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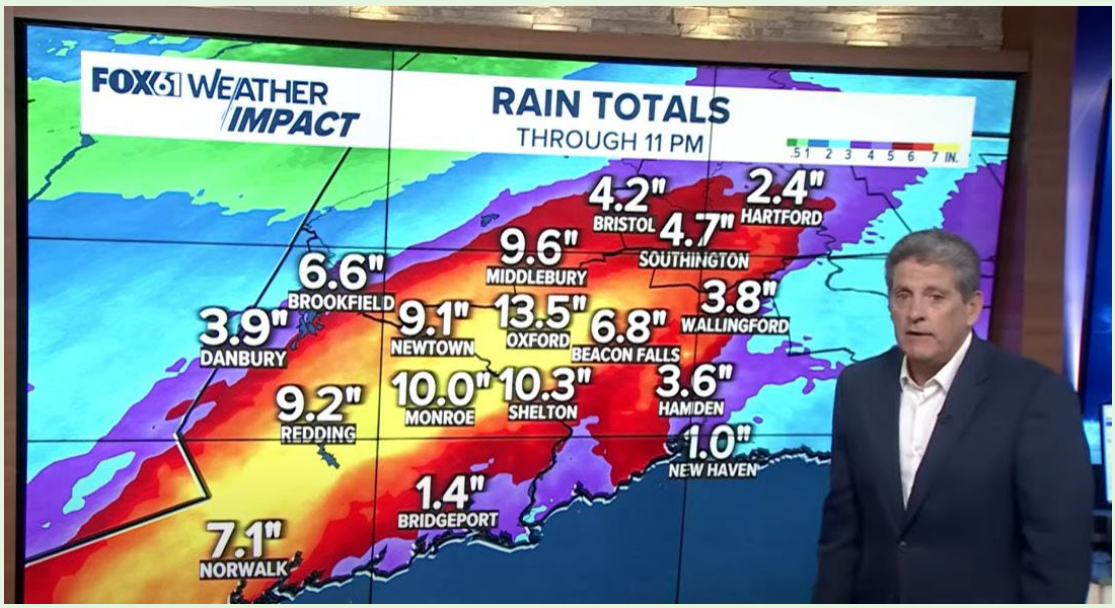
Long Island Sound Water Quality Monitoring Program **November 6, 2024**

September

Historic Flash Flooding Precedes our WQSEP24 Survey



Fox61CT and CTDEEP Meteorologist Sam Sampieri. Credit: Fox61CTNews Station

Weather

September 2024 continued the trend of warm and dry conditions across the Northeast, affecting Long Island Sound and its surrounding regions. Connecticut saw an average temperature of 63.6°F, slightly above normal, consistent with the broader Northeast region's 13th warmest September on record. While Maine experienced its sixth warmest September, coastal areas like Long Island Sound witnessed milder, yet still above-average, warmth.

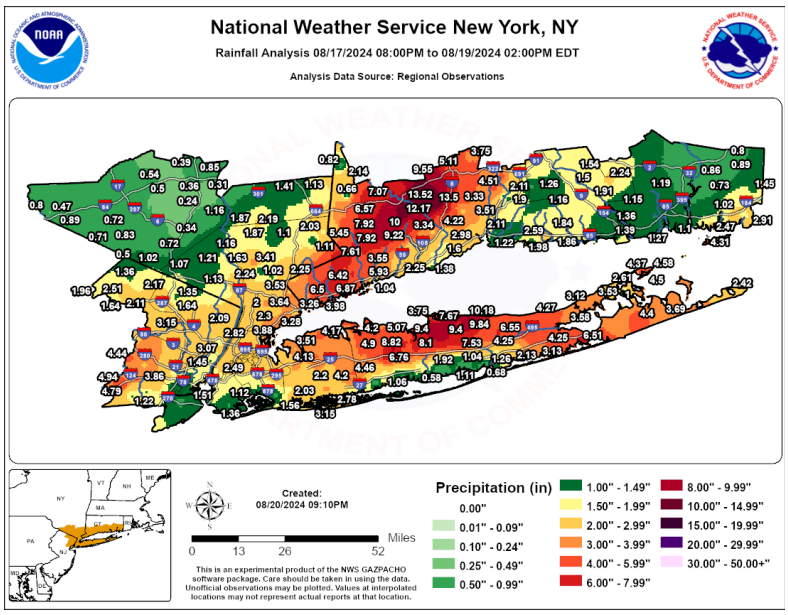
Rainfall was notably low across the region, with Connecticut recording only 1.05 inches, about 24% of typical September precipitation. Specific towns such as Stamford, New Haven, and Danbury experienced these dry conditions firsthand, contributing to the intensification of drought across the region. In New York, similar patterns were observed, with areas like Islip receiving only 0.24 inches of rain, making it the driest September on record for that location. This significant deficit contributed to worsening drought conditions, particularly in coastal New England, where dry weather led to reductions in soil moisture, streamflow, and groundwater levels. Across the Northeast, drought conditions intensified through September, with abnormal dryness expanding to include much of the coastal region. The U.S. Drought Monitor's late September report showed that around 39% of the Northeast was abnormally dry or experiencing drought conditions.

Adding to the environmental challenges, flash flooding on August 18 and 19 brought sudden and severe impacts to several Connecticut communities, highlighting the region's vulnerability to extreme weather events. In Fairfield County, dozens of road closures and multiple water rescues were reported town-wide in Stamford as floodwaters rose between 9:20 AM and 11 AM. Significant flooding along the Goodwives River in Darien closed roads near the Old Kings Market shopping center, while further north, Danbury faced road closures and a vehicle water rescue on Main Street.

Other areas were similarly impacted. Ridgefield experienced road closures with water levels reaching one to three feet in some areas, and a mudslide on Shelter Rock Road in Bethel led to a major gas leak and evacuations in the Woodland Hills Complex. Tragically, two fatalities occurred in Oxford due to rising floodwaters, underscoring the severe risks associated with these flash floods.

In New York, towns on Long Island such as **Huntington**, **Port Jefferson**, and **Smithtown** faced flash flooding that led to road closures, water rescues, and property damage. The **Nissequogue River** in Smithtown overflowed its banks due to a dam breach, resulting in evacuations and significant impact on local infrastructure.

The combination of a severe flash flood event followed by an exceptionally dry September highlights the challenges faced in managing water resources and maintaining water quality in Long Island Sound. For additional information on the August 18–19 flash flooding event, please refer to the National Weather Service's detailed report.



Please visit the Northeast Regional Climate Center's website for more information.

