

CLIMATE DRIVEN LINKAGES BETWEEN TROPHIC LEVELS IN MARINE COMMUNITIES

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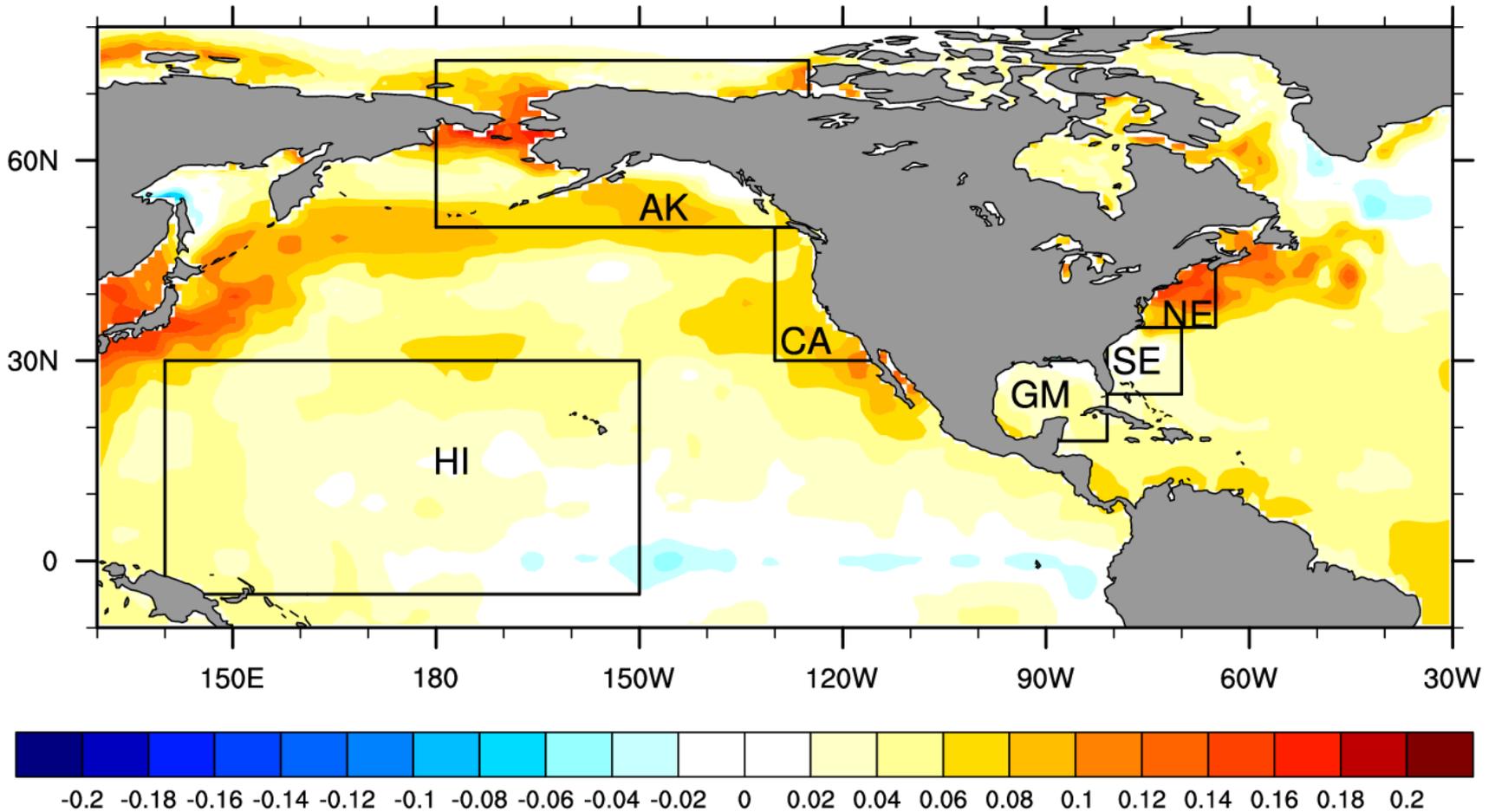
³ NOAA GFDL, Princeton NJ

Goal Of The Investigation

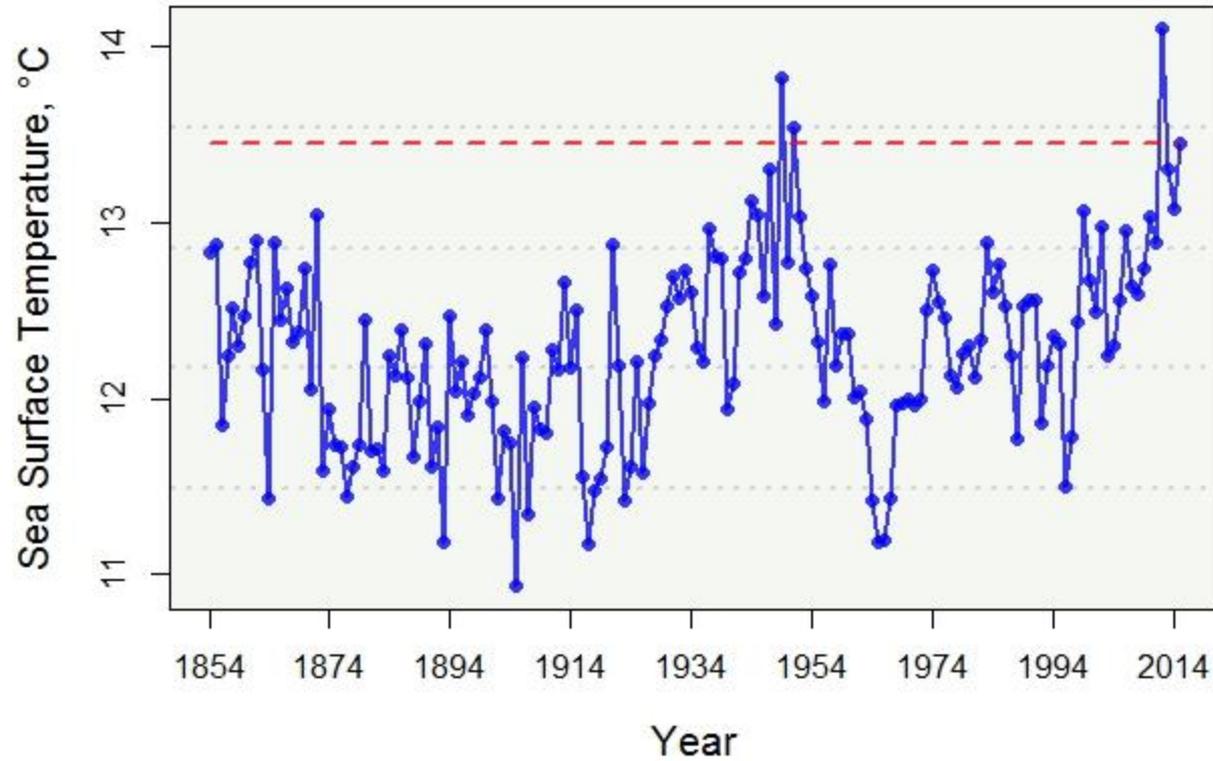
To describe shifting distributions of seasonal zooplankton communities on the NES and identify physical drivers

Warming of Northeast Shelf and US LMEs

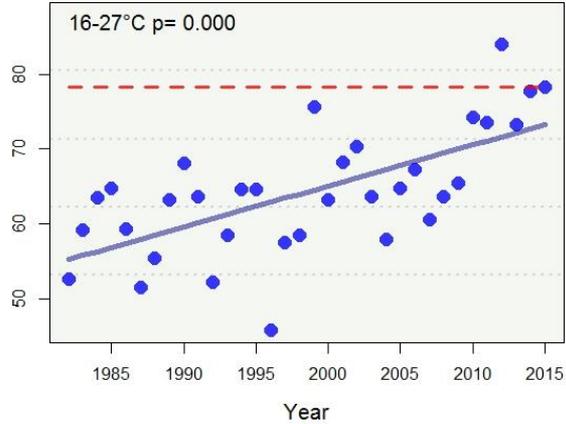
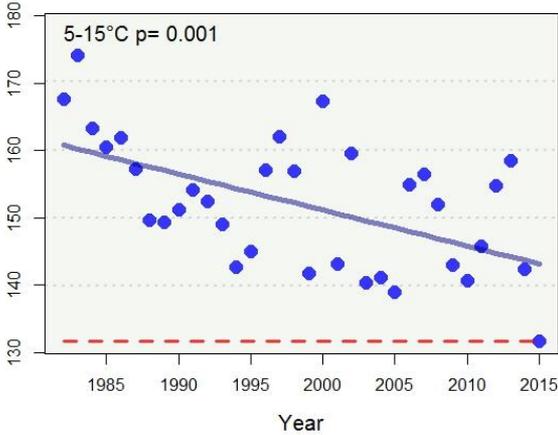
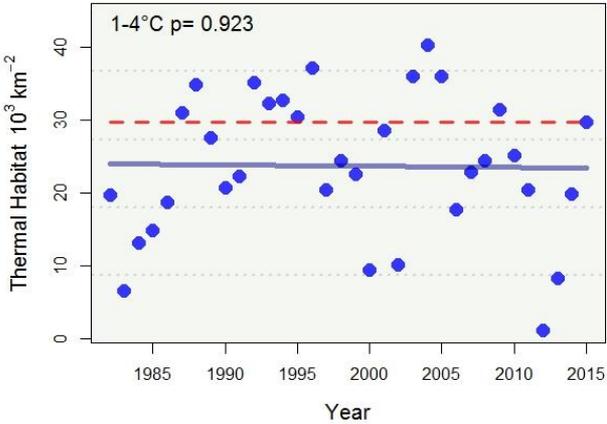
Hadley SST Trend 1900-2011 ($^{\circ}\text{C}/\text{decade}$)



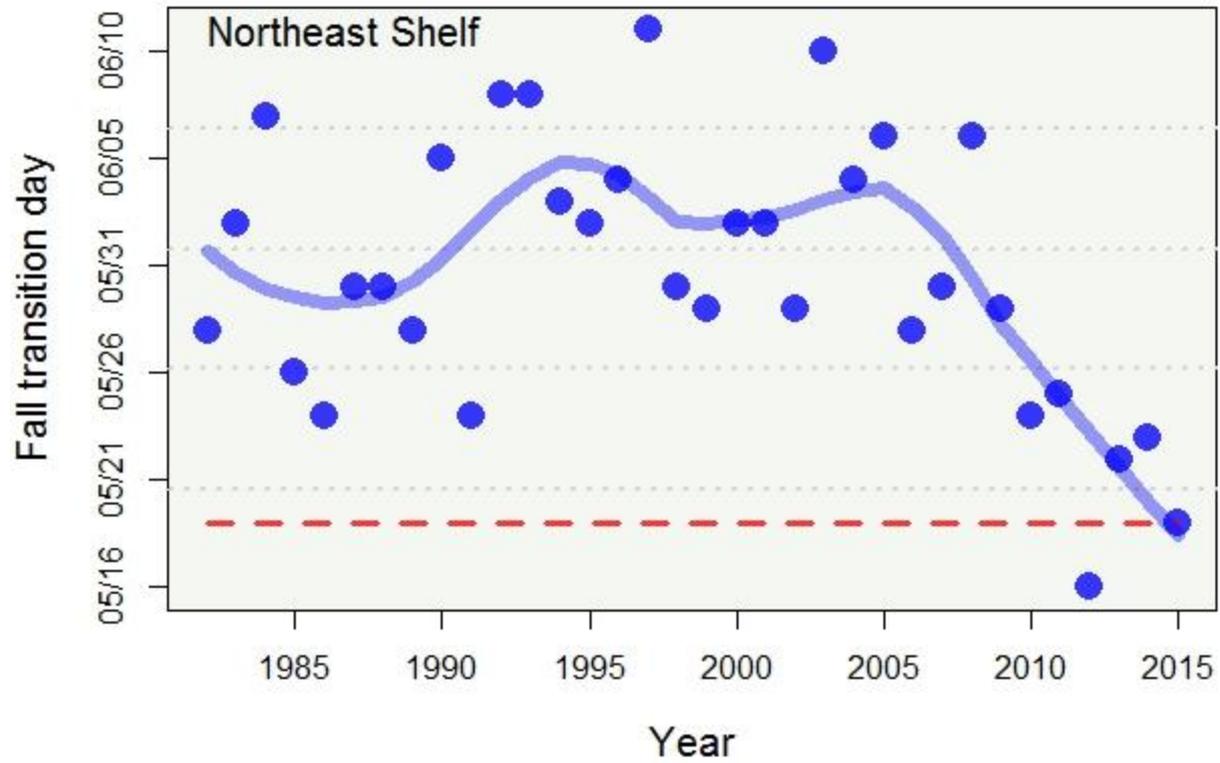
Long-term Sea Surface Temperature, 1854-2015



