Development of the 2024 stock assessment

Agenda item: 4.1.1
IPHC-2024-SRB024-08
(I. Stewart & A. Hicks)

Outline

- Stock assessment process

- Time-series and software updates

- Projection of selectivity

- SRB requests
  - General simulation
  - FISS design evaluation simulations

- Other topics

Stock assessment and review process

- Full stock assessments – every ~3 years
  - 2015, 2019, 2022, *2025 (planned)*
  - Includes re-evaluation of all data sources, model structure, etc.
- Updated stock assessments in intervening years
  - 2023, **2024**
  - Only minor/necessary changes as data sets and methods evolve

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Time-series update

- Extend all four models by 1 year (to include 2024)

- 2024 projected mortality based on adopted mortality limits

- No change to the parameter estimates or previous results

- Allows direct comparison of each incremental change from the final 2023 stock assessment to the final 2024 stock assessment (bridging analysis)

Software update

- Stock synthesis version 3.30.21 to 3.30.22.01

- No change to any of the features used in the Pacific halibut stock assessment

- No change to parameter estimates or model results

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New modelling feature

- Time-varying selectivity can now be extended into projections

- Allows propagation of uncertainty

- Previously – average of terminal 3 years of selectivity used for projections

→ Little change to results (see Table 1 of IPHC-2024-SRB024-08), but provides better internal consistency and reflection of uncertainty (especially for cases with high fishing intensity)
  - Standard procedure in true random effects models
  - Consistent with the treatment of recruitment deviations in projections

SRB requests and recommendations

1) SRB023–Rec.03 (para. 20):

*"The SRB **RECOMMENDED** that the Secretariat investigate approaches (e.g. simulation testing) to estimating uncertainty (or bounding the minimum level of uncertainty) in different assessment outputs: e.g. coastwide and Biological Region spawning stock biomass (see related actions under Section 4.2)."*

General assessment simulation testing

- Stock Synthesis has a parametric bootstrap procedure that samples from the expected values from a model fit
  - Generates n new data sets that are unbiased relative to the original model fit
  - Each data set carries the same dimension and the same precision (sample sizes for age composition data, CVs for indices of abundance) as the original data

