INTERNATIONAL PACIFIC HALIBUT COMMISSION

2023-25 FISS design evaluation

Agenda item: 5.2

IPHC-2022-IM098-10

(R. Webster and D. Wilson)

Summary

- Background
  - IPHC history of FISS, 1993-2019
  - FISS design objectives
  - Review process
- Proposed FISS designs for 2023-25
  - Scientific evaluation and revision of designs
- Consideration of cost
  - Cost-optimised FISS designs for 2023

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

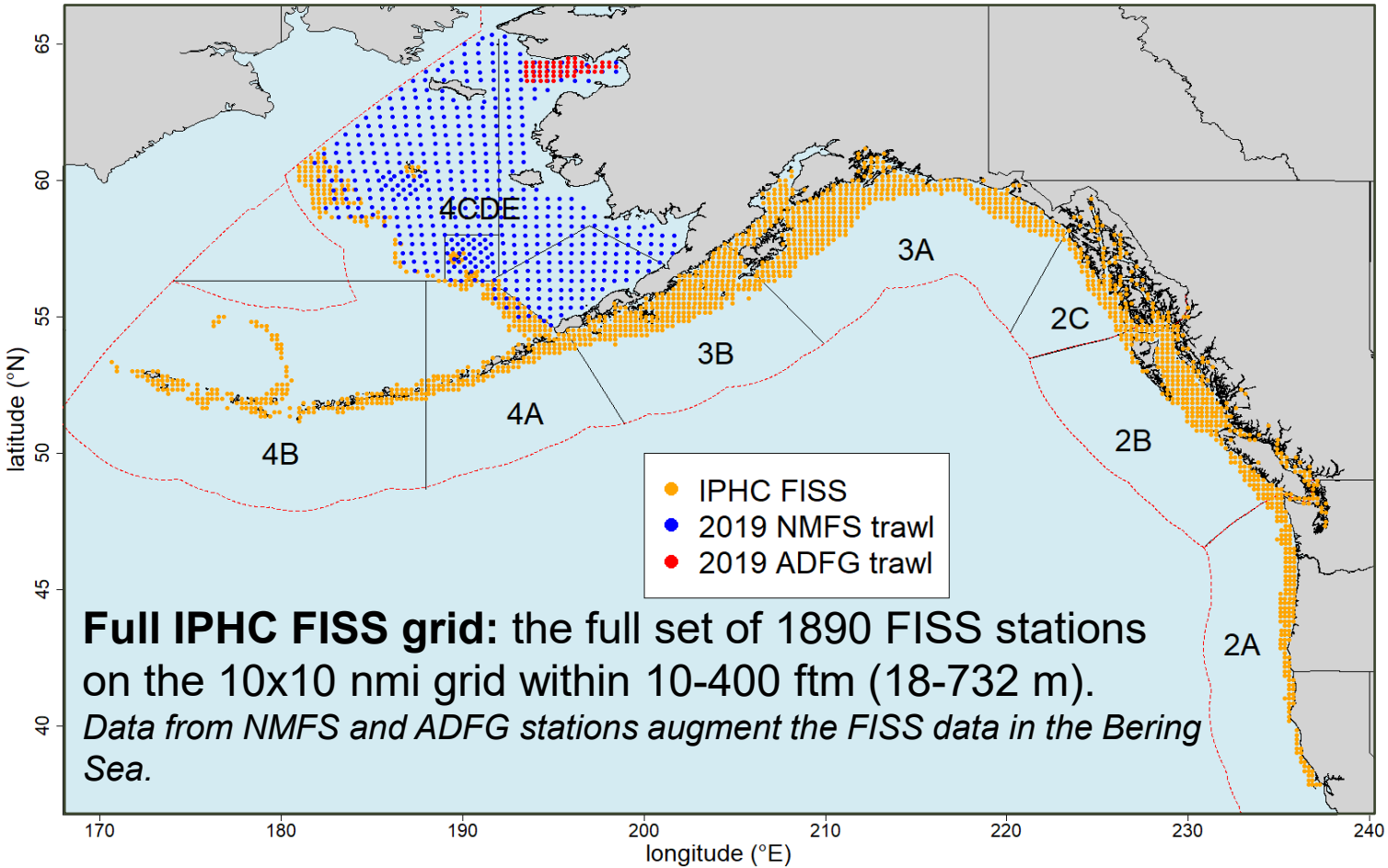
FISS history 1993-2019

- 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



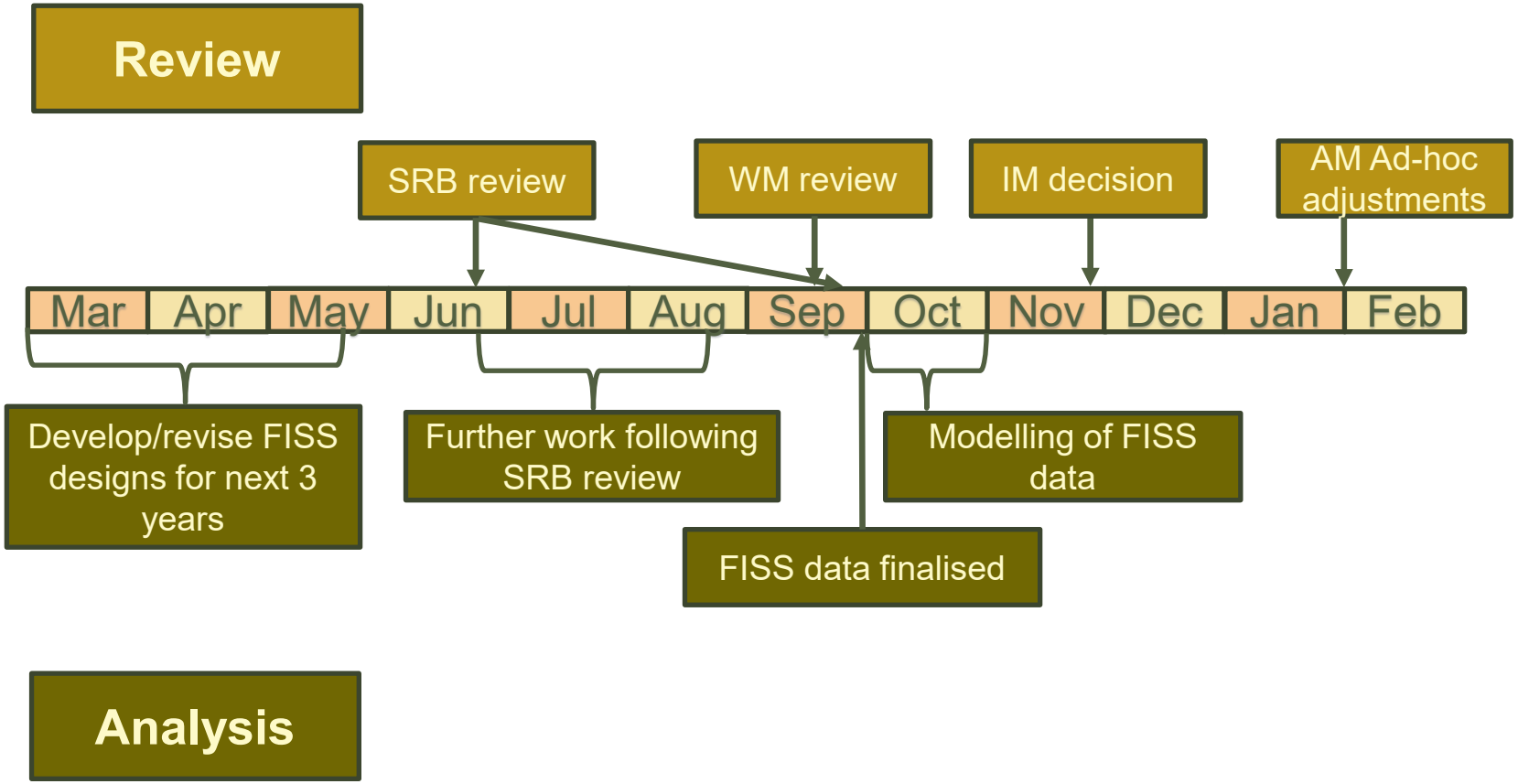
Full IPHC FISS grid: the full set of 1890 FISS stations on the 10x10 nmi grid within 10-400 ftm (18-732 m).

