GOA BOTTOM TRAWL SURVEY: EVALUATION OF 2025 RESULTS

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NOAA FISHERIES

June 2026, Presentation to the NPFMC SSC

BLUF

Was there an influence of the Gulf of Alaska bottom trawl survey redesign on 2025 results?

BACKGROUND

- Reminder: over the years PT/SSC has reviewed several presentations leading up to application in 2025 of GOA survey redesign, design has been extensively simulation tested

Gulf of Alaska Bottom Trawl Survey: Survey Area Footprint Changes

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RACE Groundfish Assessment Program

Gulf of Alaska Plan Team
November 2024


JOURNAL ARTICLE

Incorporating spatiotemporal variability in multispecies survey design optimization addresses trade-offs in uncertainty

Zack S Oyafuso, Lewis A K Barnett, Stan Kotwicki

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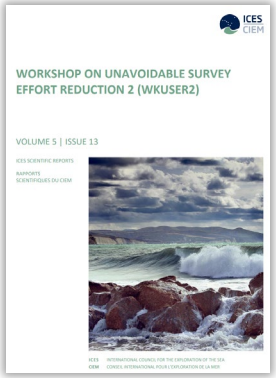
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WORKSHOP ON UNAVOIDABLE SURVEY EFFORT REDUCTION 2 (WKUSER2)

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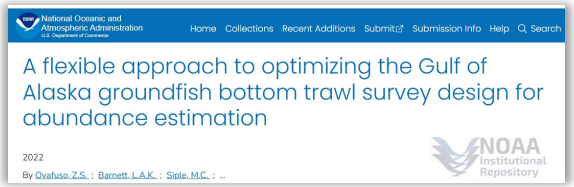
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A flexible approach to optimizing the Gulf of Alaska groundfish bottom trawl survey design for abundance estimation

2022

By Oyafuso, Z.S. ; Barnett, L.A.K. ; Siple, M.C. ; ...

NOAA Institutional Repository

BACKGROUND

- The creation of the present GOA survey area design consisted of two aspects:
  1. Genetic algorithm to determine the placement of stratum boundaries, and,
  2. Multispecies optimal allocation algorithm to maximize precision across a representative set of rockfishes, flatfishes, and gadids

Oyufuso et al. 2021

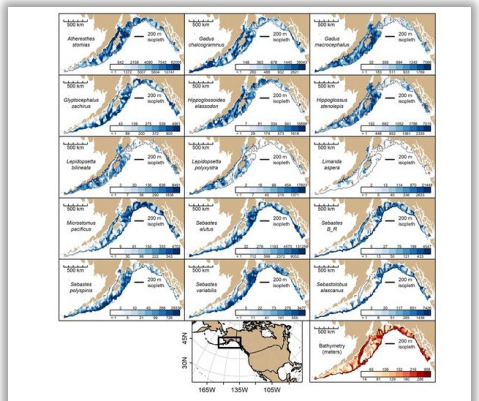


Figure 2. Predicted mean density across years (kg km $^{-2}$) for each species included in the survey optimization across the GoA. Bottom right panel shows the bathymetry within the survey footprint along with the 200 m isobath, which is a general delineation of species distributions. Refer to the Supplementary S1 for a brief explanation of the OM used to produce these predicted densities and Supplementary S2 for predicted densities by year.

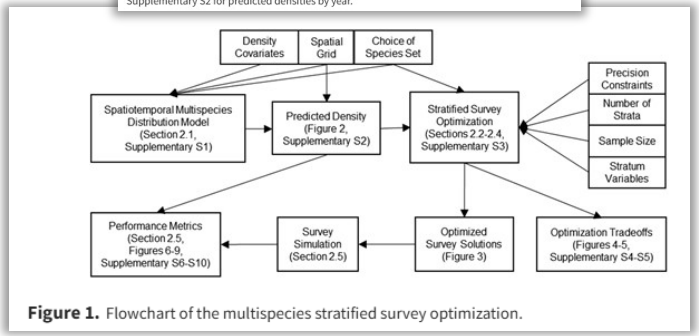
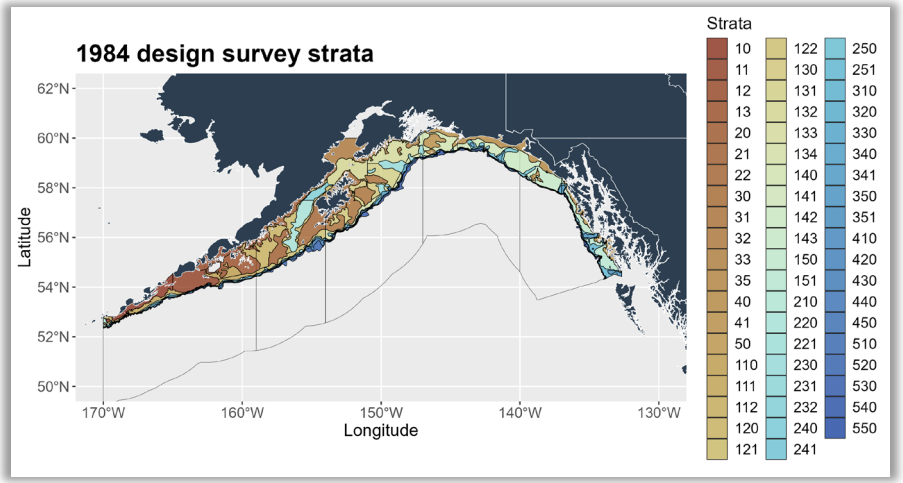
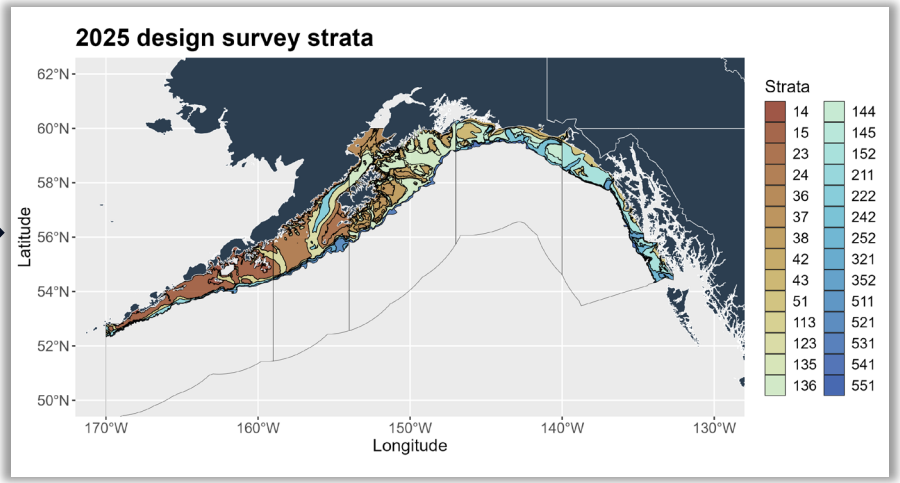


Figure 1. Flowchart of the multispecies stratified survey optimization.

