Space-time modelling of survey data

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PURPOSE

To provide results of the space time modelling of Pacific halibut survey data for the period 1993-2026.

INTRODUCTION

Since 2016 space-time modelling has been used by the IPHC to produce estimates of mean O32 WPUE (weight per unit effort), all sizes WPUE and all sizes NPUE (numbers per unit effort) indices of Pacific halibut density and abundance. The modelling depends primarily on data from the IPHC's Fishery-Independent Setline Survey (FISS, Ualesi et al. 2026), but in the Bering Sea also integrates data from the National Oceanic and Atmospheric Administration (NOAA) - Fisheries annual trawl survey and the Alaska Department of Fish and Game's (ADFG) annual Norton Sound trawl survey. Both surveys are fishery-independent data sources.

Since 2019, the weighing of Pacific halibut onboard FISS charter vessels has meant that the weight data used to compute WPUE comes almost entirely from observed weights of fish rather than estimates from a length-net weight relationship. For fish without directly measured weights, weights are predicted from a year- and IPHC Regulatory Area-specific length-net weight relationship estimated from the FISS length and weight data. For U32 fish with round weight recorded, net weights are estimated from a round-net weight relationship estimated from coastwide sample data from the 2019 FISS.

Data inputs to the space-time modelling were updated with 2026 data from the IPHC's FISS along with data from NOAA Bering Sea trawl survey data, which did not include sampling in the northern Bering Sea this year. The spatial coverage of the FISS was greater than recent years (Figure 1), although remained lower than the optimal Base Block design in Regions 3 and 4B. The latter region was unsampled in 2026 due to a lack of charter bids. The stations sampled in IPHC Regulatory Area 4A were fished for the first time since 2019. The vessel that fished the Seward charter region in IPHC Regulatory Area 3A was unable to complete 100% of planned stations due to a mechanical issue.

