

# Lobster Ecosystem Modeling + Monitoring



NNA Lobster Network All-Hands Meeting  
17 May 2024

Andrew Goode



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## 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.

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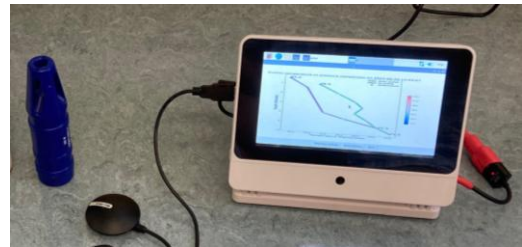
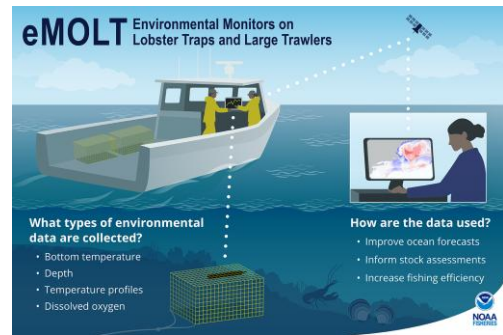
## Monitoring: eMOLT

Why?

- Provides critical benthic temperatures and water column profiles necessary to tune the hydrodynamic models to real conditions in the Gulf of Maine

How?

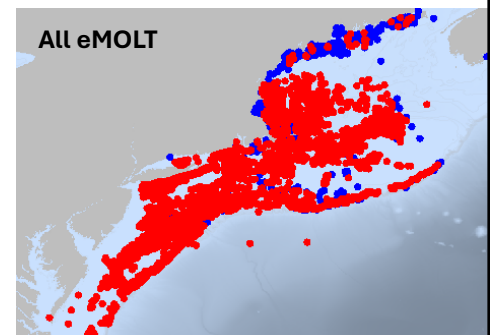
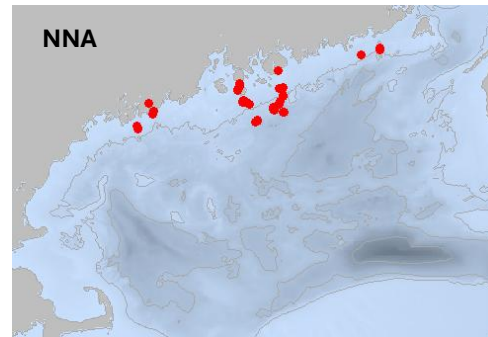
- *in situ* temperature-depth sensors, satellite transmission of data in near-real time



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## eMOLT 2023

- In 2023 the NNA program and GOMLF added **10** new participating lobstermen to the eMOLT program ranging from Bucks Harbor to Kittery
- Water column profiles showed us the seasonal breakdown of stratification across ME



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# eMOLT 2024 + Leveraging NNA Success

## NNA: Phase 2

- Increase the number of sensors each lobsterman has to improve spatial coverage within our expanded eMOLT network

## New Funds from the Maine Community Foundation

- 2024-2025: increase number of participants by ~20 (11 already confirmed)
- Deploy temperature/depth sensors across Maine and DO sensors at suspected low-oxygen locations off the Mid-coast