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

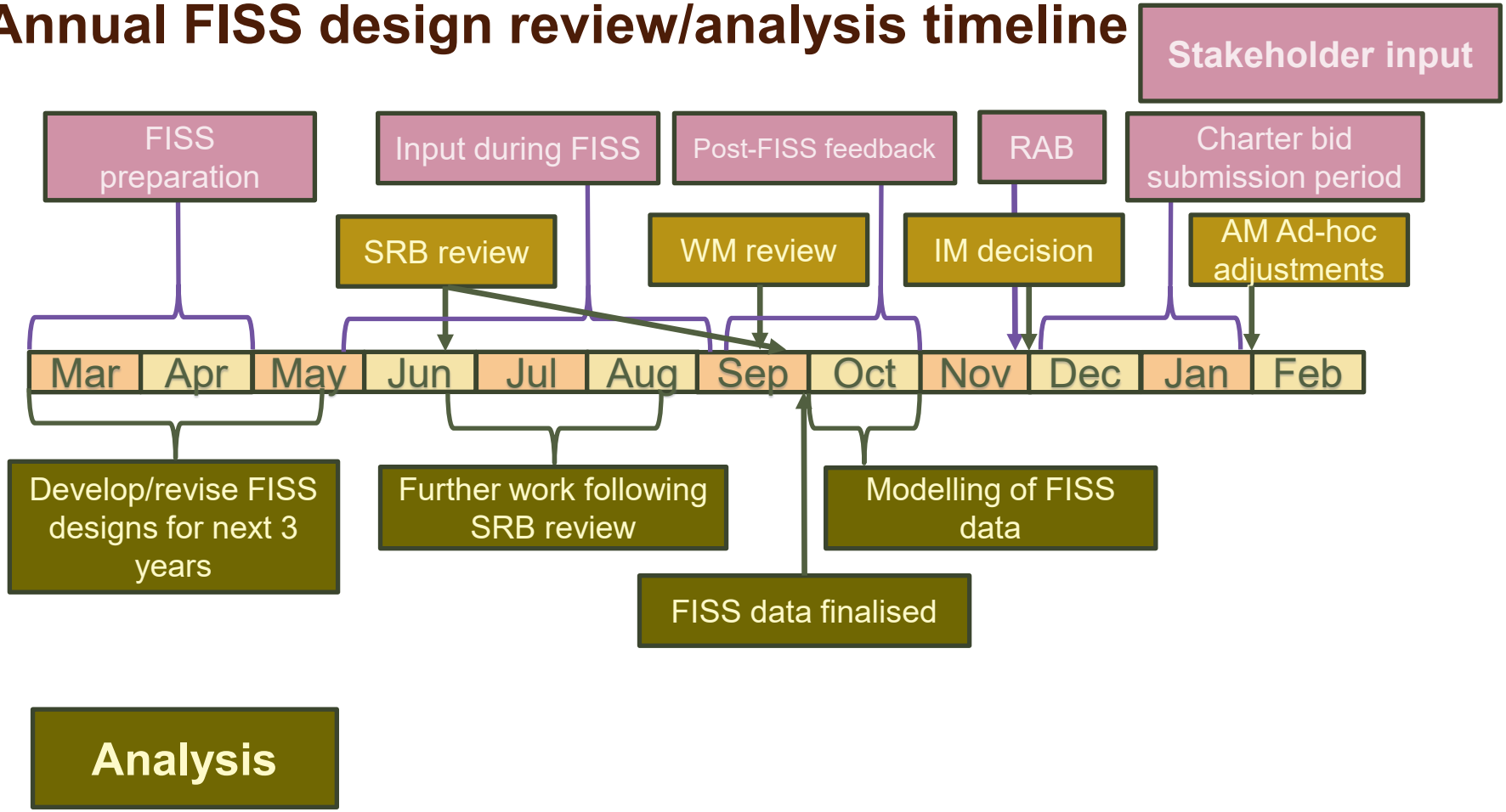
FISS objectives and design layers

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

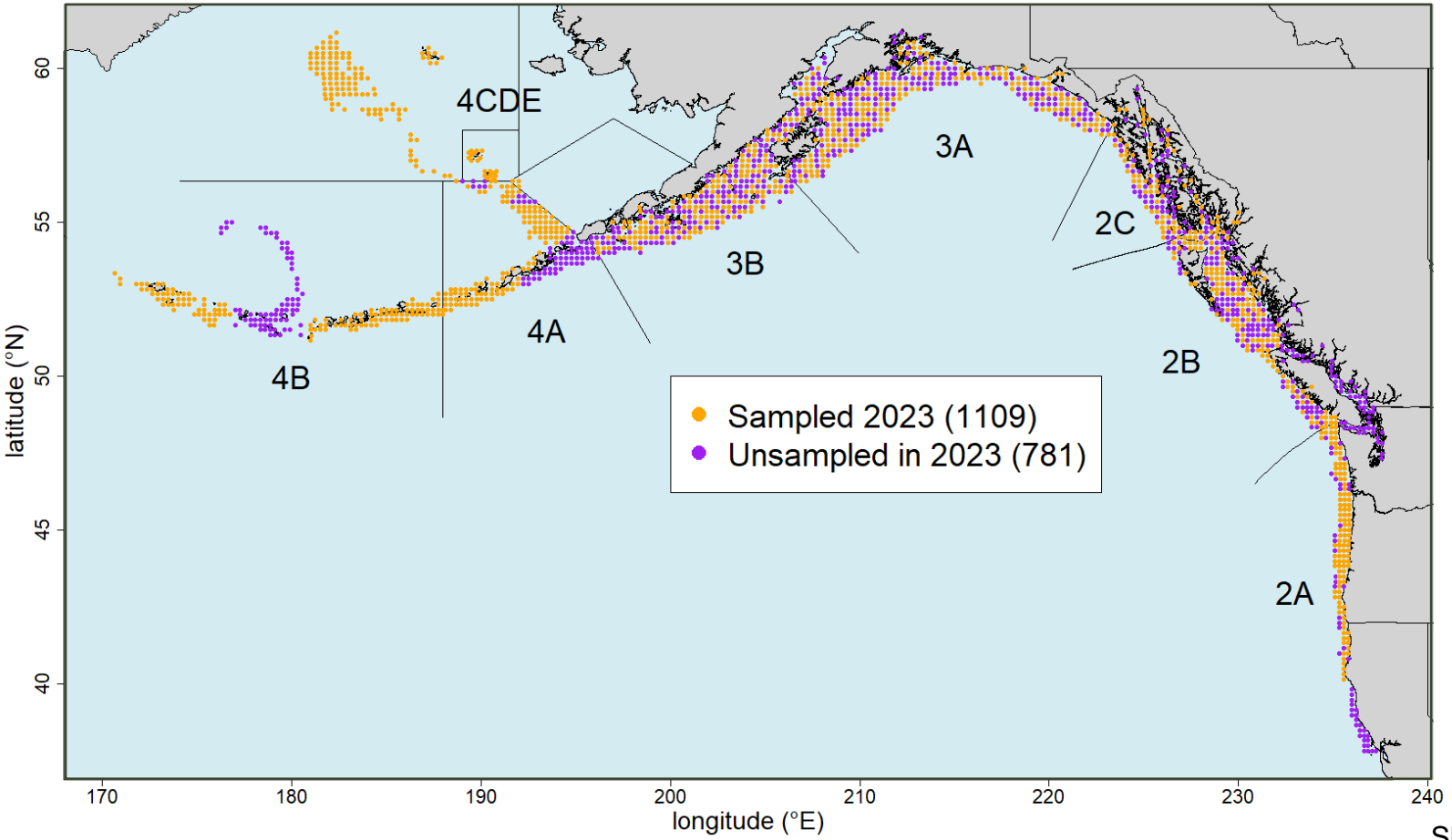


Proposed FISS designs for 2023-25

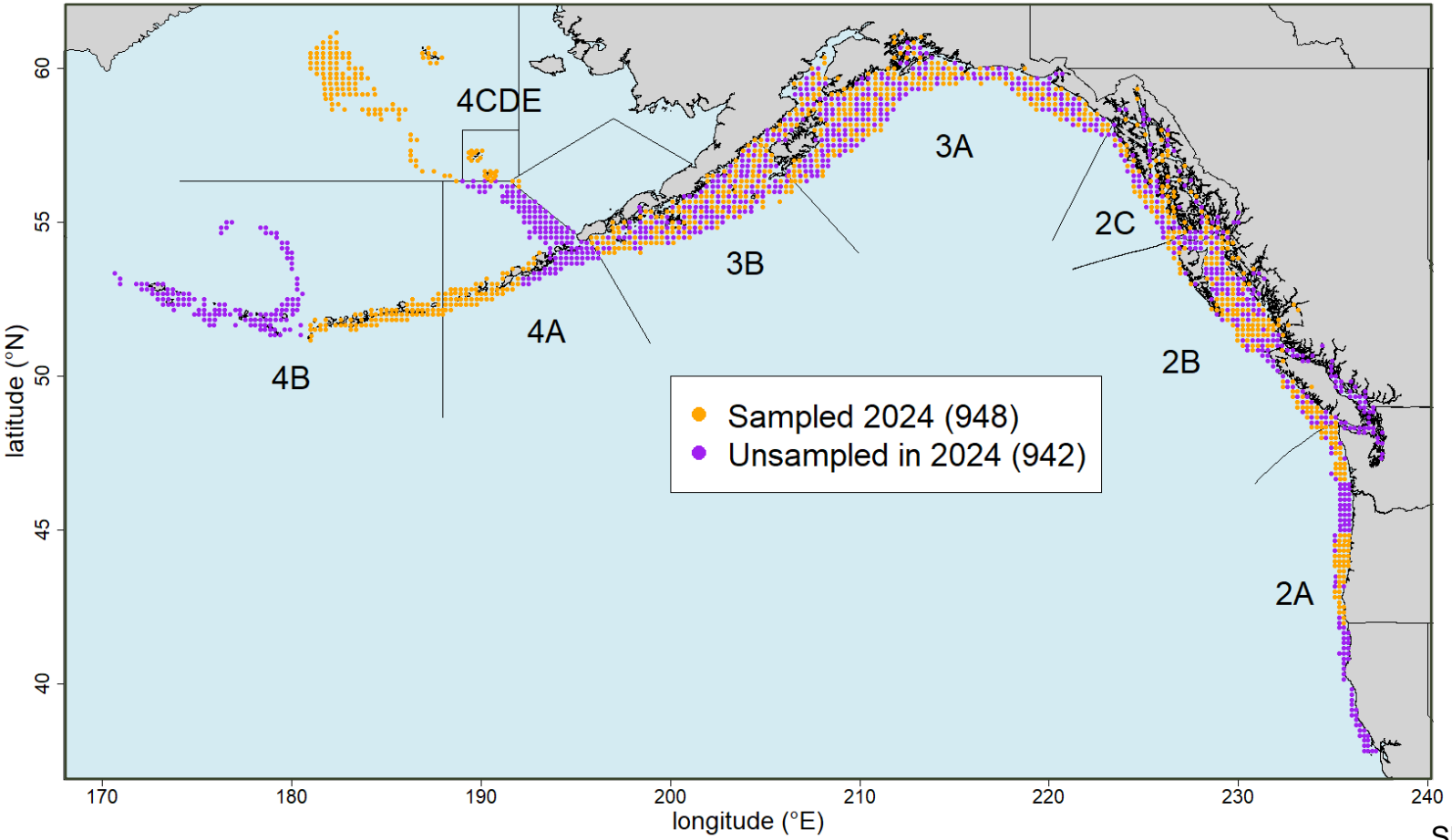
- The proposed designs again use efficient subarea sampling in IPHC Regulatory Areas 2A, 4A and 4B, but incorporate a randomized design in IPHC Regulatory Areas 2B, 2C, 3A and 3B
- We continue to propose sampling all standard FISS stations in IPHC Regulatory Area 4CDE
  - A highly dynamic area with apparently 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) and in 2022, only the southern portion has been sampled
  - We also note the following recommendation from SRB019:

SRB019–Rec.02 (para. 14) **NOTING** the presentation of three alternative 2022 sampling designs (Figs. 1, 2, and 3) that optimize the SRB018-endorsed proposed 2022 design for cost, thereby meeting the goals of long-term revenue neutrality (Secondary Objective), without compromising the scientific goals of the FISS (Primary Objective), the SRB **RECOMMENDED** that the Secretariat prioritize 2022 sampling designs that include IPHC Regulatory Area 4CDE despite the relatively low contribution of this area to overall biomass and variance. This region is an important area to monitor for future range shifts and biological samples collected here are likely to be important for understanding the biology of Pacific halibut at their leading range edge.

