SURVEY SIMULATION EVALUATION AND EXPERIMENTATION PROJECT

Survey Simulation Experimentation and Evaluation Project: update

Northeast Trawl Advisory Panel Meeting

February 08, 2024

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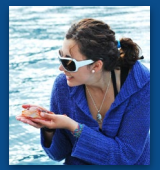


School for Marine Science & Technology
UMass Dartmouth

CINAR
Cooperative Institute for the North Atlantic Region

NOAA FISHERIES

Fishery Applications Consulting Team

BOEM
Bureau of Ocean Energy Management

Objectives

- Develop a spatially explicit simulation tool that can emulate NMFS fishery-independent surveys
- Test the performance of alternate sampling / survey design strategies under change
- Guided by a series of stakeholder workshops and engagement
- Apply in the context of the NEFSC bottom trawl survey

Expected Outcomes

- Paths forward for prioritizing changes to survey designs and strategies
- Description of desired statistical properties for supplemental sampling strategies (e.g., what sorts of data, what level of sampling effort and precision)
- Which expected scenarios (species, or species distribution drivers) might be most at risk
- Implications for scientific advice (e.g., relative impact on uncertainty in assessments)

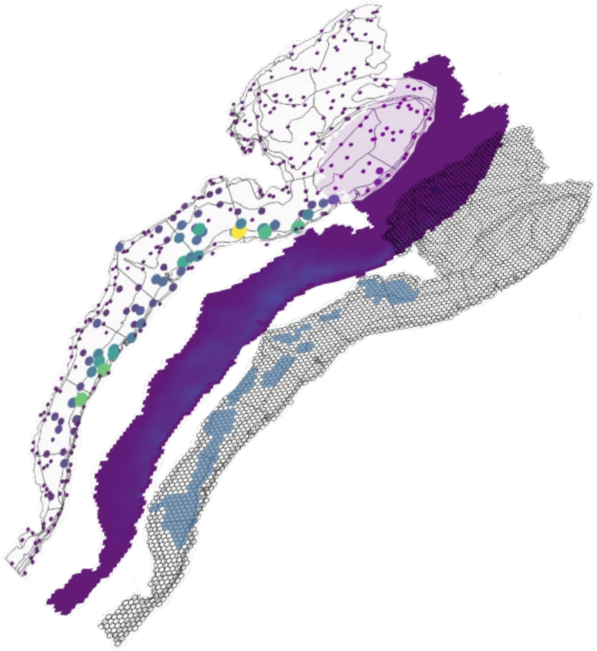
Project Activities

Current research questions

- What is the change to sampling associated with survey design changes?
- What are the impacts of preclusion on survey data products and their estimated uncertainty?
- Can the reallocation of survey effort mitigate the impacts of preclusion to survey data products and their uncertainty?
- How can supplemental sampling within wind areas be integrated and when does this improve reliability of data products?

Simulation Framework

1. Age-structured population dynamics model, distributed spatially via output of species distribution modeling
2. Scenarios for change
   - Population characteristics and productivity
   - Wind area designation, and direct/indirect effects
3. Scenarios for survey strategies and design
   - Bottom trawl survey protocol vs supplemental sampling
   - with / without preclusion, reallocation of survey effort
4. Data products & statistical estimators
   - Tow level information - catch rate, lengths, ages
   - Design-based and Model-based abundance indices
5. Performance metrics
   - Quantify actual and perceived estimation performance



Bottom layer: Northeast US survey grid with wind area cells in blue; middle layer: example species distribution with higher densities in lighter blue, top layer: example simulated survey data over survey area

Impacts to stock abundance indices due to offshore wind development-driven changes to fishery-independent surveys

Assess how bottom trawl survey data and abundance indices may change due to offshore wind:

- Using overlaps of existing (Bigelow) trawl survey data with proposed wind areas
- Simulation testing and spatiotemporal generalized linear mixed effects models (GLMMs) to evaluate survey effort and (proxies for) habitat-driven species productivity change scenarios:
  - ***Baseline***: the predicted effect by the GLMMs;
  - ***Enhancement***: assume wind energy areas have higher densities of fish than baseline
  - ***Reduction:*** assume wind energy areas have lower densities of fish than baseline

