INTERNATIONAL PACIFIC HALIBUT COMMISSION

2024-26 FISS design evaluation

Agenda item: 4.2.2
IPHC-2023-SRB022-06
(R. Webster)

Summary

- Background
  - IPHC history of FISS, 1993-2019
  - Space-time modelling
  - FISS design objectives
  - Review process
- Proposed FISS designs for 2024-26
  - Evaluation and revision of designs
- Consideration of cost

IPHC FISS

- Our most important source of data on Pacific halibut
- Provides data for estimating weight and numbers per unit effort (WPUE and NPUE) indices of density and abundance of Pacific halibut
  - Used to estimate stock trends
  - Used to estimate stock distribution
  - Important input in the IPHC stock assessment
- Provides biological data for use in the stock assessment

FISS history 1993-2019

- A standardised FISS has been conducted by the IPHC each year since 1993
  - Standardised for bait and fishing gear
- From 1993-97 coverage was limited and generally restricted to IPHC Regulatory Areas 2B, 2C, 3A and 3B
- The modern FISS design on a 10 nmi grid began in 1998
- By 2001, annual coverage occurred in all IPHC Regulatory Areas
  - Depth range 20-275 fathoms in Gulf of Alaska and Aleutian Islands
  - Depth range 75-275 fathoms along Bering Sea shelf edge

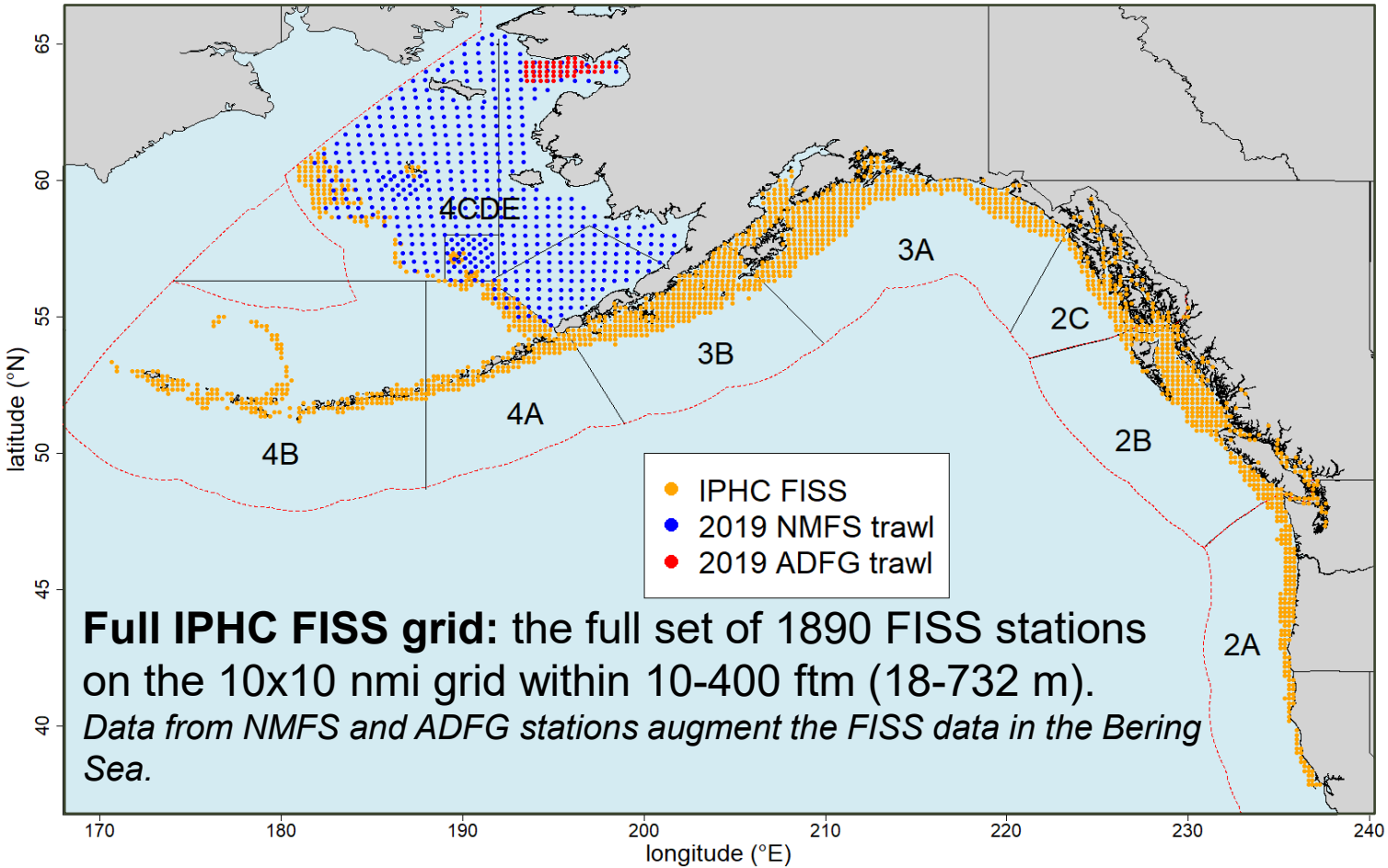
FISS history 1993-2019

- By 2010, data from other sources showed that not all Pacific halibut habitat was covered by the FISS
  - Pacific halibut were present outside the FISS depth range, in both deep and shallow waters
  - All IPHC Regulatory Areas had coverage gaps, even within the standard depth range
- Such unsampled habitat meant there was the potential for bias in estimates derived from FISS data
- Therefore, a series of FISS expansions from 2011 to 2019 were undertaken covering previously unsampled habitat in all IPHC Regulatory Areas

FISS history 2011-2019

- During the expansions, the FISS occupied for the first time 34% of the stations on the full 10 nmi FISS grid that had been previously unsampled
- The result was an improved understanding of Pacific halibut density and distribution
  - Bias was reduced, with indices for several Regulatory Areas being revised upwards or downwards
  - Uncertainty in estimates of WPUE and NPUE was reduced in most Regulatory Areas
  - These improvements were apparent throughout the time series, not only in the year of the expansion
- The resulting expanded grid of 1890 stations has provided a full FISS design from which stations can be selected for sampling in each annual FISS

