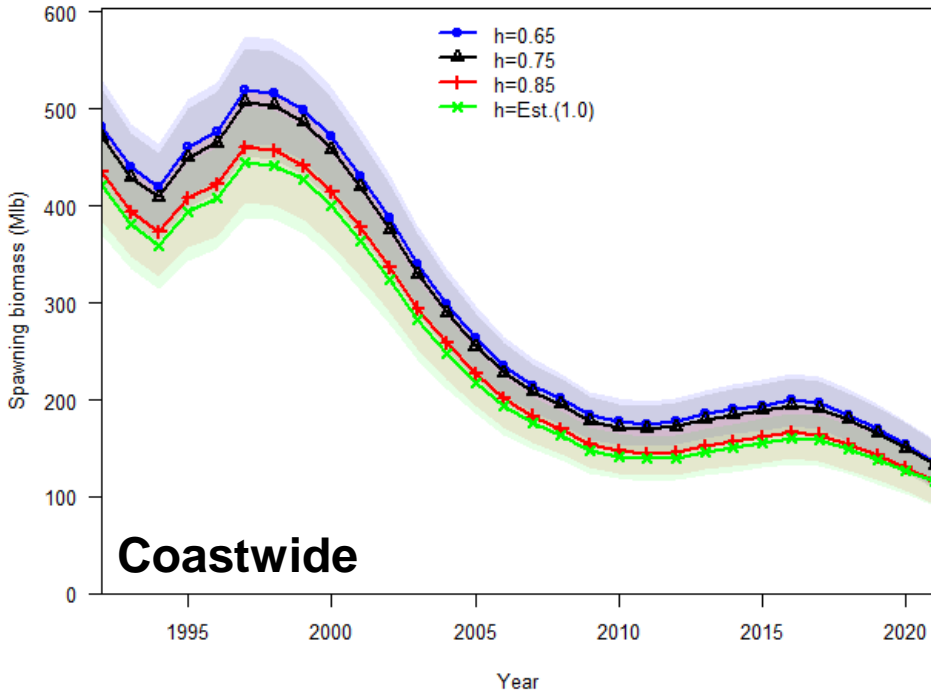SRB015 (para. 33): *"The SRB REQUESTED that for SRB016 (2020), the IPHC Secretariat:*

