



GOA Demersal Shelf Rockfish

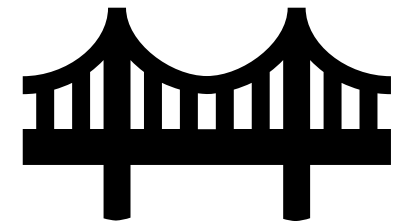
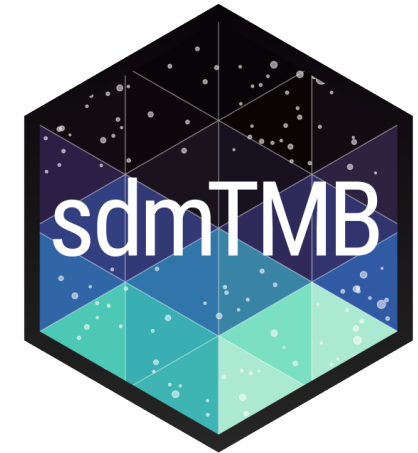
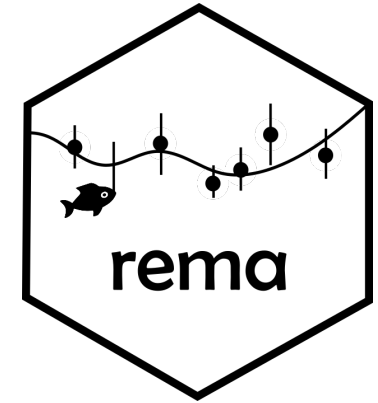
Presentation for September GPT

Aaron Lambert, Caitlin Stern, Laura Coleman, Rhea Ehresmann,
Kristin Omori, Christine Hinds, and Bridget Ferriss



Agenda

- DSR assessment methods
 - Changes to data
 - Changes to assessment
- Spatiotemporal index standardization
IPHC FISS CPUE data
- Bridging analysis
- Tier 6 guidance



Questions to keep in mind...

- Is the spatiotemporal standardization an appropriate replacement for the GAM/Tweedie IPHC CPUE method?
- Are sdmTMB CVs (SE/mean across the prediction grid) appropriate as REMA observation error?
- What criteria, *if any*, should guide consideration of a future Tier 5 → Tier 6 transition for SEO yelloweye rockfish given the reduced IPHC survey and no ADF&G ROV survey?

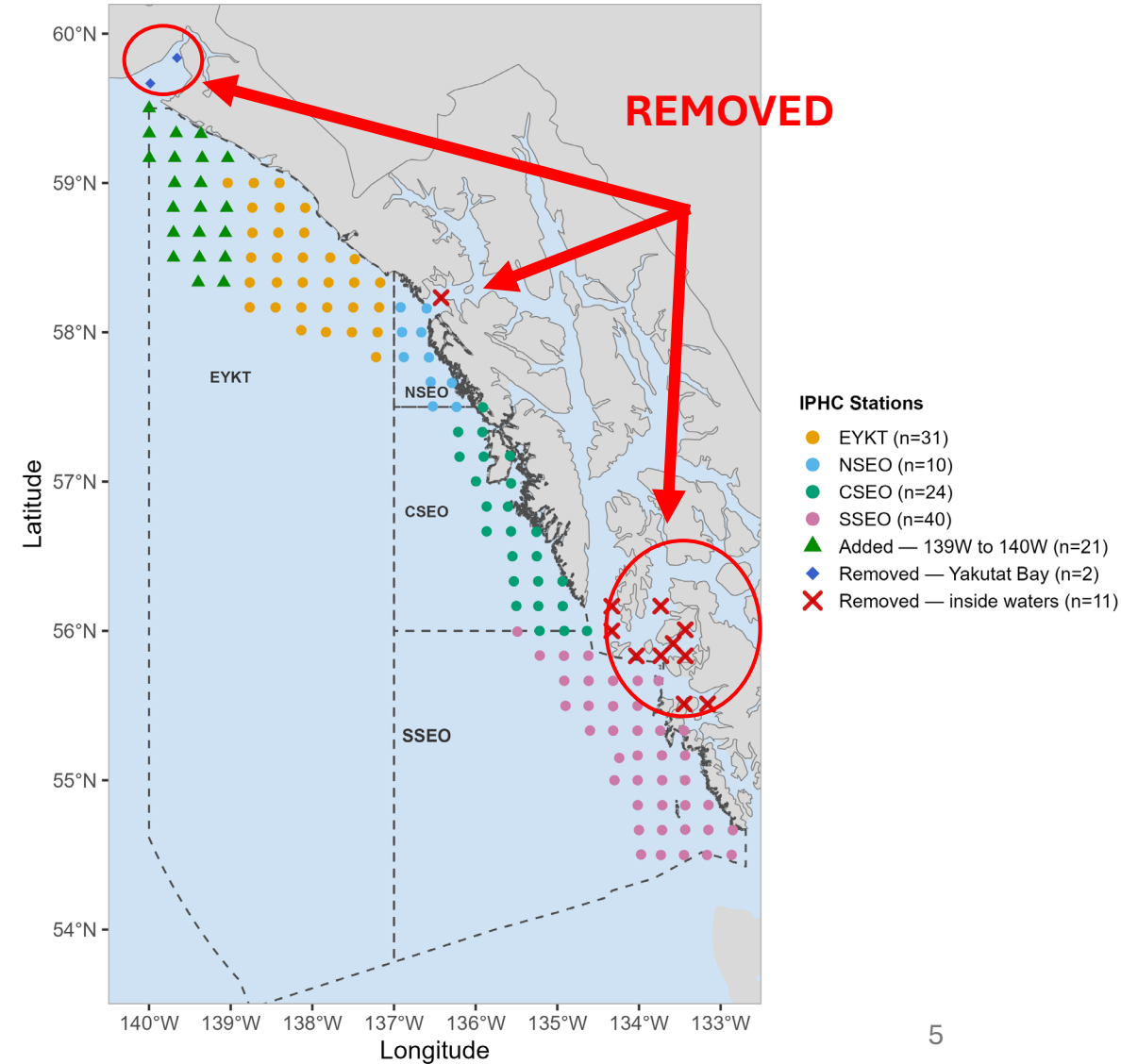
DSR Assessment



- Yelloweye, Canary, China, Quillback, Copper, Rosethorn, Tiger
- DSR in Central GOA/Western GOA/West Yakutat: **Tier 6**
 - Second assessment with this complex in DSR
- DSR except yelloweye rockfish in Southeast Outside (SEO): **Tier 6**
- Yelloweye in SEO: **Tier 5**
 - Two-index multi-area random effects model (REMA)
 - Extra biomass observation error
 - ADF&G ROV survey biomass
 - IPHC FISS survey CPUE

Changes to the input data

- IPHC survey data updated to 2025
 - Stations used in SEO changed
 - 13 stations removed from SEO