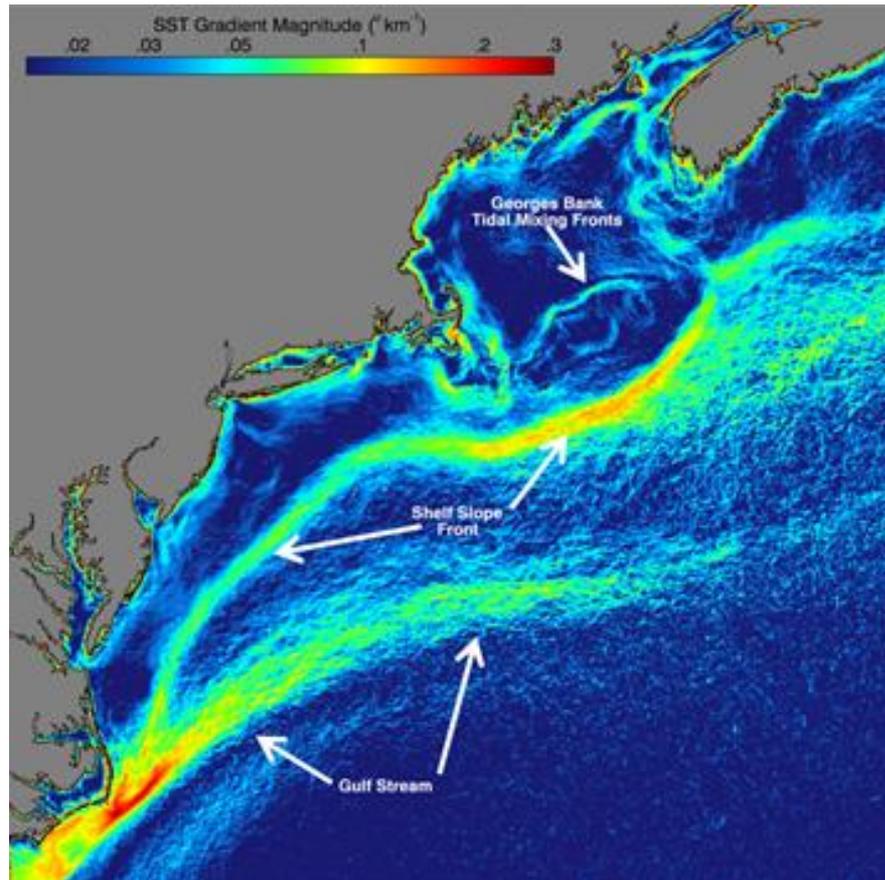
Thermal Habitat



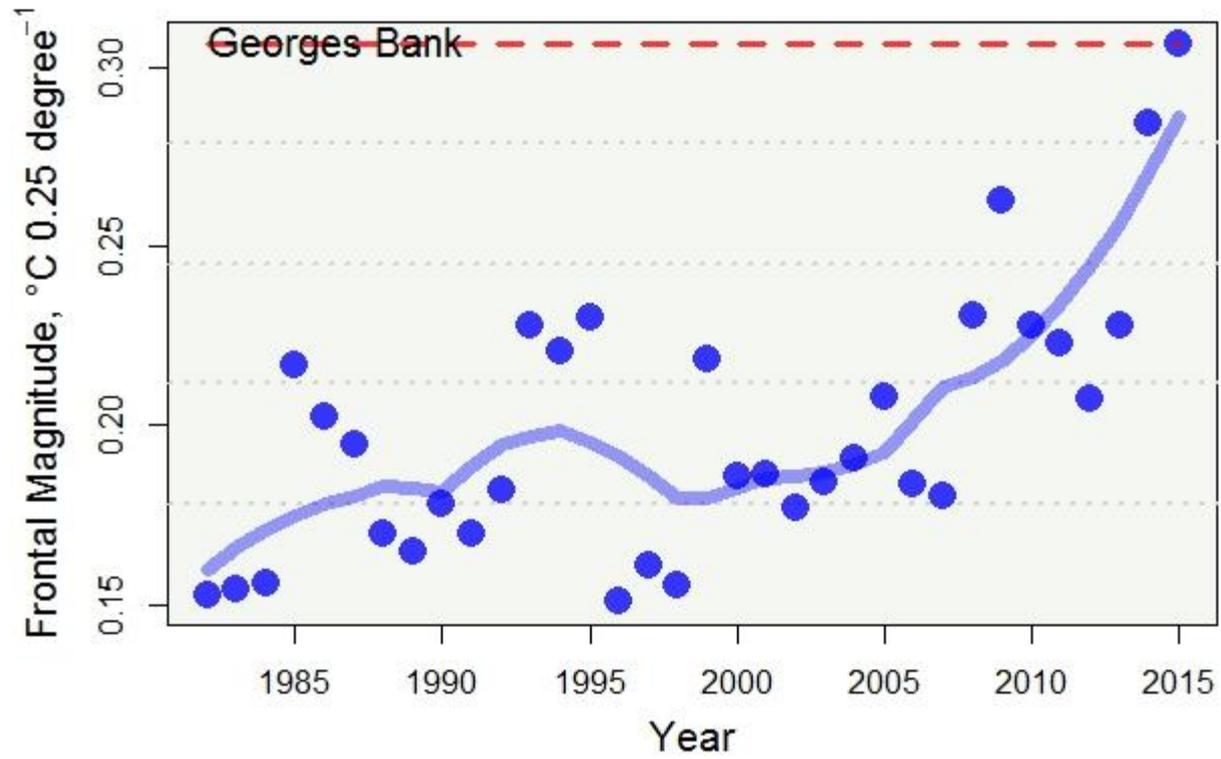
Thermal Phenology



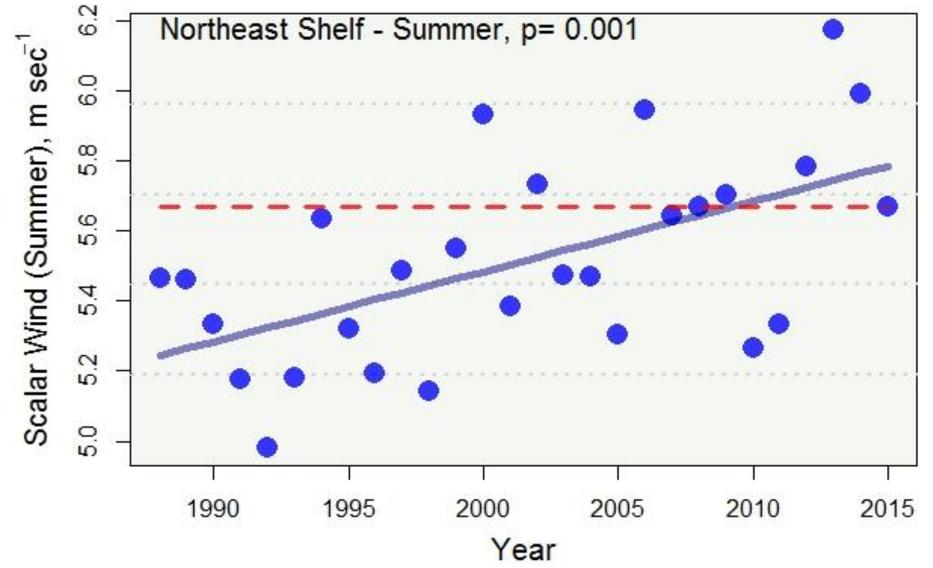
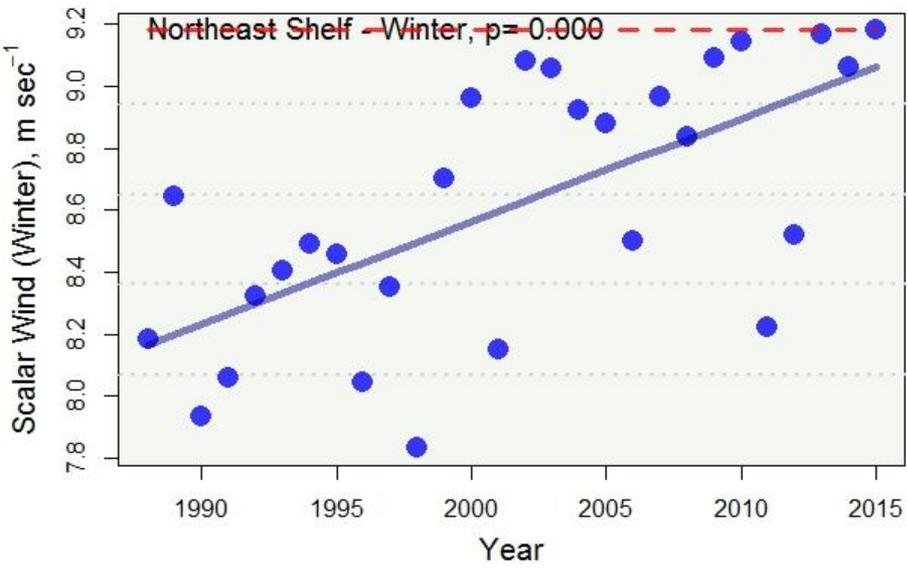
Temperature Fronts

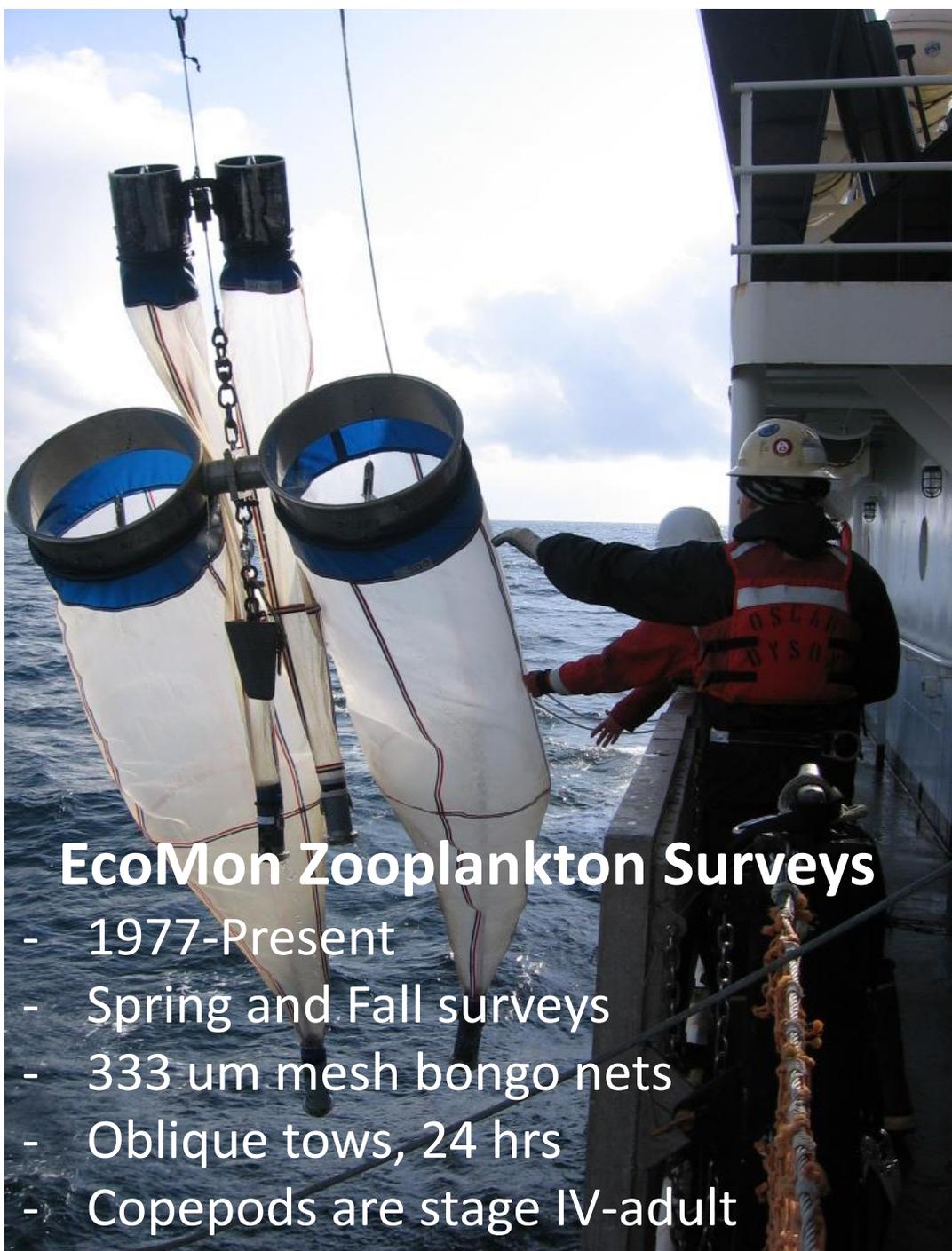


Trend in Frontal Strength



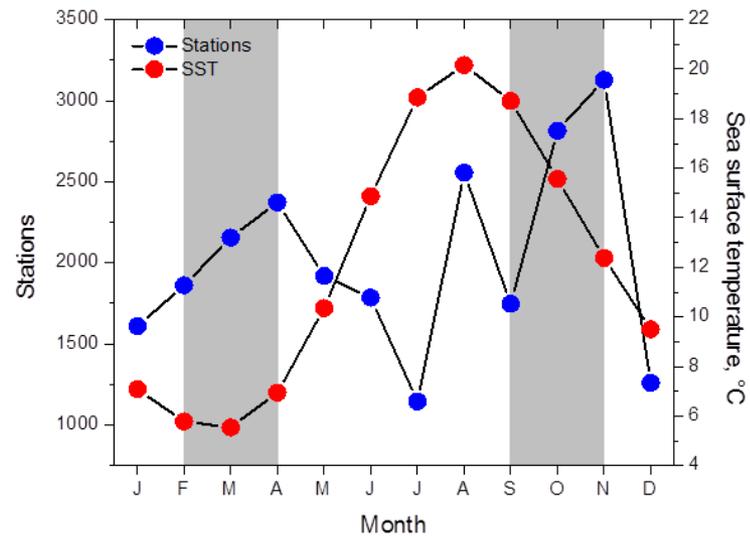
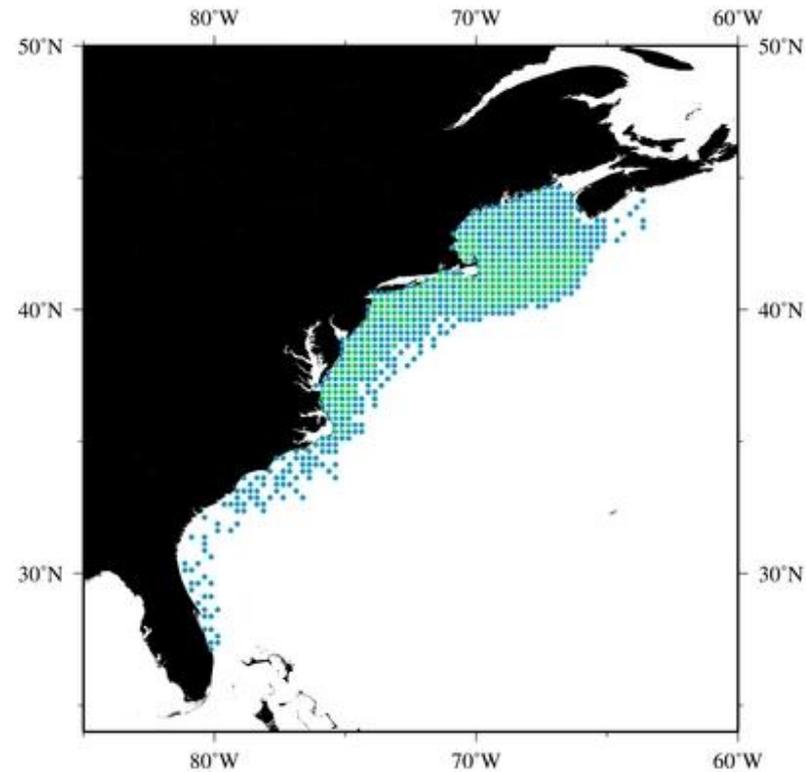
Wind





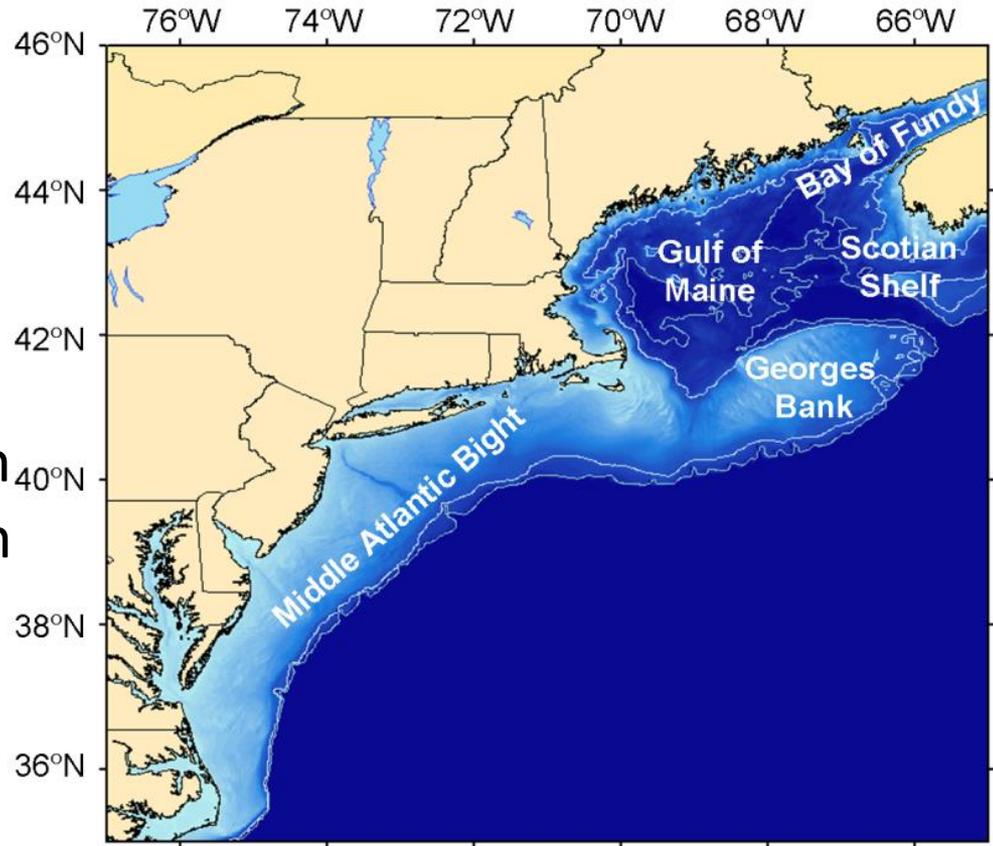
EcoMon Zooplankton Surveys

- 1977-Present
- Spring and Fall surveys
- 333 μm mesh bongo nets
- Oblique tows, 24 hrs
- Copepods are stage IV-adult