a) provide a more detailed evaluation and profile of steepness values. Specifically, this should show the different data and model components that inform the steepness parameter, and also the interaction with sigmaR. This should also help inform the SRR relationship to be used in the operating model for MSE work;
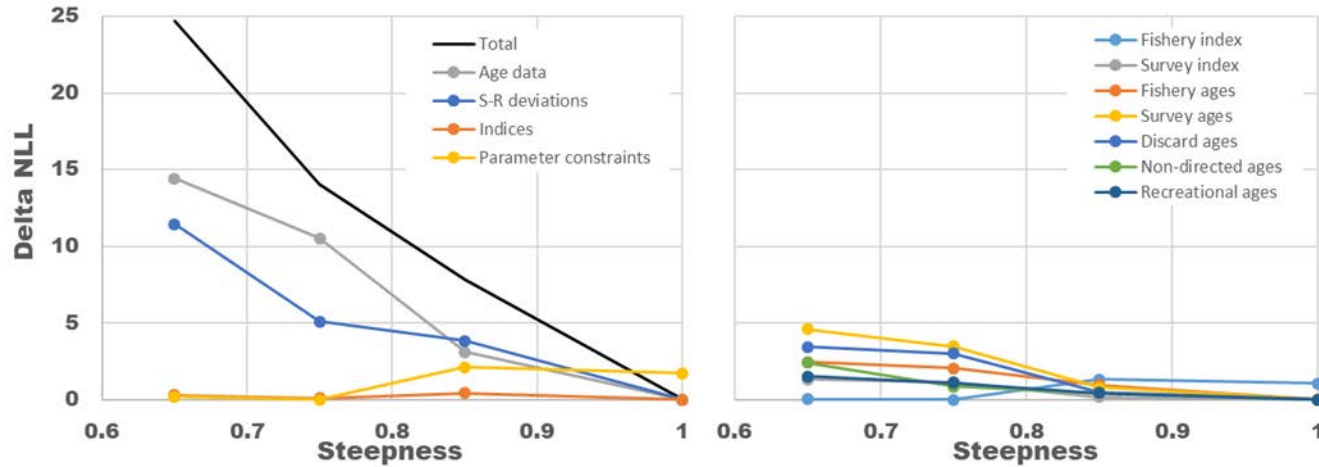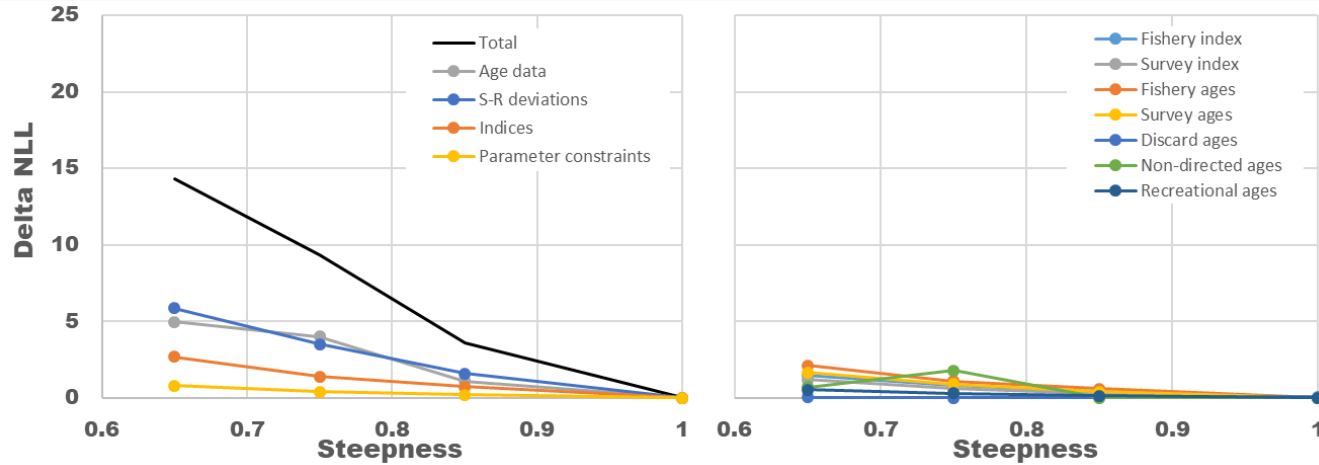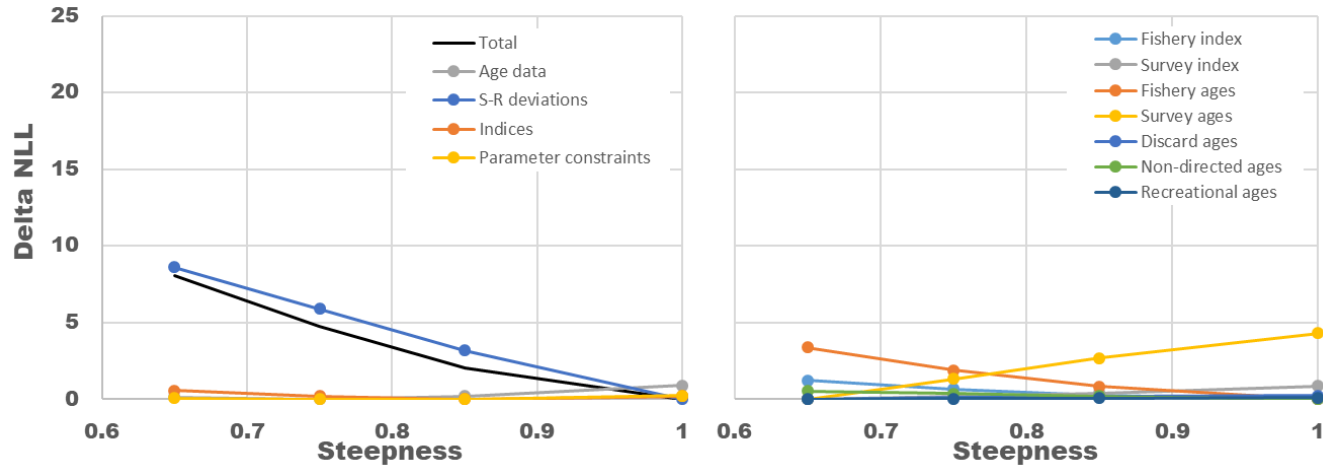
Steepness: Long models

