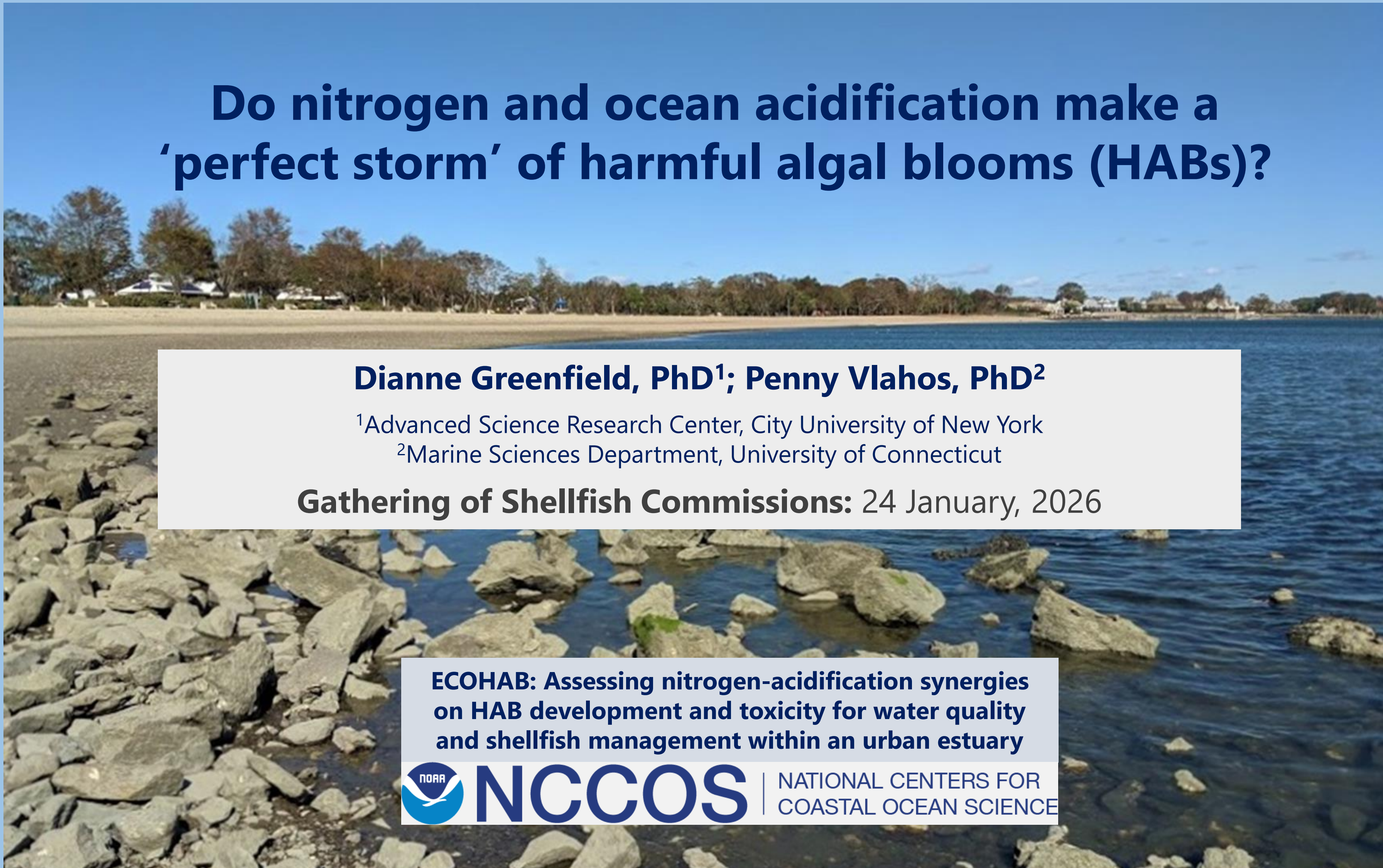

Do nitrogen and ocean acidification make a 'perfect storm' of harmful algal blooms (HABs)?