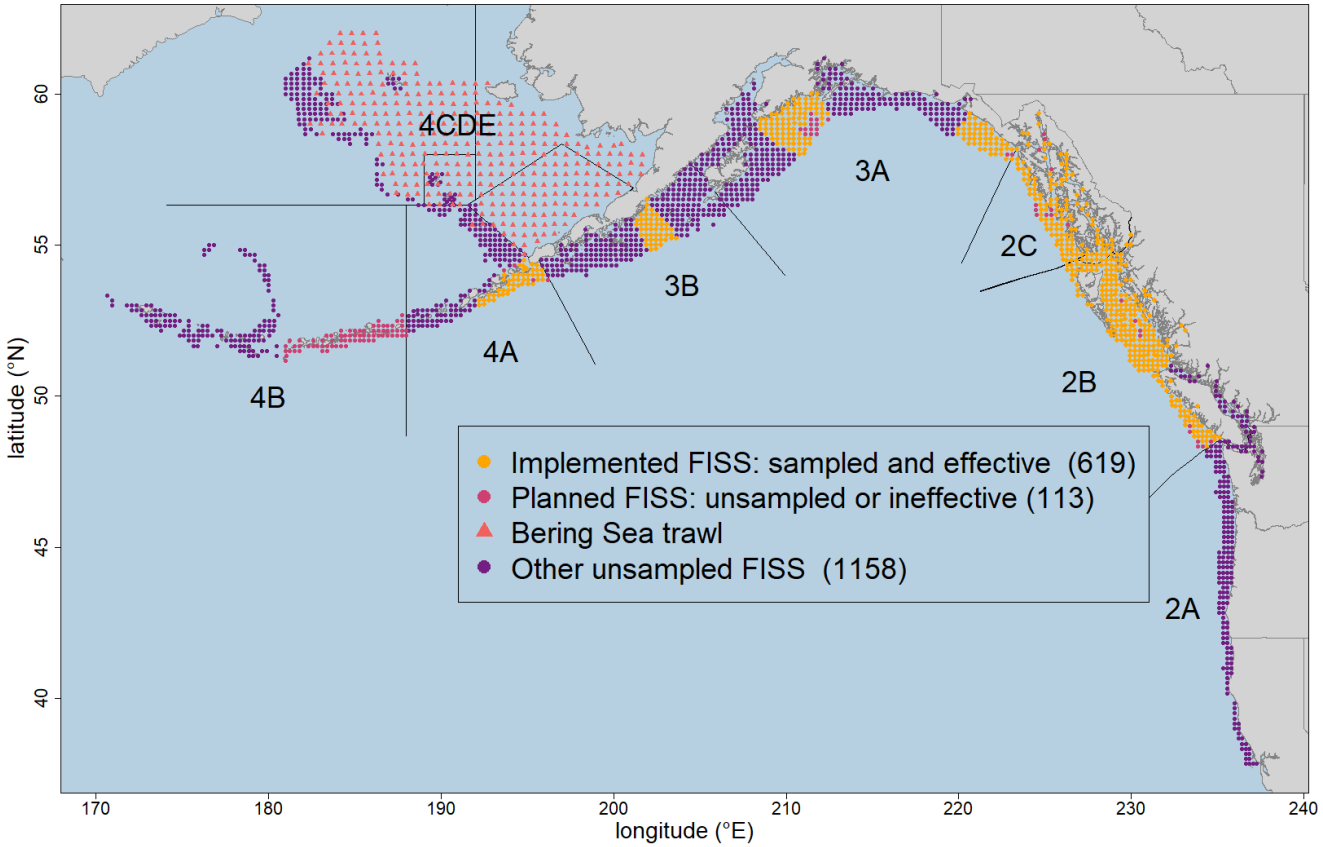


Figure 1. Map of 2026 sampled survey stations with data used in the space-time modelling (orange circles for FISS, red triangles for trawl), along with planned FISS stations that were either ineffective or not fished due to logistical reasons (fuchsia circles).

RESULTS OF SPACE-TIME MODELLING IN 2026

Figure 2 shows the time series estimates of O32 WPUE (most comparable to fishery catch-rates) over the 1993-2026 period included in the 2026 space-time modelling. Coastwide, we estimate a relatively stable index, with a 1% estimated decline since 2025. The index increased slightly in IPHC Biological Region 4 but declined in Regions 2 and 3. Coastwide indices of all sizes WPUE (Figure 3) and all sizes NPUE (Figure 4) were also estimated to be relatively stable, with changes of close to 0% since 2025. These indices showed small increases in Regions 2 and 4, and a decline in Region 3. Estimates for Biological Region 4B are highly uncertain due to the lack of sampling in 2026. Results for IPHC Regulatory Areas are shown in Appendix A.

Tables of model output (time series, stock distribution estimates) are updated annually on the IPHC website at https://www.iphc.int/data/time-series-datasets. Time series and other FISS summary information are presented on the FISS dashboard. These links are expected to be updated with 2026 data prior to the Interim Meeting on December 1.

RECOMMENDATION

That the Commission **NOTE** paper IPHC-2026-IM102-08 which provides results of the space-time modelling of Pacific halibut survey data for 1993-2026.

REFERENCE

Ualesi, K., Jack, T., and Coll, K. 2026. IPHC Fishery-independent setline survey (FISS) design and implementation in 2026. IPHC-2026-IM102-07.