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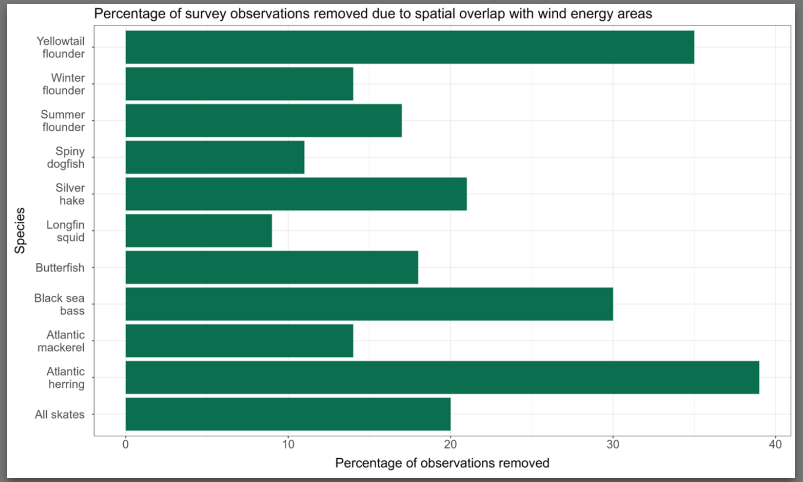
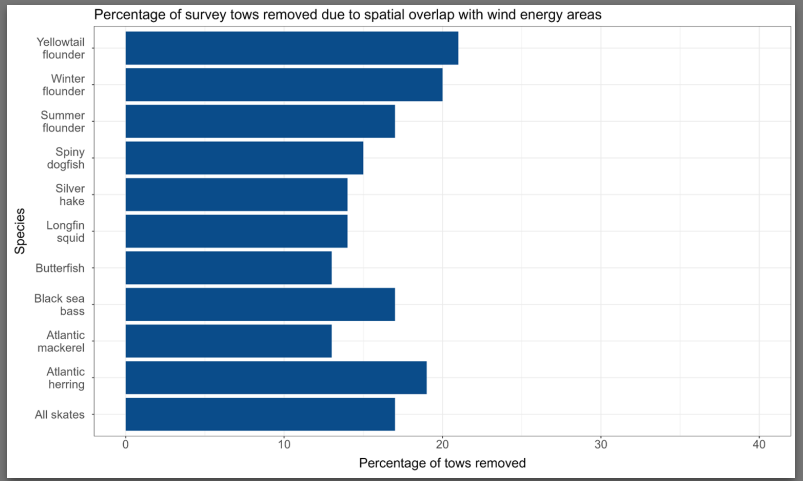
Using the NEFSC bottom trawl survey data (Bigelow years) analyze the potential impact of survey effort reduction to sampling numbers and abundance indices:

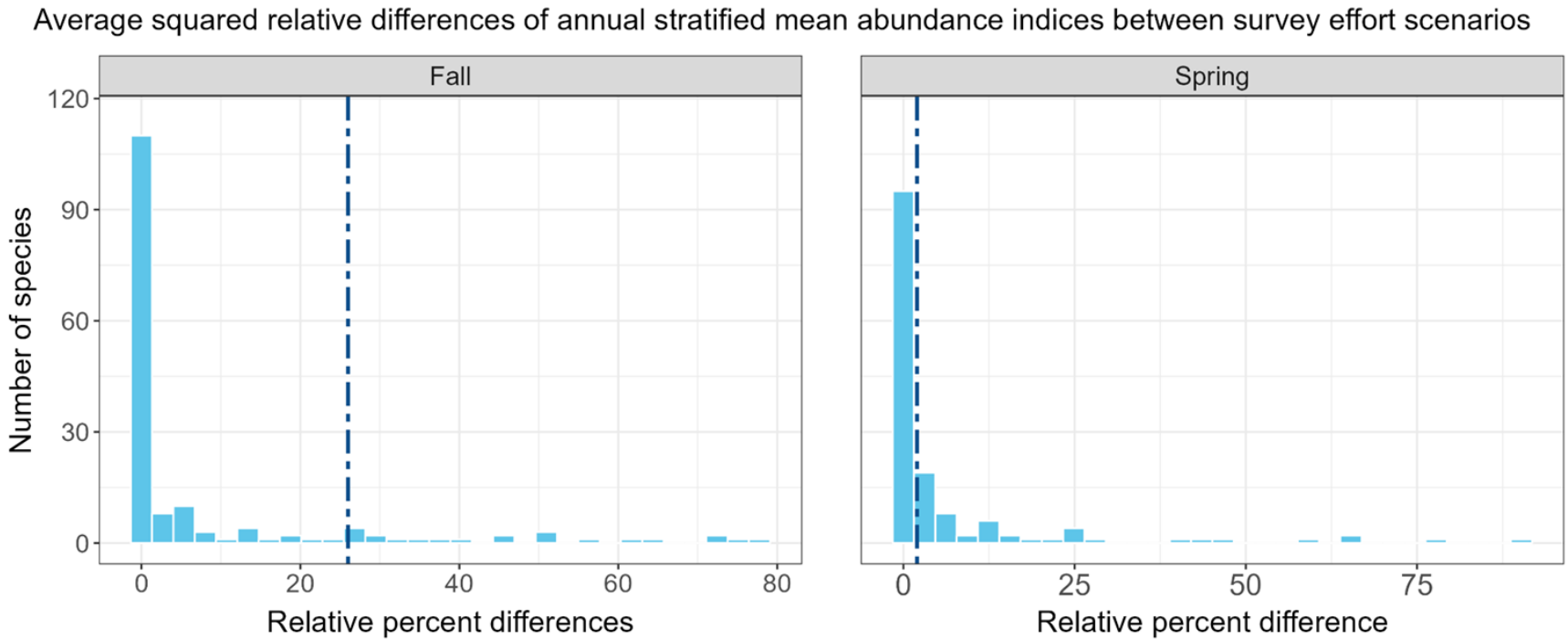
1. *Status quo*: where all survey data were used; and
2. *Preclusion*: where tows were removed if overlapped with planned offshore wind areas.



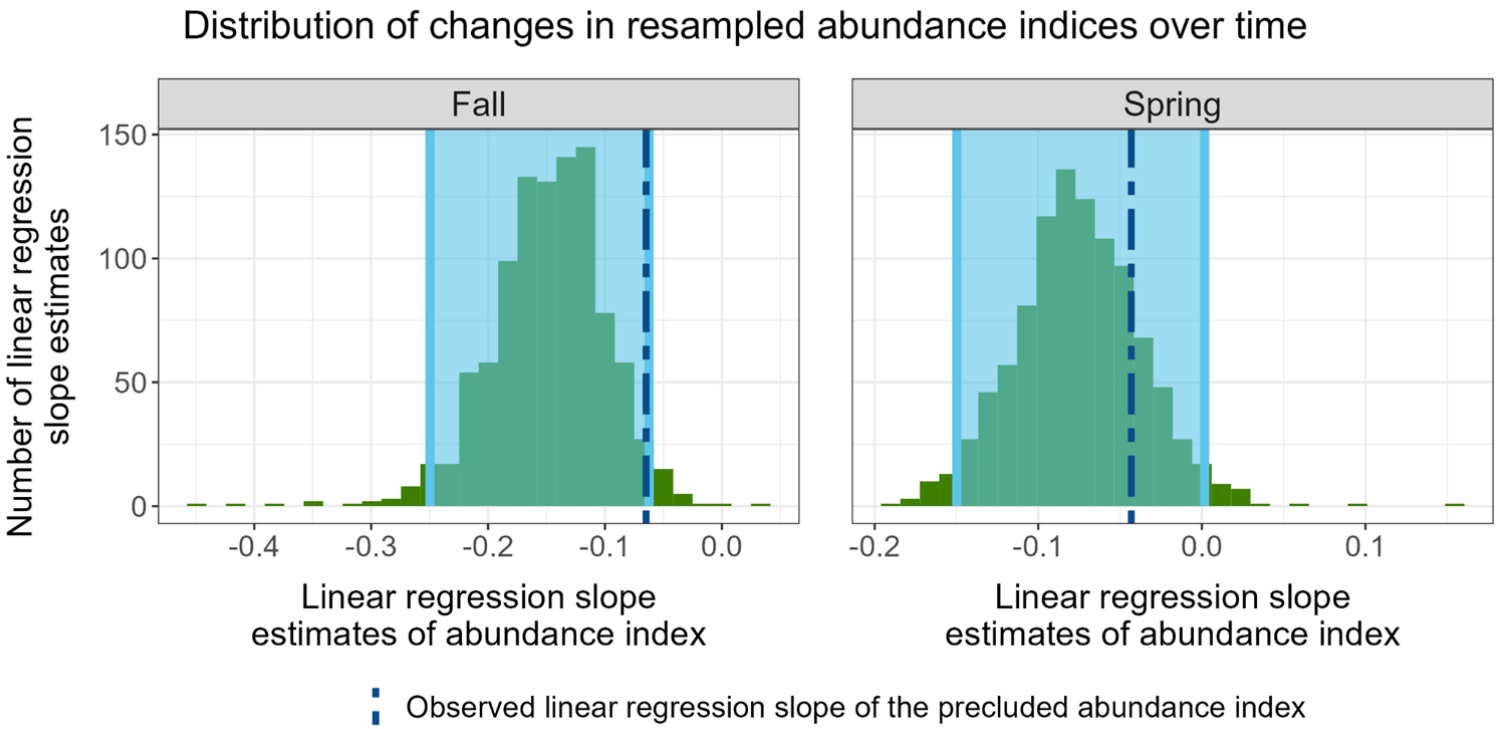
With preclusion, the survey would have lost 17% of their summer flounder observations.



