Long Island Sound Water Quality Monitoring Program

June 2025

From the Connecticut Department of Energy and Environmental Protection

(HYJUN25)

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Background

Hypoxia is a condition in which low or depleted dissolved oxygen concentrations are observed in the waters of Long Island Sound (LIS). Hypoxia impacts up to half of the LIS waters each summer. The primary cause of hypoxia is excess nitrogen from human sources. These sources include sewage treatment plant discharges, storm water runoff and atmospheric deposition.

The water temperature of Long Island Sound plays a crucial role in influencing hypoxia levels through several interconnected mechanisms. As water temperature increases, its ability to dissolve oxygen decreases, meaning warmer water naturally holds less dissolved oxygen. Additionally, higher temperatures elevate the metabolic rates of aquatic organisms, leading to increased oxygen consumption and further depletion of oxygen levels. Thermal stratification during warmer months results in a less dense, warmer layer sitting atop a denser, cooler layer, preventing the mixing of oxygen-rich surface waters with the deeper layers. This lack of mixing can isolate the bottom layers from essential oxygen, leading to hypoxia. Warmer temperatures also contribute to increased nutrient runoff from surrounding lands, enriching the water with nitrogen and phosphorus, which stimulate the growth of algae and phytoplankton. When these algae die and decompose, the process consumes a significant amount of oxygen, exacerbating hypoxia. Furthermore, higher temperatures boost the biological oxygen demand due to heightened activity levels of bacteria and microorganisms decomposing organic matter, further reducing oxygen levels. Consequently, the combination of reduced oxygen solubility, thermal stratification, enhanced nutrient runoff, eutrophication, and increased biological oxygen demand due to warmer water temperatures creates conditions where dissolved oxygen levels fall below the thresholds necessary to support healthy marine life, resulting in hypoxic zones in Long Island Sound.

Dissolved oxygen (DO) levels below 3.0 mg/L are considered hypoxic in LIS. Hypoxic conditions cause impairment and, in some cases, death to aquatic life. Some studies have found DO can become limiting below 4.8 mg/L for sensitive fish species, while more tolerant species are not affected until DO falls below 2.0 mg/L (Simpson et. al., 1995, 1996).

Since 1991, the Connecticut Department of Energy and Environmental Protection (CT DEEP) has conducted an intensive water quality monitoring program on Long Island Sound (LIS). The program is funded through a grant from the U.S. Environmental Protection Agency's (EPA) Long Island Sound Partnership. Data from the surveys are used to quantify and identify annual trends and differences in water quality parameters relevant to hypoxia, in particular nutrients, temperature, and chlorophyll. These data are also used to evaluate the effectiveness of the LIS management programs' efforts to reduce anthropogenic nitrogen inputs, since nitrogen is a primary contributor to the excessive algae growth that leads to hypoxia in LIS.

During the summer (June - September), surveys across LIS are conducted at bi-weekly intervals to better define the areal extent and duration of hypoxia. During these surveys stations are sampled for in-situ parameters including dissolved oxygen, temperature, pH, and salinity. The sampling calendar lists the expected survey dates.

The HYJUN25 survey was conducted 16-18 June 2025 aboard the R/V John Dempsey. A total of 12 stations were sampled.

Weather

Precipitation and temperature are important factors that influence both the environment and human safety.1 Heavy rain can lead to flooding in vulnerable municipalities across the Northeast.Increased precipitation also reduces salinity in estuaries, which affects sensitive organisms that rely on these habitats as nurseries. On the other hand, decreased precipitation increases the risk of drought, which negatively affects crops and increases the risk of forest fires, especially when combined with rising temperatures.1 Higher temperatures lead to increased forest fire risk, and can fuel more intense storms that endanger coastal communities.

A summary of weather conditions across the coastal portion of the Long Island Sound watershed follows to provide context for CTDEEP's surveys and the formation and progression of hypoxic conditions.

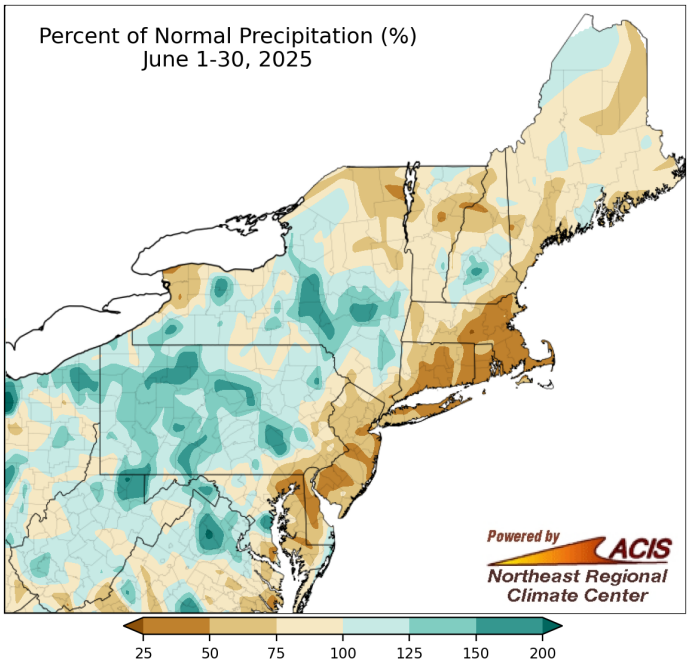
Much of the southern New England experienced unusually dry conditions during the second half of June. Bridgeport, CT received only 14% of its normal rainfall, continuing its trend toward one of the driest Junes on record. Similarly, Hartford, CT had just 27% of its normal precipitation. Islip, NY, saw little rain with only 21% of normal, and LaGuardia, NY recorded merely 18%. The one outlier was JFK Airport, which received 50% of its typical rainfall - still dry, but wetter than its neighboring stations.

Temperatures throughout the region surged during late June thanks to a searing heatwave across the Northeast, leading to blistering highs and shattered records. Bridgeport, CT reached an average temperature of 73.9°F (+2.5°F above normal), while Hartford, CT hit 73.3°F (+2.5°). In New York, Islip recorded an average of 72.9°F, a +3.5°F anomaly that helped mark its hottest June ever. JFK Airport averaged 75.2°F (+3.4°F), with LaGuardia Airport coming in at the highest average temperature of 76.9°F, which was +4.1°F above average.

