Evaluation of alternative statistical sampling designs for the NEFSC Bottom Trawl Survey

Catherine Foley, Philip Politis, & Paul Rago

Northeast Fisheries Science Center
NOAA Fisheries

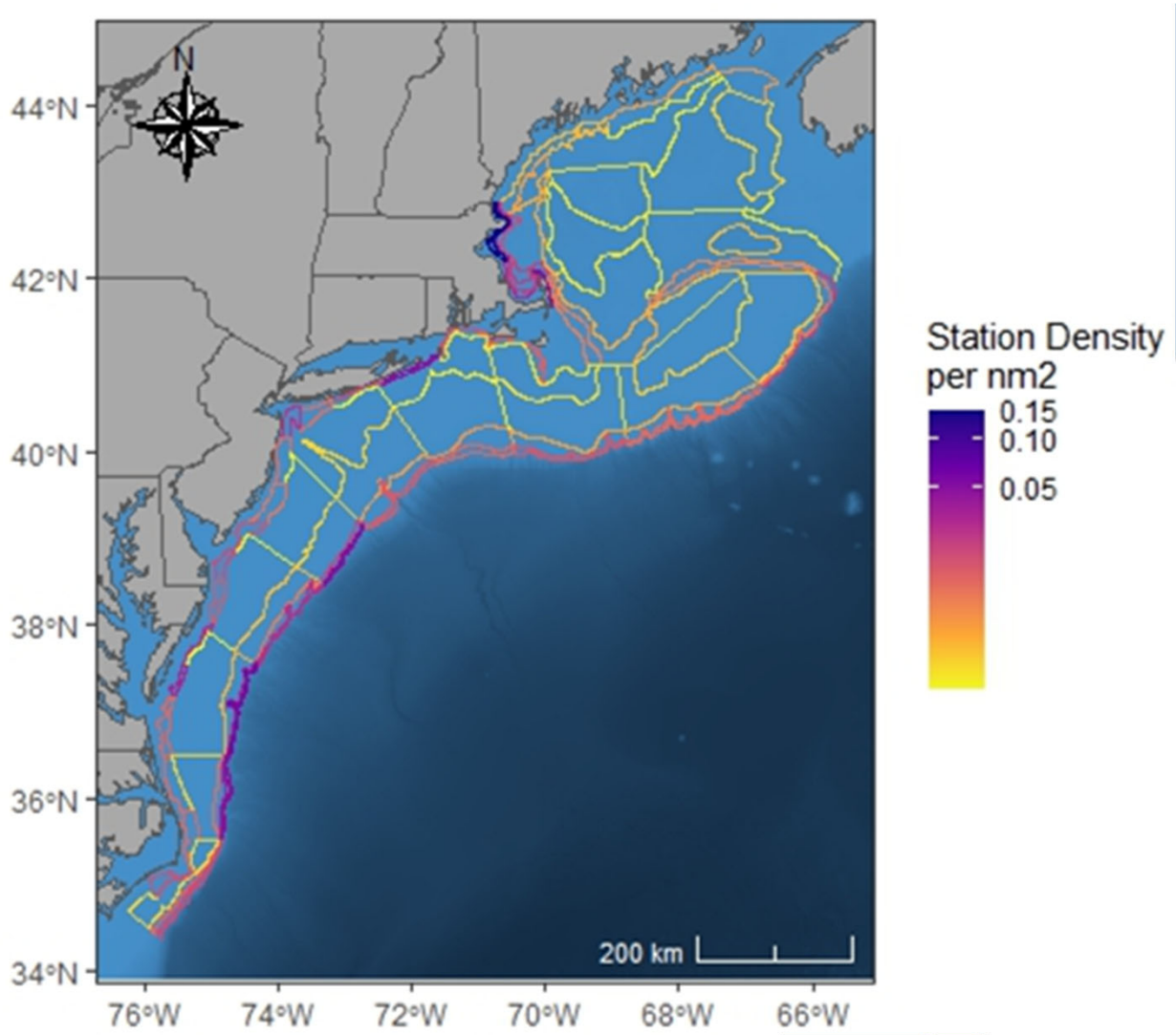
Saltwater, Inc.

NEFSC Bottom Trawl Survey:

Stratification & Station Allocation

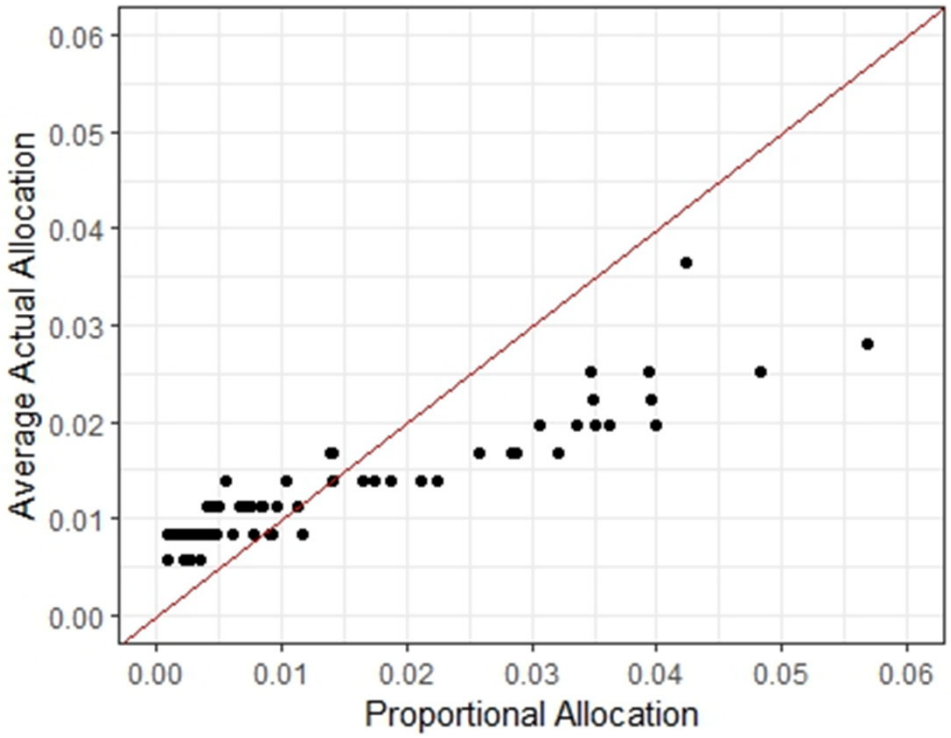
- Station allocation generally proportional to strata area, but small strata have a minimum of 3 stations.