BACKGROUND

- The creation of the present GOA survey area design resulted in:
  1. Reduced over-stratification (59 → 28 strata)
  2. Provides ≥4 stations per strata
  3. Stratum boundaries align with current NMFS statistical districts

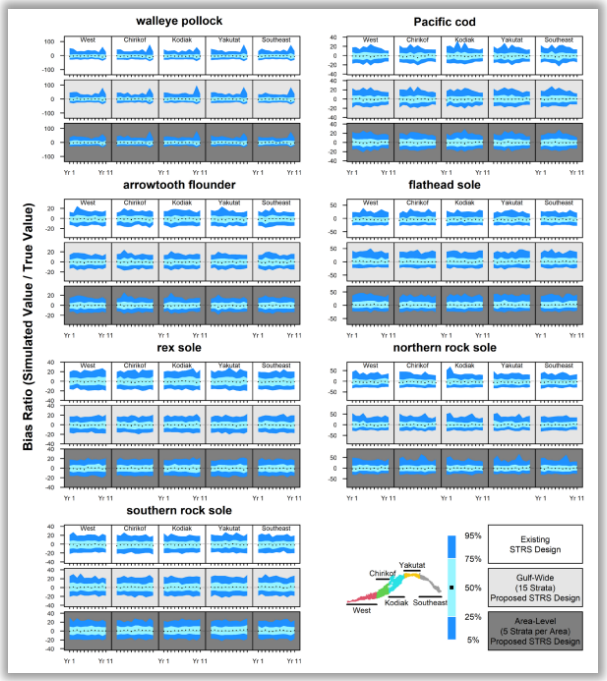




BACKGROUND

- Simulation studies evaluating survey redesign resulted in:
  1. Unbiased results
  2. Maintains or improves accuracy and precision for representative set of stocks
  3. Flexible design that can adapt to future changes in survey effort or species distributions

Oyufuso et al. 2022



2025 SURVEY CONCERNS

- Theory vs reality: simulation studies helpful in design evaluation, but real-life survey can produce surprising results
- Several concerns arose regarding the results of the 2025 GOA bottom trawl survey upon implementation of redesign
- Concerns categorized into 3 topics:
  1. Consistency of the redesign with historical GOA bottom trawl survey results
  2. Guild-level patterns in population indices
  3. Impacts of survey effort reduction

HISTORICAL CONSISTENCY OF REDESIGN

Using real data, what would happen if historical data collected following new survey design?

- Not a straight-forward question to answer
- Primary difficulty to overcome is that historical stations were chosen within a grid cell with selection probabilities based on old strata
- This means that you must reweight stations after post-stratifying into new strata so that old strata with higher number of stations don't 'overwhelm' old strata with lower number of stations upon combining within the new strata

HISTORICAL CONSISTENCY OF REDESIGN

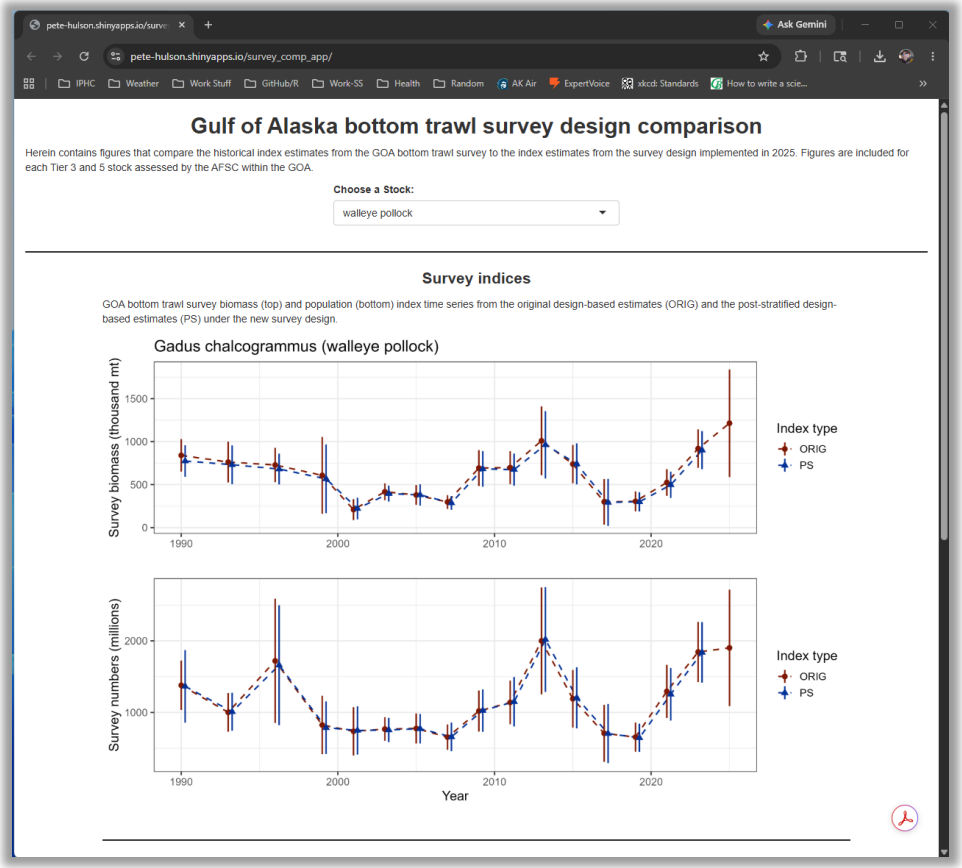
- Upon post-stratification within new strata, before you calculate design-based indices, you must re-weight to account for the new selection probabilities, otherwise you will introduce bias
  - Can think of the weight as being the inverse of the selection probability – the higher the selection probability in the original design the lower the weight, and visa versa
- The point: must account for this in post-stratifying samples so that we can determine whether the survey redesign has unintended consequences (i.e., bias) using real-world data

HISTORICAL CONSISTENCY OF REDESIGN

- Utilized survey R-package “Analysis of complex survey samples”
  - survey::postStratify() function follows Rao et al (2002 – analyzing survey data using post-stratification) with variance estimates following Valliant (1993), built upon Horvitz-Thompson estimator
- Steps taken in analysis:
  1. Reclassified historical stations within new 2025 stratum boundaries
  2. Computed selection probabilities and re-weighted station observations
  3. Compute design-based index