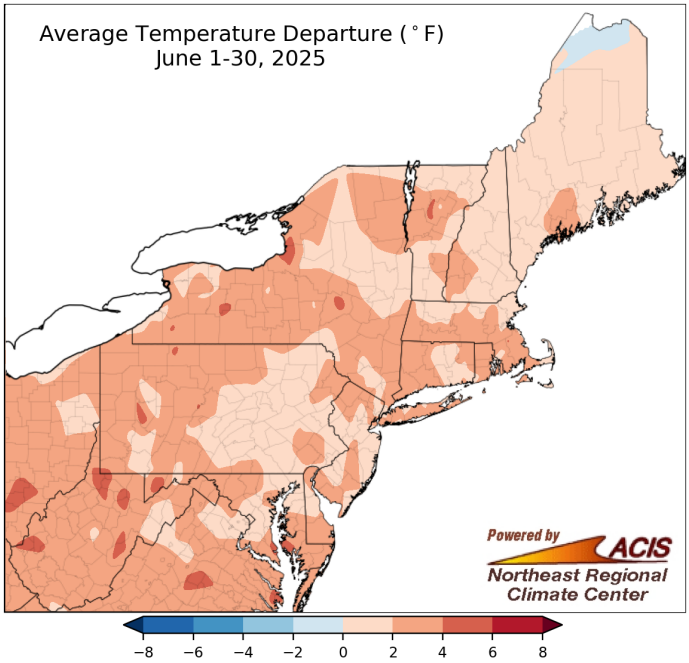
All data and visuals are sourced from the Northeast Regional Climate Center's website. For a more detailed breakdown of climate trends and additional regional data, visit their blog at https://www.nrcc.cornell.edu.

NRCC Graphics for July 1, 2025

Temperature data across the Northeast for the last month

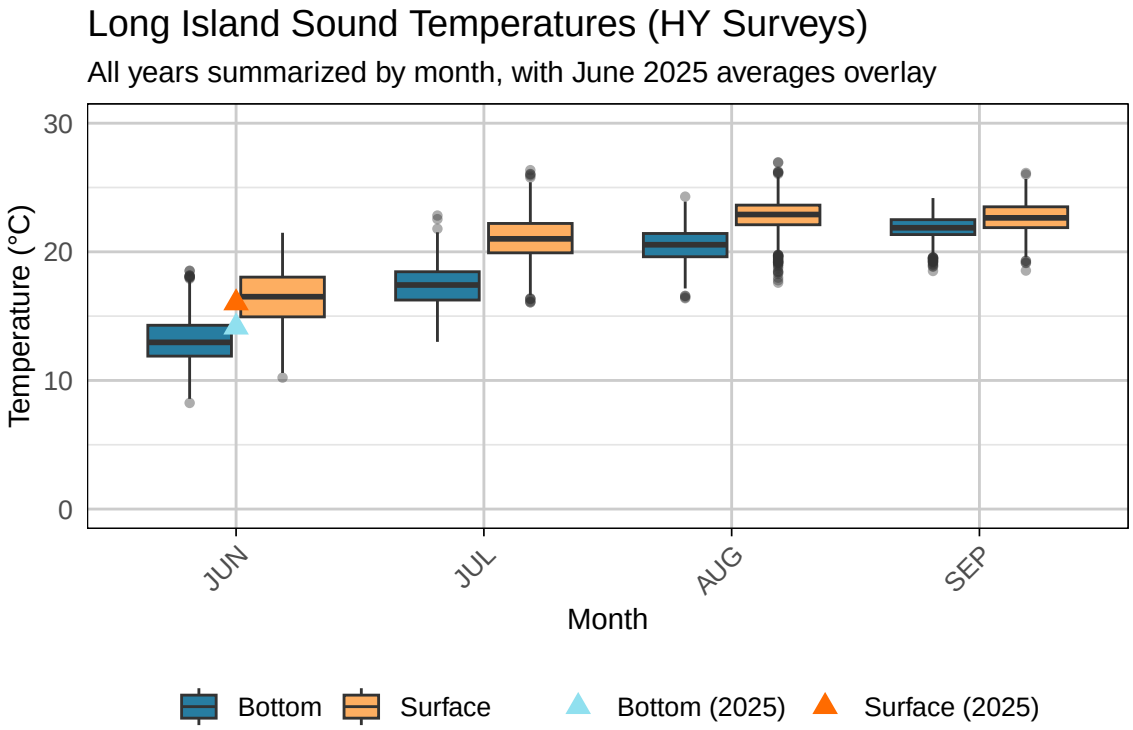


Precipitation data across the Northeast for the last month



Temperature

Looking at the change in surface and bottom water temperatures across the Long Island Sound throughout the year



Delta T (ΔT) represents the difference between surface and bottom water temperatures. Variations in water temperature contribute to stratification, which in turn exacerbates hypoxic conditions. Typically, shallower coastal stations exhibit the smallest temperature differences due to their increased susceptibility to mixing, weather, and anthropogenic influences. The greater the Delta T, the higher the potential for severe hypoxia.

Between June 2024 and June 2025, water temperature measurements from the HYJUN survey, Bottom temperatures increased significantly, with an average rise of 2.22°C (from 13.97°C to 16.19°C). Seven of twelve stations recorded higher bottom temperatures, with notable increases at Station B3 (+4.76°C), A4 (+4.68°C), C1 (+4.18°C), and 09 (+3.99°C), Station F3 was an exception, showing a significant decrease of 2.26°C.

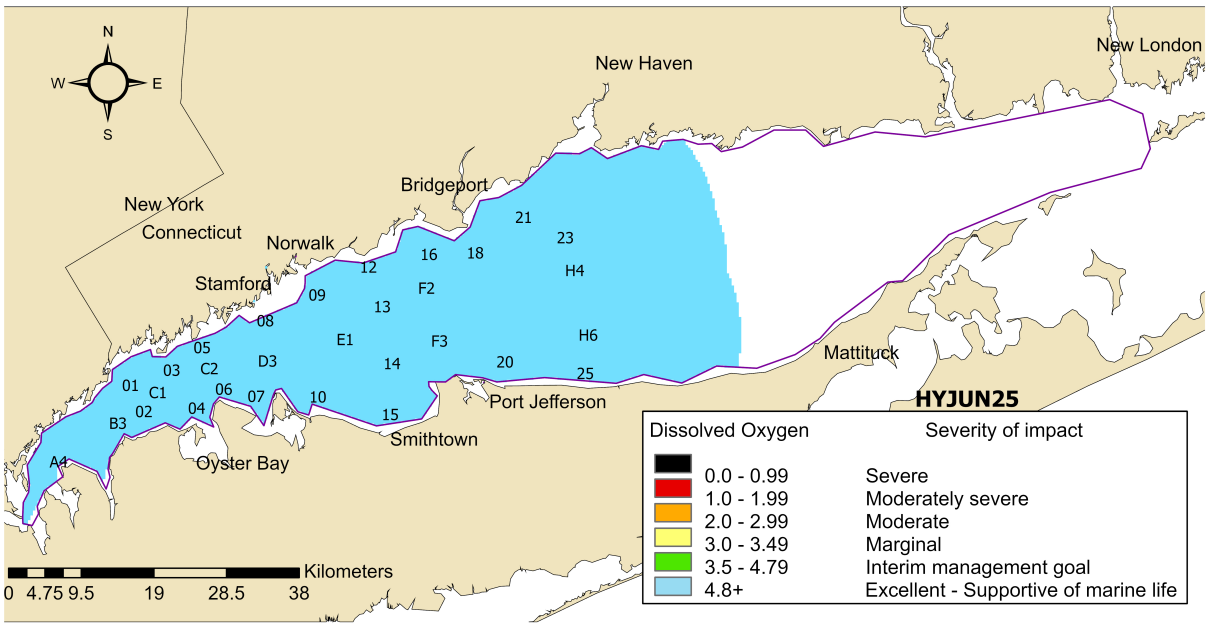
Surface temperatures exhibited a slight overall decrease of 0.55°C (from 18.17°C to 17.62°C). Six stations showed declines, with the most significant at E1 (-1.65°C), C1 (-1.23°C), and F3 (-1.18°C). Three stations (B3, D3, A4) showed minor increases, all under 0.5°C.

