Ocean Color Applications in Fisheries Science and Management in the Northeast U.S.

Kimberly J. W. Hyde
Northeast Fisheries Science Center

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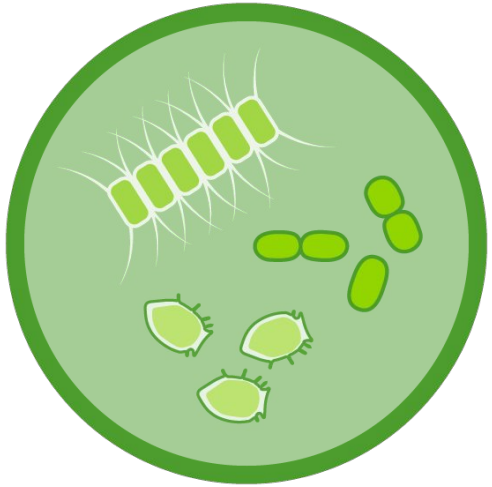
Take Away Messages

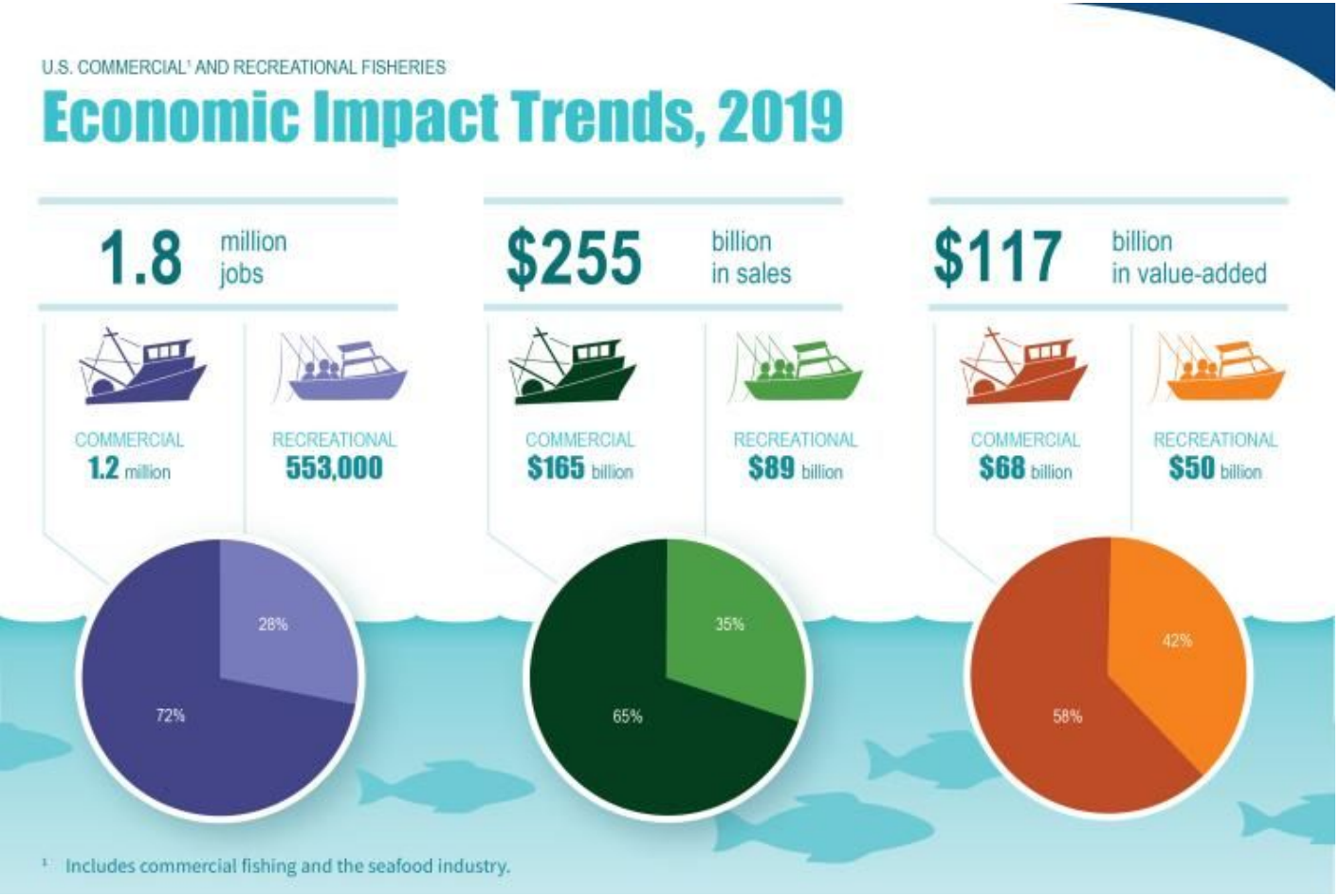


The **oceanographic conditions in the Northeast U.S. are changing** and affecting all levels of the marine food web.

Changes in the **abundance, productivity, phenology and community composition of phytoplankton** can affect the marine food web and biogeochemical cycles.

The **long-term time series** of phytoplankton have multiple operational and fisheries management applications.

NOAA Fisheries is responsible for the stewardship of living marine resources through science-based conservation and management and the promotion of healthy ecosystems.



- Productive and sustainable fisheries
- Safe sources of seafood
- Recovery and conservation of protected resources
- Healthy ecosystems

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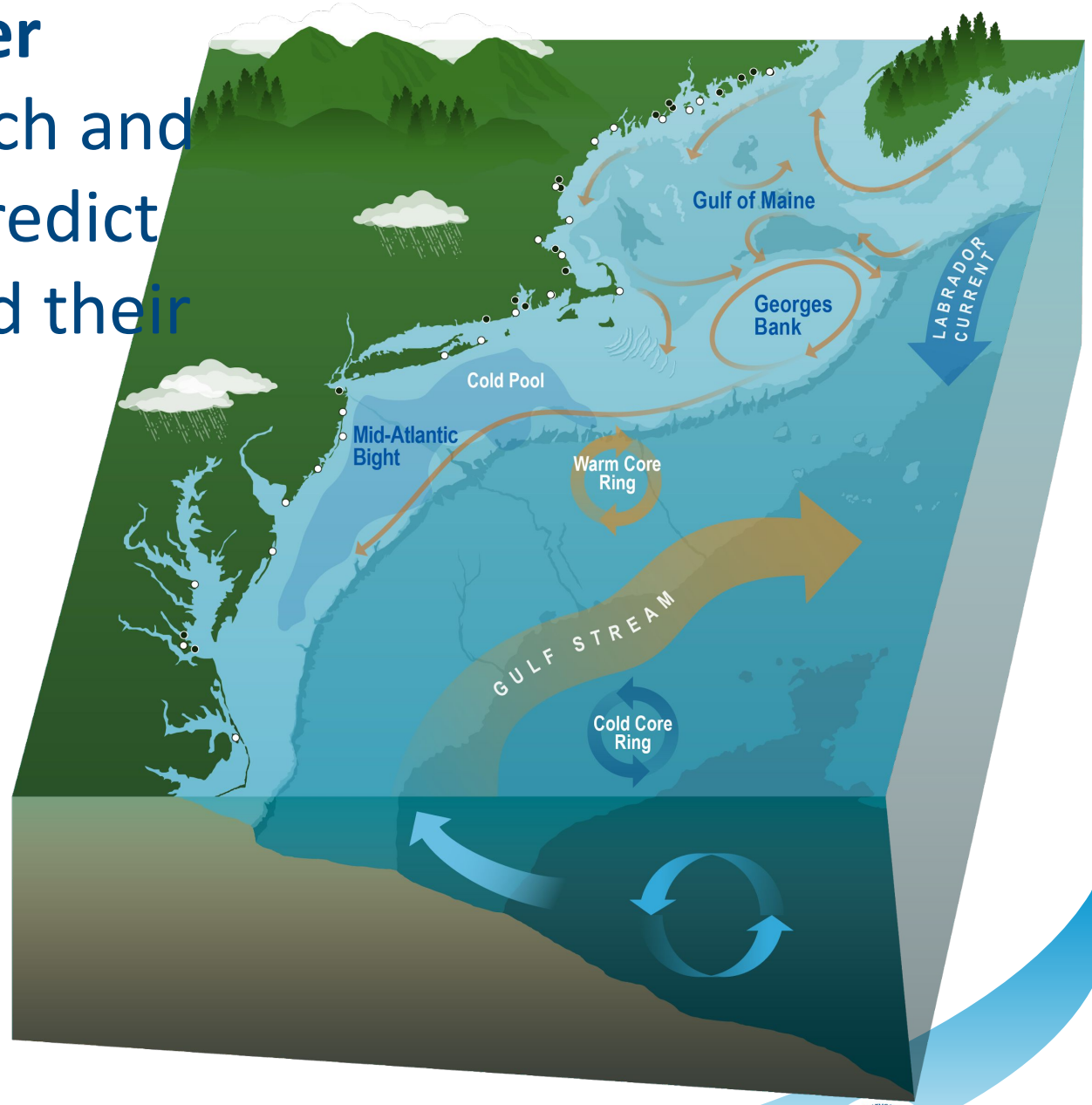
Northeast Fisheries Science Center

conducts ecosystem-based research and assessments to understand and predict changes to marine ecosystems and their subsystems affecting:

- living marine resources
- fisheries
- habitats
- ecosystem condition
- productivity
- aquaculture



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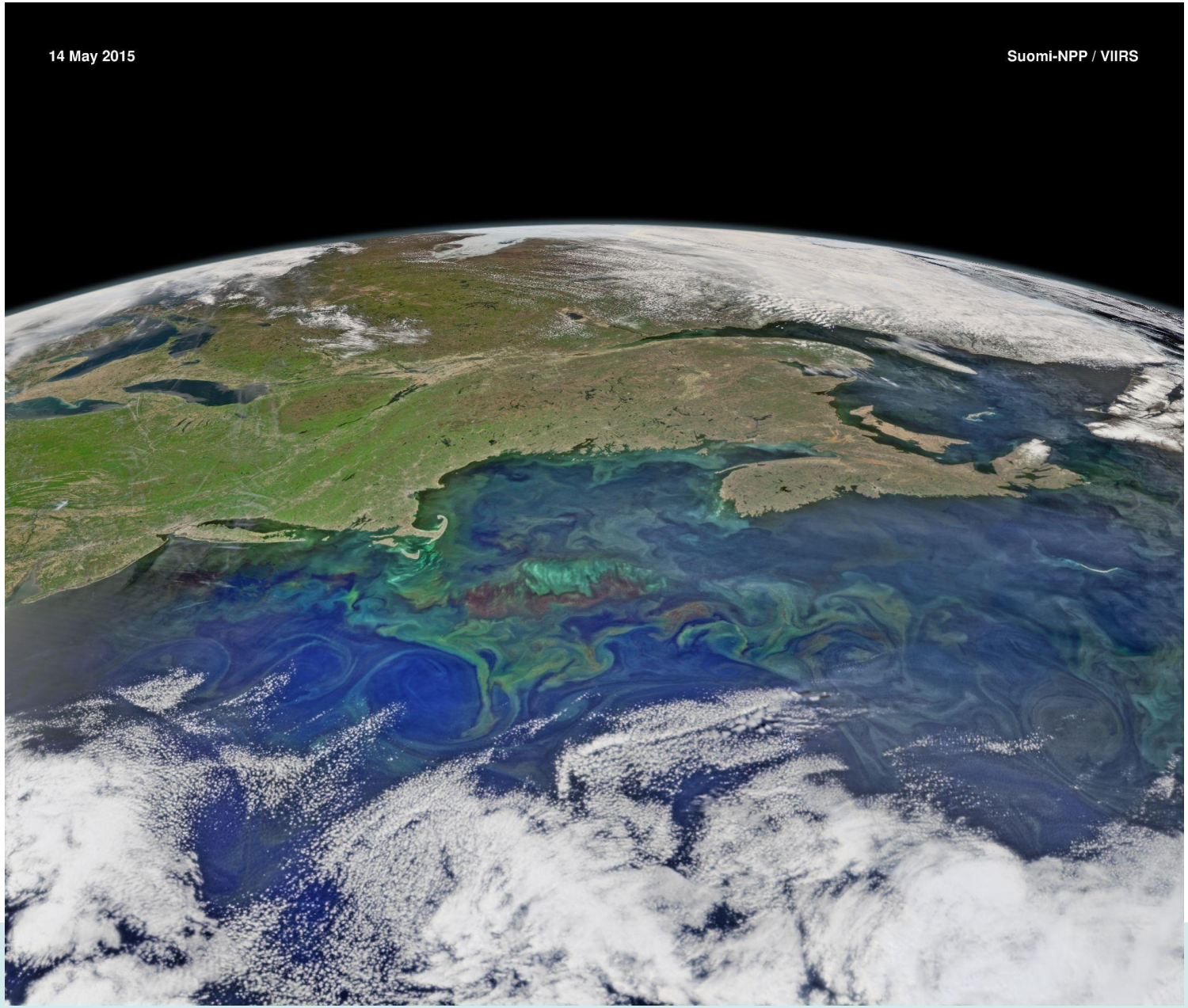
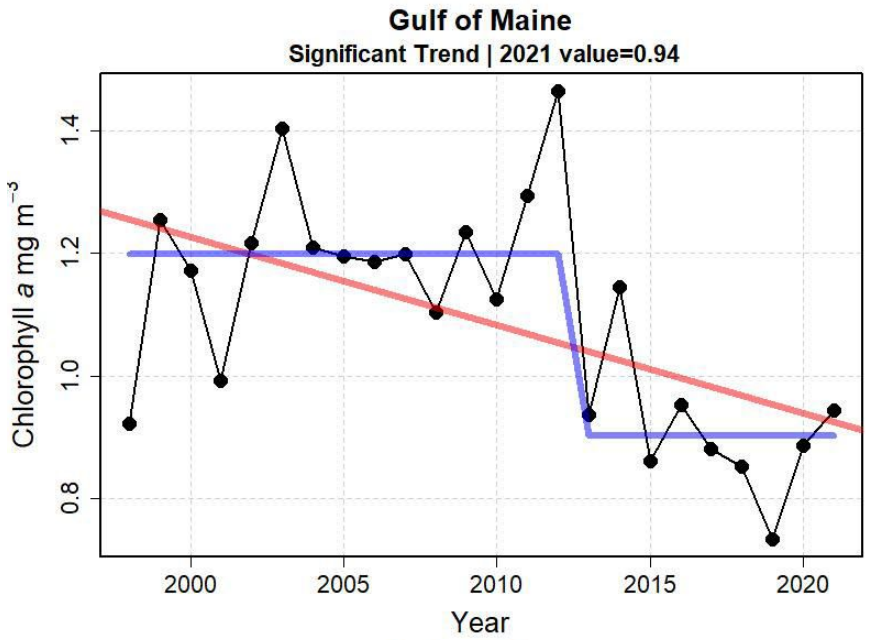
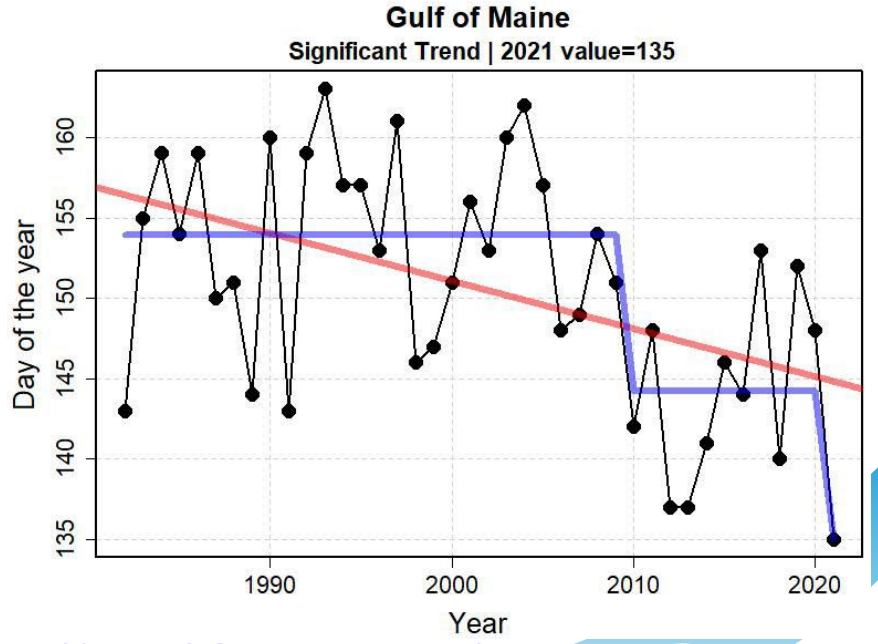
Why ocean color satellites?