Changes to the input data

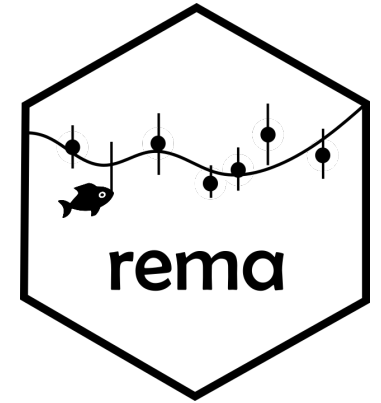
- IPhC survey data updated to 2025
 - Stations used in SEO changed
 - 13 stations removed from SEO
- SEO commercial fishery weights were updated through 2025
- **No new** ADFG ROV survey data
 - New ROV was purchased
 - Mechanical issues
 - Working on a State-wide ADF&G ROV (FY2028)
 - SLED contracted from NOAA



Changes in assessment methodology



- IPHC longline survey index standardization
 - Spatiotemporal model standardization 2026
 - sdmTMB
 - Tweedie distribution
 - Continued to be calculated as kg/hook



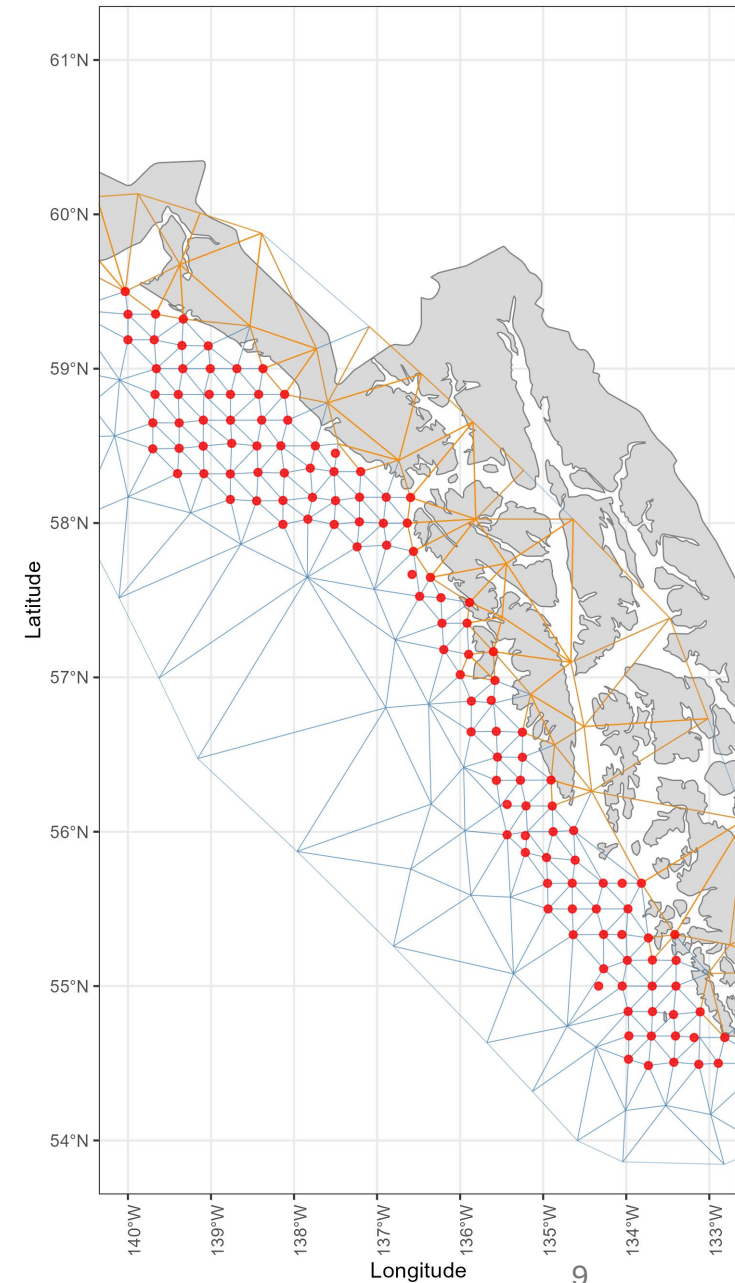
Spatiotemporal Standardization

- Motivation
 - Reduced IPHC sampling in SEO
 - All 4 management units well below average
 - No EYKT in 2024, only 3 stations in 2025
 - No NSEO in 2025
 - Spatiotemporal standardization
 - Share information across time and space
 - May produce more stable index of abundance

Year	CSEO	EYKT	NSEO	SSEO
1998	15	48	8	37
1999	18	47	8	36
2000	18	46	6	34
2001	16	47	8	34
2002	19	49	8	33
2003	19	46	8	34
2004	18	47	8	34
2005	17	48	7	36
2006	19	49	8	33
2007	19	50	8	34
2008	18	48	7	35
2009	18	47	7	35
2010	18	44	8	35
2011	18	48	6	31
2012	16	48	8	34
2013	16	45	8	35
2014	17	47	6	35
2015	17	48	5	32
2016	18	47	8	34
2017	18	48	7	34
2018	20	44	6	41
2019	20	41	9	37
2020	22	49	8	40
2021	20	41	7	39
2022	21	27	5	16
2023	21	47	9	39
2024	14	NA	4	28
2025	6	3	NA	24
Mean	17.7	44.4	7.2	33.9

Spatiotemporal Standardization

- sdmTMB
- IPHC stations used:
 - Stations ≤ 250 fathoms (YE habitat)
- Bathymetric data from ETOPO global relief model
 - 1 arc min resolution
- Barrier mesh
 - Coastline polygons from rnaturalearth
 - Built with sdmTMBextra
 - Prevent spatial correlation across land
 - Minimum triangle length 15km
 - Median distance between stations 17km



Spatiotemporal Standardization

- 7 Candidate models
- Tweedie error distribution
- Explored delta-gamma models
 - Did not converge unless 2025 EYKT was removed
- Tried AR1 and IID spatiotemporal structure
- One model with no spatiotemporal component
- All with combination of depth and/or soak time (or neither)

Model	Spatiotemporal structure	Depth smooth	Soak smooth
M1	IID	Yes	Yes
M2	AR(1)	Yes	Yes
M3	None	Yes	Yes
M4	IID	Yes	No
M5	IID	No	Yes
M6	AR(1)	No	No
M7	AR(1)	Yes	No

