NORTHEAST U.S. SHELF
Long-Term Ecological Research

Northeast U.S. Shelf LTER

Photo credit: Jacob Strock

The Northeast U.S. Shelf (NES) LTER is co-located with the highly productive Northeast U.S. Continental Shelf Large Marine Ecosystem, utilized for fisheries, recreation, energy, and transportation. The site's broad-scale studies span the Mid-Atlantic Bight and the Gulf of Maine, with a focal cross-shelf transect extending ~150 km southward from the Martha's Vineyard Coastal Observatory (MVCO) to just beyond the Ocean Observatories Initiative (OOI) Pioneer Array at the shelf break. The region is experiencing faster-than-average warming and other impacts from environmental variability and human activity.

Although patterns of ecosystem change over seasons to decades have been documented, key mechanisms linking changes in the physical environment, planktonic food webs, and higher trophic levels remain poorly understood. Northeast U.S. Shelf LTER research integrates observations, experiments, and models to understand and predict how planktonic food webs are changing, and how those changes impact the productivity of higher trophic levels.

At present:

18 investigators

5 institutions represented

13 graduate students

Marine

Principal Investigator:

Heidi M. Sosik

Woods Hole Oceanographic Institution

Est. 2017

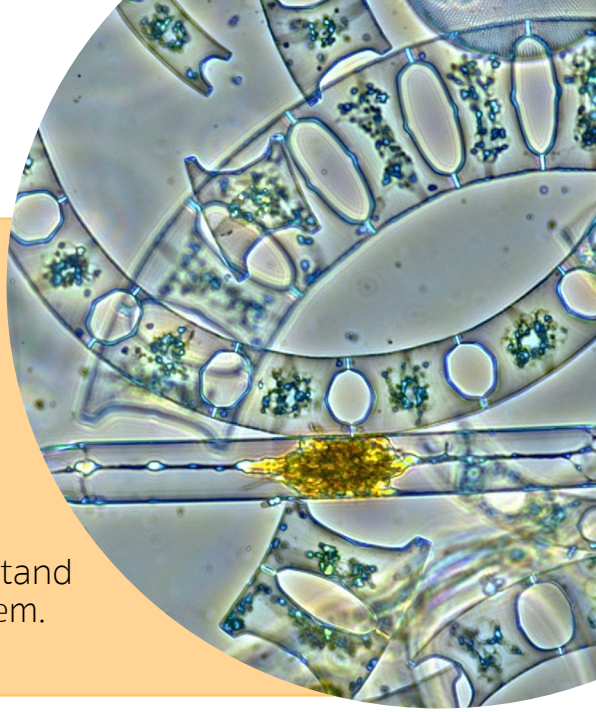
Funding Cycle:

LTER I

NSF Program:

Geosciences / Division of Ocean Sciences / Biological Oceanography

Key Findings



Shifts in phytoplankton phenology are associated with warming trends. Phytoplankton bloom dynamics at Martha's Vineyard Coastal Observatory (MVCO) are sensitive to temperature variability on both seasonal and decadal scales. Multi-year sampling has shown that the genetic background of phytoplankton is diverse and changes rapidly in coastal shelf waters. Ongoing NES LTER observations emphasize the complementary nature of multiple approaches (sequencing, imaging, and flow cytometry) to better document and understand changes in plankton diversity and how it impacts the ecosystem. [Products 1-4]

Spatiotemporal dynamics in microzooplankton. Thanks to automated imaging approaches developed by NES LTER researchers, unprecedented insight has been gained into variations in microzooplankton biomass and diversity across a broad range of space and time scales [5]. In addition, studies in Narragansett Bay documented strong microzooplankton grazing pressure on phytoplankton throughout the year, irrespective of season [6].

Decadal changes in zooplankton abundance and fish distributions. Long term changes in zooplankton abundance and biovolume were documented prior to the funding of NES LTER. The distributions of many fish species in the Mid-Atlantic Bight are shifting northward in the warming ocean. Dominant species of zooplanktivorous forage fishes have interannual, seasonal, and species-specific diet preferences. It remains unresolved how decadal changes in zooplankton influence this higher trophic level. [7-9]

Improved spatial resolution for coupled physical-biological models. NOAA has selected NES LTER PI Changsheng Chen's Finite Volume Community Ocean Model (FVCOM) as the basis of the U.S. Coastal Forecast System.

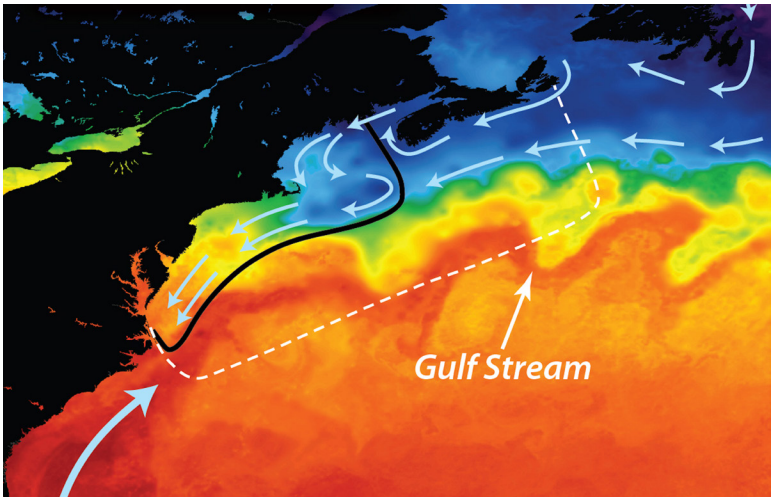
Seasonal switch in carbon cycle efficiency. Initial results from transect cruises indicate that the ratio of net community production to gross primary production peaks onshore in the winter, but offshore during summer. The ratio is a measure of carbon cycle efficiency.