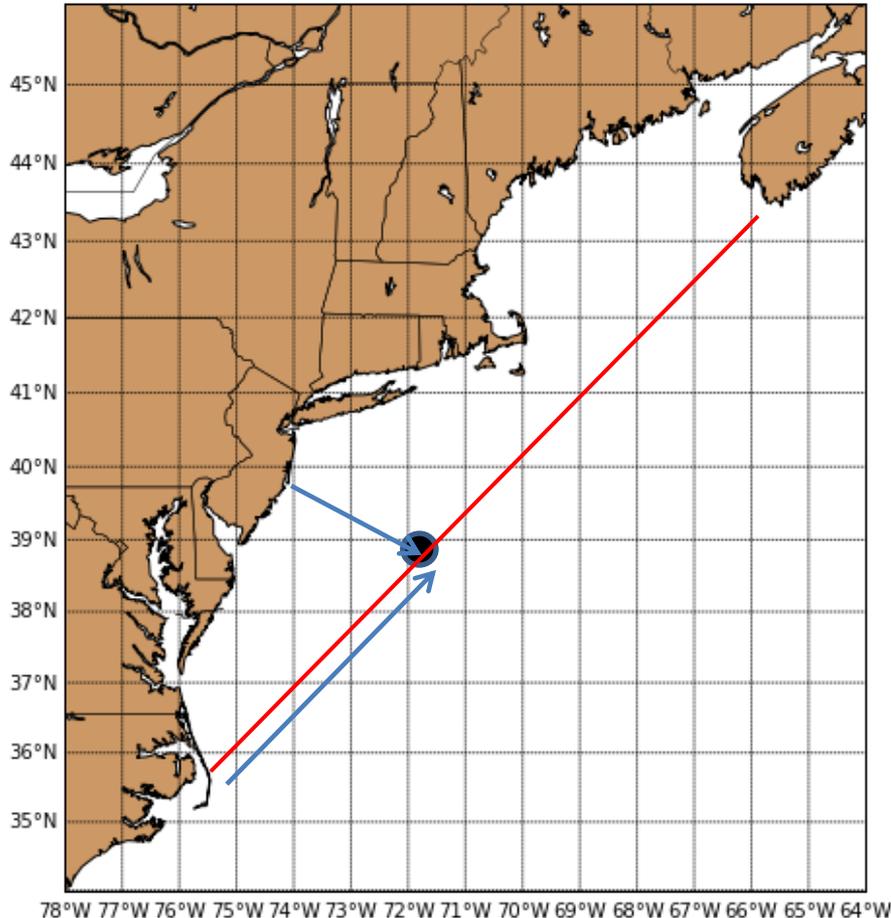


Data Preparation

- Focus on dominant taxa
- Spring: Feb-Apr
- Data were post-stratified by 1° lat/lon bins
- Bins sampled < 30 years and years with < 35 % EPU coverage were excluded from analysis; tows with zero catch included in analysis



Temporal trends in the distribution of animals: 3 methods



1. Center of Biomass

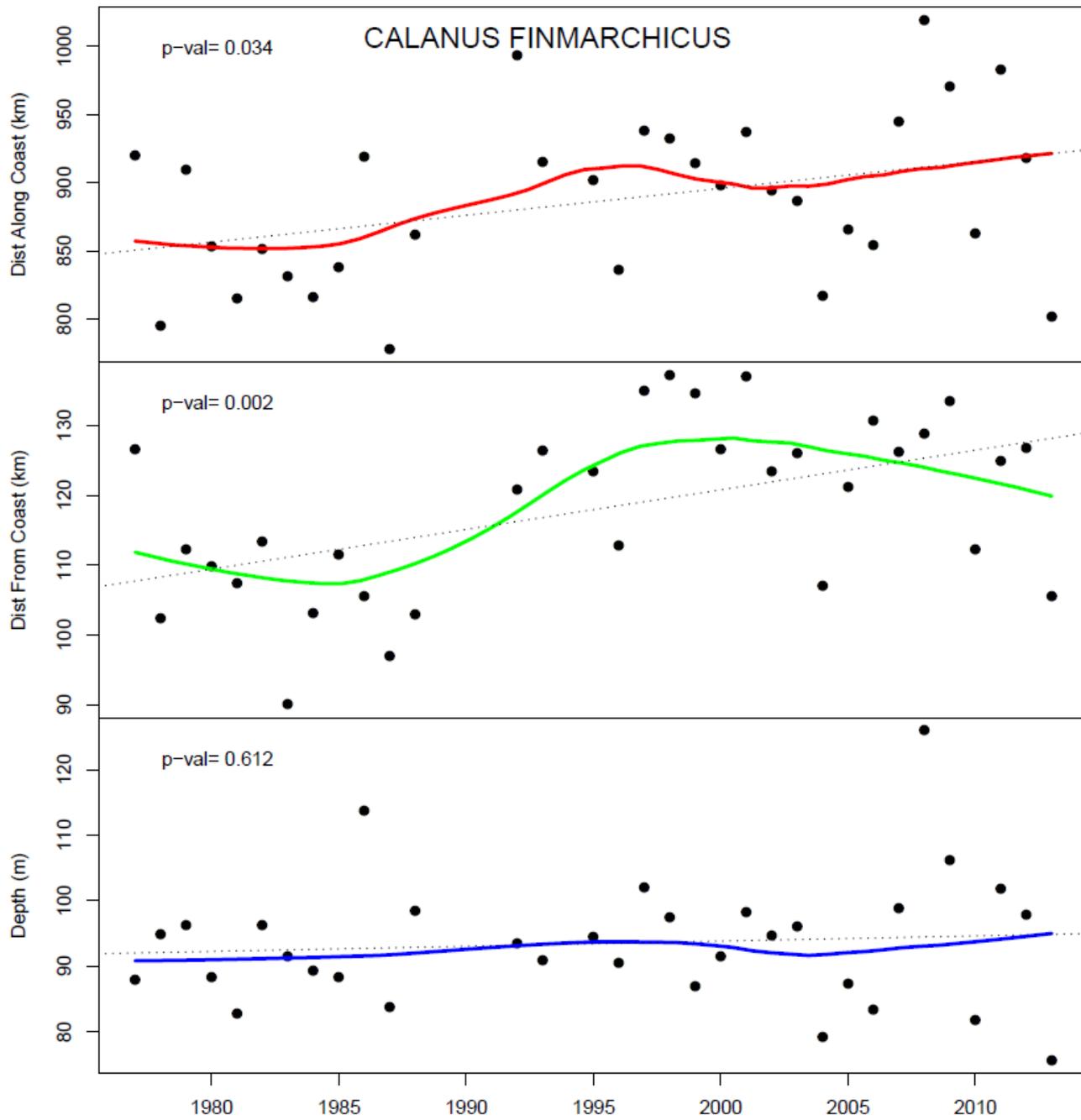
- Distance Along Coast
- Distance From Coast
- Depth at COB

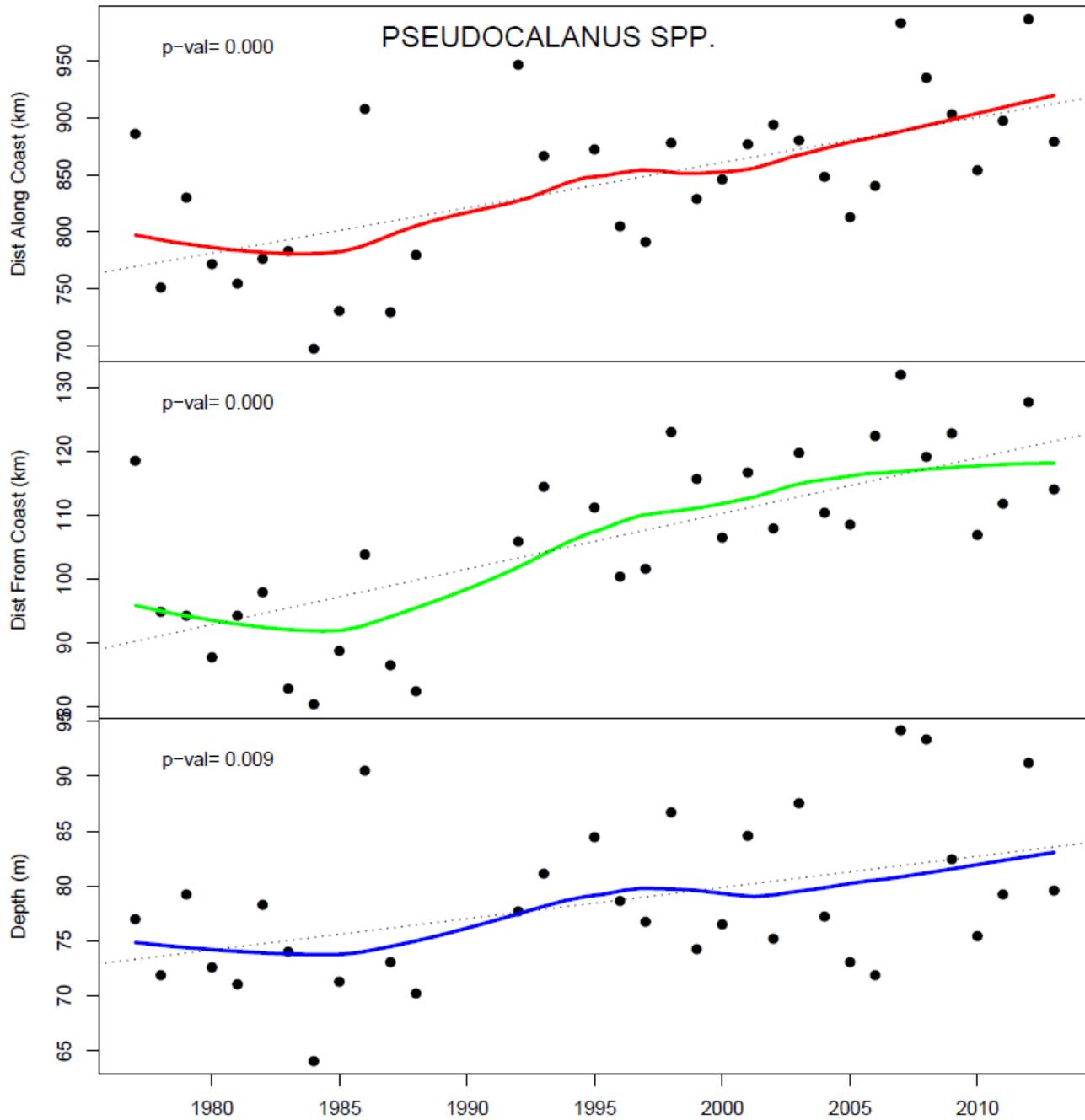
2. Kernel Density Estimate (KDE)