Spatial Distribution of Bottom Water Dissolved Oxygen Levels

In the HYJUN25 survey, 12 stations had excellent oxygen conditions. No area estimates were calculated as all concentrations were above 4.8 mg/L

Dissolved Oxygen in Long Island Sound Bottom Waters

17- 18 June 2025



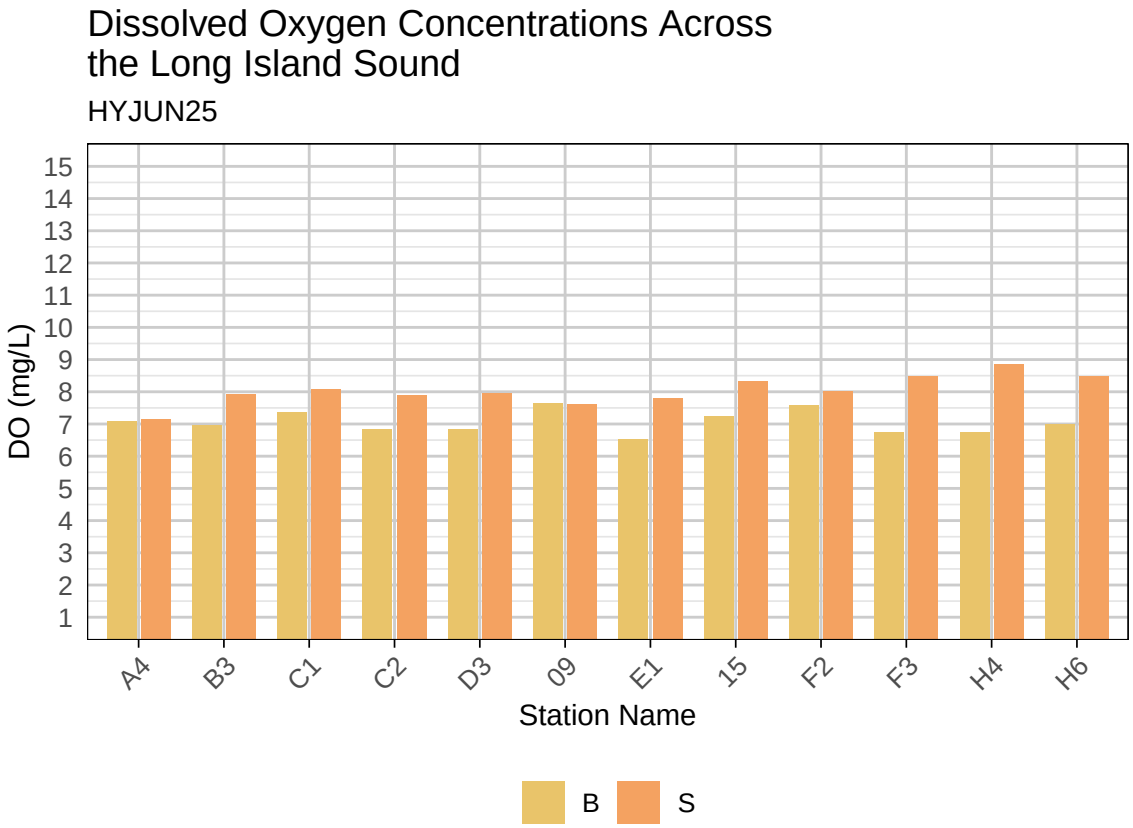
Dissolved Oxygen

Dissolved oxygen is essential for the survival of aquatic organisms, and therefore one of the most important indicators of water quality.[3] There are methods to increasing oxygen levels in a water body. For one, wind is able to aerate the water, allowing oxygen to dissolve into surface waters. Secondly, oxygen is a byproduct of photosynthesis, and can be introduced to the water through aquatic plants.[3]

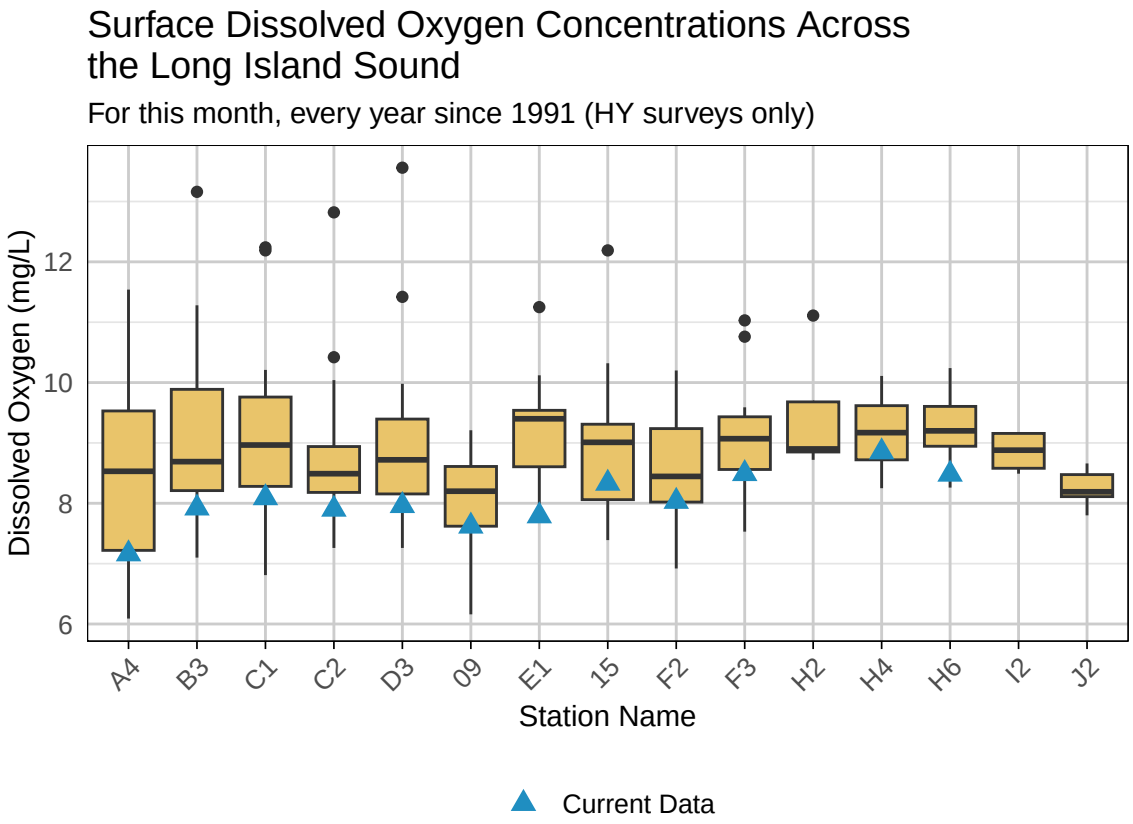
Colder water can hold more oxygen than warm water. Furthermore, freshwater is able to absorb more oxygen than saltwater, so waters with lower salinity levels often have higher DO concentrations.

