Lobster Ecosystem Monitoring & Modeling

NNA Lobster Network All-Hands Meeting
29 May 2025

Andrew Goode

1

Overarching Research Goals / Objectives

Monitoring

- Collaborate with The Lobster Institute, The Gulf of Maine Lobster Foundation, and NOAA to help expand benthic temperature monitoring by the Environmental Monitoring on Lobster Traps (eMOLT) program.

Modeling

- Integrate multiple avenues of early lobster life history research to develop a Larval Life History Model to simulate drift, growth, mortality, and settlement of larval / Postlarval lobsters.
- Update landings forecasts with postlarval supply

2

Overarching Research Goals / Objectives

Monitoring

- Update on eMOLT expansion via the NNA and other sources

Modeling

Larval tracking simulations

- Completed inputs, incomplete datasets, and needs

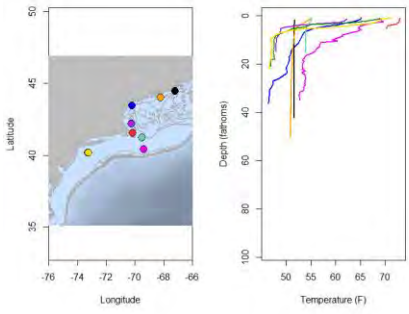
Landings Forecasting

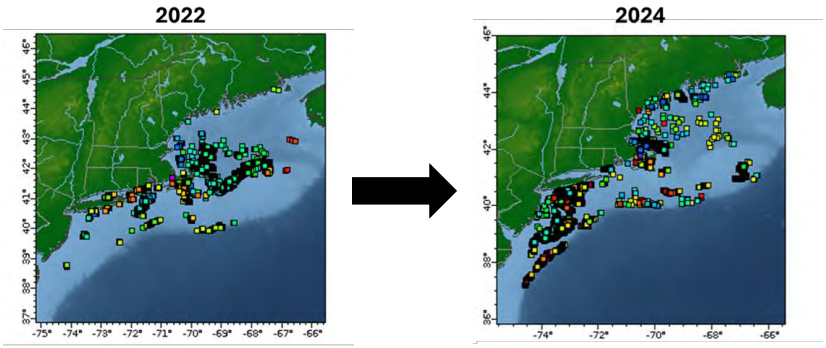
- Updates and advancements

3

eMOLT Update

- NNA Total: 18 new participants
  - From Kittery to Bucks Harbor
  - 12 Temperature-Depth Sensors
  - 12 DO Sensors





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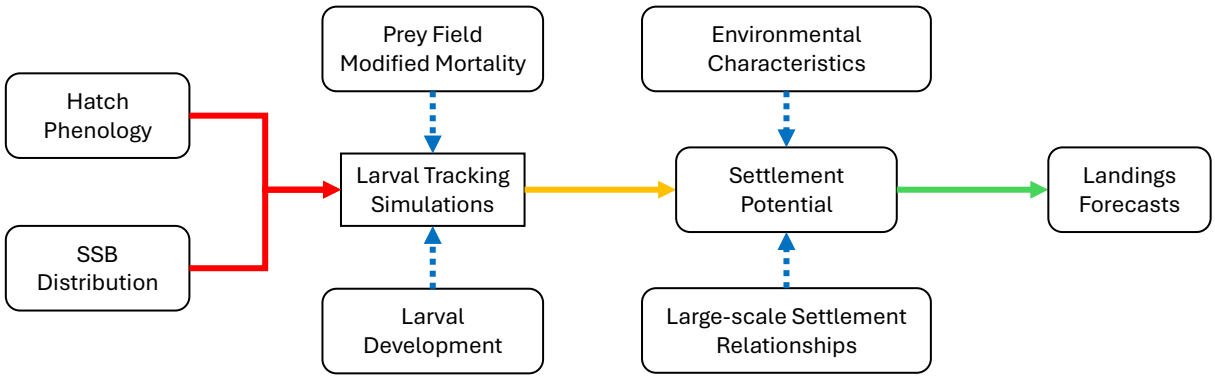
Modeling

Objective:

- Integrate HYCOM-NEMURO products to particle tracking simulations



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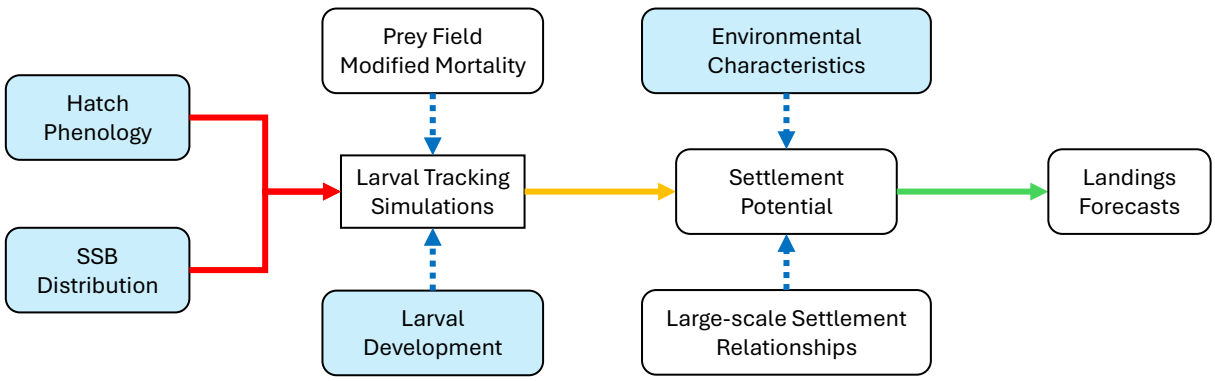
Modeling: Previous All Hands Discussions

Objective:

- Integrate HYCOM-NEMURO products to particle tracking simulations



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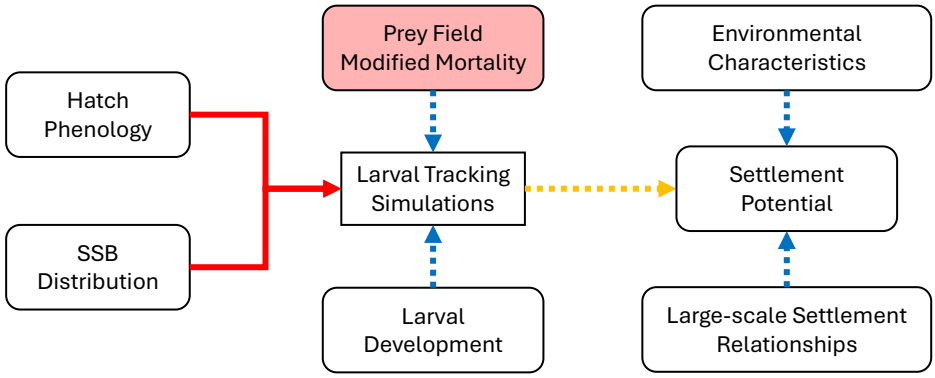
Modeling: Integration Needs

- HYCOM-NEMURO zooplankton abundances
- Tracking Using HYCOM (.nc files now in hand!!)



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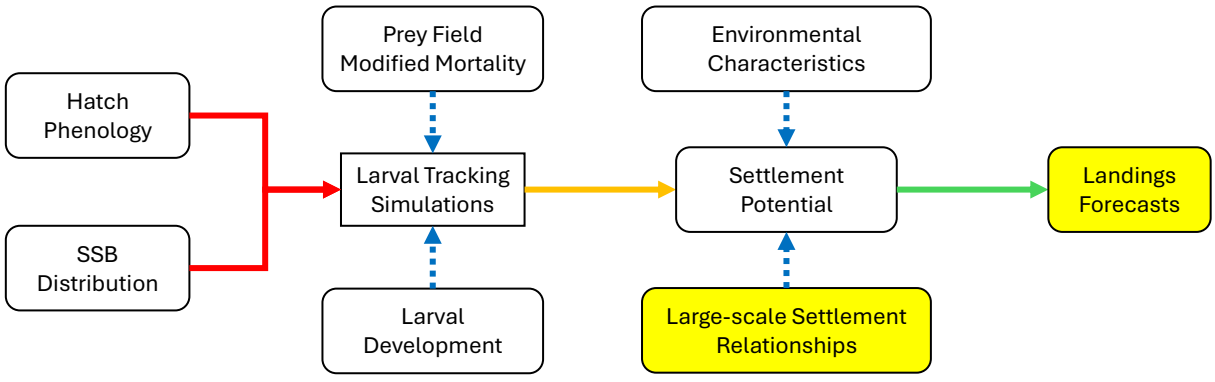
Modeling: Today's Topic – revisiting settlement, landings forecasts, and stock-recruitment



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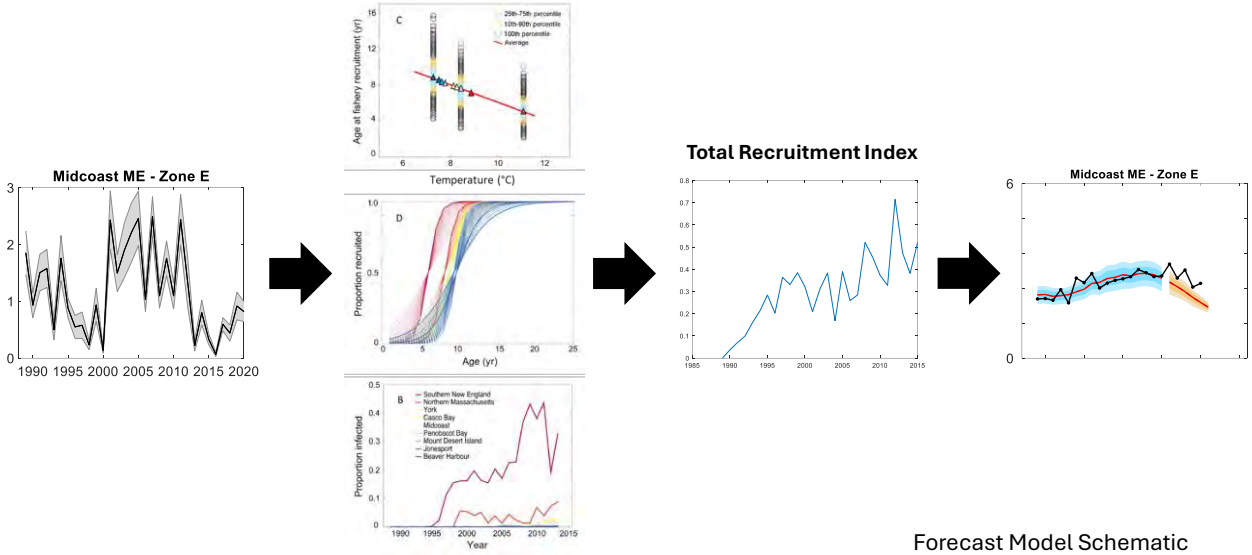
Forecasting Landings: how it works



Forecast Model Schematic
Adapted from Oppenheim et al. (2019)