- ***Key assumption:*** All sampling units within a strata have equal probabilities of being sampled



NOAA FISHERIES

Current stratification is a problem



- Mean number of stations per strata:

$$\frac{377\ stations\ per\ season}{82\ strata} \approx 5\ stations\ per\ strata$$

  - Need 3 per strata to get a (rough) variance estimate
- 51% of station allocations go to 23% of the strata by area
- Reduces flexibility for future events (e.g. wind energy areas)

NOAA FISHERIES

Potential Solutions

1. Allocate stations proportional to area but have fewer constraints (e.g. $n_h \geq 3$)

2. Reduce number of strata by collapsing existing strata into “superstrata”

3. Use a “spatially balanced” sampling design such as GRTS

Photo: J. Kircun

NOAA FISHERIES

Potential Solutions

~~1. Allocate stations proportional to area but have fewer constraints (e.g. $n_h \geq 3$)~~

2. Reduce number of strata by collapsing existing strata into “superstrata”

3. Use a “spatially balanced” sampling design such as GRTS

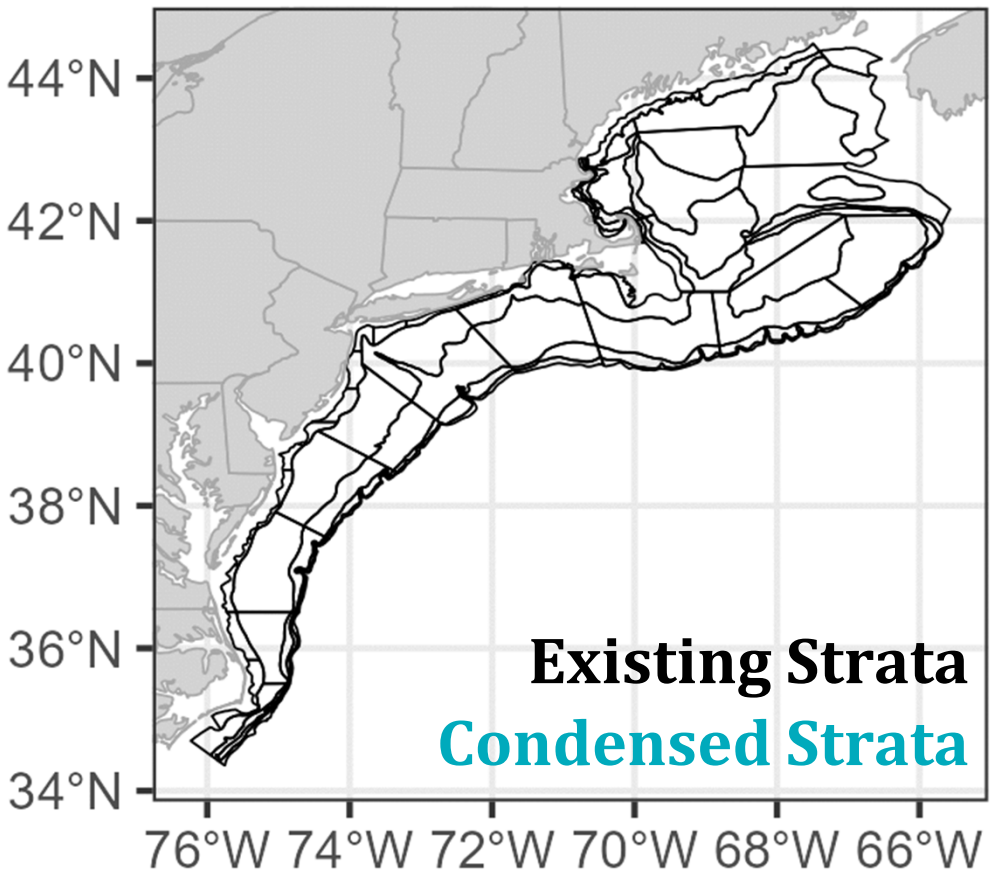
Photo: J. Kircun

NOAA FISHERIES

2. Condensing Strata

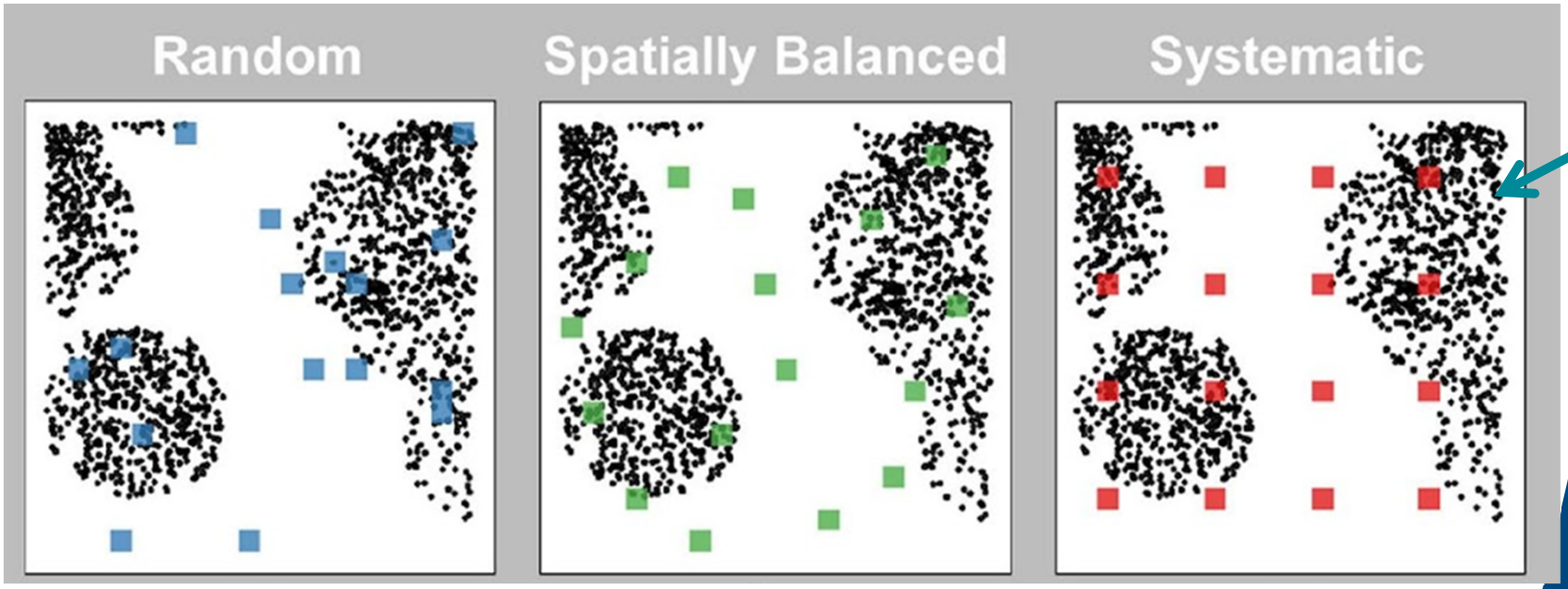
Objective:

- Maintain boundaries of commercially important stocks whenever possible
- Collapse small inshore/offshore strata
- Generate strata set of relatively consistent area to allow for more equal station allocation & sampling



NOAA FISHERIES

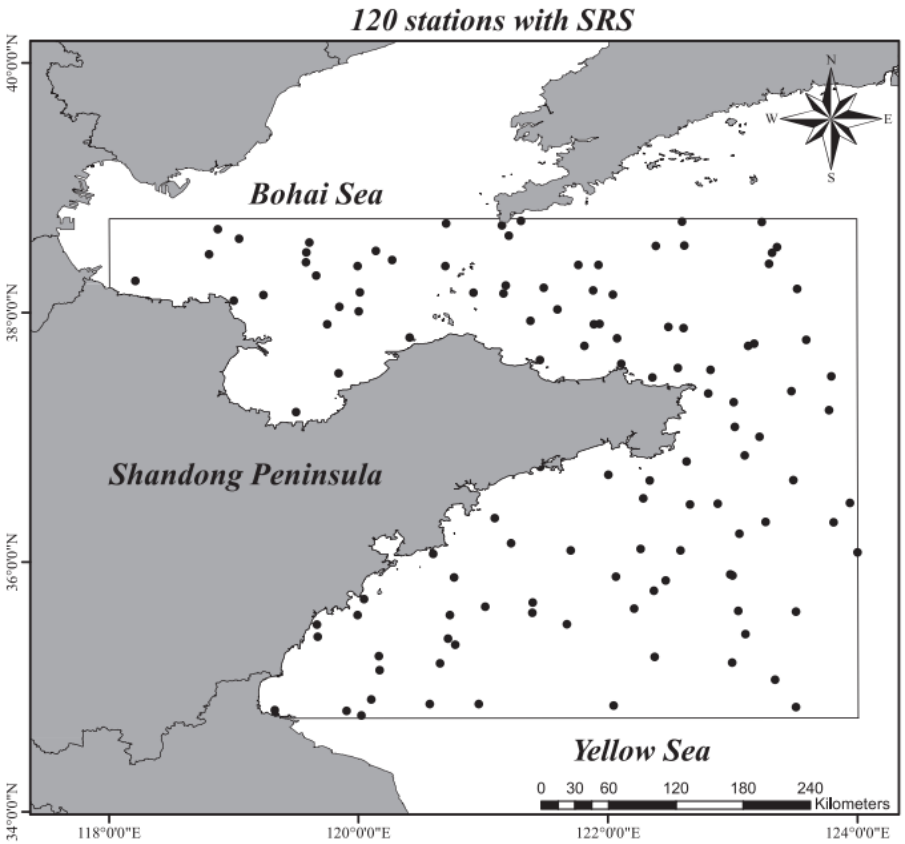
3. Spatially Balanced Sampling



Adapted from Perrett et al (2022)