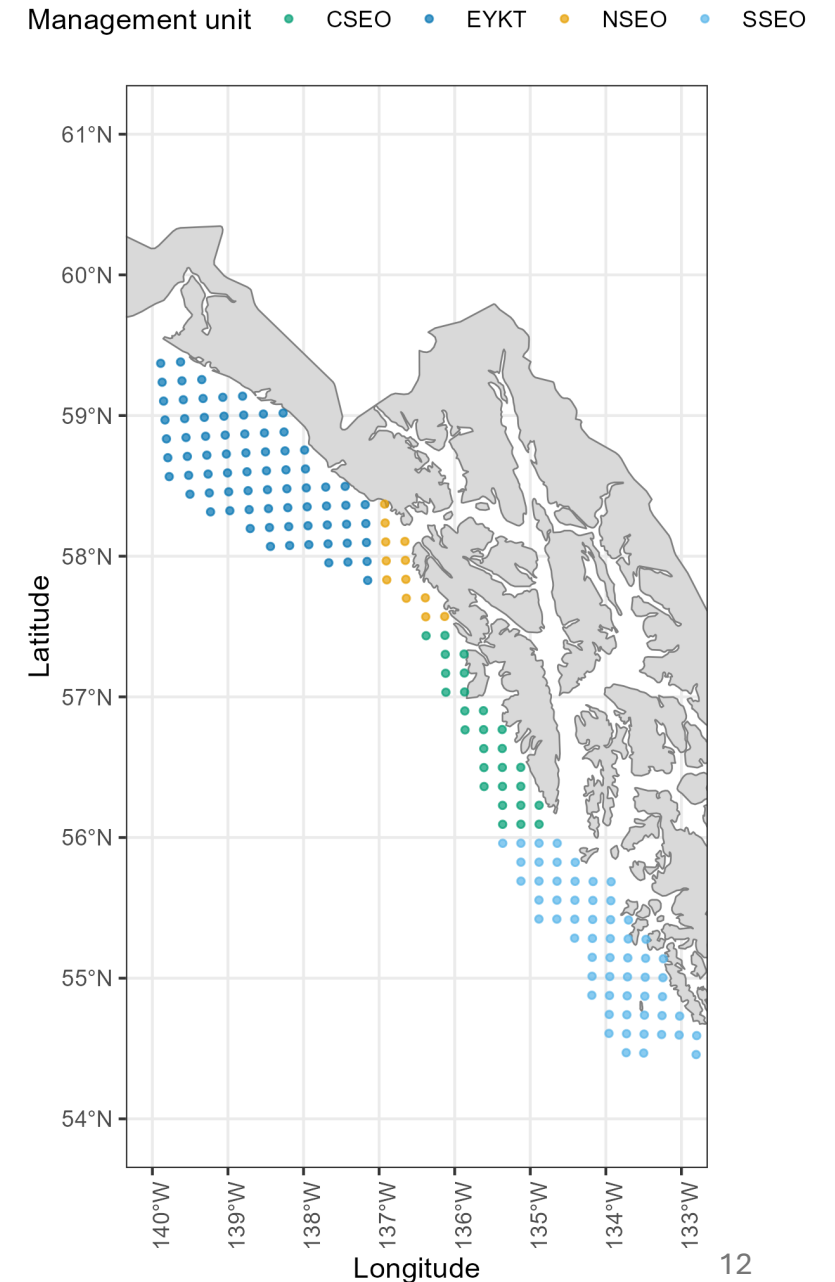
Model Validation

- Sanity() function
- DHARMA residuals
 - Kolmogrov-Smirnov test
 - Dispersion test
 - Outlier test
- Cross-validation
 - 5 random folds
 - 1998 - 2023
 - Left out 2024 and 2025 data due to convergence issues
- Selection Criteria
 - Converged
 - AIC
 - CV log-likelihood
 - MAE, RMSE



Model Predictions

- Spatial grid
 - Restricted to 14 – 250 fathoms
 - Across the SEO management area
 - 15 km resolution
- Explored other grids
 - 2km resolution
 - All SEO area (no depth restriction)
 - Predict to IPHC stations
 - All correlated highly to each other
 - 2km and 15 km $r \geq 0.99$
- Depth using nearest neighbor from marmap
- Soak time held constant at median value





Index Extraction

- Calculated from 15 km grid
- Averaged across each management unit
- CV
 - Used in REMA model
 - $SE_d = \frac{SD_d}{\sqrt{n_d}}$
 - $CV_d = \frac{SE_d}{\mu_d}$
- Tried the sdmTMB `extract_index()` function
 - CV large (0.8 – 0.95)
 - Results in low REMA biomass estimate (20,000 t)

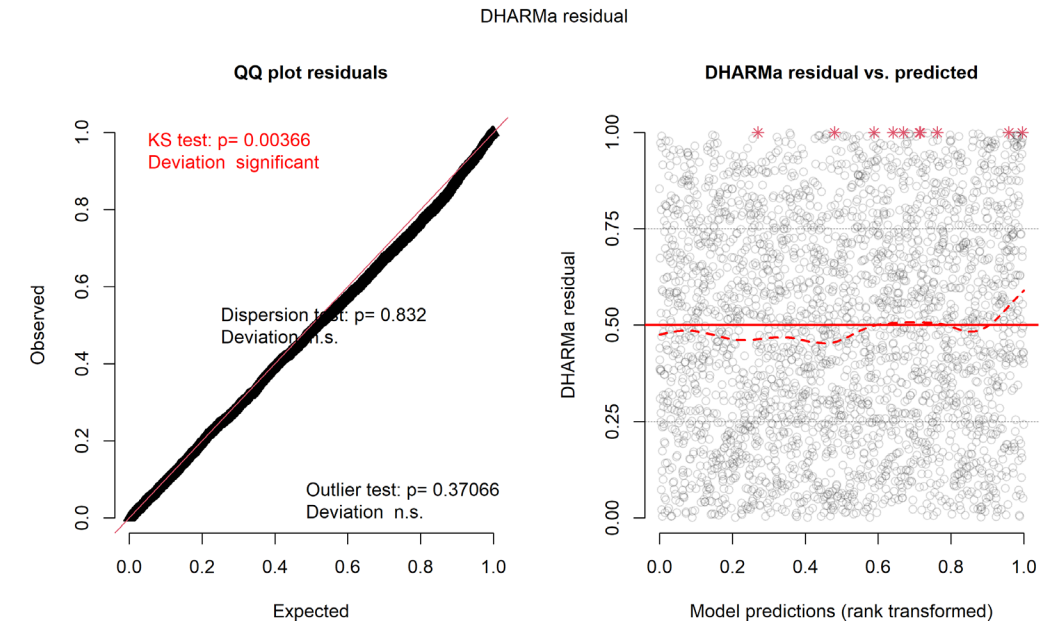
Spatiotemporal Model Selection

Model	Structure	AIC	Δ AIC	CV Log-Lik	Δ CV Log-Lik	RMSE	MAE
M2	Spatial + AR(1) + depth + soak	-488.0	0.0	280.1	-23.5	0.104	0.047
M1	Spatial + IID + depth + soak	-480.9	7.1	270.9	-32.7	0.104	0.047
M7	Spatial + AR(1) + depth	-480.0	8.0	272.9	-30.7	0.105	0.047
M4	Spatial + IID + depth	-472.7	15.3	262.4	-41.2	0.105	0.047
M3	Spatial only + depth + soak	-455.0	33.0	303.6	0.0	0.104	0.048
M5	Spatial + IID + soak	-346.9	141.1	185.0	-118.6	0.108	0.049
M6	Spatial + AR(1), no covariates	-339.1	148.9	182.4	-121.2	0.109	0.049

M2 selected: lowest AIC; AR(1) structure consistent with yelloweye life history (long-lived, high site fidelity)