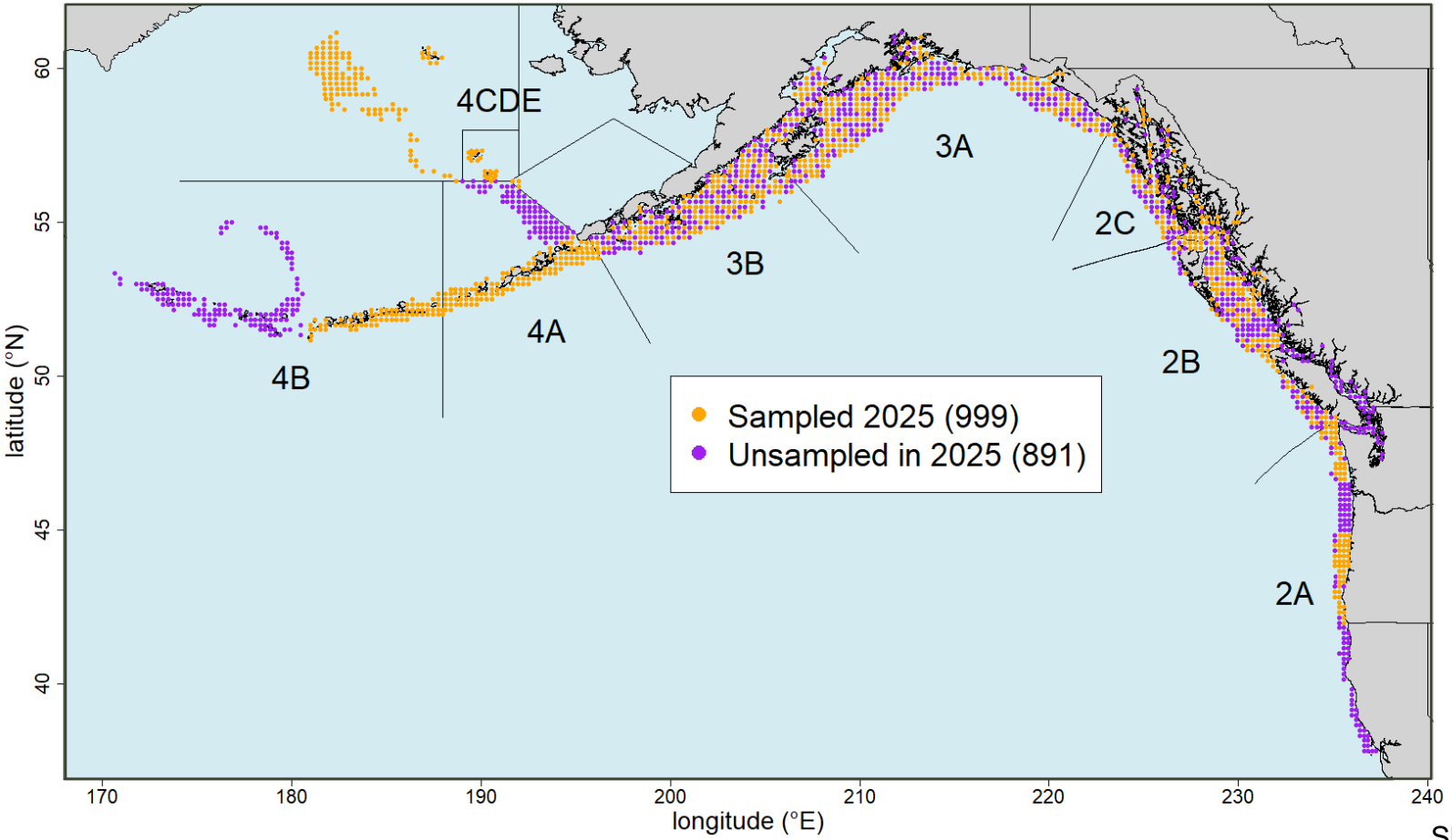
Proposed 2023 FISS design



Proposed 2024 FISS design



Proposed 2025 FISS design



Changes from preliminary 2023-24 proposals presented in 2021

- In IPHC Regulatory Area 2A, we added the moderate density waters of southern Washington/northern Oregon and northern California (2023 only)
  - Previously not proposed before 2025
- In IPHC Regulatory Area 4B, we added the western subarea (2023 only)
  - Previously proposed for 2022 but lacked a suitable charter bid

Scientific Review Board endorsement

- At SRB020, the SRB endorsed the final 2023 FISS design and provisionally endorsed the 2024-25 designs presented above (IPHC-2022-SRB020-R paragraph 12).

- At SRB021, the SRB reiterated their endorsements (IPHC-2022-SRB021-R paragraph 19) *"while also recognising that the 2023 design will need to be further optimised to ensure other Commission objectives are met, including but not limited to maintaining long-term revenue neutrality."*

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 2025 FISS:

Area	2022	2023	2024	2025
2A	13	12	13	15
4A	10	9	10	10
4B	12	9	10	12

Minimizing bias

- To minimize bias due to not sampling one or more subareas each year, we selected a sampling frequency that aims to keep the change in biomass proportion of each subarea within 10% between successive sampling years.
  - This is based on estimated changes in WPUE over the 1993-2021 period
- For example, if a subarea's % of its Reg. Area's biomass changed by no more than 8% over 1 or 2 years but by up to 12% over 3 years, we should sample it at least every three years.

Maximum expected unobserved change in biomass % across all subareas since previous sampling, based on proposed 2023-25 designs and the implemented 2022 design

