Space-time modelling of survey data

Agenda item: 5.1
IPHC-2025-AM101-10
(R. A. Webster)

Space-time model estimates of WPUE and NPUE

- As in 2016-23, space-time modelling was used to estimate O32 and all sizes WPUE, and all sizes NPUE indices from 1993 onwards
  - For IPHC Regulatory Areas 4A and 4CDE, modelling uses data from the FISS and agency trawl surveys (NOAA, ADFG)
    - A calibration is used to convert trawl data to FISS equivalent
  - Other areas use FISS data only
  - Raw station data are adjusted for hook competition and timing of FISS relative to the fishery

Space-time model estimates of WPUE and NPUE

- The models predict WPUE and NPUE at all grid stations, whether they were surveyed in a given year or not
  - Estimates are calculated as averages across station predictions
  - Lack of sampling or reduced sampling is reflected in greater uncertainty (higher variances, CVs)
- Official estimates are computed for:
  - Biological Regions
  - IPHC Regulatory Areas
  - Coastwide IPHC Convention waters, from San Francisco Bay to Bering Strait
- Station-level output is supplied to the online IPHC Space-time Explorer tool available on the IPHC website

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2024 data updates

Modelling was informed by new survey data from three sources:

- FISS sampling in IPHC Regulatory Areas 2B, 2C, 3A, 3B and 4CDE

- NOAA trawl survey in the eastern Bering Sea
  - No northern Bering Sea sampling in 2024

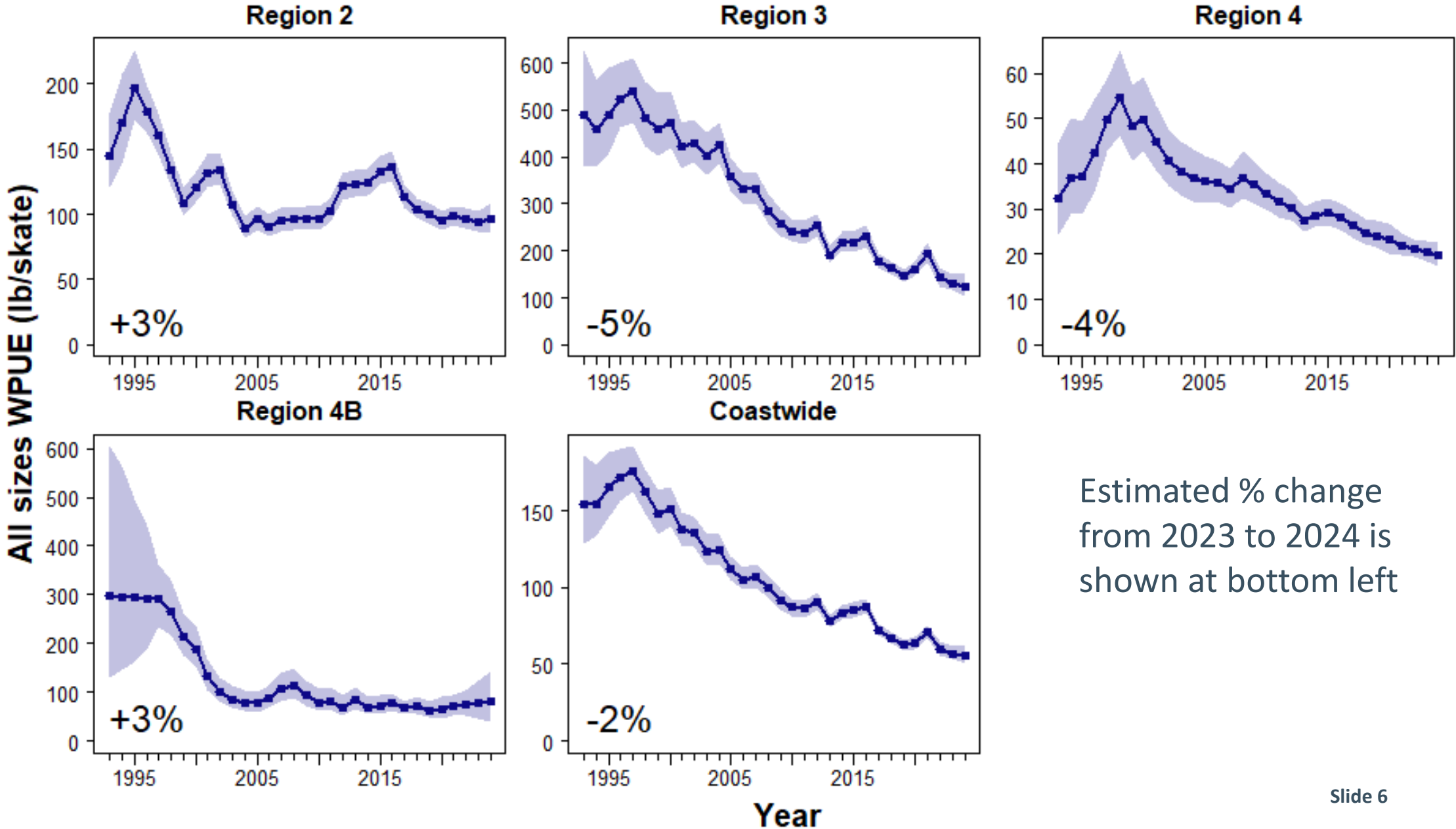- ADFG trawl survey in Norton Sound in the northern Bering Sea