Dissolved Oxygen Summary

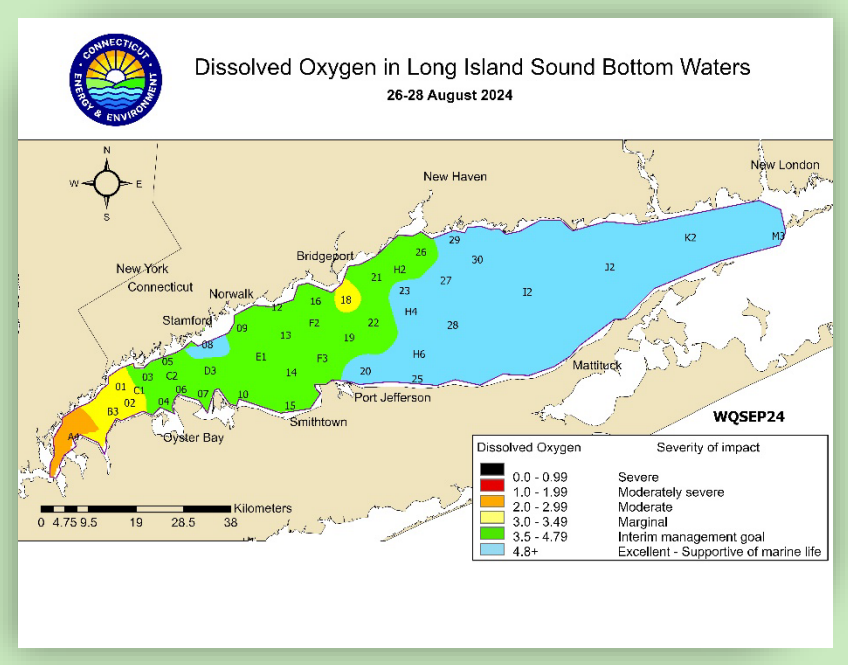
CT DEEP sampled 42 stations during the WQSEP24 survey that was conducted from 26-28 August 2024. Dissolved oxygen (DO) concentrations in the bottom waters of Long Island Sound during the WQSEP24 degraded slightly compared to HYAUG24 concentrations.

The lowest concentration measured during the survey was 2.82 mg/L at Station A4 and the highest was 7.11 mg/L measured at Station M3.

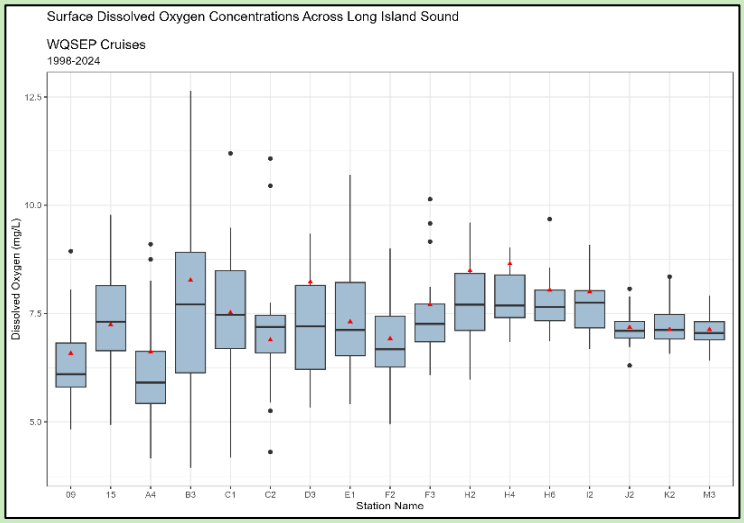
Of the 27 bottom water measurements recorded in September at Station A4 between 1998 and 2024, the median concentration was 2.95 mg/L with a range of 0.93 to 6.08 mg/L. The mean was 3.27 mg/L.

Leading up to the WQSEP24 survey, A4 had concentrations of 3.25 mg/L during HYAUG24 and 2.25 mg/L in WQAUG24.

During the WQSEP24 survey there were 51.9 km^2 (20.04 mi^2) of bottom water with DO less than 3.0 mg/L and 1002.9 km^2 (387.22 mi^2) with concentrations between 3.0 and 4.8 mg/L.



Preliminary data from this survey and prior 2023 cruises are available in Excel spreadsheet format as well as on the UCONN ERDDAP site.



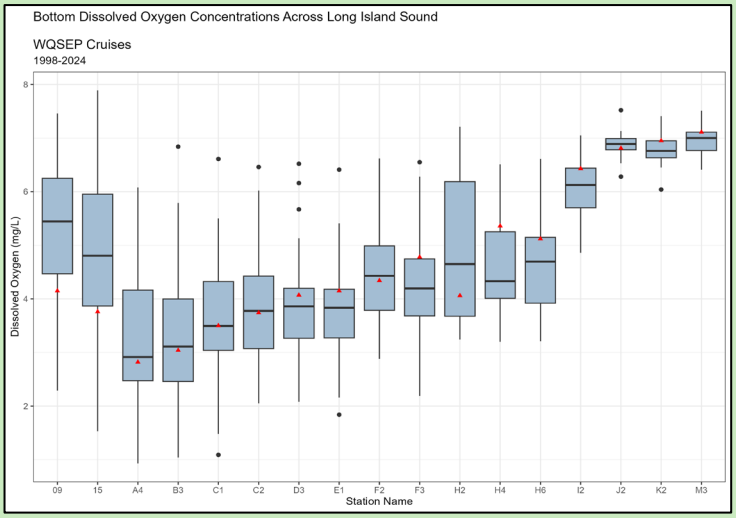
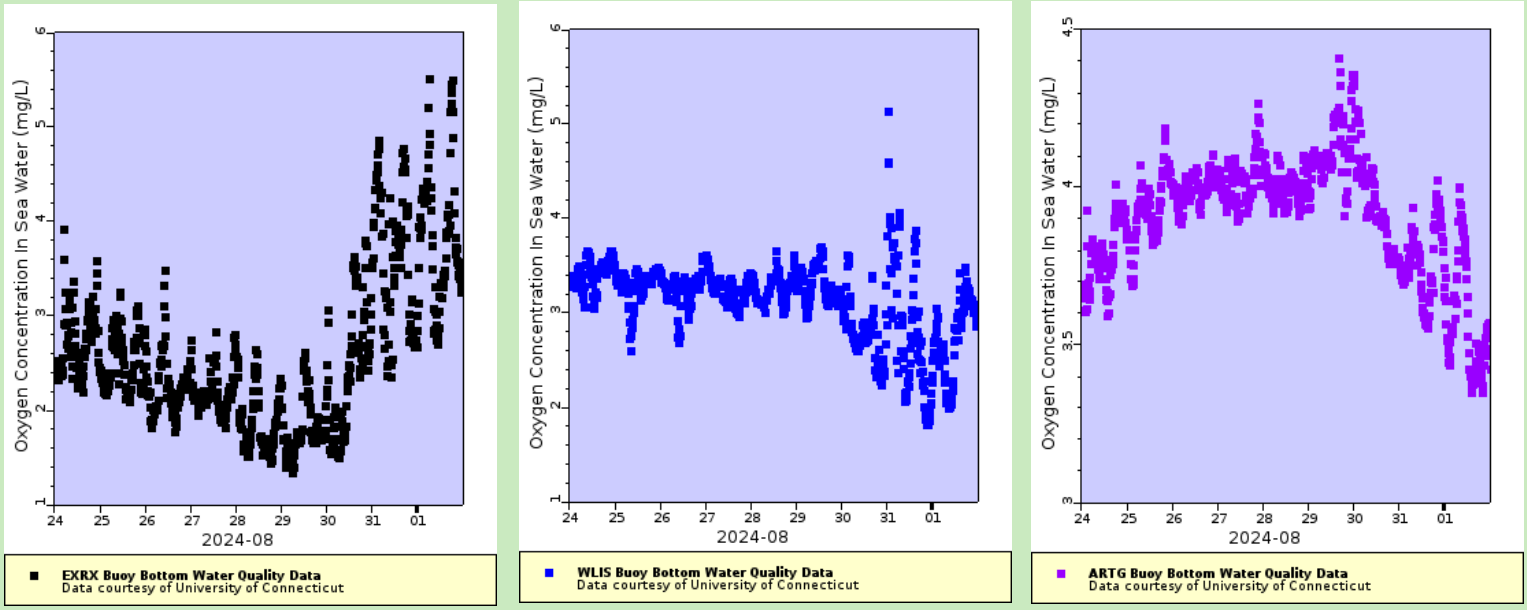


