INTERNATIONAL PACIFIC HALIBUT COMMISSION

2023-25 FISS design evaluation

Agenda item 5

IPHC-2022-SRB021-06

(R. Webster)

Topics

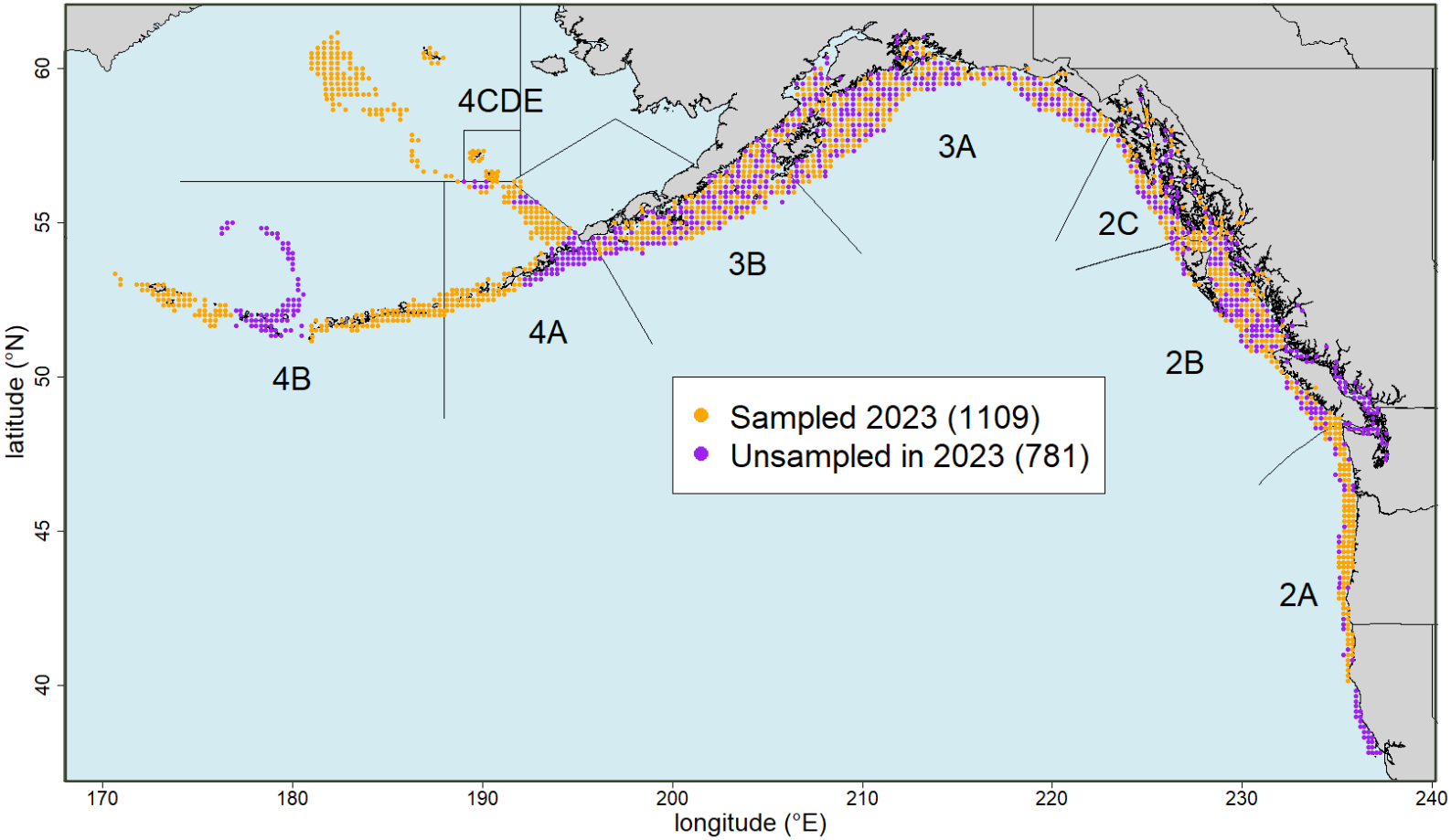
1. 2023-25 FISS design evaluation
2. Bering Sea model update
3. Bias evaluation methodology