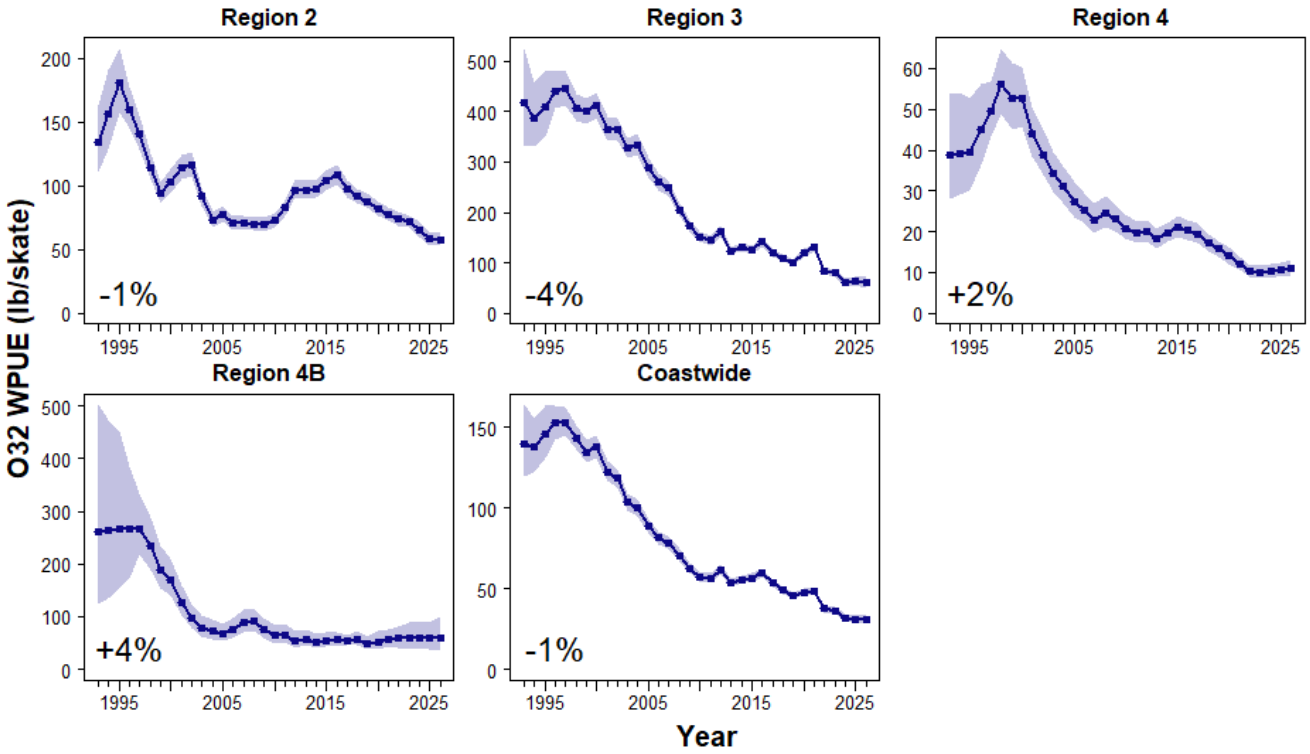


Figure 2. Space-time model output for O32 WPUE for 1993-2026 for Biological Regions. Filled circles denote the posterior means of O32 WPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean O32 WPUE from 2025 to 2026.