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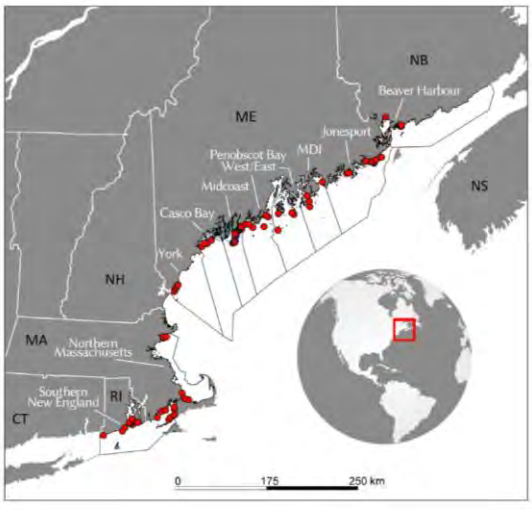
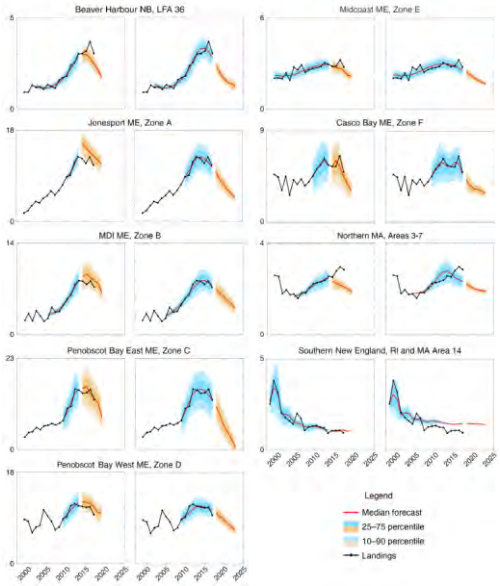
Forecasting Landings





New England ALSI Sites and Corresponding Landings Forecasts
Oppenheim et al. (2019)

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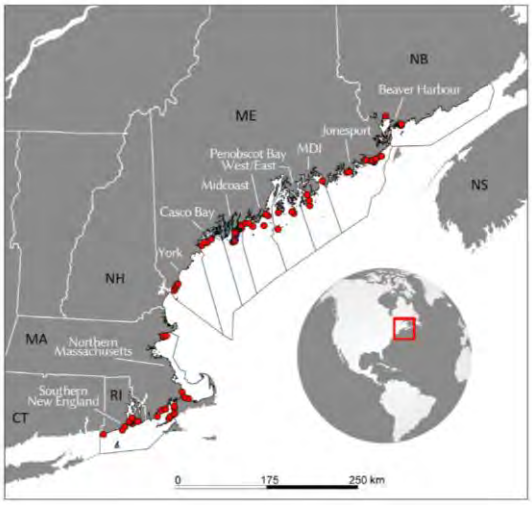
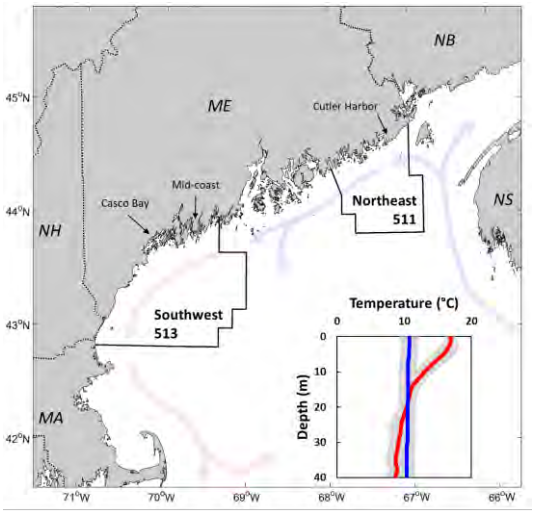
Scale of settlement relationships



New England ALSI Sites
Oppenheim et al. (2019)



Contrasting GoM Oceanography
Goode et al. *(in revision)*

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Scale of settlement: context matters

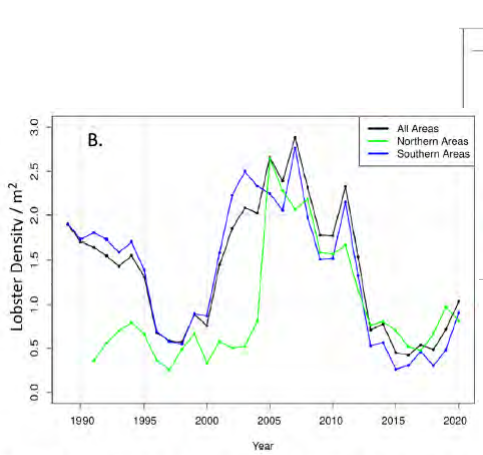
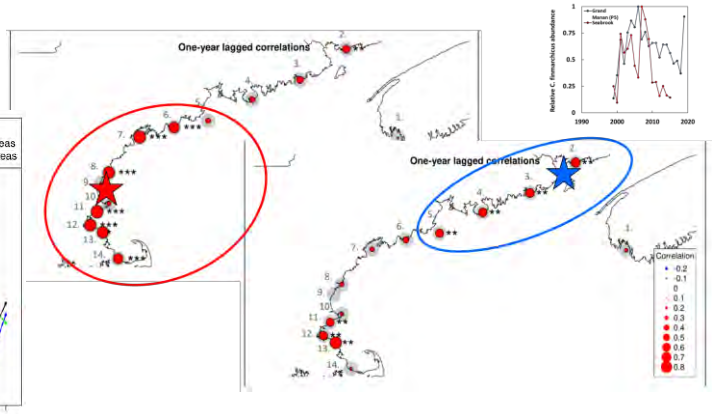


Fig. 2. A. Modeled ALSI settlement trends (+/- 2SE) for all combined study areas in the Gulf of Maine. B. Modeled ALSI settlement trends for all combined study areas, as in A, and separate trends for southwestern and northeastern study areas.