Steepness: Short models

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Profiles: coastwide short

INTERNATIONAL PACIFIC
HALIBUT COMMISSION

Profiles: AAF short

Profiles: coastwide long

Profiles: AAF Long
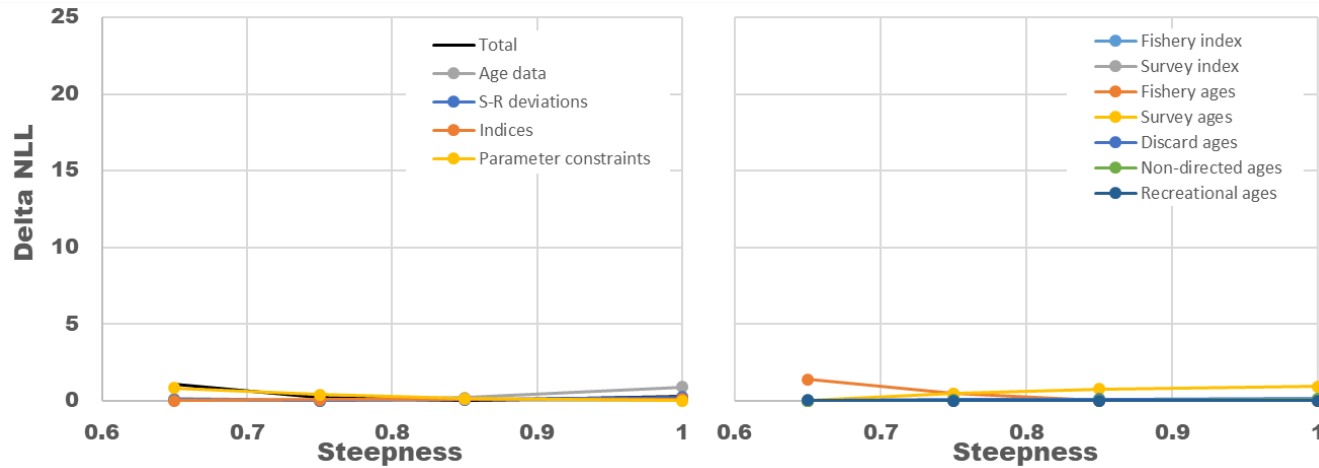
Steepness - Conclusions

- Little information in the data on steepness; much of the likelihood surface created by σ_r
- However, retuning σ_r did not change the results
- No clear and strong data conflicts were identified
- Coastwide models showed the largest effects of different values, biomass and relative biomass somewhat offsetting
- Also no evidence in the data for simple age-based maternal effects