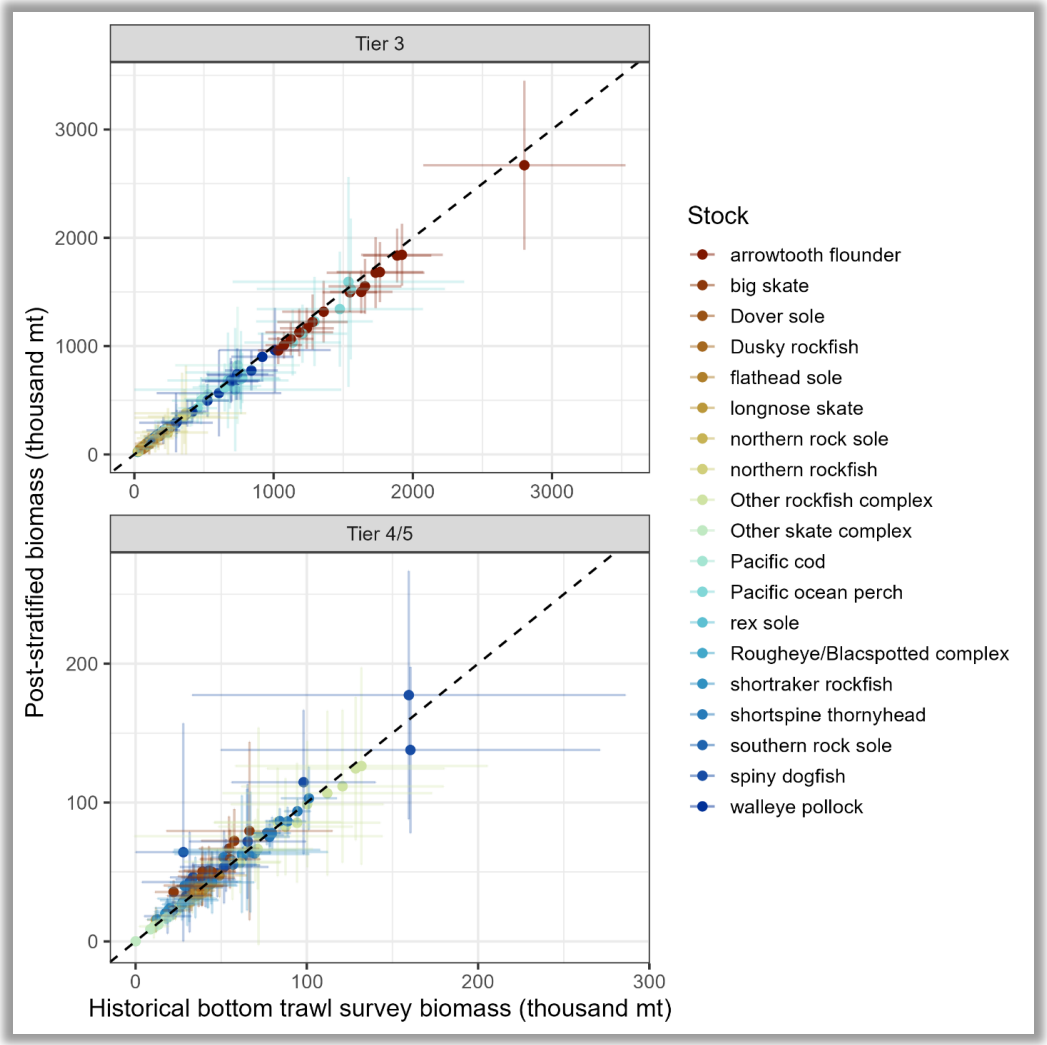
HISTORICAL CONSISTENCY OF REDESIGN

- Post-stratified compared to historical indices for all Tier 3, 4, and 5 stocks assessed in the GOA (shiny app)
- Results provided for GOA-wide biomass and abundance, as well as GOA subregion biomass



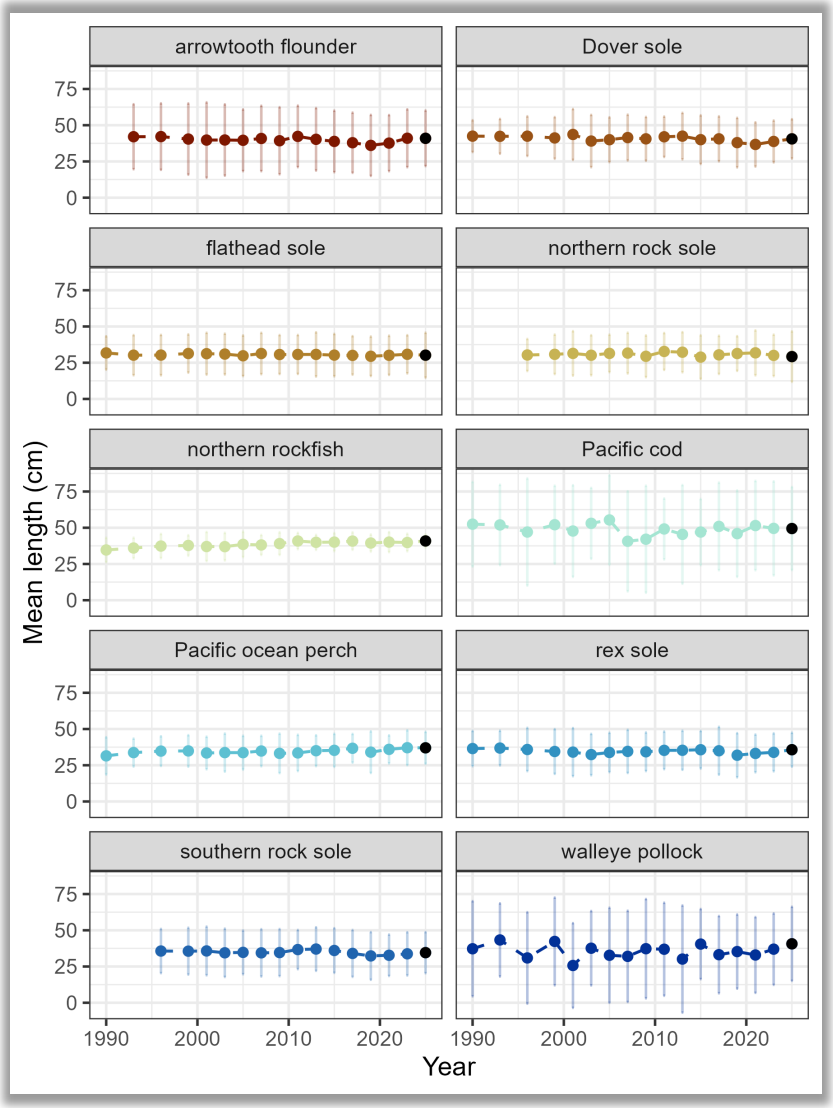
HISTORICAL CONSISTENCY OF REDESIGN

- In general: post-stratified estimates consistent in magnitude and trend with historical results
- As expected, Tier 3 results less variable than Tier 4-5
- No results fall outside 95% CIs



HISTORICAL CONSISTENCY OF REDESIGN

- Mean length in 2025 (black point) consistent with recent trends and within historical range



HISTORICAL CONSISTENCY OF REDESIGN

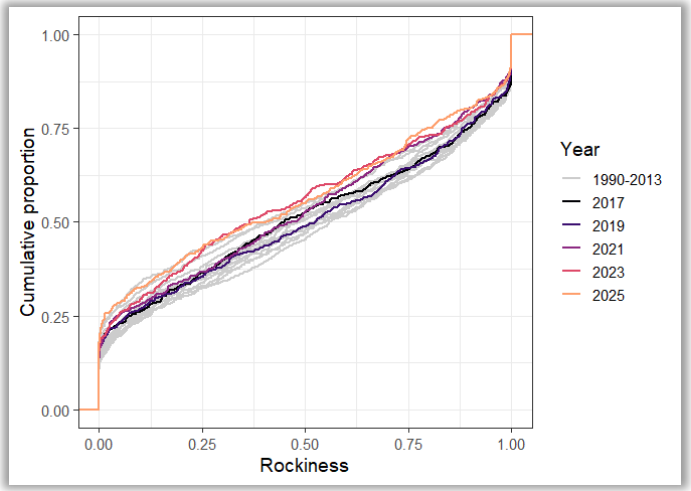
- Habitat sampled: rockiness

Table 4. Count of Gulf of Alaska bottom trawls coded with net damage (2017-2025) and, specifically, trawls with net damage attributable to each vessel.

Year	No. Hauls w/Net Damage	No. Hauls on AKP with Net Damage	No. Hauls on OEX with Net Damage
2017	17	7	10
2019	7	3	4
2021	15	5	10
2023	14	3	11
2025	9	3	6

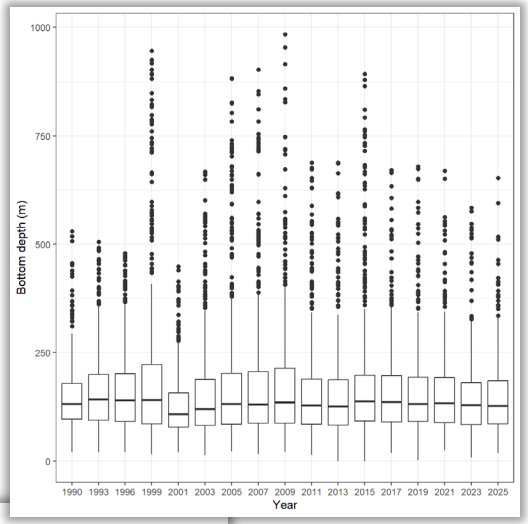
- Number of nets torn in 2025 similar to 2019, but lower than 2017, 2021, and 2023