Table 1. Minimum Dissolved Oxygen Concentrations and Areal estimates for WQSEP Cruises Conducted from 1998-2023 by CT DEEP.

Cruise	Minimum DO Observed (mg/L)	Station with Minimum DO	Area under 4.8 mg/L (km^2)	Area under 3 mg/L (km^2)
WQSEP98	1.19	B3	1457.8	435.3
WQSEP99	3.75	H6	169.3	0
WQSEP00	3.39	15	455	0
WQSEP01	1.02	02	1216.7	292.4
WQSEP02	4.58	B3	107.5	0
WQSEP03	2.23	E1	1241.1	33.5
WQSEP04	0.93	A4	1396.7	296.1
WQSEP05	0.99	A4	1031.8	223.8
WQSEP06	2.89	F3	593.9	0
WQSEP07	2.88	A4	886	41.6
WQSEP08	2.17	02	1562.5	340.5
WQSEP09	1.84	E1	1234.1	332.1
WQSEP10	3.66	A4	213.7	0
WQSEP11	4.32	A4	75	0
WQSEP12	2.55	02	1643	131.7
WQSEP13	2.33	B3	1207.3	100.1
WQSEP14	2.74	A4	856.7	34.3
WQSEP15	2.52	A4	892.4	56.3
WQSEP16	1.87	A4	1170.1	139
WQSEP17	2.46	A4	565.9	109.8
WQSEP18	2.34	A4	1411.8	133.6
WQSEP19	2.74	E1	699	52.6
WQSEP20	2.79	A4	875.6	43.0
WQSEP21	1.69	B3	792.2	43.5
WQSEP22	1.90	A4	1109.1	153.3
WQSEP23	3.56	A4	864.0	0
WQSEP24	2.82	A4	1054.8	51.9



Above: Continuous Dissolved Oxygen Data from three LISICOS Buoys across Long Island Sound

Temperature Data Summary

Bottom water temperatures rose an average of 0.29˚C from HYAUG24 to WQSEP24, while surface water temperatures saw a 0.17˚C decrease.

The maximum surface water temperature during the WQSEP24 survey occurred at Station 03 (24.2˚C) while the maximum bottom water temperature occurred at Station 25 (22.94˚C).

The average surface and bottom water temperature for WQSEP24 (17 year-round stations only) were 22.91ºC and 21.58ºC, respectively. WQSEP24 average temperatures were lower than in 2023 (S: 23.49ºC, B: 21.70ºC) and in 2022 (S:24.09·C, B:23.00ºC).

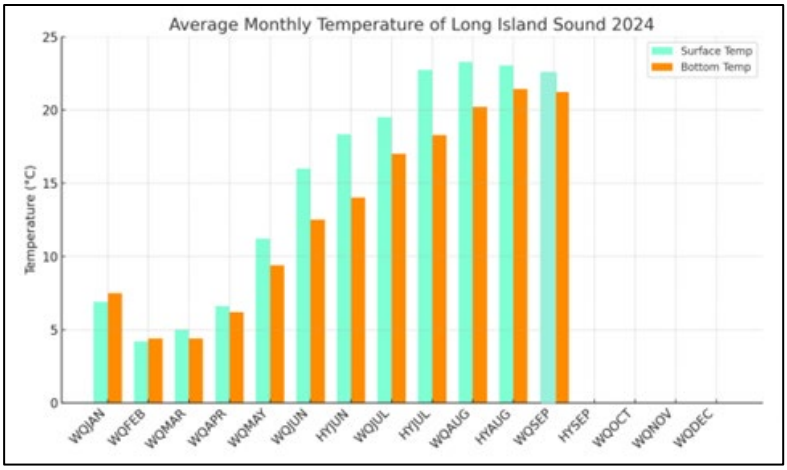
Delta T (ΔT)

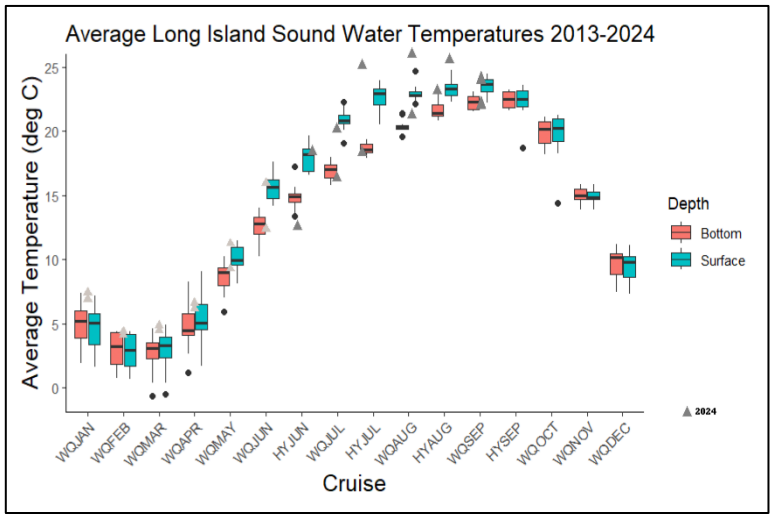
The greatest temperature difference between the surface and bottom waters during the WQSEP24 survey was 2.38˚C, measured at Station 03. The smallest temperature difference was 0.2˚C at Station 08.