Model M2 Diagnostics

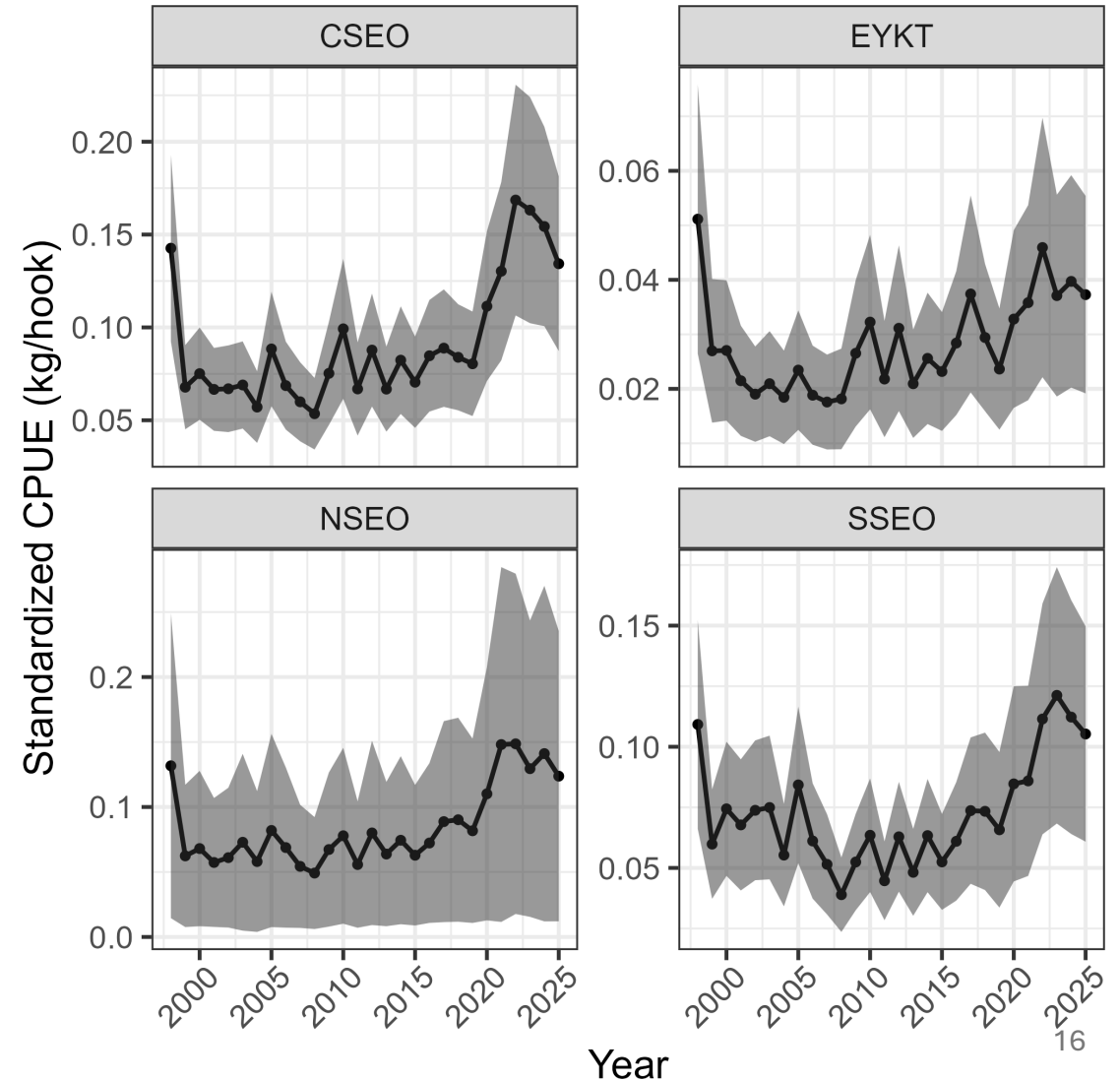
- DHARMA residuals
 - No significant dispersion; no outlier deviations
 - All 7 candidate models departed significantly from uniformity (KS test)
- Moran's I (M2): significant in 2 /28 years (1998, 2004)
- Key parameter estimates
 - Spatial range: 44.9 km (95% CI 33.2–60.9)
 - Spatial SD ($\sigma_o = 2.44$) >> spatiotemporal SD ($\sigma_E = 0.32$)
 - Stable habitat effects dominate over year-to-year shifts
 - AR(1) correlation $\rho = 0.62$ (95% CI 0.20–0.84)
 - Moderate temporal persistence
 - Soak time contributes negligible information
 - Improves AIC by 8 points



Parameter	Estimate	SE	Lower 95 pct	Upper 95 pct
Spatial range (km)	44.933	6.957	33.172	60.862
Tweedie dispersion (ϕ)	0.134	0.009	0.117	0.154
Spatial SD (σ_o)	2.435	0.261	1.973	3.005
Spatiotemporal SD (σ_E)	0.316	0.043	0.243	0.412
Tweedie power (p)	1.246	0.012	1.223	1.269
AR(1) correlation (ρ)	0.616	NA	0.203	0.842
Depth smooth SD	15.138	NA	5.332	42.977
Soak smooth SD	0.001	NA	0.000	NA