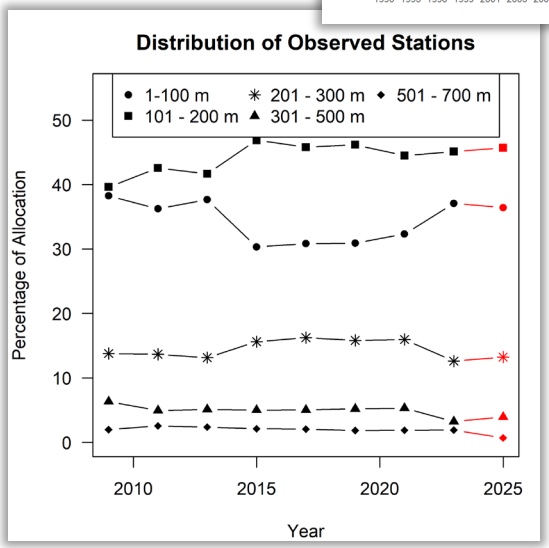
- Cumulative distribution of stations across degrees of rockiness consistent with 2023 survey



HISTORICAL CONSISTENCY OF REDESIGN

- Habitat sampled: depth
  - Distribution of 2025 stations across depths consistent with historical time series
  - Allocation of stations slightly smaller for 1-100 m and 501-700 m





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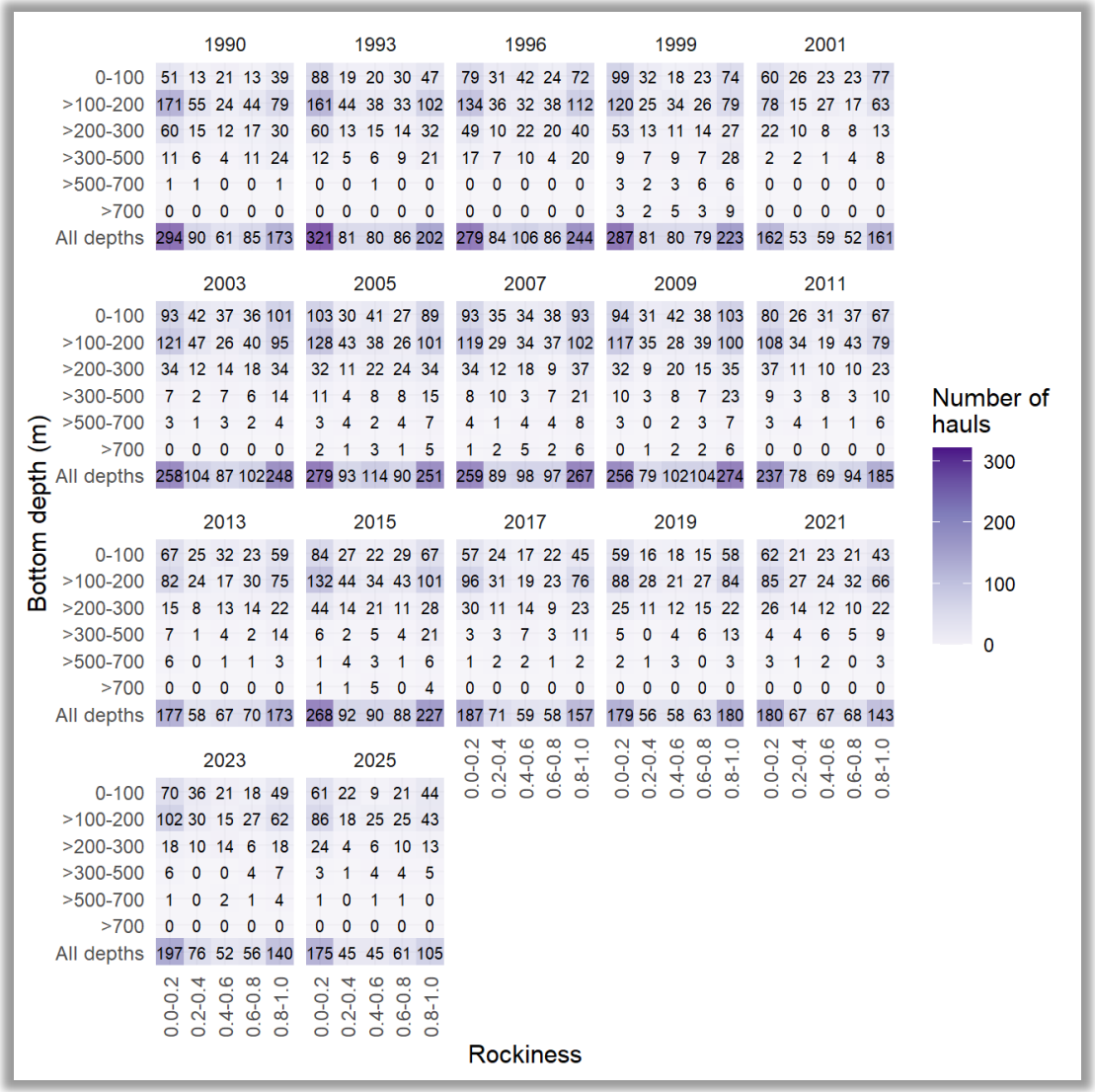
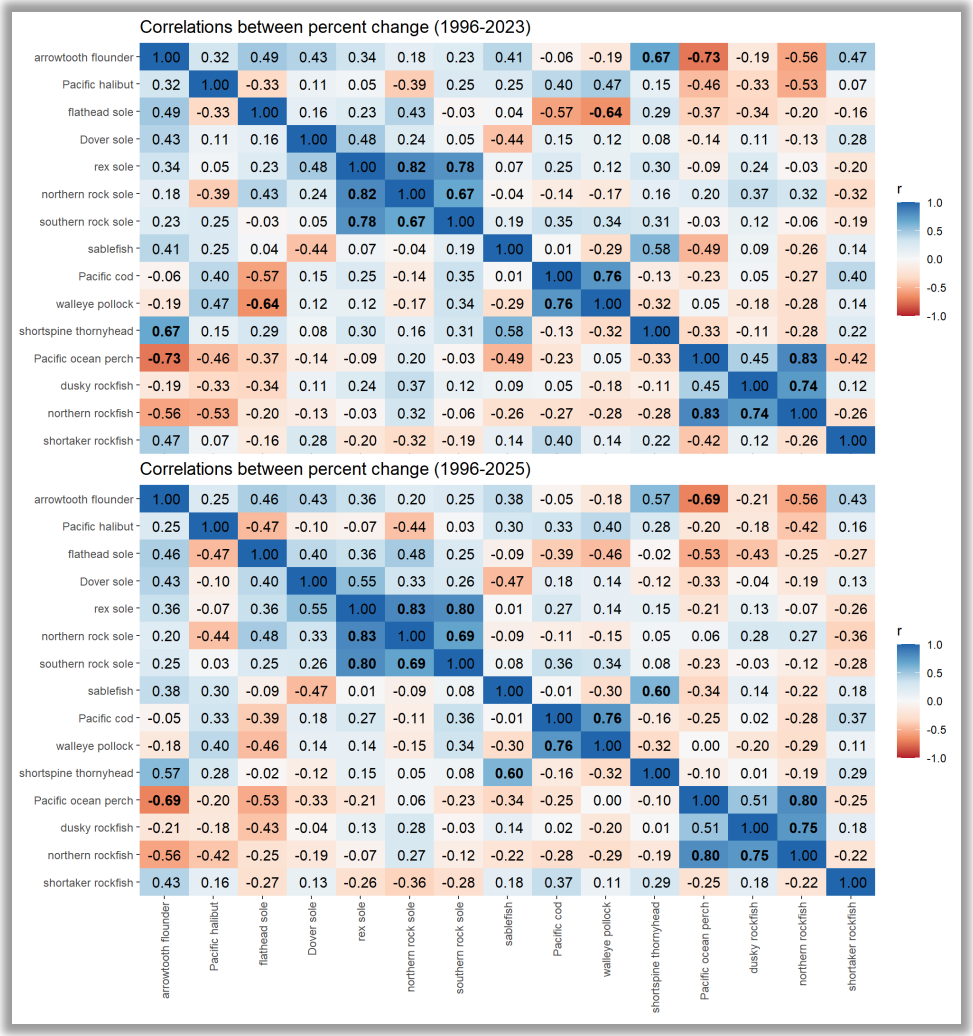