Photo credits: U.S. LTER (top); Heidi Sosik (left)

Synthesis

Initiated cross-site comparisons with other pelagic marine sites. Investigators from NES LTER co-organized a special session at the 2018 LTER All Scientists Meeting with 3 other oceanic sites. This collaboration is also expected to produce standardized protocols.

Co-authored work on the status and future prospects for the 100+ ILTER coastal and marine sites. As part of ILTER, NES LTER is already contributing Essential Ocean Variables to global efforts (as recommended by Framework for Ocean Observation). This work has drawn attention to new technologies and the ongoing importance of coordinated observational activities between LTER sites [10].



Data Accessibility

The primary goals of NES LTER information management are to facilitate continued public access to LTER data and metadata. Ship-provided data from transect cruises can be found in the Rolling Deck to Repository (R2R) and broad scale cruise data is deposited with NOAA NEFSC partners. Both types of data are ultimately archived at the National Center for Environmental Information (NCEI).

Data from post-cruise analyses will be shared as curated data products via the Environmental Data Initiative repository (EDI). Physical oceanographic model data are stored in the Northeast Coastal Ocean Forecast System (NECOFS). Code for the local information management system (IMS) is available in GitHub repositories online.

Photo credits: U.S. LTER

Partnerships

NOAA Northeast Fisheries Science Center (NEFSC) | Ocean Observatories Initiative (OOI) | Martha's Vineyard Coastal Observatory (MVCO) | Northeast Coastal Ocean Forecast System (NECOFS)

Broader Impacts

Ecosystem-based management. Researchers at NES LTER partners with NOAA Northeast Fisheries Science Center (NEFSC) for collaborative research pertinent to managing living marine resources and to integrate LTER data with the longer term NOAA datasets. NEFSC scientists serve on LTER graduate student dissertation committees.

Professional development for teachers. The NES LTER Schoolyard program engages regional teachers in webinars focused on science and data literacy. Teachers are encouraged to join research cruises and enroll their students in the NES LTER Data Jam competition. Researchers from NES LTER also present annually at the Massachusetts Marine Educators Annual Meeting.

Northeast U.S. Shelf LTER engages undergraduates from many backgrounds. Data collected by NES LTER researchers during laboratory and open sea research are used in undergraduate courses, such as Wellesley College's "Chem 103: Elements and the Environment," which teaches students from all majors scientific literacy through an environmental lens.

Top Products

1. Peacock, EE et al. 2014. Parasitic infection of the diatom Guinardia delicatula, a recurrent and ecologically important phenomenon on the New England Shelf. **Marine Ecology Progress Series**. doi: 10.3354/meps10784
2. Hunter-Cevera, KR et al. 2016. Physiological and ecological drivers of early spring blooms of a coastal picophytoplankter. **Science.** doi:10.1126/science.aaf8536
3. Rynearson, T et al. 2018. Impacts of microdiversity on succession and organism interactions in the plankton. **2018 Ocean Science Meeting**, Portland, OR
4. Sosik, HM. 2018. Sequencing, cytometry, and imaging provide complementary assessment of plankton communities in the MVCO time series. **ICES Annual Science Conference 2018**, Hamburg, Germany
5. Brownlee, EF et al. 2016. Microzooplankton community structure investigated with imaging flow cytometry and automated live-cell staining. **Marine Ecology Progress Series**. doi: 10.3354/meps11687
6. Lawrence, C. and S. Menden-Deuer. 2012. Drivers of protistan grazing pressure: seasonal signals of plankton community composition and environmental conditions. **Marine Ecology Progress Series**. doi: 10.3354%2Fmeps09771
7. Morse, RE et al. 2017. Distinct zooplankton regime shift patterns across ecoregions of the U.S. Northeast continental shelf Large Marine Ecosystem. **Journal of Marine Systems**. doi: 10.1016%2Fj.jmarsys.2016.09.011
8. Kleisner, KM et al. 2016. The Effects of Sub-Regional Climate Velocity on the Distribution and Spatial Extent of Marine Species Assemblages. **PLOS ONE**. doi: 10.1371/journal.pone.0149220
9. Suca, JJ et al. 2018. Feeding dynamics of Northwest Atlantic small pelagic fishes. **Progress in Oceanography.** doi: 10.1016/j.pocean.2018.04.014
10. Muelbert, JH et al. 2019. ILTER - the International Long-Term Ecological Research network as a platform for global coastal and ocean observation. **Frontiers in Marine Science**. doi: 10.3389/fmars.2019.00527

Photo credits: U.S. LTER; NES LTER (bottom)