1. 2023-25 FISS design evaluation

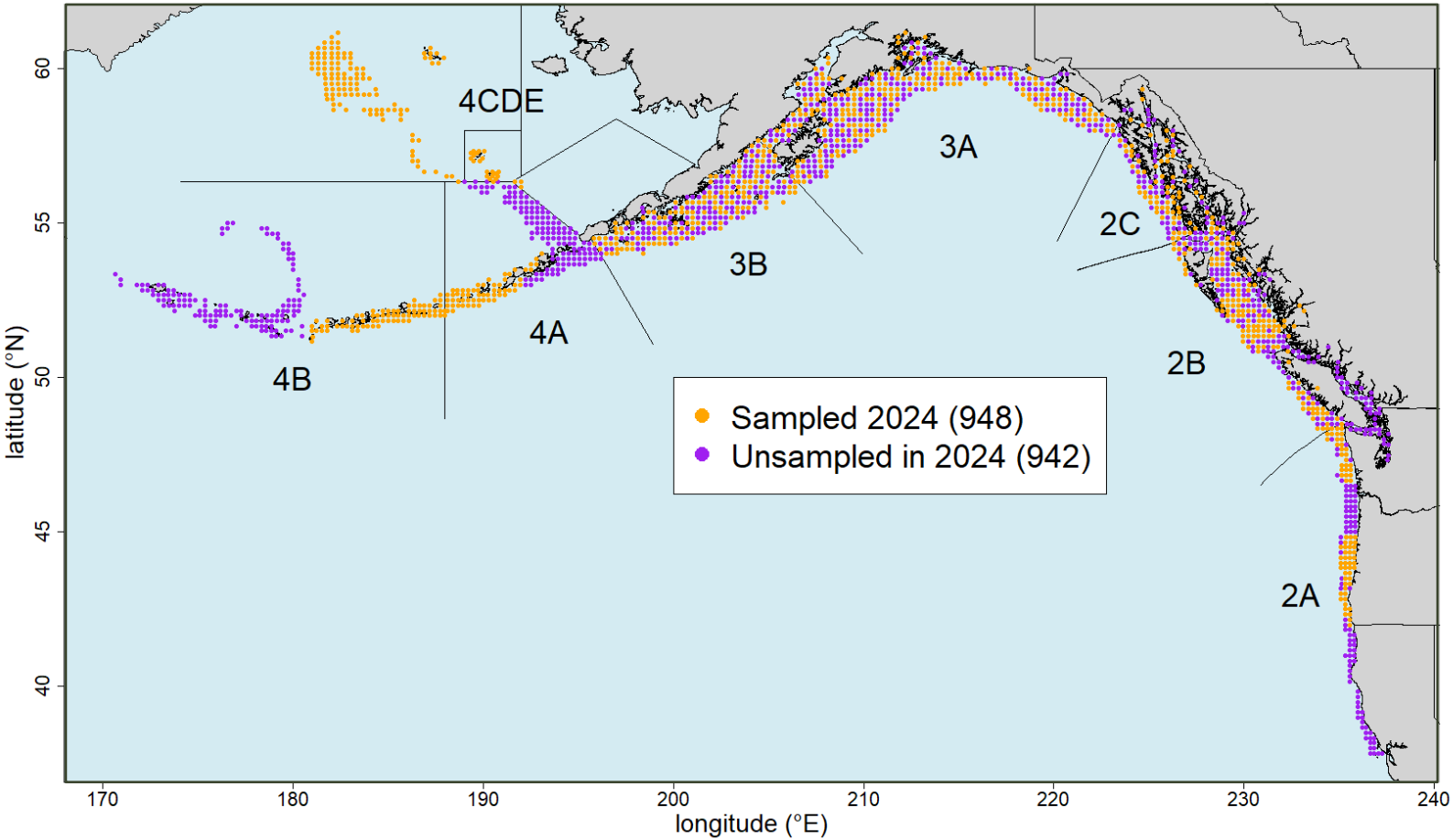
- At SRB020, the Secretariat presented proposed FISS designs for 2023-25 together with an evaluation of those designs.
- Based on the evaluation, it is expected that the proposed designs would lead to estimated indices of density that would meet bias and precision criteria.
- In their report (IPHC-2022-SRB020-R, paragraph 12) the SRB stated:

> *The SRB **ENDORSED** the final 2023 FISS design as presented in Fig. 2, and provisionally **ENDORSED** the 2024-25 designs (Figs. 3 and 4), recognizing that these will be reviewed again at subsequent SRB meetings.*

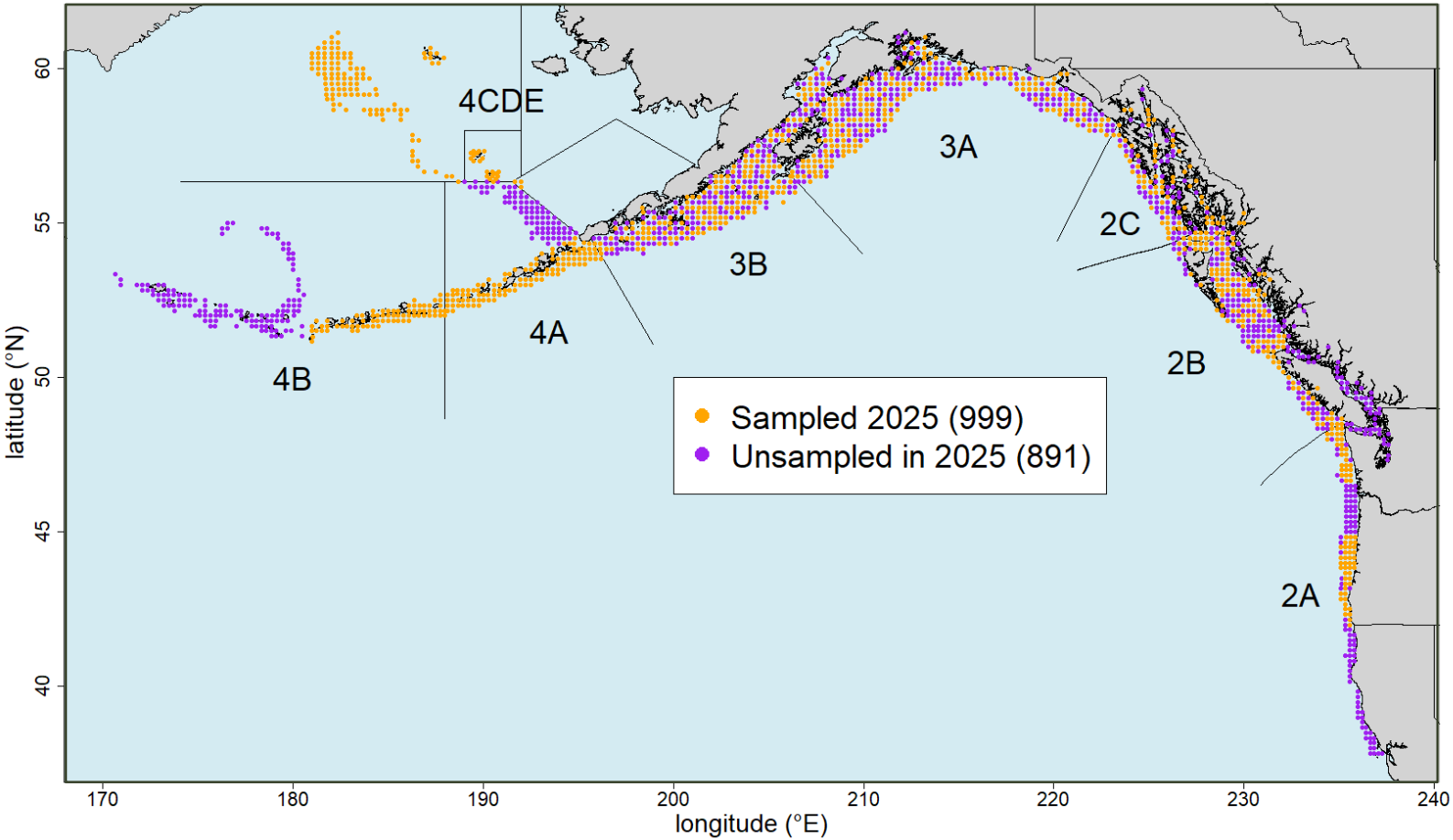
Proposed 2023 FISS design



Proposed 2024 FISS design



Proposed 2025 FISS design



Recommendation

That the Scientific Review Board:

1) **RECOMMEND** that the Commission note the SRB endorsement of the proposed 2022 design (Figure 1.1 of IPHC-2022-SRB021-06) and provisional endorsement of the proposed 2024-25 designs (Figures 1.2 and 1.3).