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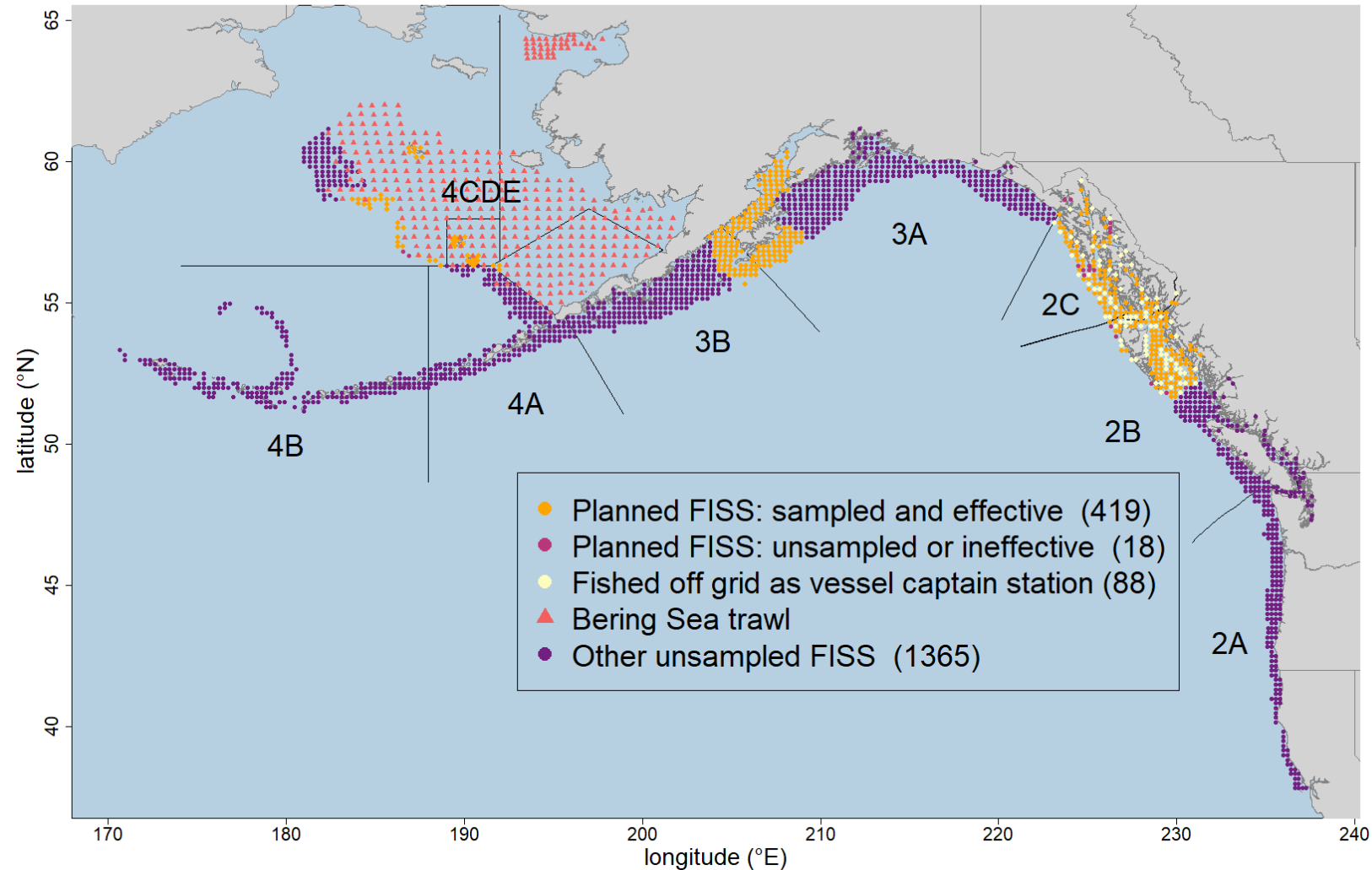
O32 WPUE by biological region