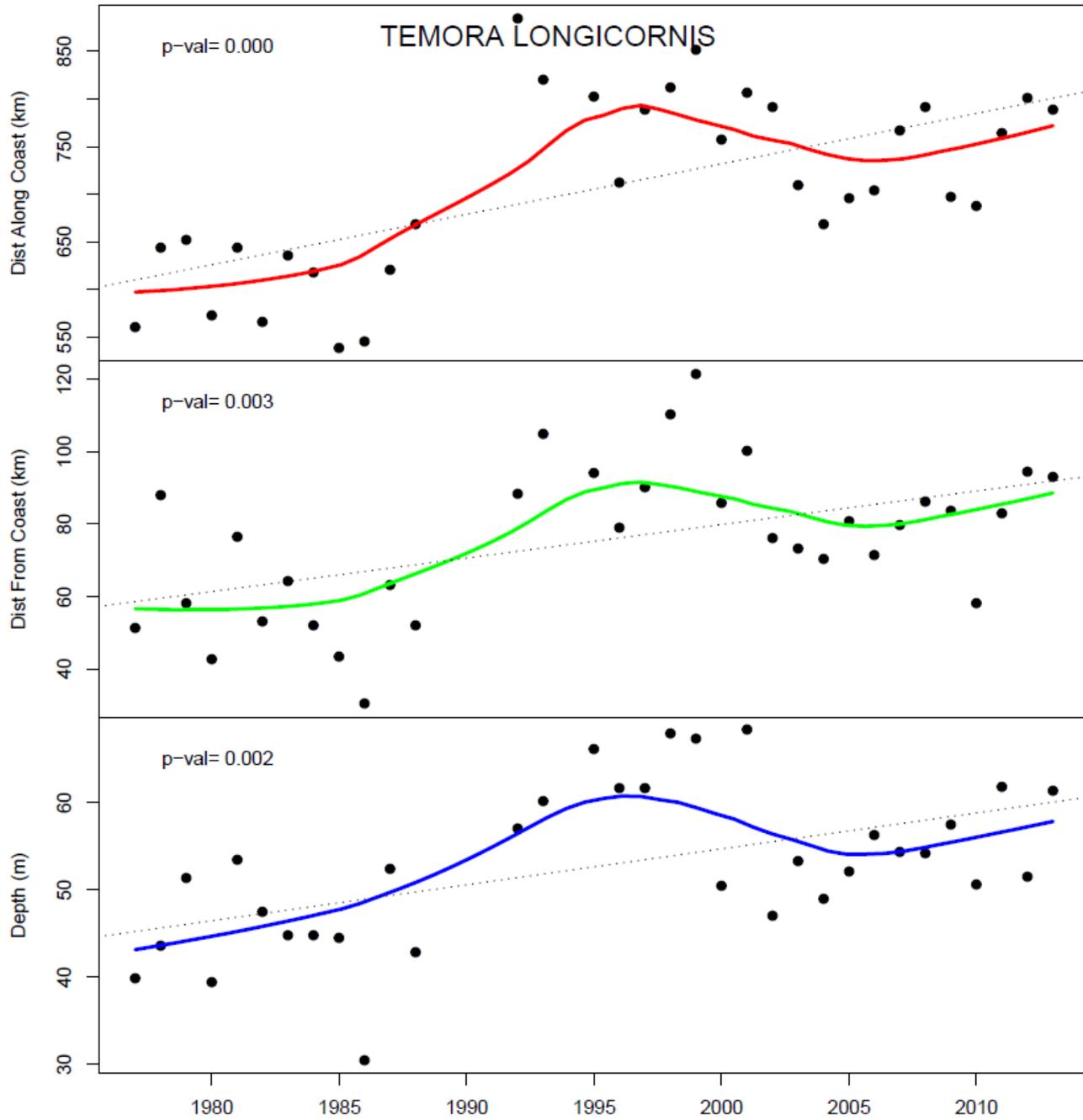
- Gridded Probability Density Function

3. Pixel-wise Trend Analysis

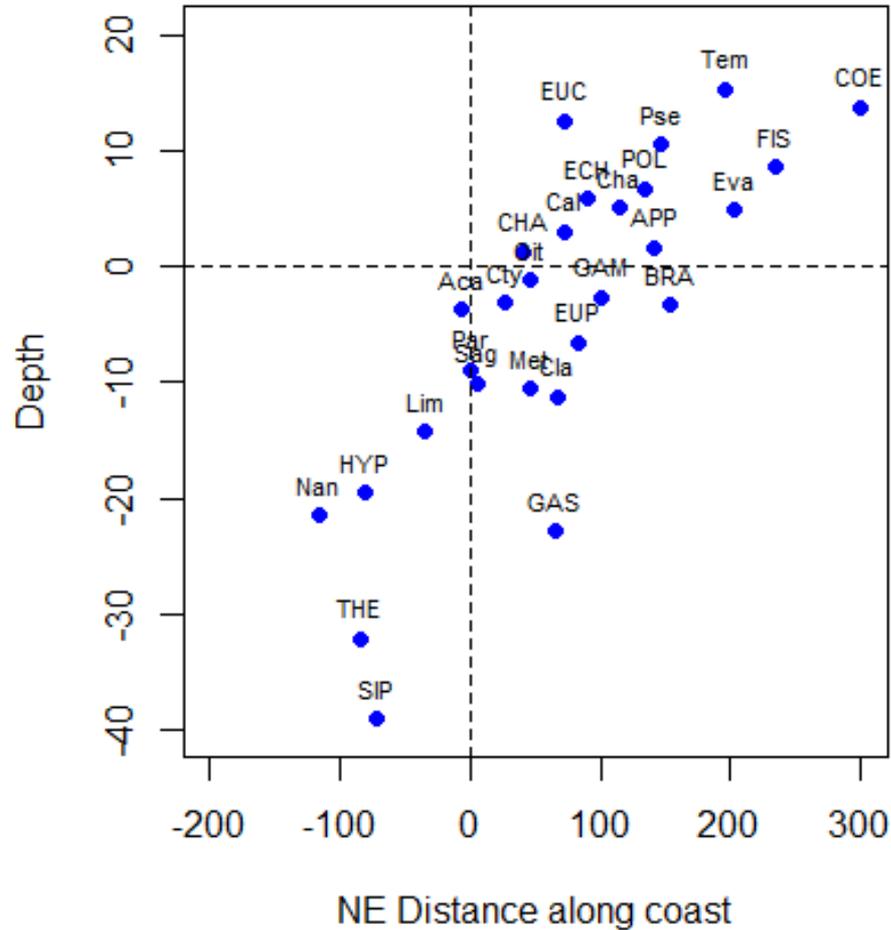
- Compute per-pixel trend based on KDE

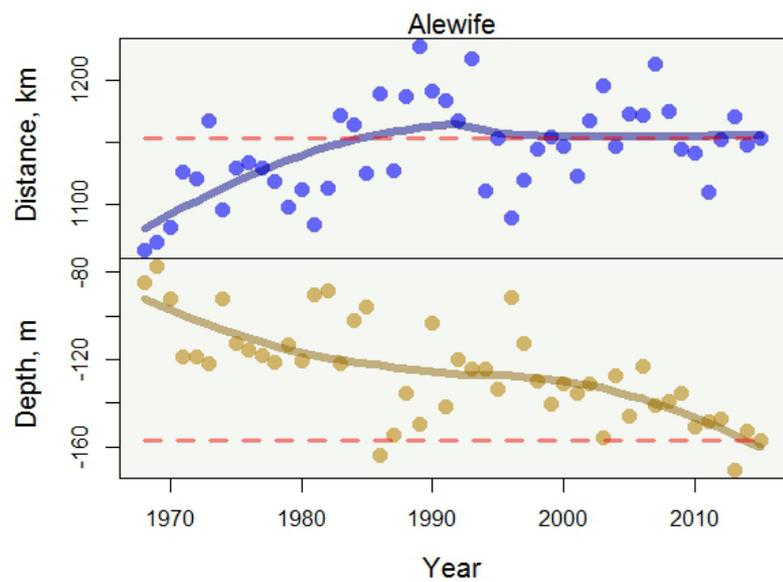
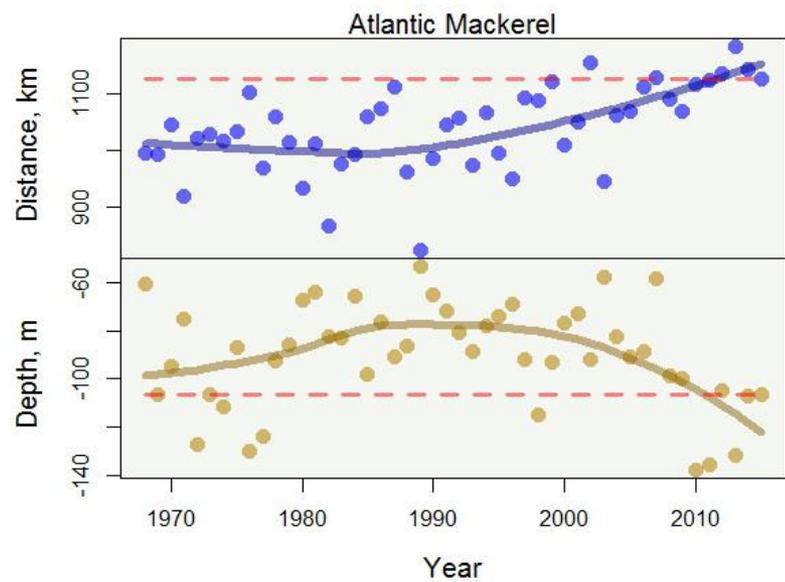
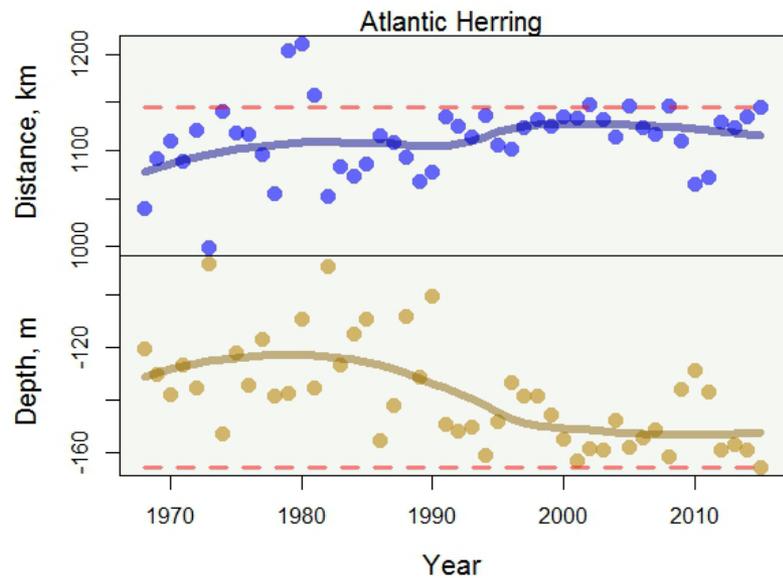
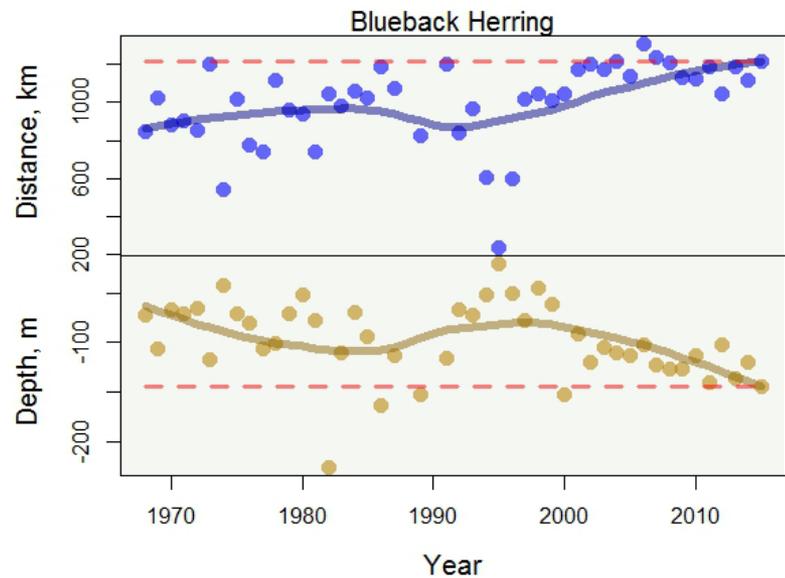


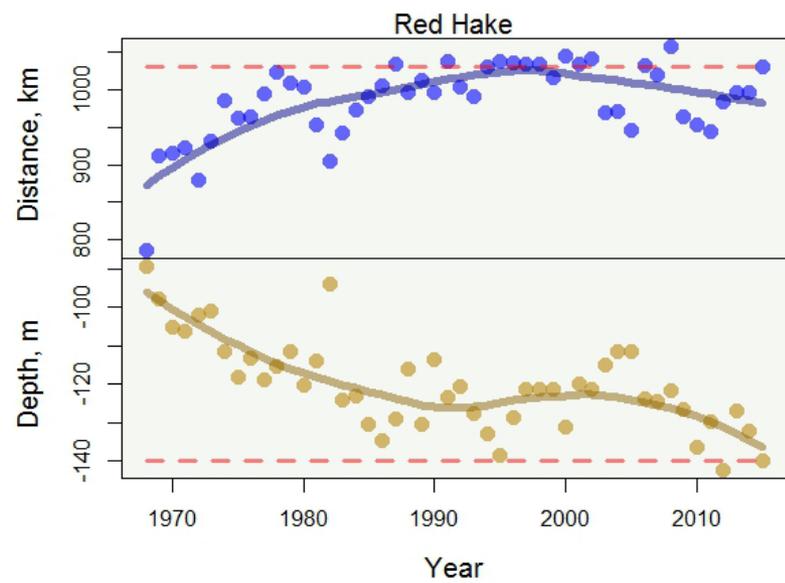
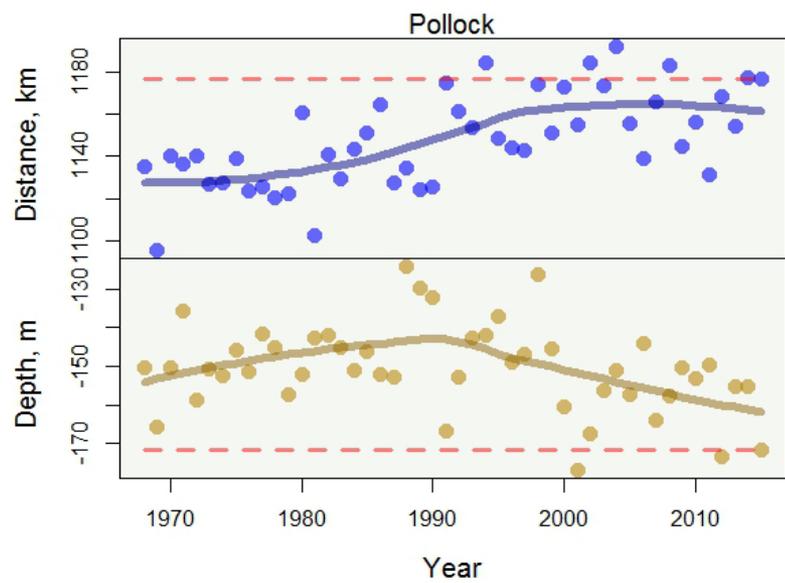
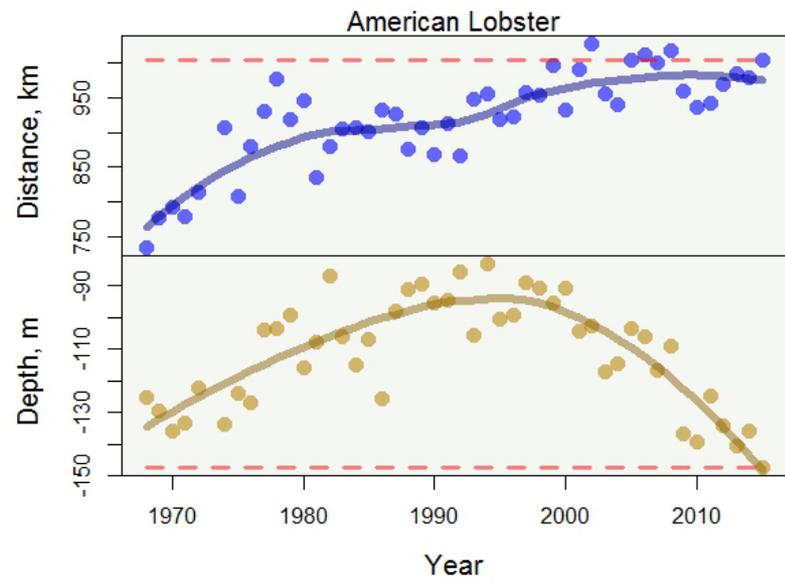
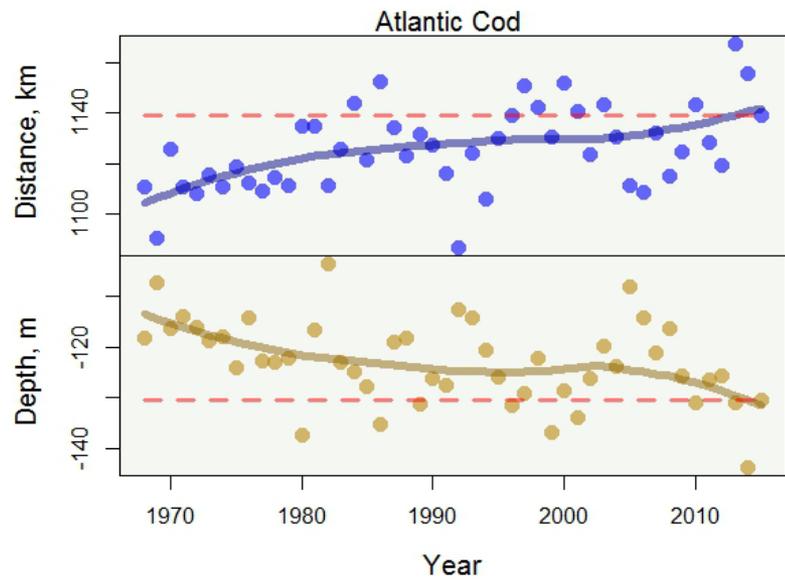




37-Year Change in the Distribution of the Centers of Biomass for 28 Zooplankton Taxa