Linking GoM Biological Oceanography
Adapted from Shank et al. (2024)

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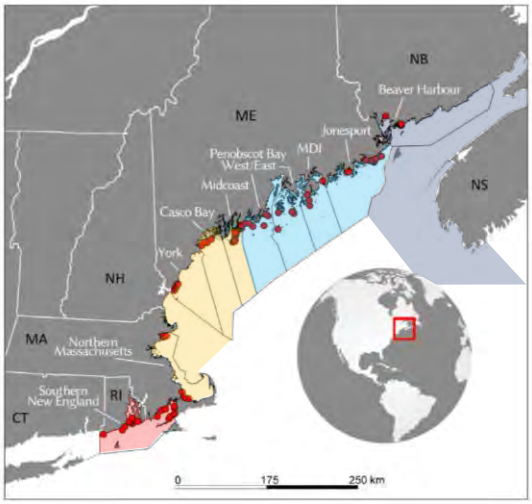
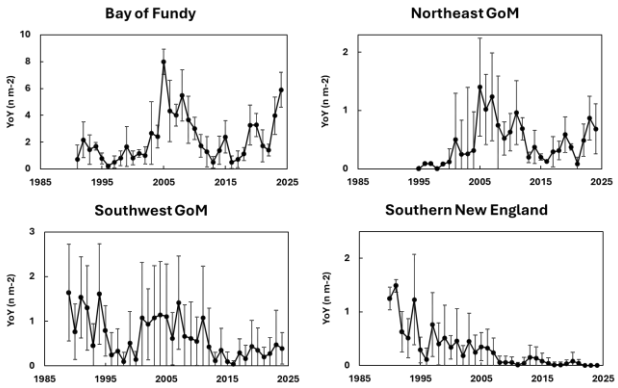
Scale of settlement relationships



Updated Forecasting Regions
Adapted from Oppenheim et al. (2019)



ALSI at the Oceanographic Scale

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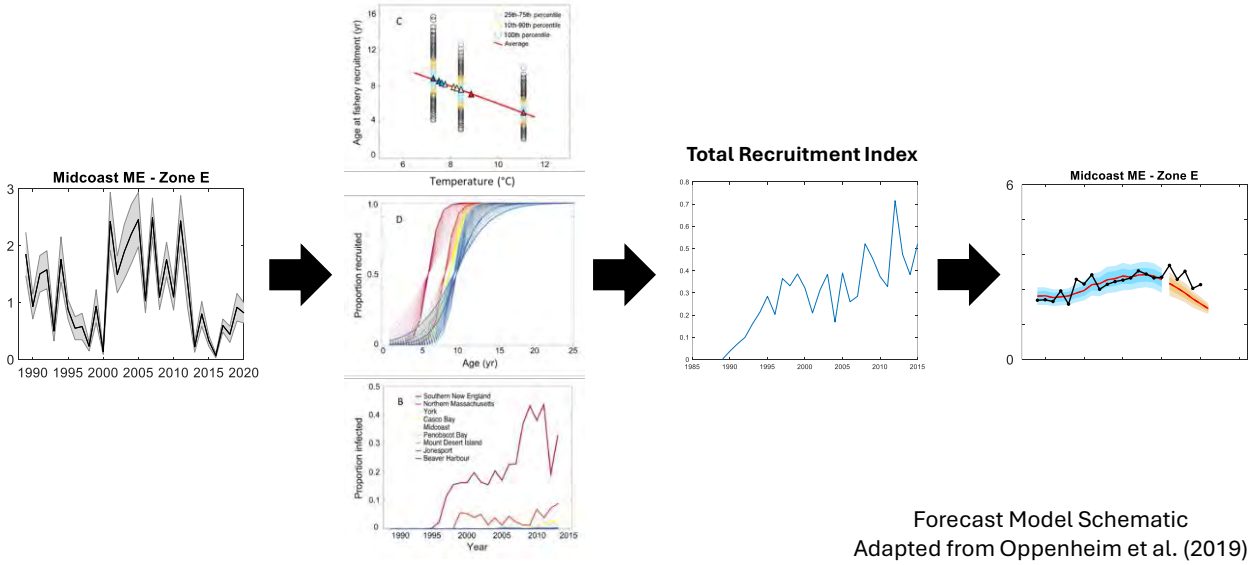
Questioning Assumptions



Forecast Model Schematic
Adapted from Oppenheim et al. (2019)

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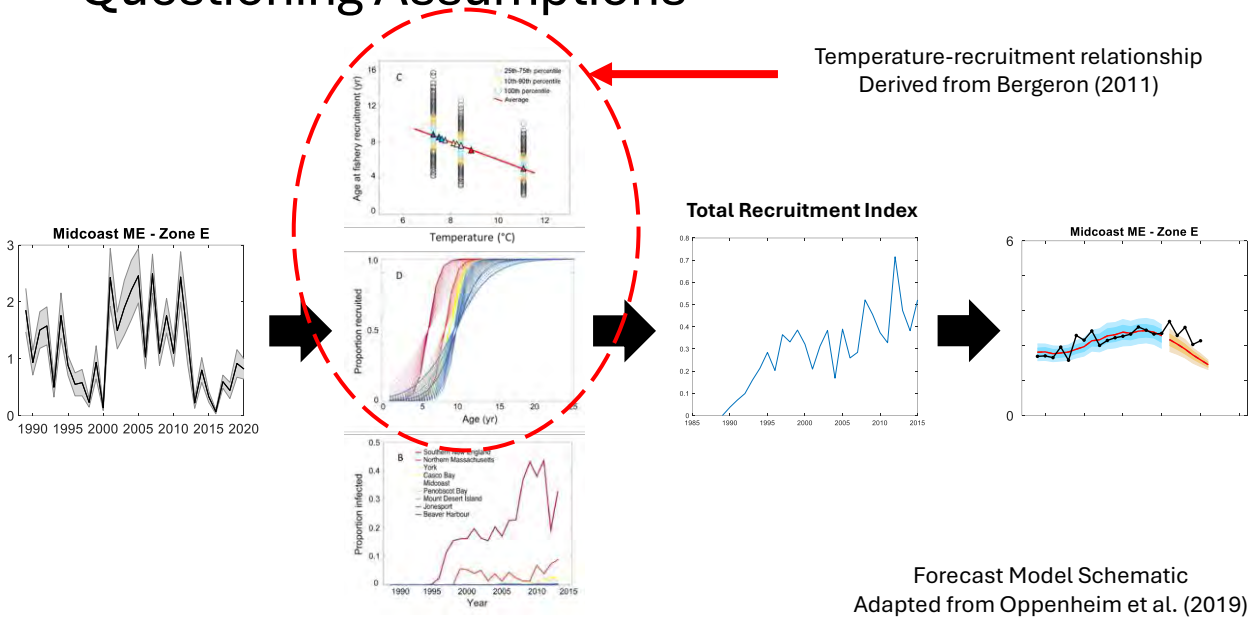