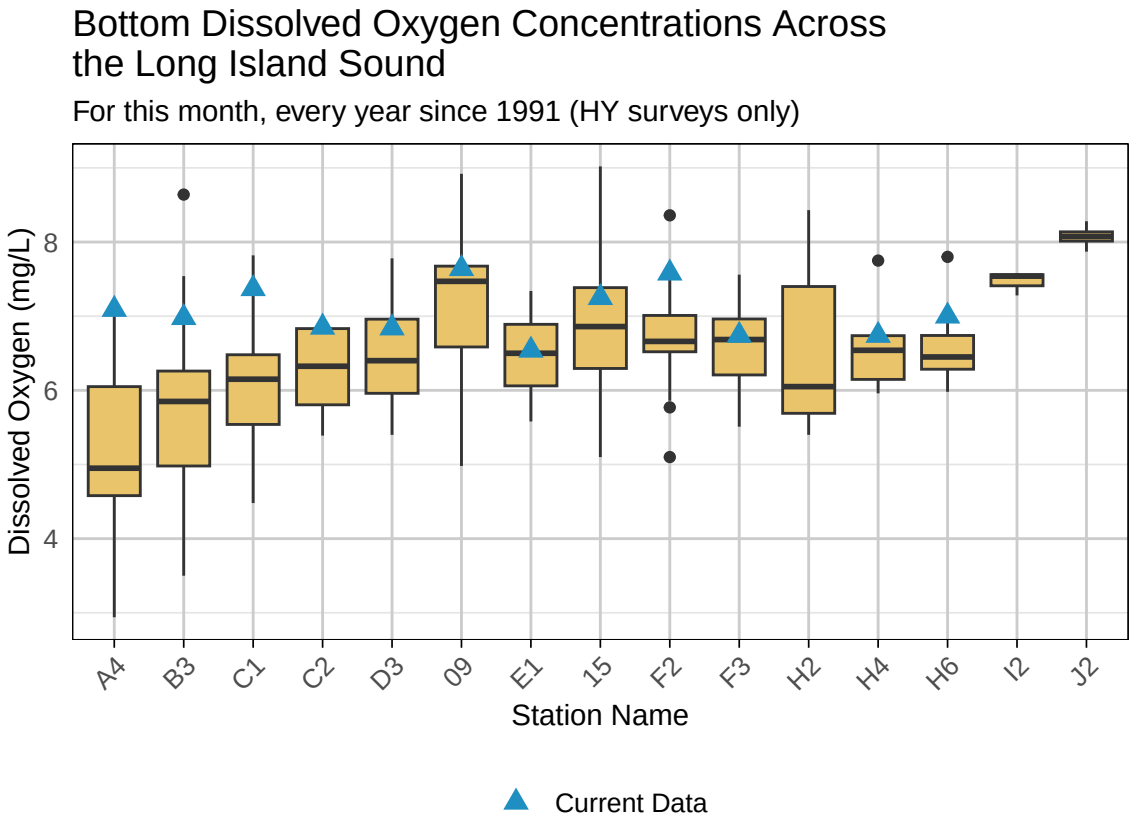
In the HYJUN25 survey, the average surface dissolved Oxygen (DO) concentration was 8.05 mg/L and the average bottom DO concentration was 7.05 mg/L. The highest surface DO concentration was 8.85 at Station H4, and the lowest surface DO was 7.16 at Station A4. The highest bottom DO concentration was 7.64 mg/L at Station 09 and the lowest bottom DO was 6.54 at Station E1. Zero stations have a surface or bottom dissolved oxygen concentration below 3 mg/L, which is considered hypoxic.

Measured Dissolved Oxygen level across the Long Island Sound by station



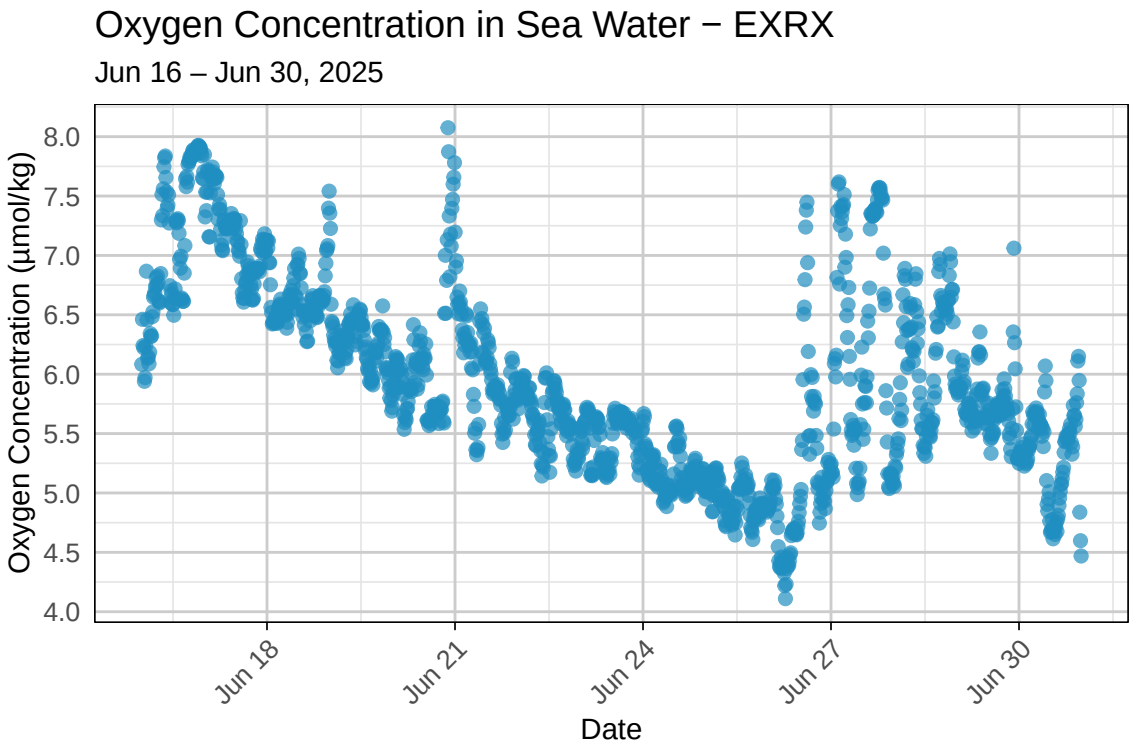
Comparing the average Long Island Sound DO values for each month since 1991