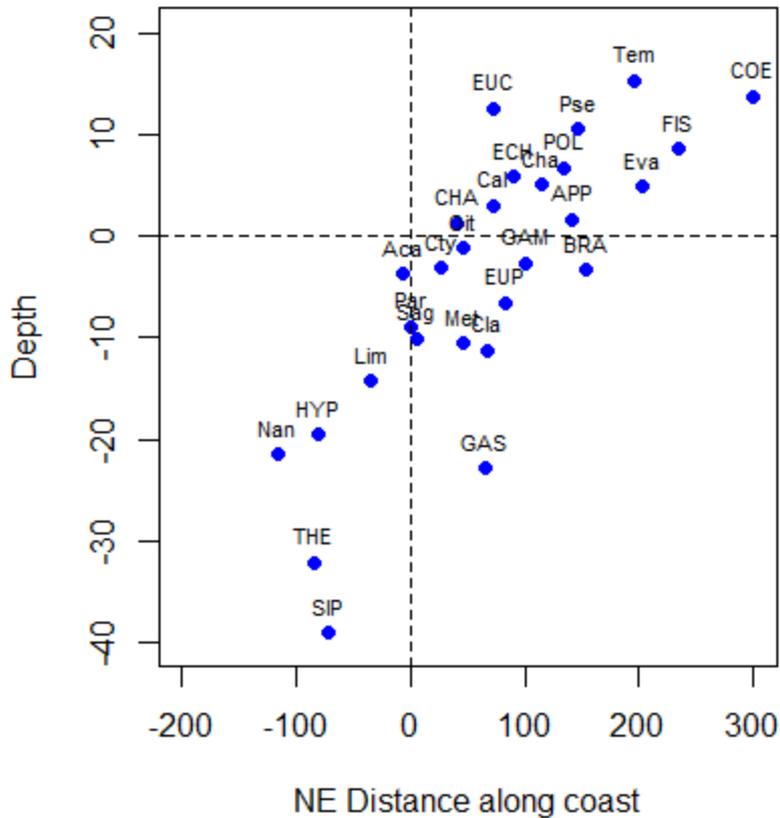




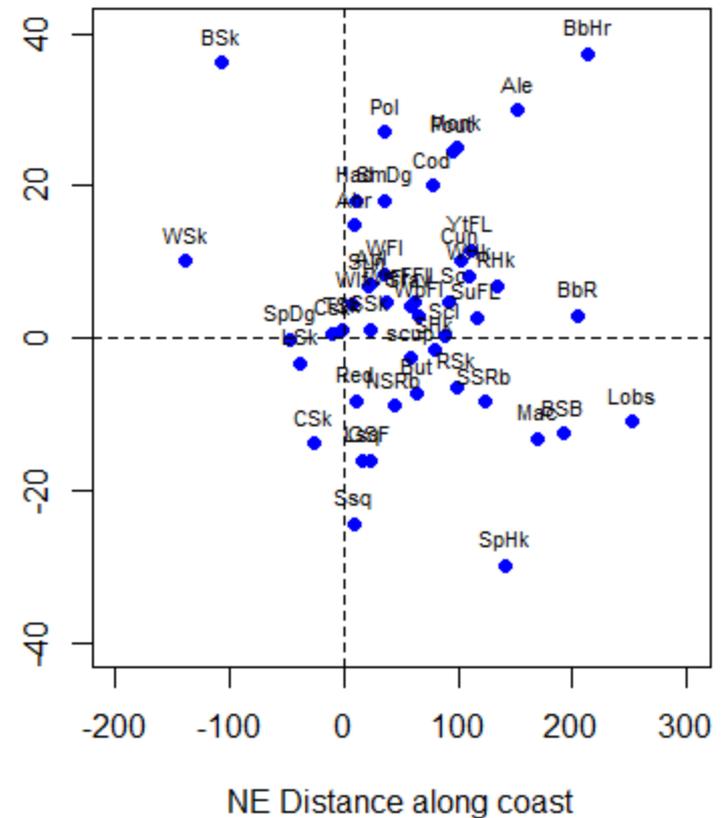


37-Year Change in the Distribution of the Centers of Biomass

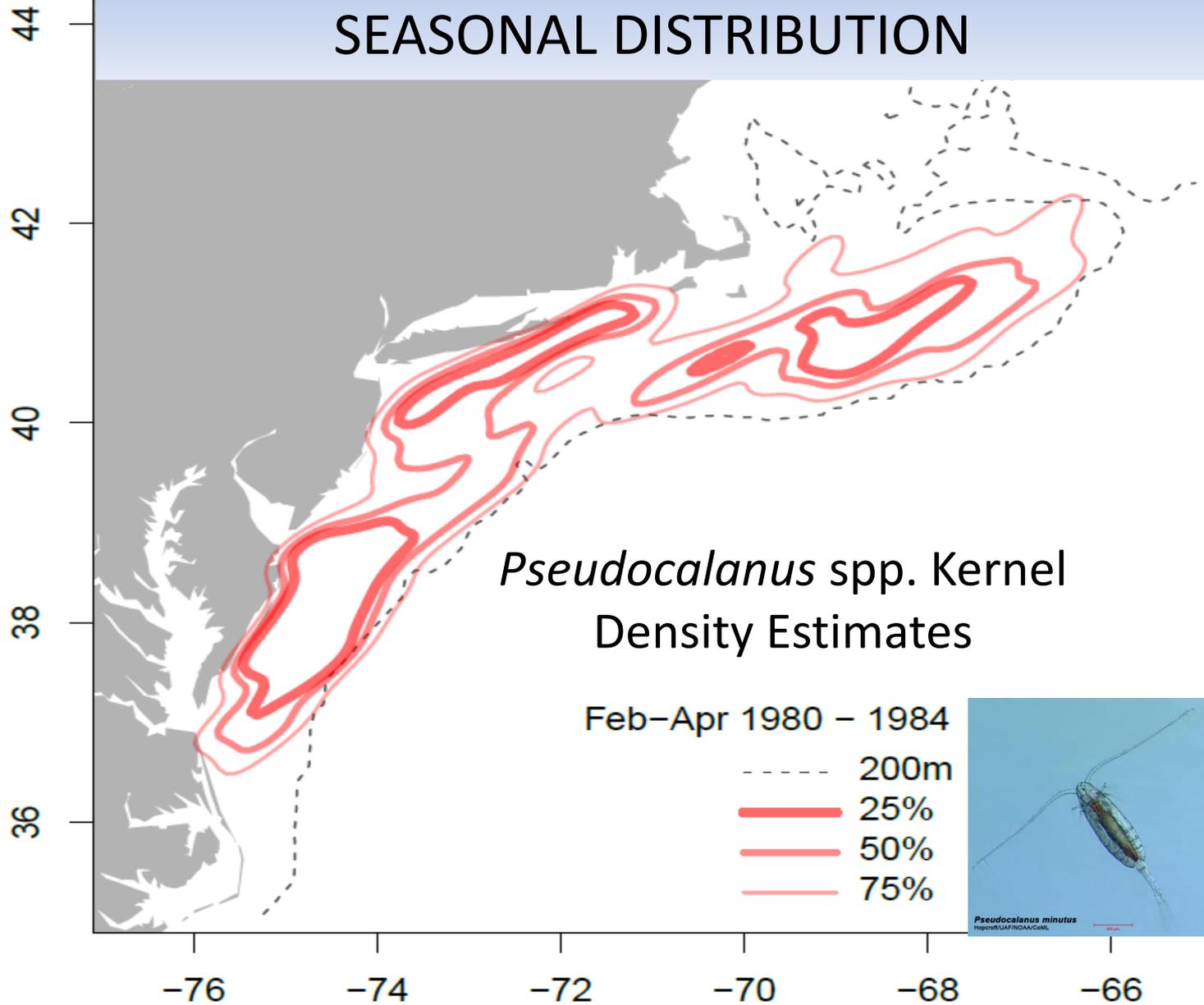
EcoMon Survey
28 Zooplankton Taxa