ΔT's averaged 1.4ºC compared to 1.79˚C during the WQSEP23 survey. WQSEP22 ΔT's averaged 1.09ºC.

Delta T (ΔT) is the difference between the surface and bottom water temperature. Differences in water temperature contribute to stratification and exacerbate hypoxic conditions. In general, the shallower coastal stations tended to have the smallest temperature differences, as they are more susceptible to mixing, weather, and anthropogenic influences (human caused Influences). The greater the delta T, the greater the potential for hypoxia to be more severe.

In June, DEEP's hypoxia monitoring cruises began. The DEEP's monitoring program records water temperatures and salinity during its hypoxia monitoring cruises to help estimate the extent of favorable conditions for the onset and ending of hypoxia. Water temperature plays a major role in the timing and severity of the summer hypoxia event. Water temperature differences in the western Sound during the summer months are particularly influential in contributing to the difference in dissolved oxygen content between surface and bottom waters.

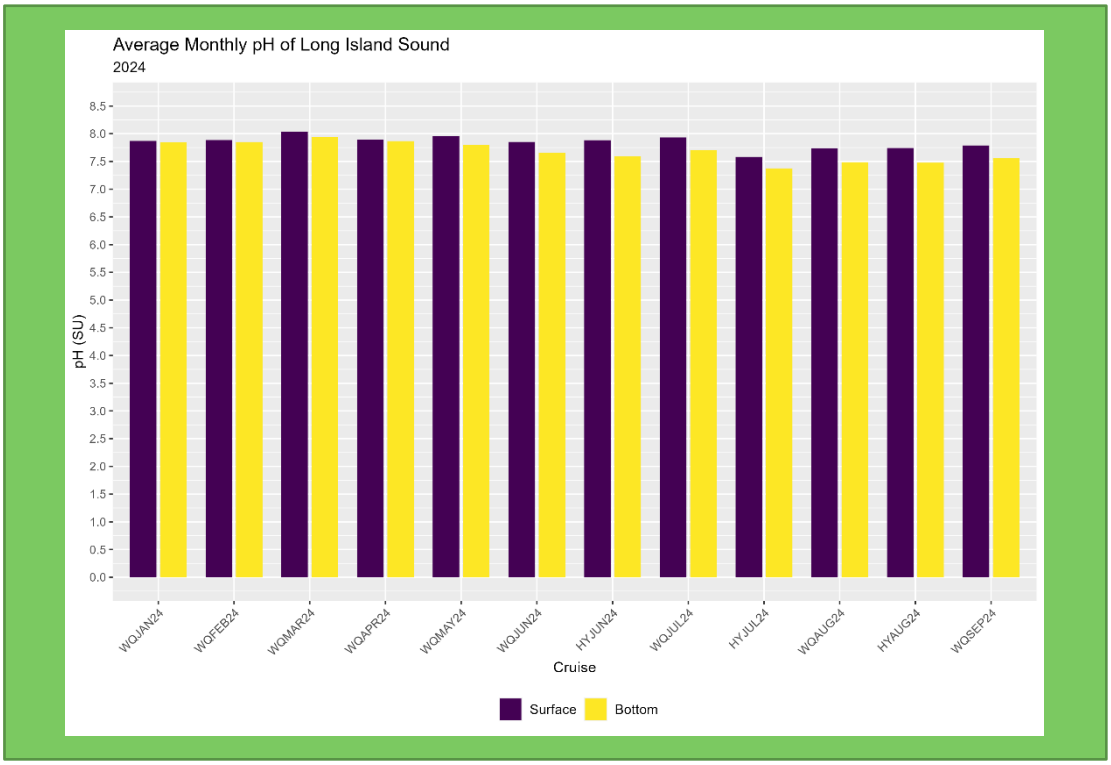


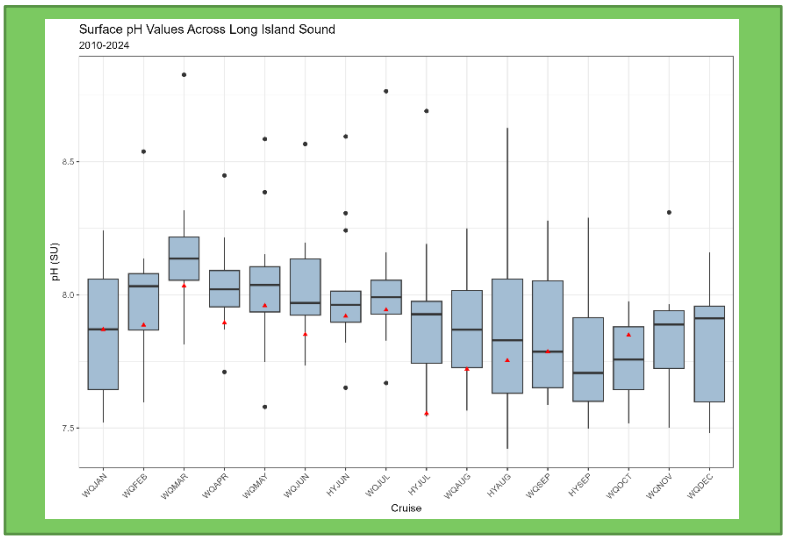


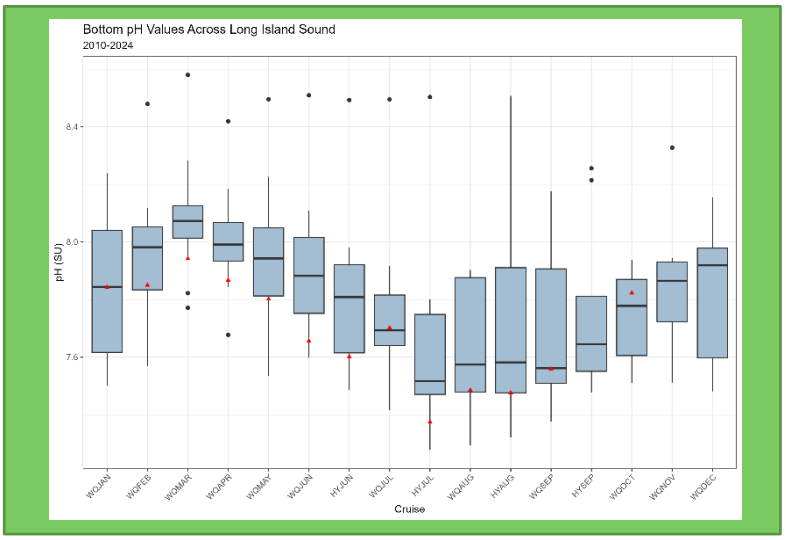
pH

The average surface and bottom pH from all the stations across LIS during the WQSEP24 survey were 7.78 and 7.53 SU, respectively. The lowest bottom pH was 7.3 (Station A4), the highest bottom pH was 8.03 (Station J2), the lowest surface pH was 7.55 (Station 06), and the highest surface pH was 7.95 (Stations 03 and 28).