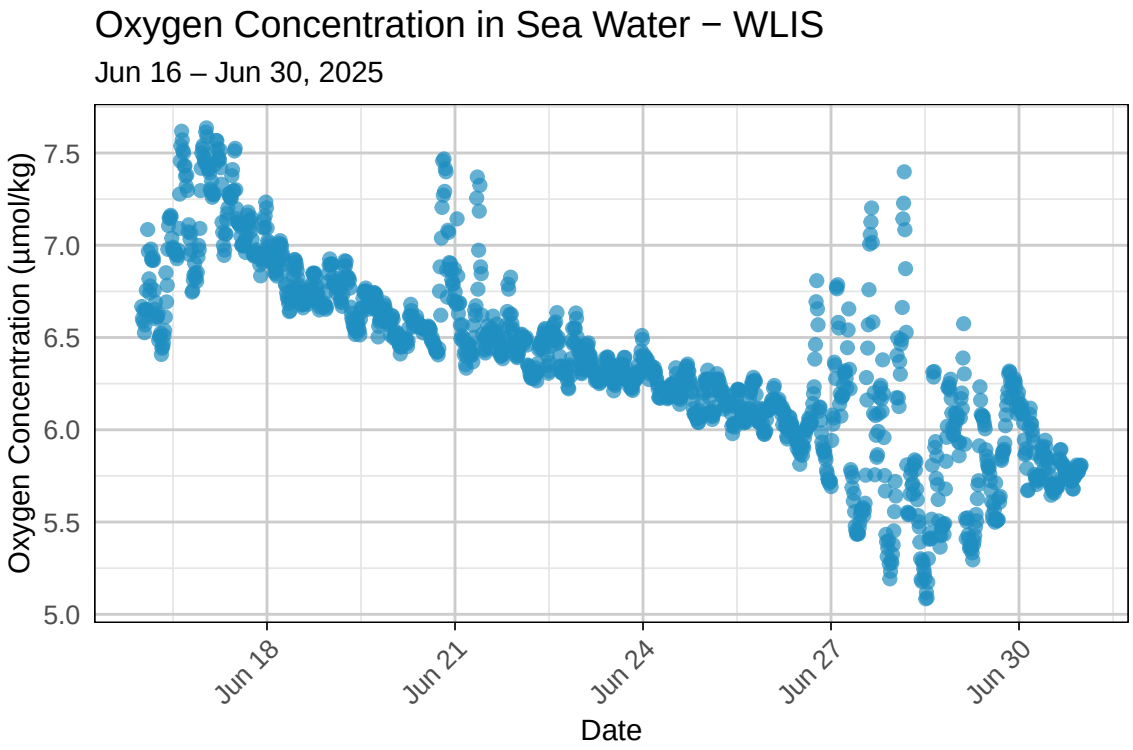


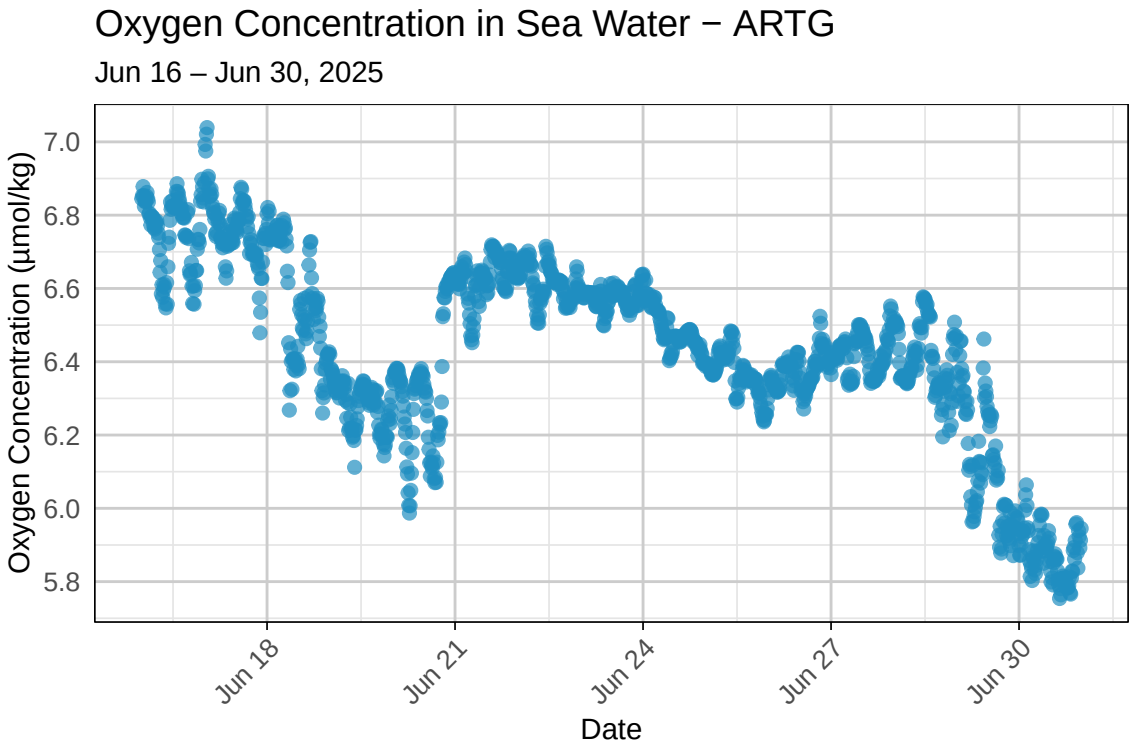


Recent Dissolved Oxygen Levels at EXRX, WLIS, and ARTG Stations

The Long Island Sound Integrated Coastal Ocean Observing System (LISICOS) collects and reports real-time continuous meteorological, water quality, and wave height data. The system is operated and maintained by the University of Connecticut with funding from the Long Island Sound Partnership and the Northeast Regional Association of Coastal Ocean Observing Systems (NERACOOS). The following graphs depict time series data from the LISICOS buoys (downloaded from the UCONN ERDDAP server) for the period surrounding the HYJUN25 survey.