Full FISS grid



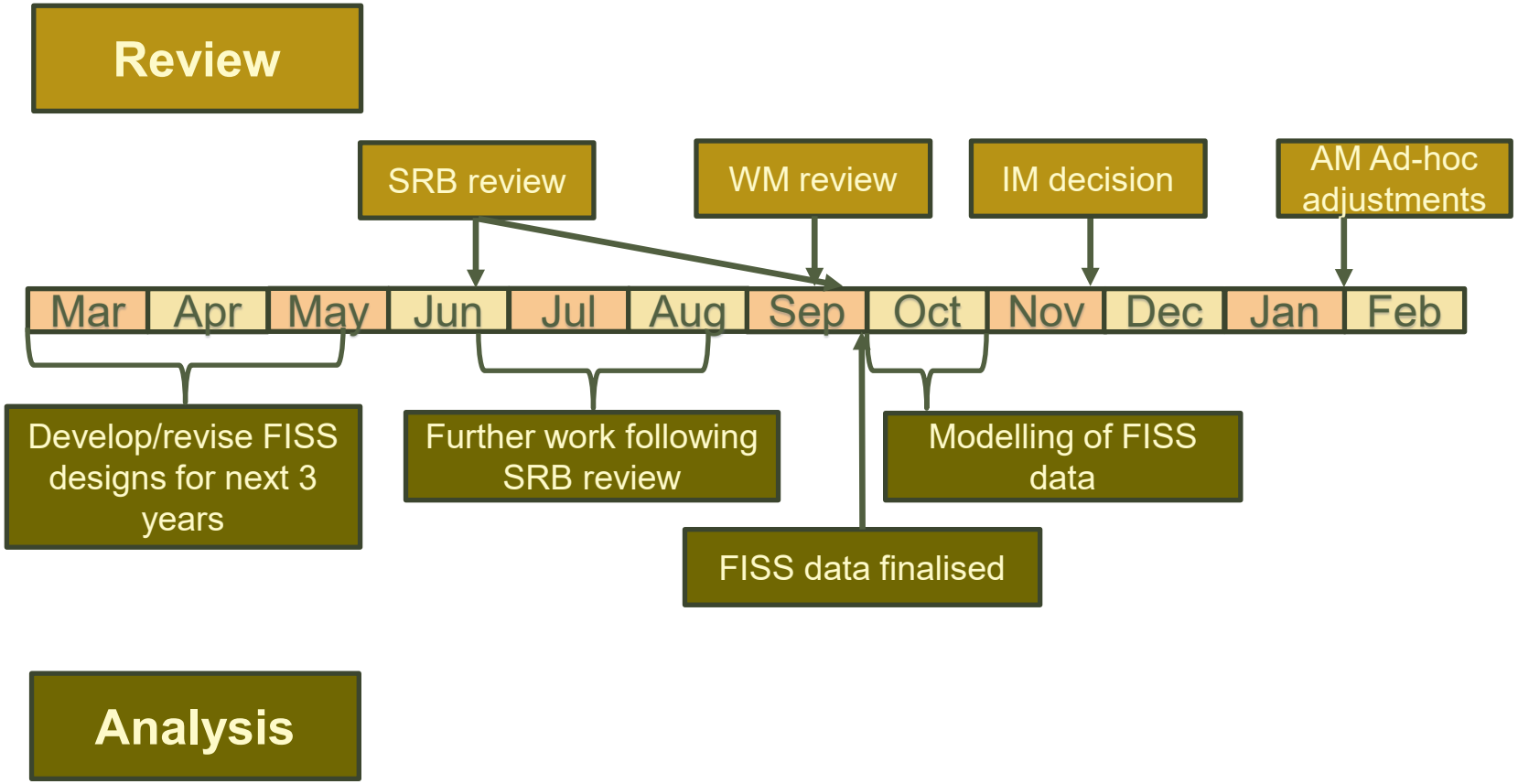
Full IPHC FISS grid: the full set of 1890 FISS stations on the 10x10 nmi grid within 10-400 ftm (18-732 m).

Data from NMFS and ADFG stations augment the FISS data in the Bering Sea.

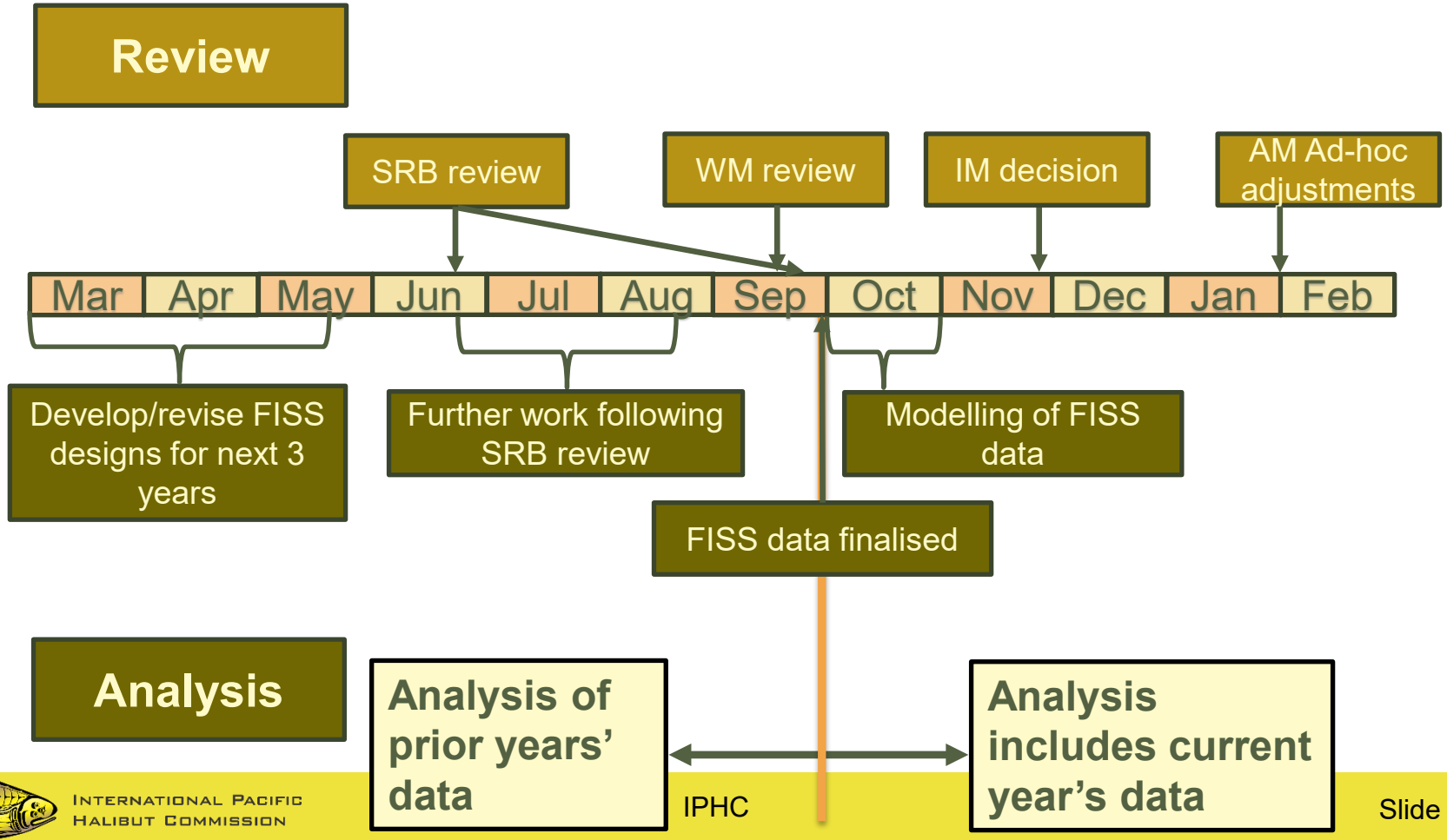
FISS objectives and design layers

Priority	Objective	Design Layer
Primary	Sample Pacific halibut for stock assessment and stock distribution estimation	Minimum sampling requirements in terms of: • Station distribution • Station count • Skates per station
Secondary	Long term revenue neutrality	Logistics and cost: operational feasibility and cost/revenue neutrality
Tertiary	Minimize removals, and assist others where feasible on a cost-recovery basis.	Removals: minimize impact on the stock while meeting primary priority Assist: assist others to collect data on a cost-recovery basis IPHC policies: ad-hoc decisions of the Commission regarding the FISS design