Area	2022	2023	2024	2025
2A	9	9	9	9
4A	10	7	6	8
4B	13	5	8	10

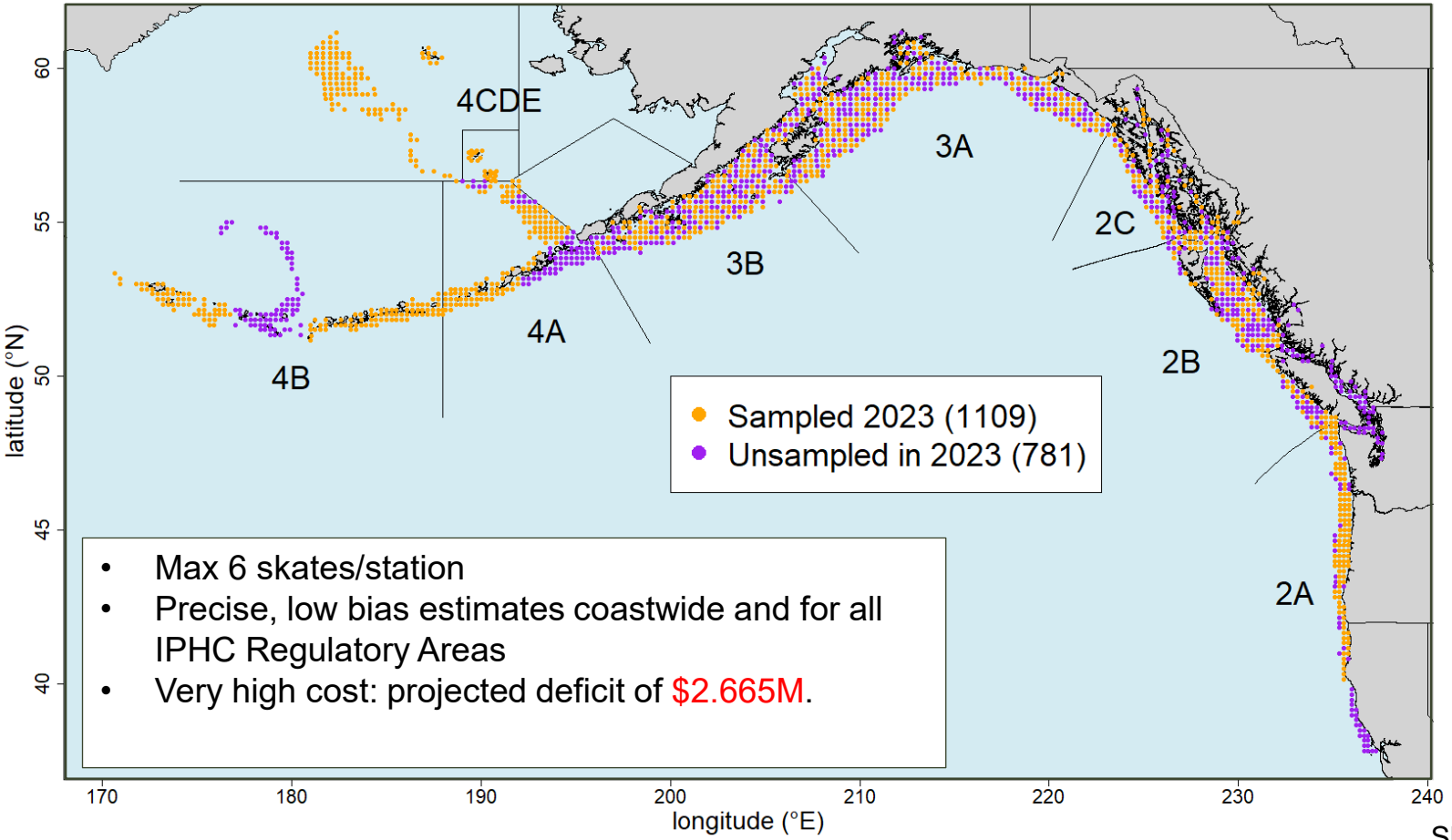
Consideration of cost

- The proposed FISS designs for 2023-25 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

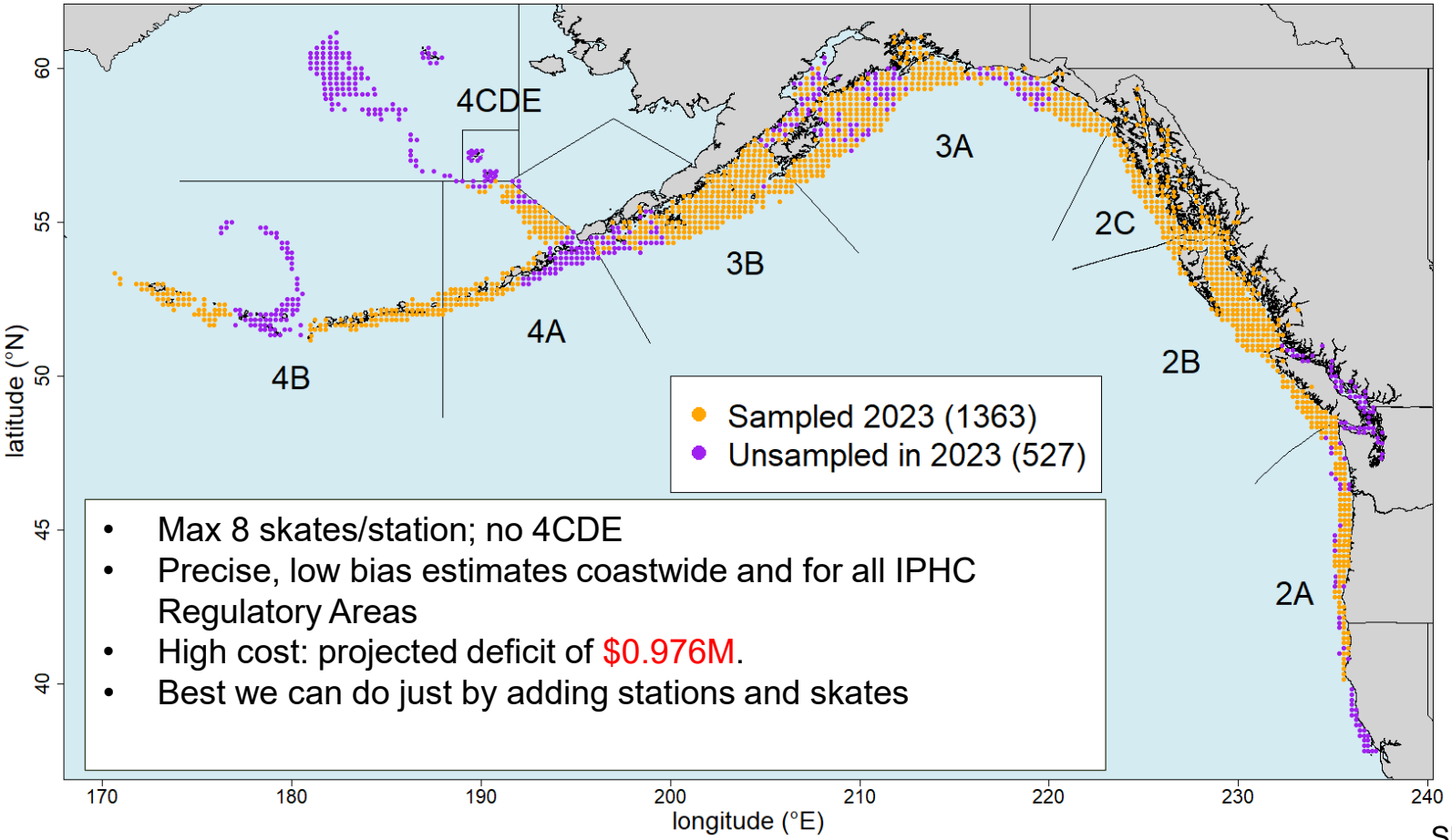
- In recent years, balancing these factors has resulted in modifications to the design proposals:
  - e.g., increase sampling effort in high-density regions and decrease effort in low density regions
- Here we present a sequence of designs optimised for cost to different degrees.