The average surface and bottom pH graphs for all the cruises from 2010 to date only include the 17 year-round stations.





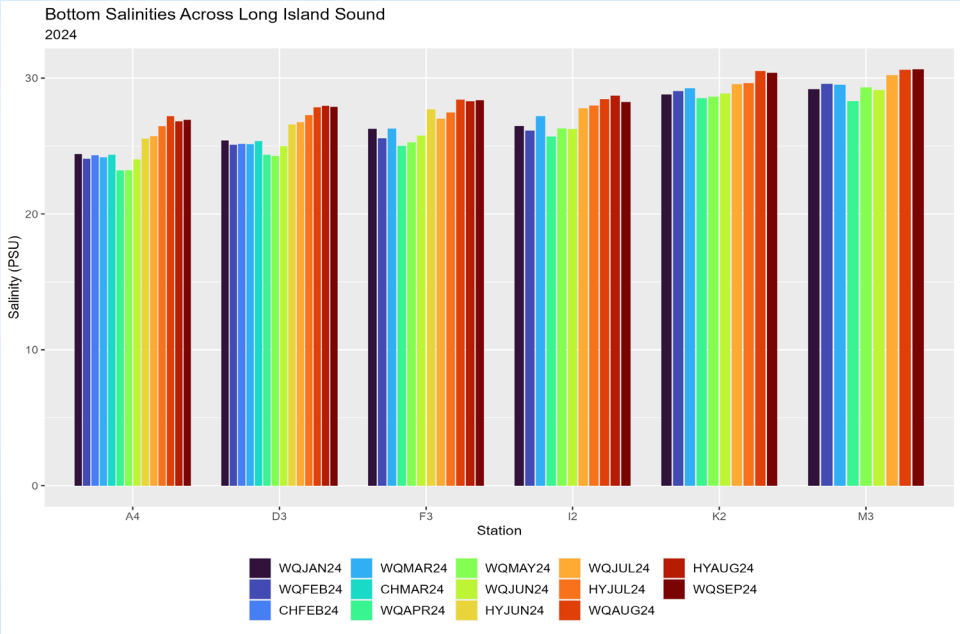


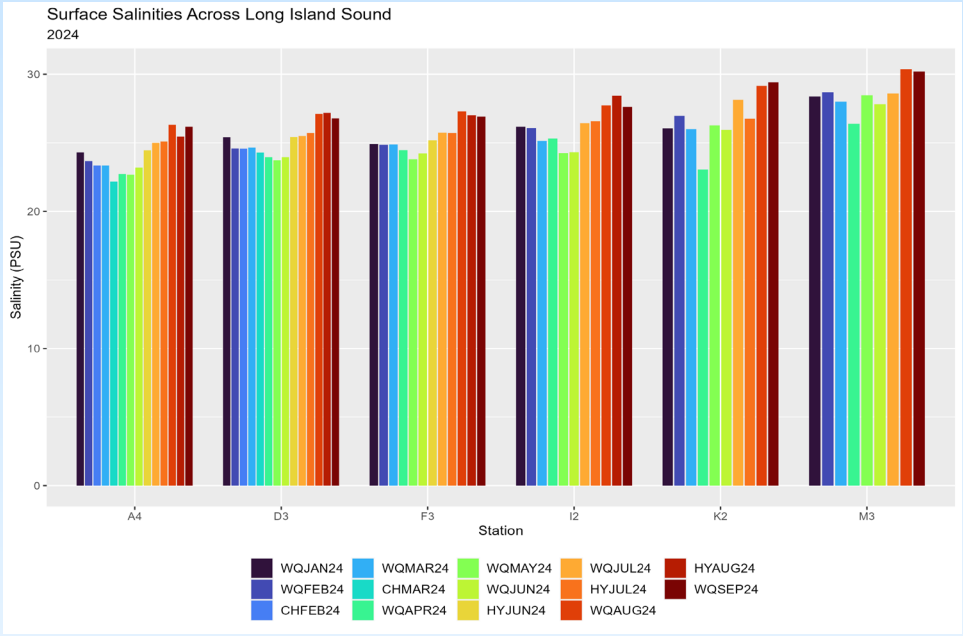
Salinity

Surface salinities across Long Island Sound generally decrease slightly from January through May due to snow melt and spring rains. The less dense freshwater will float on top of the denser saltwater contributing to stratification and impacting hypoxia. Additionally, nutrients carried by runoff fuel phytoplankton growth. Surface and bottom water salinities in 2024 were constant across much of the Sound.

Surface and bottom salinity values during the WQSEP24 survey were slightly below the 2009-2023 average for Stations A4 and D3. (See table to the right).

	A4	D3
2024 Surface	26.18	26.78
2009-2023 Average Surface	26.52	27.51
2024 Bottom	26.93	27.89
2009-2023 Average Bottom	27.09	28.1