2. Bering Sea model update

- NMFS trawl to FISS calibration study conducted in 2006 and 2015 when surveys overlapped in eastern Bering Sea.
- Once a length calibration has been undertaken, the calibrated trawl index is scaled to have the same lb/skate units as FISS.
- Scale factors have been estimated external to the space-time modelling of combined FISS and trawl data.
- A single scale factor is estimated for each variable: O32 WPUE, all sizes WPUE and all sizes NPUE.
- Scalars are assumed known: no variance is propagated into the space-time model estimates.

Estimating gear scaling within the model

- The space-time model separates the WPUE or NPUE process into zero and non-zero components.
- Gear (calibrated trawl, setline) coefficients can be added to each model component to account for differences in index values due to gear effects.

Variable	Description	Zero parameter	Non-zero parameter
Gear type	1=trawl, 0=FISS	g_z	g_{nz}
Calibration stations (overlapping trawl and FISS 2006, 2015 stations)	1=calibration, 0 otherwise	c_z	c_{nz}
Interaction (trawl stations within the calibration study)	1=trawl calibration, 0 otherwise	gc_z	gc_{nz}

Parameter estimates

- Estimates for trawl effect parameters:

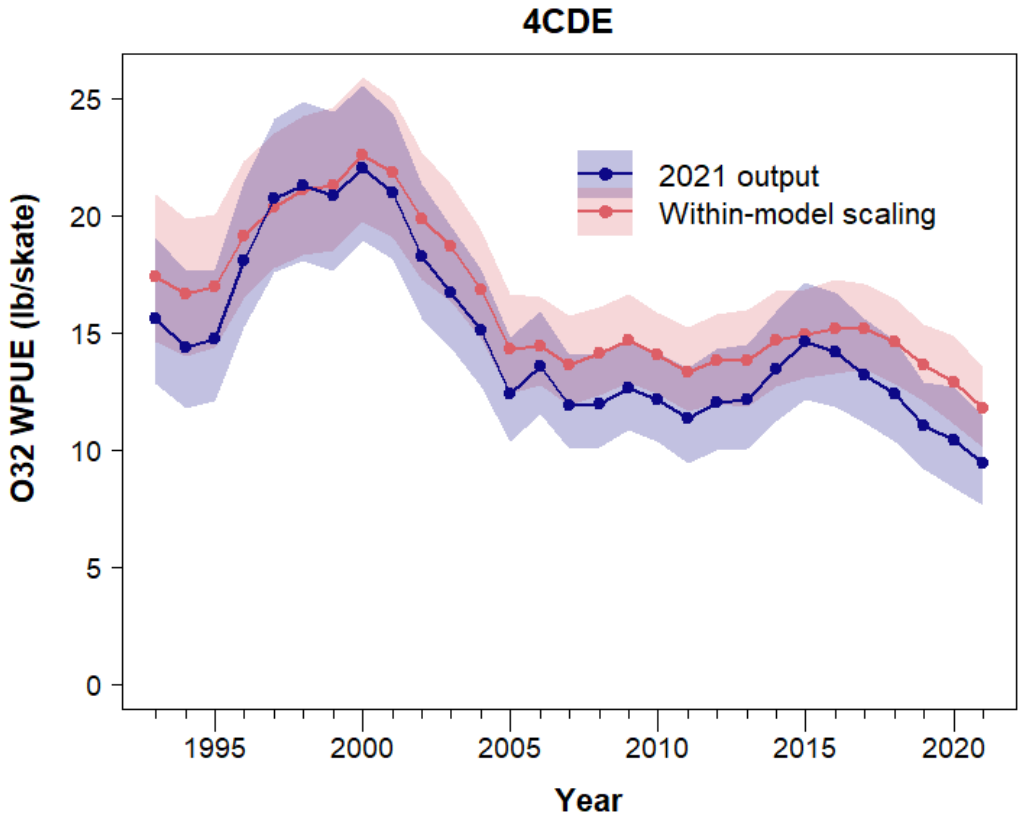
Parameter	Posterior mean (SD)	Parameter	Posterior mean (SD)
g_z	−3.095 (0.130)	g_{nz}	−3.315 (0.050)
gc_z	0.999 (0.265)	gc_{nz}	0.494 (0.117)