- This is a model 'self-test', not a simulation based on alternative assumptions of population dynamics, sampling properties, etc.
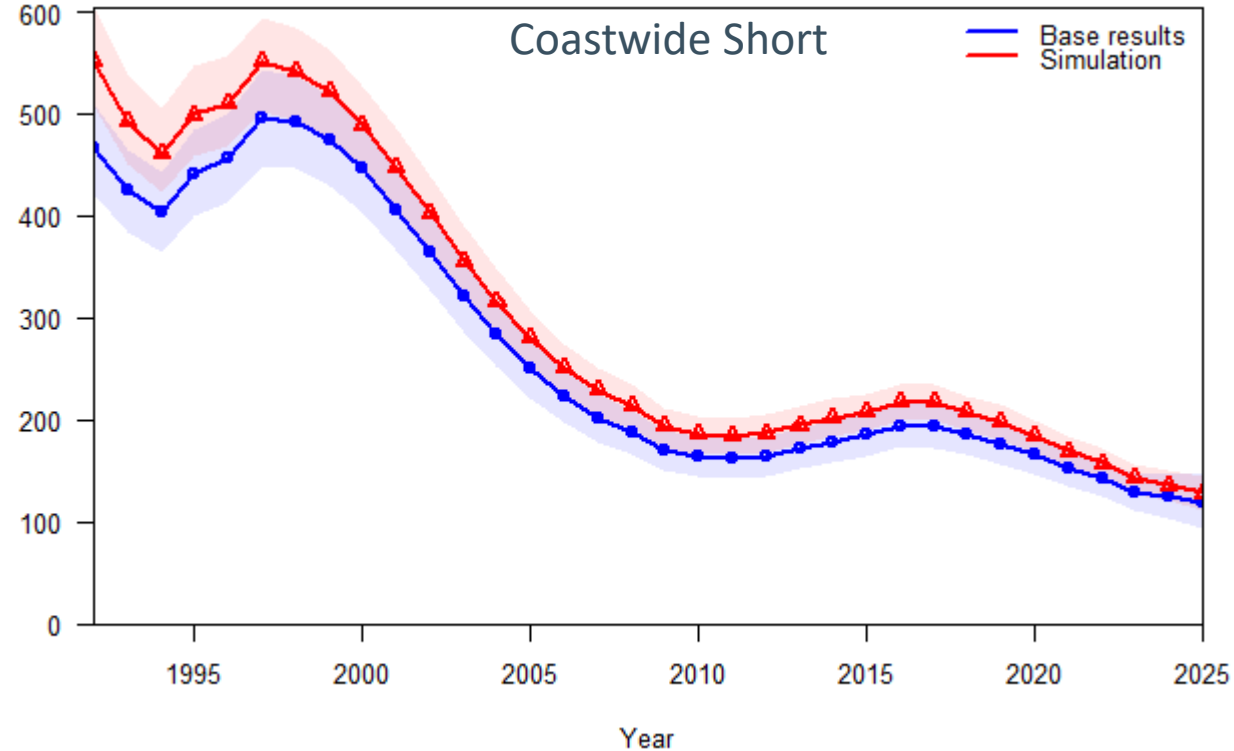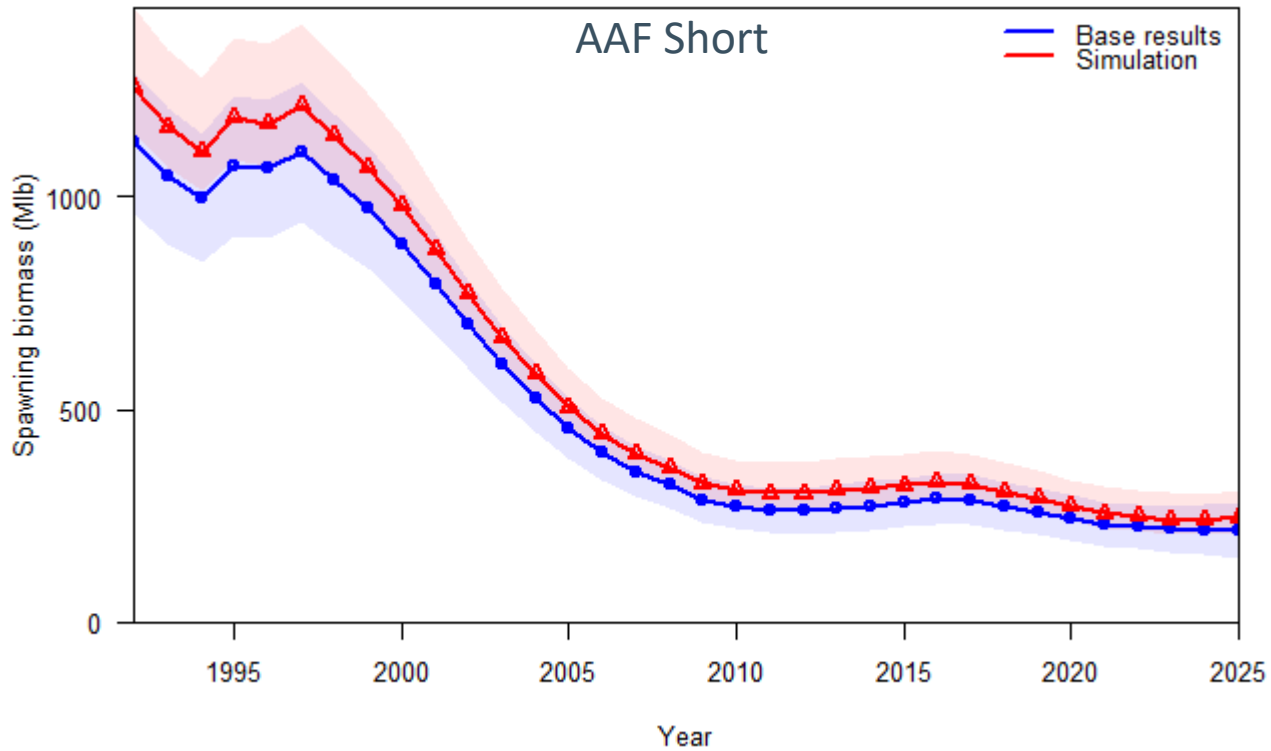
General assessment simulation testing

- Each of the four assessment models were used to create 100 new data sets

- Each of the new data sets was fit using that assessment model

- Results were summarized by individual model
  - Distribution of the MLEs for each fit were compared to the uncertainty intervals from the original model fit

- Results were also summarized for the ensemble as if it was producing standard management quantities
  - 2.5th, 50th, and 97.5th intervals for each of the 100 simulated ensembles to the original ensemble distribution