Option 1: Pre-cost optimised design



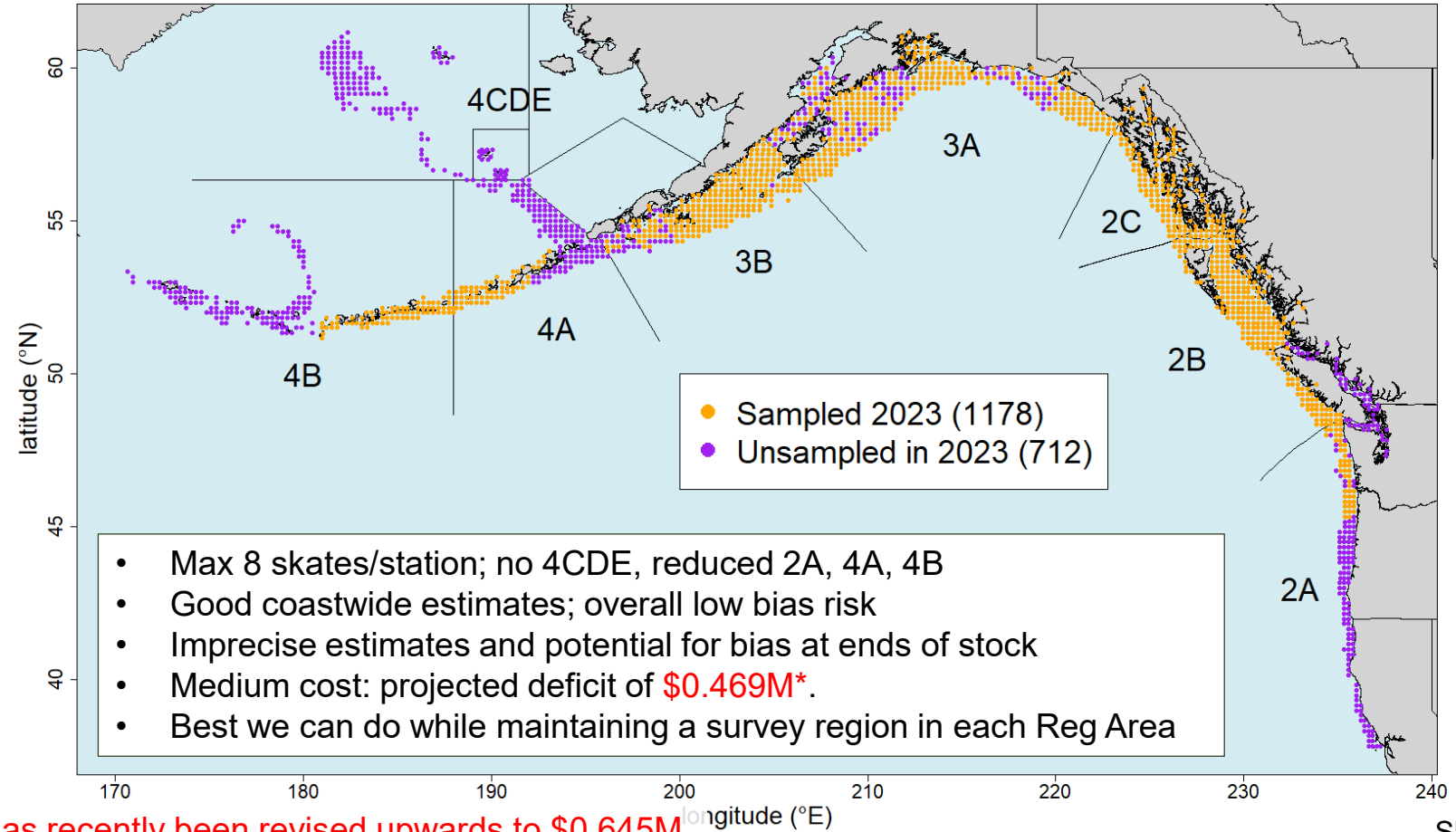
- Max 6 skates/station
- Precise, low bias estimates coastwide and for all IPHC Regulatory Areas
- Very high cost: projected deficit of $2.665M.

Option 5: Optimised design #2, max 8 skates



- Max 8 skates/station; no 4CDE
- Precise, low bias estimates coastwide and for all IPHC Regulatory Areas
- High cost: projected deficit of $0.976M.
- Best we can do just by adding stations and skates