Preclusion of surveys from wind areas affects abundance indices for summer flounder, and more so in the fall.



Estimates of population trend when wind areas are not available are different from estimates with general reduction in survey effort



Simulation study

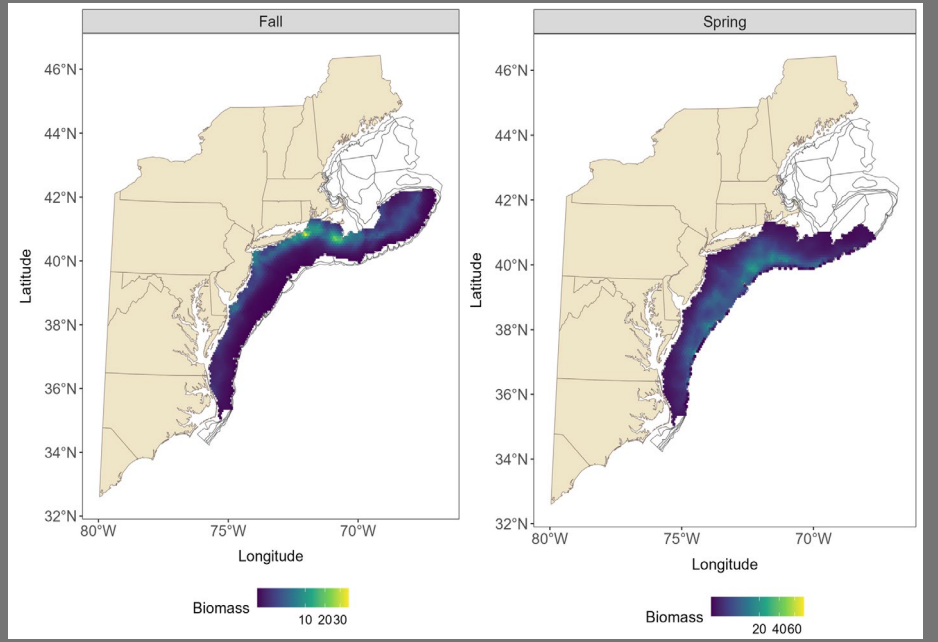
Current work following is using spatiotemporal GLMMs to simulate and evaluate changes to design-based abundance indices under survey effort and habitat-driven species productivity change scenarios

Preliminary results for summer flounder:

- Wind preclusion of survey effort affects abundance index estimates.
- Impacts to abundance indices mirror productivity changes

Remaining work:

- Quantify change to annual abundance indices & compare to ‘simulation truth’
- Apply analysis to Atlantic mackerel