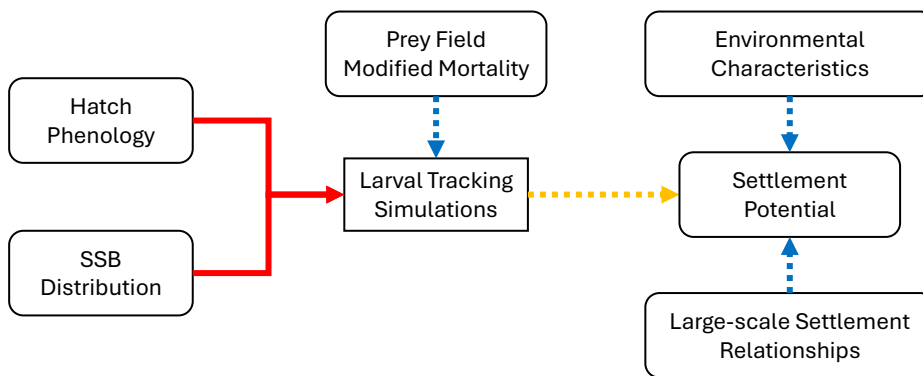


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# Modeling

## Objective:

- Integrate HYCOM-NEMURO products to particle tracking simulations

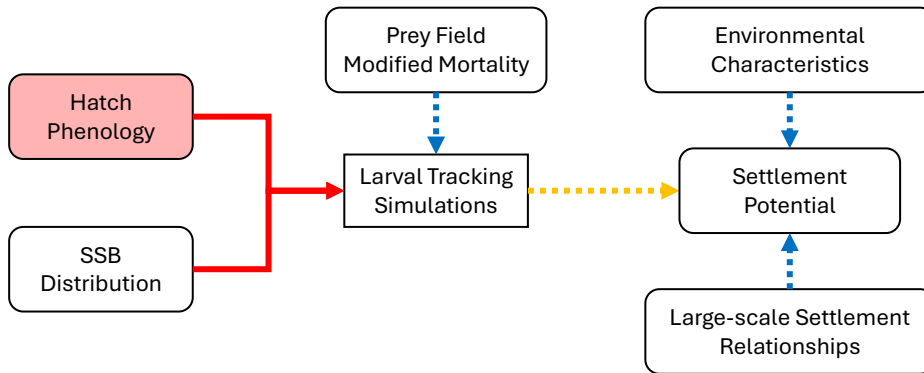


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# Modeling

## Objective:

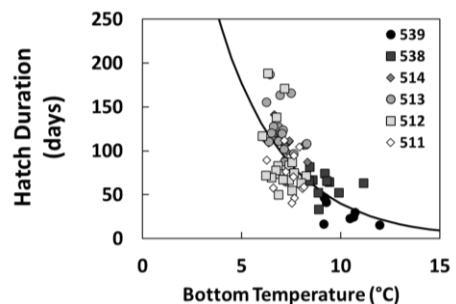
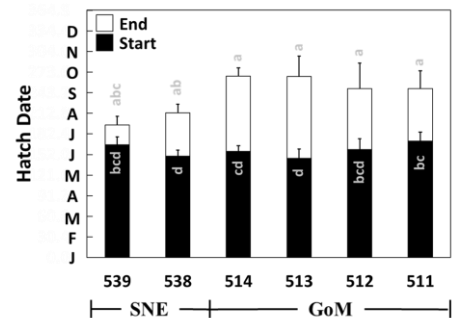
- Integrate HYCOM-NEMURO products to particle tracking simulations



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# Hatch Phenology

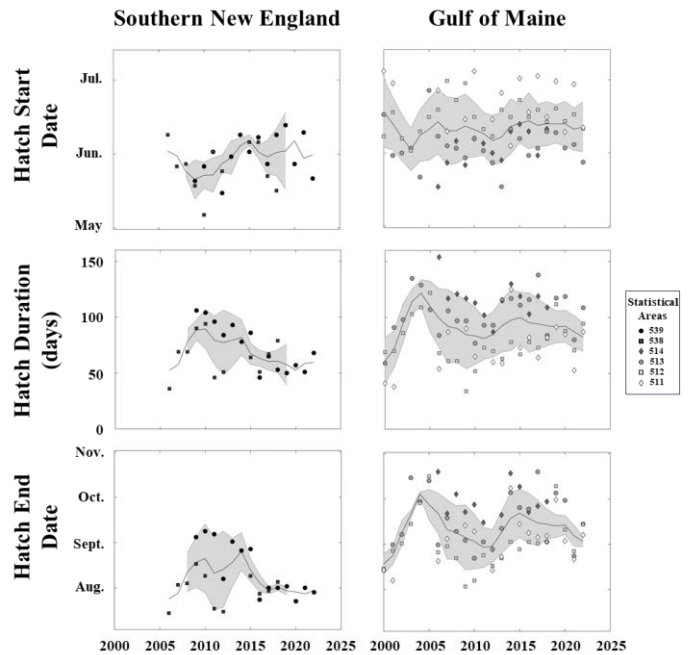
- Ventless Trap and Sea Sampling Surveys to characterize regional patterns of egg hatch and correlates to environmental conditions
- Onset of hatch relatively consistent across space
- Shortened duration of hatch season at elevated temperatures



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# Hatch Phenology

- Interannual fluctuations within each geographic region produces changes and fluctuations in the onset, duration, and conclusion of egg hatching behavior

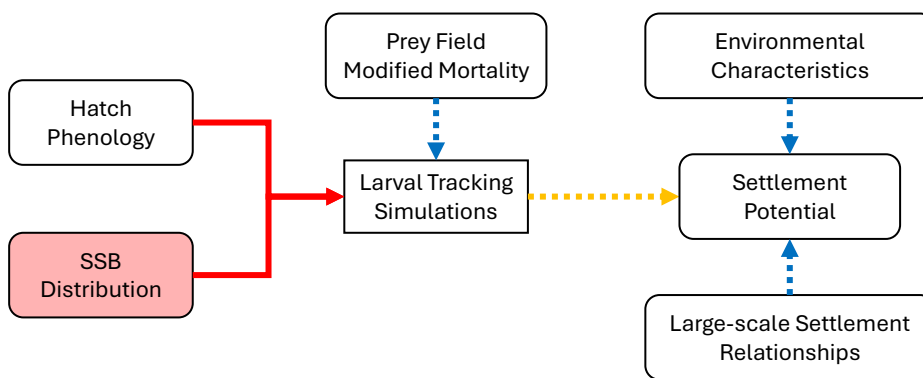


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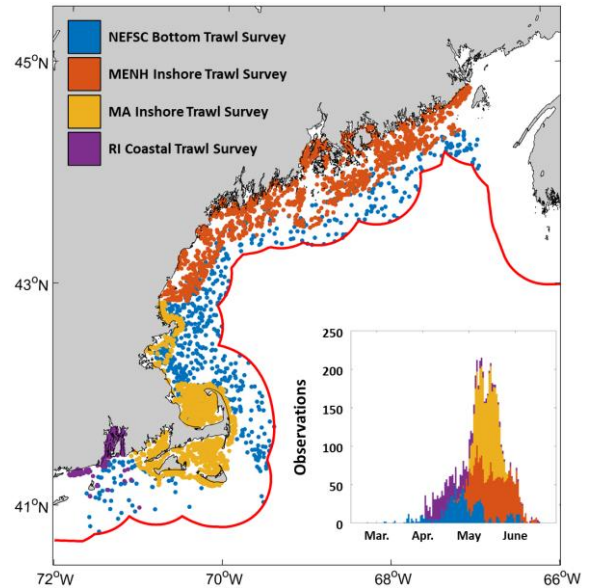
## SSB Distribution