https://www.fisheries.noaa.gov/resource/document/current-conditions-northeast-us-shelf-ecosystem

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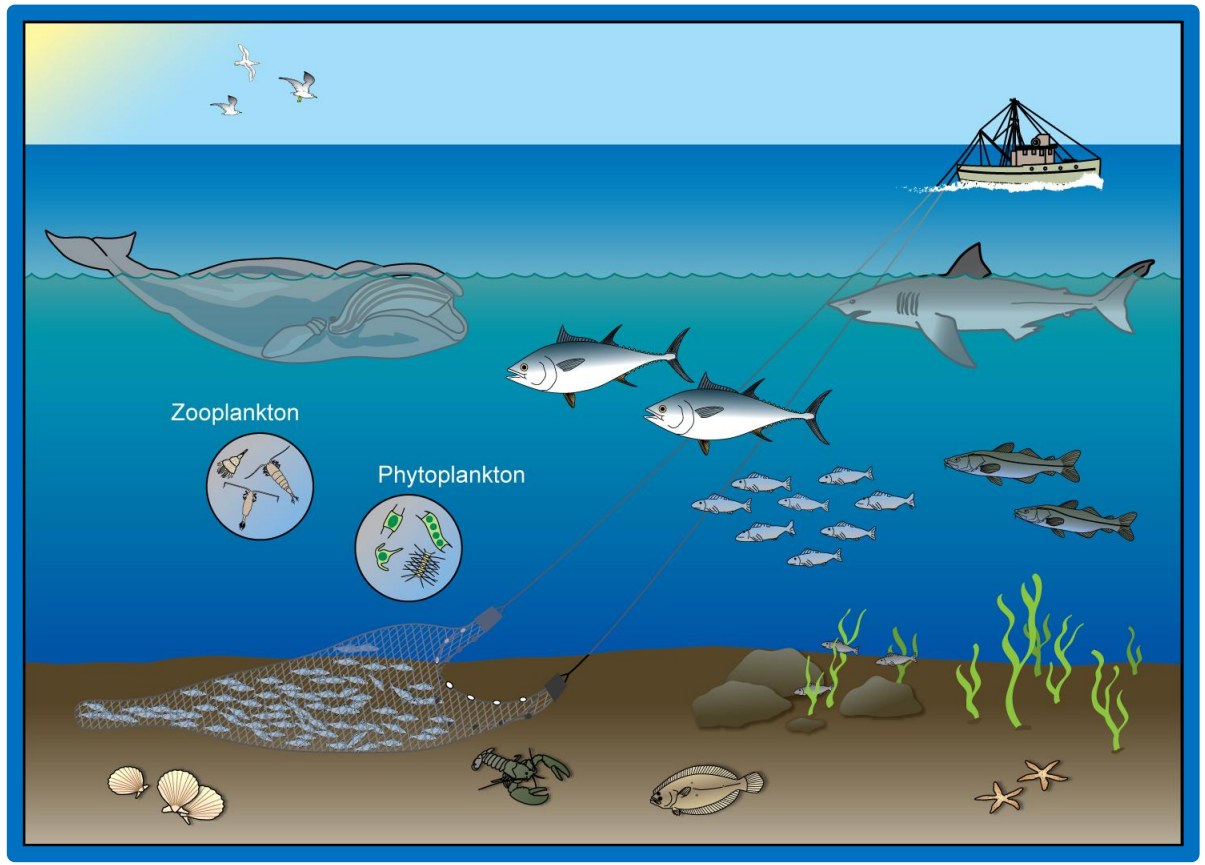
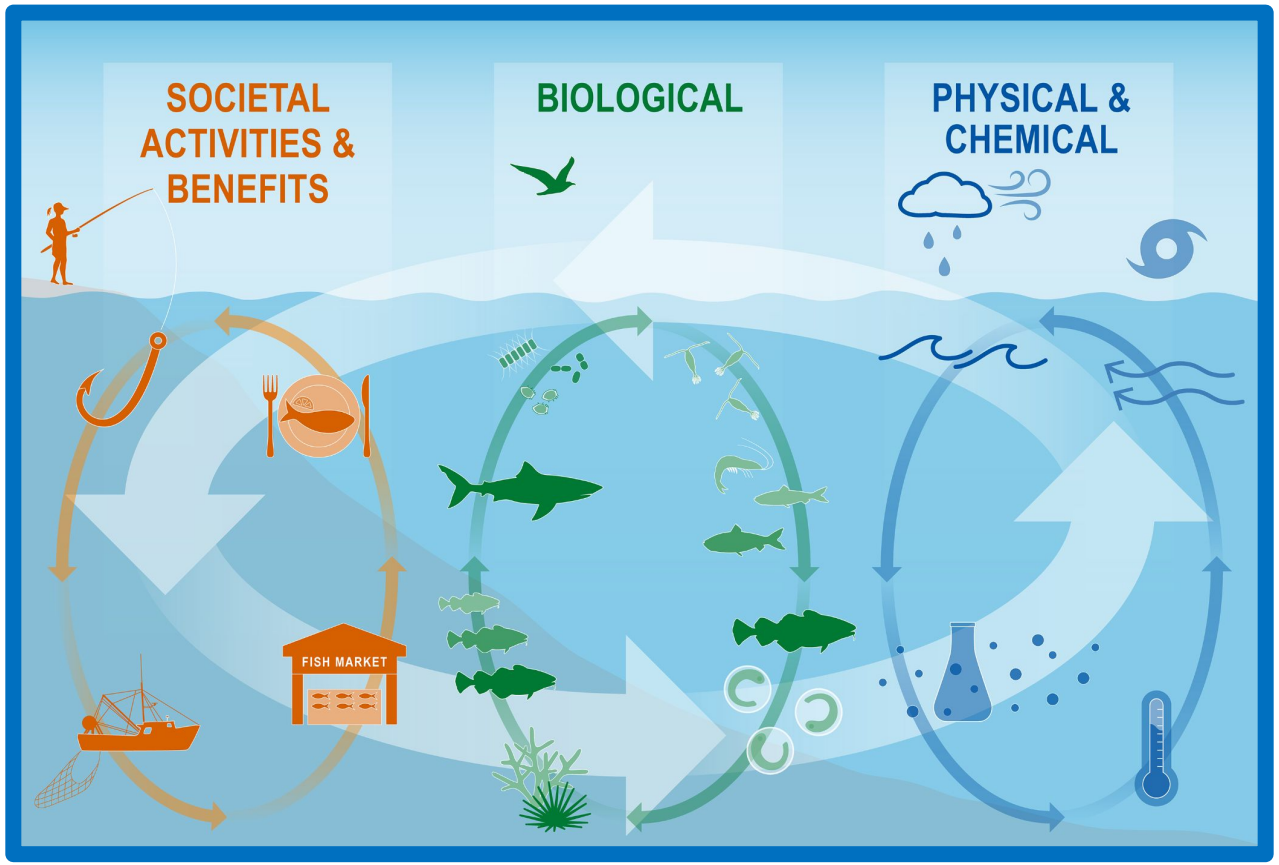
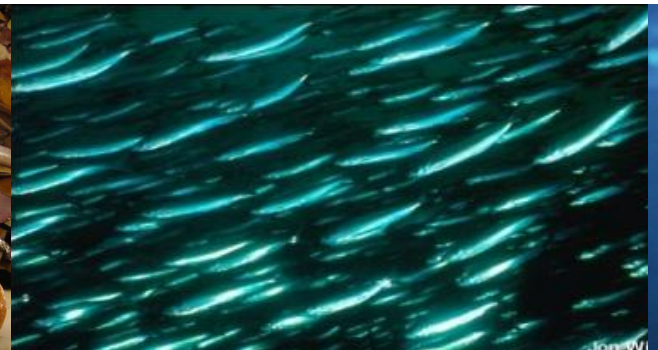
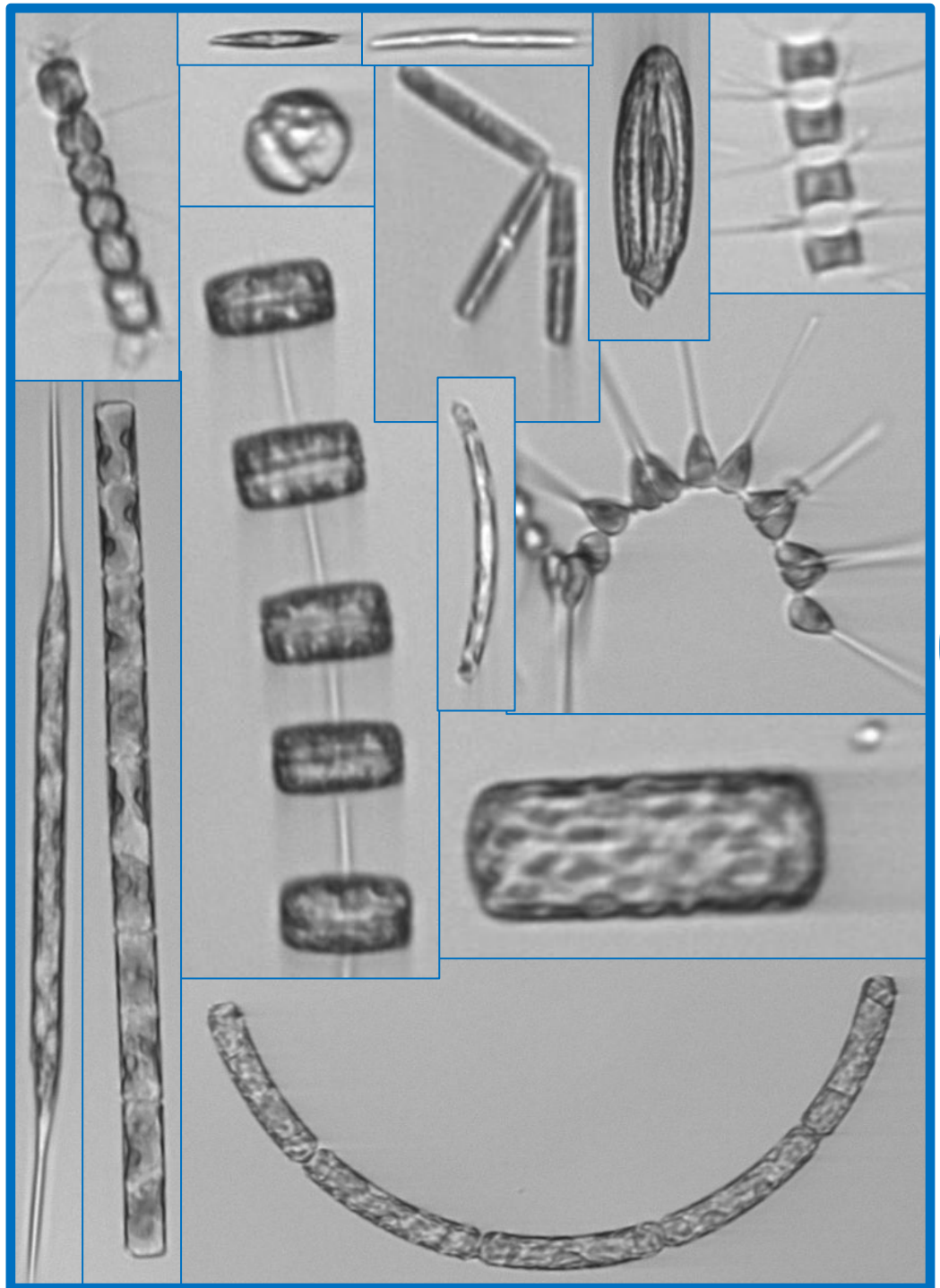
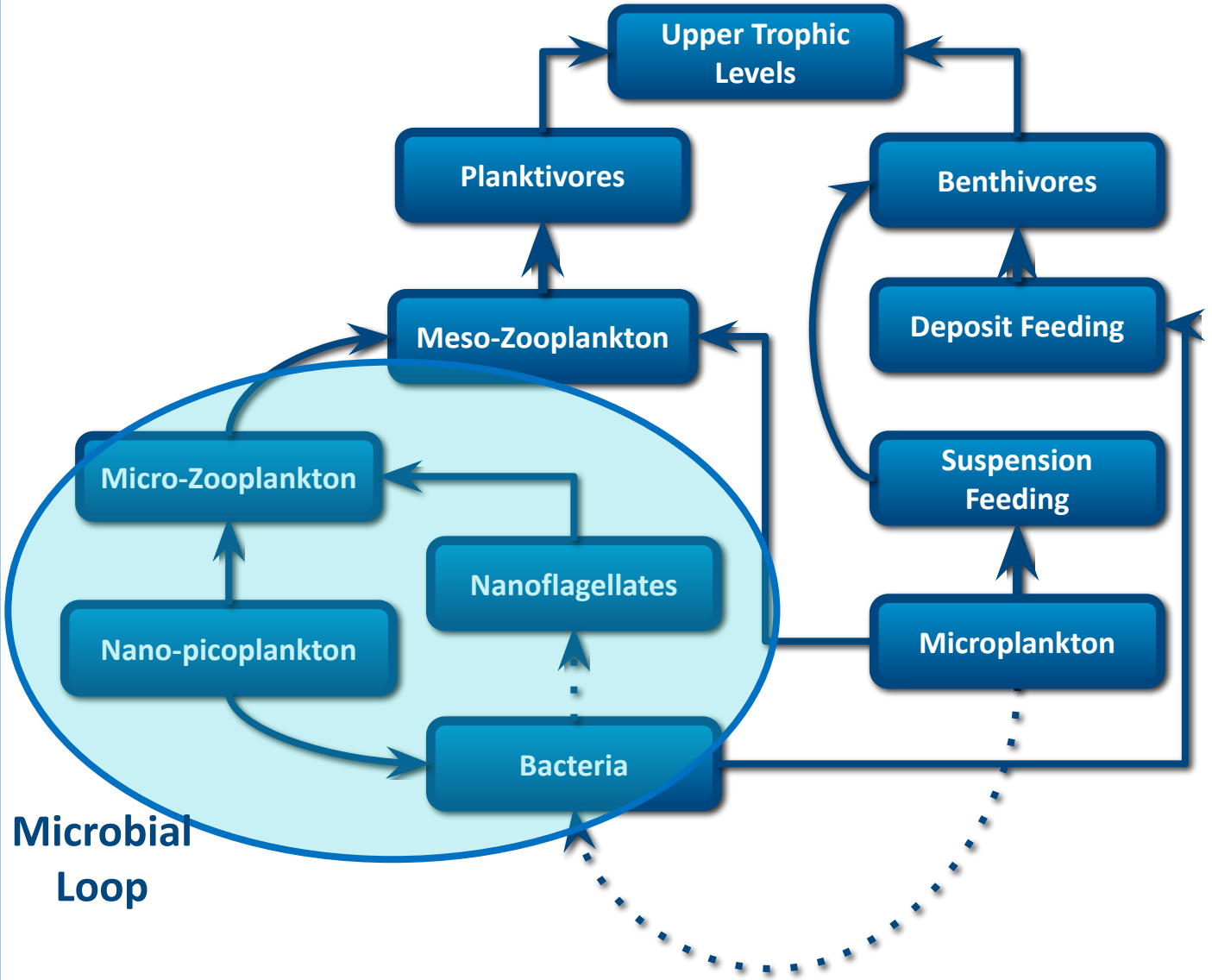
Ecosystem Based Management