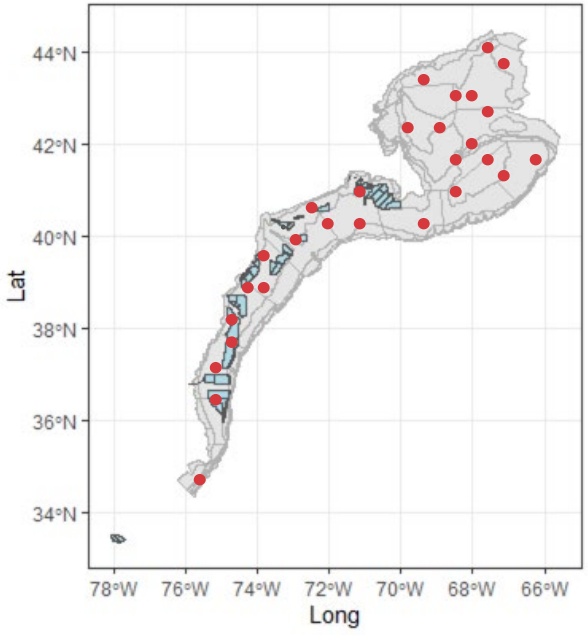
Spatial distribution predictions of expected biomass catch rates based on seasonal spatiotemporal GLMM fits

Survey simulation testing

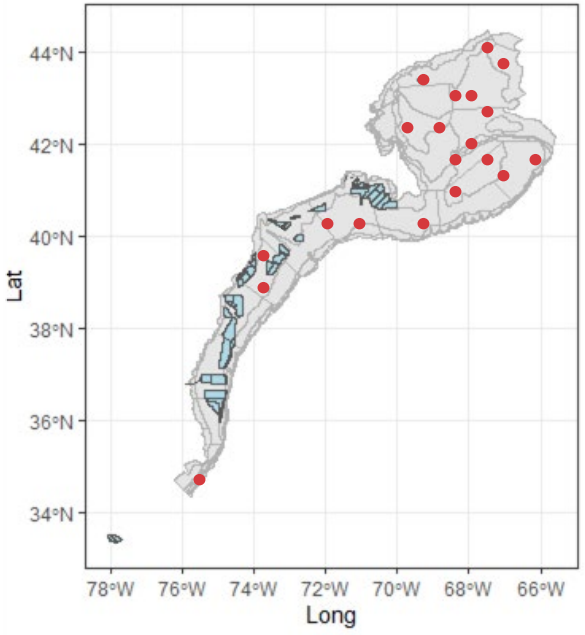
- **Conduct simulations of NEFSC bottom trawl survey in presence of offshore wind under change**
  - What are the impacts of preclusion on survey data products and their estimated uncertainty?
  - Can the reallocation of survey effort mitigate the impacts of preclusion to survey data products and their uncertainty?
  - **Apply to multiple focal species, representing key dynamics of interest**
- **Evaluate performance of supplemental sampling strategies**
  - How can supplemental sampling within wind areas be integrated and when does this improve reliability of data products?
  - **Add second survey footprint under range of scenarios for survey design, sampling method, and integration of supplemental data into data product estimation.**