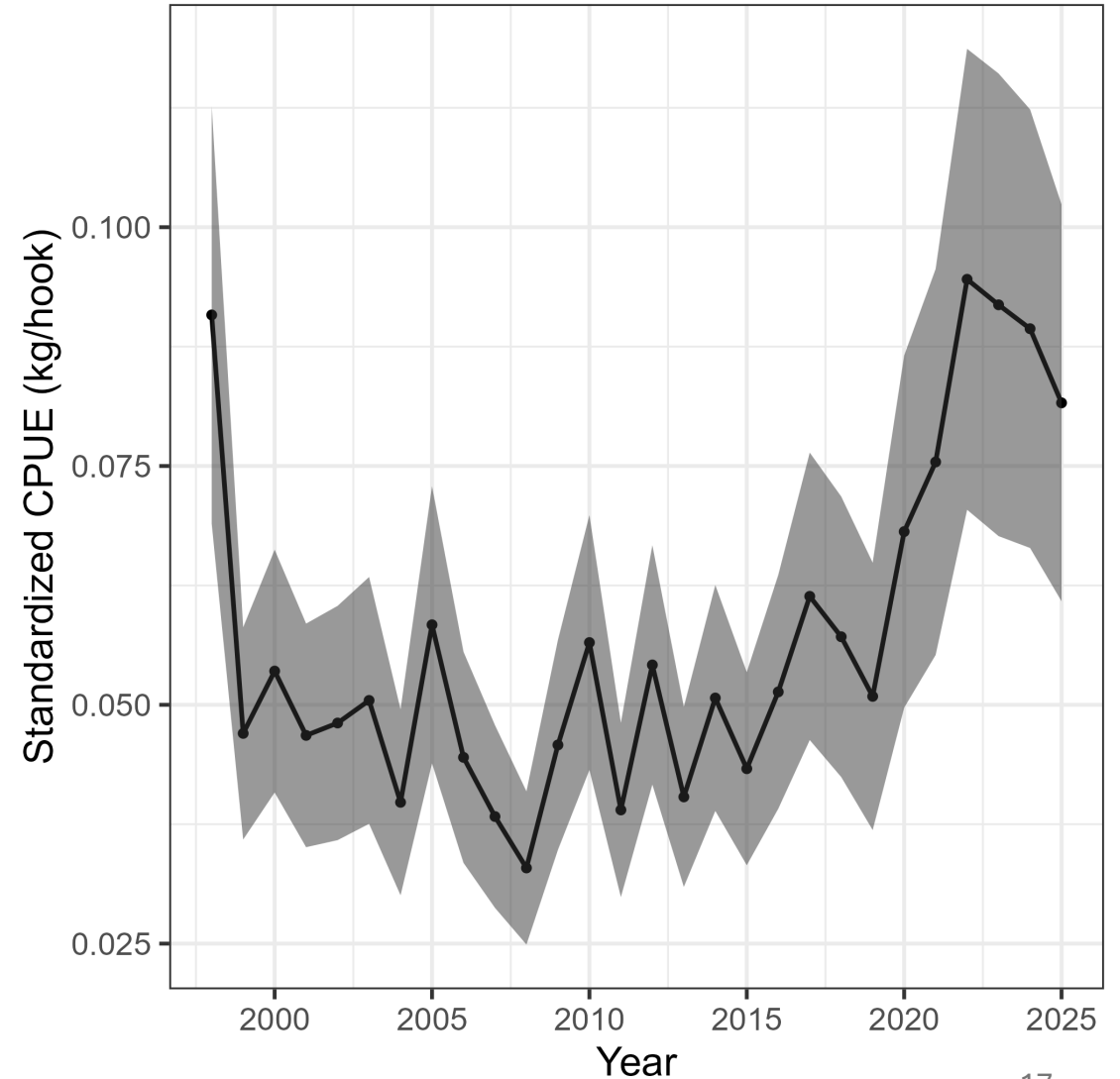
Standardized CPUE Indices

- Initial declines to mid-2000s
- Increase from ~2015 – 2022
- Slow decrease (during reduced sampling)
- NSEO shows the widest uncertainty
 - Fewest historical stations (~7/year)



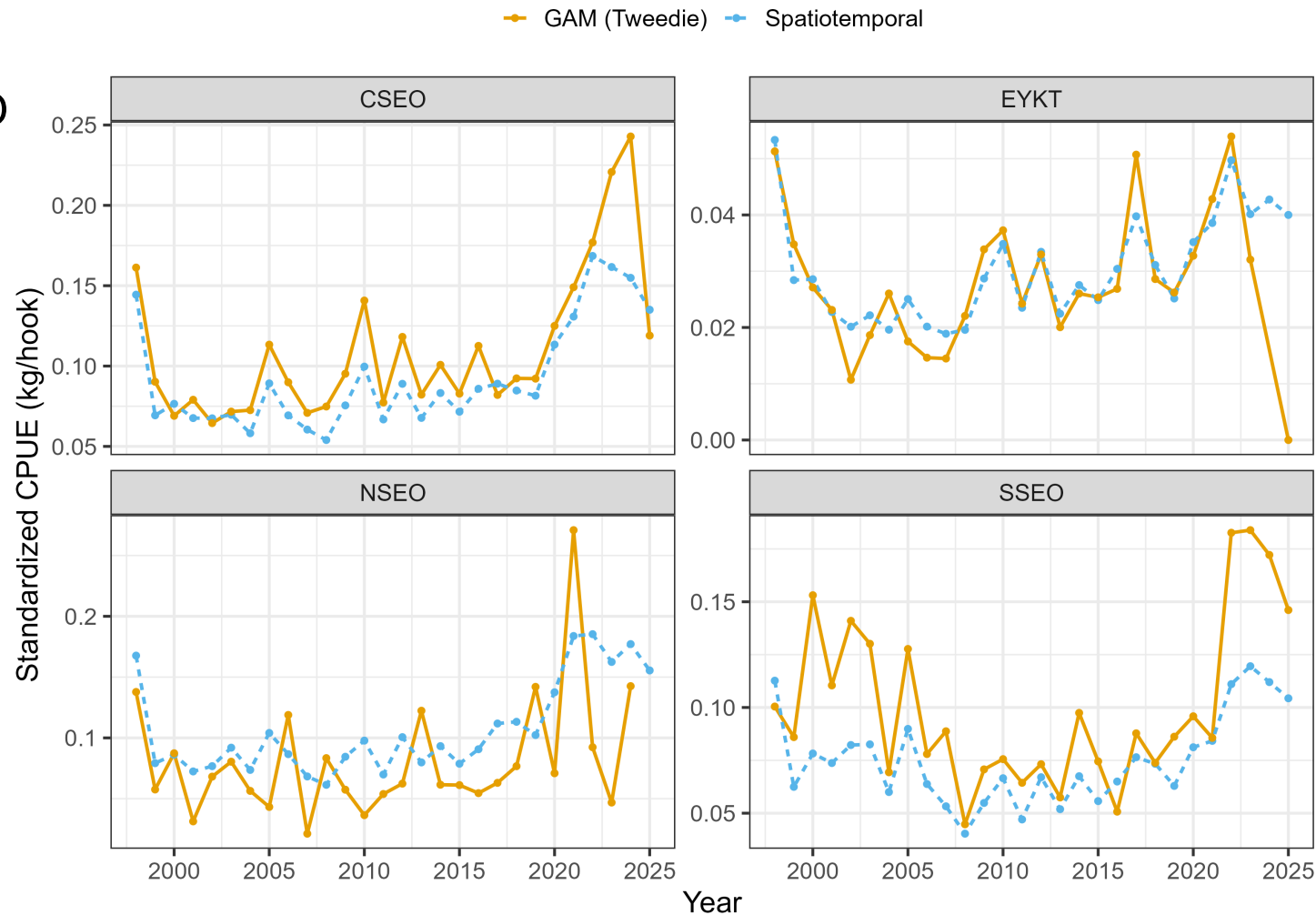
Standardized CPUE Indices

- Initial declines to mid-2000s
- Increase from ~2015 – 2022
- Slow decrease (during reduced sampling)
- NSEO shows the widest uncertainty
 - Fewest historical stations (~7/year)
- An SEO area-wide index follows the same overall pattern



sdmTMB vs. GAM Standardization

- Highly correlated with GAM index
 - CSEO (r=0.94), EYKT (r=0.91), SSEO (r=0.78)
- Weaker agreement in NSEO (r=0.53)
 - GAM shows greater interannual volatility from small sample sizes
- EYKT: GAM index collapses to zero in 2025 (3 stations, all zero-catch)
- We recommend the sdmTMB standardization for 2026 assessment



Bridging Analysis

Evaluating the effect of IPHC CPUE methodology changes since the 2022 assessment on biomass estimates