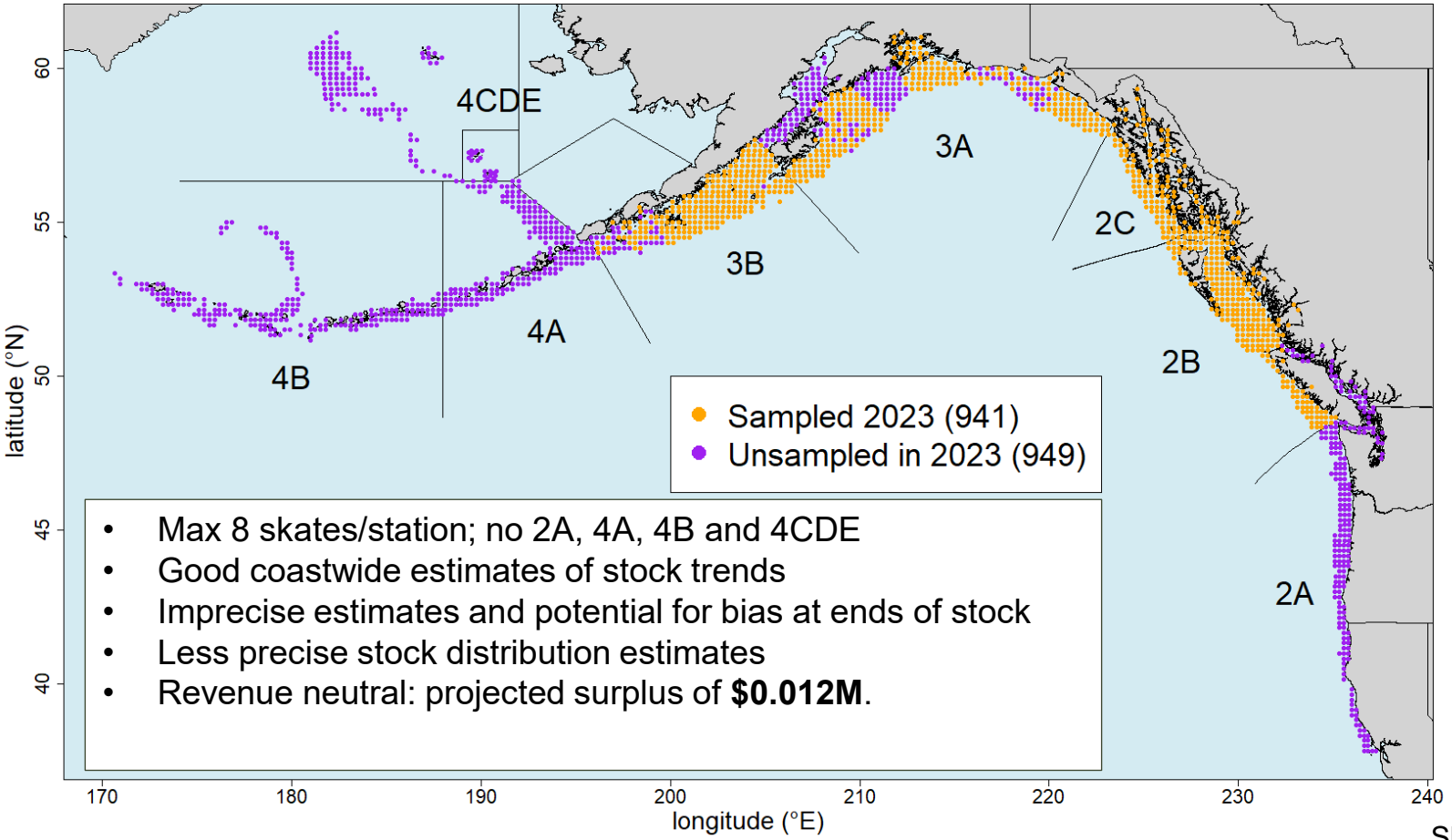
Option 6: Achieve loss of <$0.5M



- Max 8 skates/station; no 4CDE, reduced 2A, 4A, 4B
- Good coastwide estimates; overall low bias risk
- Imprecise estimates and potential for bias at ends of stock
- Medium cost: projected deficit of $0.469M*.
- Best we can do while maintaining a survey region in each Reg Area

*Cost has recently been revised upwards to $0.645M

Option 7 (updated): Revenue neutral design



- Max 8 skates/station; no 2A, 4A, 4B and 4CDE
- Good coastwide estimates of stock trends
- Imprecise estimates and potential for bias at ends of stock
- Less precise stock distribution estimates
- Revenue neutral: projected surplus of **$0.012M**.

Option 7: Revenue neutral design

- Approximately 70-80% of Pacific halibut stock by weight is in the four core areas
- High sample size of 941 stations (updated) provides precise coastwide time series estimates with relatively low bias
- Precision targets unlikely to be met in IPHC Regulatory Areas 2A, 4A and 4B
- Increased risk of bias in estimates of indices for these areas, and in estimates of stock distribution
- Design likely to result in indices and biological data that maintain basic stock assessment inputs but with higher uncertainty in 2023

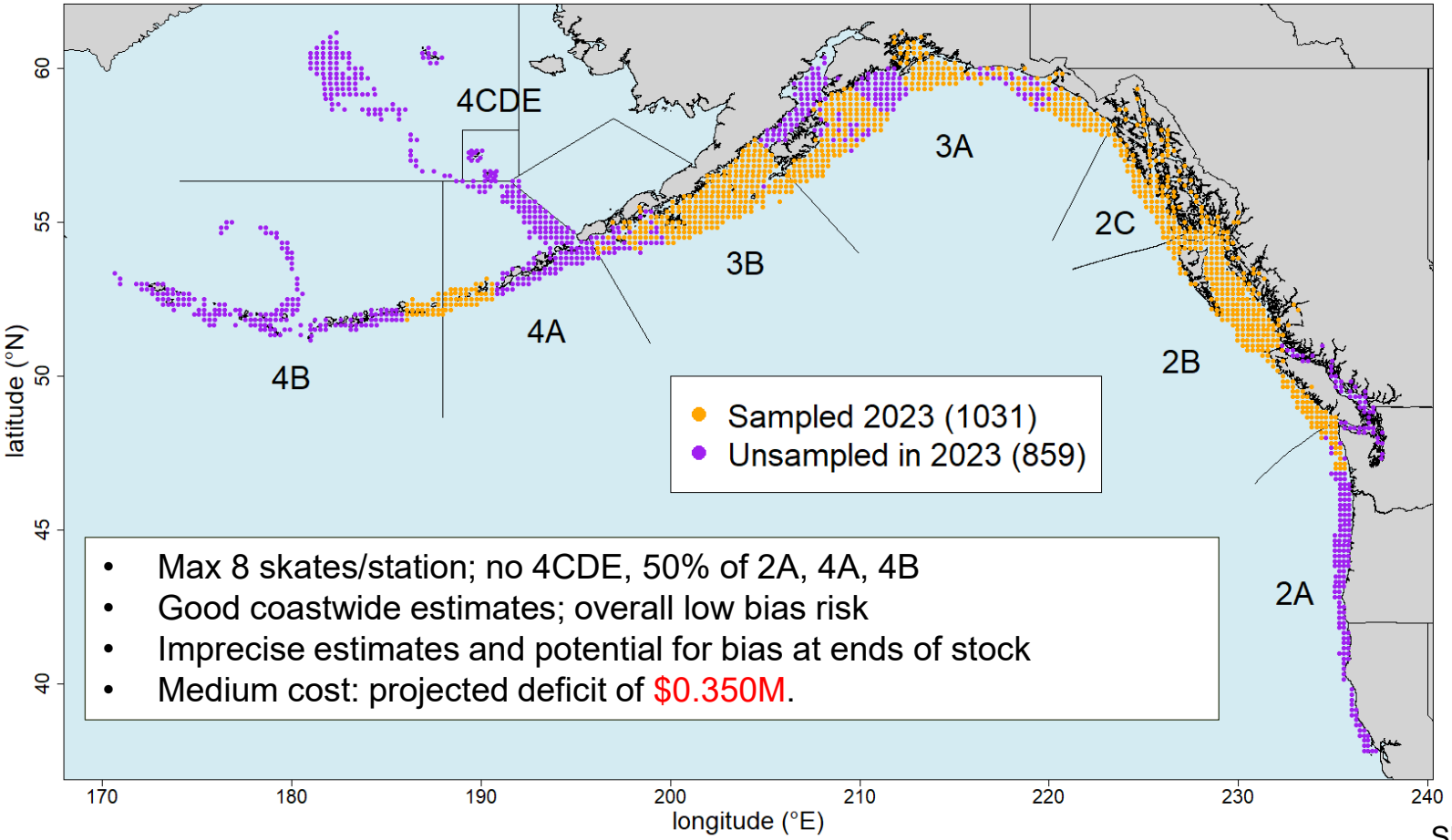
Intermediate options

- We also considered options intermediate to Options 6 and 7 to preserve some sampling at ends of stock:
  - Option 6a: Remove 4B stations only from Option 6
  - Option 6b: Remove 4A stations only from Option 6
  - Option 6c: Remove 2A stations only from Option 6
    - Deficits of $0.426-0.498M
  - Option 7a: Add back 50% of 2A, 4A and 4B stations to the revenue neutral design
  - Option 7b: Add back 24 stations in each of 2A, 4A and 4B to revenue neutral design
    - Deficits of $0.320-0.350M