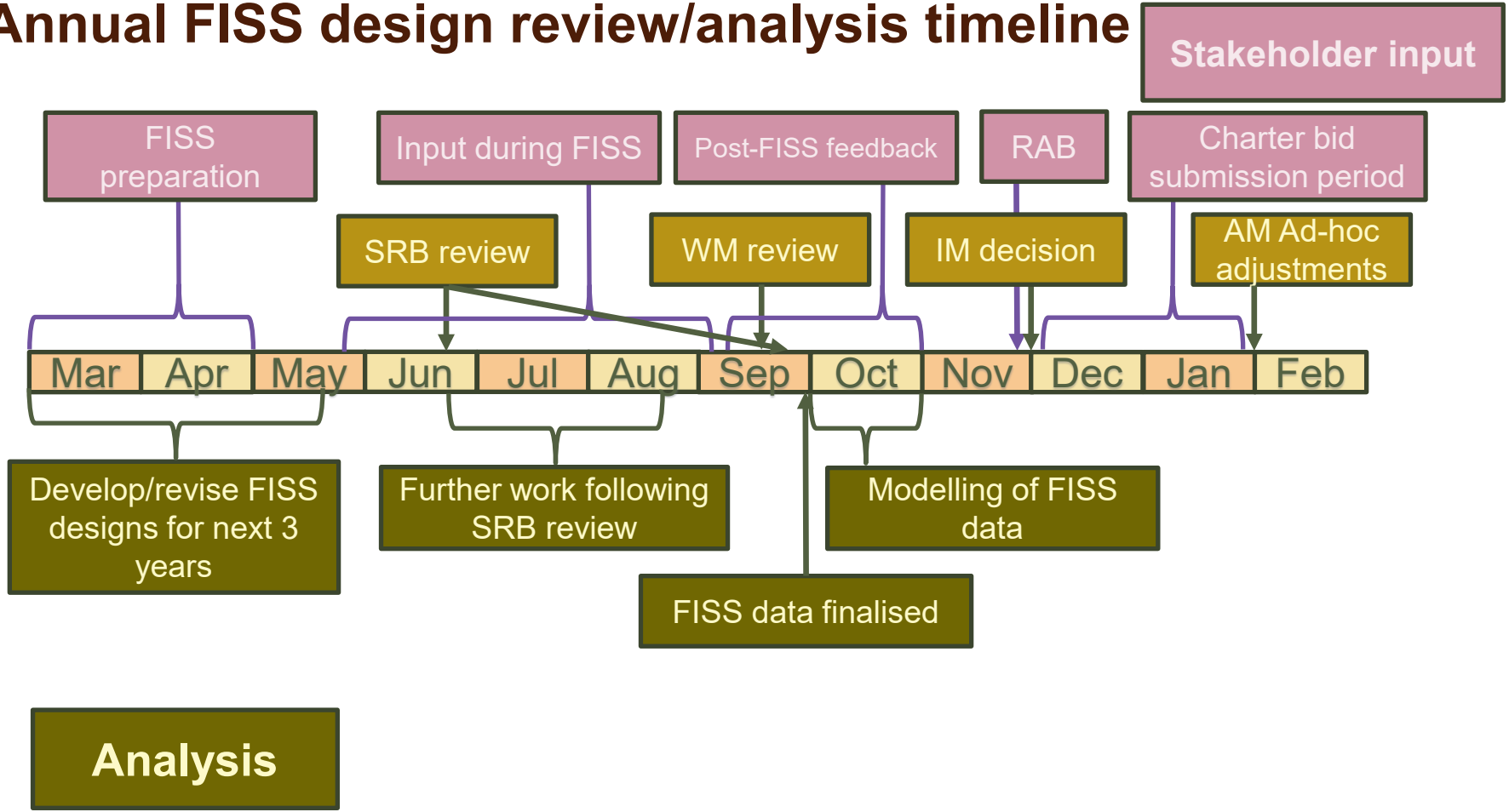
Annual FISS design review/analysis timeline



Annual FISS design review/analysis timeline



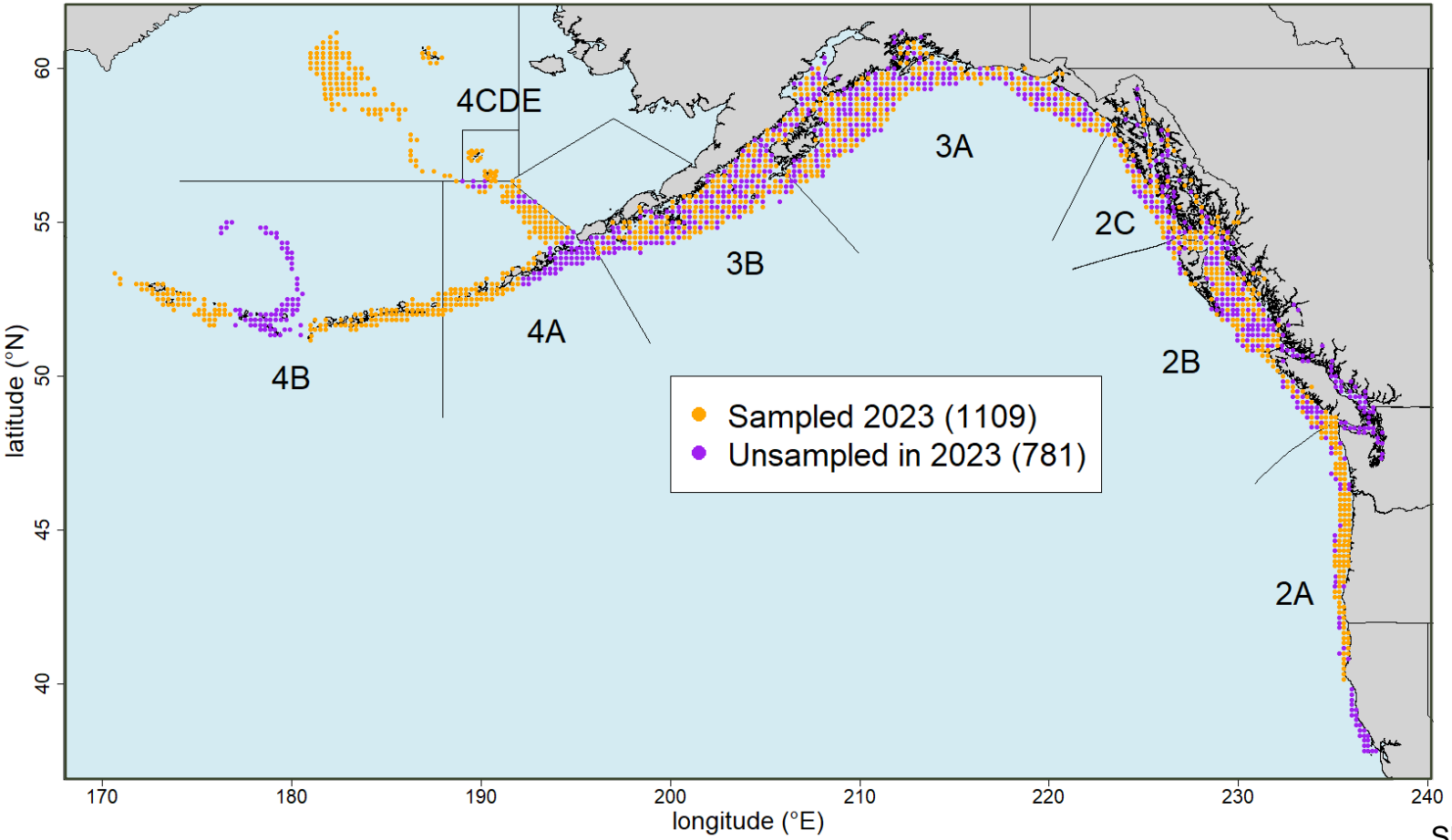
Annual FISS design review/analysis timeline