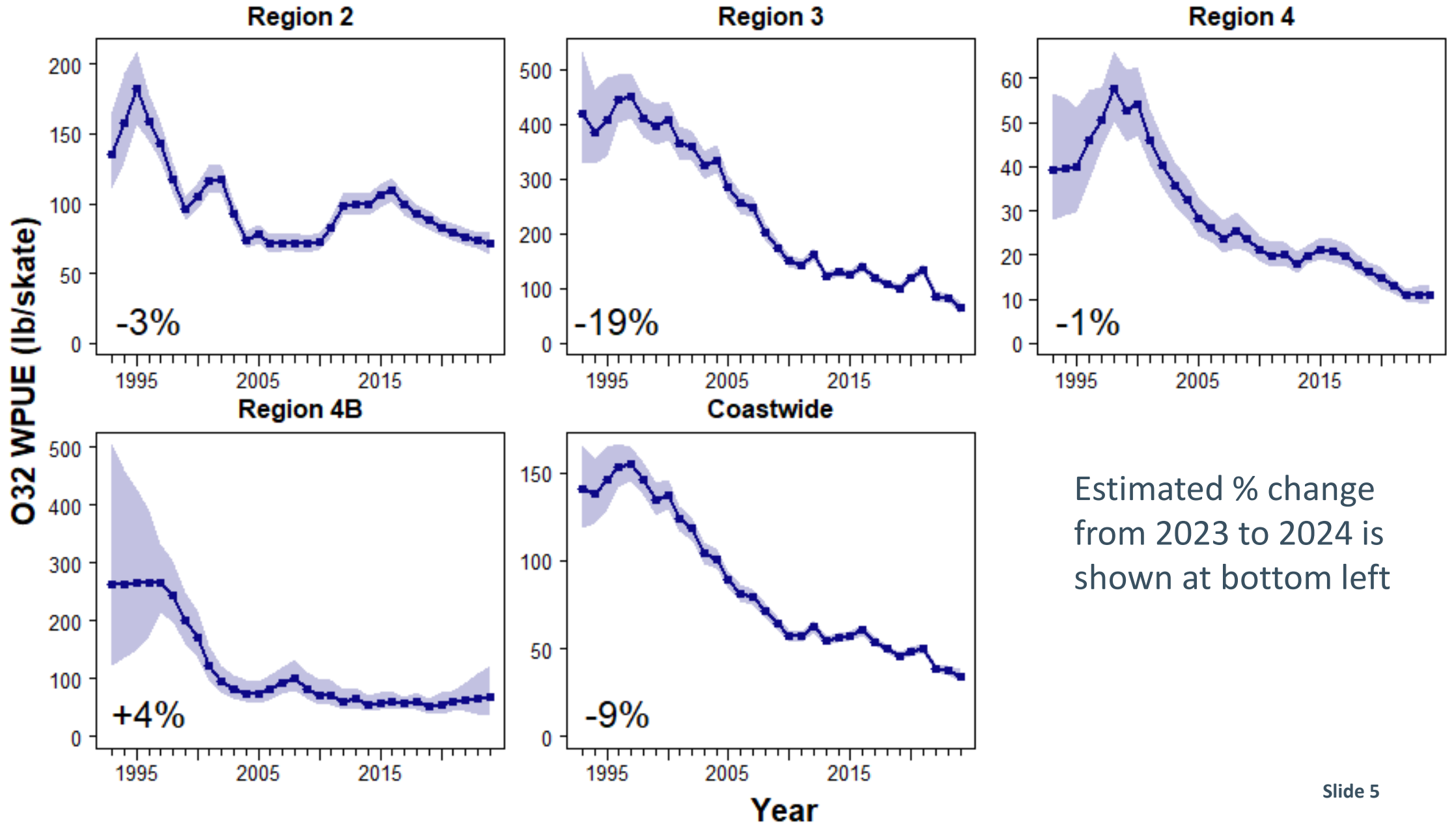
Estimated % change from 2023 to 2024 is shown at bottom left