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Gathering of Shellfish Commissions: 24 January, 2026

ECOHAB: Assessing nitrogen-acidification synergies on HAB development and toxicity for water quality and shellfish management within an urban estuary

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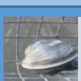
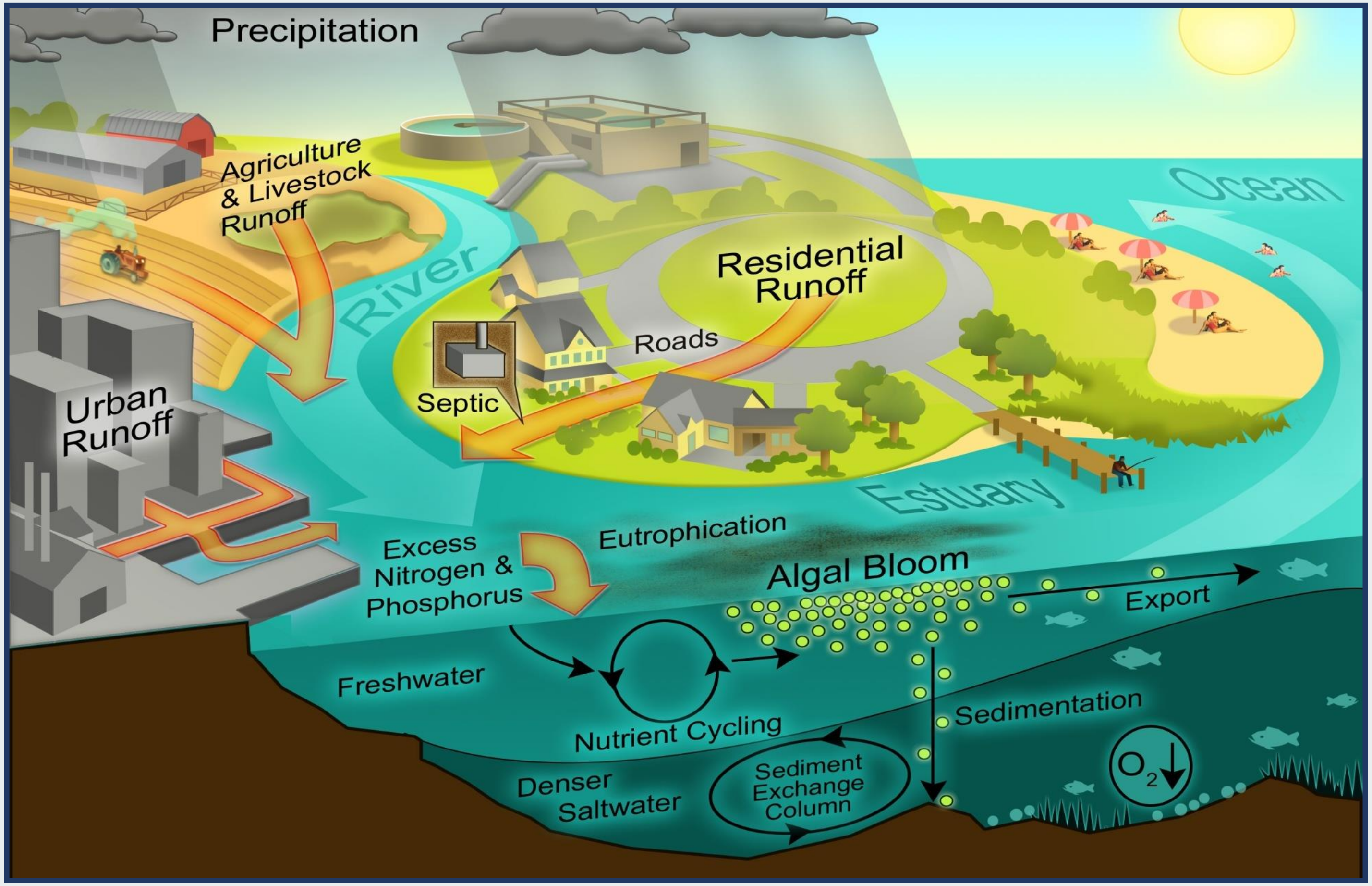
Calf Pasture Beach, Norwalk CT