- This leads to these estimated scale effects:
  - 8.1 for zeros, meaning odds of non-zeros is ~8 times greater on FISS than trawl
  - 16.8 for non-zeros, meaning when fish are caught, the index value is ~17 times greater on the FISS than the trawl survey

Parameter estimates

- These values are generally consistent with the scale factor of 37 applied to all calibrated trawl values (zeros and non-zeros) outside of the model for O32 WPUE
  - The calibrated trawl index needs to be scaled up to match the units of the FISS index
- However, treating the zero-model component separately affects how zeros are handled:
  - The trawl survey has a higher proportion of zero values than the FISS
  - This is ignored when scaling all data by the same factor outside the model: 37 times 0 is still zero, and the model treats data from both gears as coming from the same process
  - By including the gear difference within the model, we allow the probability of a zero to be vary with gear type, and thus this probability gets adjusted when undertaking prediction (when values are predicted assuming FISS gear only)
  - This has an impact on the time series, especially when there are no FISS sets among the trawl sets (i.e., outside of 2006 and 2015) and when zeros are more common on the trawl (i.e., in years with lower Pacific halibut density)

Revised O32 time series for 4CDE



Comments

- Estimating gear differences within the model adds flexibility that better allows for differences in the data generating processes for each gear type.
- Our intention is to use this revised model for estimating the Regulatory Area 4CDE time series
- Some calibrated trawl data are also used in Regulatory Area 4A, but very few values come from the 2006 and 2015 experiment
  - Will continue to use external estimates of scaling factors for this area
- Some technical issues (with revised models crashing) still need to be resolved

3. Bias evaluation methodology

- At present we evaluate bias potential of a possible FISS design as follows:
  - Use space-time model output to estimate time series for each subarea (just for Regulatory Areas 2A, 4A and 4B at present).
  - For each year in each subarea, calculate number of years for a change of at least 10% in proportion of Reg Area's biomass to have occurred.
  - If *at any point in the time series* the number of years is less than the proposed period since a subarea was last sampled, the possible design is rejected.
- This approach weights all years equally, regardless of how far in the past they are.
- As the time series grows, the chance of a 10% or greater change over a given interval for *at least one year in the time series* increases, i.e., possible designs are more likely to be rejected over time.