All sizes WPUE by biological region

Region 2 — +3%

Region 3 — -5%

Region 4 — -4%

Region 4B — +3%

Coastwide — -2%

All sizes WPUE (lb/skate)

Year

Estimated % change from 2023 to 2024 is shown at bottom left
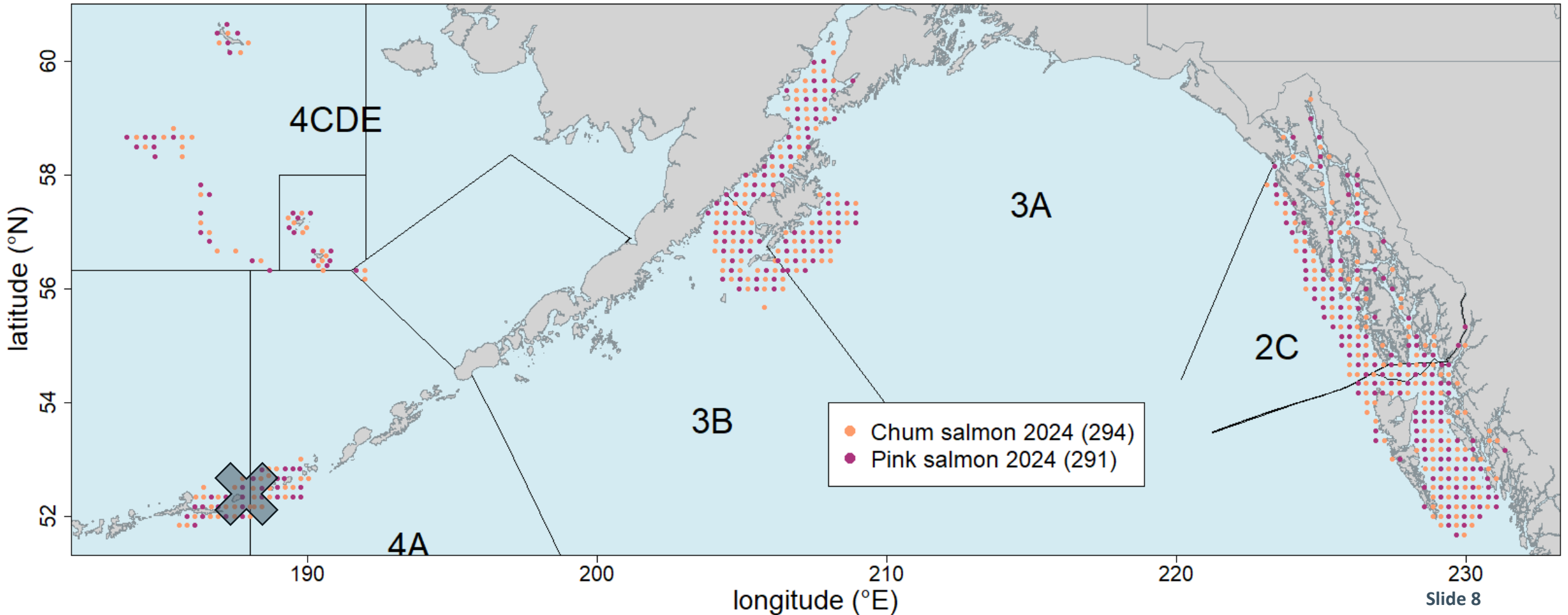
All sizes NPUE by biological region