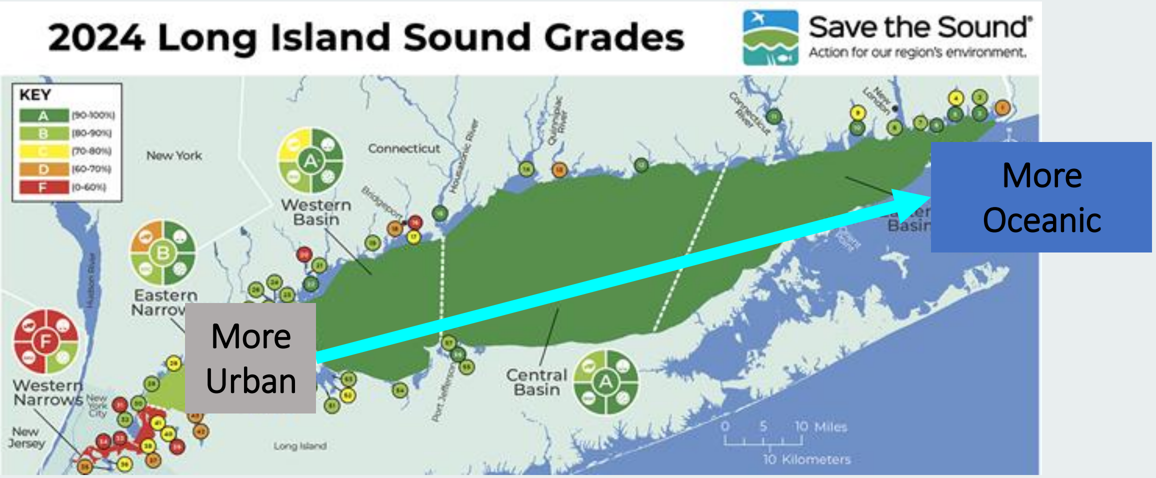


Brief Background



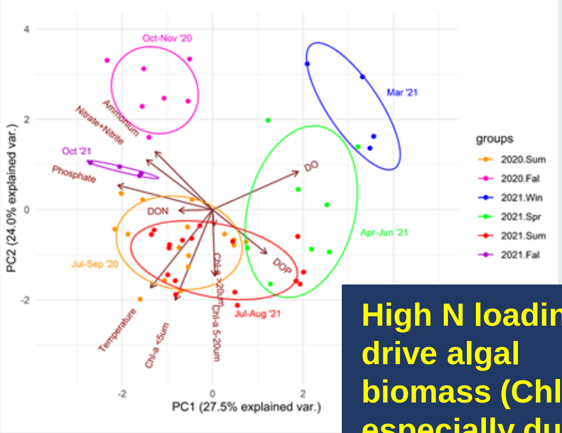
- Nutrients (especially nitrogen (N)) facilitate algal bloom development. In Long Island Sound (LIS), N has been liked to decades of algal blooms and hypoxia.
- Effective wastewater management has reduced N-loadings, but water quality impairments, including algal blooms, persist.

Brief Background



Urban-oceanic transition => **Decreasing** algal biomass (Chl *a*), nutrients (dissolved inorganic nitrogen, phosphorus), and other water quality indicators. **Increasing** dissolved oxygen, salinity. The shoreline is **more complicated**. HAB species have been detected across LIS shores & embayments, but they do not always follow an urban-suburban gradient. ***WHY??***