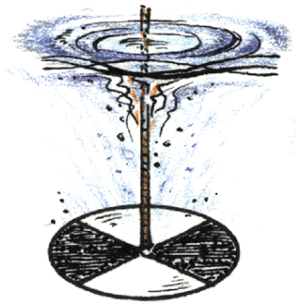


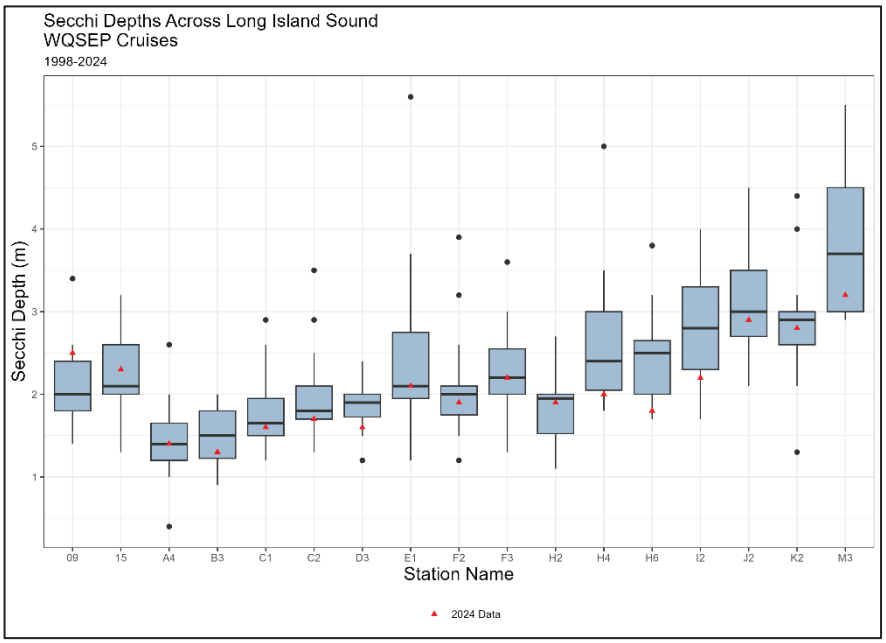
Secchi Disk Depth

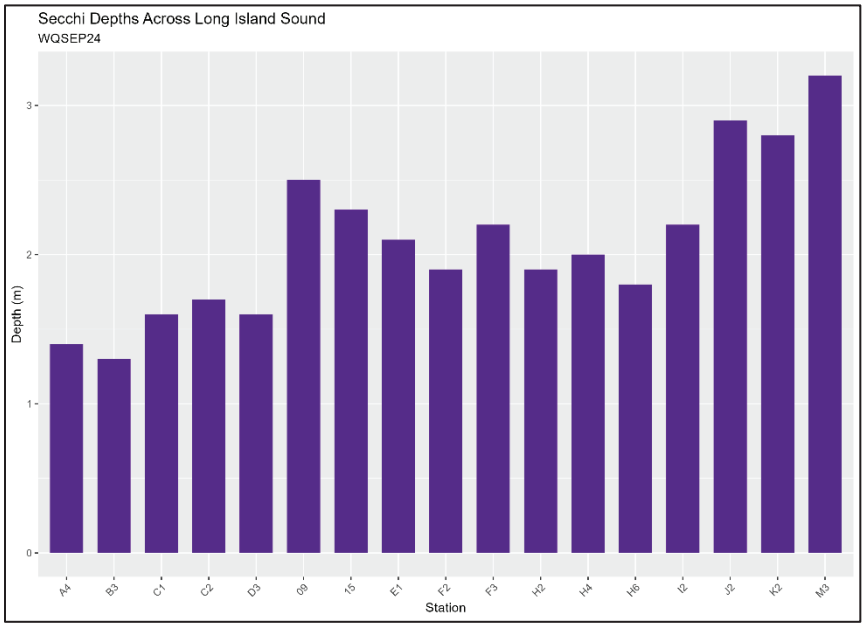
Water clarity is a measure of how much light penetrates the water column. Clarity can be reduced by the presence of suspended solids, organic matter, phytoplankton, and zooplankton.

To assess the water clarity across Long Island Sound, Secchi disks are used at each station. The black and white disk is lowered into the water column until such a depth is reached that the black and the white quarters can no longer be differentiated. This is called the Secchi depth.

Secchi depths were taken at 42 stations during the WQSEP24 survey; these depths ranged from 1.3 meters (Station 02 & B3) to 3.2 (Station M3).





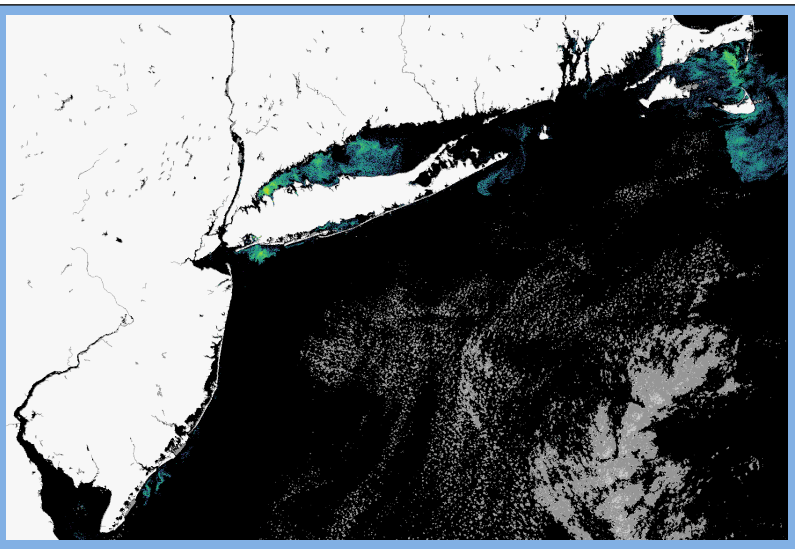


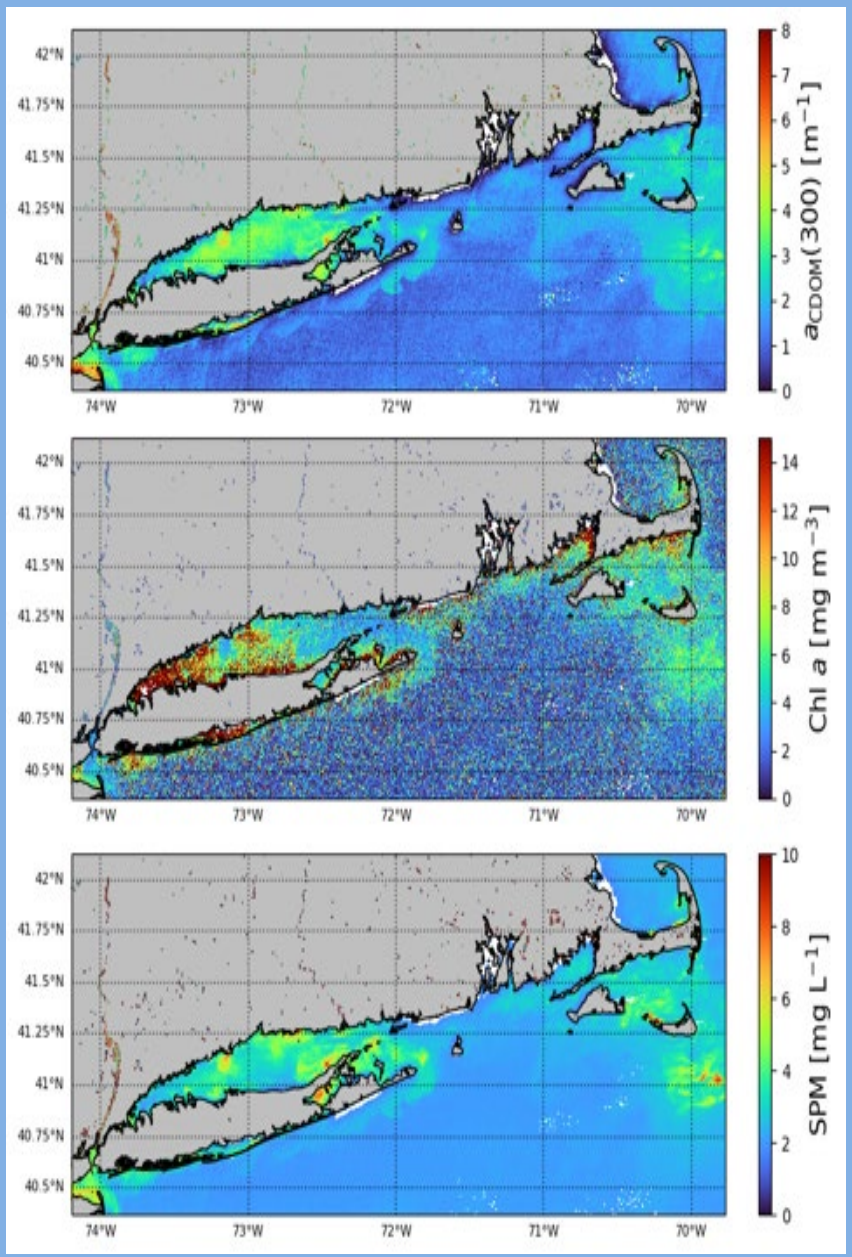
The Long Island Sound Report Card developed by Save the Sound utilizes the following water clarity depths thresholds:

1. >2.28 m (A- to A+; 90-100)
2. 2.12 to <2.28 (B- to B+; 80-89)
3. 1.95 to <2.12 (C- to C+; 70-79)
4. 1.8 to <1.95 (D- to D+; 60-69)
5. 0 to <1.8 (F; <60)

In Report Card terms, 9 stations were in the A- range (>2.28m), 2 stations were in the B- range (2.12-2.28), 8 stations were in the C- range (1.95-<2.12m), 9 stations were in the D- range (1.8 to <1.95m), and 15 stations failed (<1.8m).

Spotlight- NCCOS HAB Monitoring System





The [Harmful Algal Bloom Monitoring System] was developed by the National Centers for Coastal Ocean Sciences (NCCOS) to assist in locating, monitoring, and quantifying algal blooms in US coastal and lake regions in the form of geographic based images. These products are available in near real-time. A major goal of the program is to develop HAB forecasts and early warnings to alert managers before blooms cause harm and allow for mitigation of impacts.

On August 22, 2024 the NOAA HAB Forecasting Team notified Northeast managers of blooms present on 8/21/24 imagery in Long Island Sound, as well as Buzzards Bay, south shore of Cape Cod, Nantucket and Narragansett Bay (See top image on the left). The purpose was to garner interest in satellite image products in the region for bloom monitoring. **Long Island Sound researchers and stakeholders interested in subscribing to the email list may complete [this form].**

Staff from CTDEEP, CT Bureau of Aquaculture, NY Department of Marine Resources, along with researchers from CUNY and Stony Brook University were able to respond by collecting samples and remote sensing imagery optimized for LIS to characterize the bloom as non-hazardous.

The Tzortziou Bio-optics Lab provided LIS-optimized images from the Sentinel 3 satellite OLCI sensor for chlorophyll a, Colored Dissolved Organic Matter (CDOM), and Suspended Particulate Matter (SPM) from 8/21/24 (see images on the left).

The National Oceanic and Atmospheric Administration (NOAA) formed the National Centers for Coastal Ocean Science (NCCOS) in 1999 as the focal point for NOAA's coastal ocean science efforts. We help NOAA meet its coastal stewardship and management responsibilities and provide coastal managers with the scientific information necessary to decide how best to protect environmental resources and public health, preserve valued habitats, and improve the way communities interact with coastal ecosystems. **Learn more:** *https://coastalscience.noaa.gov/about/*

Spotlight (Continued)

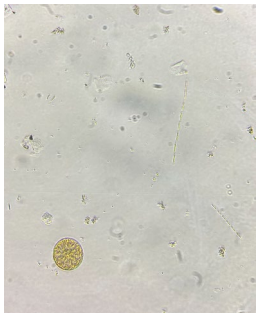
The Gobler Lab responded that they had collected samples on 8/19/24 with elevated concentrations of several dinoflagellate genera. They would sample 30 sites across NY on 8/26.

The Connecticut Department of Agriculture/Bureau of Aquaculture (DA/BA) collected two samples from Greenwich as part of their routine HAB monitoring of CT embayments on 8/20/24. Emily Marquis, environmental analyst and HAB specialist for DA/BA, noted the samples were dominated by typical non-toxic dinoflagellates. She also collected samples on 8/28/24 from Milford to Stonington which were dominated by diatoms, with some dinoflagellates and zooplankton.

Other analysts with DA/BA observed large mud/sediment plumes emanating from the Housatonic River that stretched out into the middle of the Sound (See images to the left) following the flash flooding event. They noted the air smelled like dirt.

NY DEC Bureau of Marine Resources, Shellfish Harvest Area Classification Unit sampled Western LIS and Hempstead Harbor on 8/26/24. Phytoplankton within the Hempstead Harbor sample were very sparse with only a couple of diatoms encountered.

The Greenfield Lab at the City University of New York also sampled Hempstead Harbor with very few cells observed. Additionally, the Greenfield lab collected surface Western Long Island Sound water samples in collaboration with CTDEEP on August 12 and 26. Laboratory analyses revealed that mean total Chl a levels (measured fluorometrically) reached a peak of 23.8 ug/L in the westernmost survey station (A4) on August 12 then ranged 7.3-17.8 ug/L across WLIS on August 26.



Top left and right: Diatoms encountered in NYDEC samples from Hempstead Harbor.

Bottom: Diatoms observed by Greenfield Lab at CUNY from Hempstead Harbor.

Spotlight (Continued)

Top Left: Contents of cod end following plankton tow at Station H4
Top Right: Contents of cod end following plankton tow at Station B3
Center: Plankton Samples from H4 and sieves
*Bottom: Copepod (*Acatia tonsa*) and diatoms observed in plankton samples from Stations H4 (Courtesy of Dr. Gihong Park, UConn).*

CTDEEP sampled six stations (K2, I2, H4, F2, D3, and B3) over the course of WQSEP24 for zooplankton community analyses and 10 stations (K2, I2, J2, H4, F2, E1, A4, B3, D3, C1) for phytoplankton community analyses.