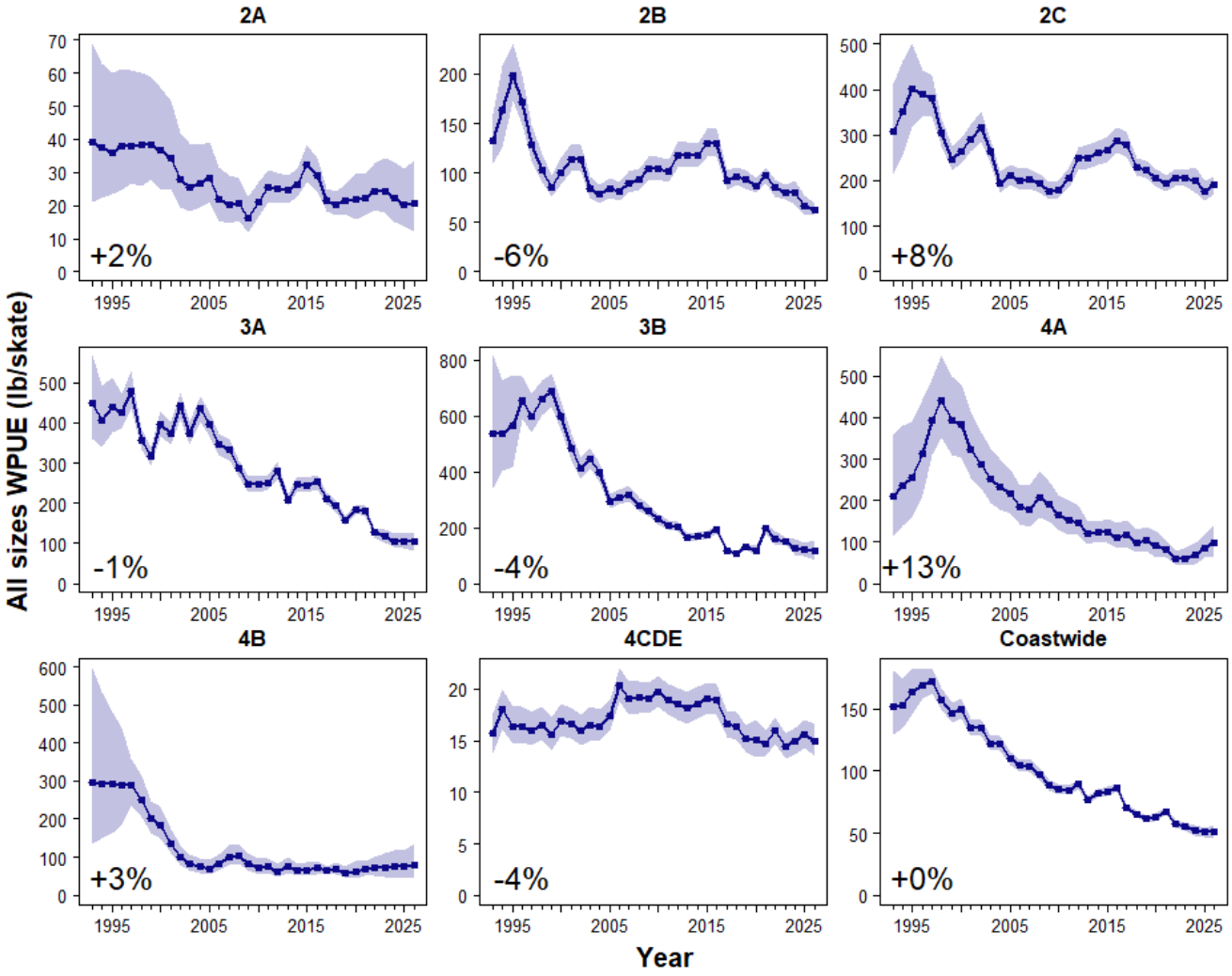


Figure 3. Space-time model output for all sizes WPUE for 1993-2026 for Biological Regions. Filled circles denote the posterior means of all sizes WPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean all sizes WPUE from 2025 to 2026.

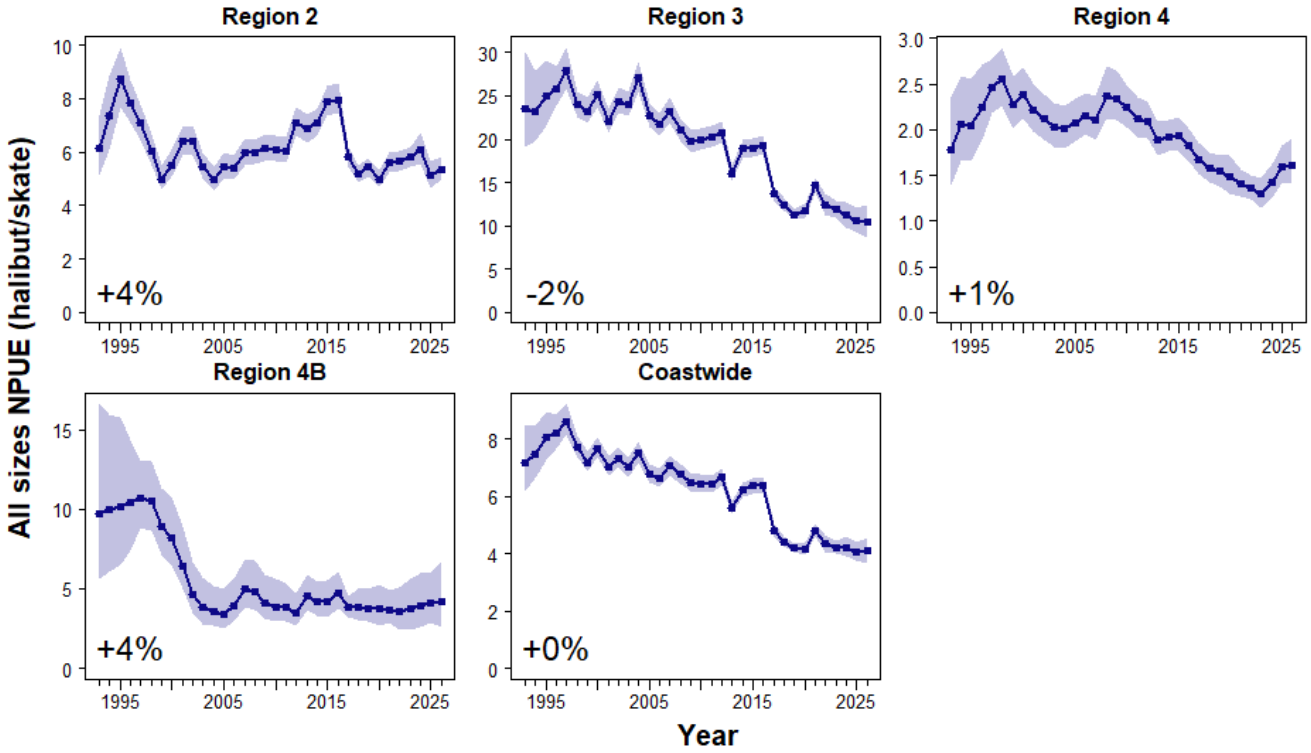


Figure 4. Space-time model output for all sizes NPUE for 1993-2026 for Biological Regions. Filled circles denote the posterior means of all sizes NPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean all sizes NPUE from 2025 to 2026.