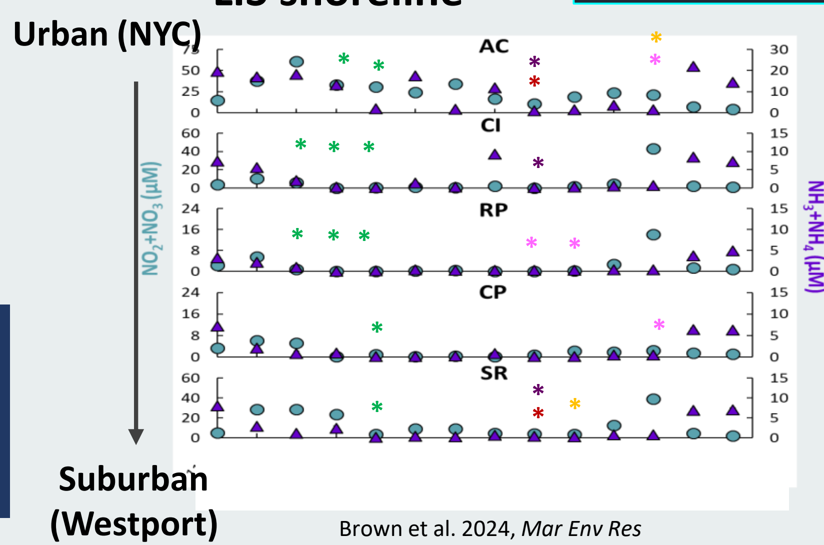
LIS mainstem



Roldan-Ayala et al. 2023, *ECSS*

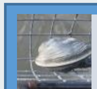
High N loadings drive algal biomass (Chl *a*), especially during warmer months

LIS shoreline



Brown et al. 2024, *Mar Env Res*

N-enriched shore sites had more HABs (warm colored asterisks) – ***not necessarily along an urban-ocean gradient.***