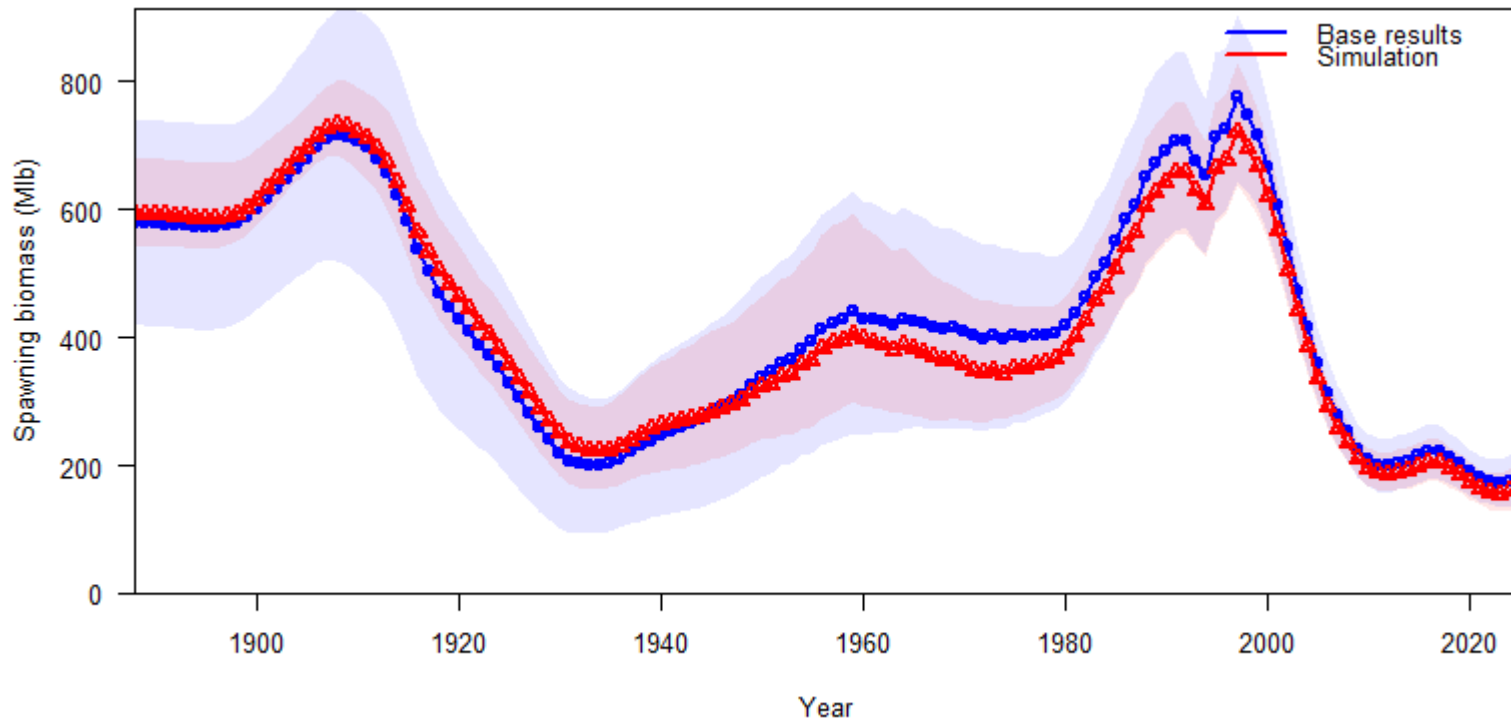INTERNATIONAL PACIFIC
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General assessment simulation testing