NOAA FISHERIES

3. Spatially Balanced Sampling



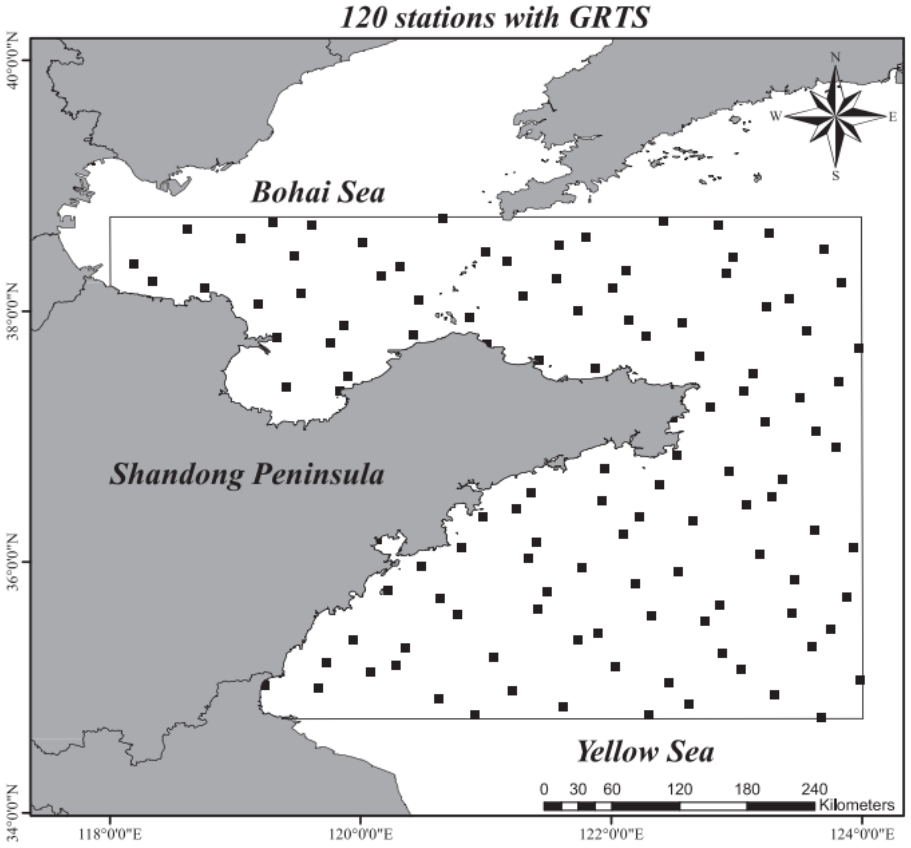


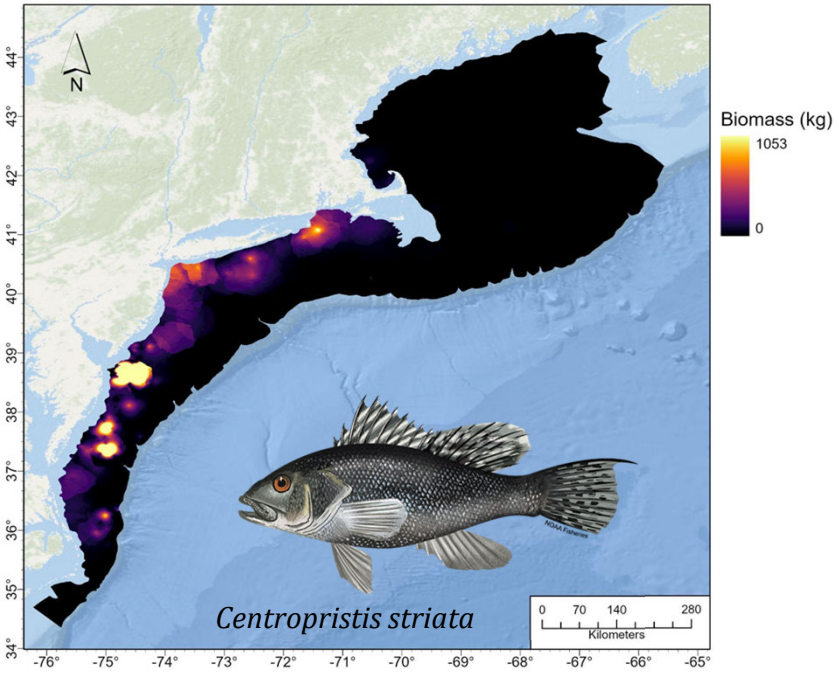
Fig. 3. (*continued*).