"Cell size is a master trait that shapes ecological niches of phytoplankton "

(Litchman & Klausmeier, 2008)

Project Overview

Primary goal: Comprehensively characterize the spatial and temporal variability of the phytoplankton community in the Northeast Shelf ecosystem over the 20+ year ocean color time series for operational fisheries applications.

Primary questions: Which algorithms perform best? Can they be regionally improved using local *in situ* observations? How do abundance and absorption-based algorithms compare?

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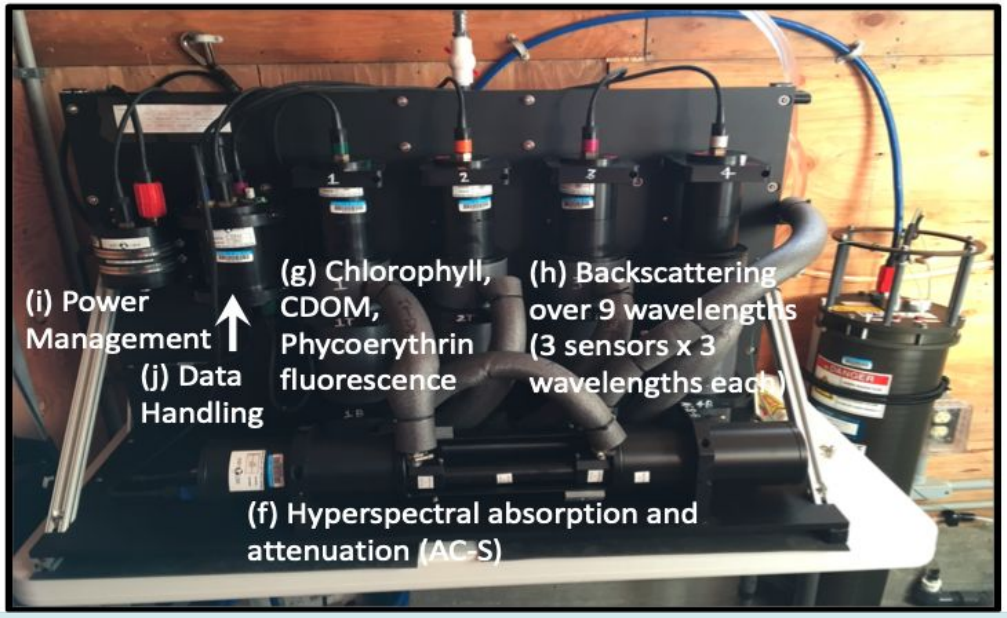
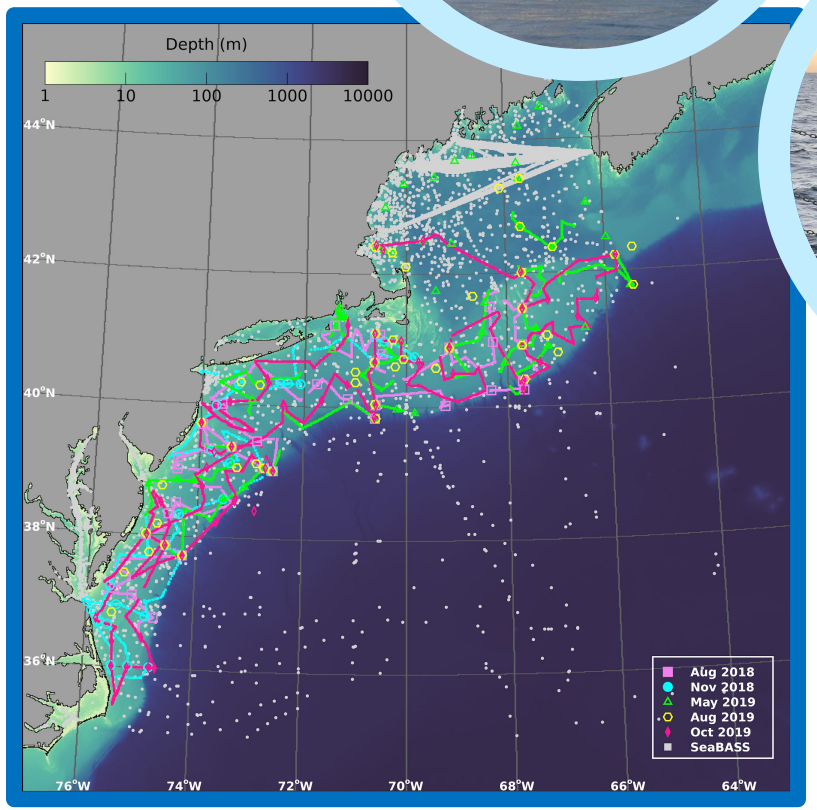
Primary objectives: Collect *in situ* measurements of optical properties, phytoplankton imagery (IFCB), pigments (HPLC), and nutrients and evaluate and optimize the performance of satellite size class algorithms.

In situ Observations



- Temperature/Salinity
- Absorption/Attenuation/
- Scattering/Backscattering
- Chl, CDOM, Fluorescence
- Radiometry



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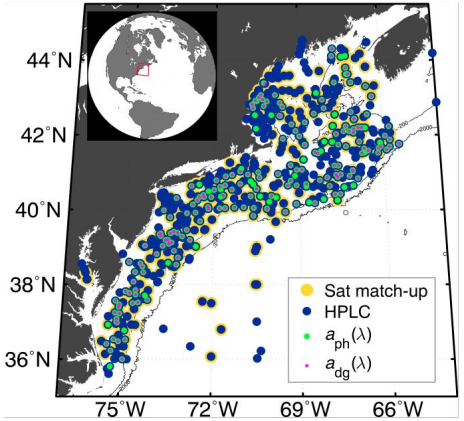
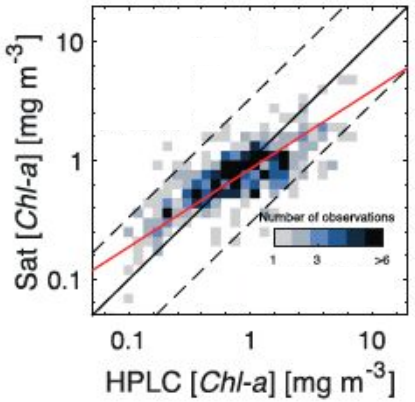
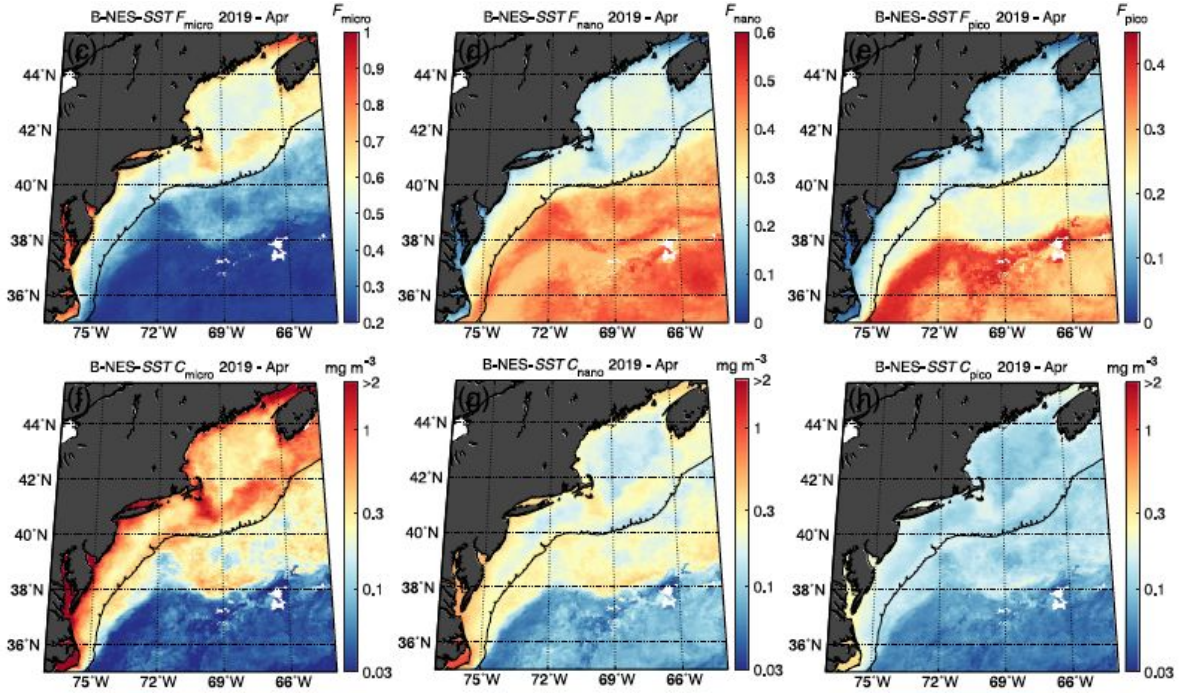
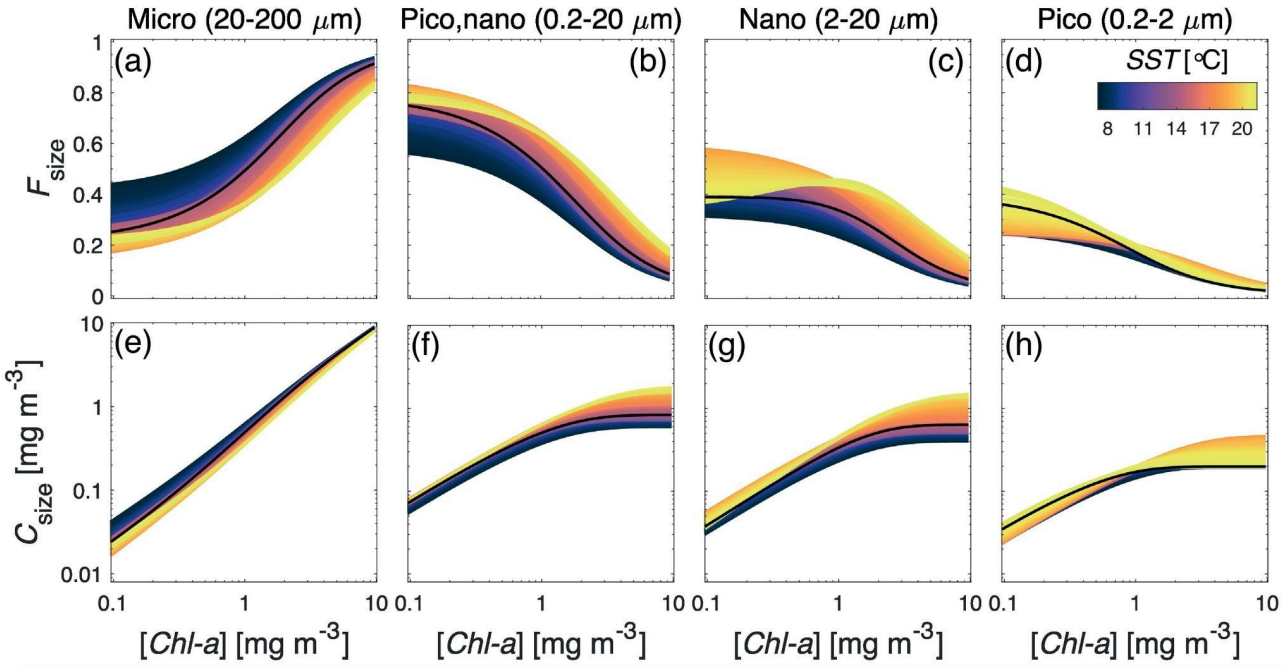
Algorithm validation