APPENDIX A

Space-time modelling results by IPHC Regulatory Area

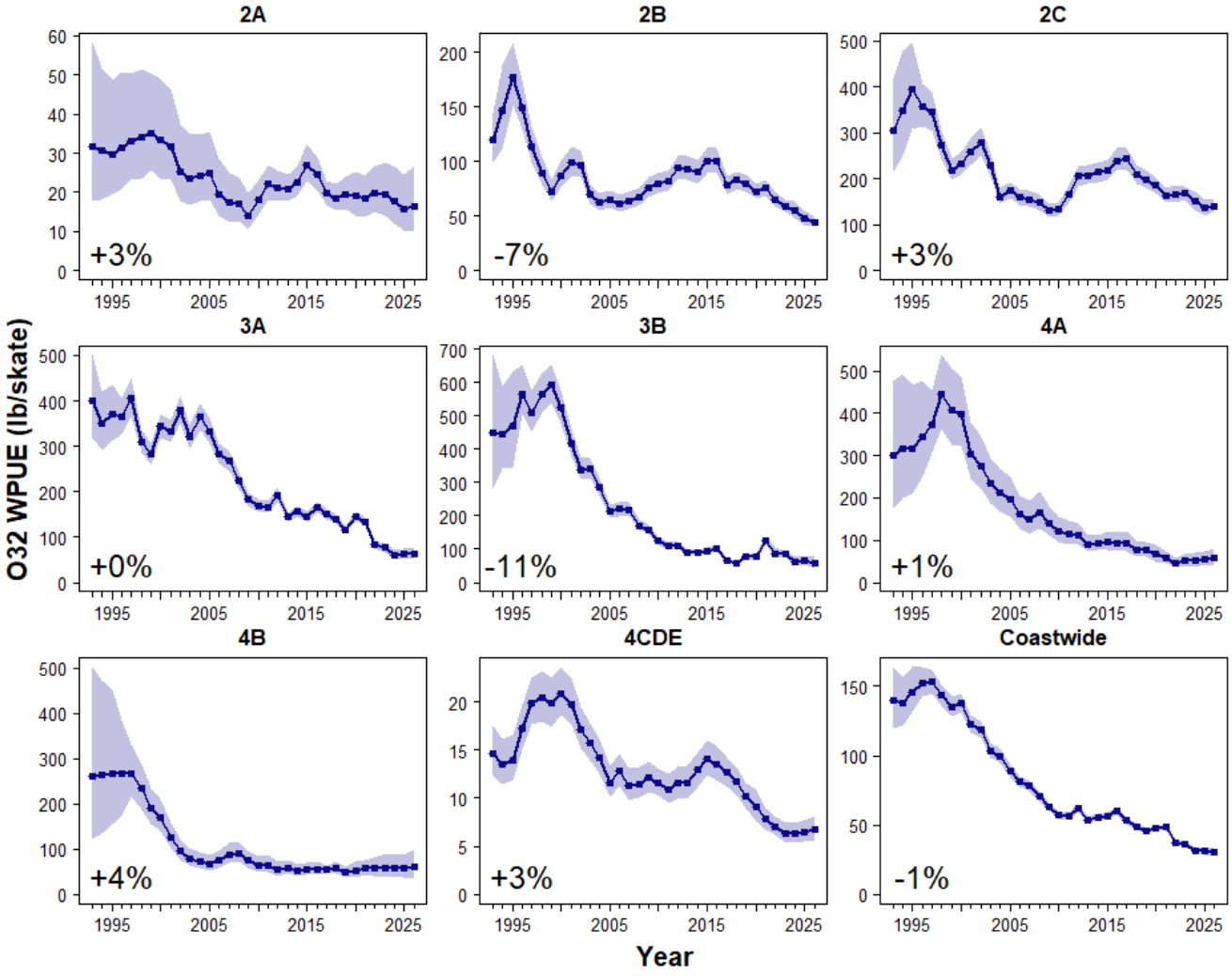


Figure A.1. Space-time model output for O32 WPUE for 1993-2026. Filled circles denote the posterior means of O32 WPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean O32 WPUE from 2025 to 2026.