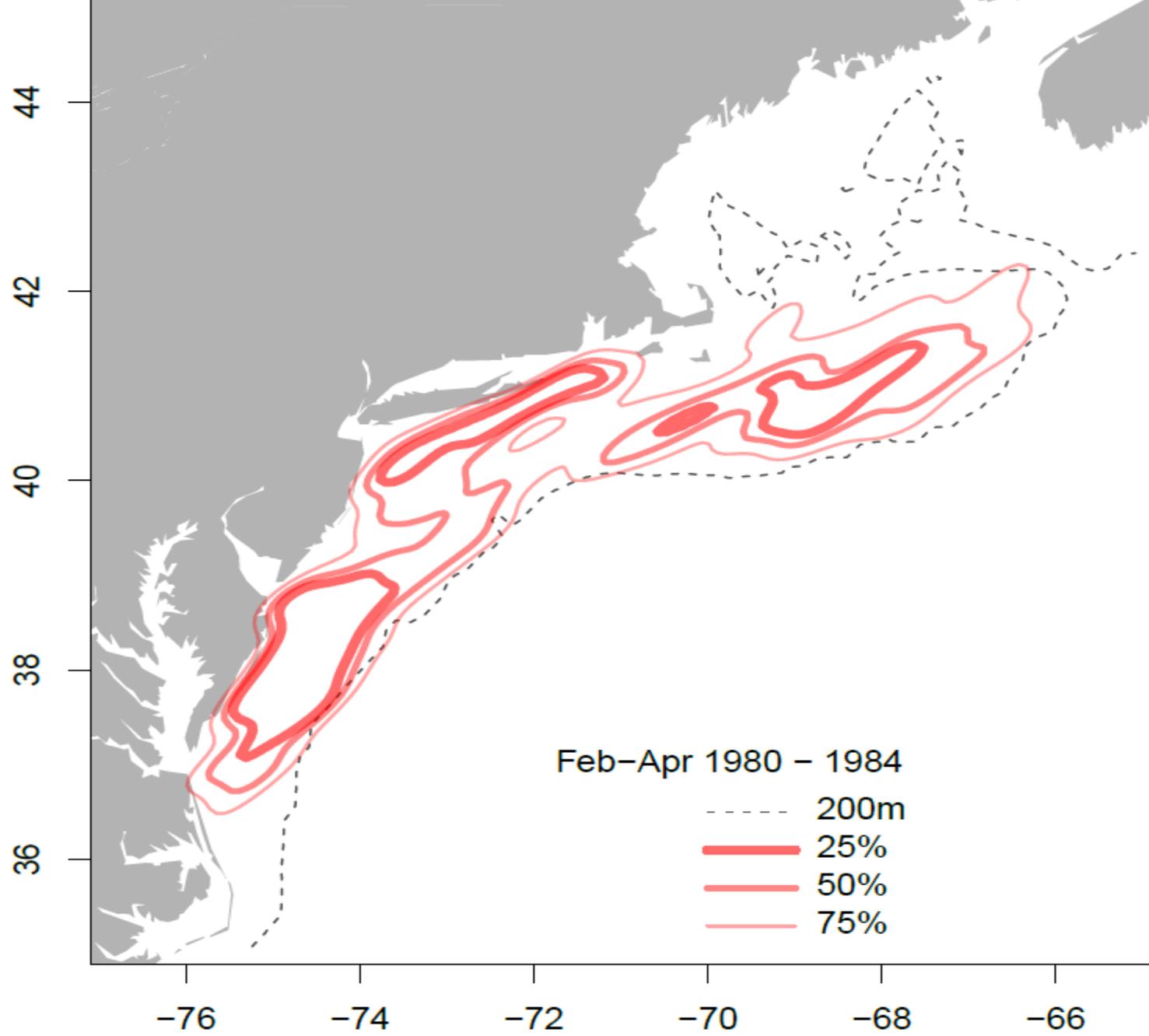


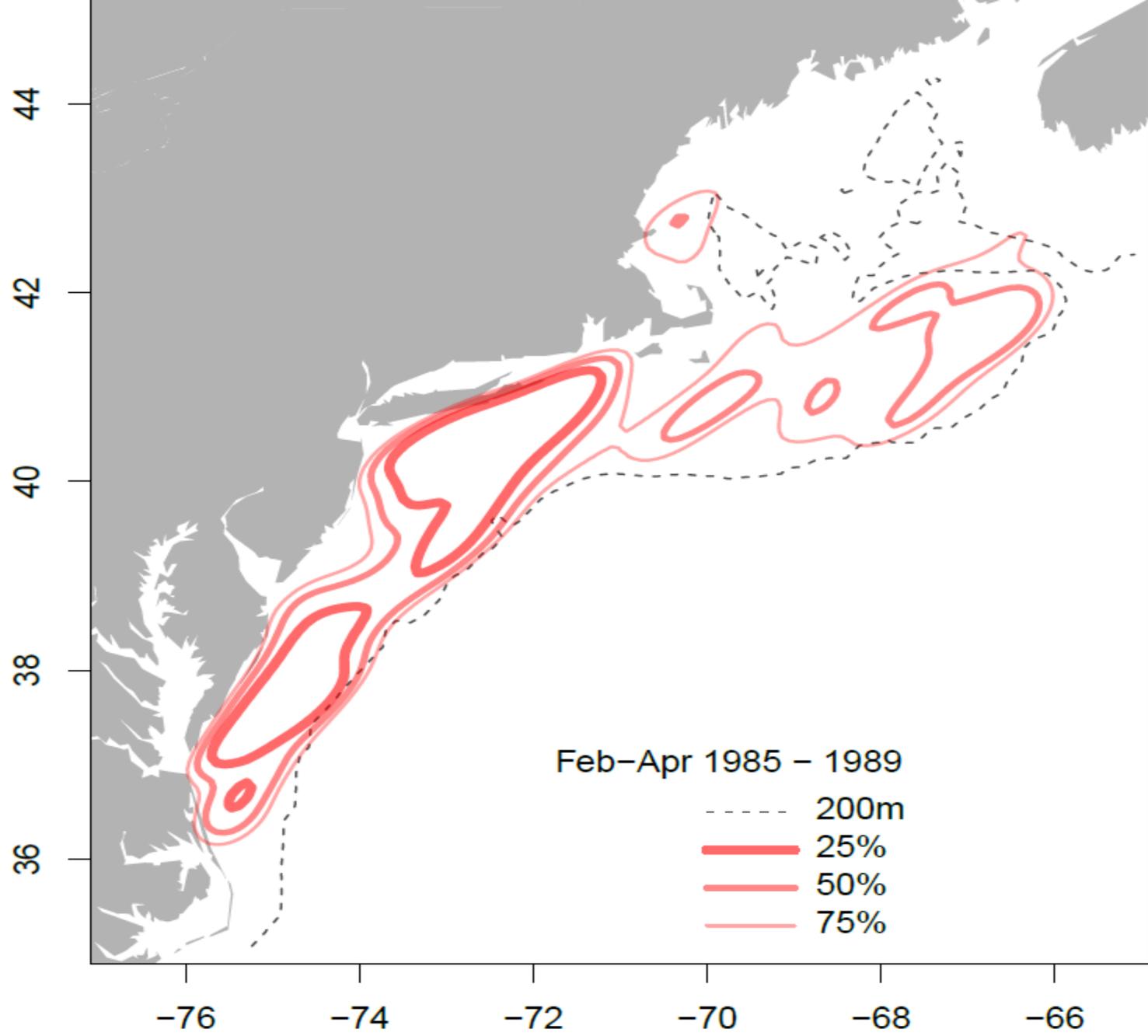
Trawl Survey
47 Fish Taxa

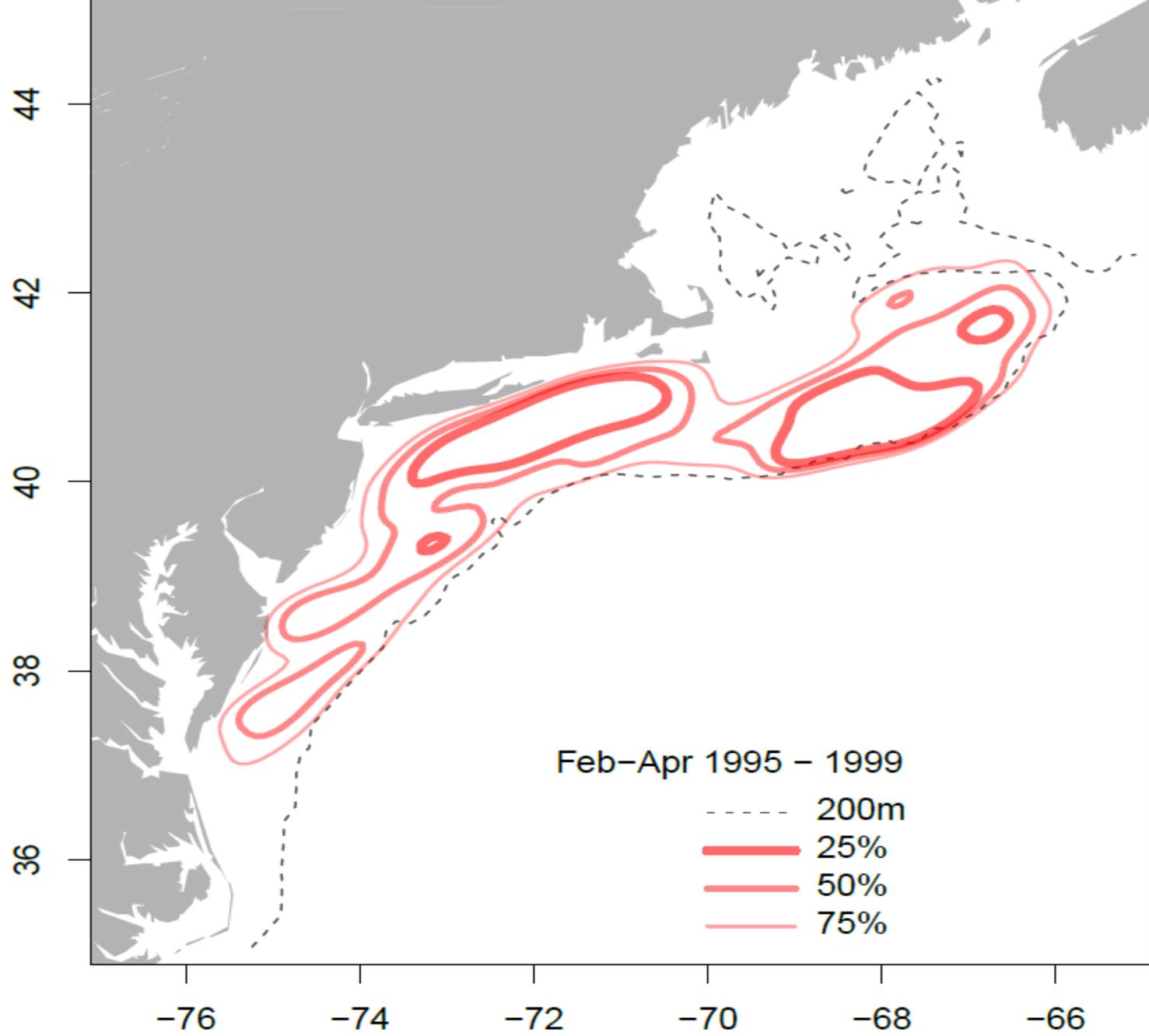


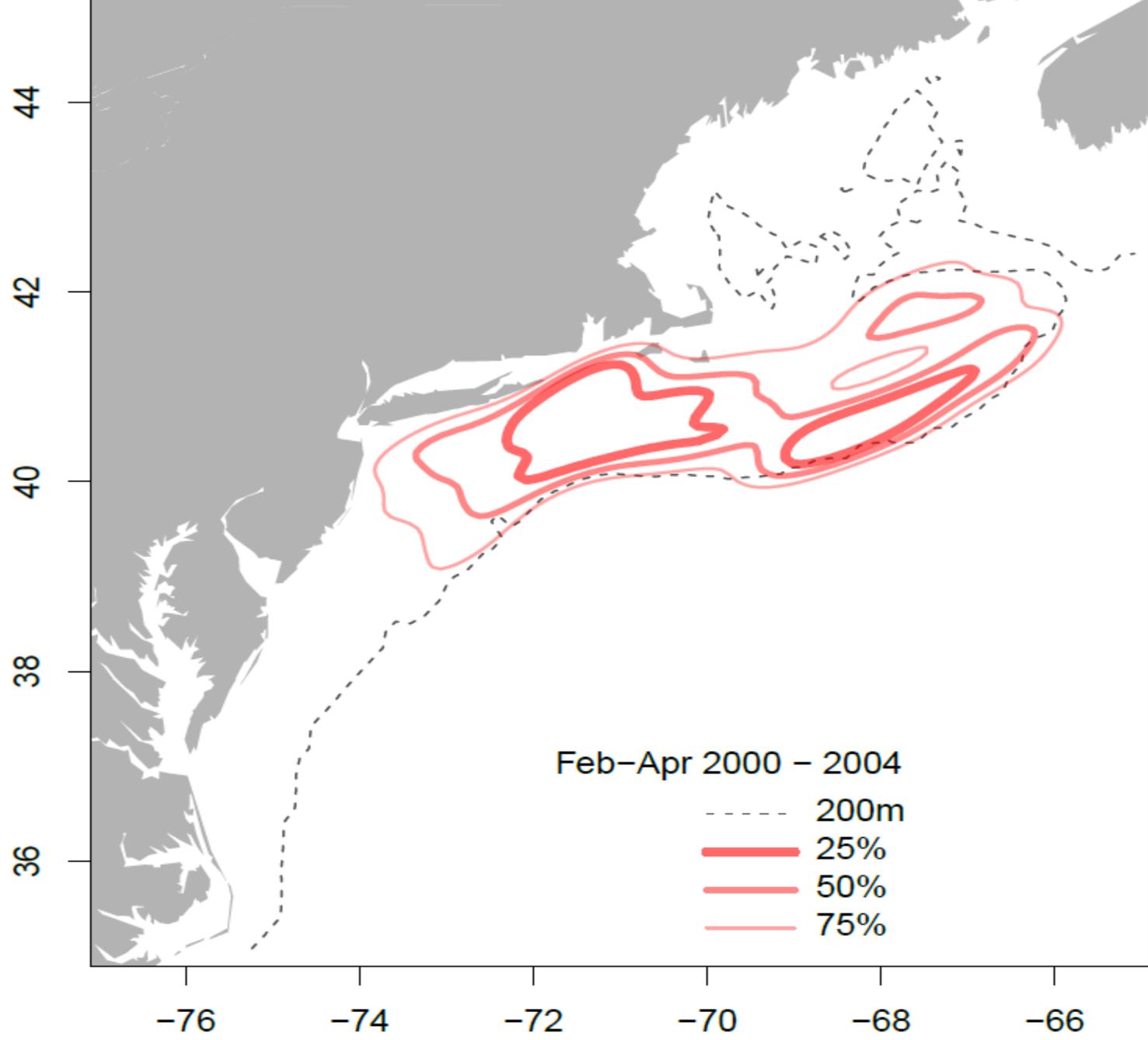
VISUALIZING CHANGES IN ZOOPLANKTON SEASONAL DISTRIBUTION