Gathering of CT Shellfish Commissions, New Haven CT, 2026

Brief Background

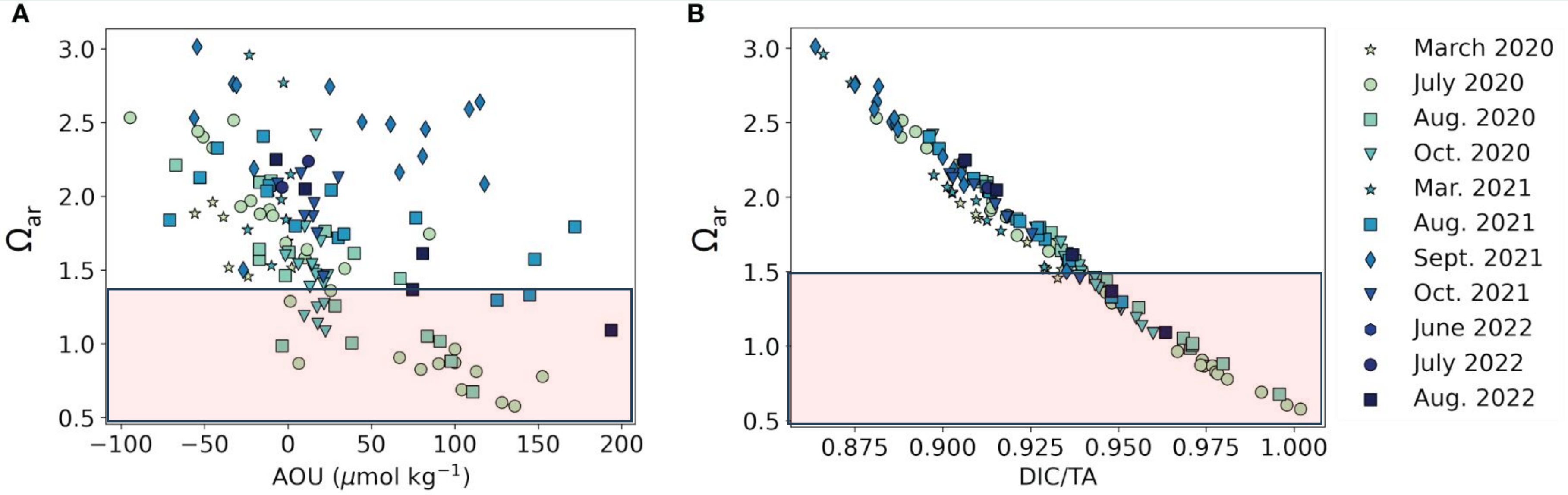


Figure 4 The relationship between aragonite saturation state (Ω_{ar}) calculated from TA and DIC and **(A)** apparent oxygen utilization (AOU) ($R^2 = 0.26$, $p < 10^{-9}$, n = 139), **(B)** DIC/TA ($R^2 = 0.98$, $p < 10^{-100}$, n = 139) from March 2020 – August 2022. Marker color represents different sampling events, and marker shape represents the month of sampling.

Front. Mar. Sci., Sec. Marine Biogeochemistry, Vol 11 -2024 https://doi.org/10.3389/fmars.2024.1398087

Brief Background

Year	Hypoxic Area (km^2)[a]	Hypoxic Duration (d)[a]	Housatonic River Discharge ($m^3\ s^{-1}$)[b]	Average DIC ($\mu mol\ kg^{-1}$)	Average TA ($\mu mol\ kg^{-1}$)	Average DIC/TA	Average Ω_{ar}
2020	163	43	17 ± 13	1909.7 ± 31.0	1933.3 ± 11.8	0.977 ± 0.014	0.88 ± 0.22
2021	368	47	137 ± 118	1789.2 ± 34.8	1951.6 ± 18.6	0.914 ± 0.012	1.98 ± 0.23
2022	225	57	15 ± 7	1927.9 ± 20.1	1999.5 ± 12.0	0.963 ± 0.000	1.09 ± 0.00
1990-2021	538	52	–	–	–	–	–

[a]Hypoxic area and duration from Long Island Sound Study (2022). [b]Housatonic River discharge from USGS (2022a).

Table 1 Western LIS (west of longitude -73.0) summertime (July – September) average bottom water hypoxic area, Housatonic River discharge, DIC, TA, DIC/TA, and Ω_{ar} by year.

We know that N and OA both impact HABs. But the environmental linkages between these stressors to harmful algal blooms in the LIS region remain poorly understood.

Front. Mar. Sci., Sec. Marine Biogeochemistry, Vol 11 -2024 https://doi.org/10.3389/fmars.2024.1398087

Project Hypothesis/Objectives

Hypothesis:

HAB and OA dynamics are inextricably linked through their associations with nitrogen loadings

Objectives and Timeframe:

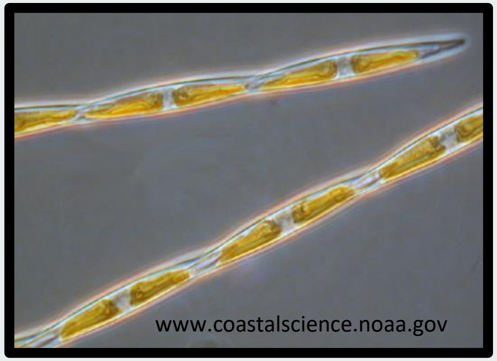
1. Determine the spatial and temporal variability of key HABs and related water quality. (**Years 1-3**)

2. Measure the full carbonate (OA) system along with HABs. (**Years 1-3**)

3. Test HAB species responses to N and OA combined. (**Years 2-3**)

4. Generate HAB risk assessments using field and experimental data collected during this project. (**Years 2-3**)

Key HAB Taxa



Alexandrium

- Produces saxitoxin (PSP)
- Multiple species in LIS
- Most common early-mid spring

Pseudo-nitzschia

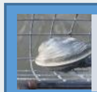
- Produces domoic acid (ASP)
- Multiple species in LIS
- Most common early spring and early fall