Steepness - Conclusions

- Steepness currently represents an unmodelled source of uncertainty

- Using 0.75 is a compromise that retains some relationship between spawning stock and recruitment (important for reference points), but does not impose a value substantially lower than is consistent with the data
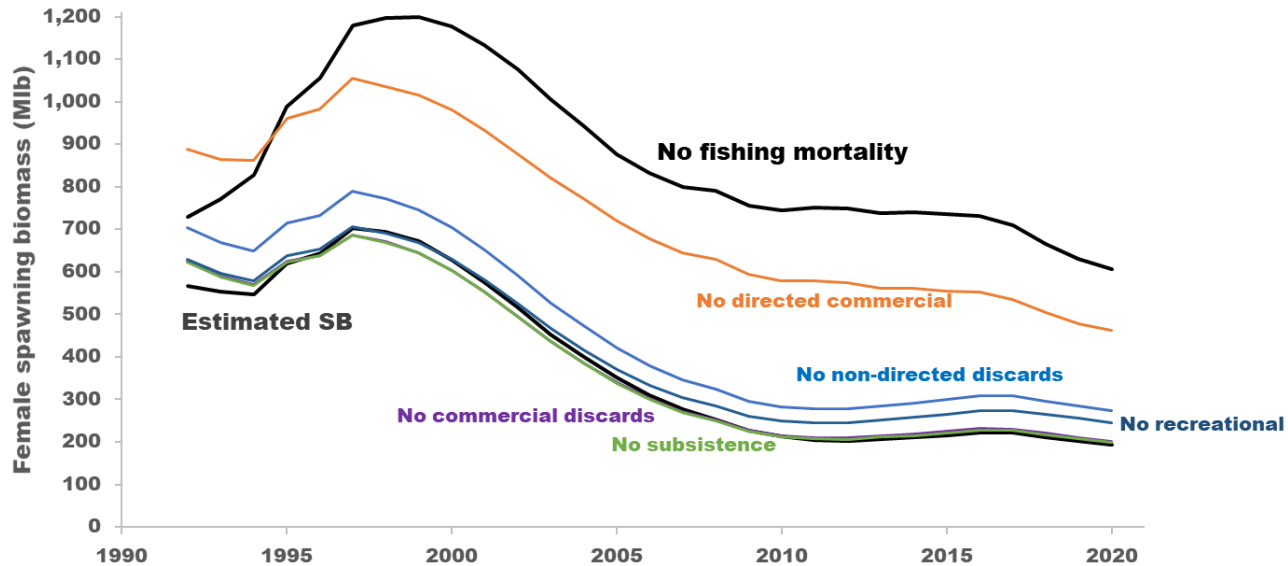
SRB Requests (2)

SRB015 (para. 33): *"The SRB REQUESTED that for SRB016 (2020), the IPHC Secretariat:*

b) consider examining the relative impact of different fleets (sources of mortality) on historical SSB (e.g. set fleet x F = 0, replay, then fleet x and y, etc.)."

Fleet impacts

Generally consistent with the magnitude of cumulative mortality from each source.
Relative trends differ slightly – indicative of changing effects over time.
Could be easily misinterpreted as an alternate management history.

SRB Requests (3)

SRB015–Rec.04 (para. 34): *"NOTING the discussion of recommendations arising from the external peer review of the IPHC stock assessment (Section 4), the SRB RECOMMENDED that the IPHC Secretariat:*

a) Update data weighting for the 2019 assessment;

Data weighting the final 2019 assessment

- Final fully-informed spatio-temporal model output created a much more precise index for the final model (particularly for Region 3)

Data weighting the final 2019 assessment

- This led to fairly large changes in survey data weighting (lower weights; Table 1)

→ Finalizing the weighting <u>after</u> the data were finalized was the right choice in 2019.
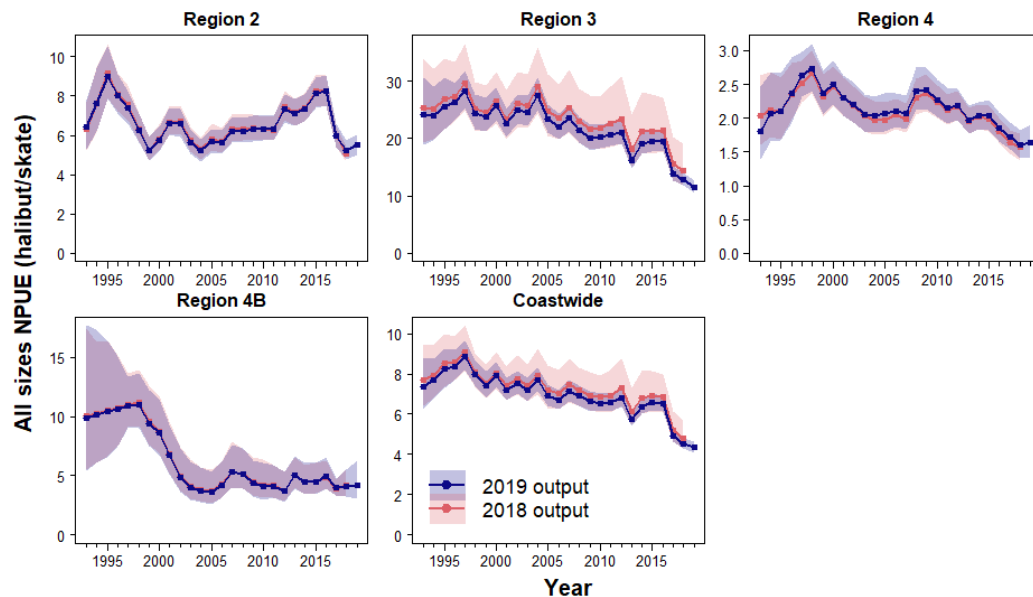
SRB Requests (4)