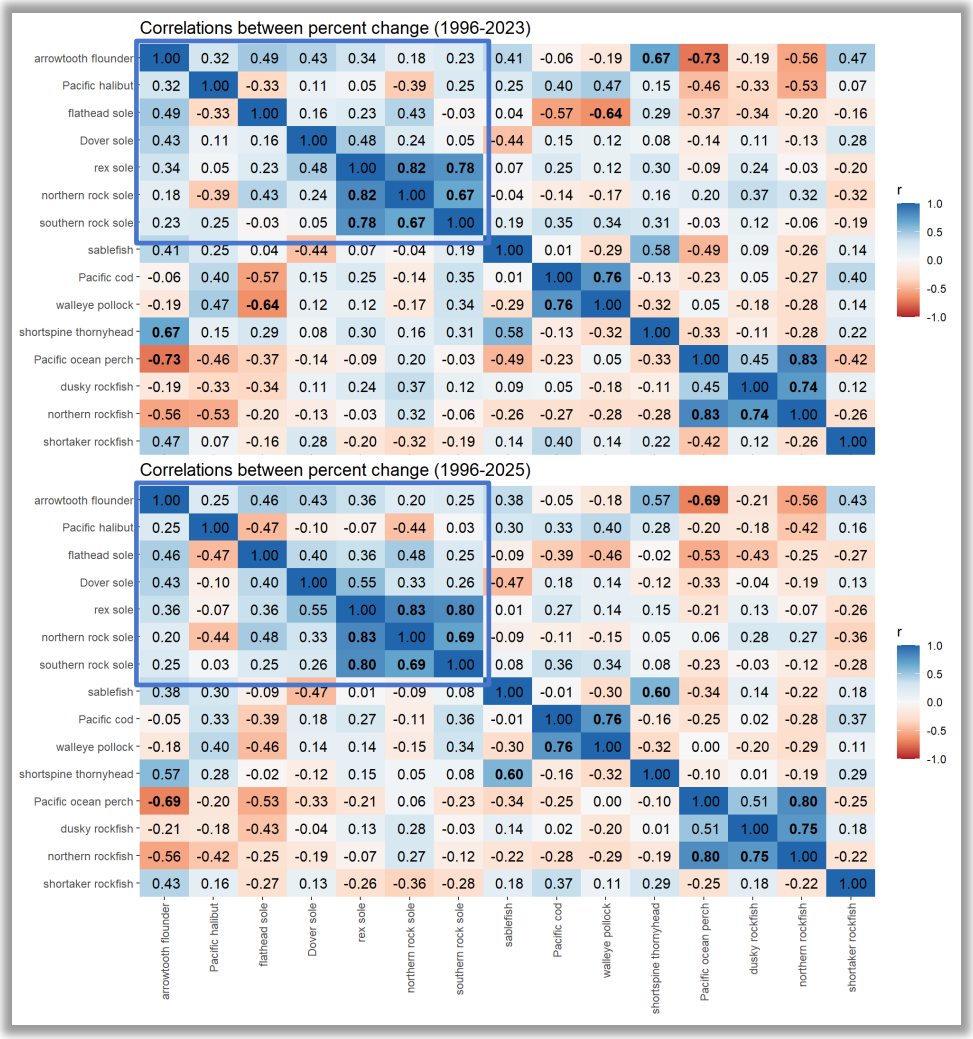
- Habitat sampled: depth and rockiness
  - Proportionally consistent, but fewer stations in any given depth-rockiness bin due to fewer stations in 2025

GUILD-LEVEL CORRELATIONS



- Across the time series, there are correlations among guilds, particularly among flatfish, gadids, and rockfish, and flatfish vs rockfish
- Adding 2025 data doesn't drastically change this observation

GUILD-LEVEL CORRELATIONS



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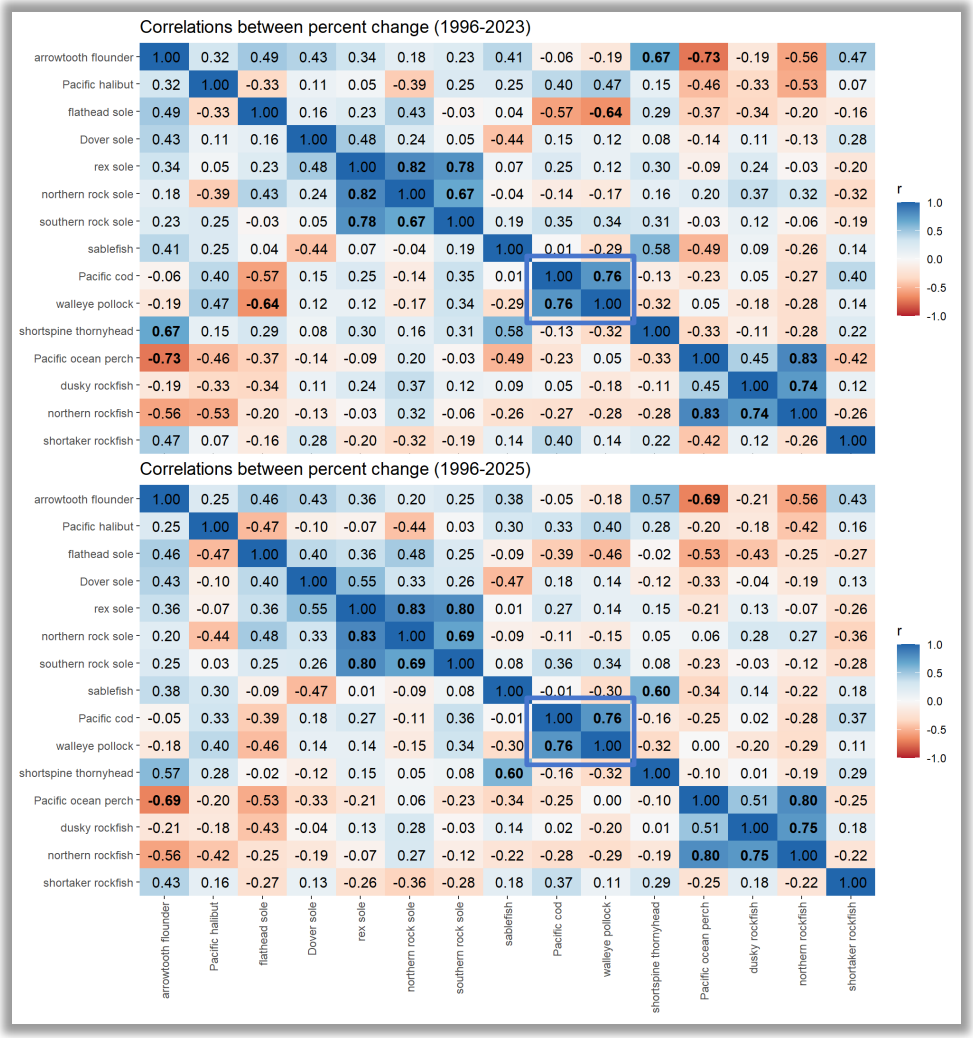