Cheng et al (2024)

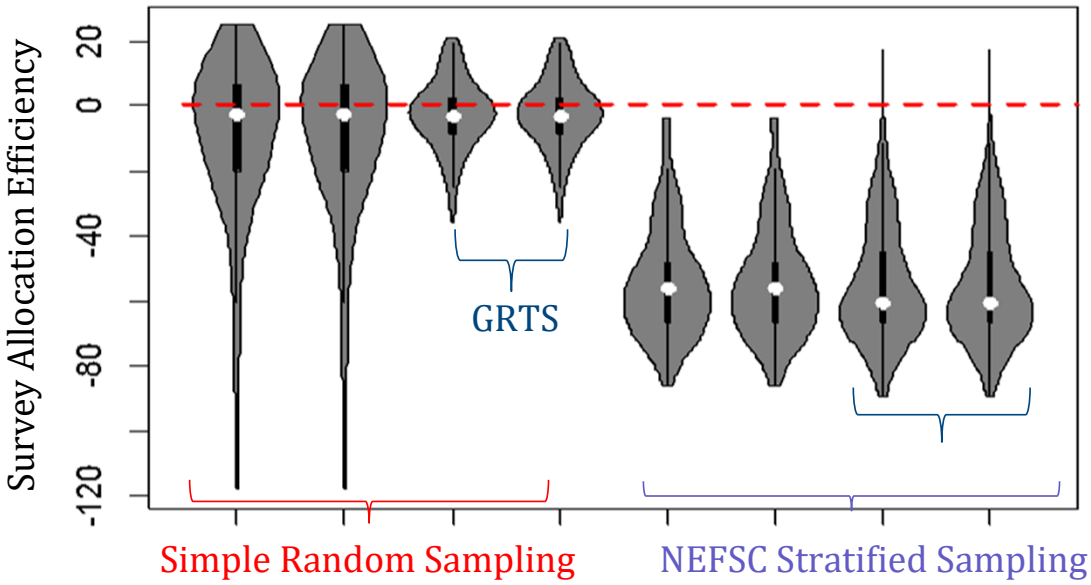
NOAA FISHERIES

Example: Black Sea Bass Survey Allocation Efficiency

Fall Biomass



Decreased allocation efficiency with NEFSC stratification

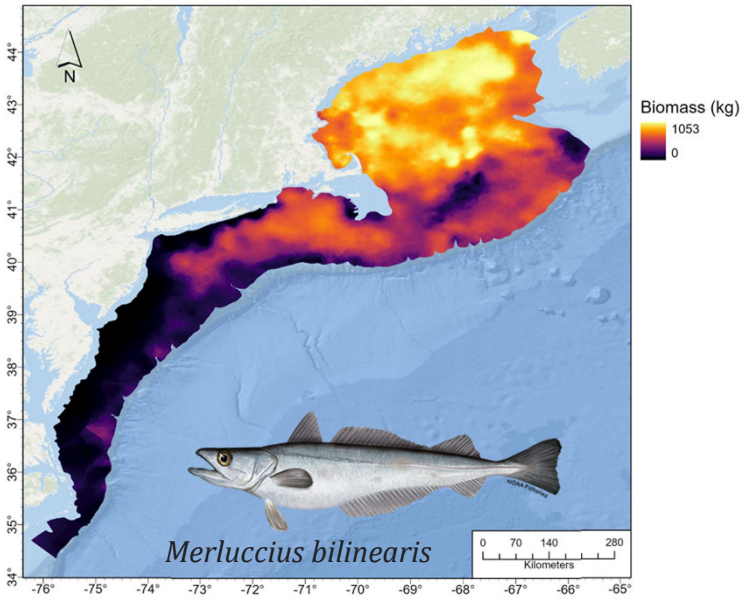


- Std and spatially balanced sampling
- Std and local variance estimation

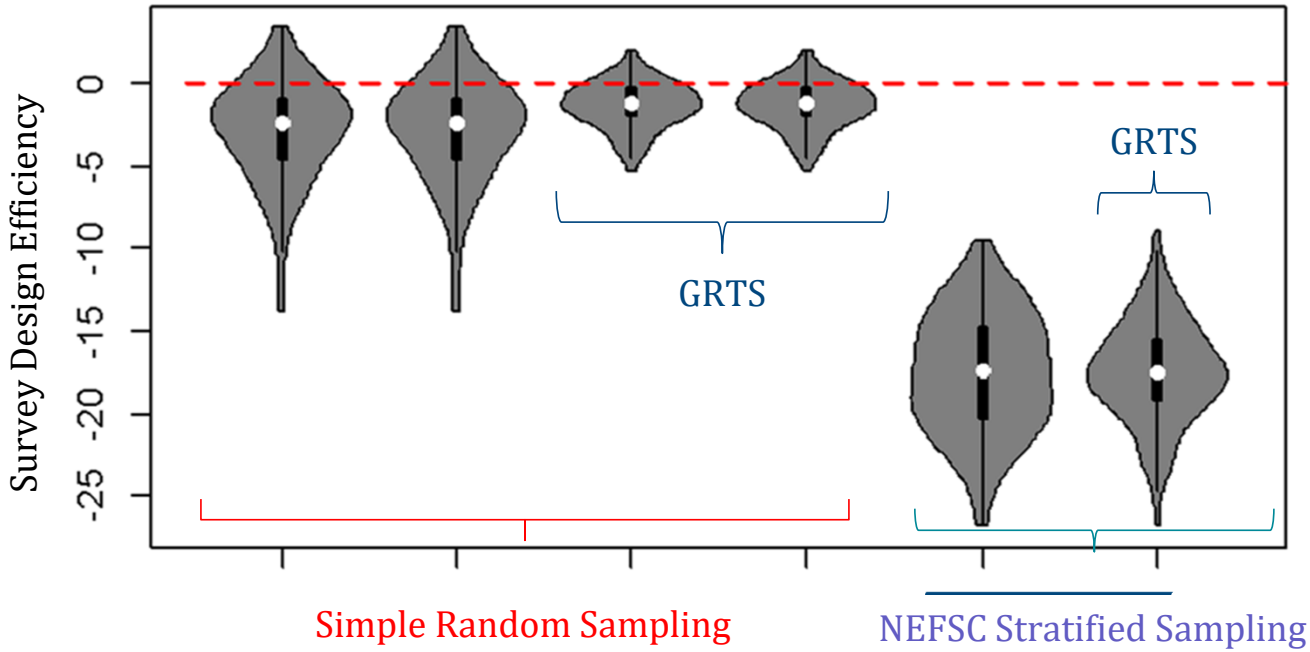