Dinophysis

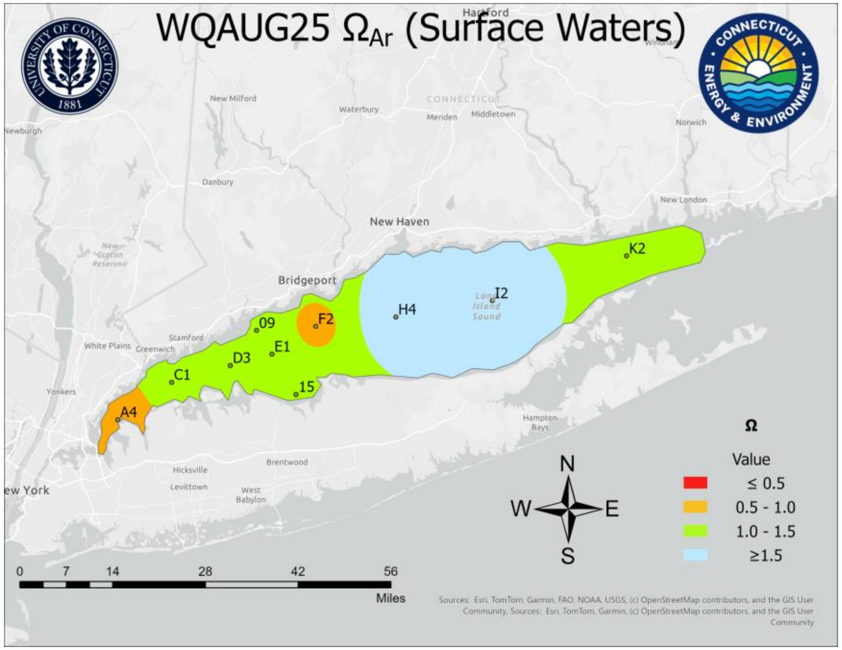
- Produces okadaic acid (DSP)
- 2 main species in LIS
- Most common early-mid summer

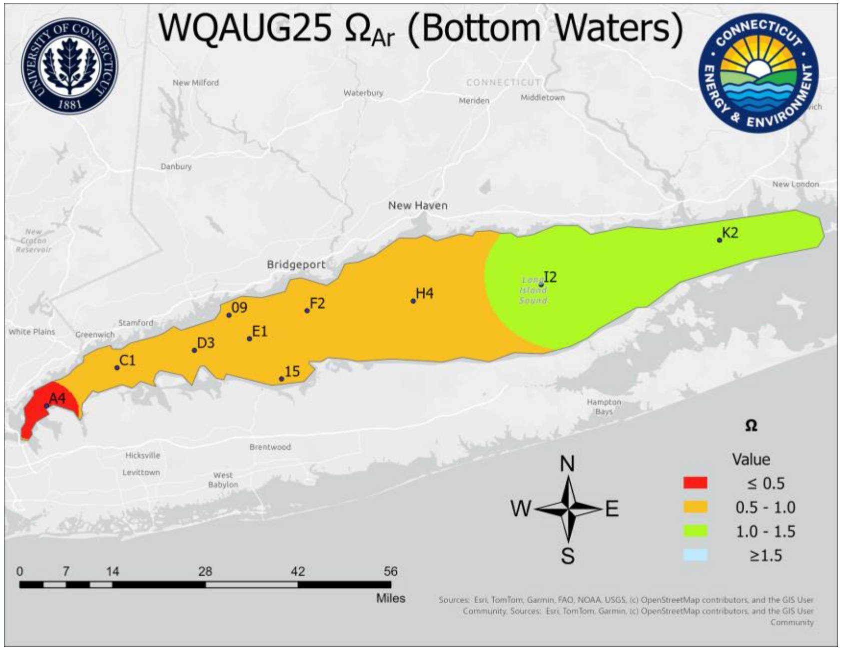
❑ Above 3 taxa were identified by NY/CT managers as priorities for this project due to their ongoing threats to shellfish safety

❑ Emphasis is placed on *Alexandrium*, *Dinophysis*, and *Pseudo-nitzschia*, but all observed HABs are of interest