SRB015–Rec.04 (para. 34): *"NOTING the discussion of recommendations arising from the external peer review of the IPHC stock assessment (Section 4), the SRB RECOMMENDED that the IPHC Secretariat:*

b) For SRB016:

i. evaluate the types of weightings (e.g., Dirichlet-multinomial) for compositional data;

Data weighting approaches

- Many methods exist, none are exactly right for fisheries compositional data

- The assessment currently uses the 'Francis method', starting with the number of samples (not fish) in each year x source.

- This tends toward lower compositional weights than the 'McAllister-Ianelli' method, and produces residuals consistent with the multinomial error assumption.

Data weighting approaches

- Francis method requires iteration – an automated/estimated approach is desirable.

- Dirichlet-multinomial has been applied in a few assessments, but not in complex applications (to our knowledge).
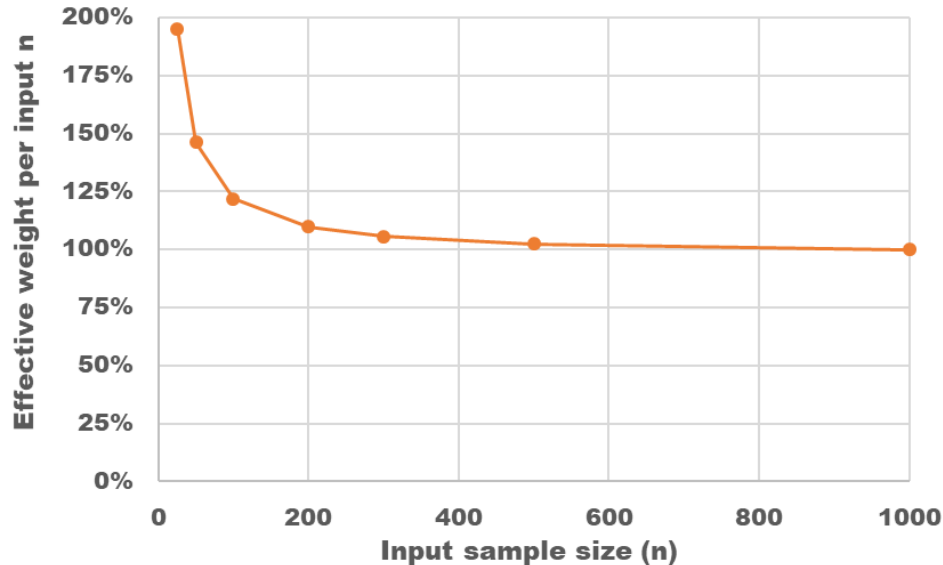
Dirichlet-Multinomial

Not linearly proportional to the multinomial:
      small samples get increasingly large weight at small θ

$$effective\ multinomial\ sample\ size = \left(\frac{1}{1+\theta}\right) + n\left(\frac{\theta}{1+\theta}\right)$$