Temperature-recruitment relationship
Derived from Bergeron (2011)

Forecast Model Schematic
Adapted from Oppenheim et al. (2019)

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Questioning Assumptions

How old ***are*** you?!

Table 1.9.Mean age-at-recruitment to fishery (minimum harvestable size 82.5 mm) and upper and lower confidence intervals for all regions by sex. The range of years estimated within the confidence intervals is also shown.

Region	Sex	Average age (years)	Lower 95%	Upper 95%	Range (# of years)
BOF	M	9.0	6.1	12.4	6.3
	F	8.4	5.3	11.7	6.4
GOM	M	7.7	4.7	9.6	4.9
	F	7.6	4.7	10	5.3
SNE	M	4.5	2.6	6.4	3.8
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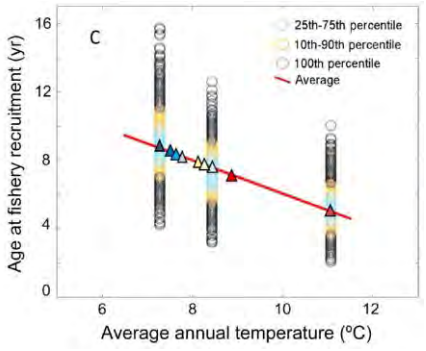
Oceanographically-varying Age at Fishery Recruitment
Bergeron (2011)



Temperature versus Age at Fishery Recruitment
Oppenheim et al. (2019)

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Questioning Assumptions

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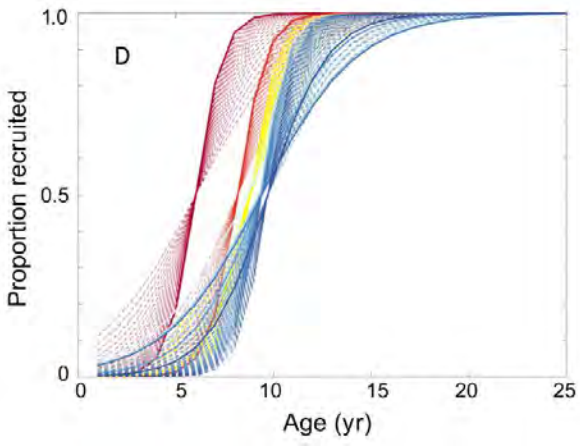
Model Sensitivity Testing

How do different combinations of parameters for the logistic growth equation impact regional landings forecasts?

- α: assumed age at 50% recruitment
  - Smaller = younger when recruited to fishery
- β: slope of the logistic curve
  - Smaller = individual recruitment classes recruit into fewer landings cohorts



Logistic Age-at-fishery recruitment
Oppenheim et al. (2019)

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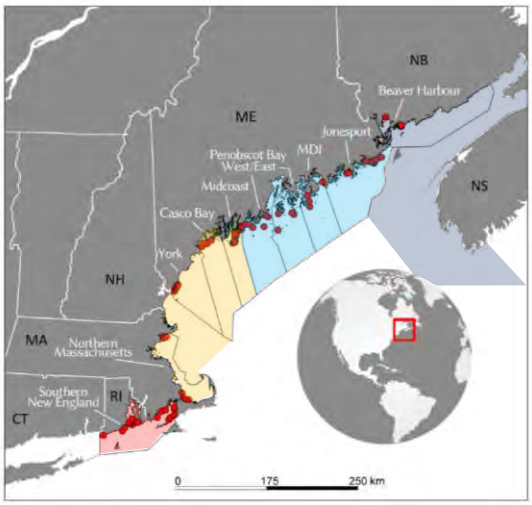

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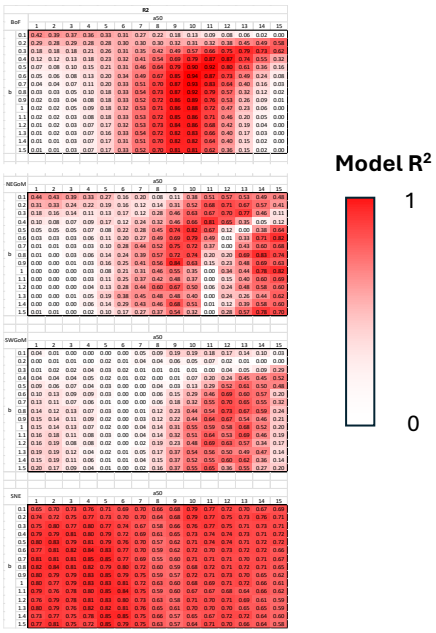

Forecast Model R^2 Values Under
Different Logistic Equation Assumptions

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Questioning Assumptions

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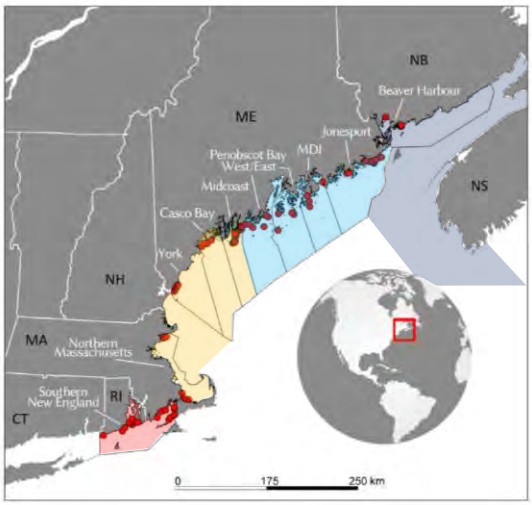