Contents lists available at ScienceDirect

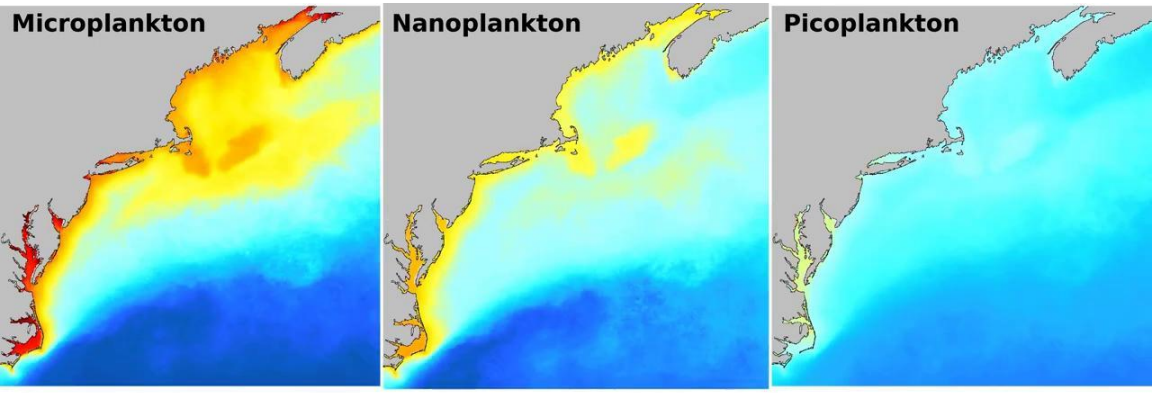
Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

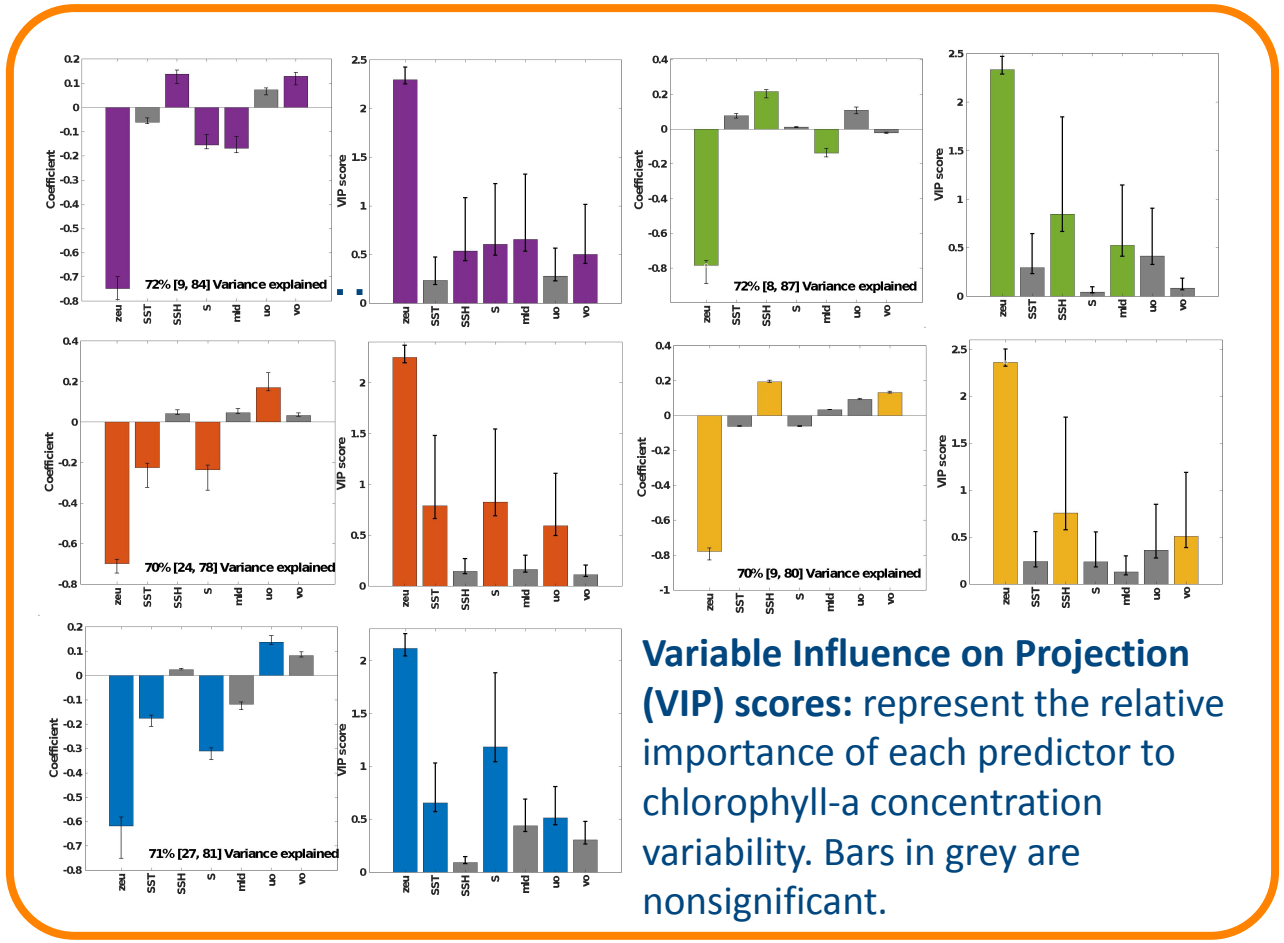
Optimization and assessment of phytoplankton size class algorithms for ocean color data on the Northeast U.S. continental shelf

Kyle J. Turner [a,*], Colleen B. Mouw [a], Kimberly J.W. Hyde [b], Ryan Morse [b], Audrey B. Ciochetto [a]

Next Steps



What are the **environmental drivers** of phytoplankton abundance and community size composition in the U.S. Northeast Continental Shelf?



Variable Influence on Projection (VIP) scores: represent the relative importance of each predictor to chlorophyll-a concentration variability. Bars in grey are nonsignificant.

Rowan Cirivello

Somang Song

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Fisheries Applications

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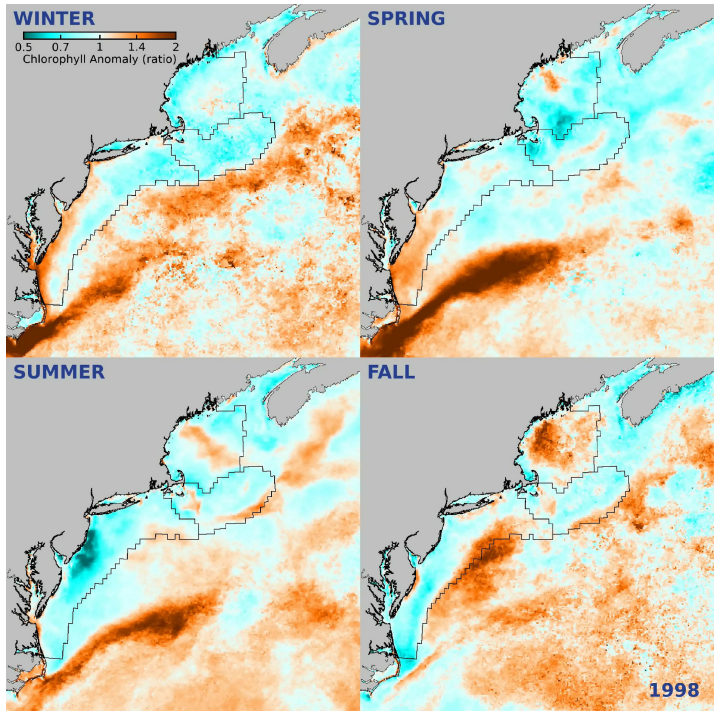
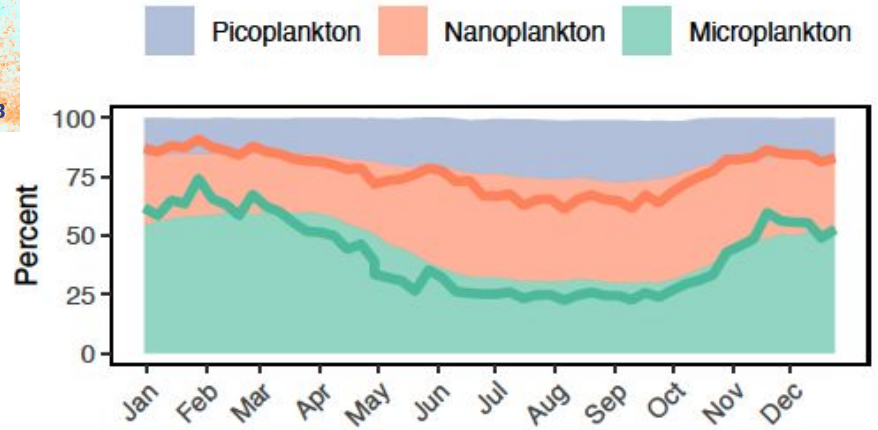
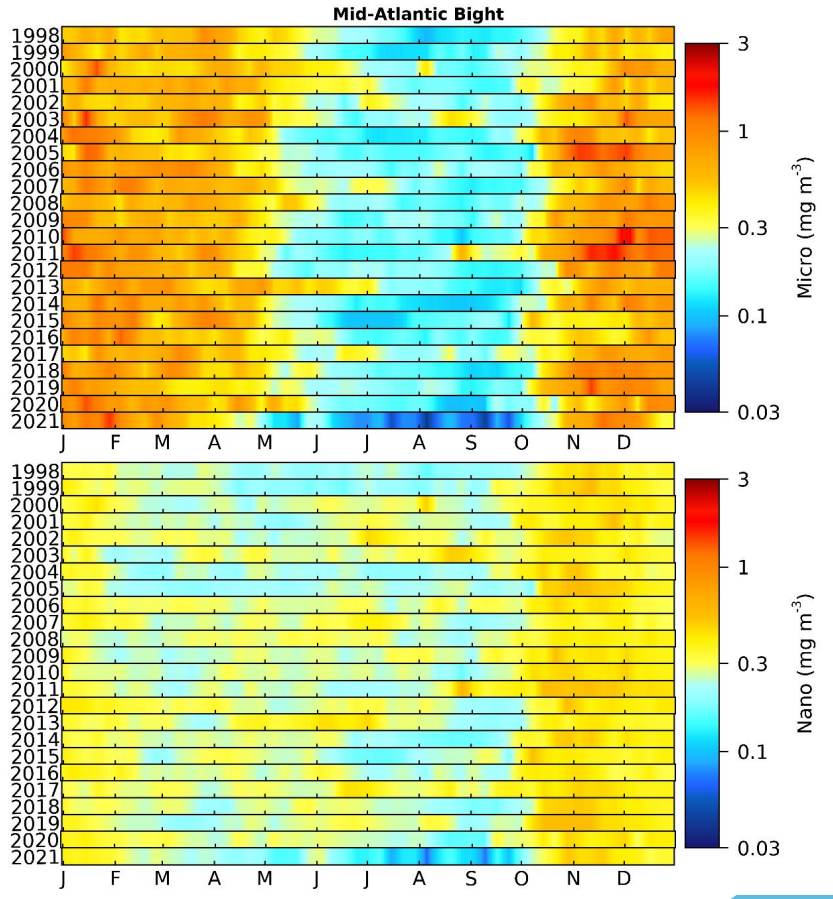
Ecosystem Reports & Products

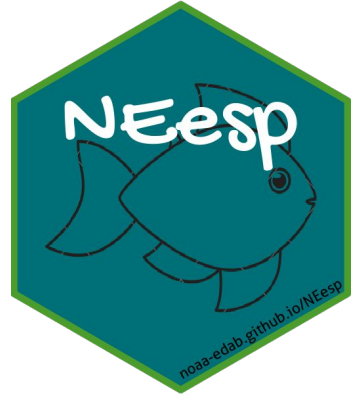






https://www.fisheries.noaa.gov/new-england-mid-atlantic/ecosystems/state-ecosystem-reports-northeast-us-shelf