### Trawl Survey CPUE

- MENH Inshore Trawl Survey
- MA Bottom Trawl Survey
- RI Coastal Trawl Survey
- NMFS Bottom Trawl Survey

Normalize catch of females > 75 mm carapace length to area swept to estimate potentially reproductive biomass per km<sup>2</sup>

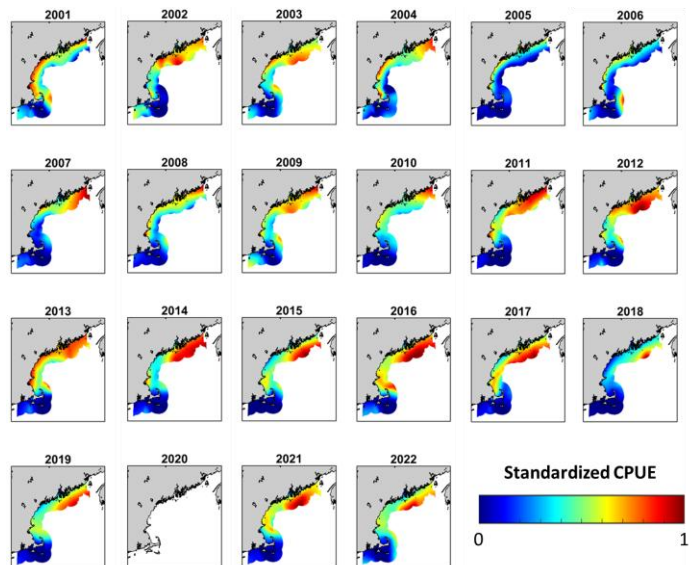
Catch from the Spring survey to approximate SSB distribution within the 24nm coastal zone prior to hatch



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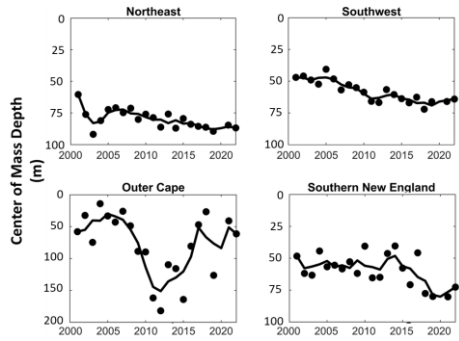
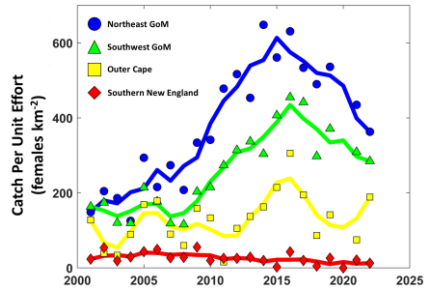
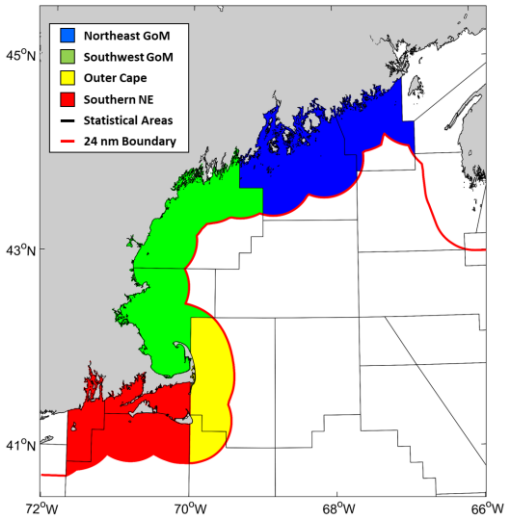
## SSB Distribution

- SSB distribution varies substantially over our study period
- From concentrated nearshore to more dispersed and spread offshore



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# SSB Distribution



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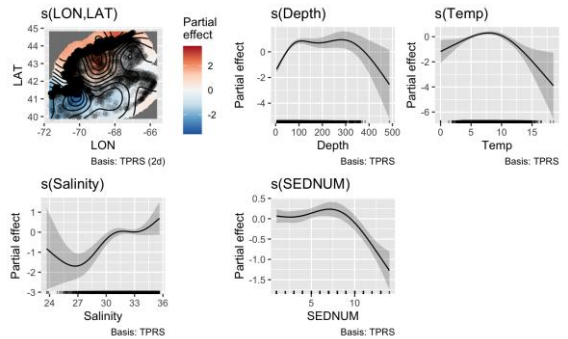
# SSB Distribution

Two-stage Generalized Additive Model to analyze environmental correlates corresponding to presence/absence and log CPUE