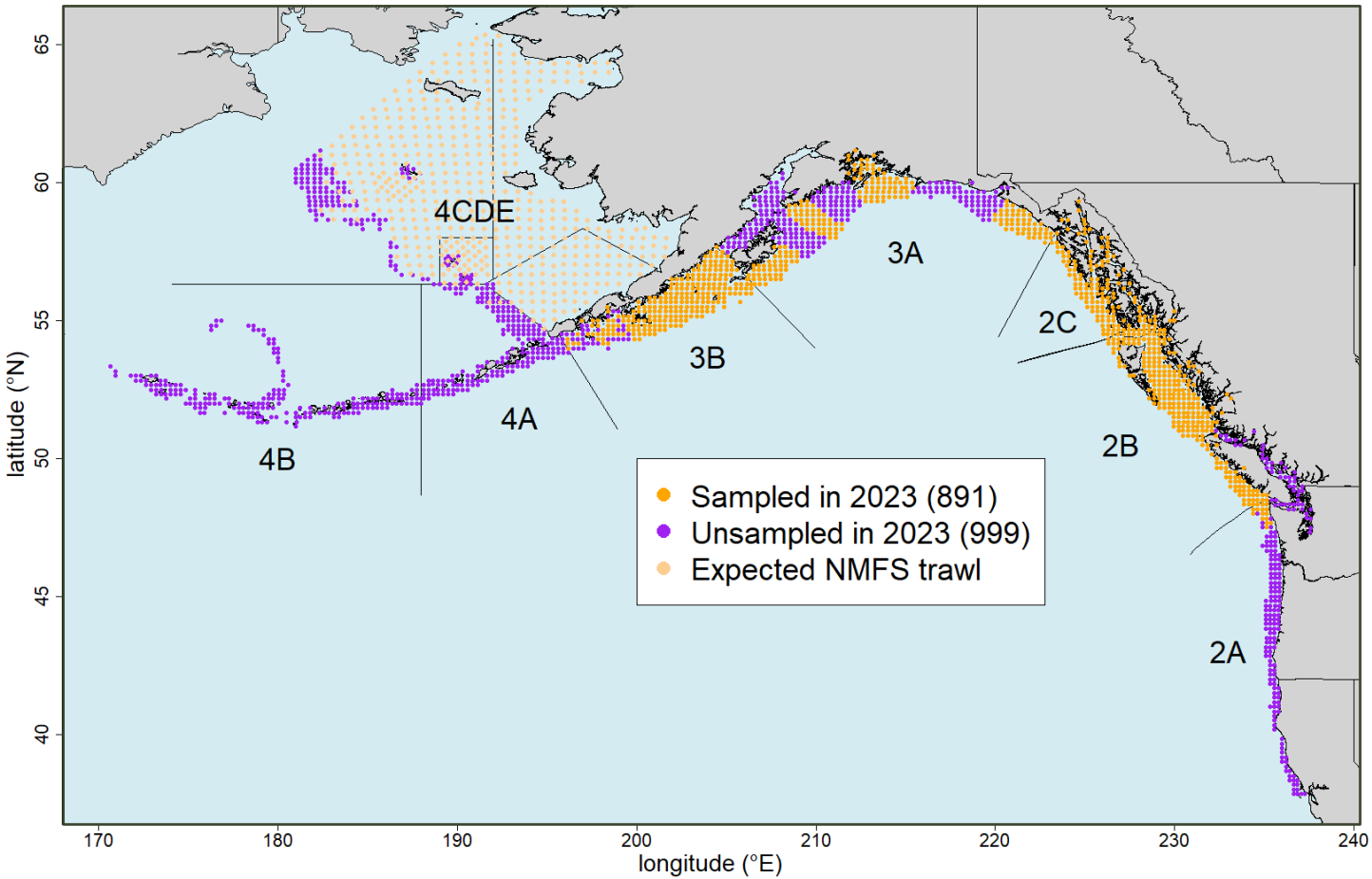
Annual revision of FISS design proposals

- As new FISS data come in each year, we revise our understanding of the spatial distribution of Pacific halibut.
- Local contraction or expansion of the distribution, or changes in inter-annual variability in subareas, can lead to revisions in the timing and frequency of FISS sampling in each subarea that will be incorporated into subsequent design proposals.
- Changes in the variability of Pacific halibut catch rates among stations can affect the number of stations proposed for sampling.
- Changes in the proposed designs to account for secondary and tertiary objectives will also affect design proposals in subsequent years.

Proposed 2023 FISS design (SRB020)