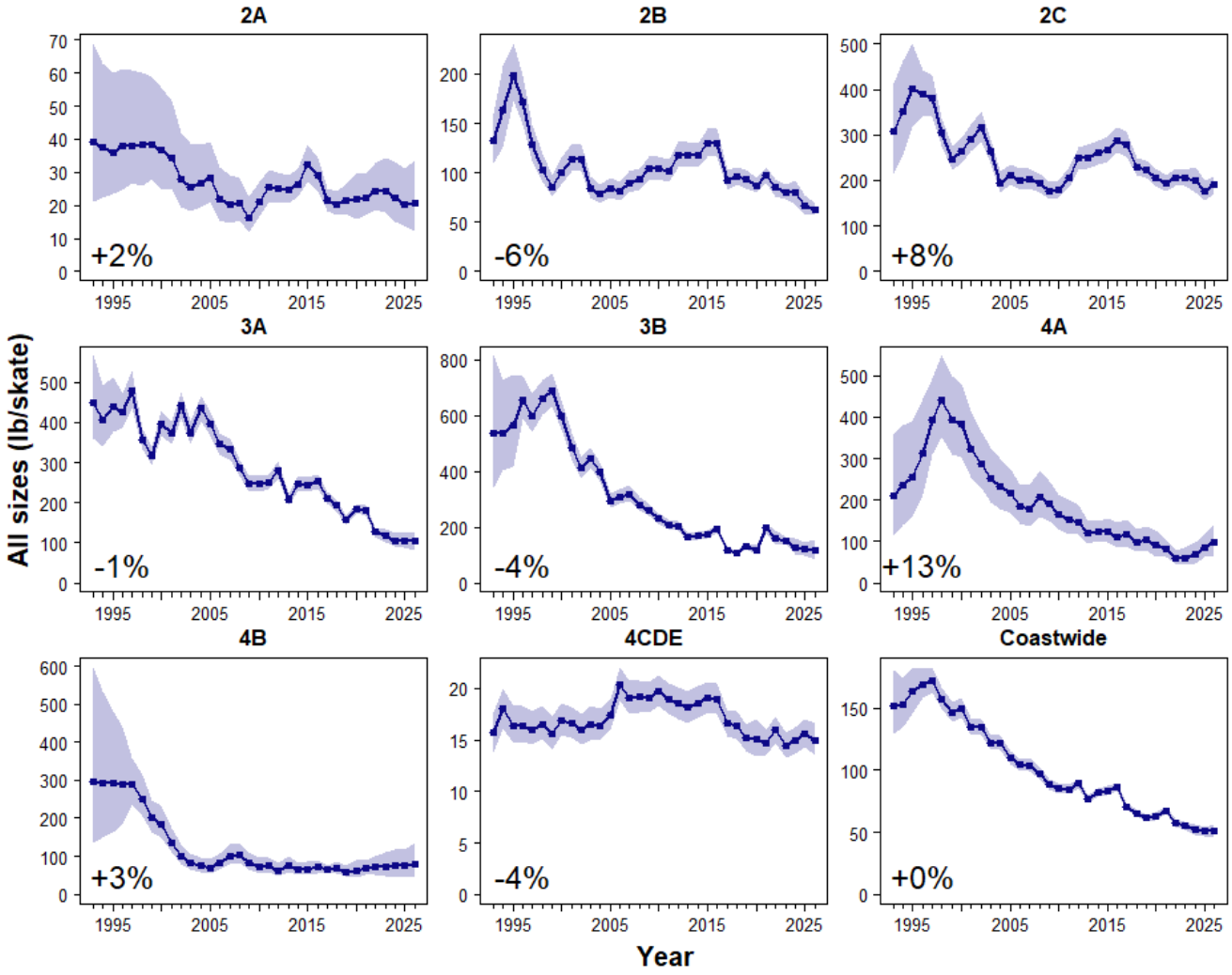


Figure A.2. Space-time model output for all sizes WPUE for 1993-2026. Filled circles denote the posterior means of all sizes WPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean all sizes WPUE from 2025 to 2026.