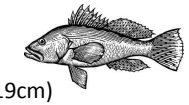
Ecosystem and Socioeconomic Profiles



Black Sea Bass Ecosystem Processes In New England and the Mid Atlantic

Recruits
(17 - 21°C, 50-200m [shell patches], 2-12cm)
- Determined by first winter survival

Adults
(9 - 27°C, 2-60m [reef/structure], >19cm)
- Mature at 1-3 years old
- Temperature drives offshore migration



Eggs & Larvae
(10 - 26°C, 30-50m [upper water column], 1-15mm)
- June- Sept
- Possible gelatinous plankton predation

YOY
(> 8°C, 30-100m [sand ridges], 16-100mm)
- Migrate to mid shelf
- Warmer winter shelf temperature increases survival

MIGRATION

Fall: Offshore driven by temperature (10°C)

Spring: Inshore by May, cue unknown

Continental Shelf
(Winter Habitat)

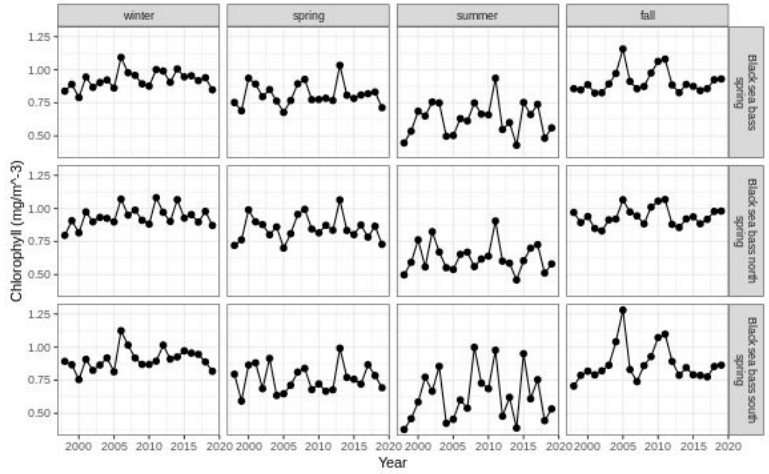
Spawning
(20-50m [rocky reefs], >19cm)
- May - June
- Hermaphroditism
- Sneaker males can make up for fishery removals

Adults
(9 - 27°C, 2-60m [reef/structure], >19cm)

MIGRATION

Adults
(> 8°C, 60-150m, >19cm)

Gulf Stream



Abigail Tyrell, Ricky Tabandera, & Scott Large

https://noaa-edab.github.io/ESP_docs/docs/

Developed in collaboration with assessment leads and the Fay Lab

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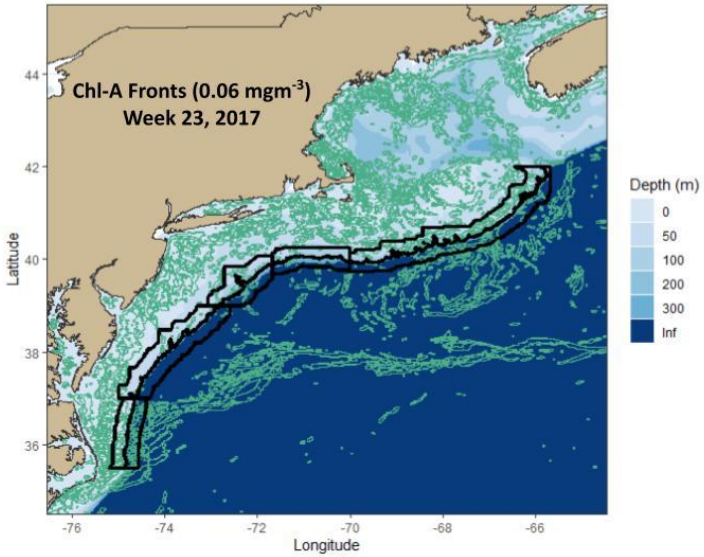
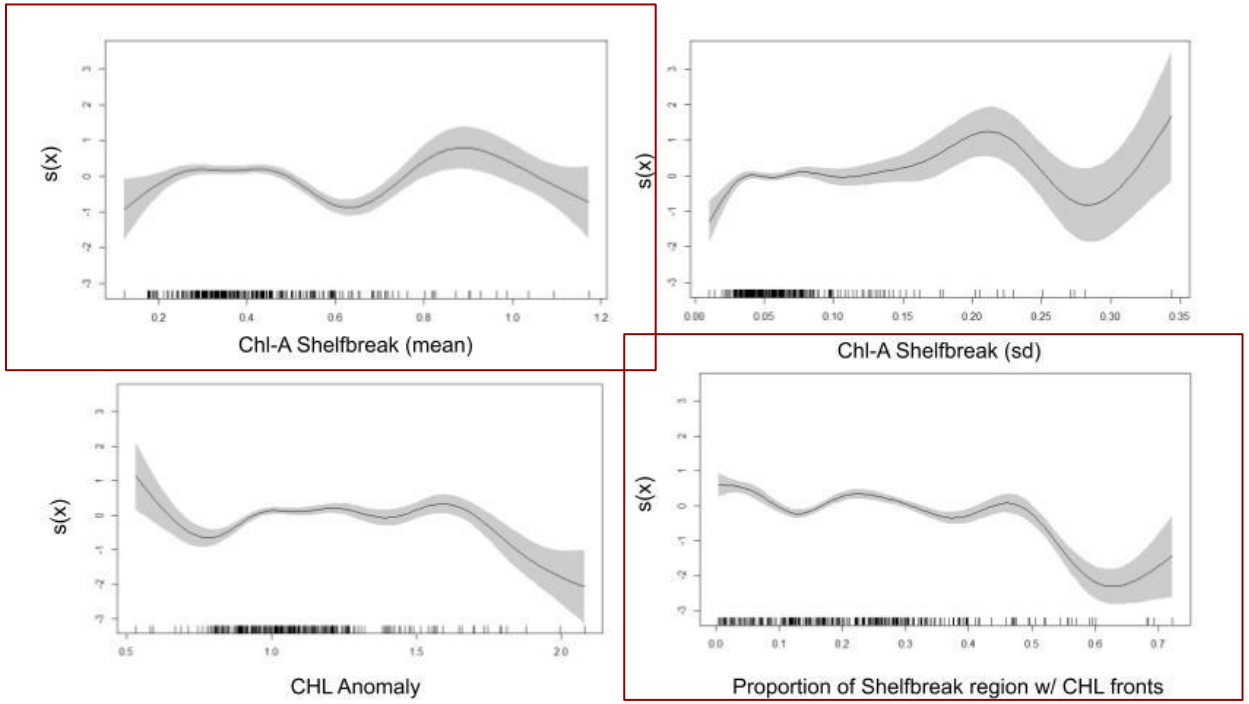
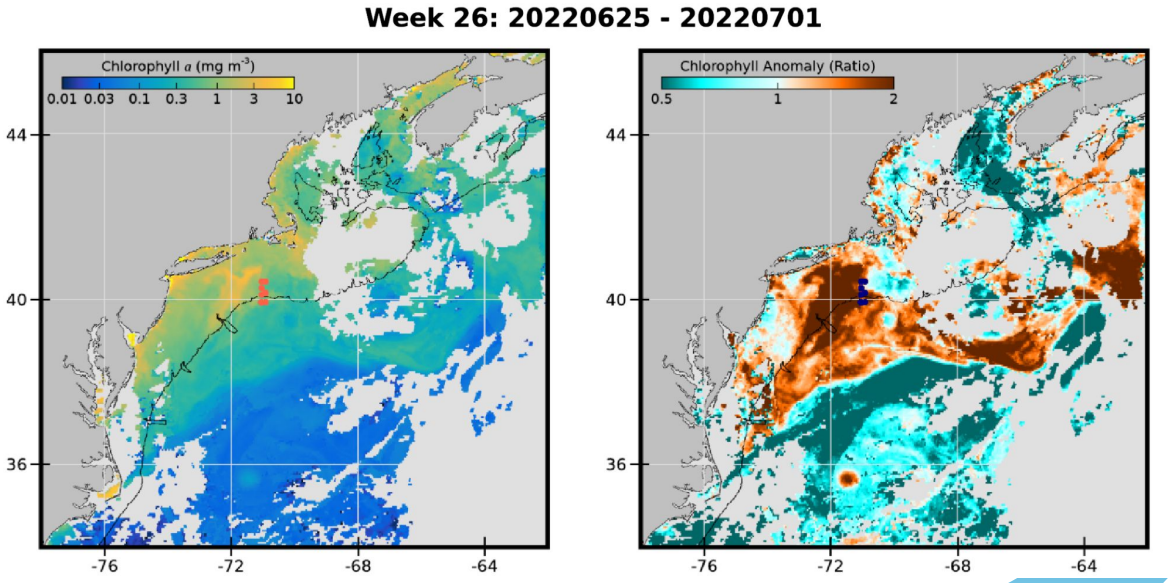
Research Assessment



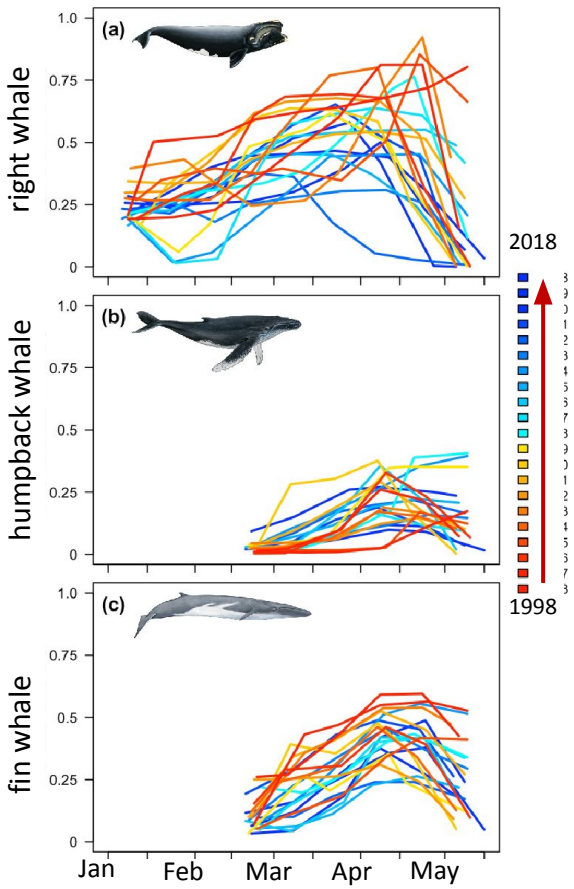




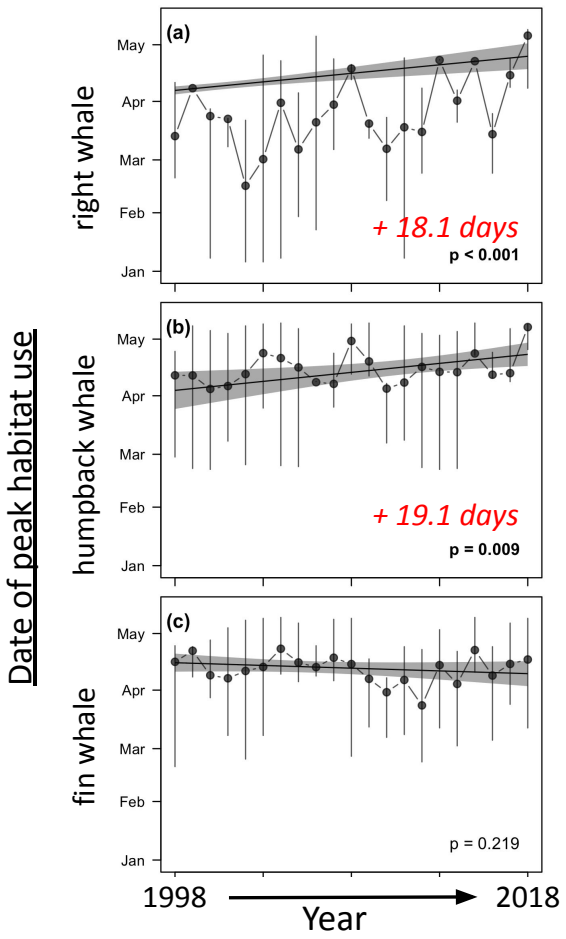
Sarah Salois & Kimberly Hyde

Protected Species

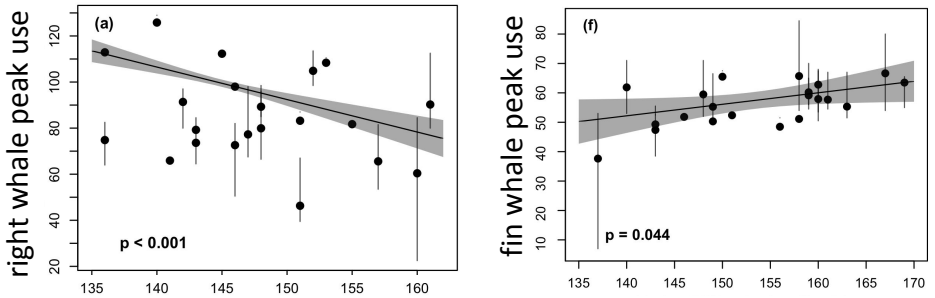
Annual habitat use dynamics



Changing Phenology

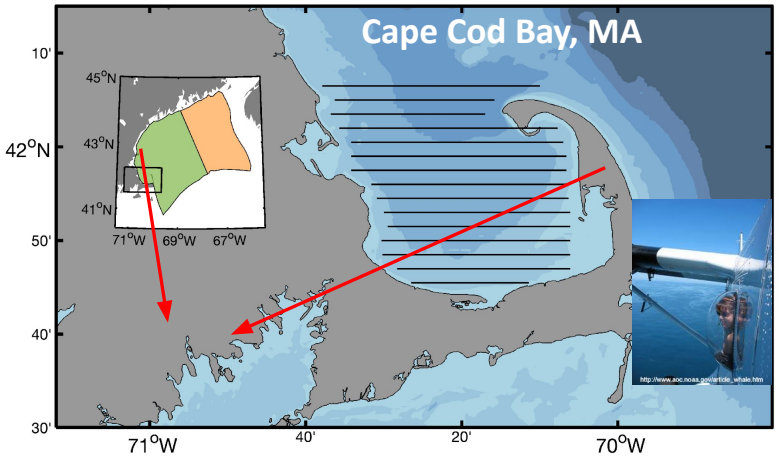


Relationship between peak habitat use and regional temperature phenology



Western GOM spring onset

Eastern GOM spring onset



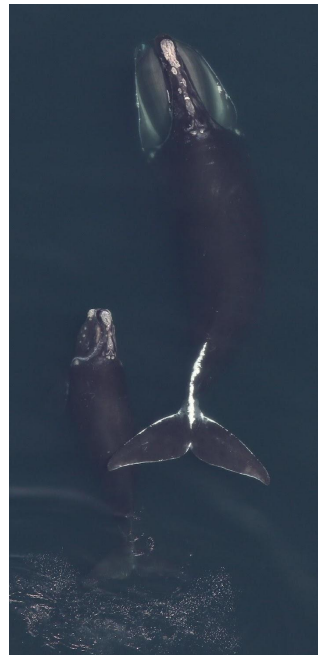


Photo credit: Brigid McKenna, Center for Coastal Studies under NOAA research permit #19315-01