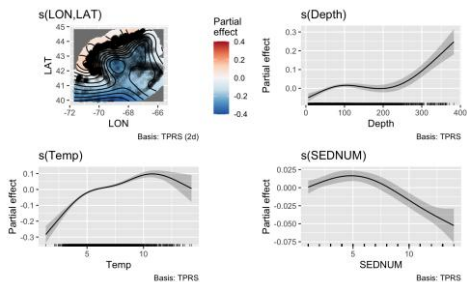
Candidate covariates

- Depth, Temperature, Salinity, Sediment Characteristics, LON, LAT

## Presence / Absence



## LOG CPUE

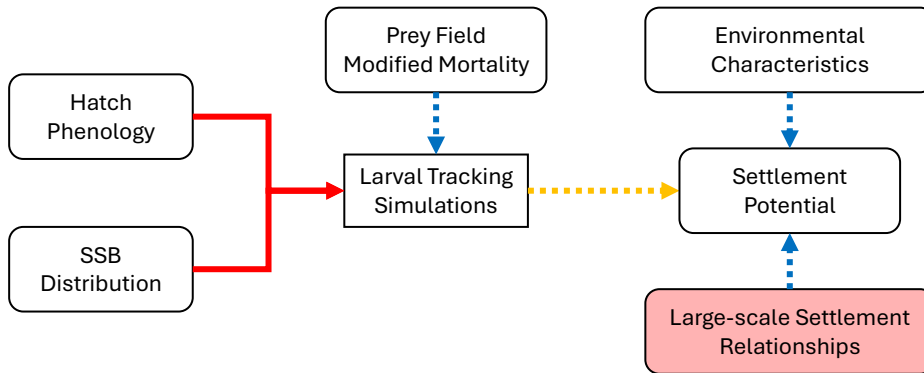


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# Modeling

## Objective:

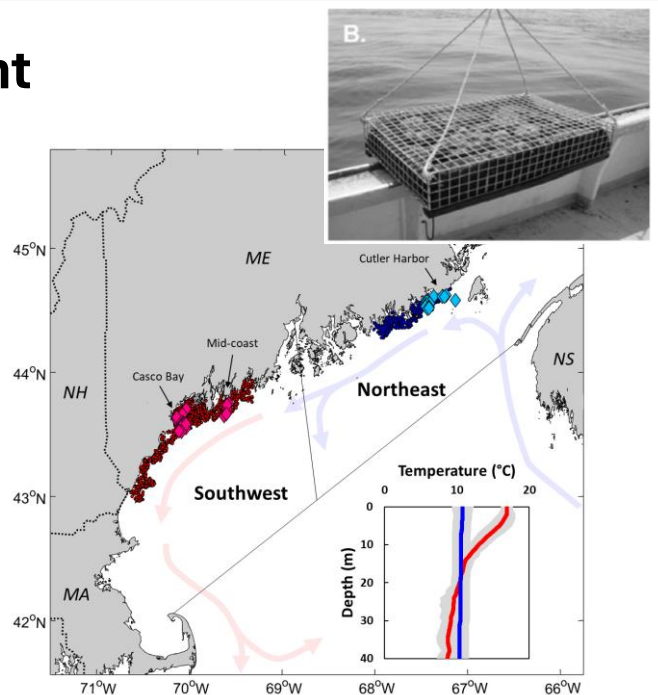
- Integrate HYCOM-NEMURO products to particle tracking simulations



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# Large-scale Settlement Relationships

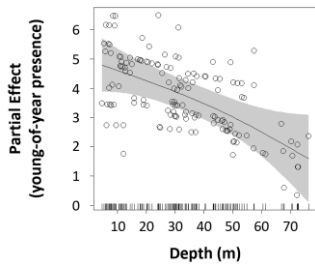
- Passive settlement bio-collectors to evaluate the interactive effects of temperature, depth, and distance from shore on settlement patterns
- Two-stage GAM to separately model presence/absence and log settlement density



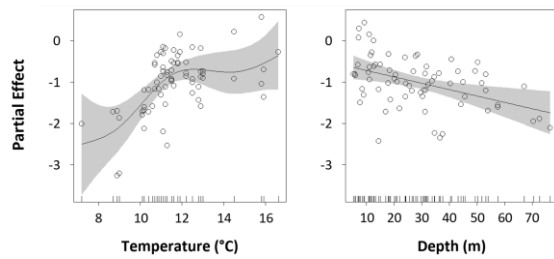
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# Large-scale Settlement Relationships

Presence / Absence



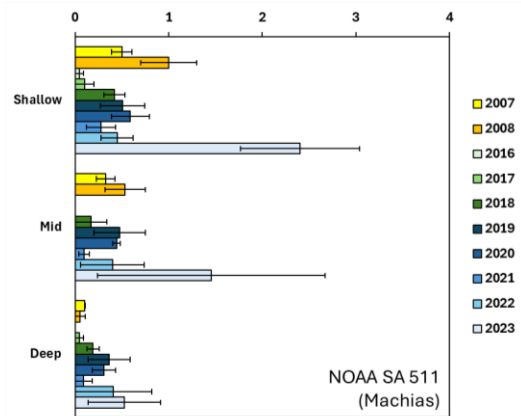
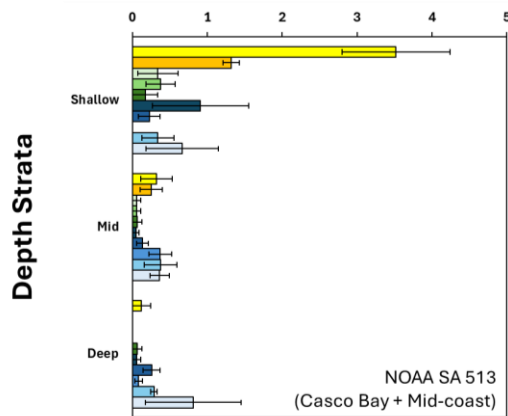
LOG Density