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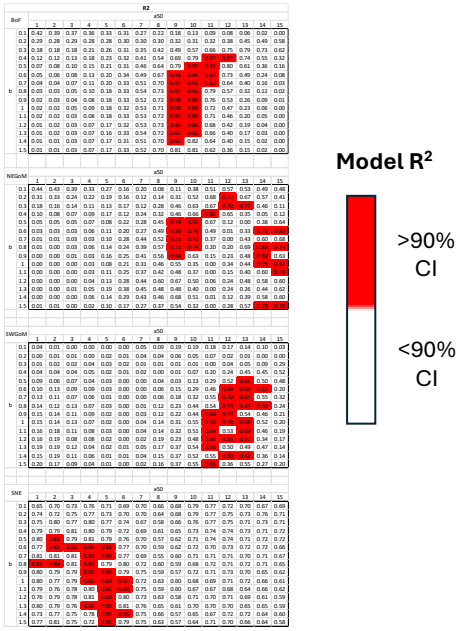

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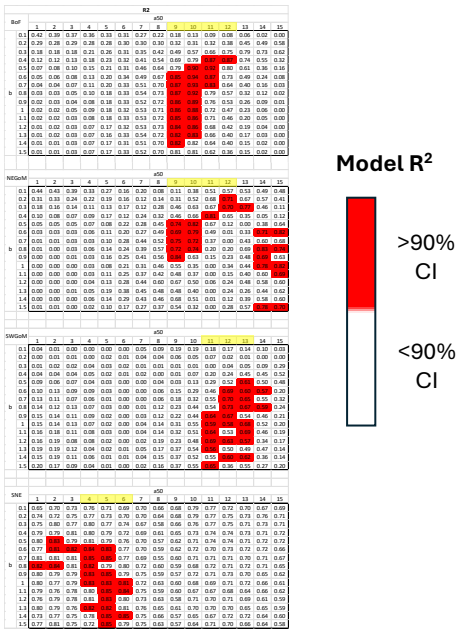

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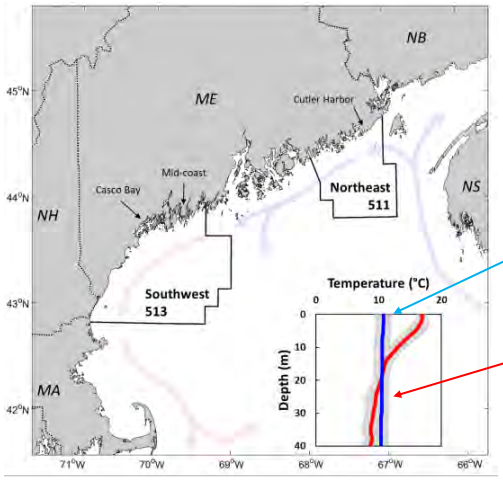

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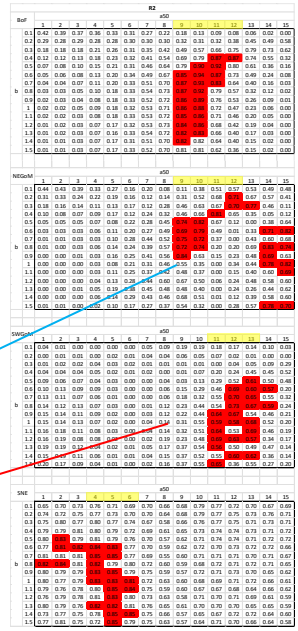

Model R^2

>90% CI

<90% CI

Forecast Model R^2 Values Under Different Logistic Equation Assumptions

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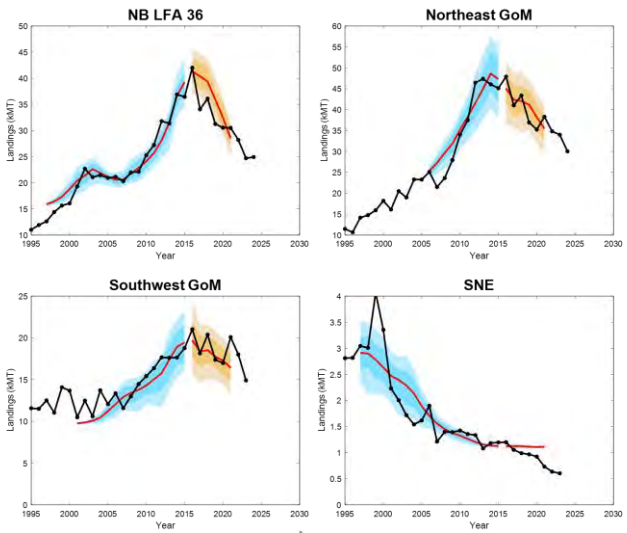
Model Performance: **2015-present**



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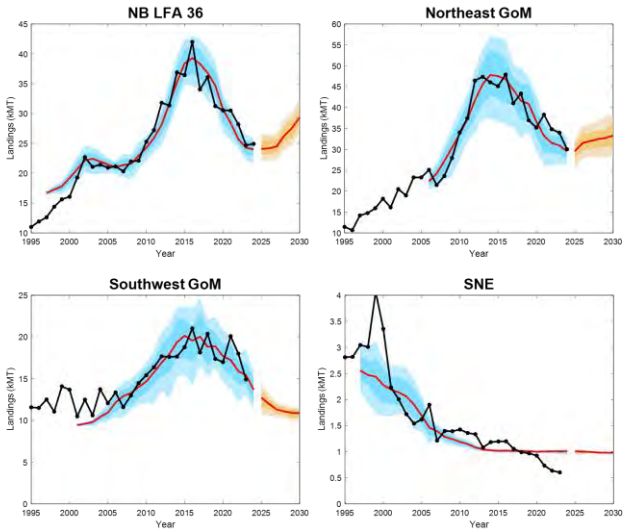
What do forecasts with these conditions look like?
2024+