Both short time-series models slightly overestimated the spawning biomass

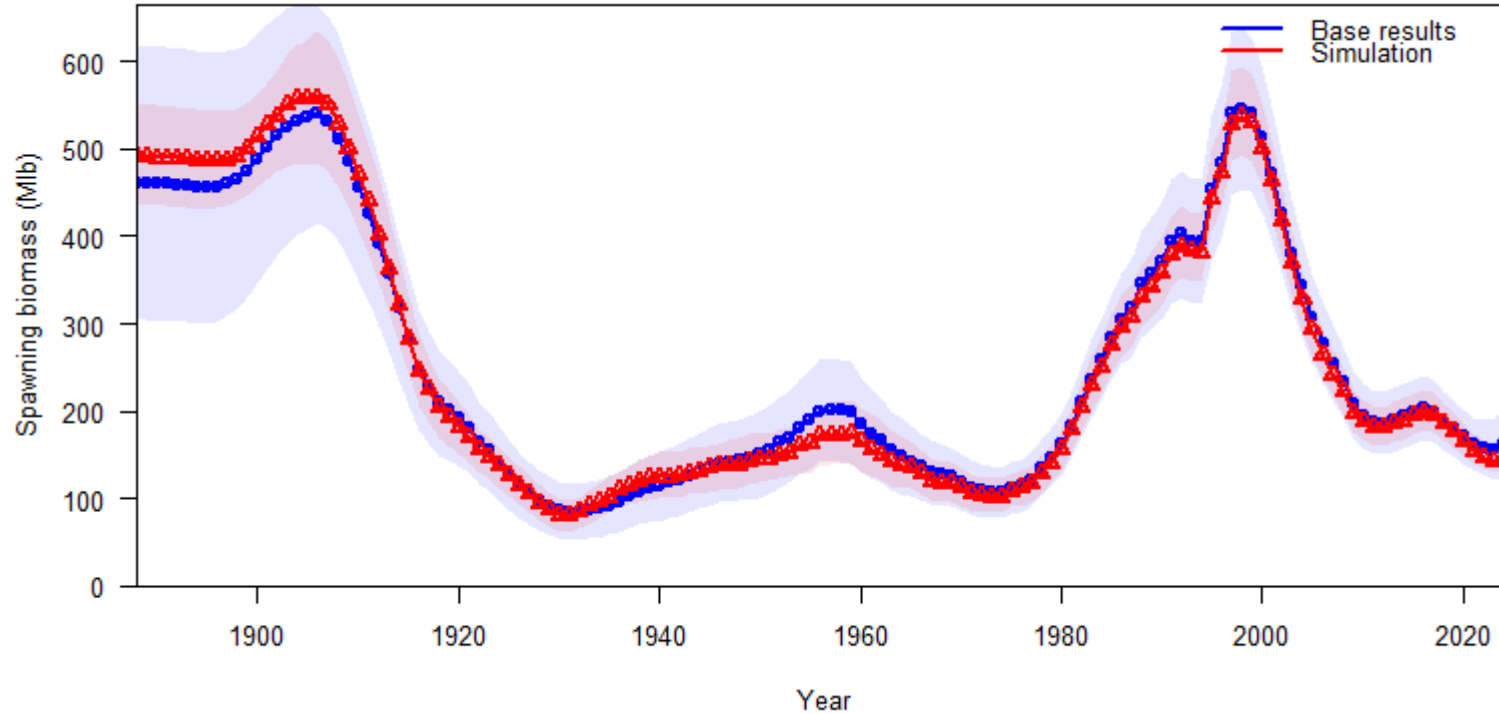INTERNATIONAL PACIFIC
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General assessment simulation testing