NOAA FISHERIES

Example: Silver Hake Allocation Efficiency

Fall Biomass



Decreased allocation efficiency with NEFSC stratification

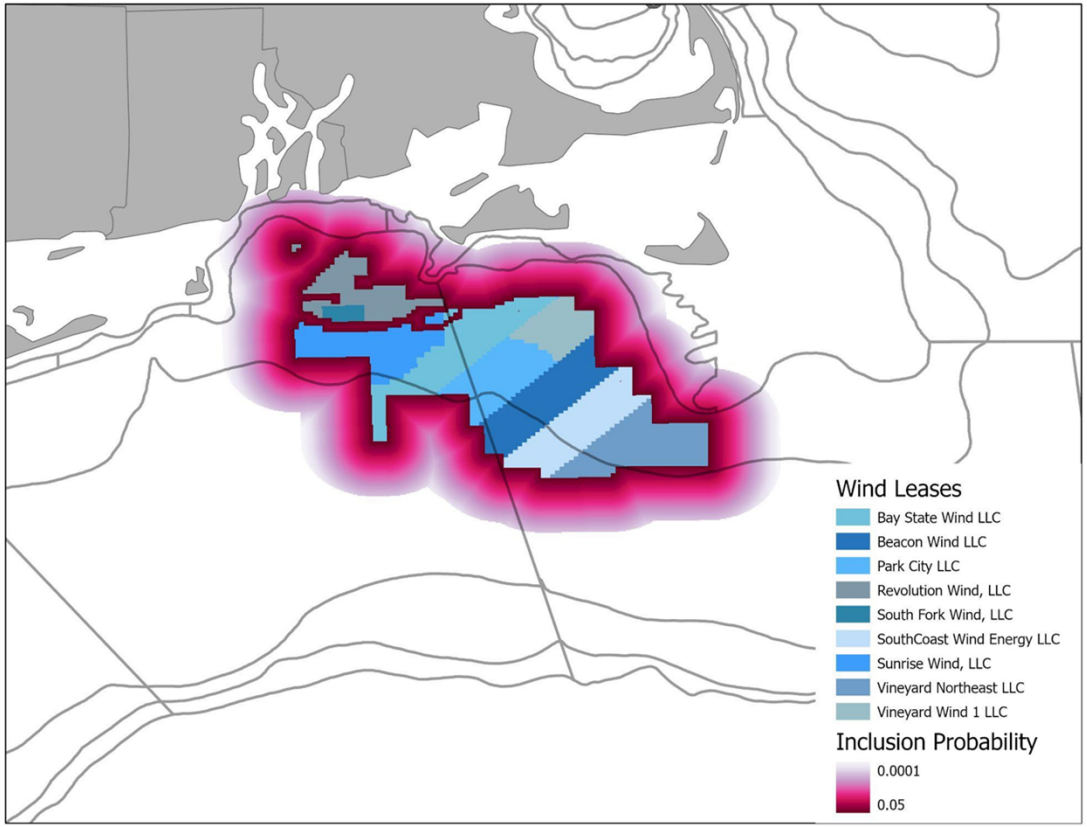


- Std and spatially balanced sampling
- Std and local variance estimation

NOAA FISHERIES

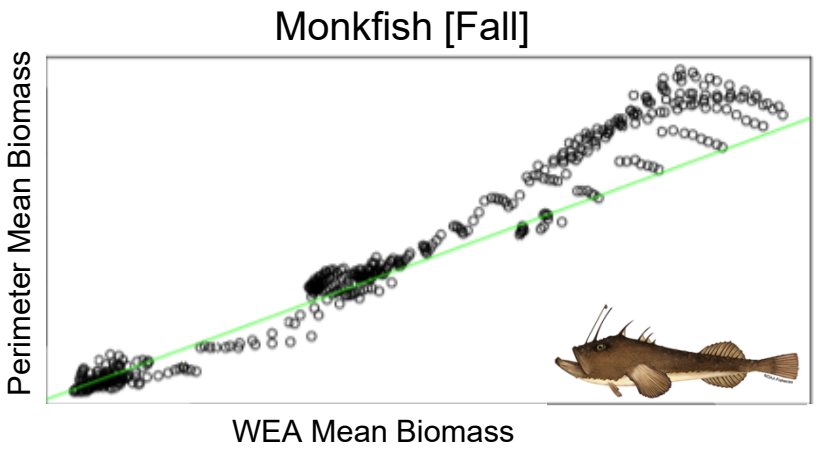
Inclusion Probabilities in Vicinity of WEA