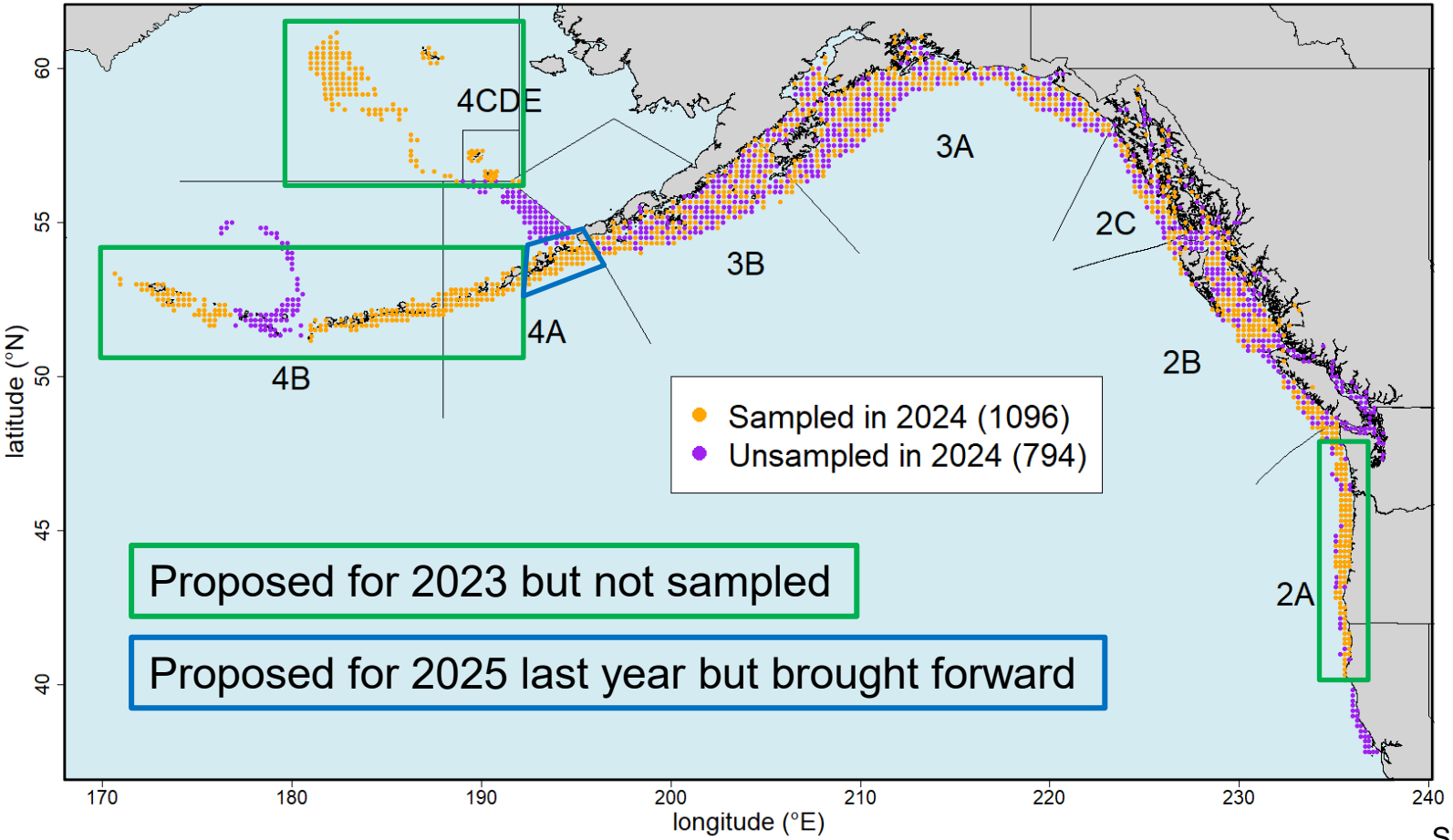
Implemented 2023 design



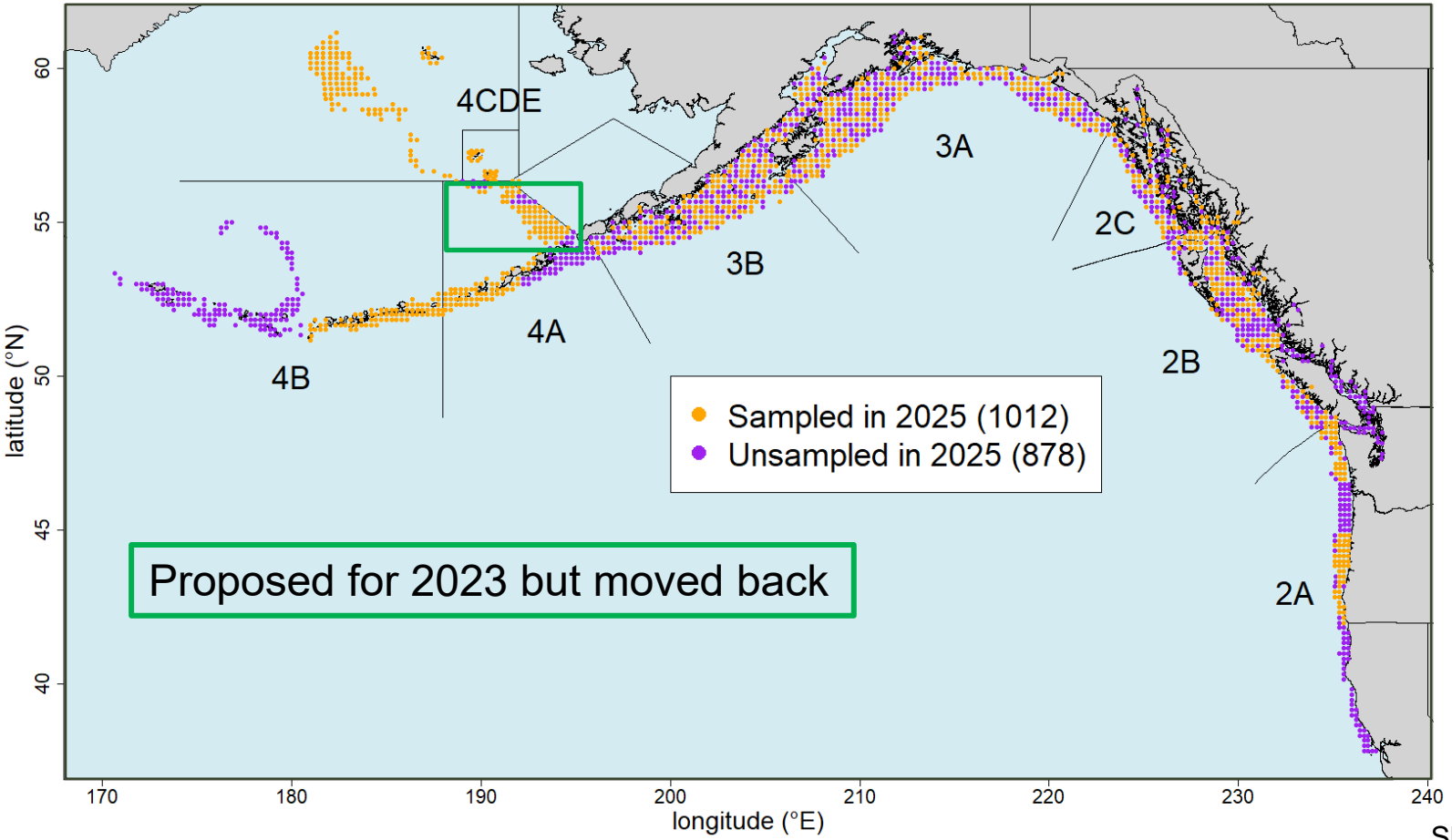
Proposed FISS design for 2024

- The proposed 2024 design includes sampling in regions in IPHC Regulatory Areas 2A, 4A and 4B that were proposed but unsampled in 2023
- One other change from last year's 2024 proposal was to bring forward sampling in southeastern IPHC Regulatory 4A
- The proposal also includes random sampling of stations in the core areas (2B, 2C, 3A and 3B) and sampling all standard FISS stations in IPHC Regulatory Area 4CDE:
  - A highly dynamic area with apparently northward-shifting distribution, and uncertainty regarding connectivity with populations near to and within in Russian waters
  - We note that complete sampling did not take place in 2021 (north only) or 2022 (south only) and no FISS sampling is taking place in 2023