DOI: 10.1111/gcb.16225

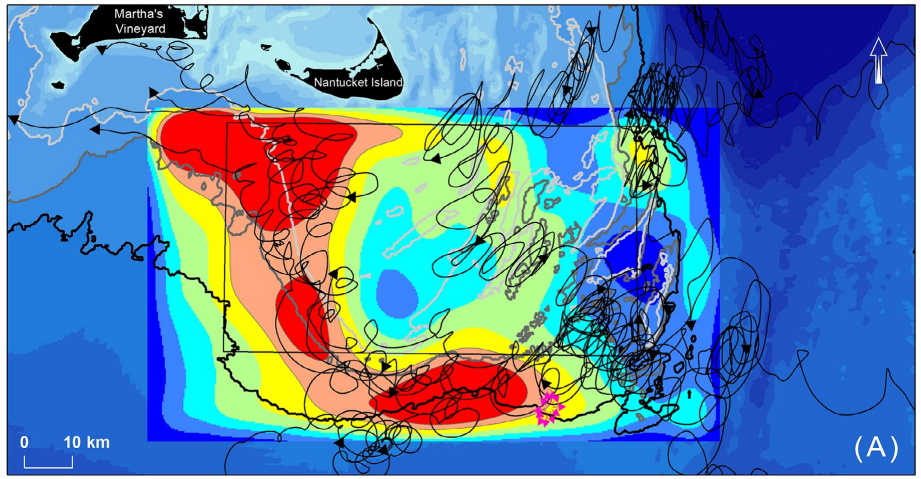
Global Change Biology WILEY

RESEARCH ARTICLE

Decadal-scale phenology and seasonal climate drivers of migratory baleen whales in a rapidly warming marine ecosystem

Daniel E. Pendleton[1] | Morgan W. Tingley[2] | Laura C. Ganley[1] | Kevin D. Friedland[3] | Charles Mayo[4] | Moira W. Brown[5] | Brigid E. McKenna[4] | Adrian Jordaan[6] | Michelle D. Staudinger[6,7]

Protected Species



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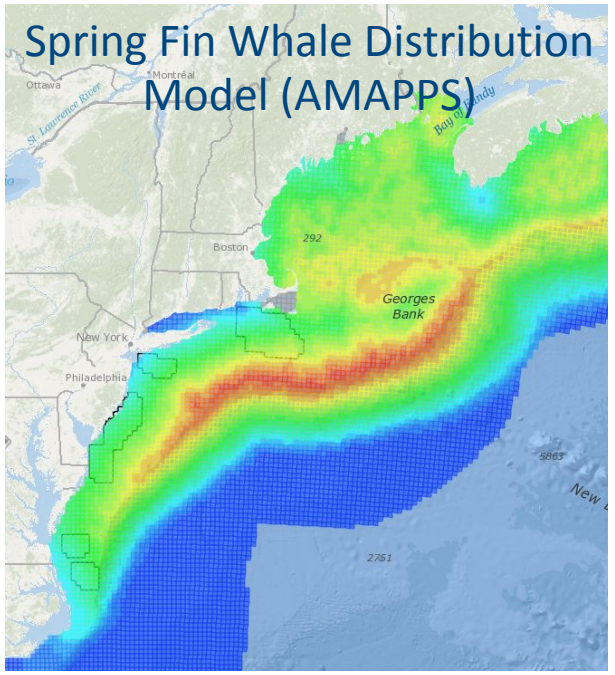
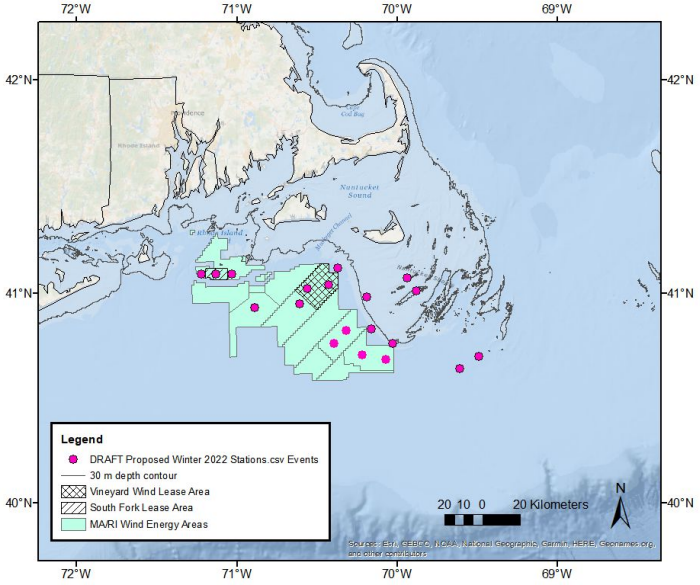
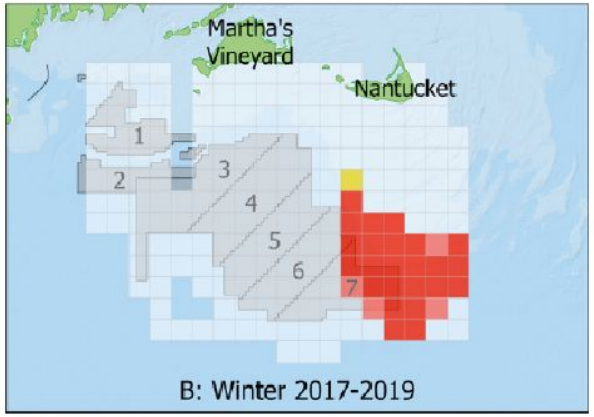
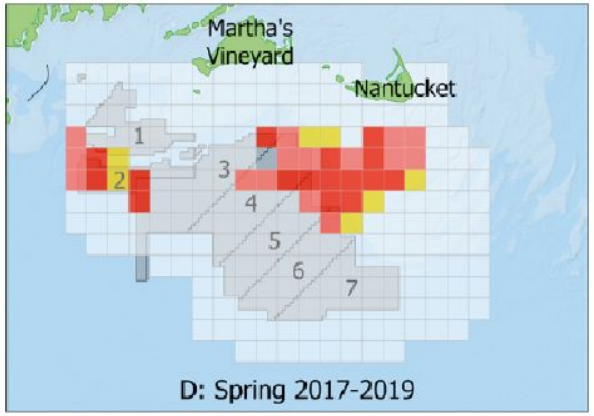
Spatial ecology of long-tailed ducks and white-winged scoters wintering on Nantucket Shoals

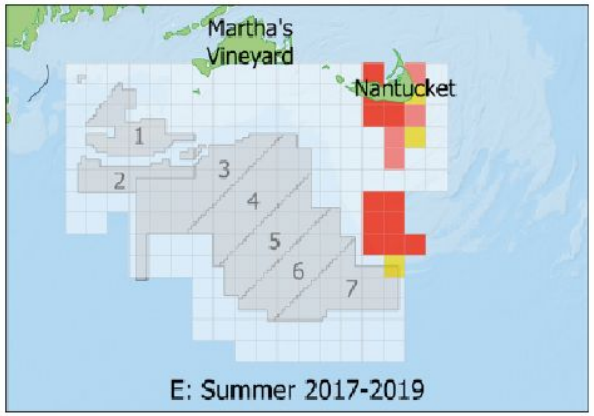
Timothy P. White, Richard R. Veit











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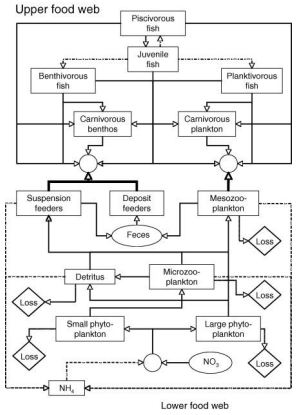
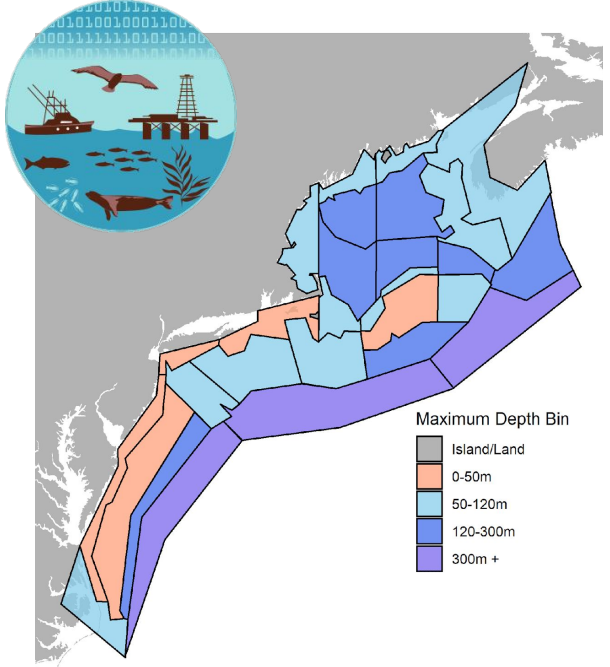
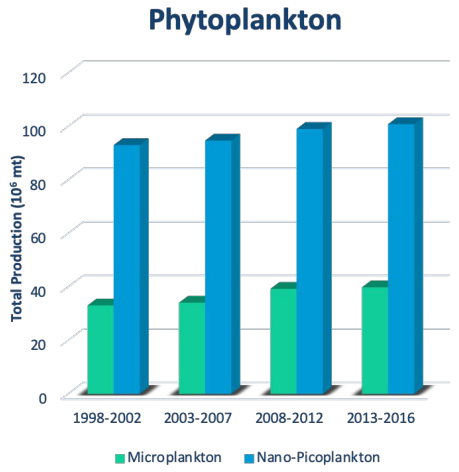
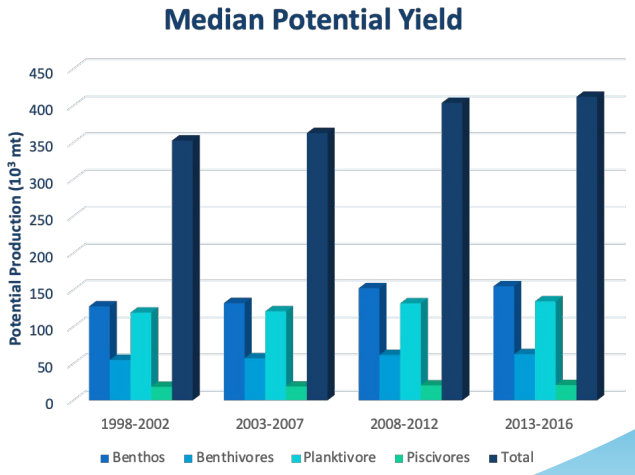
Modeling