Oxygen Concentration in Sea Water − WLIS
Jun 16 – Jun 30, 2025
Oxygen Concentration (µmol/kg)
7.5
7.0
6.5
6.0
5.5
5.0
Jun 18
Jun 21
Jun 24
Jun 27
Jun 30
Date

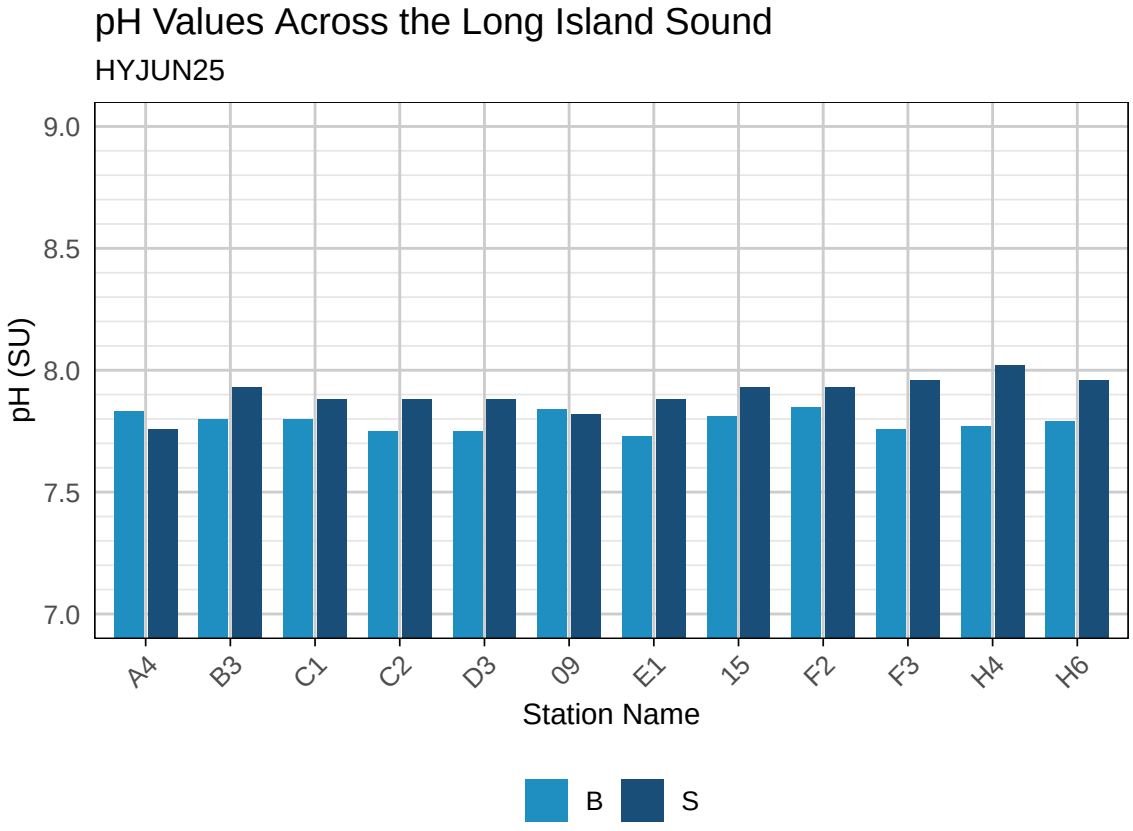

Oxygen Concentration in Sea Water − ARTG
Jun 16 – Jun 30, 2025
Oxygen Concentration (µmol/kg)
7.0
6.8
6.6
6.4
6.2
6.0
5.8
Jun 18
Jun 21
Jun 24
Jun 27
Jun 30
Date

pH

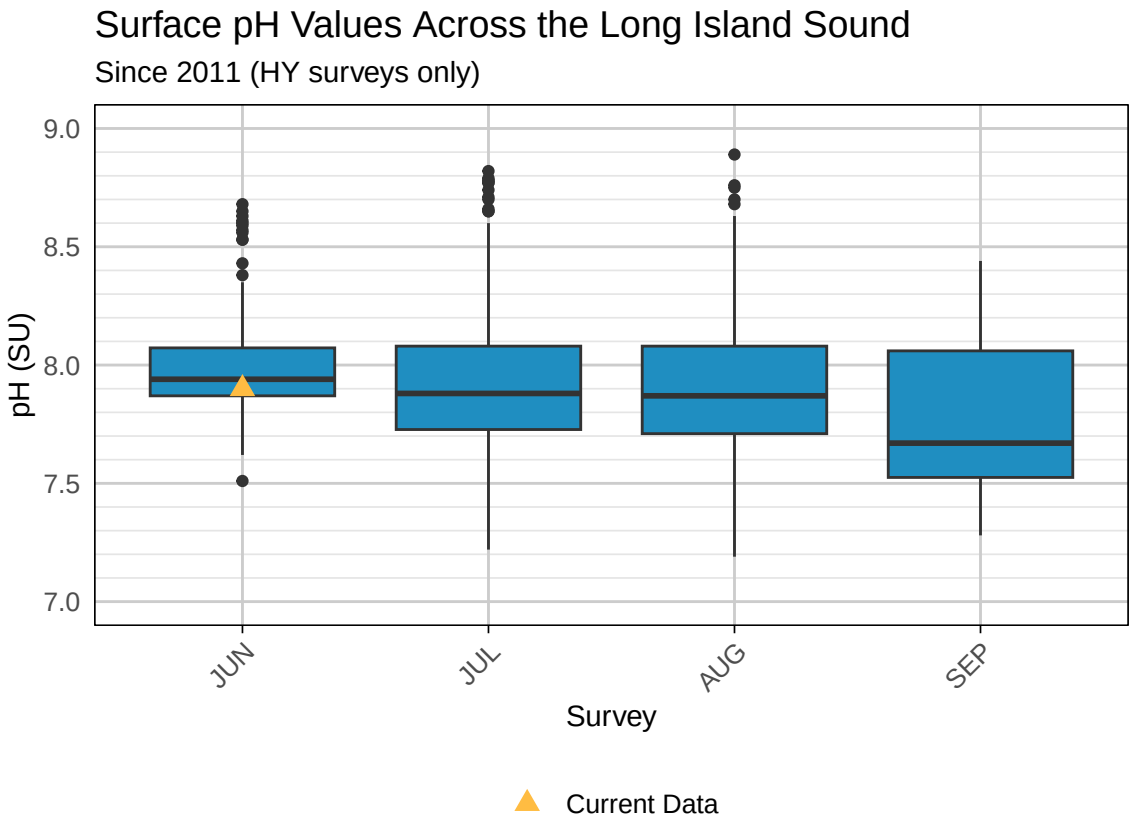
Ocean acidification has detrimental effects on marine life. Waters with a lower pH value, and therefore a greater acidity, have fewer carbonate ions. Calcifying species use available carbonate ions to produce their calcium carbonate shells. Therefore, ocean acidification harms the growth of calcifying species. This includes certain species of clams, oysters, and coral. Studies also show that increased ocean acidity can stunt the growth of many fish species.