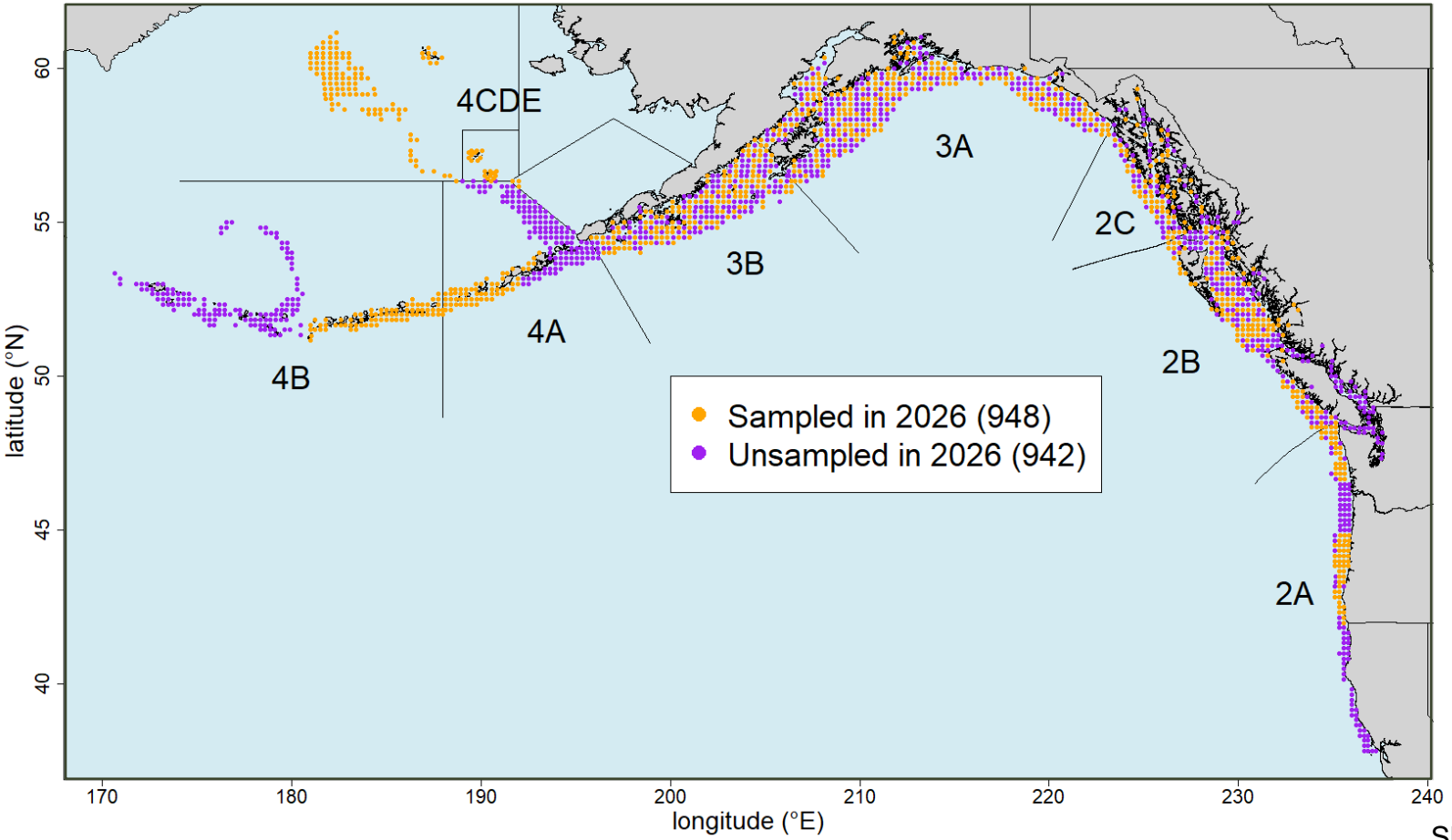
Proposed 2024 FISS design



Proposed 2025 FISS design



Proposed 2026 FISS design



Projected CVs

- The proposed designs have high sampling rates in Regulatory Areas 2B, 2C, 3A, 3B and 4CDE
  - CVs will remain well within the target range (<15% per Reg. Area)
- Randomised or full sampling designs in these areas will result in unbiased estimation
- In other Reg. Areas we project the following CVs (%) after completion of the 2026 FISS:

Area	2023	2024	2025	2026
2A	12	11	12	14
4A	14	9	9	12
4B	16	9	10	12

Minimizing bias

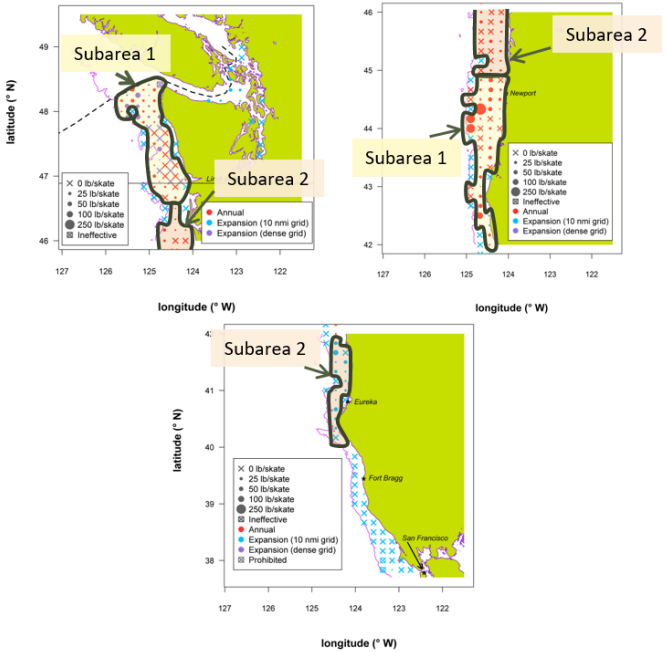
- At SRB021 we proposed a new method for assessing bias potential based on probabilities of “large” change estimated from space-time model posterior samples
  - Here “large” means a region within a Reg. Area changes by at least 10% in terms of absolute biomass proportion within a specified number of years
  - The number of years of most interest is the time elapsed since the region was last sampled by the FISS
- We applied this approach to IPHC Regulatory Areas 2A, 4A and 4B where there is a risk of bias due to not all regions being sampled annually.
- The results of this analysis informed our choice of designs shown on previous slides.

IPHC Regulatory 2A

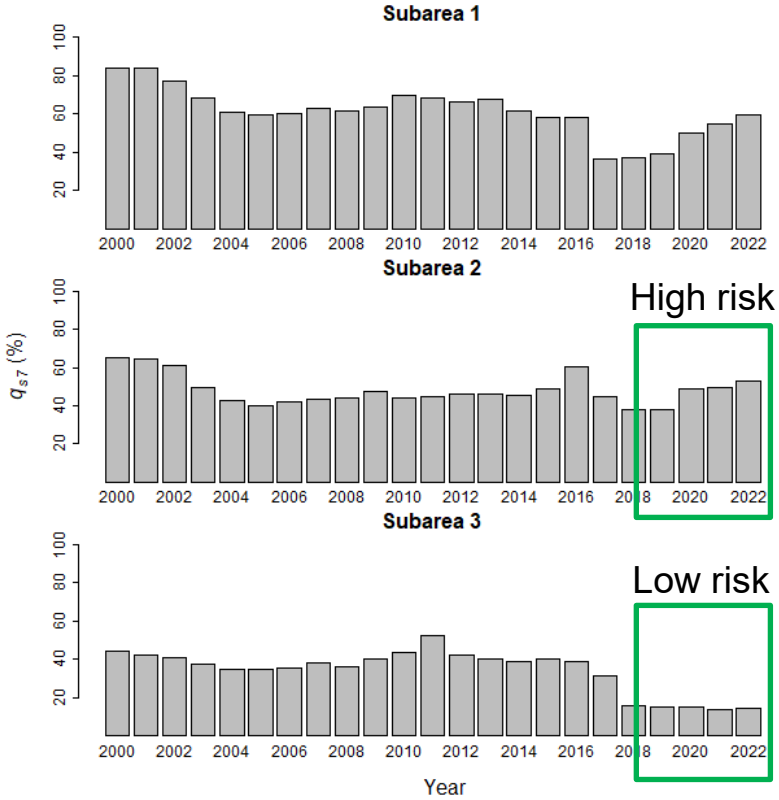
Subarea 1 is recommended for annual sampling:

- Core of 2A stock; needed to maintain CVs<15%

Subareas 2 and 3 were last comprehensively sampled in 2017, and partially sampled in 2018-19.



Risk of ≥ 10% change in biomass % over previous 7 years



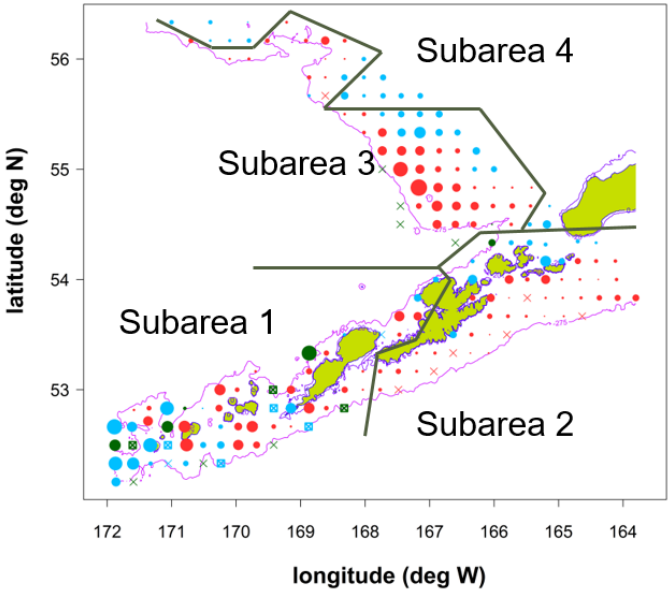
IPHC Regulatory 4A

Subarea 1 is recommended for annual sampling:

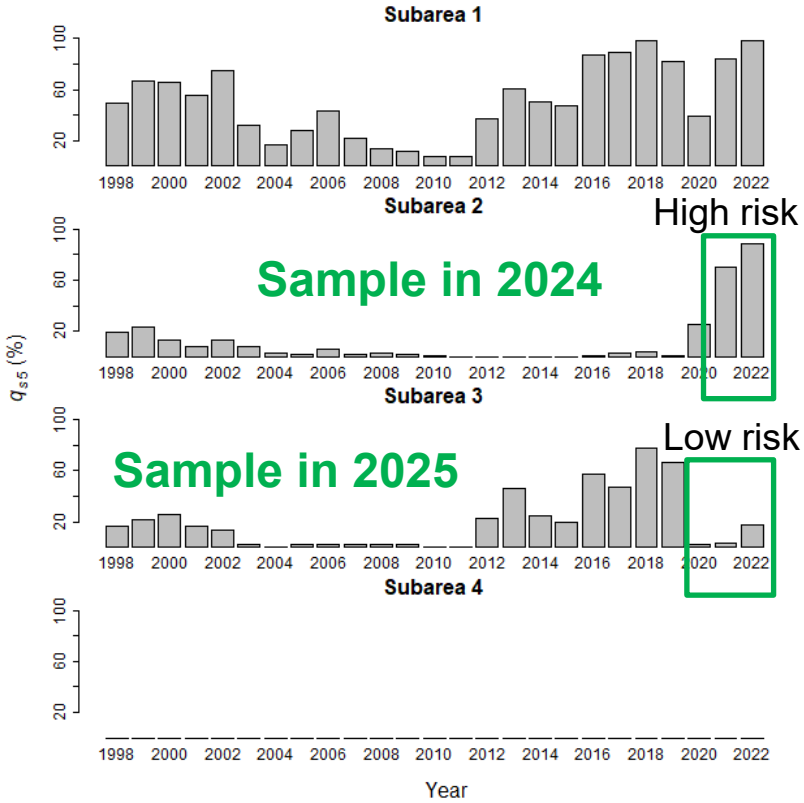
- Core of 4A stock; needed to maintain CVs<15%
- High risk of large change over short time period

Subareas 2 and 3 were last sampled in 2019.

Subarea 4 is very small and has annual data from NMFS trawl stations.



Risk of ≥ 10% change in biomass % over previous 5 years



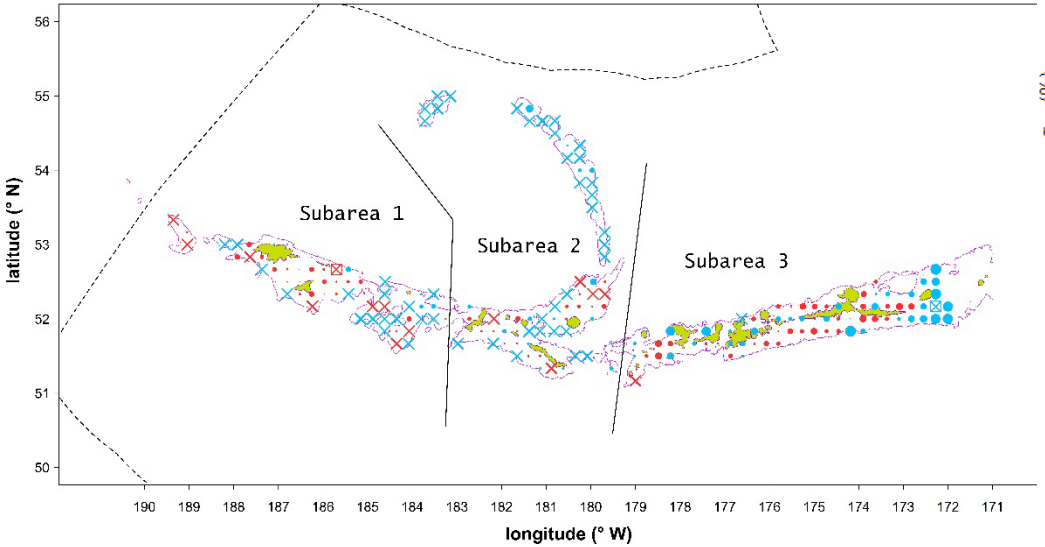
IPHC Regulatory 4B

Subarea 3 is recommended for near-annual sampling:

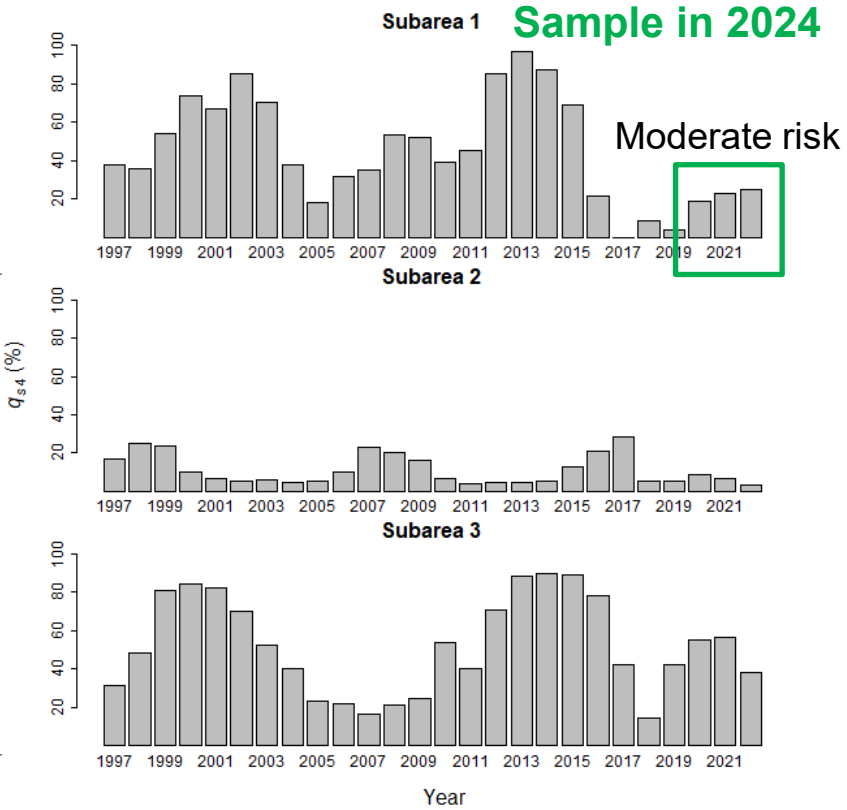
- Core of 4B stock; needed to maintain CVs<15%

Subarea 2 was last sampled in 2022

Subarea 1 was last sampled in 2019



Risk of ≥ 10% change in biomass % over previous 5 years



Projected CVs

- As part of our evaluation of the FISS design process, we compared projected CVs for O32 WPUE for IPHC Regulatory Areas that use these as part of the annual design evaluation
  - CVs in other areas are well within the <15% target range

Area	2022 projected CV(%)	2022 estimated CV (%)
2A	14	16
4A	10	14
4B	14	19

- 2A: Spatial variability higher in 2021 but not 2022: smaller difference than last year
- 4A, 4B: Not all planned sampling stations were completed in 2021 due to logistical issues and this was not accounted for in 2022 projections; the western subregion in 4B was proposed but not sampled in 2022.