The AAF long time-series model slightly underestimated the spawning biomass
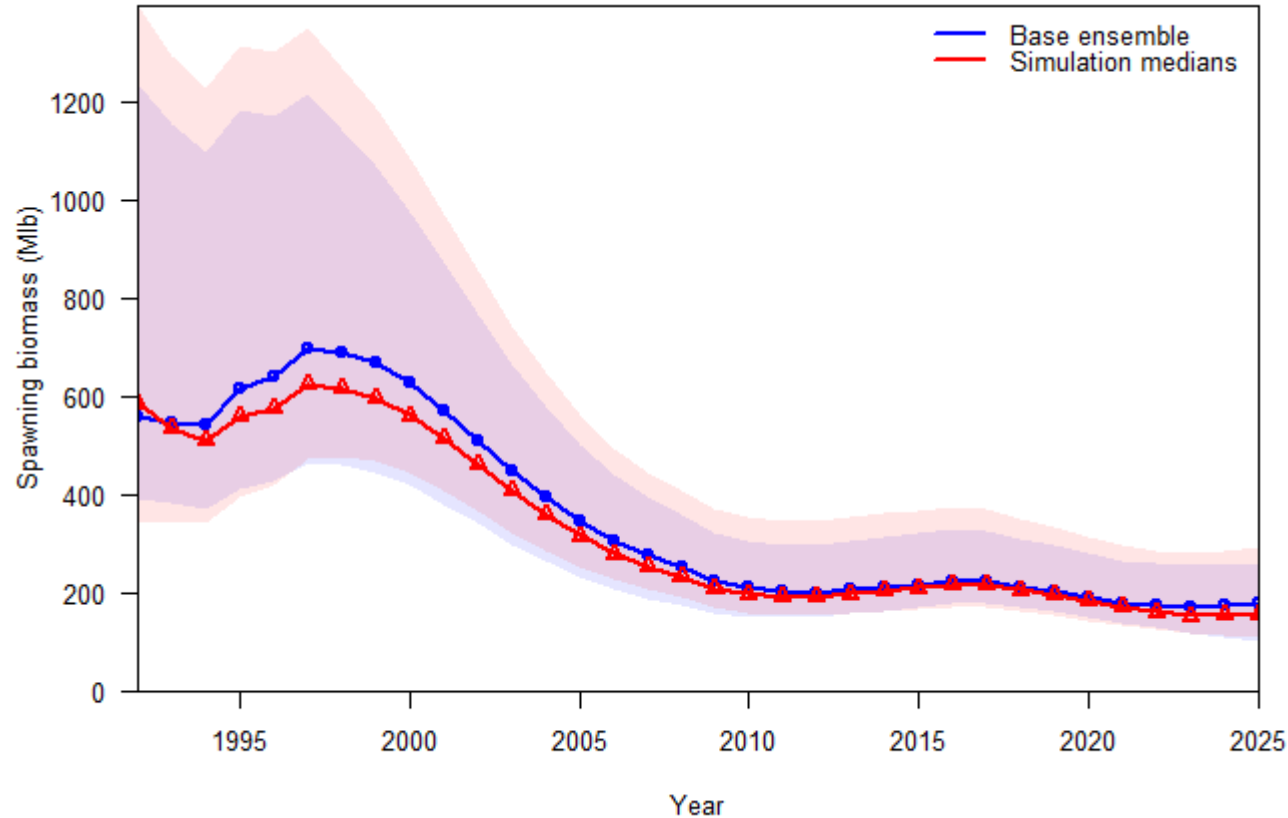
General assessment simulation testing

The coastwide long time-series model also slightly underestimated the spawning biomass

General assessment simulation testing

The full ensemble slightly underestimated the spawning biomass, but had a similar probability distribution

General assessment simulation testing

- Minor differences between original and simulation fits for individual models may be caused by conflicting signal among data sets not entirely corrected by iterative reweighting

- Management quantities have similar probability distributions

- Results highlight an additional benefit of the ensemble approach used in recent stock assessments

SRB requests and recommendations

2)   SRB023–Rec.19 (para. 59):

*"The SRB **RECOMMENDED** that the Secretariat continue exploring ways of estimating the impacts of different FISS designs and efficiency decisions on stock assessment outputs and fishery performance objectives. The end goal should be to provide a decision support tool that can frame decisions about FISS design in terms of costs and benefits in comparable currencies."*

3)   SRB023–Req.07 (para. 60):

*The SRB **REQUESTED** that the Commission NOTE that some longer-term (2025 and beyond) implications of reduced FISS designs are predictable and potentially consequential. For instance, higher FISS CVs will generally result in higher inter-annual variation in TCEY under the current decision-making process. This would occur for two reasons: (1) biomass estimates and projections from the assessment model will have greater uncertainty and therefore greater variability in outputs and (2) ad hoc management adjustments to the interim harvest policy recommendations would be more frequent and/or more variable for greater input uncertainty. The SRB therefore REQUESTED the following analyses for SRB024:*

a) Assessment of reduced FISS designs (2025-2027) via simulation tests of assessment model outputs (e.g. probability of decline, estimated stock abundance and status, TCEY) under alternative revenue-neutral FISS designs using the existing stock assessment ensemble;

b) Mitigation options of reduced FISS designs (short-term and long-term) via MSE simulations of management procedures that deliberately aim to reduce inter-annual variability in TCEY via multi-year TCEYs and (possibly) fixed stock distribution schemes;

c) Components (a,b) above would be integrated since (a) will need to inform simulations in (b)."

4)   SRB023–Req.08 (para. 61):

*"The SRB **REQUESTED** that simulations above (para. 60) include:*

a) a relationship in which the FISS CV is relatively higher at lower stock abundance (i.e. the current CV issue is a function of stock abundance rather than a short-term condition);

b) target regulatory area CVs of 15%, 20%, 25%, and 30%;

c) coastwide target CV of 15% without controlling specific regulatory area CVs."