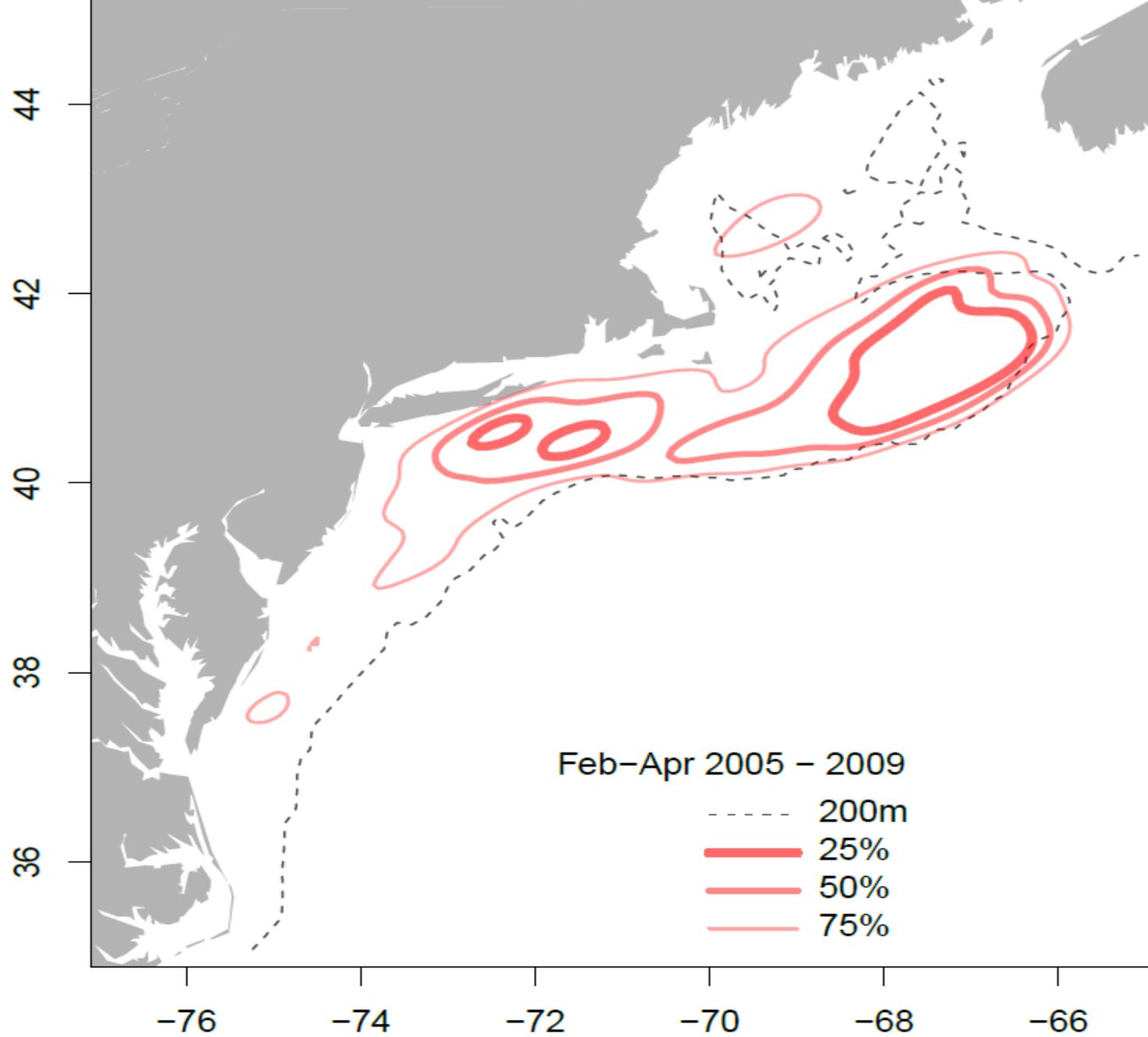


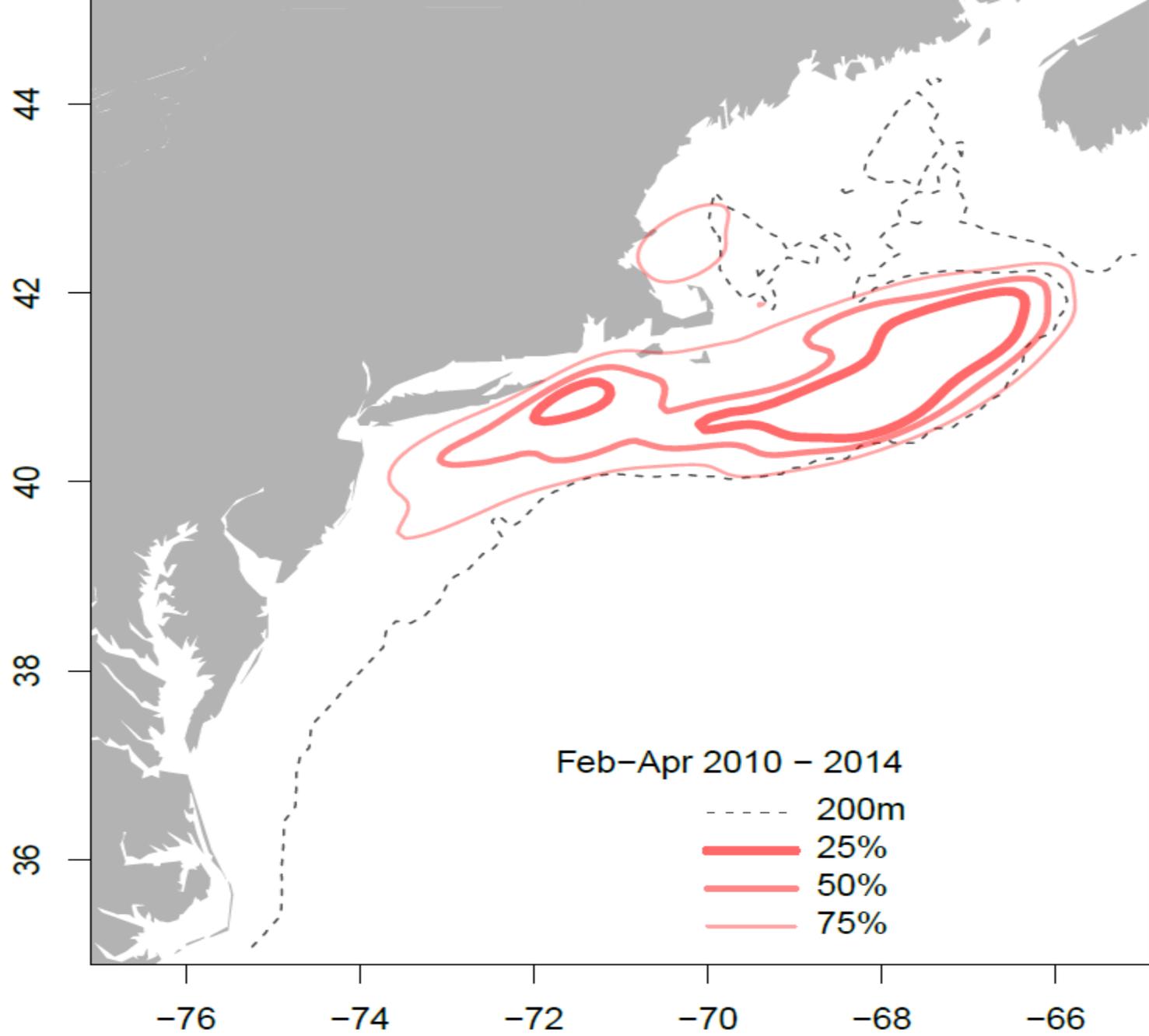






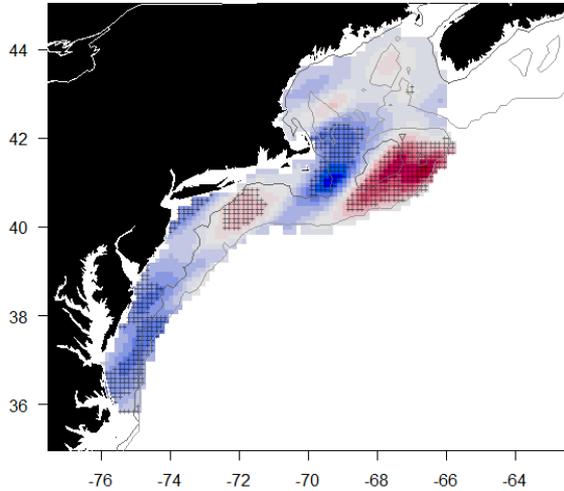




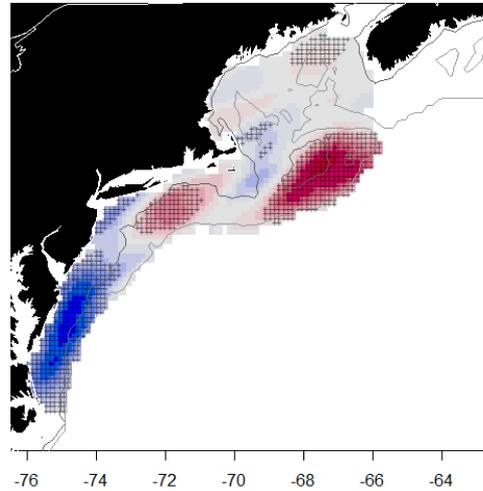


Trend in Spring Distribution 1977-2015

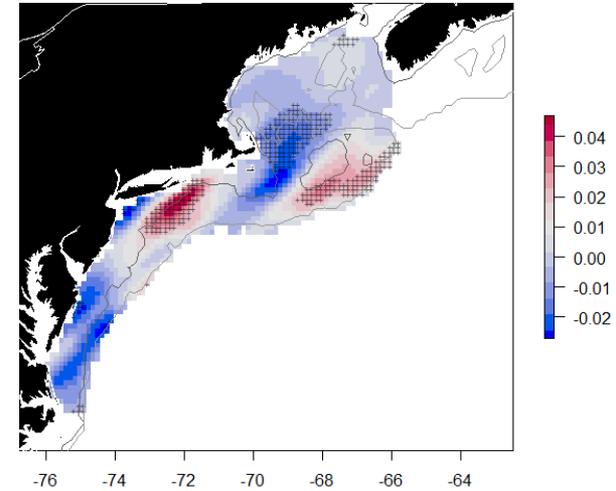
Calanus finmarchicus



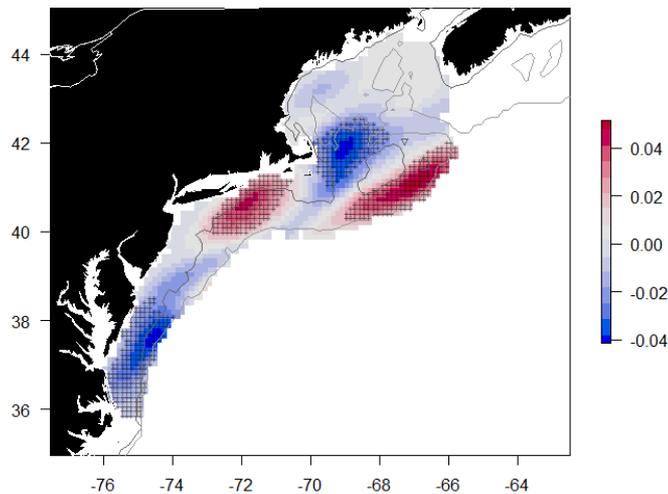
Pseudocalanus spp.



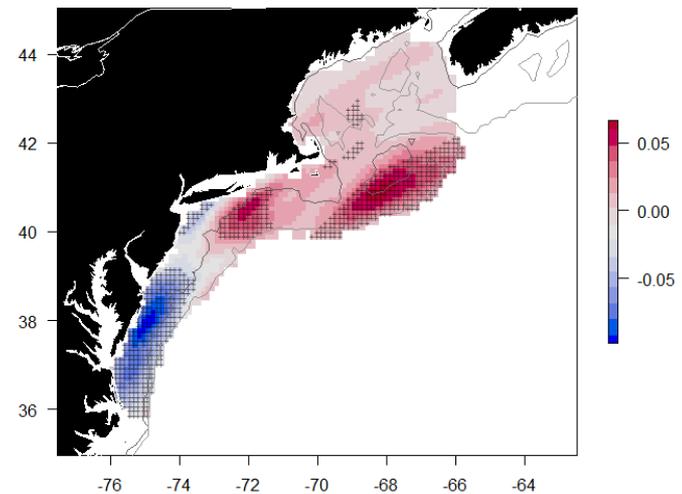
Centropages typicus



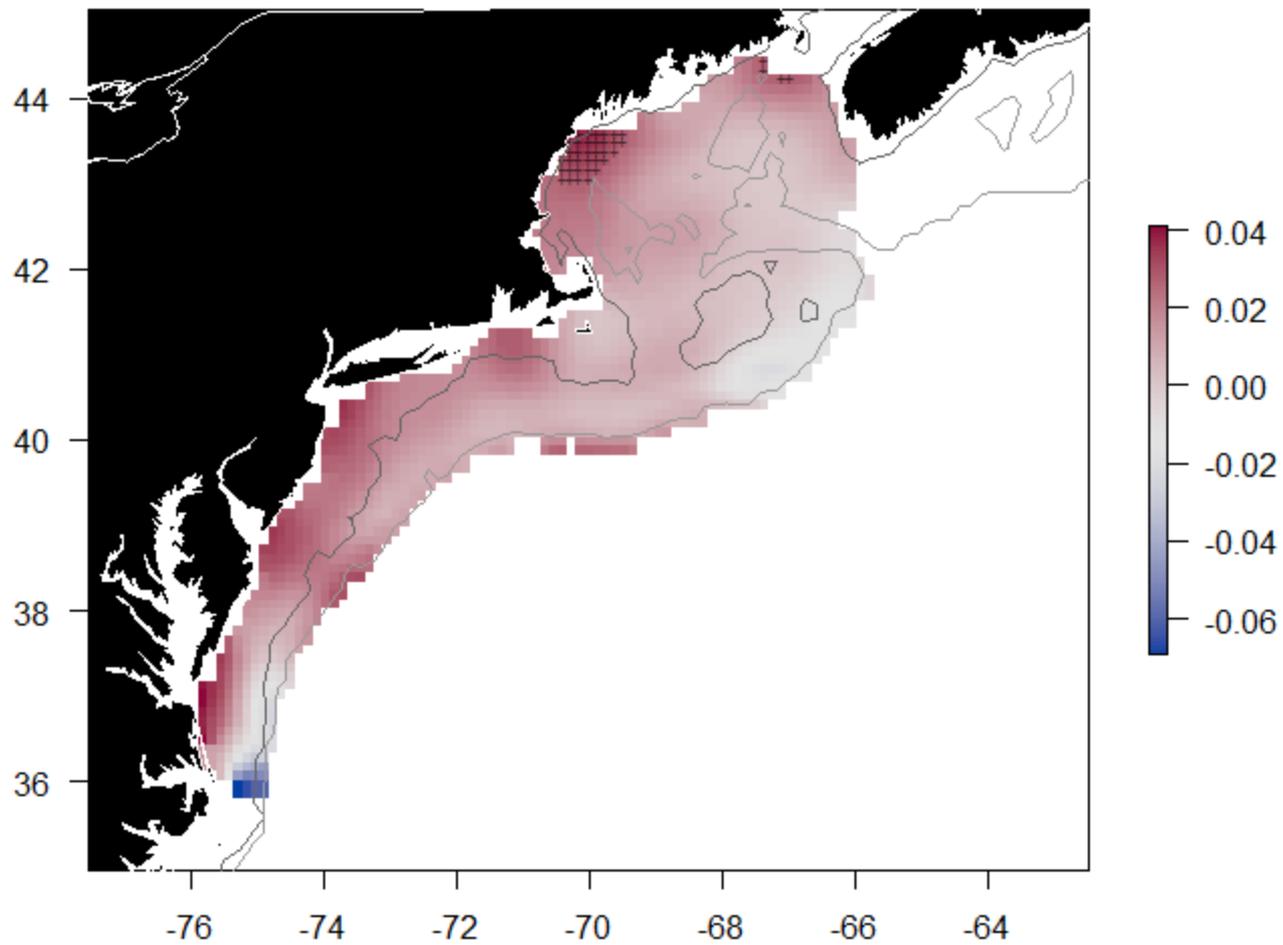
Metridia lucens



Temora longicornis

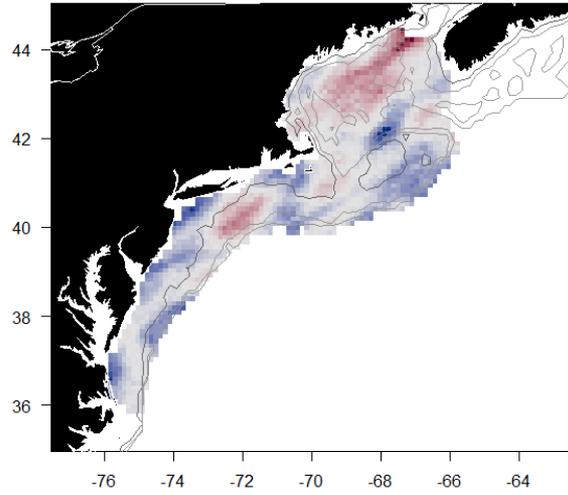


SST Spring Trend

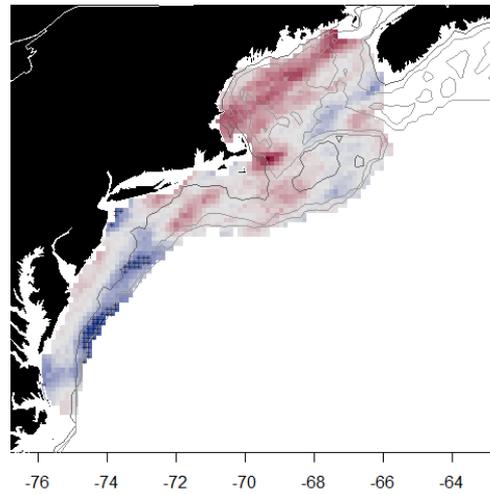


SST

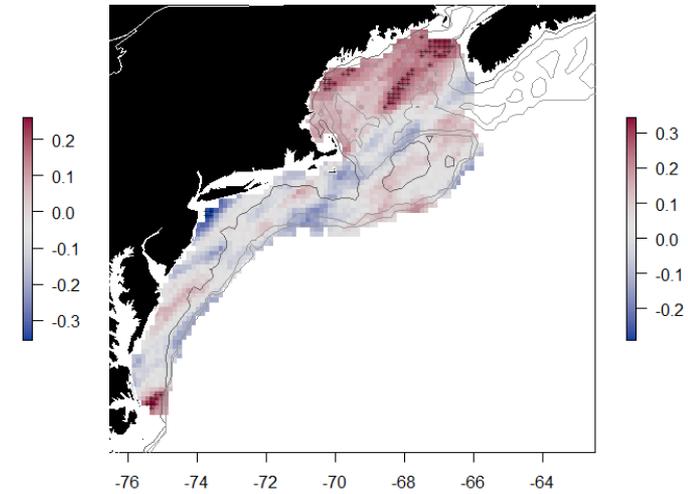
Calanus finmarchicus



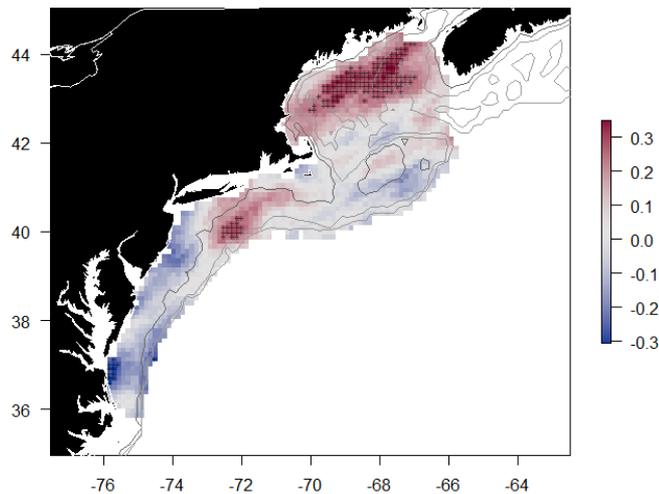
Pseudocalanus spp.