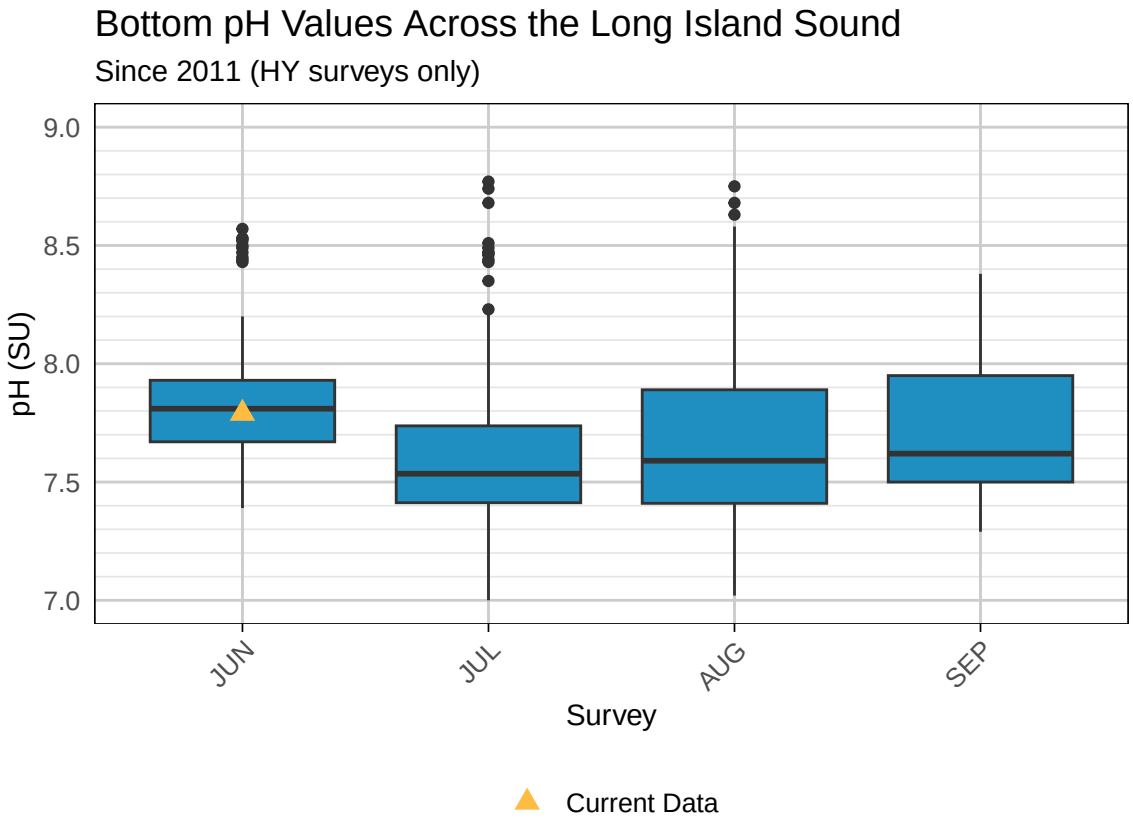
The average acidity of the ocean is around 8.1. This is a 0.06 decrease since 1985. However, the average pH of the Long Island Sound has been found to decrease by 0.04 each decade - a much more drastic change.[2]

The average surface and bottom pH from all stations across the LIS during the HYJUN25 survey were 7.9 and 7.79 respectively. The highest surface pH was 8.02 at Station H4, and the lowest surface pH was 7.76 at Station A4. The highest bottom pH was 7.85 at Station F2 and the lowest bottom pH was 7.73 at Station E1.



Comparing the average Long Island Sound pH values for each month since 2011





Salinity

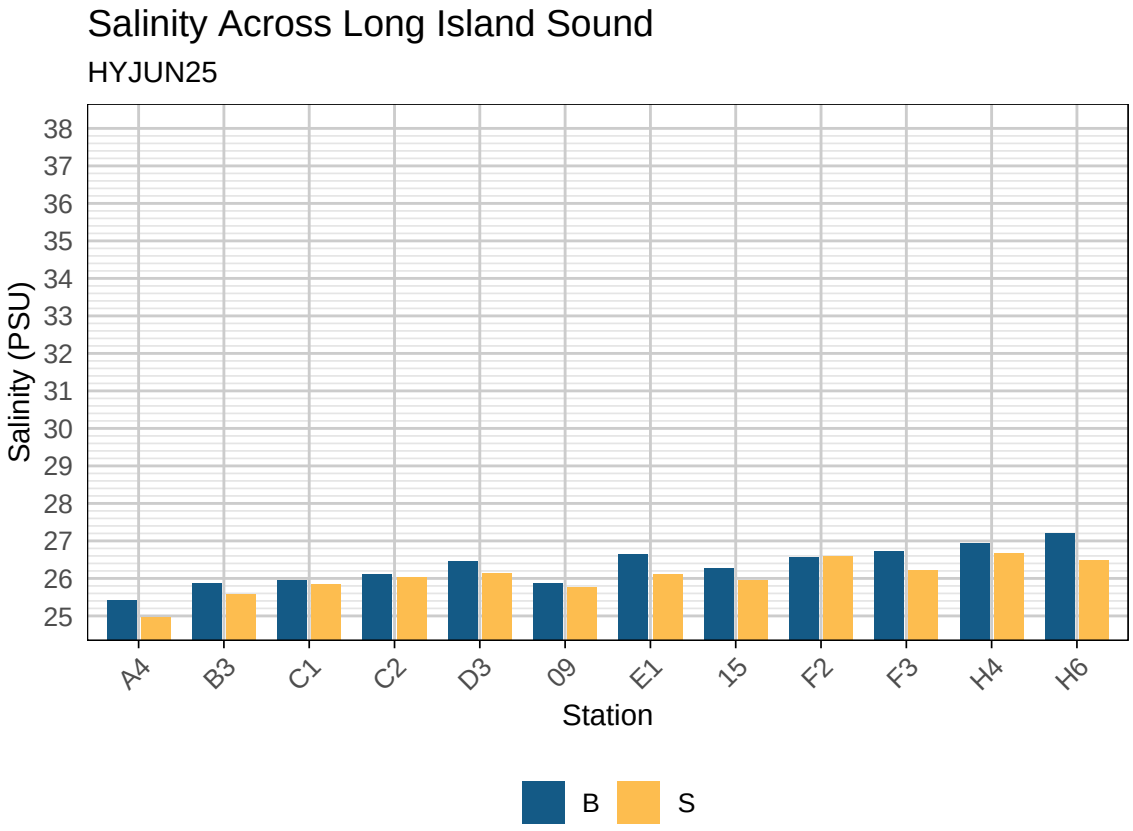
The Long Island Sound is an estuary, meaning its waters are a mix of both fresh and salt water. This is referred to as brackish water. The salt water is supplied by the Atlantic Ocean, while the majority of LIS fresh water comes from three major Connecticut Rivers: the Thames, the Connecticut, and the Housatonic - from east to west.[6] Estuaries are considered to be some of the most ecologically productive ecosystems on Earth.[6]

Many species rely on estuaries for breeding and nursing their young. Furthermore, many major marine species that spend most of their time in the ocean spend part of their life cycles within an estuary. This includes salmon, herring, and oysters.[4] The average salinity of the Long Island Sound is approximately 28 PSU, compared to the ocean, which has a higher average salinity of 35 PSU.