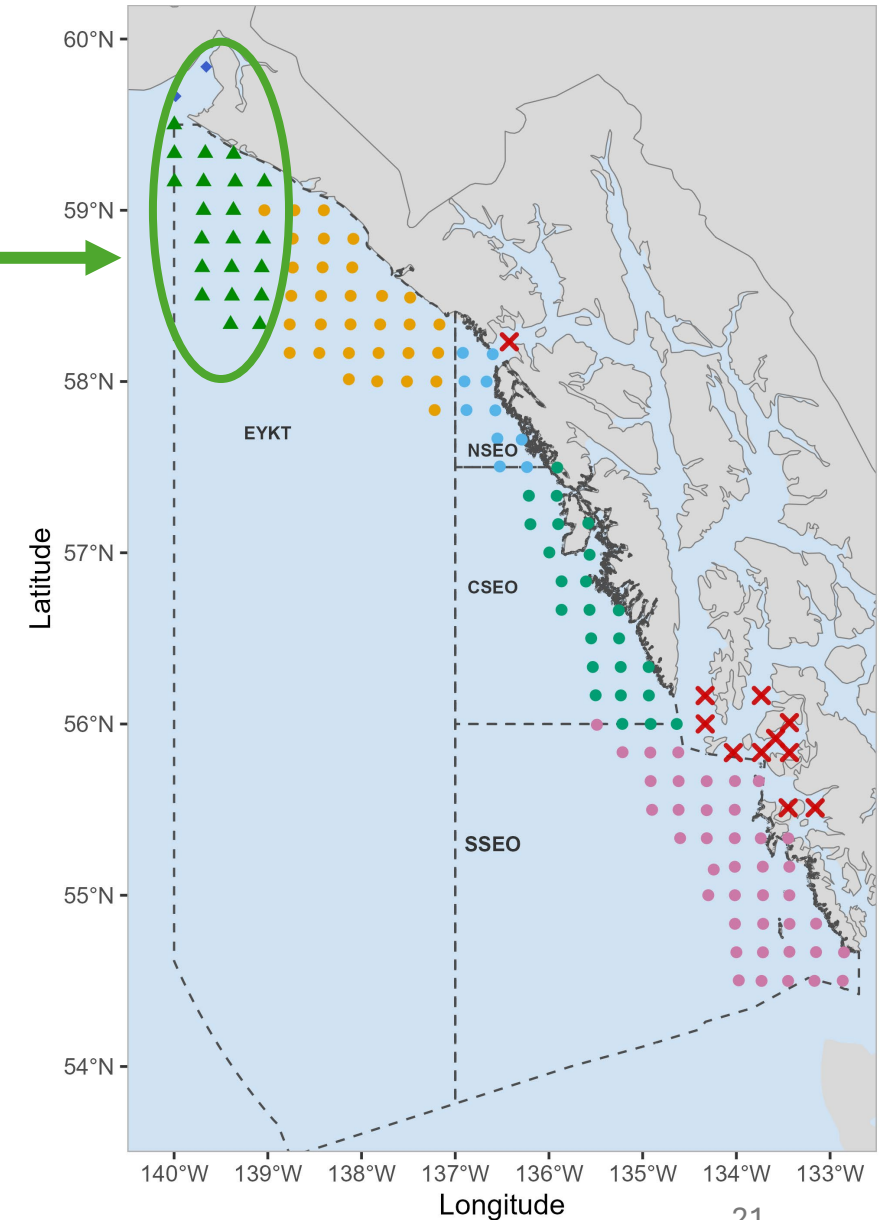
Bridging Analysis: Background

- Requested by GPT and SSC 2024
- 2024 SAFE methodology updates:
 - IPHC hook adjustment factor (corrects for hook saturation/competition)
 - Corrected EYKT longitude boundary (137°W → 140°W)
 - IPHC CPUE from numbers/hook → kg/hook
 - GAM/Tweedie standardization (inclusion of zero-catch stations)

Corrected IPHC Station Set

- 2024 Correction
 - 23 stations added – EYKT boundary correction (139–140°W)

2024 Longitude correction (Lon)

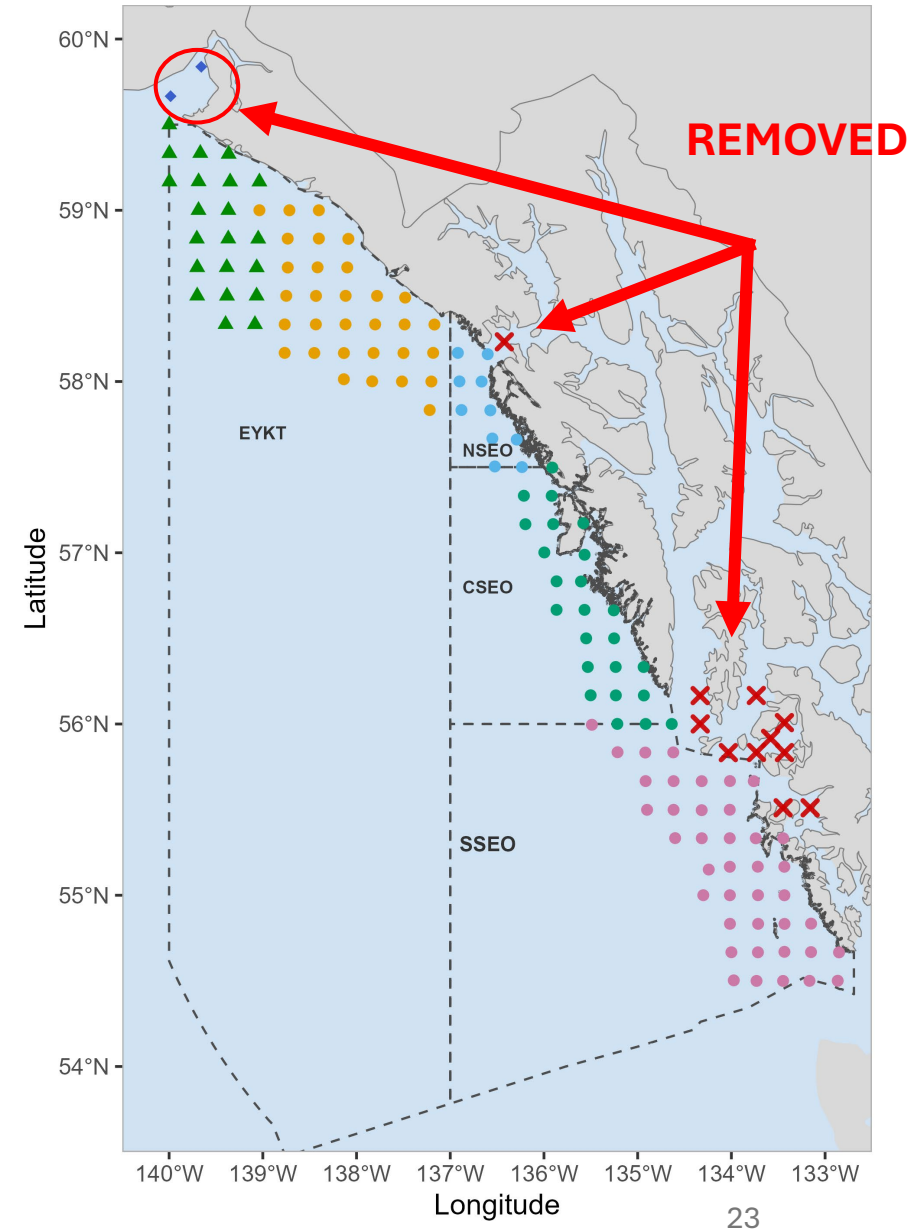


Bridging Analysis: Background

- Requested by GPT and SSC 2024
- 2024 SAFE methodology updates:
 - IPHC hook adjustment factor (corrects for hook saturation/competition)
 - Corrected EYKT longitude boundary (137°W → 140°W)
 - IPHC CPUE from numbers/hook → kg/hook
 - GAM/Tweedie standardization (inclusion of zero-catch stations)
- 2026 - further lat/long corrections
 - Inside-waters stations misassigned to SEO management units
 - Refined EYKT latitude boundary (59.5°N, excludes Yakutat Bay)