Proposed new approach

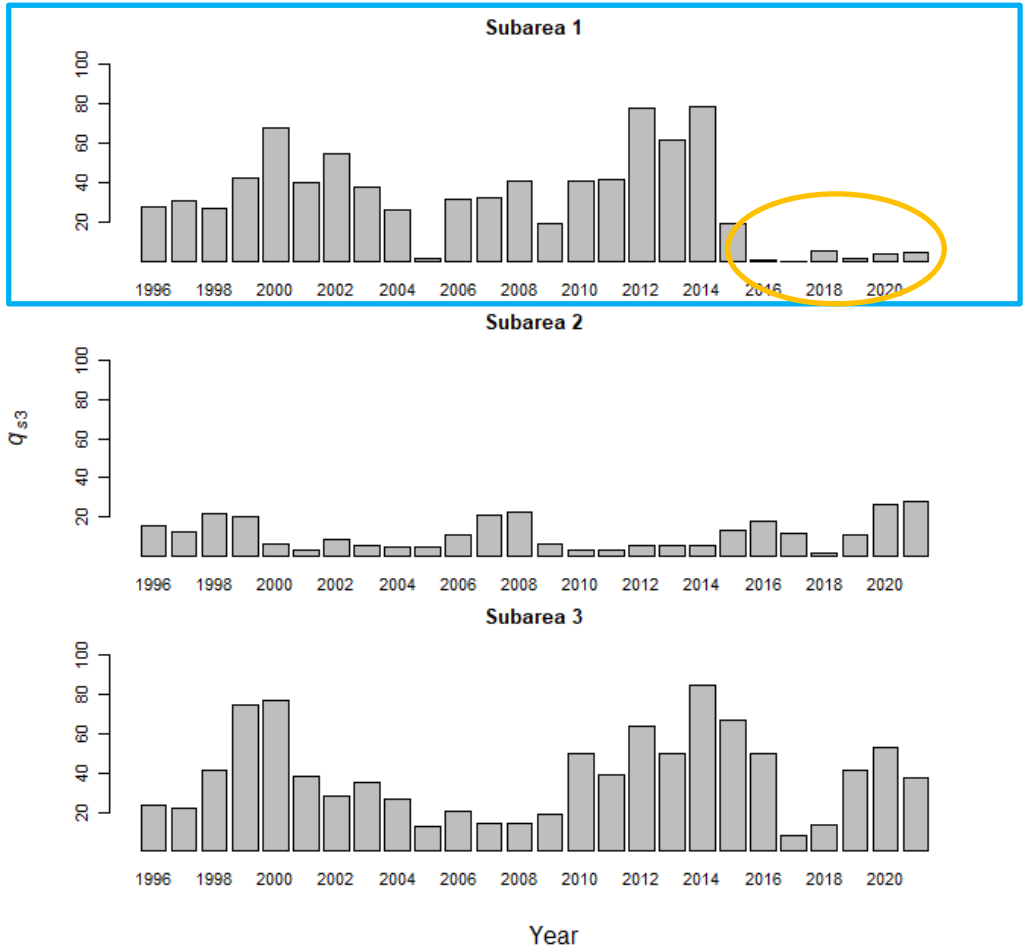
- Use the space-time model output to estimate the probability of at least a 10% change in biomass proportion over a specified time period
  - Do this for each year in each subarea
- Use these probabilities to assess the likelihood of this size of change over a proposed unsampled interval
  - Give greater weight to probabilities from recent years in this evaluation

Example: Subarea 1 in 4B

- This subarea encompasses the western Aleutian Islands.
- Last sampled in 2019, with some stations not sampled since 2017.
- Proposed for sampling in 2022 based on historical time series showing >10% change in biomass proportion over three years at least once in the past.
- No viable bids in 2022; proposed for sampling in 2023, four years since previous survey
- Current bias evaluation assumes high risk of bias based on entire historical time series

Estimated probabilities of at least 10% change in biomass proportion over previous three years.

Low probabilities of large change in recent years



Comments

- Time since high probability of large (>10% biomass) change is easily factored into the evaluation
  - Can focus on probabilities in the most recent years
- Probabilities incorporate uncertainty in the time series
  - For example, lack of sampling increases the variance of WPUE, and this variability propagates into the probabilities of large change

Recommendations

That the Scientific Review Board:

1) **NOTE** paper IPHC-2022-SRB021-06 (part 2) that presents an update to the space-time model for IPHC Regulatory 4CDE, and a proposal for revising the evaluation of bias potential in future FISS design proposals.

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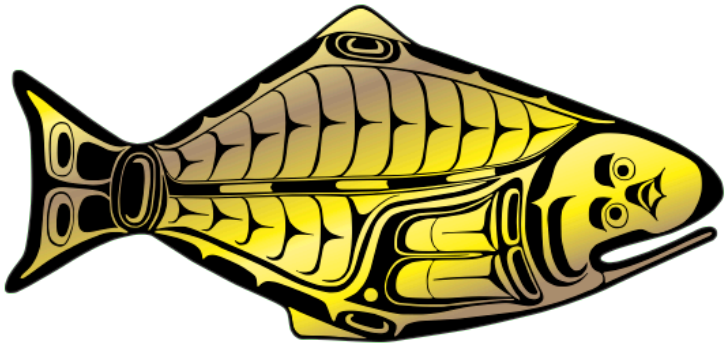

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