Intermediate options

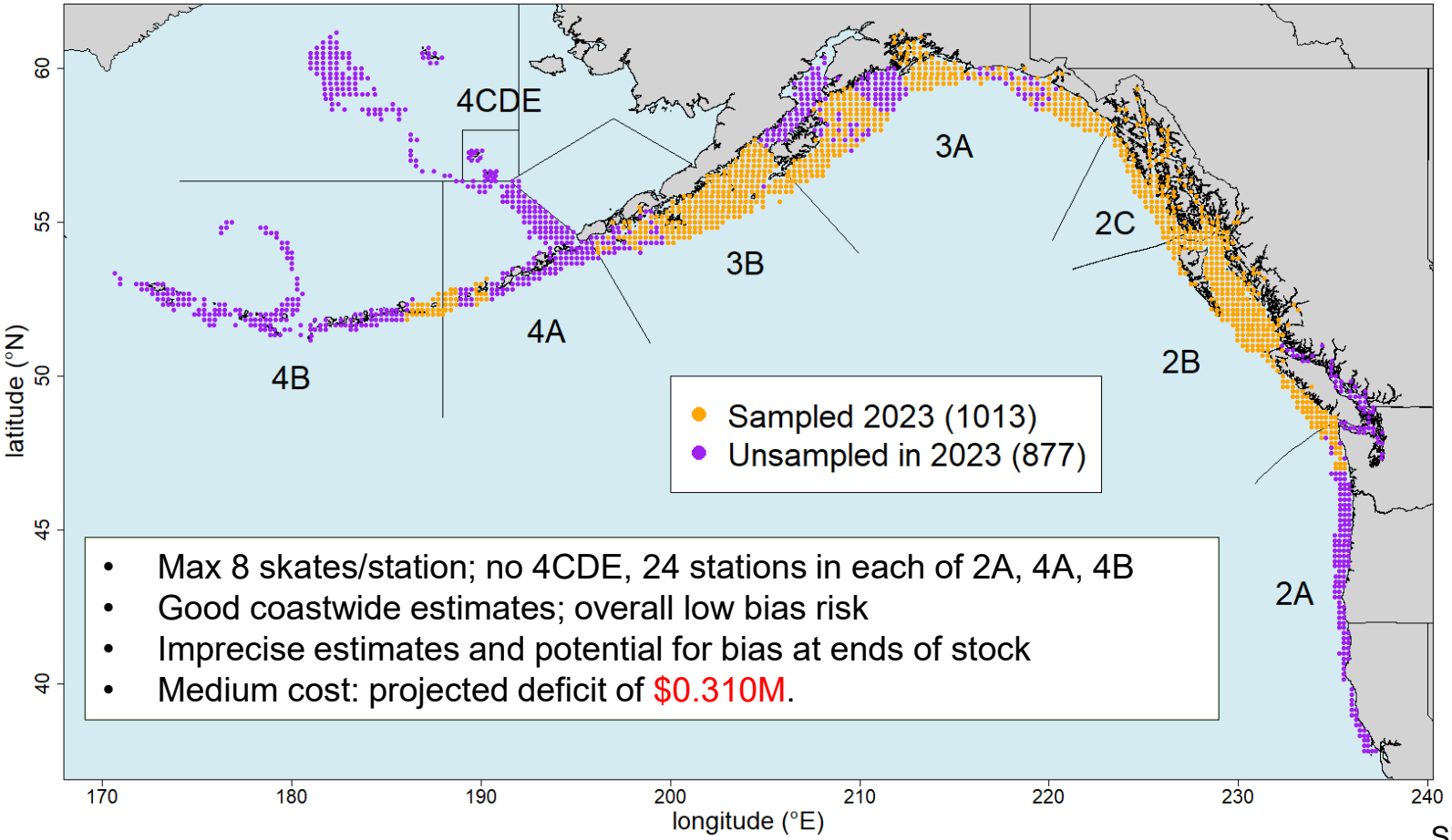
- We also considered options intermediate to Options 6 and 7 to preserve some sampling at ends of stock:
  - ~~Option 6a: Remove 4B stations only from Option 6~~
  - ~~Option 6b: Remove 4A stations only from Option 6~~
  - ~~Option 6c: Remove 2A stations only from Option 6~~
    - ~~Deficits of $0.426-0.498M~~
  - Option 7a: Add back 50% of 2A, 4A and 4B stations to the revenue neutral design
  - Option 7b: Add back 24 stations in each of 2A, 4A and 4B to revenue neutral design
    - Deficits of $0.320-0.350M

Option 7A



- Max 8 skates/station; no 4CDE, 50% of 2A, 4A, 4B
- Good coastwide estimates; overall low bias risk
- Imprecise estimates and potential for bias at ends of stock
- Medium cost: projected deficit of $0.350M.

Option 7B



- Max 8 skates/station; no 4CDE, 24 stations in each of 2A, 4A, 4B
- Good coastwide estimates; overall low bias risk
- Imprecise estimates and potential for bias at ends of stock
- Medium cost: projected deficit of $0.310M.

Planning for 2024 and 2025

- Assuming no sampling at ends of stock in 2023:
  - Design proposal for 2024 will include fishing subareas originally proposed for 2023 in IPHC Regulatory Areas 2A, 4A and 4B
  - Potential for addition of more stations to 2024 and 2025 designs to bring estimates closer to achieving precision and bias targets

Recommendations

That the Commission:

1) **NOTE** paper IPHC-2022-IM098-10 that presents the FISS design proposals for 2023-25 together with scientific evaluations of the designs, and cost evaluations of additional 2023 design options;

2) **ENDORSE** revenue neutral design Option 7 for the 2023 FISS or a modified version;

3) Provisionally **ENDORSE** the proposed designs for 2024-25, as endorsed by the Scientific Review Board at SRB021, recognizing that the 2024-25 designs are expected to be modified in subsequent years.

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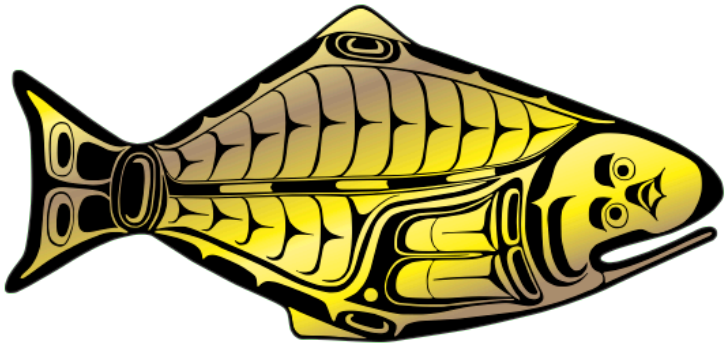

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