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# Large-scale Settlement Relationships

Young of Year Density (n m<sup>-2</sup>)

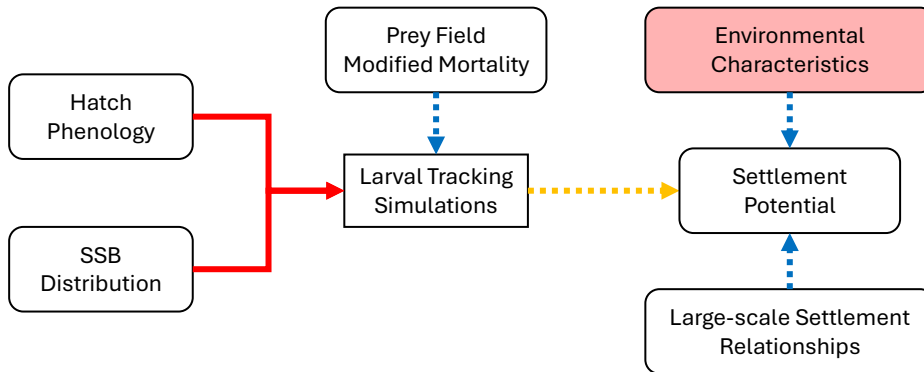


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# Modeling

## Objective:

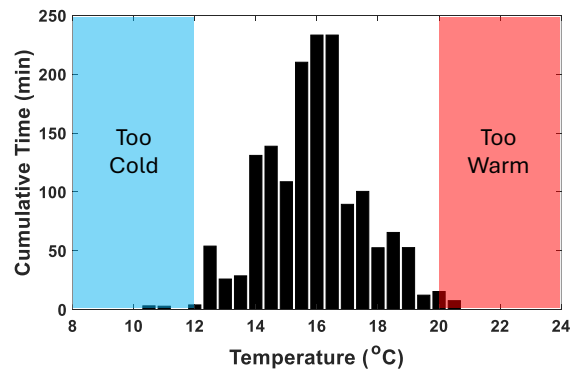
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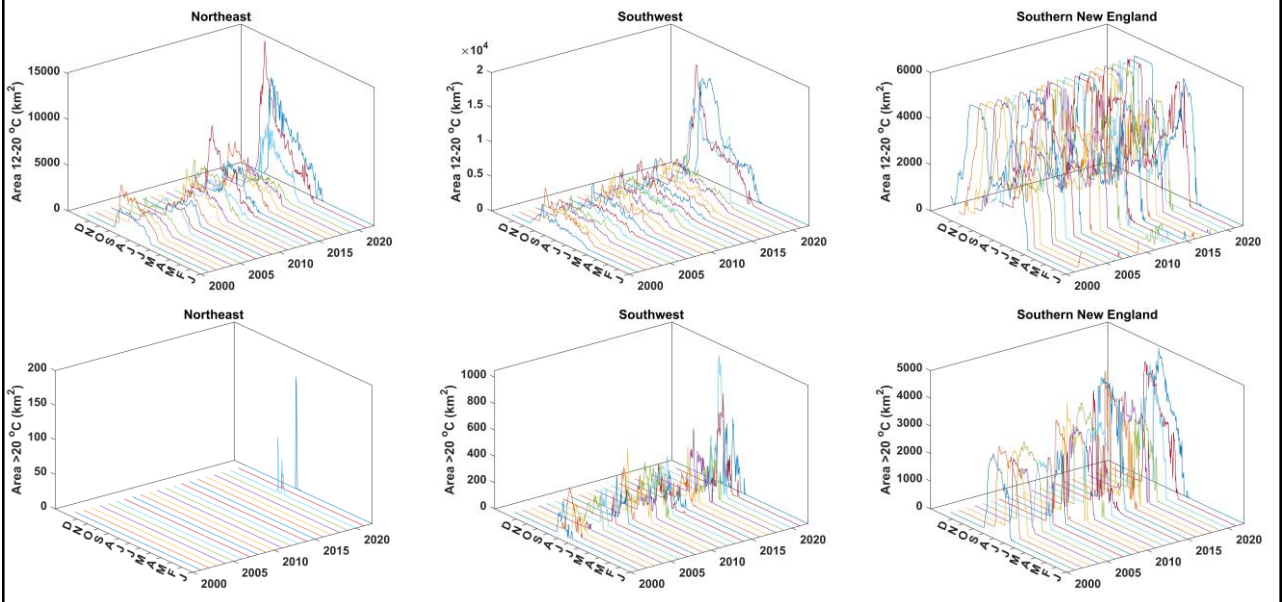
# Environmental Characteristics

- Use modeled bottom temperatures to characterize the spatiotemporal fluctuations in critical thermal habitat for settling postlarvae.
- 12-20 °C as optima
- >20 °C as thermally stressful
- How does the area and phenology of this habitat change?