Survey simulation testing: sampling strategies scenarios

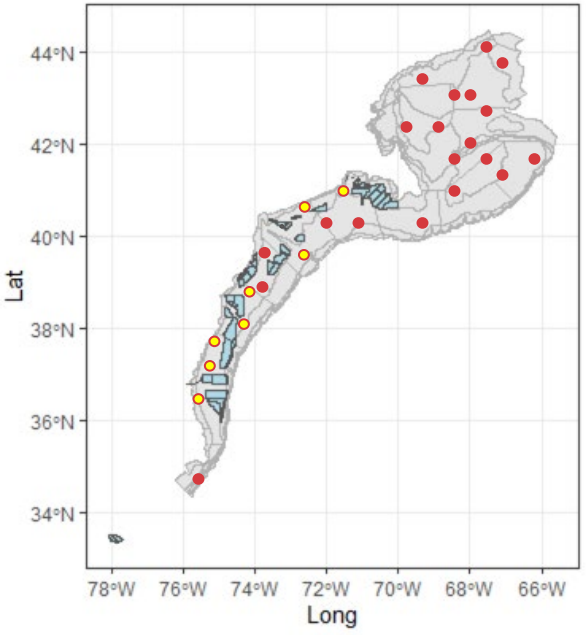
Scenario 1
Status quo



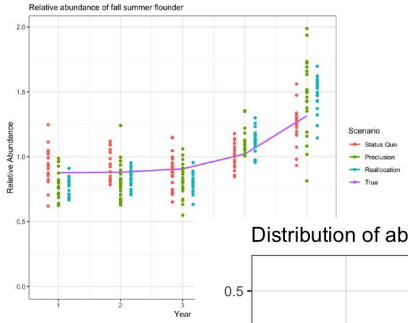
Scenario 2
Preclusion

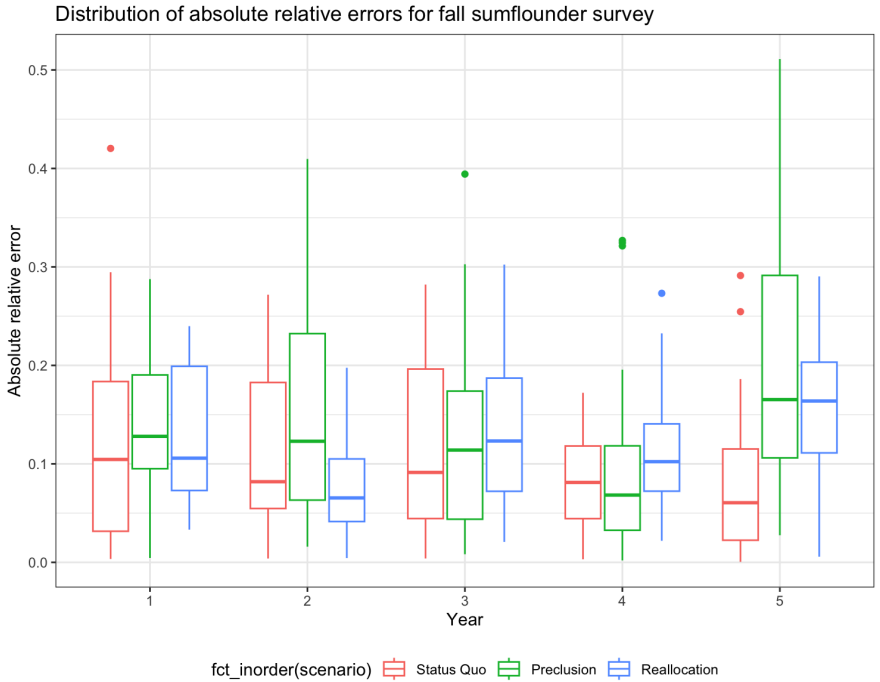


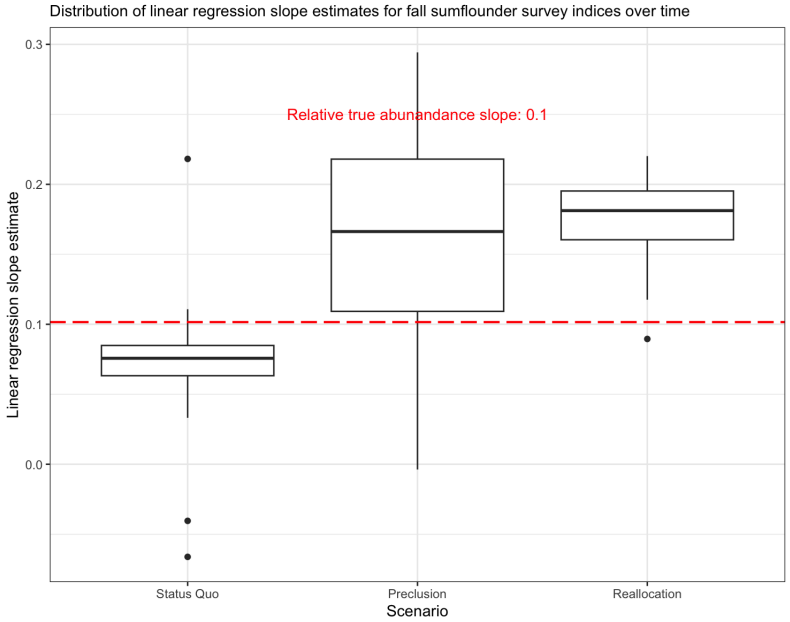
Scenario 3
Reallocation



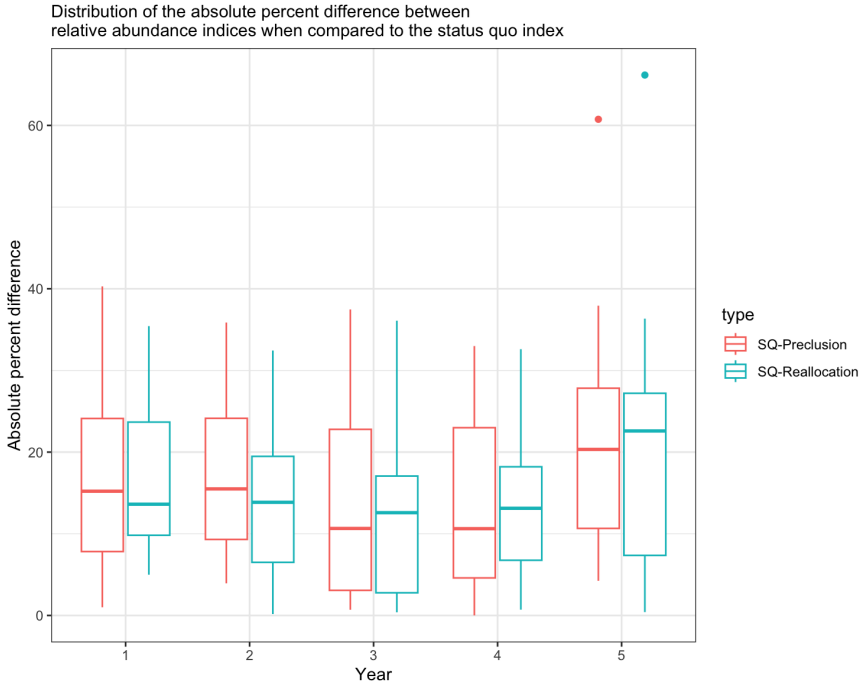
Stratified mean abundance estimates for summer flounder in fall show decreased performance in wind-area affected surveys