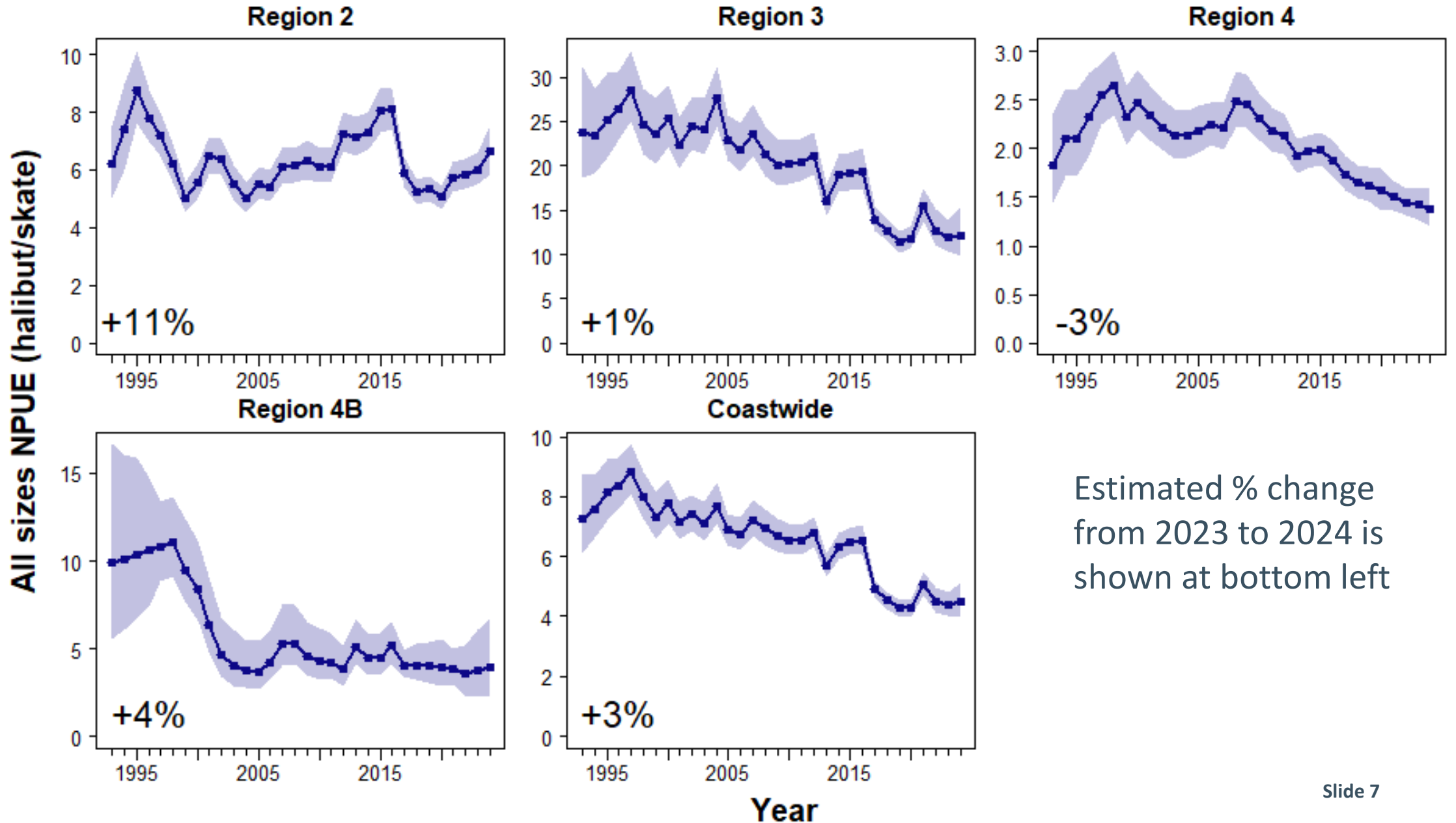
Estimated % change from 2023 to 2024 is shown at bottom left

Ratio of pink salmon to chum salmon catch rates

- 50% of sets on the 2024 FISS used less expensive pink salmon baits and 50% used standard chum salmon baits