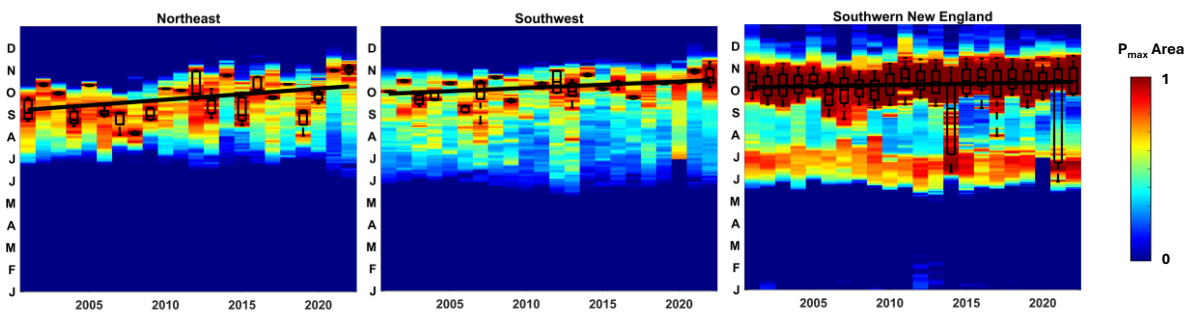
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# Environmental Characteristics



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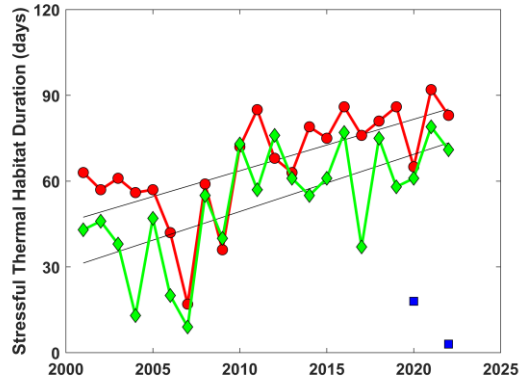
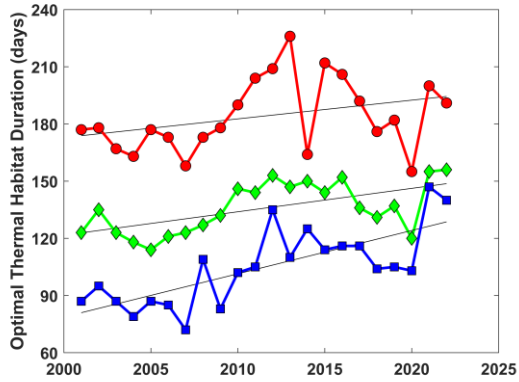
# Environmental Characteristics



- Both GoM regions show significant shifts in the phenology of peak thermal habitat availability later in the year

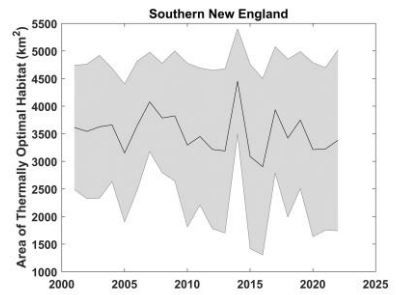
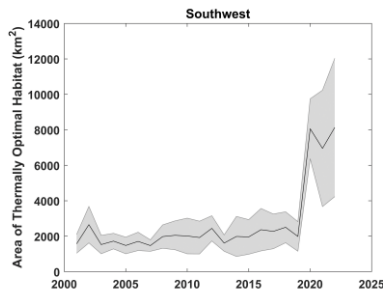
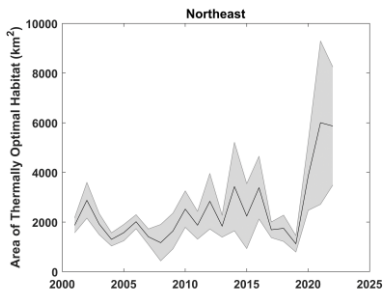
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# Environmental Characteristics



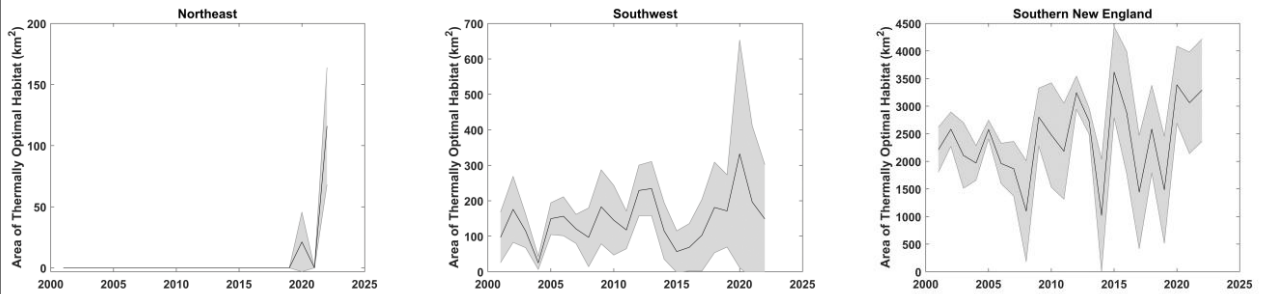
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# Environmental Characteristics