Aragonite Saturation in LIS

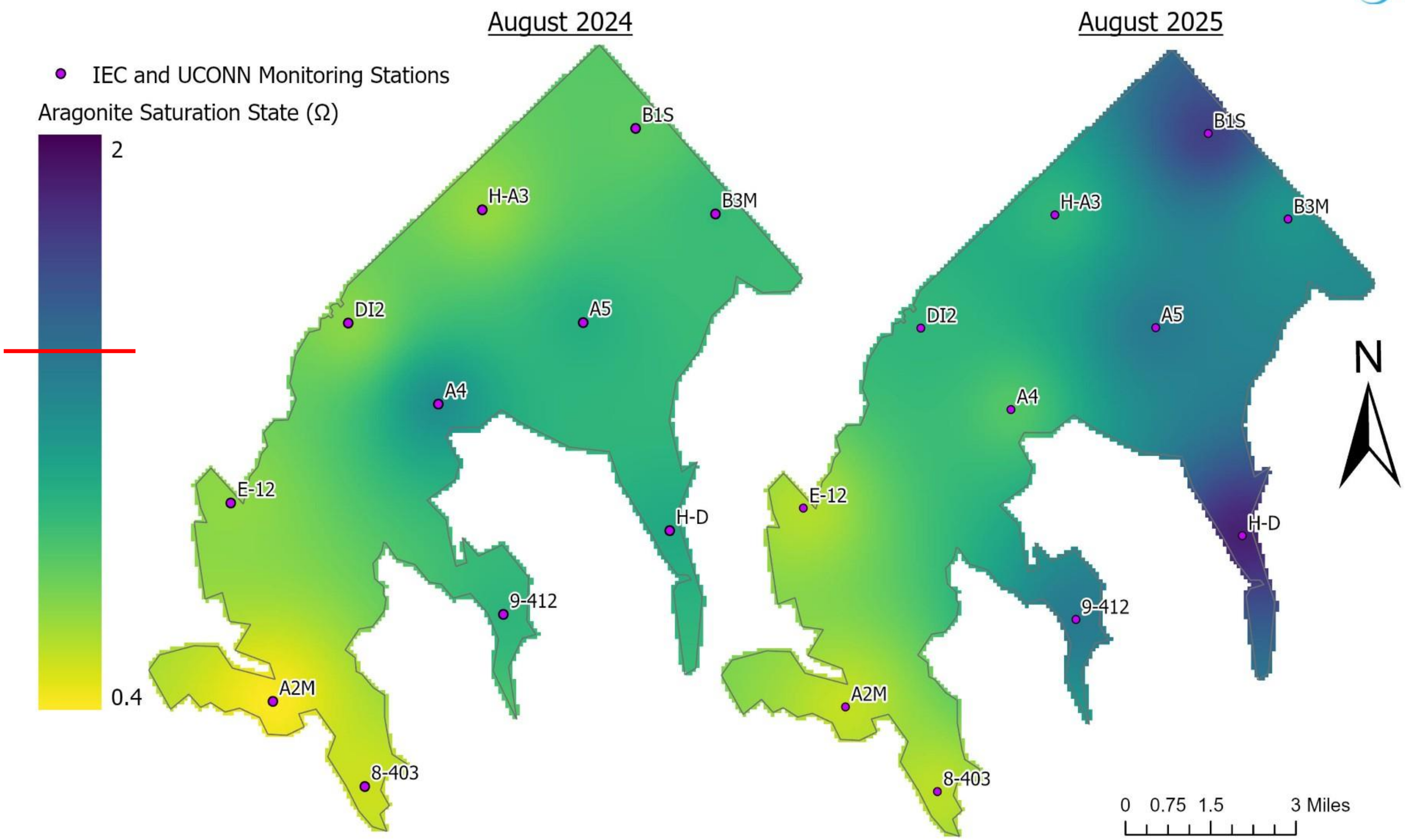




Aragonite Saturation State (Ω) of Interstate Environmental Commission Samples in Western Long Island Sound August 2024 and August 2025