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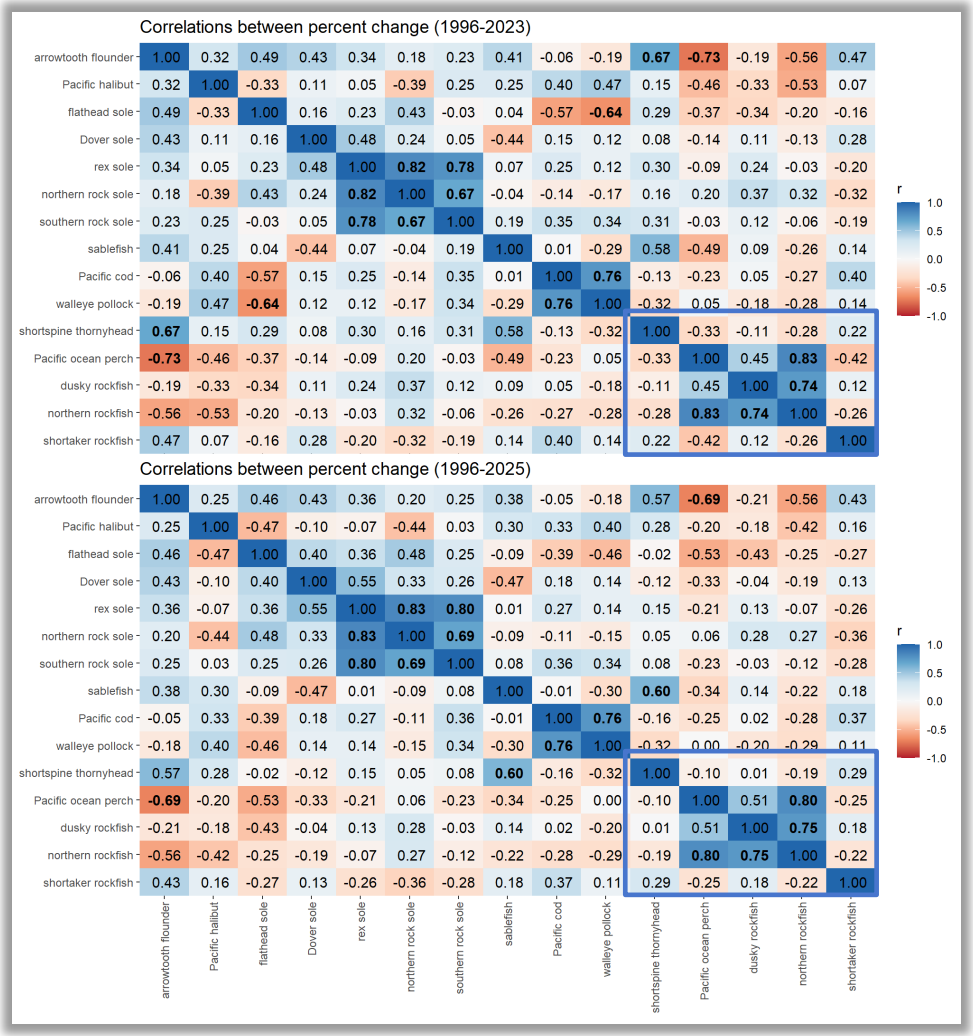

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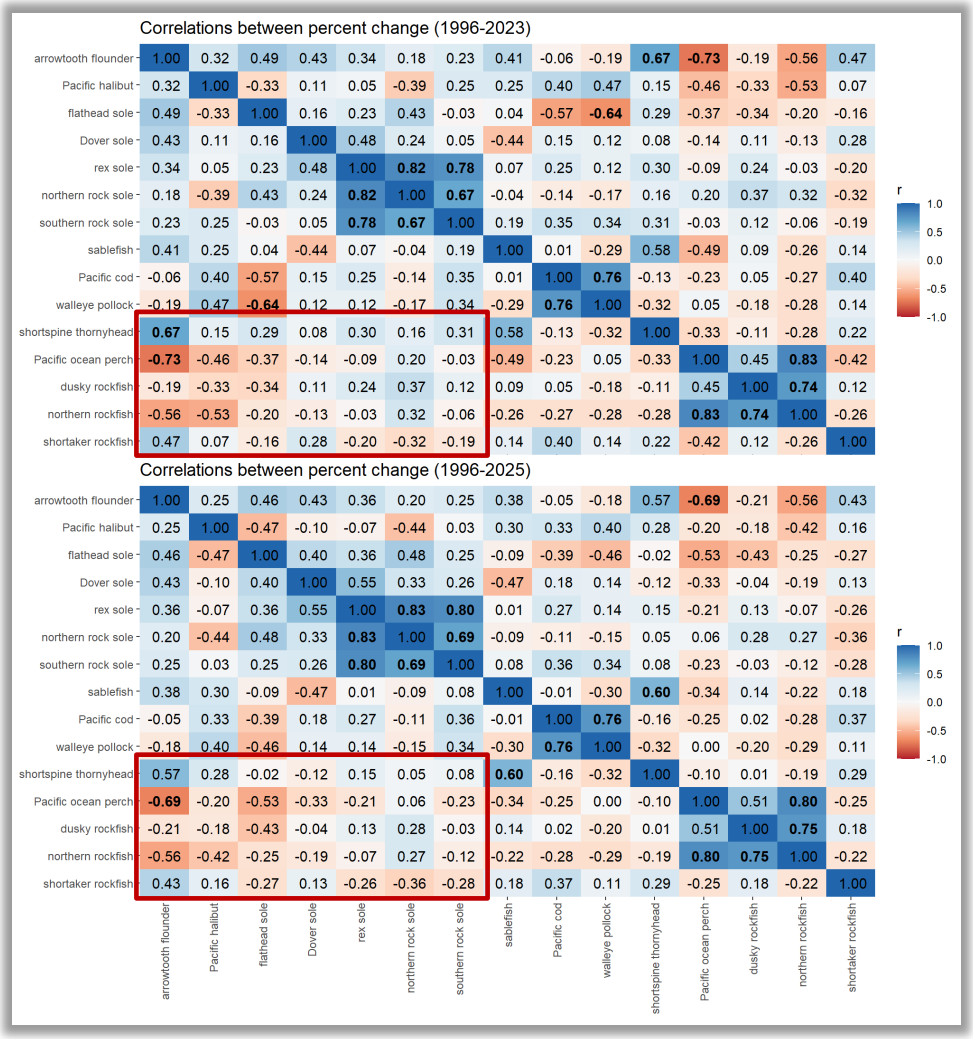