Stations K2, I2, and J2 were sampled on 8/26/24. A4, B3, C1 and D3 were sampled on 8/27/24. F2 and H4 were sampled on 8/28/24. All samples were sent to UConn Marine Science Department for enumeration and taxonomy.

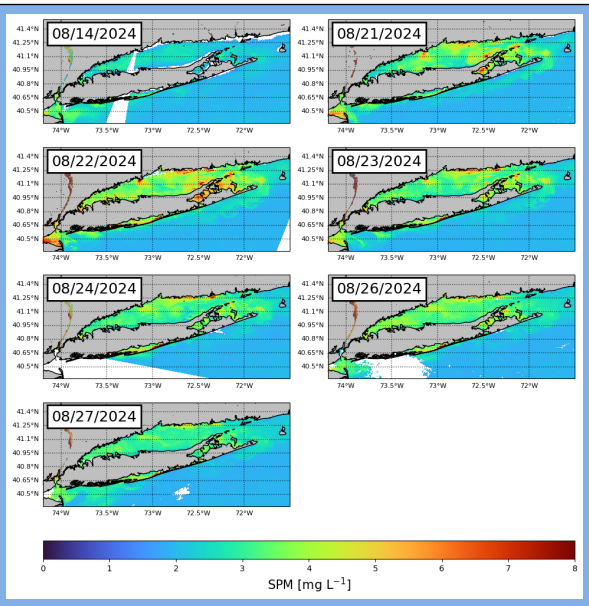
Dr Huan Zhang stated major blooms of the diatom *Skeletonema* spp. were found in the surface phytoplankton samples at stations A4, B3, C1 and D3 (major), F2 (regular), H4, I2 and J2 (minor). Blooms of nanoplankton (cells mostly round shape, 4-5 µm in diameter) were found at A4, B3, C1 and D3 (major), F2 (regular), H4, I2 and J2 (minor). Very low cell abundance was found at K2.

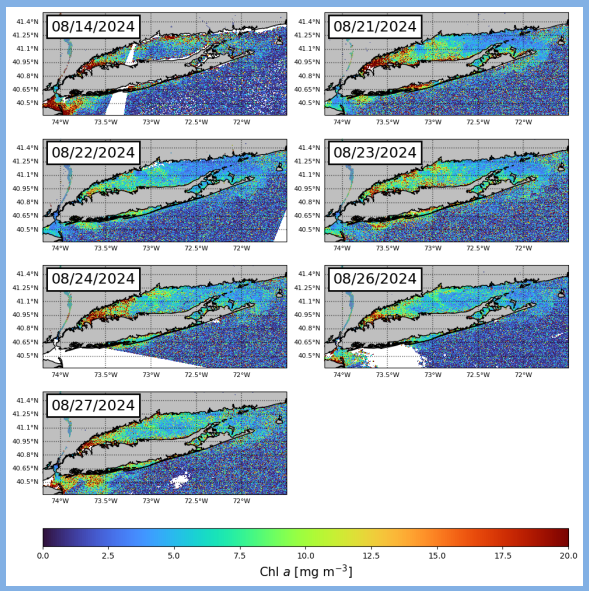
In the bottom water samples, he observed only regular (A4) or minor (C1, D3) blooms of nanoplankton. A very large quantity of debris was found at A4 and D3, a large amount of debris at B3 and C1, and some debris at E1, F2, H4 and I2. Low cell abundances were found at stations B3, E1, F2, H4, I2 and J2, and a very low cell abundance at K2, respectively.

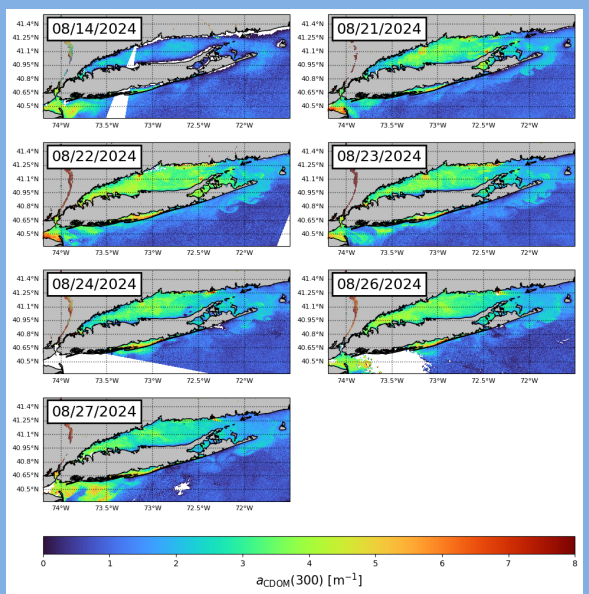
The highest phytoplankton concentration in the surface water samples over the summer (July-September) was observed at station C1 in September (19.69 million cells L^{-1}).

Preliminary results from the Station H4 zooplankton sample processed by Dr. Gihong Park of the Dam lab following a ~100X dilution found diatoms (*Chaetoceros* and some *Ditylum*, *Pseudo-nitzschia* and *Thalassiosira*) along with the copepod *Acatia tonsa* in adult and copepodite stages.

Spotlight (Continued)







Following the survey, the Tzortziou Bio-optics lab also prepared these remote sensing imagery panels that are optimized for LIS. They show the progression of the bloom over the course of 15 days beginning on 8/14/24 and ending on 8/28/24, including the WQSEP24 survey.

In the top panel, note the increase in Suspended Particulate Matter (SPM) on 8/21 and 8/22 in the Hudson River, mouth of the Housatonic River, along the CT coast in Guilford, Clinton, and Madison, and in the Peconics and Gardiner's Bay, NY.

In the middle panel, elevated chlorophyll a concentration (CHL A) near 20 mg/m3 are visible in the Western Narrows on 8/14, intensifying/expanding through 8/21 into Central Long Island Sound. Elevated concentrations persist through 8/27/24, ranging from 7mg/m3 to more than 20 mg/m3, in agreement with field measurements by the Greenfield Lab.

The bottom panel shows concentrations of Colored Dissolved Organic Material (CDOM) increasing and spreading across the Sound as the rivers discharge runoff from the flash flooding event.

Chlorophyll a data have not been returned from the Center for Environmental Science and Engineering at UConn to compare to the images.

To explore more imagery please visit the NOAA CoastWatch website.

For more information on the Long Island Sound Water Quality and Hypoxia Monitoring Program please visit:

Long Island Sound Water Quality and Hypoxia Monitoring Program Overview (ct.gov)

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