Ratio of pink salmon to chum salmon catch rates

- Model output shows that estimates of the ratio of pink to chum salmon catch rates is almost always less than 1, implying pink salmon baits had lower catch rates than standard chum salmon baits
- Ratios generally decrease from east to west
- Official model output is standardized to chum salmon baits

Posterior means of ratios of pink to chum salmon catch rates (with 95% posterior credible intervals)

IPHC Reg. Area	O32 WPUE	All sizes WPUE	All sizes NPUE
2B	0.87 (0.68, 1.13)	0.80 (0.62, 1.02)	0.72 (0.57, 0.92)
2C	1.01 (0.81, 1.27)	0.89 (0.72, 1.11)	0.83 (0.66, 1.03)
3A	0.74 (0.59, 0.93)	0.71 (0.57, 0.87)	0.68 (0.55, 0.83)
3B	0.64 (0.49, 0.94)	0.62 (0.49, 0.78)	0.58 (0.46, 0.73)
4CDE	0.48 (0.29, 0.81)	0.32 (0.08, 1.22)	0.36 (0.10, 1.27)

Vessel captain stations

- IPHC Regulatory Areas 2B and 2C only: When fishing three (3) or more stations a day, vessel captains could choose to switch out a FISS station for one set located off the grid that has a higher expected catch rate.
  - As well as potentially increasing revenue, running time between sets could be reduced.
- As a one-year measure, we did not expect this to introduce bias in the estimates
  - Predictions were still made at official grid station positions, whether fished or not, and unfished station values are most highly correlated with values obtained the previous year.
  - As a check, models were fitted with and without data from vessel captain stations.

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Vessel captain stations

- Modelling with and without vessel captain station data showed evidence that **their inclusion did introduce bias** into estimates of O32 WPUE and all sizes WPUE.

- Mean values of the 2024 O32 WPUE and all sizes WPUE indices were up to 13% higher when data from vessel captain stations were included

- Mean values of all sizes NPUE indices were almost the same with and without vessel captain station data:
  - Implies captains were able to target locations with larger Pacific halibut rather than locations with greater numbers of fish

- Official model output was produced without data from vessel captain stations to avoid bias

Vessel captain stations

Posterior means of density indices (with 95% posterior credible intervals) with and without data from vessel captain stations.

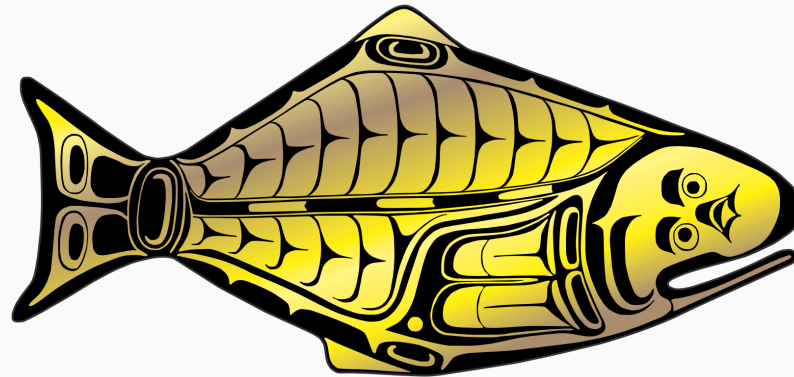| IPHC Reg. Area	O32 WPUE (lb/skate)		All sizes WPUE (lb/skate)		All sizes NPUE (halibut/skate)	
	With vessel captain stations	Without vessel captain stations	With vessel captain stations	Without vessel captain stations	With vessel captain stations	Without vessel captain stations
2B	70.5 (59.4, 82.6)	62.2 (51.5, 74.7)	97.7 (82.1, 116.0)	89.4 (74.7, 108.0)	6.8 (5.7, 8.2)	6.7 (5.4, 8.1)
2C	170.8 (147.1, 195.7)	156.4 (134.0, 181.5)	216.5 (188.3, 248.2)	206.5 (176.7, 238.4)	12.8 (11.0, 14.8)	12.9 (11.0, 15.3)

Recommendation

That the Commission **NOTE** paper IPHC-2025-AM101-10 which provides results of the space-time modelling of Pacific halibut survey data for 1993-2024.

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