Corrected IPHC Station Set

- 2024 Correction
 - 23 stations added – EYKT boundary correction (139–140°W)
- 2026 Correction
 - 2 stations removed – north of 59.5°N (Yakutat Bay)
 - 11 stations removed – inside-waters stations previously misassigned to SEO management units



Bridging Analysis: Background

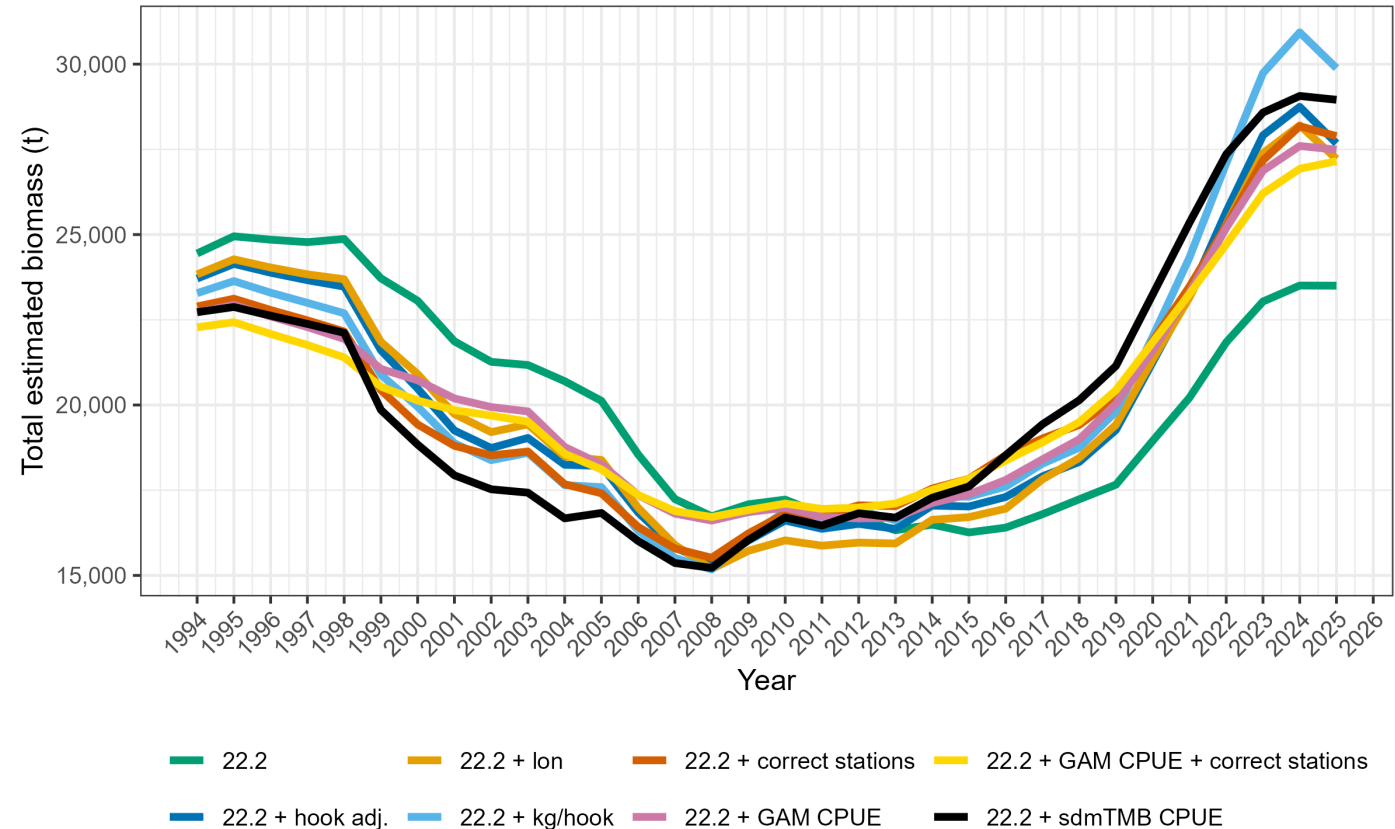
- Requested by GPT and SSC 2024
- 2024 SAFE methodology updates:
 - IPHC hook adjustment factor (corrects for hook saturation/competition)
 - Corrected EYKT longitude boundary (137°W → 140°W)
 - IPHC CPUE from numbers/hook → kg/hook
 - GAM/Tweedie standardization (inclusion of zero-catch stations)
- 2026 - further lat/long corrections
 - Inside-waters stations misassigned to SEO management units
 - Refined EYKT latitude boundary (59.5°N, excludes Yakutat Bay)
- Spatiotemporal standardization (sdmTMB)
- Eight sequential REMA model runs
 - **Model 22.2 structure and ROV biomass the same in all bridge models**

The Eight-Step Bridge

Step Number	Step	Station set	CPUE units	Hook adj.	EYKT boundary
1	22.2	Non-zero	numbers/ho ok	No	137°W
2	+ hook adj.	Non-zero	numbers/ho ok	Yes	137°W
3	+ lon	Non-zero	numbers/ho ok	Yes	140°W
4	+ kg/hook	Non-zero	kg/hook	Yes	140°W
5	+ GAM CPUE	All ≤ 250 fm	kg/hook	Yes	140°W
6	+ correct stations	Non-zero	kg/hook	Yes	140°W, 59.5°N
7	+GAM CPUE + correct stations	All ≤ 250 fm	kg/hook	Yes	140°W, 59.5°N
8	+ sdmTMB CPUE (2026 recommended)	All ≤ 250 fm	kg/hook	Yes	140°W, 59.5°N

Bridging Results: Biomass

- All updated methods increase biomass relative to the 2022 model (22.2; **Green**)
- Largest single change: hook adjustment + kg/hook conversion (23,501 → 29,881 t)
- Station correction reduces biomass relative to the kg/hook step – removed productive stations
- Differences most pronounced 2022–2025, coinciding with reduced IPHC survey effort