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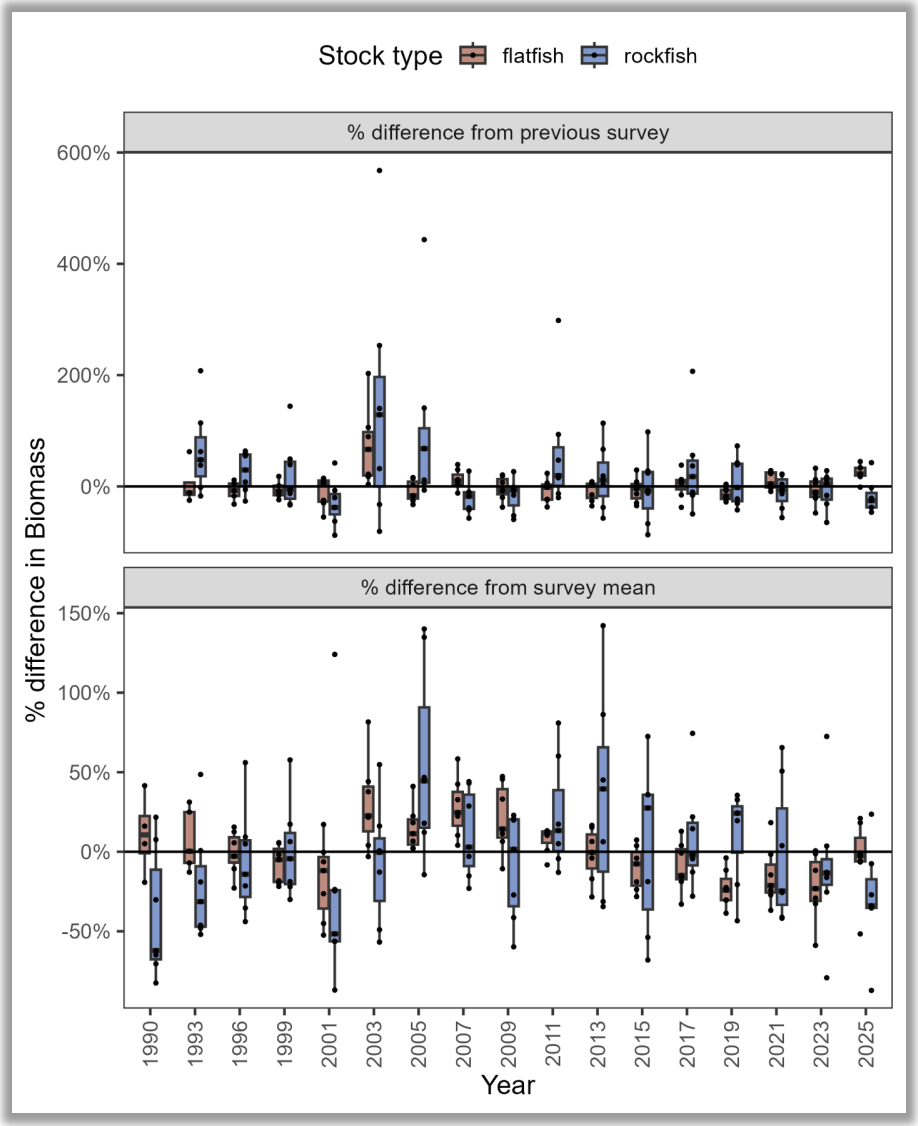
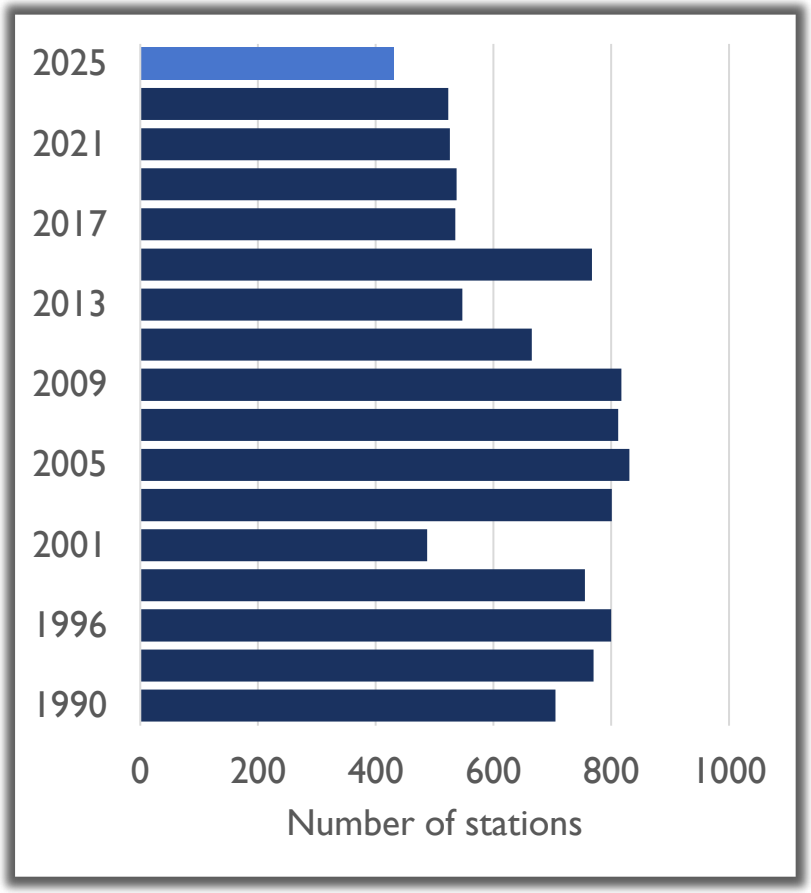
GUILD-LEVEL CORRELATIONS

- Compared to (1) the previous survey, or (2) the survey mean: 2025 within historical range of percent changes for flatfish and rockfish stocks



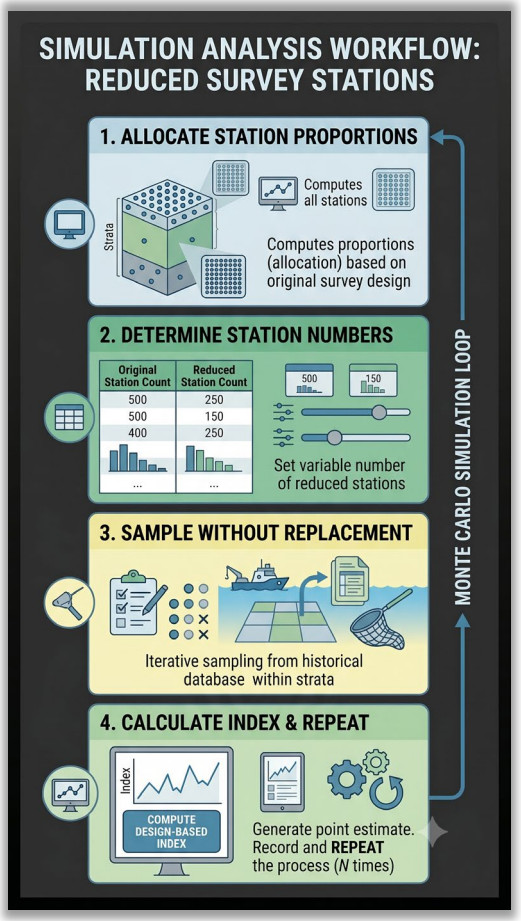
SURVEY EFFORT REDUCTION

- In 2025, rate of stations-per-day reduced from 4.5 to 4.0:
  - Mitigates ergonomic injuries
  - Current daily rate target in the Bering Sea and Aleutian Islands bottom trawl surveys
- 2025 survey fished 107 days and successfully completed 431 sampling stations



SURVEY EFFORT REDUCTION

- To further evaluate the reduction in number of stations, performed simulation analysis with historical data
- Steps of analysis:
  1. Compute proportion of stations across strata (mimics allocation for the given survey)
  2. With set number of stations, distribute across strata to determine number of stations within the strata
  3. Within a strata, sample without replacement from historical stations
  4. Compute design-based index, repeat