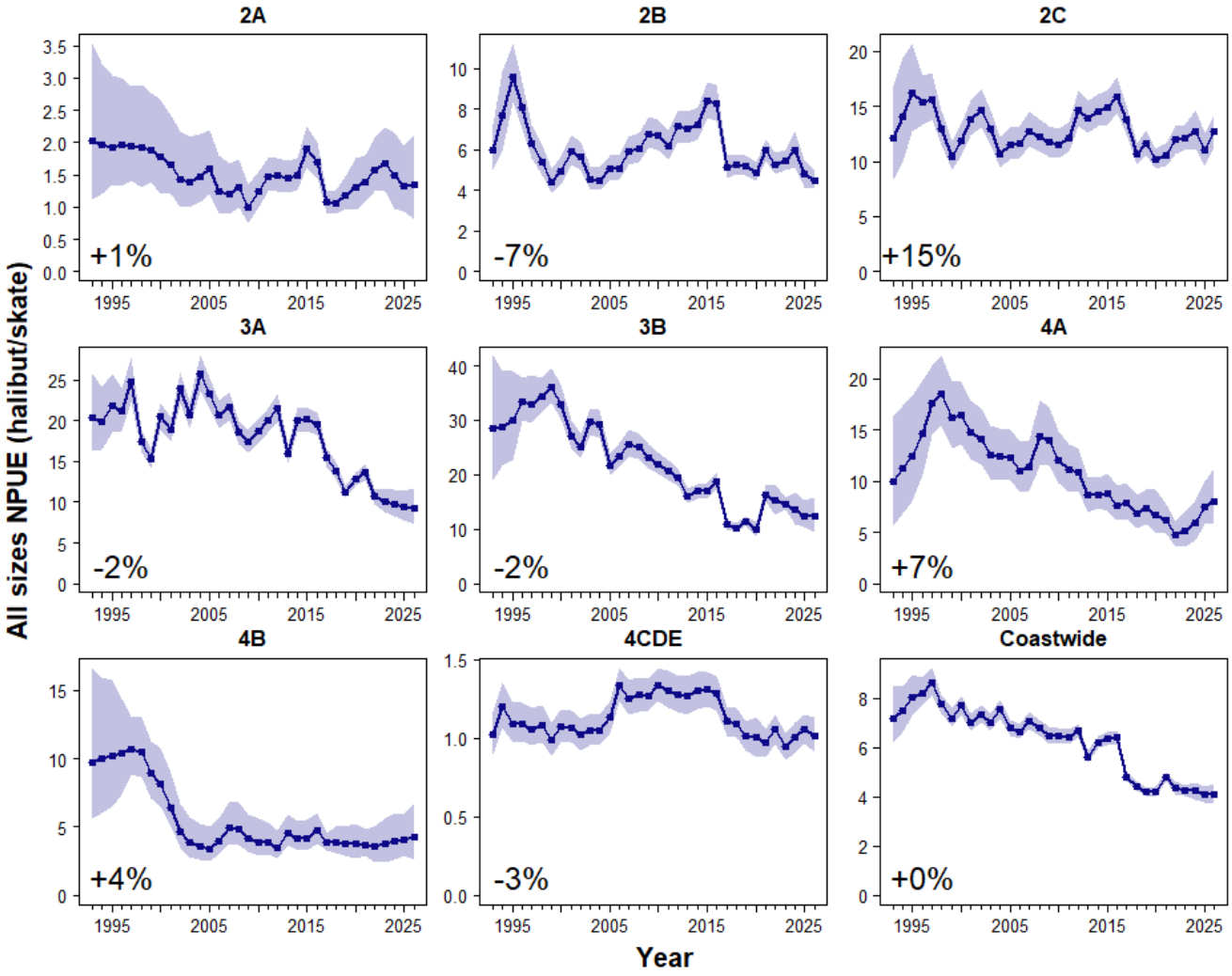


Figure A.3. Space-time model output for all sizes NPUE for 1993-2026. Filled circles denote the posterior means of all sizes NPUE for each year. Shaded regions show posterior 95% credible intervals, which provide a measure of uncertainty: the wider the shaded interval, the greater the uncertainty in the estimate. Numeric values in the lower left-hand corners are estimates of the change in mean all sizes NPUE from 2025 to 2026.