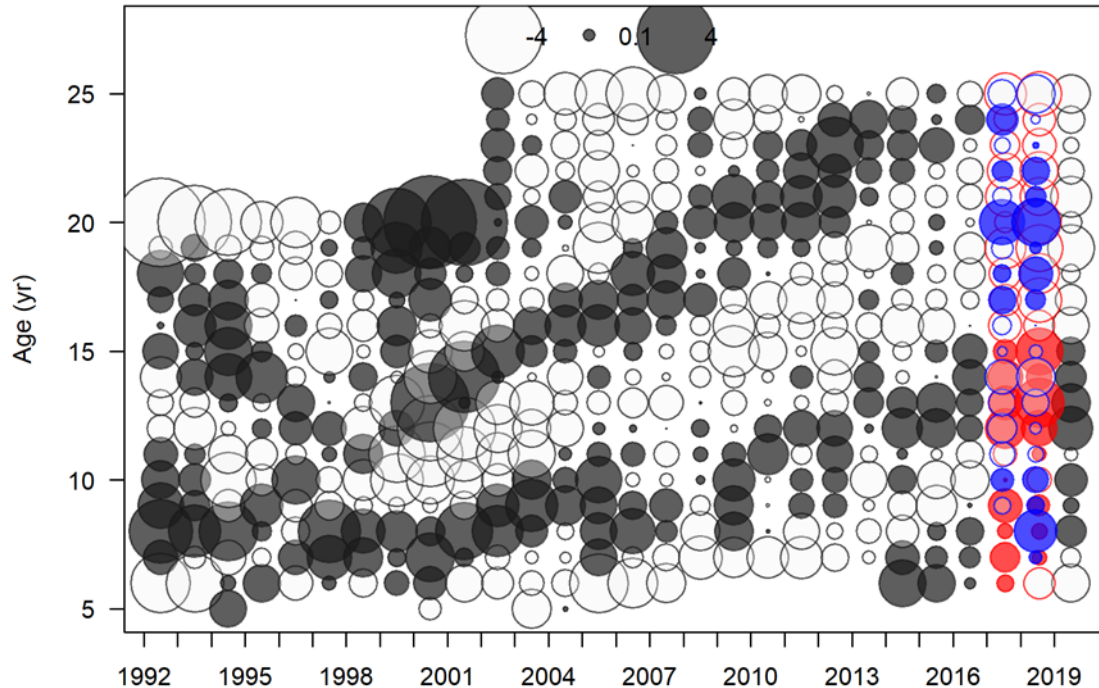INTERNATIONAL PACIFIC
HALIBUT COMMISSION

Dirichlet-Multinomial

- Other issues: Nominal weight requires a parameter at the bound – not good for estimation. Fixing then requires iterative model runs.

- Residuals may be much larger than are consistent with the assumed distribution.

D-M: Fishery residuals short coastwide

Maximum Pearson residual value = 5.8; many > 2

Data weighting

- Other distributions and methods exist.

- Further investigation may be warranted (along with Bayesian models and evaluation of process error) during the next full assessment.

SRB Requests (5)

SRB015–Rec.04 (para. 34): *"NOTING the discussion of recommendations arising from the external peer review of the IPHC stock assessment (Section 4), the SRB RECOMMENDED that the IPHC Secretariat:*

b) For SRB016:

ii. advise on the impact of data re-weighting as new information arises. This could be more sensitive as new sex-composition data are included;

Data weighting during updates

- Retrospective data weighting changes from 2017-2019 (post commercial fishery sex-ratio data) showed little change among years (Table 1) .

- Probably best to continue to reweight each year:
  - For internal consistency
  - To avoid model issues if a new data source arises

SRB Requests (6)

SRB015–Rec.04 (para. 34): *"NOTING the discussion of recommendations arising from the external peer review of the IPHC stock assessment (Section 4), the SRB RECOMMENDED that the IPHC Secretariat:*

b) For SRB016:

iii. keep apprised of new software developments (e.g. CAPAM meeting in NZ) and report on potential future directions (e.g. if alternatives provide improved Bayesian integration or adaptations for simulation testing etc.)."

International Pacific Halibut Commission

'Next generation' modelling and the IPHC

- Secretariat staff participated in the 2019 CAPAM workshop

- Unlikely to be a single 'super-model' anytime soon

- Primary goal for the IPHC is to continue research and development of our specific scientific needs
  - stock synthesis is supporting this in the short-term (e.g. rapid evaluation of maternal effects, alternative likelihoods, etc.)