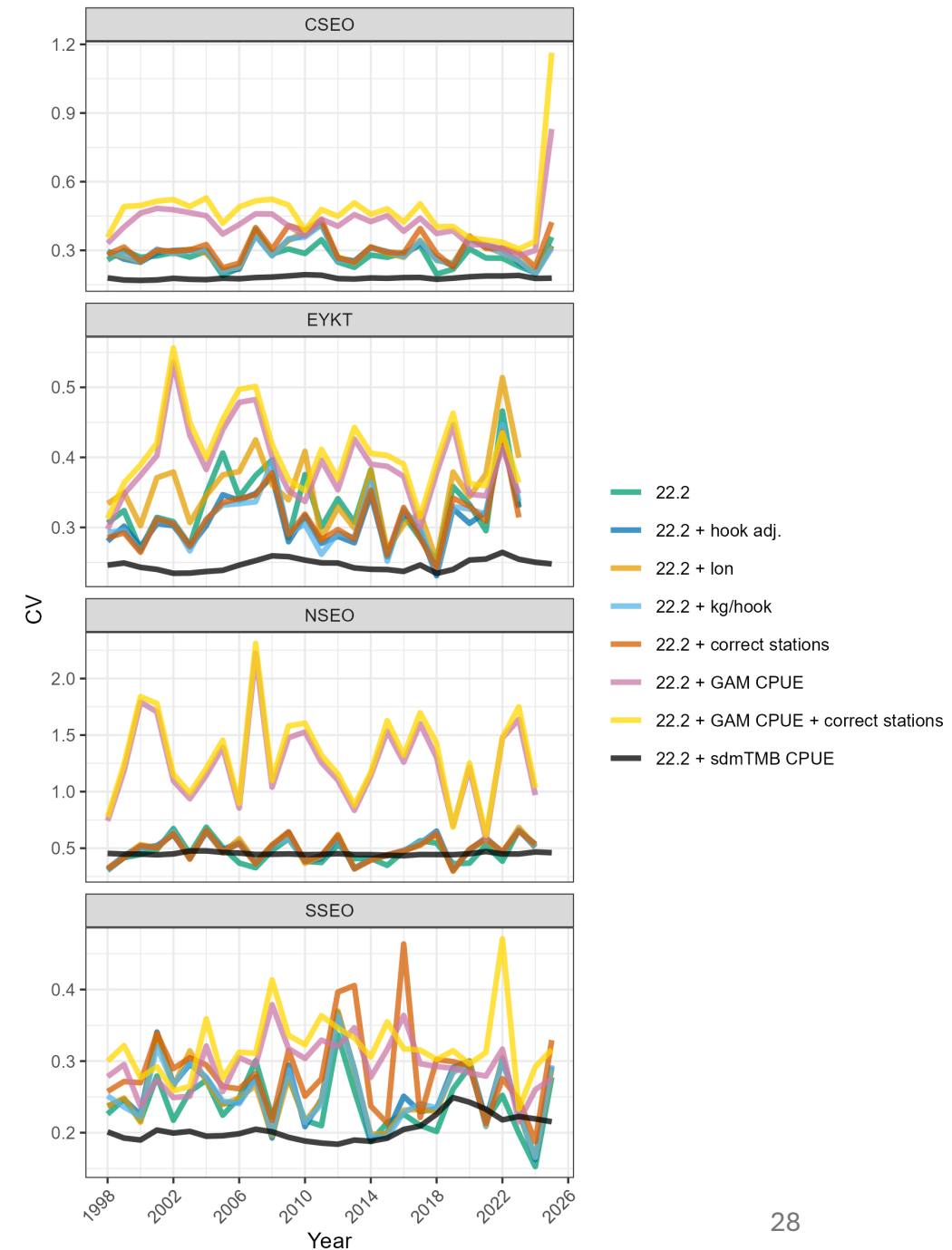
Bridging Results: Harvest Specs

Model Run	Biomass (t)	YE OFL (t)	YE maxABC (t)
22.2 (2022 accepted)	23,501	470	353
22.2 + kg/hook	29,881	598	448
22.2 + correct stations	27,888	558	418
22.2 + GAM CPUE + correct stations	27,154	543	407
22.2 + sdmTMB CPUE (2026 recommended)	28,955	579	434

Recommended 2026 model: 28,955 t biomass (95% CI 23,581–35,553 t)

CV Sensitivity Analysis

- sdmTMB CVs (SE/mean across prediction grid cells) are smaller and less variable across years than bootstrap- or GAM-derived CVs
- Increased index precision is an expected property of spatiotemporal standardization (Fuster-Alonso et al. 2024)
- Does this added precision appropriately inform the REMA fit, or over-weight the CPUE index relative to the ROV survey?
- To see the effect:
 - scaled sdmTMB CVs by multipliers of 1–5
 - Mean CV of all non-sdmTMB bridging indices



CV Sensitivity Analysis: Results

CV Scenario	Biomass (t)	YE OFL (t)	YE maxABC (t)
sdmTMB CV ×1 (base, recommended)	28,955	579	434
sdmTMB CV ×2	24,518	490	368
sdmTMB CV ×3	21,111	422	317
sdmTMB CV ×4	20,122	402	302
sdmTMB CV ×5	19,801	396	297
CV = mean of other indices	27,052	541	406

We recommend the base model CV (×1) but request GPT/SSC guidance on whether it is appropriate for harvest specifications, or whether a more conservative assumption is warranted

Tier 5 and 6 questions for future assessments

- No ADF&G ROV survey since 2023
 - New ROV was purchased
 - Mechanical issues
 - Possible ROV funding FY 2028
 - Possible SLED contracting through NOAA
- IPHC effort substantially reduced:
 - EYKT: **0** stations (2024), **3** stations (2025) vs. **~44/year** historical average
 - NSEO: **4** stations (2024), **0** stations (2025) vs. **~7/year** historical average
- We could not find precedent for criteria to move from Tier 5 to 6.

Quantity	Tier 5 (recommended)	Tier 6	% change
Yelloweye OFL	579 t	256 t	-56%
Yelloweye maxABC	434 t	192 t	-56%

Year	CSEO	EYKT	NSEO	SSEO
1998	15	48	8	37
1999	18	47	8	36
2000	18	46	6	34
2001	16	47	8	34
2002	19	49	8	33
2003	19	46	8	34
2004	18	47	8	34
2005	17	48	7	36
2006	19	49	8	33
2007	19	50	8	34
2008	18	48	7	35
2009	18	47	7	35
2010	18	44	8	35
2011	18	48	6	31
2012	16	48	8	34
2013	16	45	8	35
2014	17	47	6	35
2015	17	48	5	32
2016	18	47	8	34
2017	18	48	7	34
2018	20	44	6	41
2019	20	41	9	37
2020	22	49	8	40
2021	20	41	7	39
2022	21	27	5	16
2023	21	47	9	39
2024	14	NA	4	28
2025	6	3	NA	24
Mean	17.7	44.4	7.2	33.9

Tier 5 and 6 questions for future assessments

- Example criteria:
 - Consecutive years (3+ years) with no IPHC survey in a specific management unit (NSEO, SSEO, CSEO, EYKT);
 - A reduction below 50% of the current station historical average across the SEO for three consecutive years;
 - REMA model convergence issues related to IPHC index fit (i.e., Hessian or gradient failures).

Quantity	Tier 5 (recommended)	Tier 6	% change
Yelloweye OFL	579 t	256 t	-56%
Yelloweye maxABC	434 t	192 t	-56%

Year	CSEO	EYKT	NSEO	SSEO
1998	15	48	8	37
1999	18	47	8	36
2000	18	46	6	34
2001	16	47	8	34
2002	19	49	8	33
2003	19	46	8	34
2004	18	47	8	34
2005	17	48	7	36
2006	19	49	8	33
2007	19	50	8	34
2008	18	48	7	35
2009	18	47	7	35
2010	18	44	8	35
2011	18	48	6	31
2012	16	48	8	34
2013	16	45	8	35
2014	17	47	6	35
2015	17	48	5	32
2016	18	47	8	34
2017	18	48	7	34
2018	20	44	6	41
2019	20	41	9	37
2020	22	49	8	40
2021	20	41	7	39
2022	21	27	5	16
2023	21	47	9	39
2024	14	NA	4	28
2025	6	3	NA	24
Mean	17.7	44.4	7.2	33.9