Consideration of cost

- The proposed FISS designs for 2024-26 already incorporate some consideration of cost
  - Logistically efficient subarea designs are proposed in lower-density IPHC Regulatory Areas.
- The goal here was to provide statistically efficient and logistically feasible designs for consideration by the Commission
- The FISS is funded by sales of captured fish and is intended to have long-term revenue neutrality, meaning that any design must also be evaluated in terms of the following factors:
  - Expected catch of Pacific halibut
  - Expected Pacific halibut sale price
  - Charter vessel costs, including relative costs per skate and per station
  - Bait costs
  - IPHC Secretariat costs

Consideration of cost

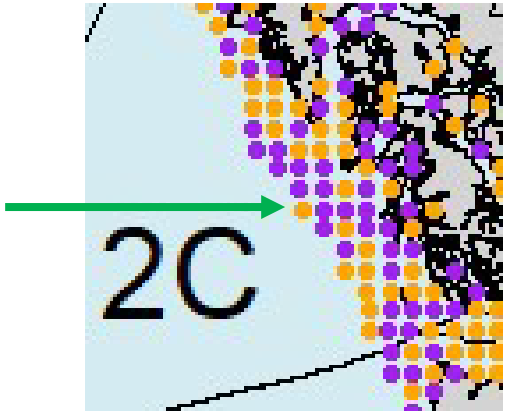
- In recent years, balancing these factors has resulted in modifications to the design proposals:
  - e.g. increase sampling effort in high-density regions and decrease effort in low density regions
- At IM098, Secretariat staff presented a sequence of designs with varying costs, ranging from the science-based proposal to a revenue-neutral option.

Consideration of cost

- In recent years, balancing these factors has resulted in modifications to the design proposals:
  - e.g., increase sampling effort in high-density regions and decrease effort in low density regions
- At IM098, Secretariat presented a sequence of designs with varying costs, ranging from the science-based proposal to a revenue-neutral option.
- The selected design balanced the primary science objective with the secondary objective of long-term revenue neutrality by greatly reducing sampling outside of the core areas of the stock.
- Such sampling reductions have implications for the quality of resulting estimates, particularly if reductions continue over multiple years.

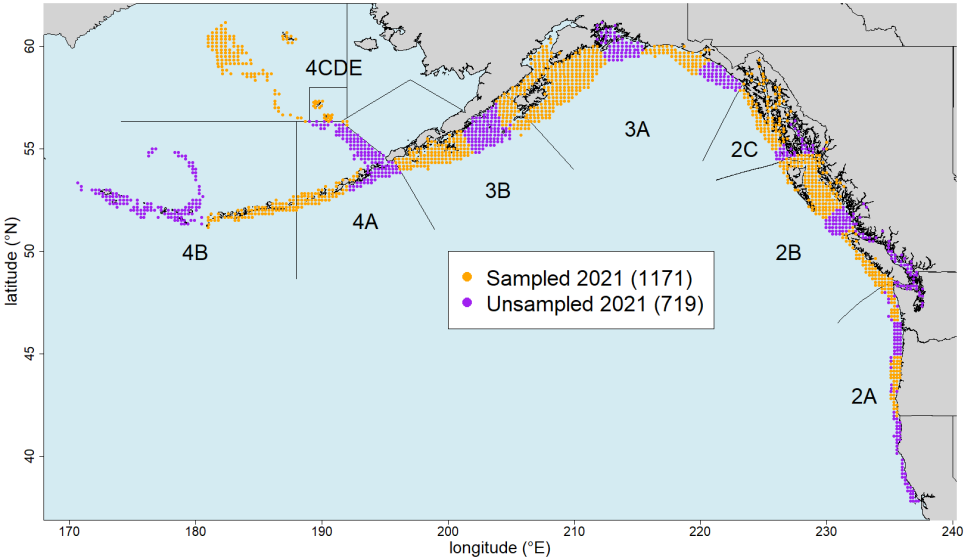
More cost-effective designs in core areas?

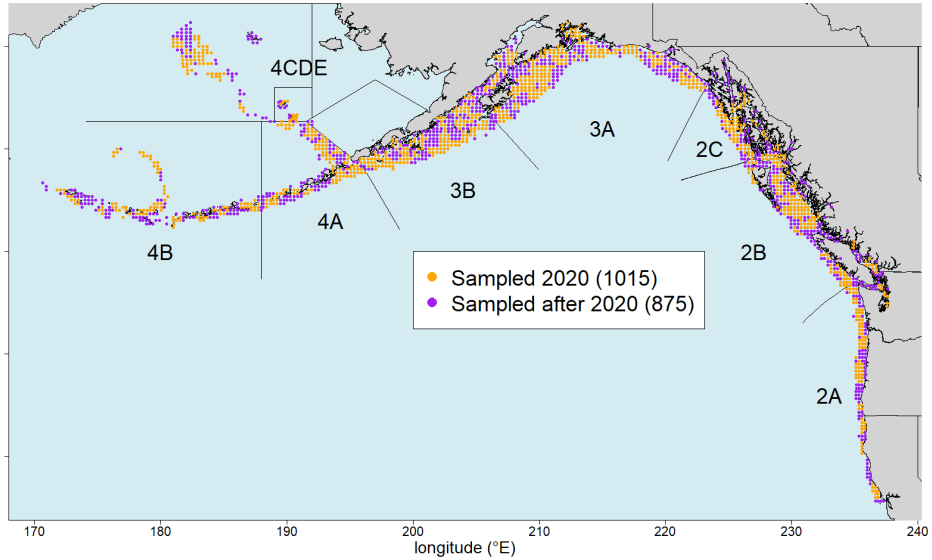
- The randomized station selection in the core areas (2B, 2C, 3A, 3B) may not lead to the most operationally efficient design:
  - Potential to fish just one or two stations/day when stations are isolated, when up to four stations/day is possible



More cost-effective designs in core areas?

- Two other designs we discussed in the past:
  - Fish entire FISS charter regions, rotating which ones are selected each year (based on precision/bias needs)
  - Fish stations in clusters, selecting clusters at random





More cost-effective designs in core areas?

- We invite the SRB to comment on alternative design options for the core IPHC Regulatory Areas.
- We also note that we have suggested that isolated stations can be avoided by adding extra stations nearby.
  - This was done annually in 2C in the past, and in 2B during the 2018 expansion.

Recommendations

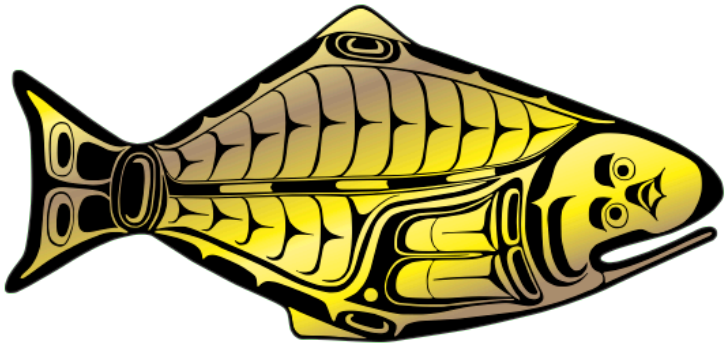
That the Scientific Review Board:

1) **NOTE** paper IPHC-2023-SRB022-06 that provides background on and a discussion of the IPHC fishery-independent setline survey design proposals for the 2024-26 period;

2) **ENDORSE** the proposed 2024 FISS design as presented in Figure 2 of IPHC-2023-SRB022-06, and

3) Provisionally **ENDORSE** the 2025-26 designs (Figures 3 and 4 of IPHC-2023-SRB022-06), recognizing that these will be reviewed again at subsequent SRB meetings.

INTERNATIONAL PACIFIC



HALIBUT COMMISSION