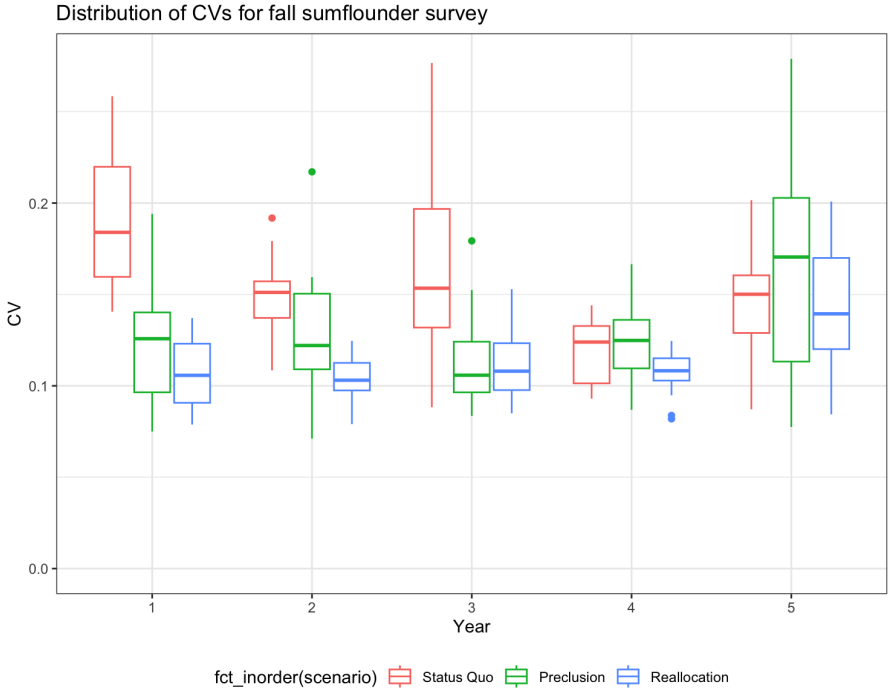






Preliminary: when a positive catch rate effect in wind habitat areas, some evidence that reallocating survey effort does not mitigate changes to performance
Though perceived uncertainty is reduced





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Questions?

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