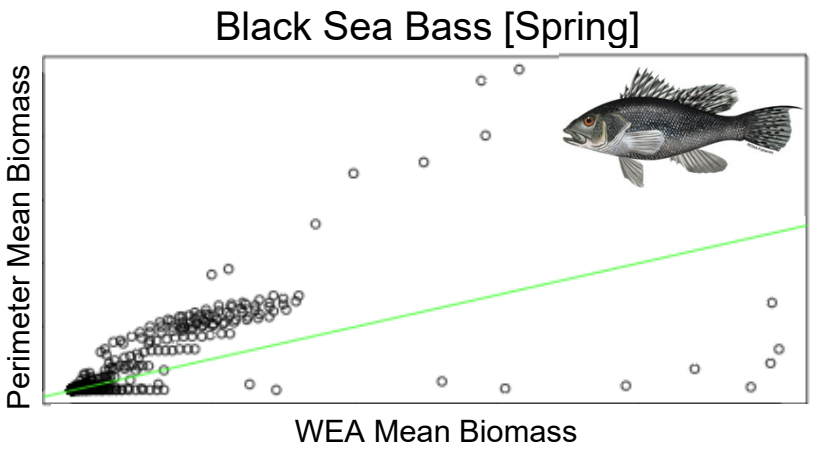
- Exploit measures of local coherence
- Increase inclusion probability for perimeters of wind energy areas to infer density within wind area. *To be tested.*



NOAA FISHERIES

Perimeter Sampling: Preliminary Results

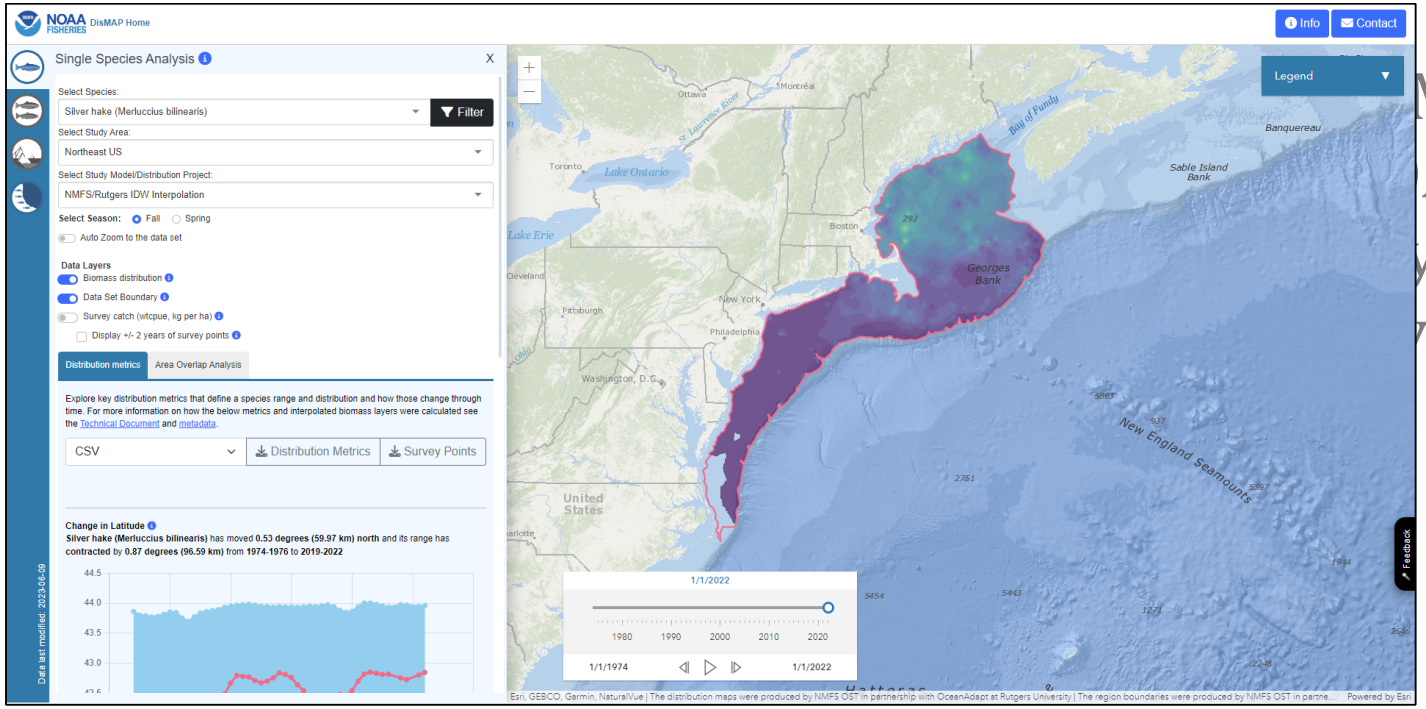




Generally, perimeter sampling is representative of the assessed species WEA biomass at smaller WEA spatial size