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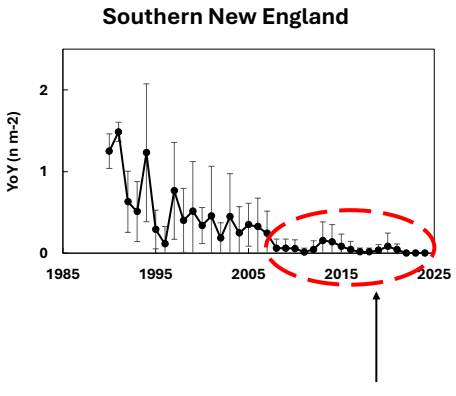
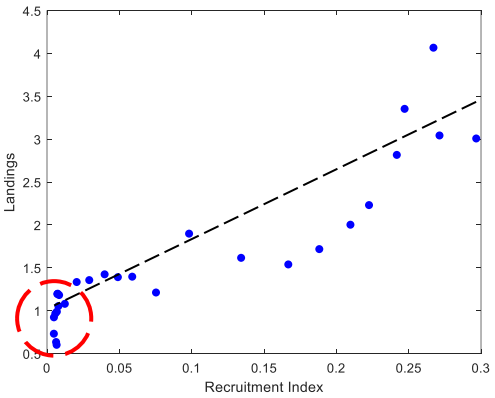
Things to consider…



Detectability issue



… skews regression

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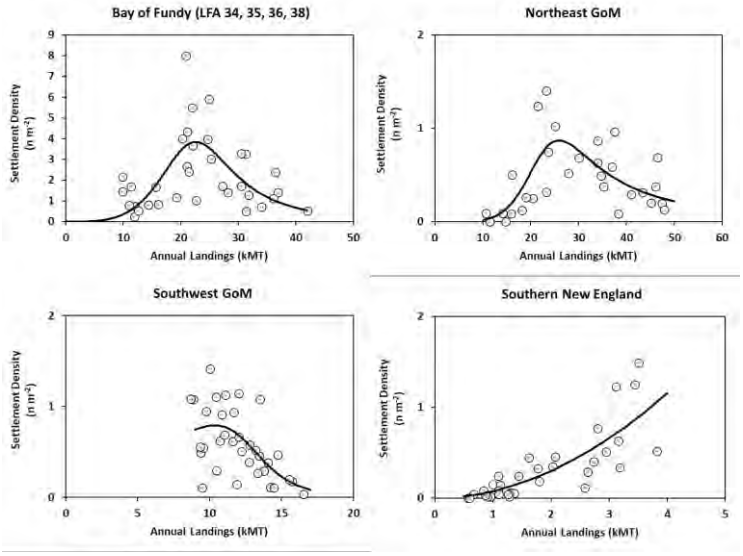
Putting the Environment In Context



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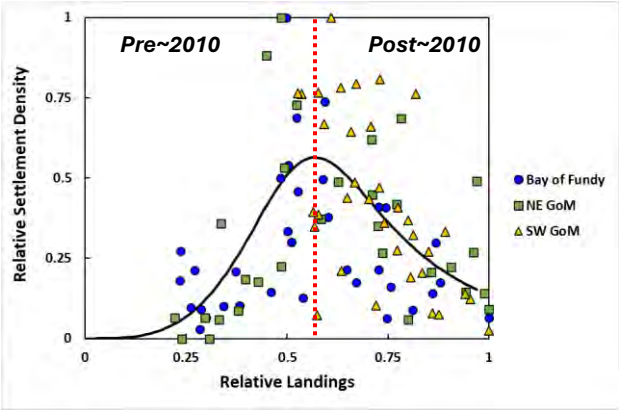
Putting the Environment In Context



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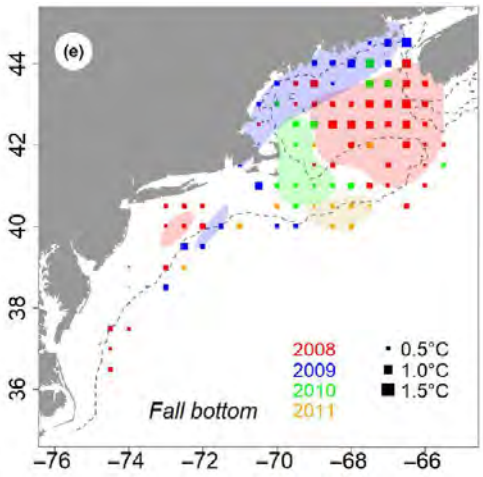
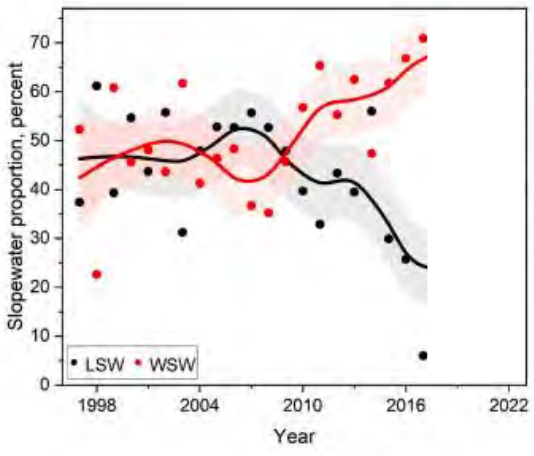
Context: Gulf of Maine Regime Shifts



Autumn bottom temperature regime shifts and their locations. Symbol size denotes strength of regime shift. Friedland et al. (2020).