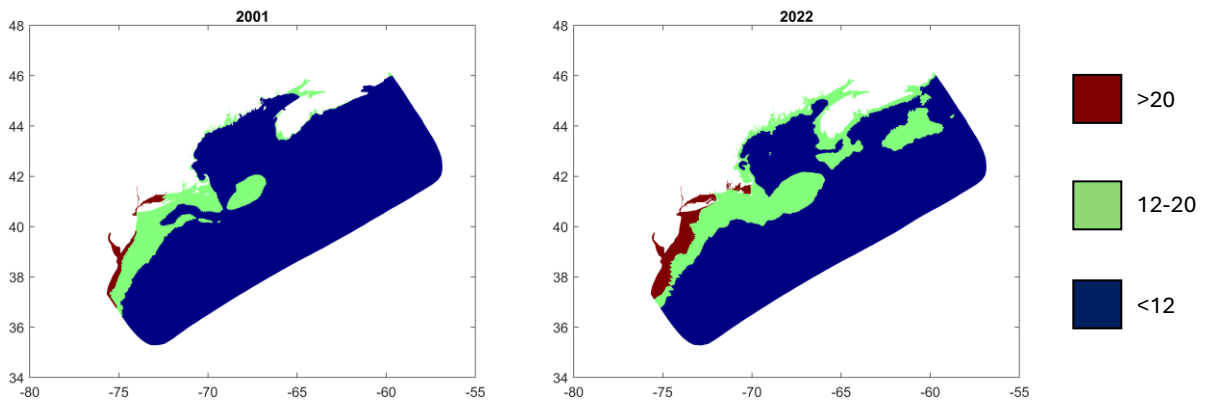
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## Environmental Characteristics



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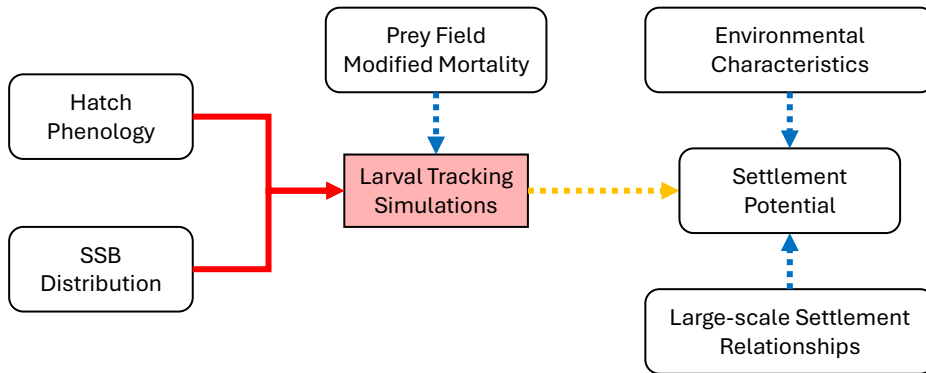


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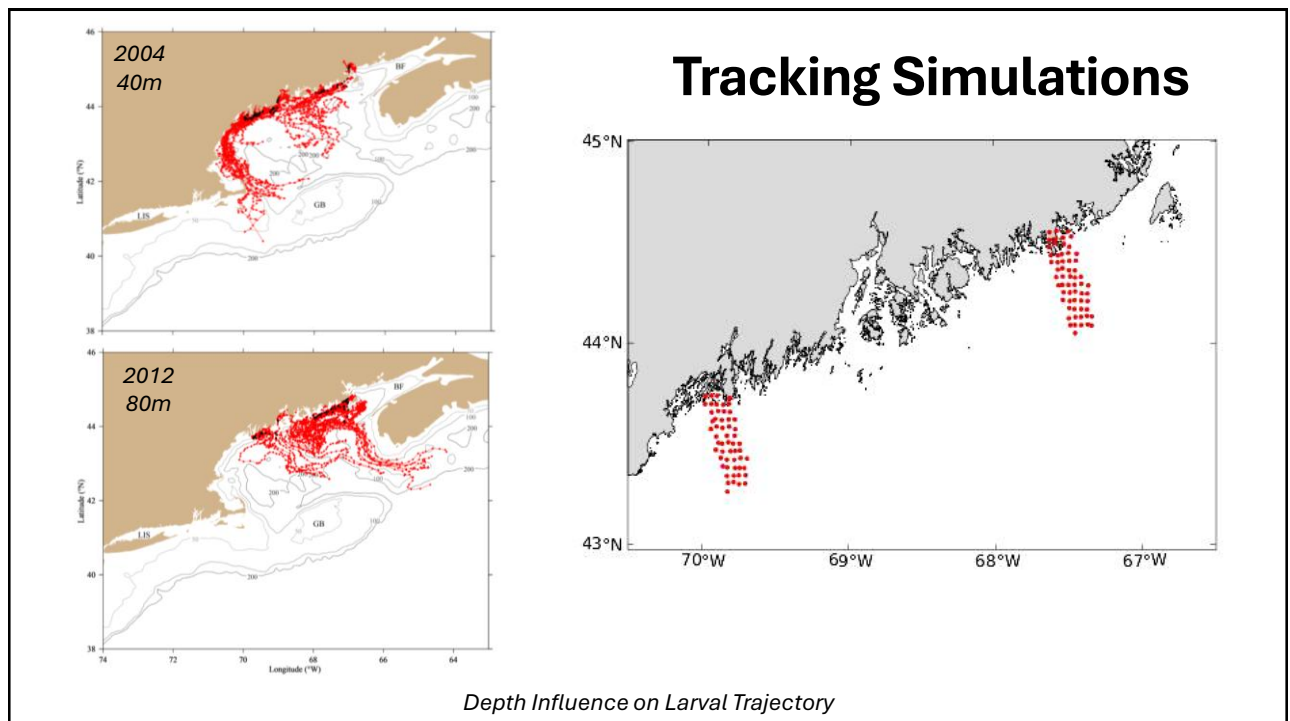
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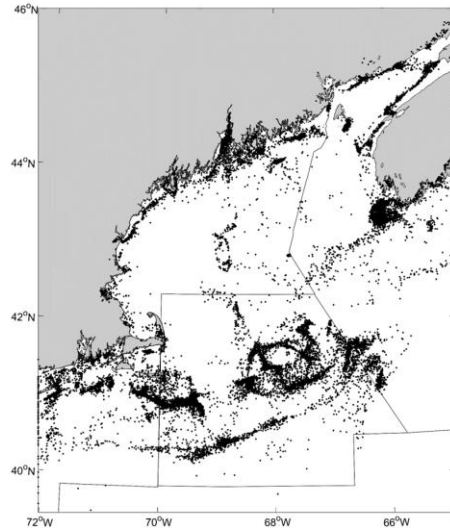
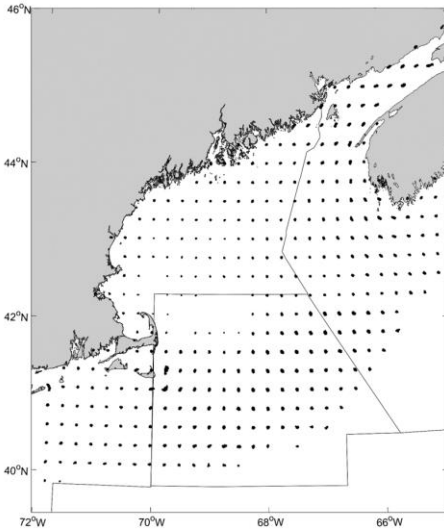