FISS design simulation proposal

- 3 phase approach to FISS design evaluation:
  1) Projections of CVs using the space-time model (IPHC-2024-SRB024-06) reported at this meeting
  2) Simulation experiment using the stock assessment model to evaluate the results from phase 1
  3) MSE evaluation using the results from phase 2

FISS design simulation proposal

- 3 FISS designs:
  1) 'Base block design' - preferred design given Commission guidance and supplementary funding; unbiased (over the 3-year rotation) and relatively precise
  2) 'Core design' - possible under reduced supplementary funding/revenue, similar to 2023; potentially biased and would provide reduced information, larger CVs and gaps in estimates of stock distribution
  3) 'Reduced core design' – possible under continued self-funding only, similar to 2024; likely biased with large CVs and no coverage over broad areas of the stock distribution

FISS design simulation proposal

- Steps to produce new simulation data sets:
  - Extend time-series to 2027 for each of the four models
  - Define 'true' models as those using the base block design and unbiased FISS indices
  - Fit 'true' models with no trend, +15% trend in FISS index, -15% trend in FISS index; assume all other data sets continue to be collected as in 2023
  - Bootstrap 100 new data sets for each model and trend

FISS design simulation proposal

- Experiment 1: Effect of increased CVs due to design reductions
  - 'True' data from the fit to bootstraps based on the Base block design with no trend
  - Compare to fit to bootstraps from models using less precise data (index CV and age compositions) representing the core and reduced core designs
- How does a reduced but unbiased FISS affect management quantities?
  - Report ensemble-based bias in: fishing intensity, spawning biomass, estimated risk of stock decline

FISS design simulation proposal

- Experiment 2: Effect of failing to detect an increasing trend due to design reductions
  - 'True' data from the fit to bootstraps based on the Base block design with +15% increase in FISS index
  - Compare to fit to bootstraps from models using less precise (index CV and age compositions) and biased data (no trend) representing the core and reduced core designs
- How does a reduced and biased FISS affect management quantities?
  - Report ensemble-based bias in: fishing intensity, spawning biomass, estimated risk of stock decline

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FISS design simulation proposal

- Experiment 3: Effect of failing to detect a decreasing trend due to design reductions
    - 'True' data from the fit to bootstraps based on the Base block design with -15% increase in FISS index
    - Compare to fit to bootstraps from models using less precise (index CV and age compositions) and biased data (no trend) representing the core and reduced core designs

- How does a reduced and biased FISS affect management quantities?
    - Report ensemble-based bias in: fishing intensity, spawning biomass, estimated risk of stock decline

FISS design simulation proposal

- This simulation-based approach misses one critically important aspect of the FISS data in the IPHC management process: *participant confidence*

- Recent years have shown that management discussions are affected by gaps in the FISS both quantitatively (e.g., poorly informed estimates of stock distribution) and qualitatively (perception of risk)

- Long term FISS planning must include financial stability, evidence that the design meets quantitative objectives and ensuring continued participant confidence in the process and annual results

2024 Stock assessment timeline

- July-September:
  - Assessment simulation testing of alternative FISS designs
  - 2023 sex-specific fishery age composition estimates available
  - Exploration of maturity results in the stock assessment
- September (SRB meeting): Response to June SRB requests
  - No further model changes except as recommended by SRB025
- October: Final 2024 data sets become available
- 1 November: Data sets close for 2024
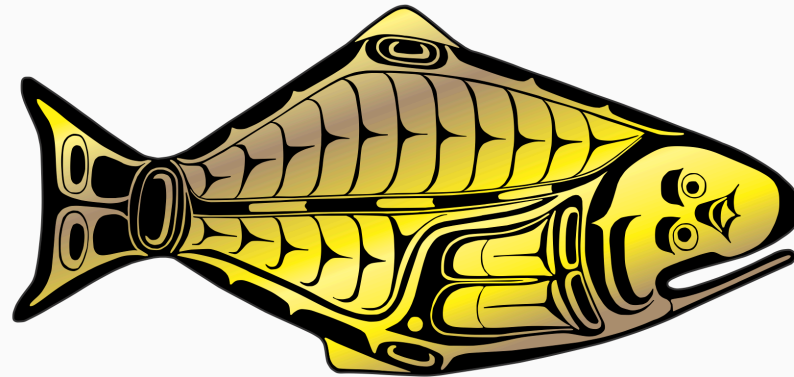- Late November: 2024 stock assessment results provided to the Commission

Recommendations

a) **NOTE** paper IPHC-2024-SRB024-08 which provides a response to requests from SRB023, and an update on model development for 2024.

b) **REQUEST** any modifications to the proposed FISS design simulations.

c) **REQUEST** any further analyses to be provided at SRB025, 24-26 September 2024.

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