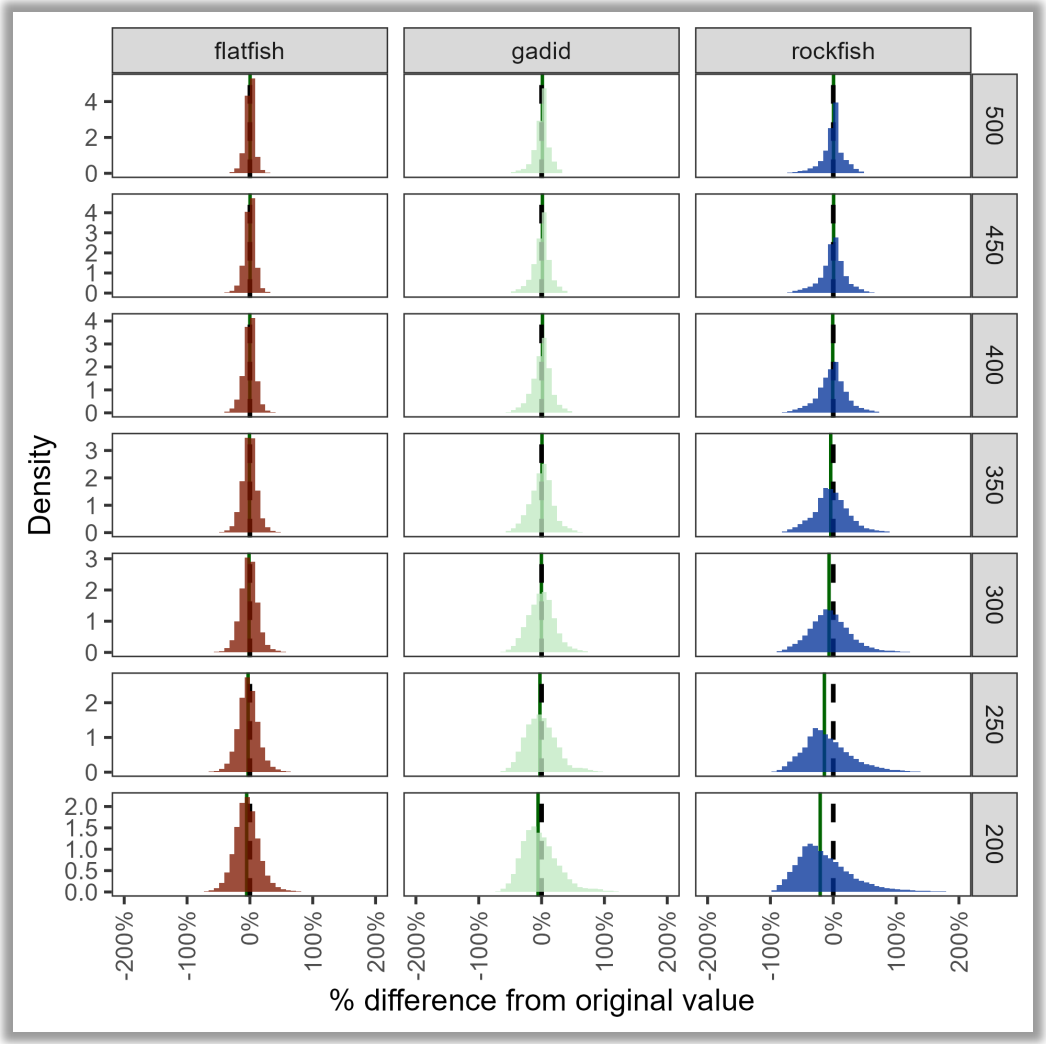


SURVEY EFFORT REDUCTION

- Number of stations evaluated: 200 – 500 by 50
- Statistics used:
  - Percent difference from original value
  - CV in biomass estimate
- Performed for all Tier 3, 4, and 5 stocks, grouped into flatfish, gadid, and rockfish guilds

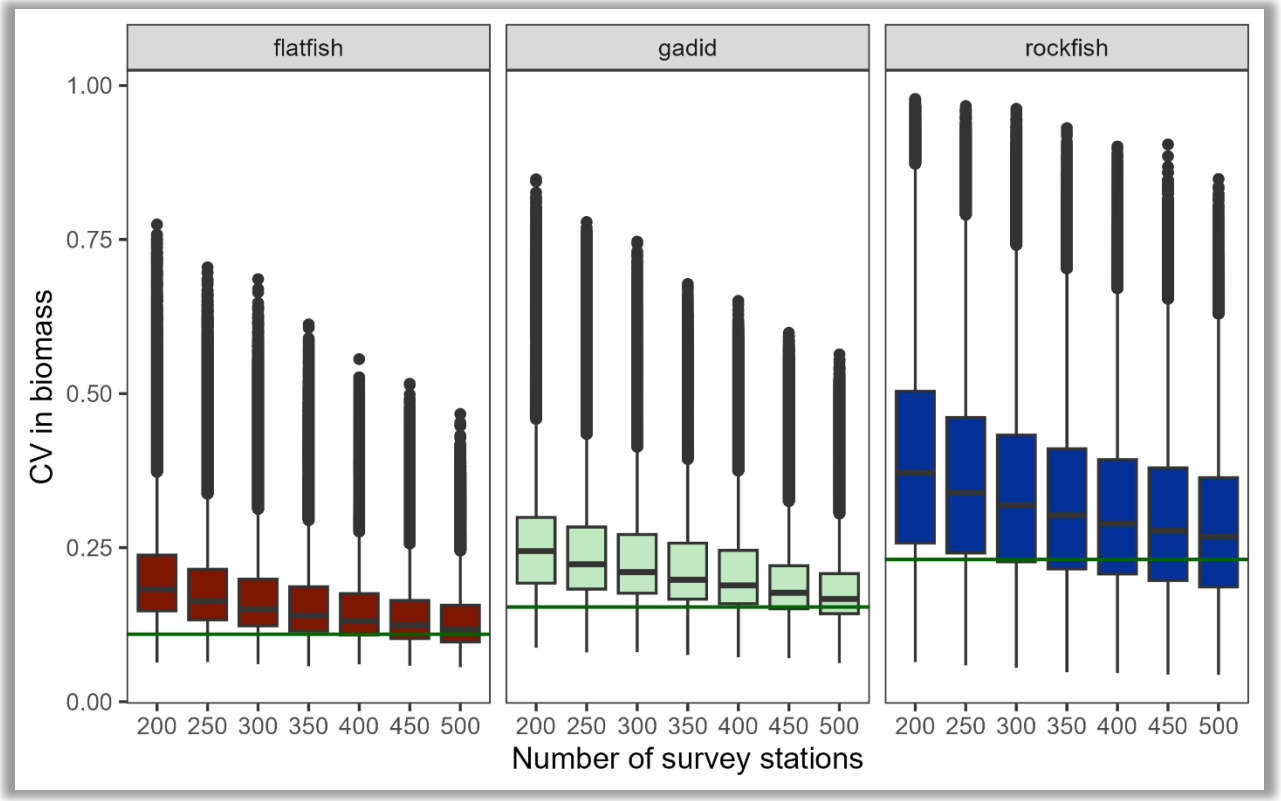
SURVEY EFFORT REDUCTION

- Variability in percent difference: flatfish < gadids < rockfish
- Rockfish tend to have a negatively skewed distribution
- Between 350-400 stations negative bias emerges for rockfish, flatfish and gadids slight negative bias below 250-300 stations



SURVEY EFFORT REDUCTION

- As number of stations reduced, variance increases… no ‘break point’ detected



DISCUSSION

Was there an influence of the GOA bottom trawl survey redesign on 2025 results? ***NO***

- The results from the 2025 survey continue trends we have recently observed and estimates that are within historical ranges
- The guild-level correlations are within range of historical results
- Habitat sampled (rockiness and depth) proportionally similar to previous surveys
- The redesign itself didn't impose any unwanted biases or variability

DISCUSSION

Was there an influence of the GOA bottom trawl survey reduced effort on 2025 results? ***UNLIKELY***

- The simulation analysis suggests that at 400-450 stations the results remain unbiased
- Although, the variability in the design-based estimates increases as stations are reduced, both in the resulting point-estimates, as well as increased uncertainty in any given point estimate
- Difficult to disentangle effect of survey effort reduction with sampling variability in performing a survey

CONCLUSIONS

- The GOA bottom trawl redesign is, in the long term, expected to increase precision of survey indices
  - From assessment perspective: the redesign seems to produce consistent results across stocks
- But can't decouple any improvement in precision in 2025 results in the face of potential increase in variability due to decrease in survey effort

CONCLUSIONS

Take Homes:

- There is no survey design logistically or monetarily feasible that will completely overcome variability in a survey
- We should continue to expect survey results that are at times surprising and variable for some stocks that we'll need to investigate and understand, regardless of the survey design.
- The GOA bottom trawl survey design remains statistically consistent with historical time series and theoretically unbiased.

QUESTIONS?