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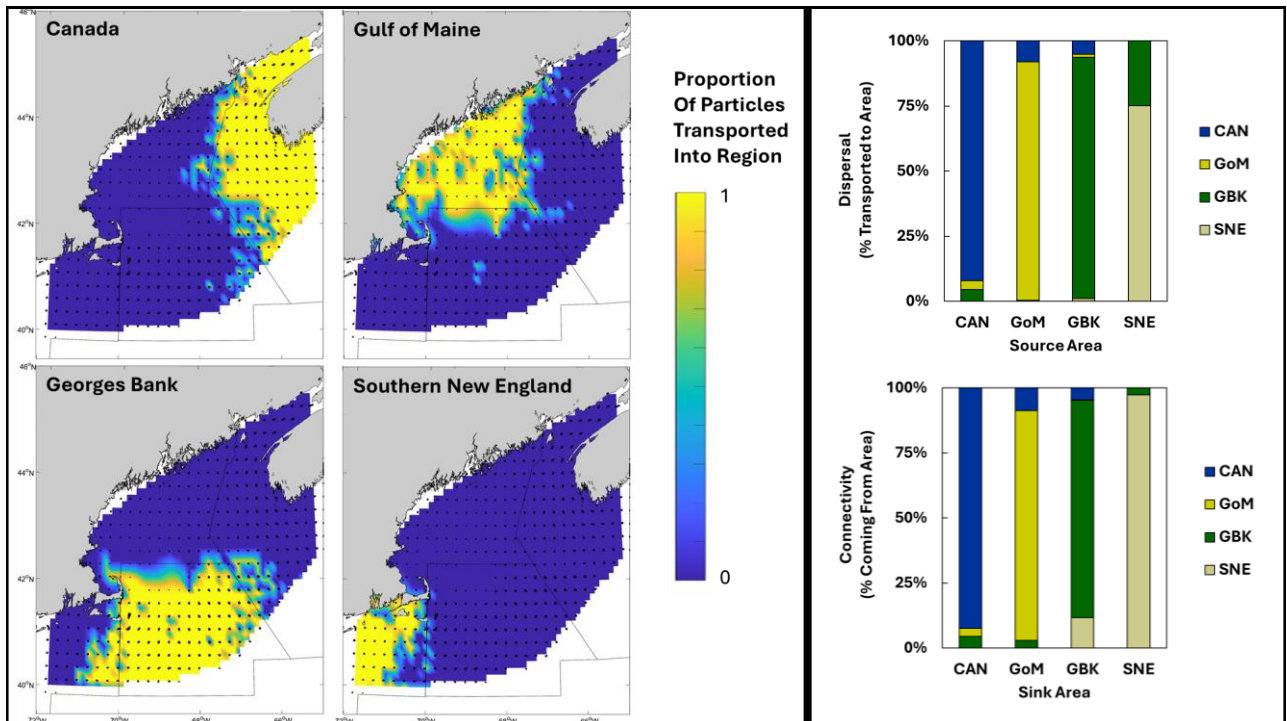


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# Tracking Simulations



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