Percentage of Labrador Slope Water (LSW) and Warm Slope Water (WSW) at the Northeast Channel (1997-2022). Friedland et al. (2024)

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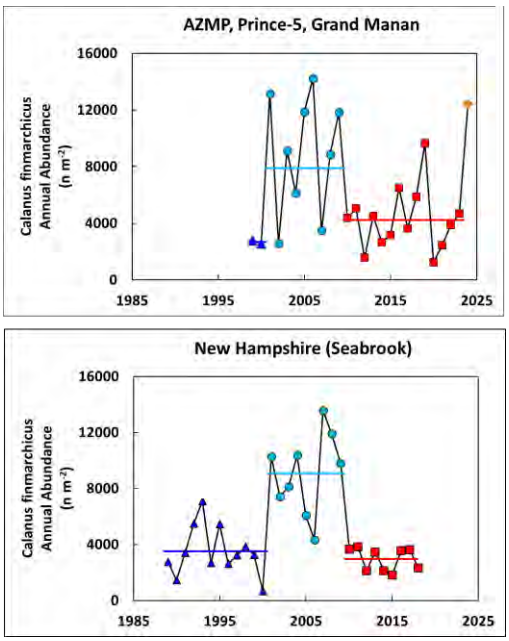

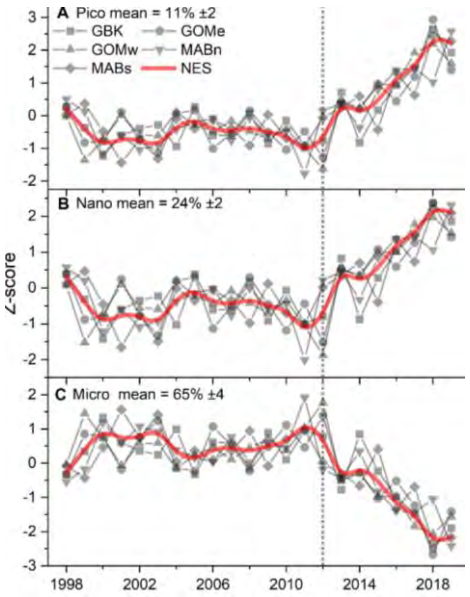

Changing Phytoplankton Composition Friedland et al., (2020)

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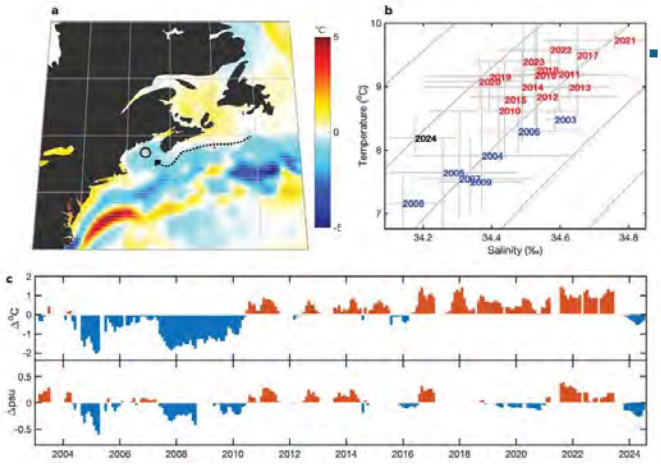
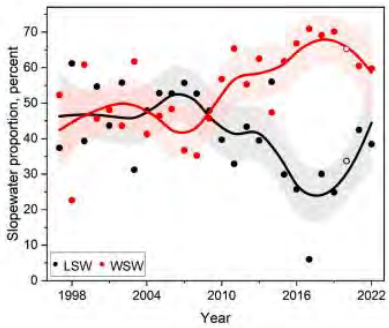
Context: Gulf of Maine Regime Shifts, Reversal?



Shifting hydrography of Jordan Basin, Gulf of Maine. A) map of sea surface temperature and location of the Jordan Basin NERACOOS buoy (250 m). B) Jordan Basin TS diagram. C) Jordan Basin TS anomaly time series. Blues: cold/fresh regime. Reds: warm/salty regime. (Record et al. 2024).



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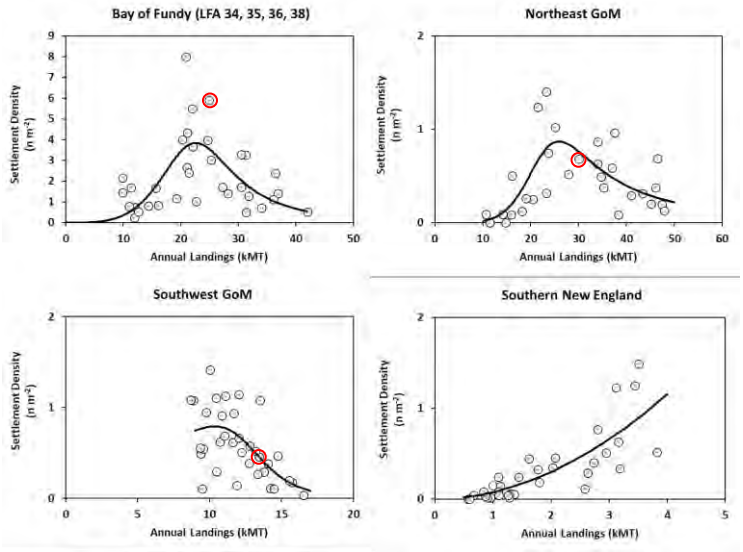
Putting the Environment ***Back*** In Context



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Next Steps

- Acquire Bay of Fundy trawl data (hopefully)
- Run connectivity simulations using recently transferred HYCOM files and compare against finer-scale simulations using NECOFS
- Use simulated *Calanus* fields to parameterize larval mortality and tune larval supply – settlement relationships.
- Start tying it all together…

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