IPHC model needs

- Currently very tactical – rapid and consistent, but lacking Bayesian and/or formal random-effects
- Medium term – coordination with and support for the MSE, simulation testing, cross development
- Longer term - depends on Management Procedure adopted in 2021
  - May allow for more in-depth, but less frequent assessments (multi-year or survey-based)

New data: Recreational sex-ratios at age
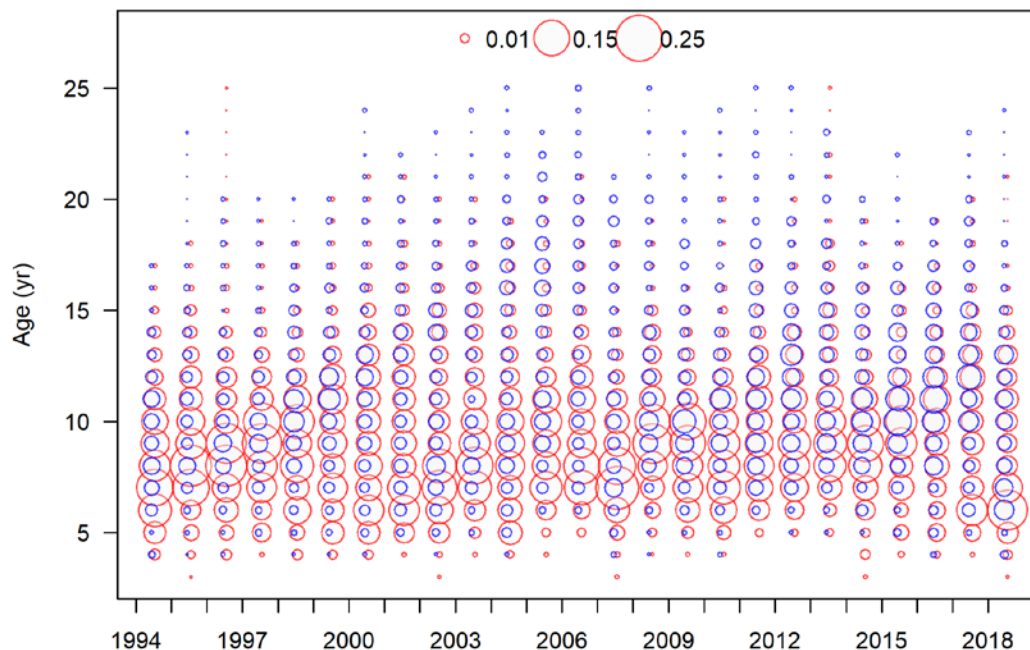
- Average = 72% female, slightly higher than previously assumed via equal selectivity.
- < 2% change in assessment quantities when maximum selectivity separated for males and females.
- Will be reported as a step in the 2020 'bridging' results.

Further 2020 development

- For September:
  - Address any further SRB requests
  - Add any additional data available
- November:
  - Update existing data series
  - Final model weighting, diagnostics and parameter checks
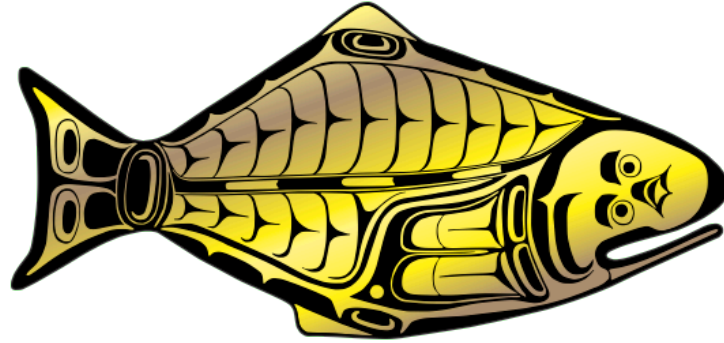 - Produce 2020 assessment for management use

Recommendations

That the SRB:

- **NOTE** paper IPHC-2020-SRB016-07 which provides a response to requests from SRB015 and an update on model development for 2020.
- **REQUEST** any further analyses to be provided at SRB017, September 2020.

INTERNATIONAL PACIFIC

HALIBUT COMMISSION