UCONN UNIVERSITY OF CONNECTICUT

Interstate Environmental Commission



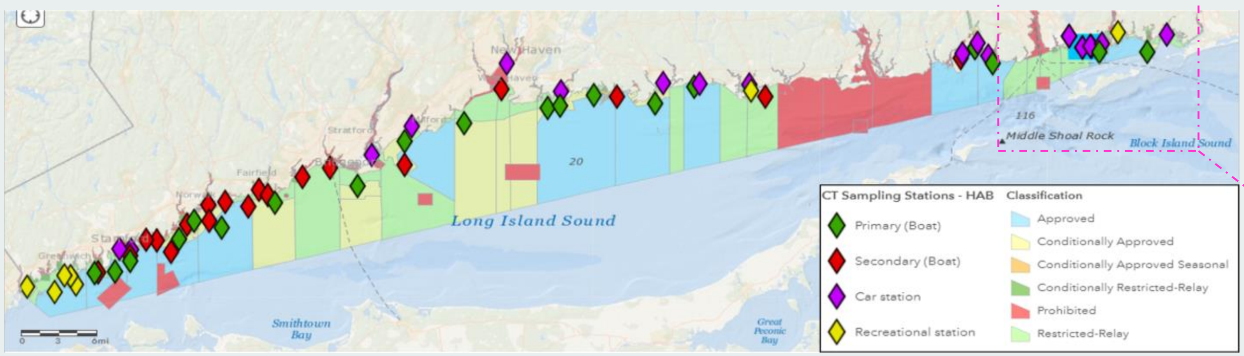
Note: *Aragonite Saturation State (Ω) was calculated using CO2SYS from measured total alkalinity (TA), dissolved inorganic carbon (DIC), and pH with temperature, salinity, available nutrient inputs, etc. Maps were created in ArcGIS Pro using inverse distance weighting (IDW); identical color scales were applied for annual comparison.

Layout Created by: Alexis Sims
Research Assistant UCONN
Date: 01/21/26

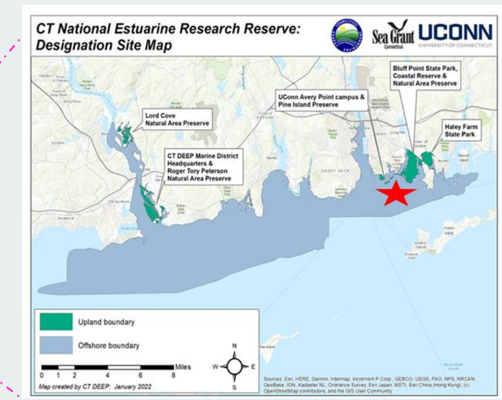
Data sources: Interstate Environmental Commission (IEC); USGS

Sampling and Analytical Overview (2026)

- **Stations**: Offshore (CTDEEP), Nearshore (north and south shores of LIS, CT emphasized here)
- **Water Quality**: physical parameters, nutrients
- **Phytoplankton:** chlorophyll *a*, HABs, toxins (when needed)
- **Aragonite saturation (OA)**: Ocean acidification chemistry



Locations of 68 CT DABA HAB and biotoxin monitoring stations, as 19 primary (boat, sampled most frequently, typically monthly), 19 secondary (boat), 18 car, and 12 recreational stations. Primary stations represent 14 towns with the highest shellfish harvests.



Nearshore Location of new CT National Estuarine Research Reserve, near Mumford Cove (starred)

In addition to leveraged bloom-response efforts, we shall survey sites in areas identified as management concern (e.g., observations of *Pseudo-nitzschia*, *Alexandrium*) that span varying N and OA conditions

Gathering of CT Shellfish Commissions, New Haven CT, 2026

How can you help?

1. Coordination and Communication – what works best?
2. Collect water samples if you see something that resembles a bloom (we will provide guidance & sampling materials)?
3. Participate in a 'sample blitzes' where multiple commissions sample on the same day?
4. Communicate observations of discolored water or blooms (along with state managers)?
5. Other ideas?

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