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Modeling

Ecological Modelling 471 (2022) 110038

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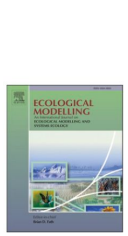
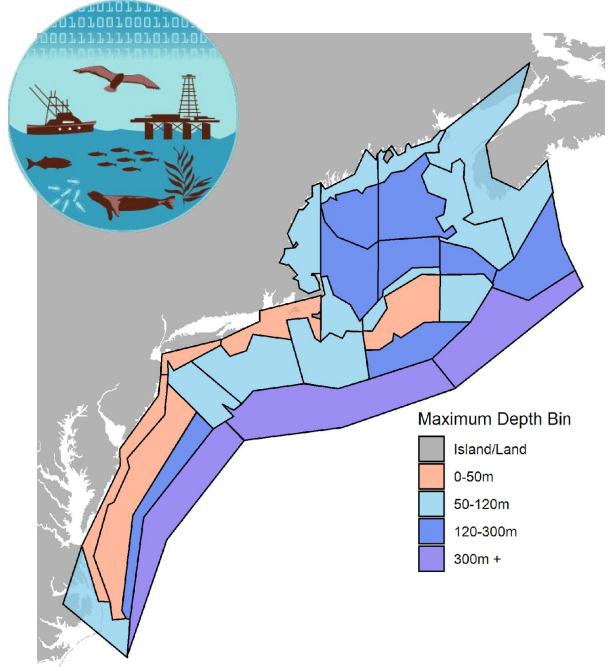
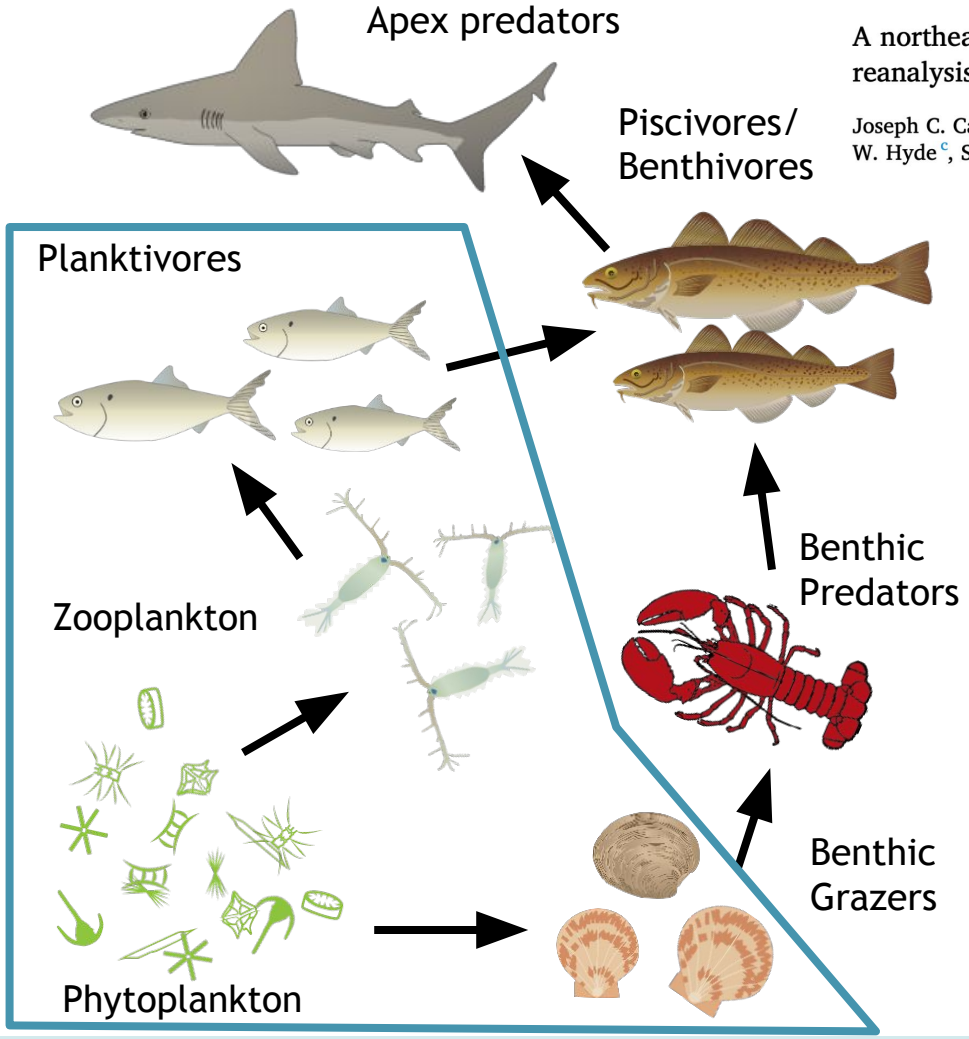
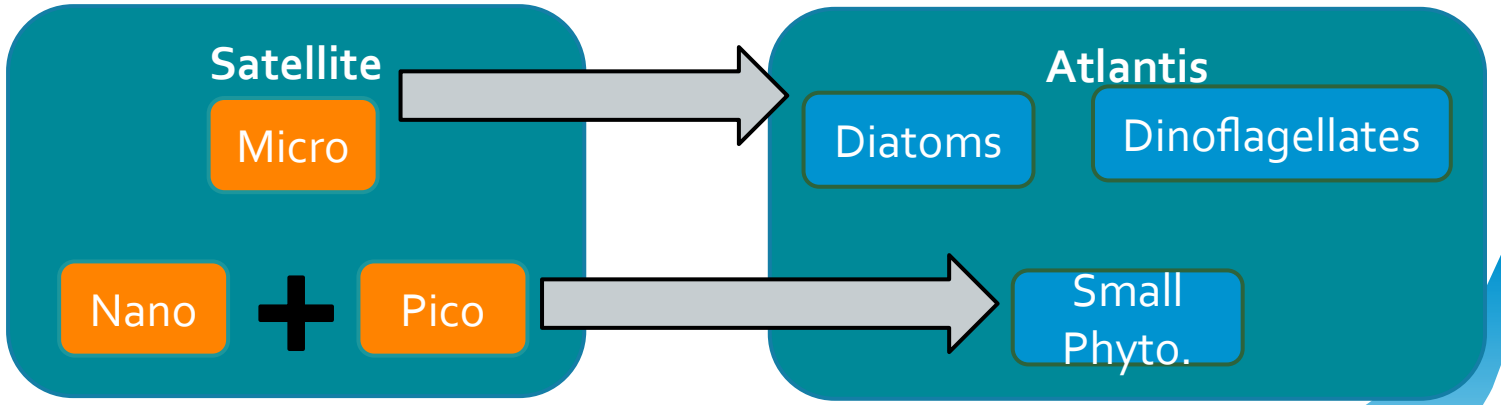




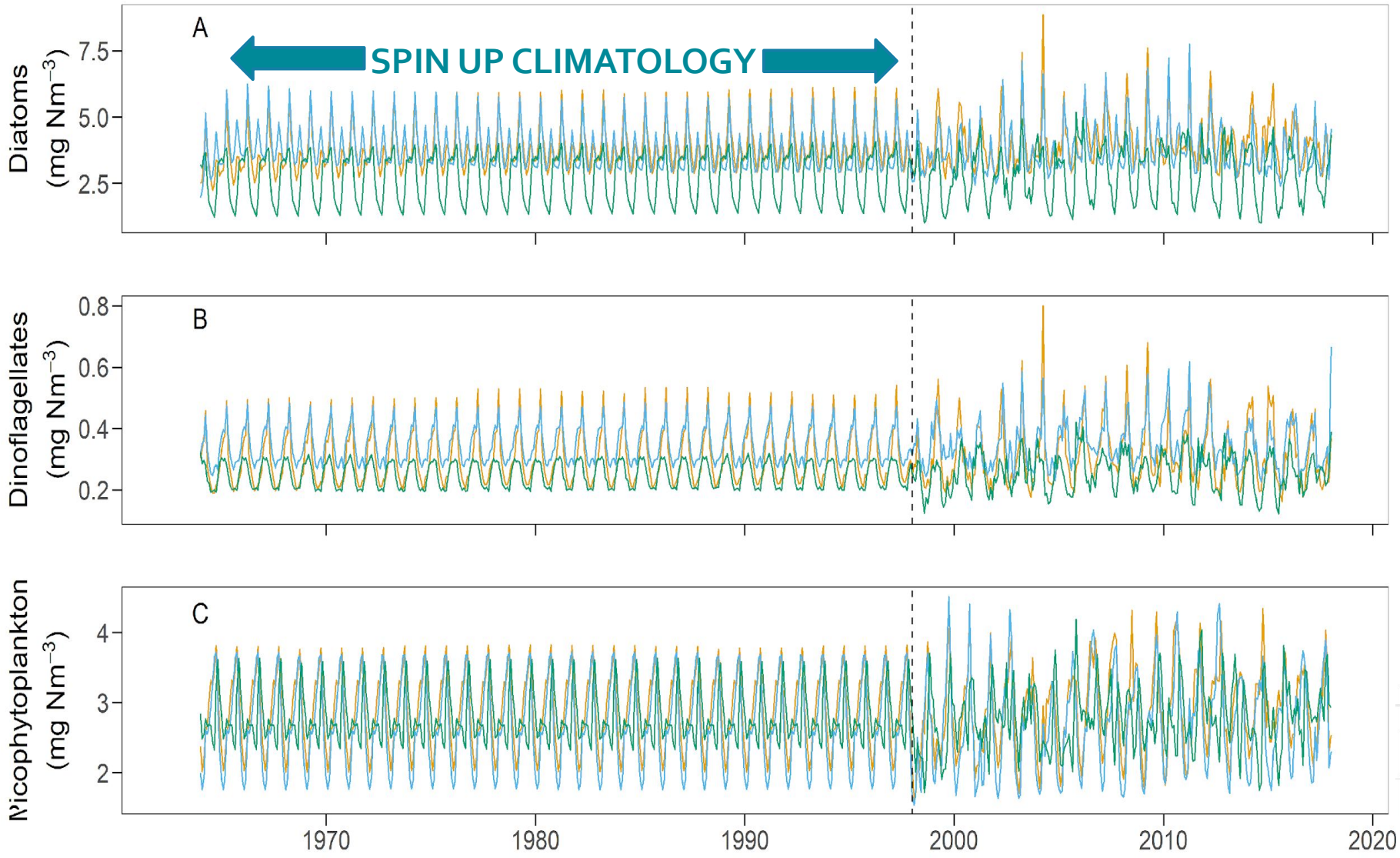
A northeast United States Atlantis marine ecosystem model with ocean reanalysis and ocean color forcing

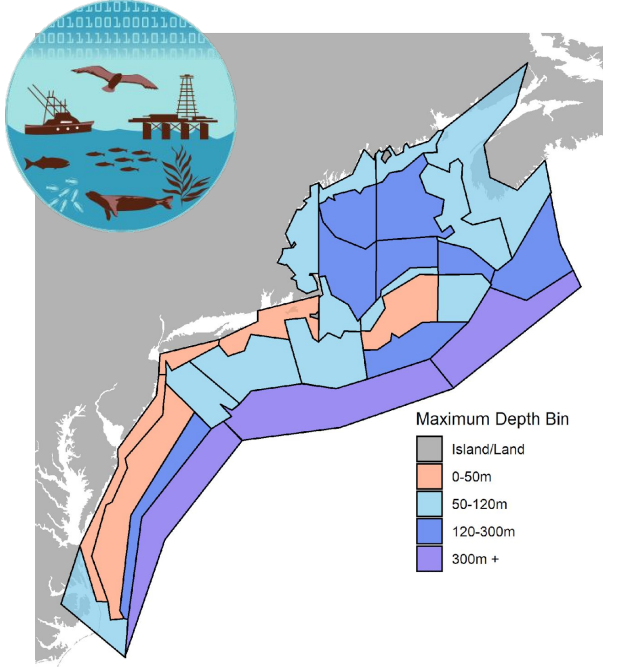
Joseph C. Caracappa [a,*], Andrew Beet [b], Sarah Gaichas [a], Robert J. Gamble [a], Kimberly J. W. Hyde [c], Scott I. Large [a], Ryan E. Morse [d], Charles A. Stock [e], Vincent S. Saba [f]





Modeling





Georges Bank
Gulf of Maine
Mid-Atlantic Bight

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Regime shifts

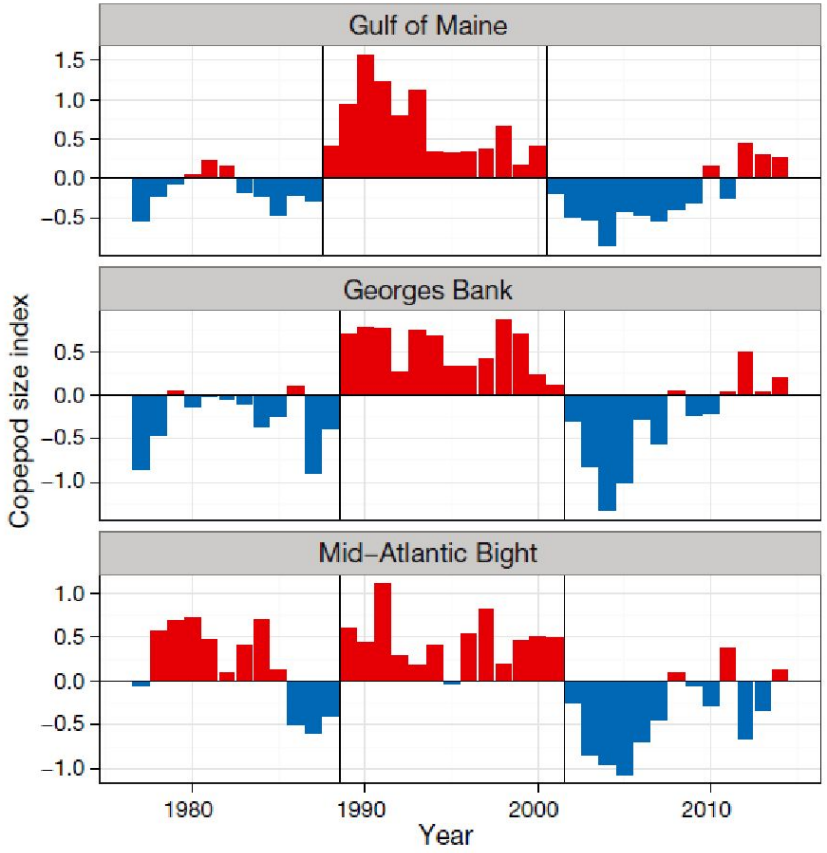
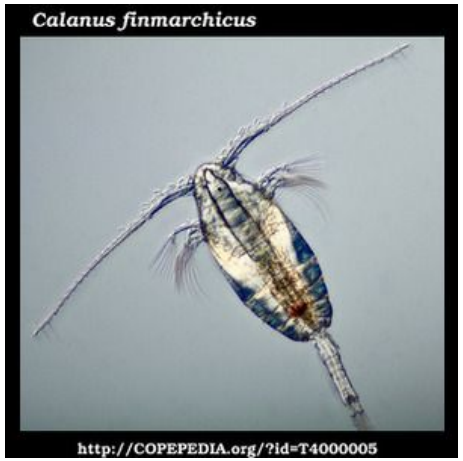
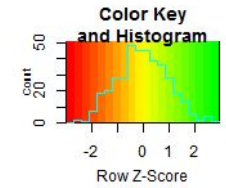
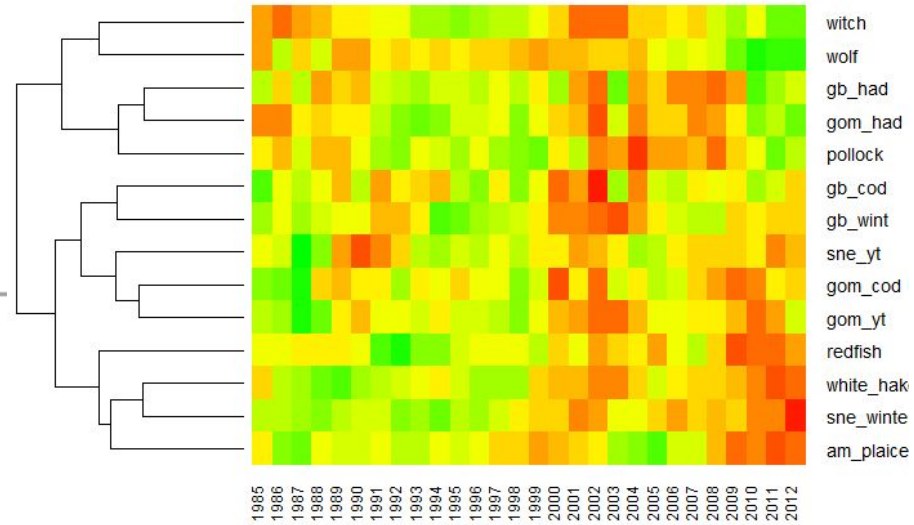