NOAA FISHERIES

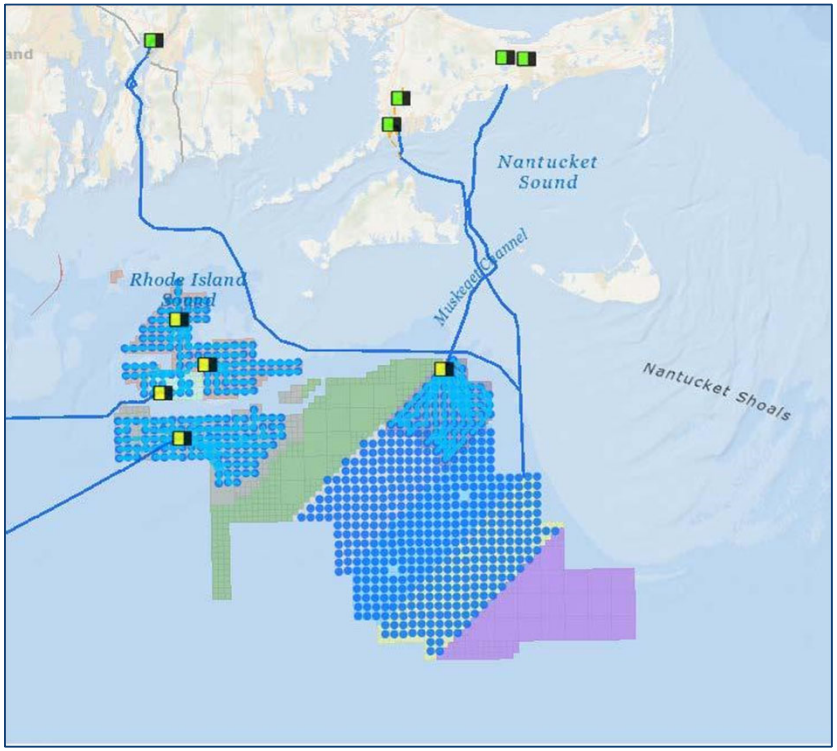
Perimeter Sampling: Next Steps

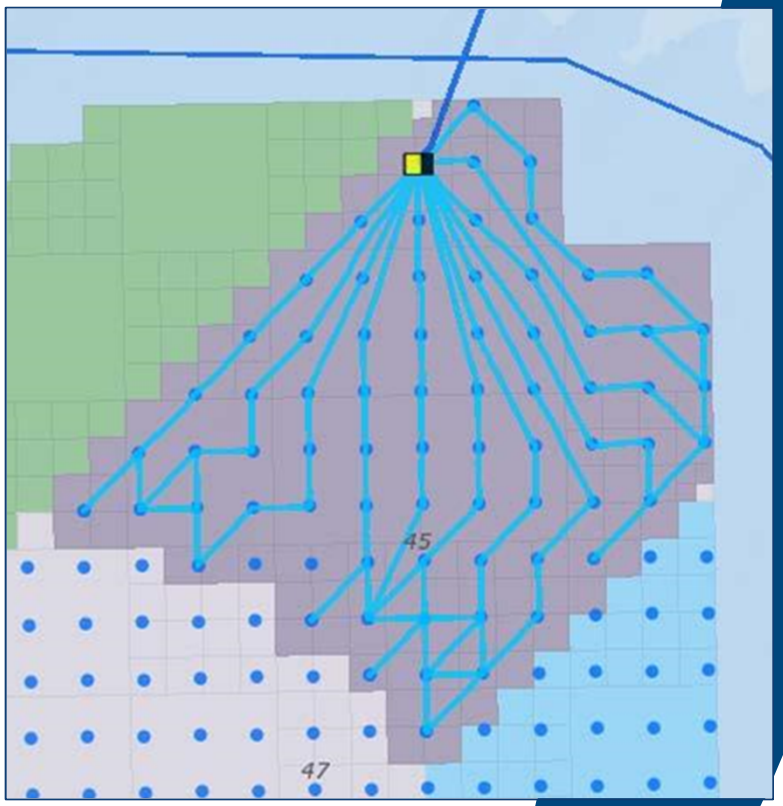


Mapping
AA
y to
ve

NOAA FISHERIES

Supplemental Sampling: Inter-array Cables

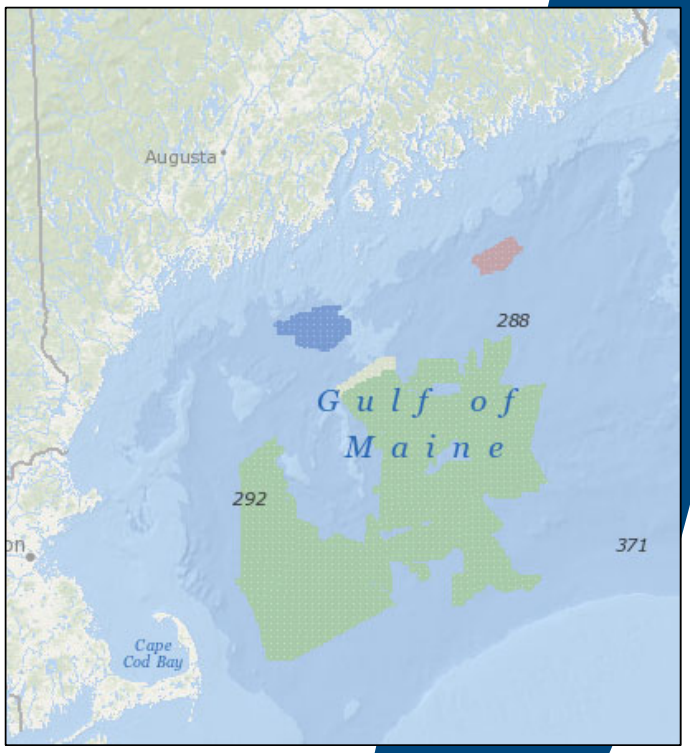




Images: NE Ocean Data Portal

NOAA FISHERIES

Floating Wind



NOAA FISHERIES

Questions?

Contact Information:

Catherine Foley

catherine.foley@noaa.gov