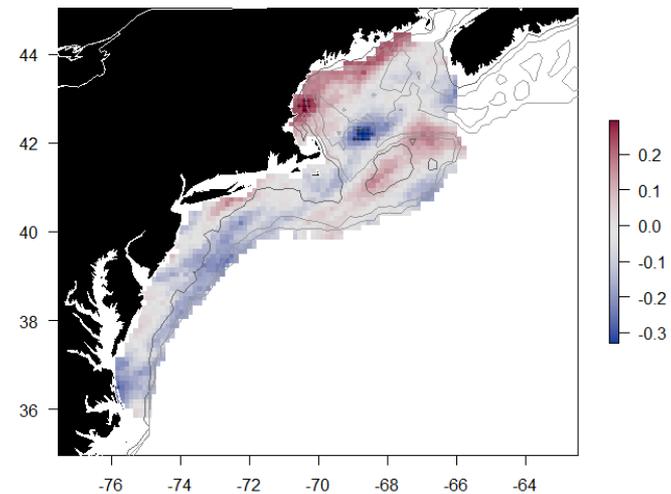
Centropages typicus



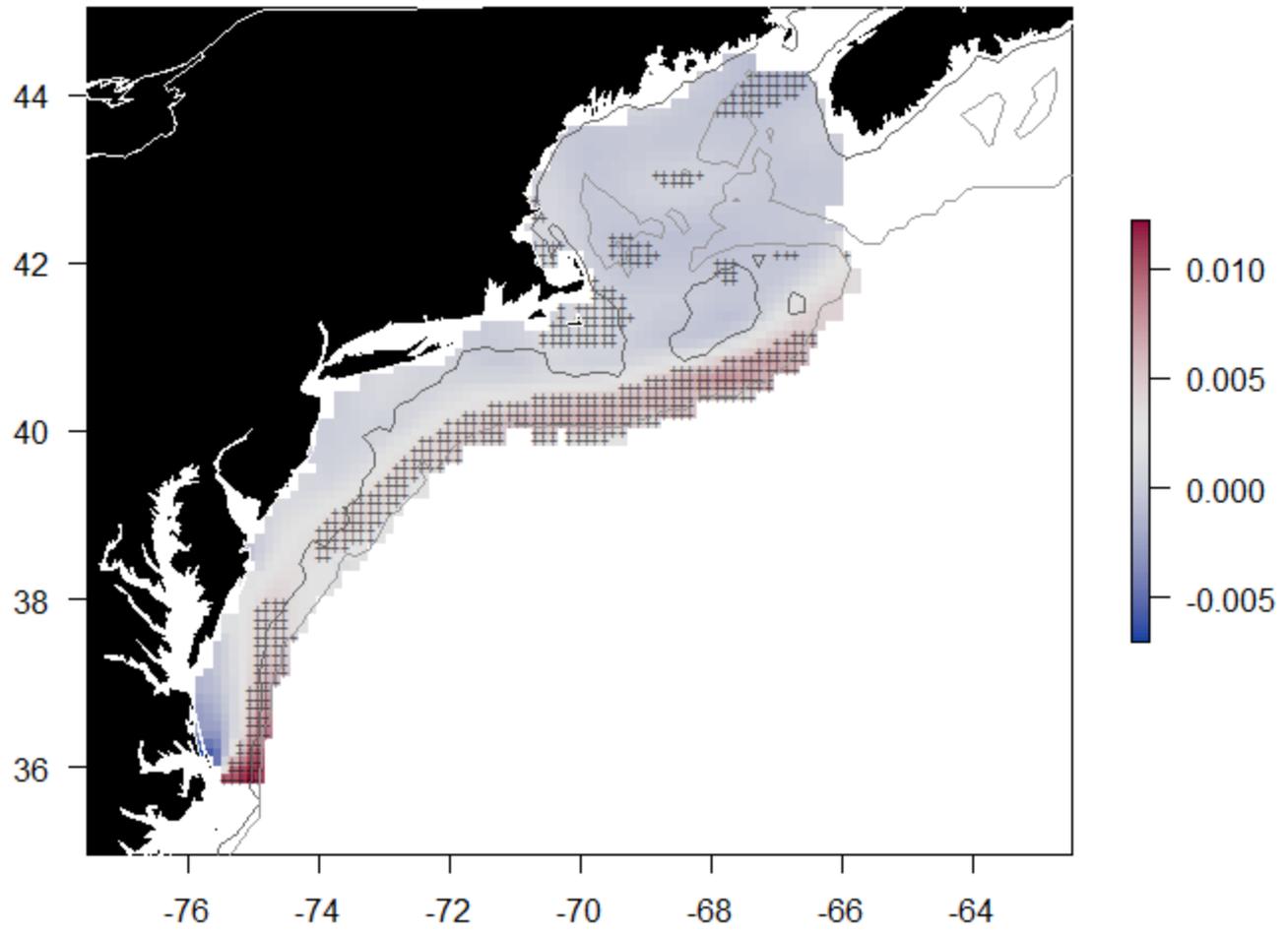
Metridia lucens



Temora longicornis

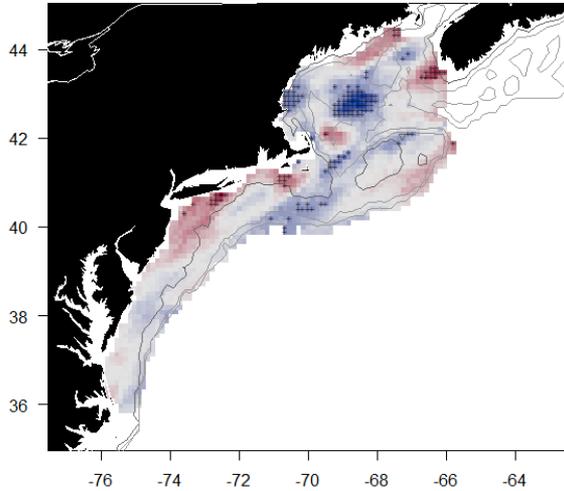


Fronts Spring Trend

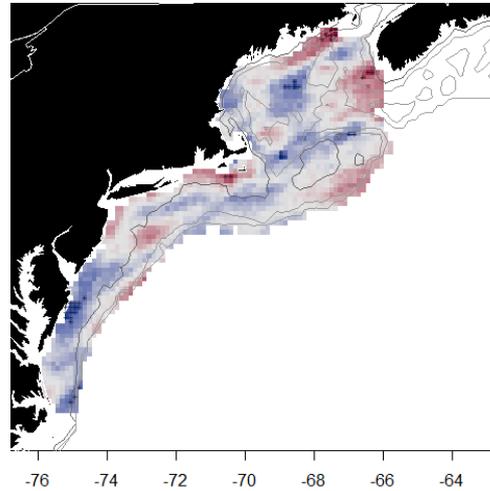


Fronts

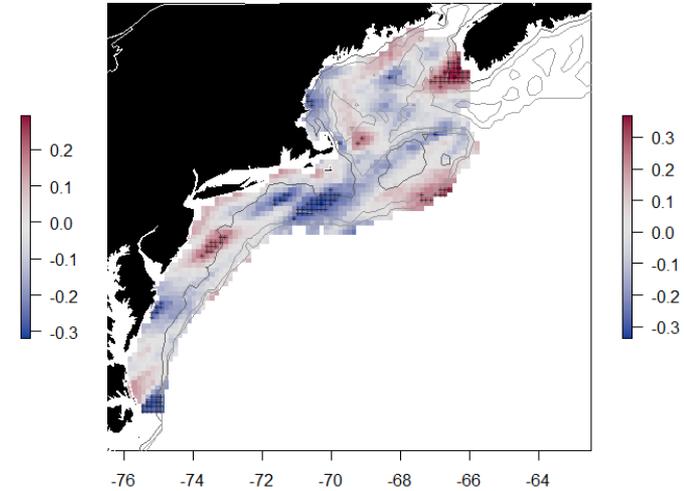
Calanus finmarchicus



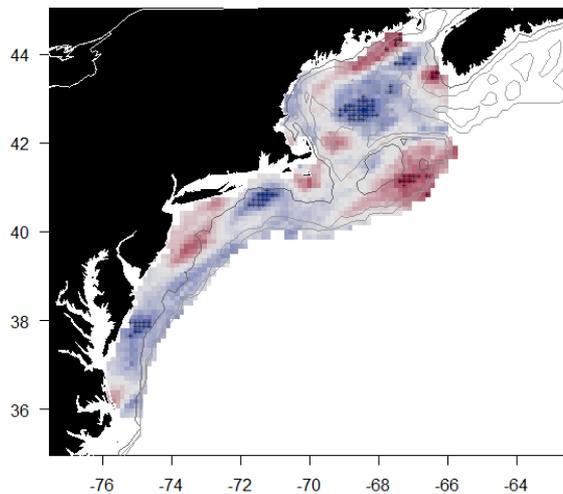
Pseudocalanus spp.



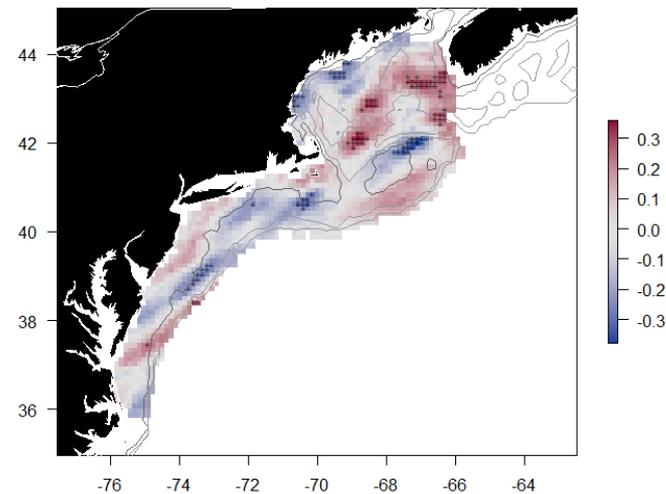
Centropages typicus



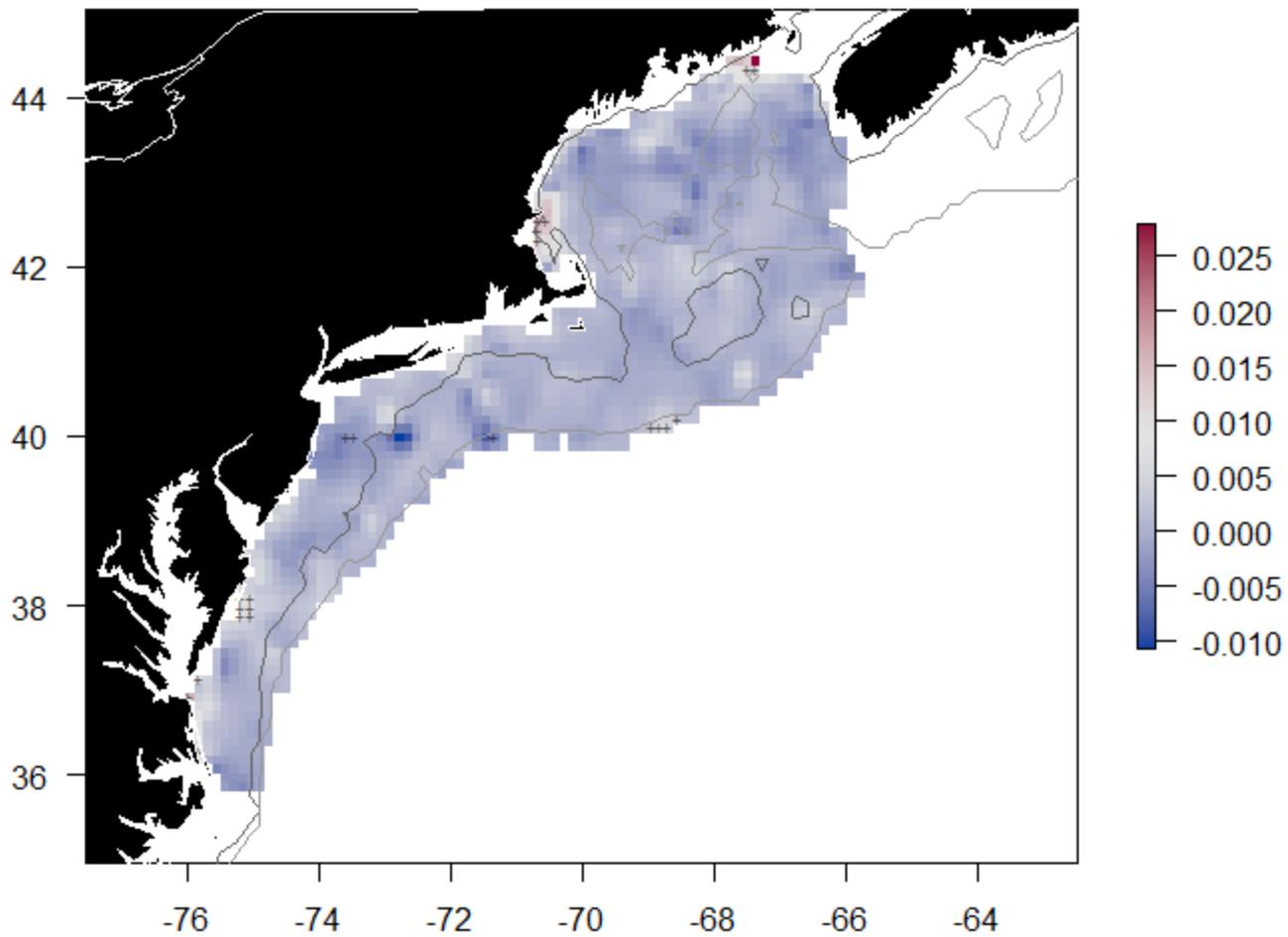
Metridia lucens



Temora longicornis

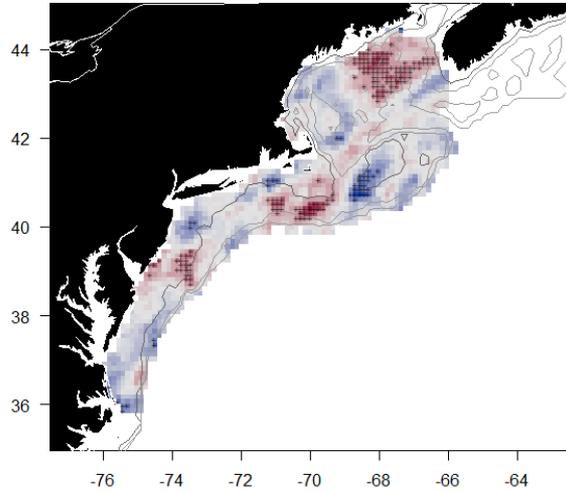


Wind Stress Spring Trend

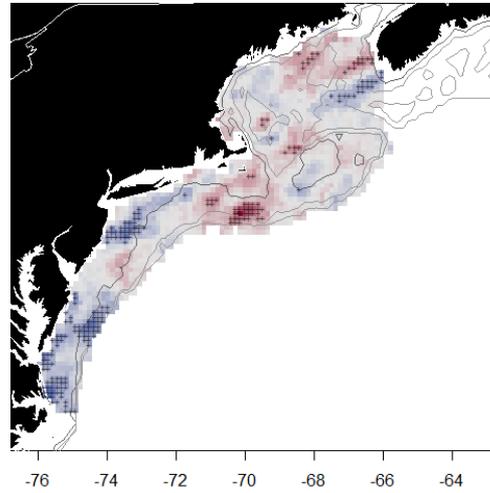


Wind

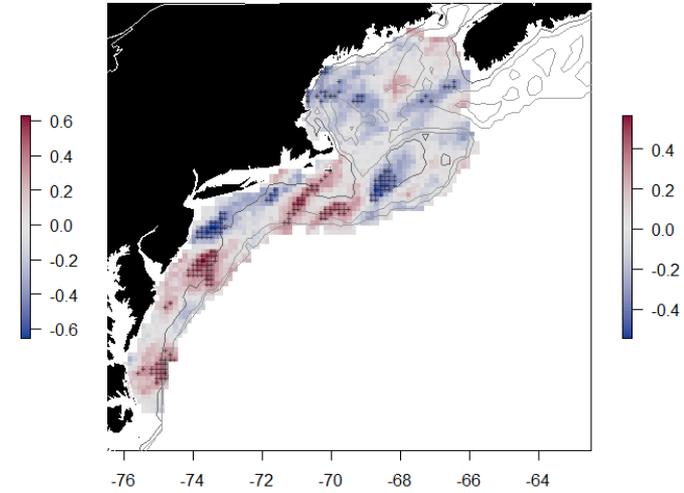
Calanus finmarchicus



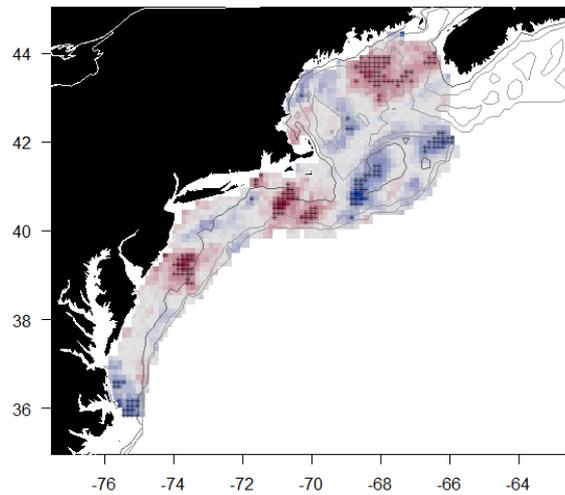
Pseudocalanus spp.



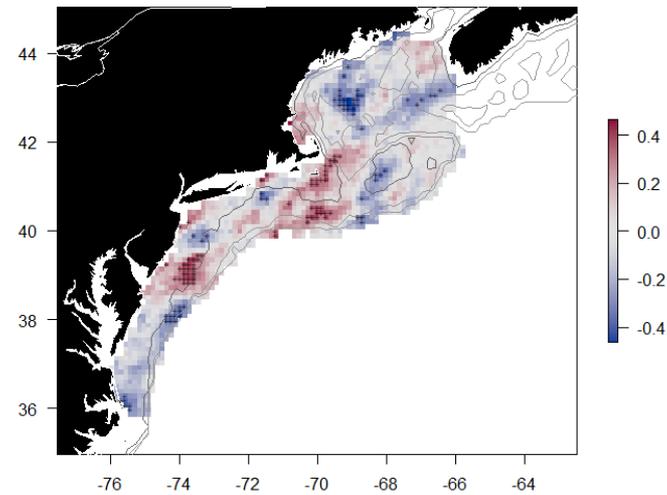
Centropages typicus



Metridia lucens



Temora longicornis



Summary

- Measurable changes in the physical dynamics on the NES
- Seasonal distribution of many zooplankton and fish taxa have shifted
- Strong coherence between trophic levels regarding shifting distributions in the NES LME; general trend to the NE for spring communities
- Kernel density estimates for dominant copepod spp. suggest increasing relative abundance on GBK and in the N. MAB; decrease in S. MAB
- Changes appear to be related to changes in SST, wind, and frontal magnitude

Acknowledgments: we thank
Jon Hare, Dave Richardson,
Harvey Walsh,
the NEFSC staff, and
the many scientists
who have worked on
the bottom trawl and
plankton surveys over
the years



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