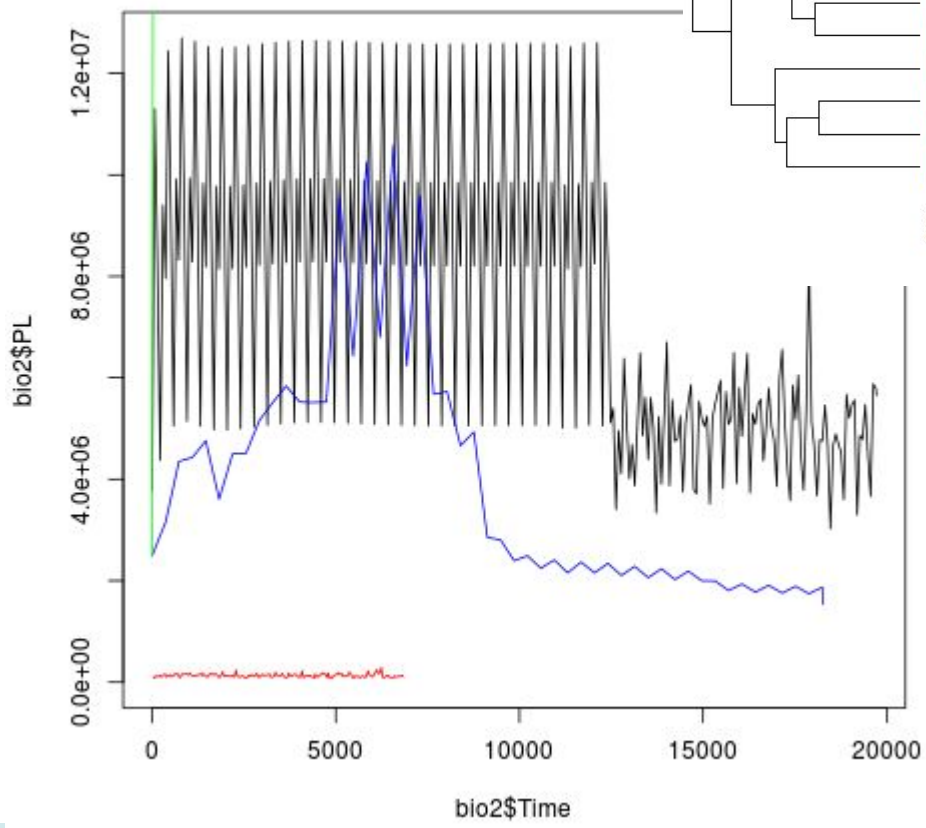
Fig. 4. Copepod size index (small copepod anomaly – large copepod anomaly) time series. Each bar represents the average annual anomaly, and vertical lines denote regime change points

Peretti et al. 2017









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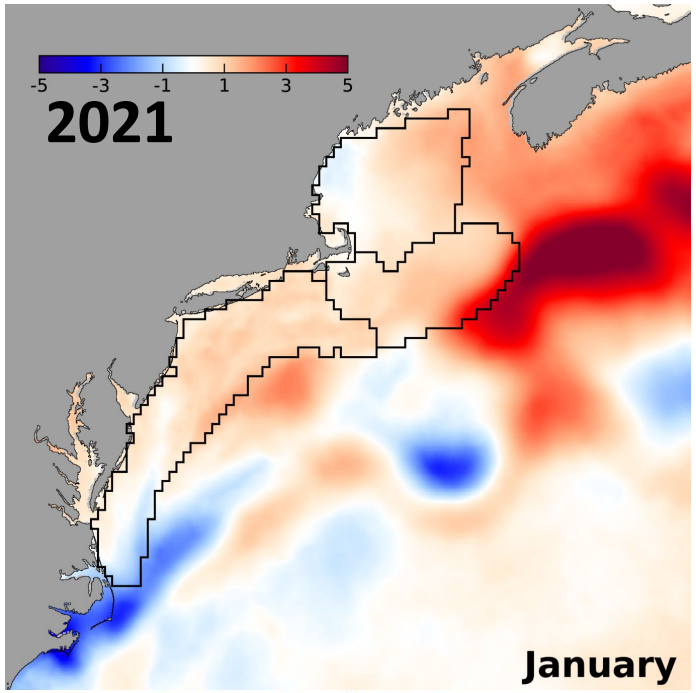
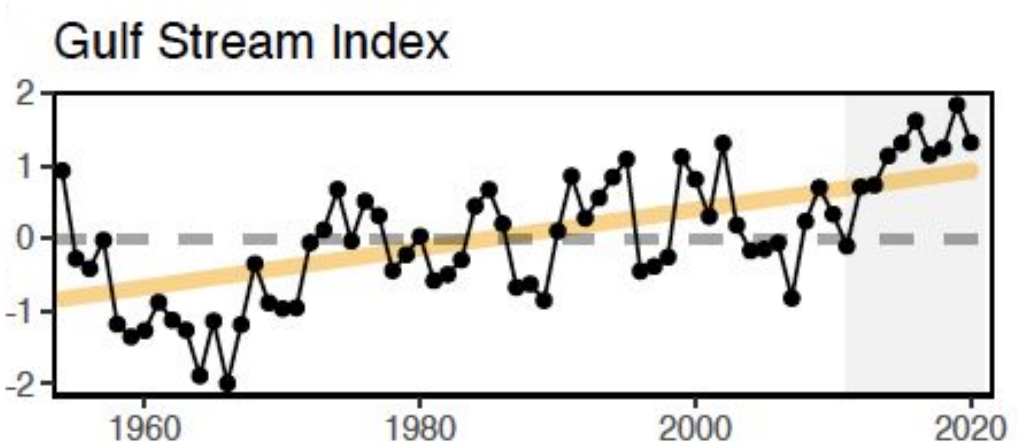
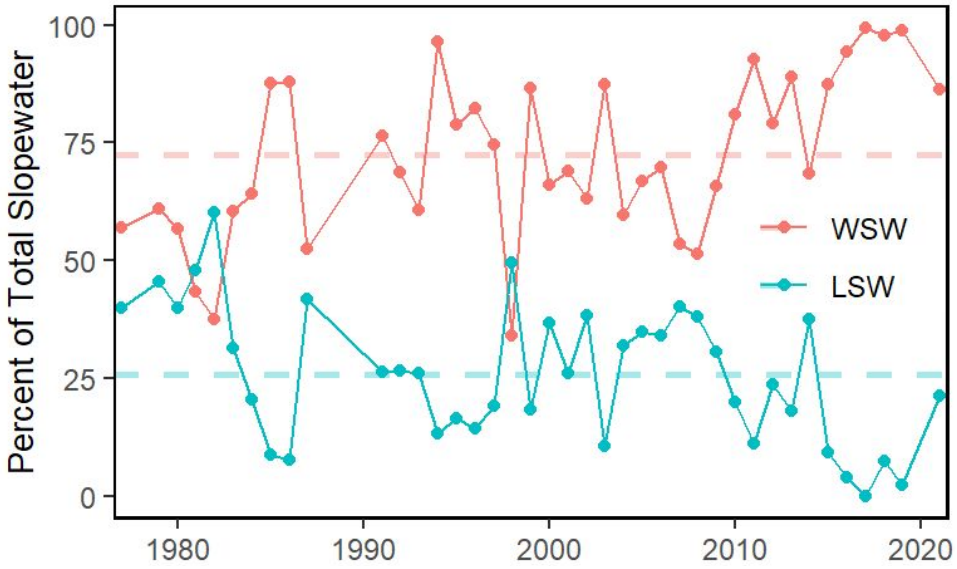
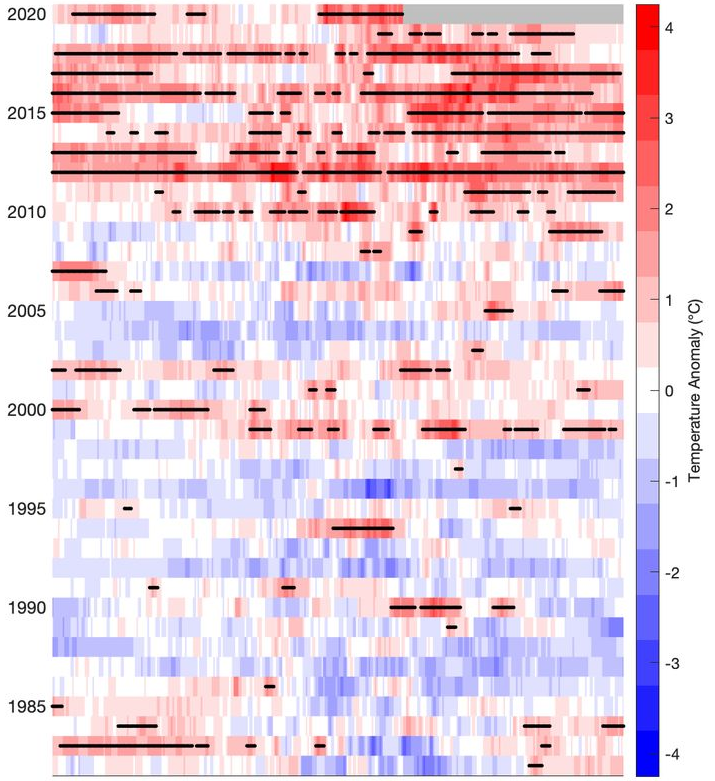


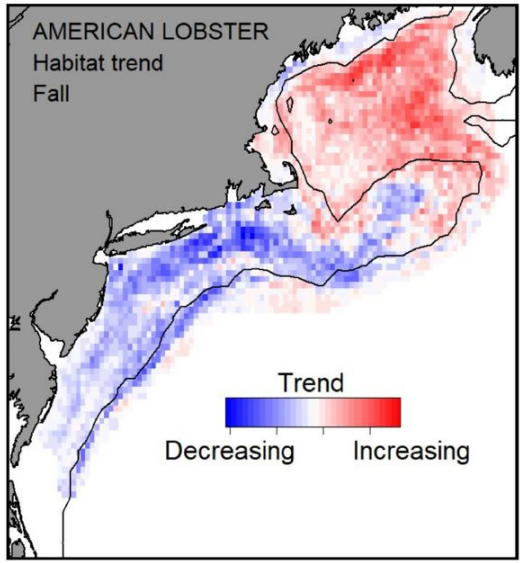




https://www.fisheries.noaa.gov/new-england-mid-atlantic/ecosystems/state-ecosystem-reports-northeast-us-shelf



GMRI



https://www.fisheries.noaa.gov/new-england-mid-atlantic/ecosystems/fisheries-habitat-northeast-us-shelf-ecosystem

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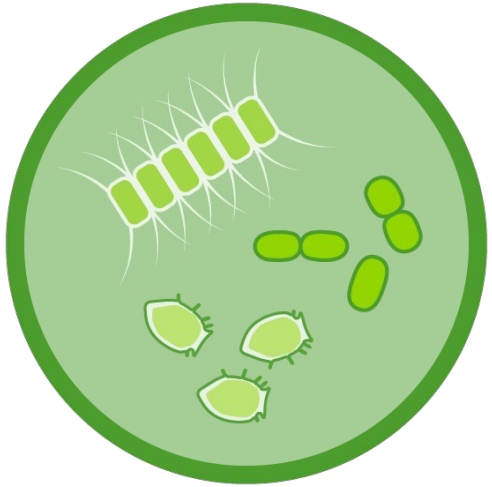
Fisheries Satellite Data Requirements

- Accurate, consistent, timely, climatological quality high-resolution ocean color data/products that can detect changes in the phytoplankton community
  - Merged (e.g. OC-CCI)/gap-filled (DINEOF) sensor agnostic products
- Hyperspectral data (i.e. PACE) for more accurate detection of phytoplankton functional groups
- High quality *in situ* validation data & optimized regional algorithms
- Near real-time data for dynamic ocean management
- High resolution geostationary imagery (GLIMER & GeoXO)
  - Aquaculture, HABs, Coastal Runoff

Take Away Messages



The **oceanographic conditions in the Northeast U.S. are changing** affecting all levels of the marine food web.

Changes in the **abundance, productivity, phenology and community composition of phytoplankton** can affect the marine food web and biogeochemical cycles.

The **long-term time series** of phytoplankton have multiple operational and fisheries management applications.

Thank You

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