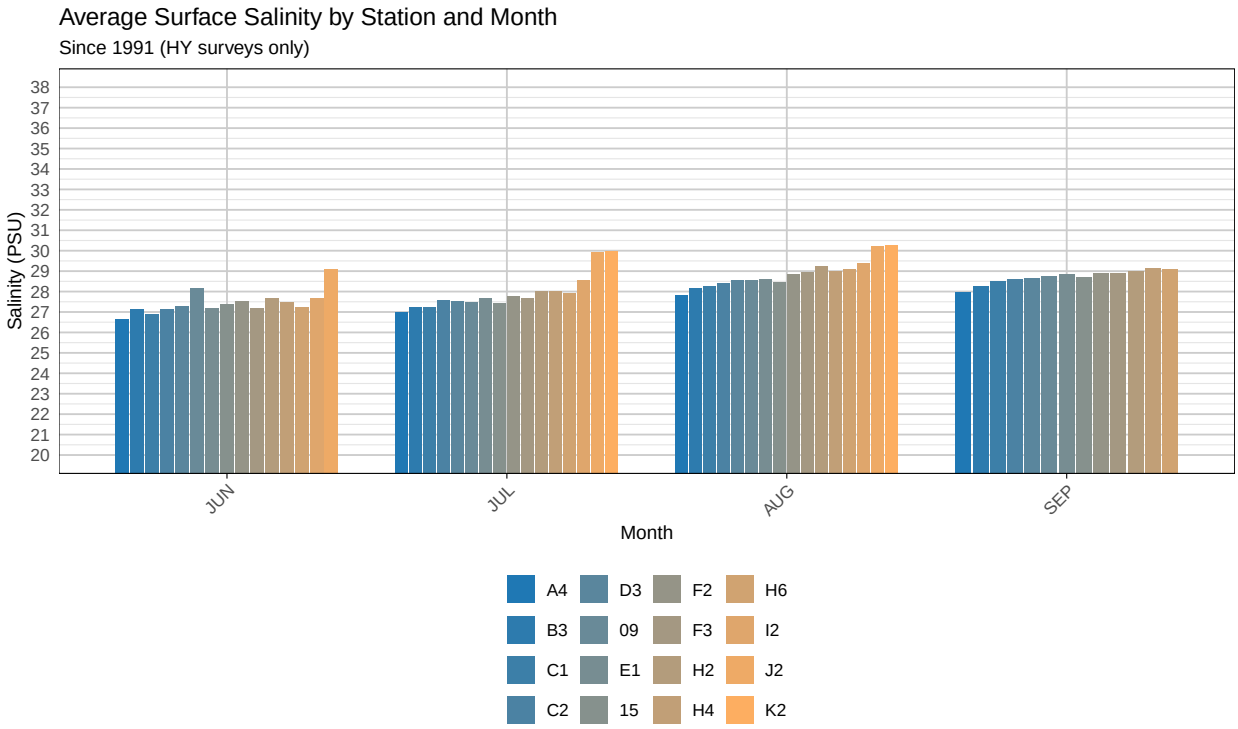
The average surface and bottom salinities from all stations across the LIS during the HYJUN25 survey were 26.04 PSU and 26.35 PSU respectively. The highest surface salinity was 26.67 PSU at Station H4, and the lowest surface salinity was 24.97 PSU at Station A4. The highest bottom salinity was 27.21 PSU at Station H6 and the lowest bottom salinity was 25.43 PSU at Station A4.

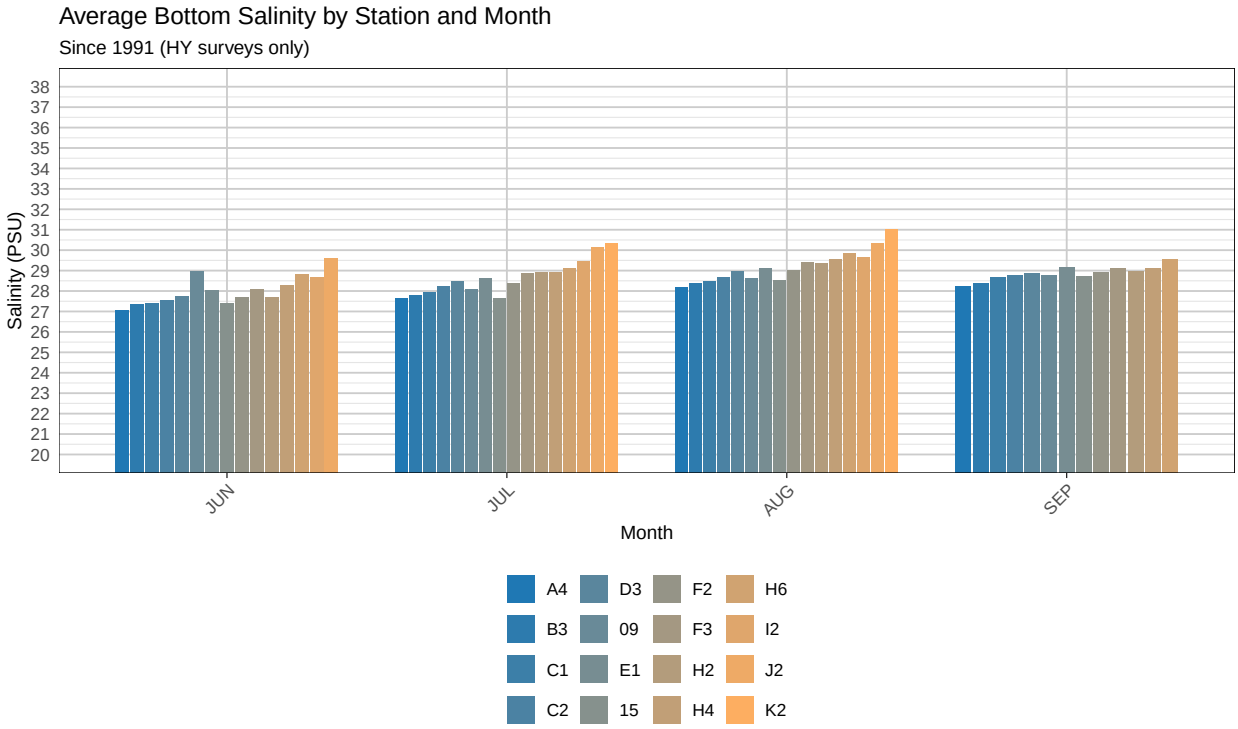
Average salinity across the Long Island Sound by station

Eastern stations near the Atlantic Ocean tend to have higher salinities due to ocean exchange. The stations on the x-axis are arranged from east to west.



Changes in salinity throughout the year



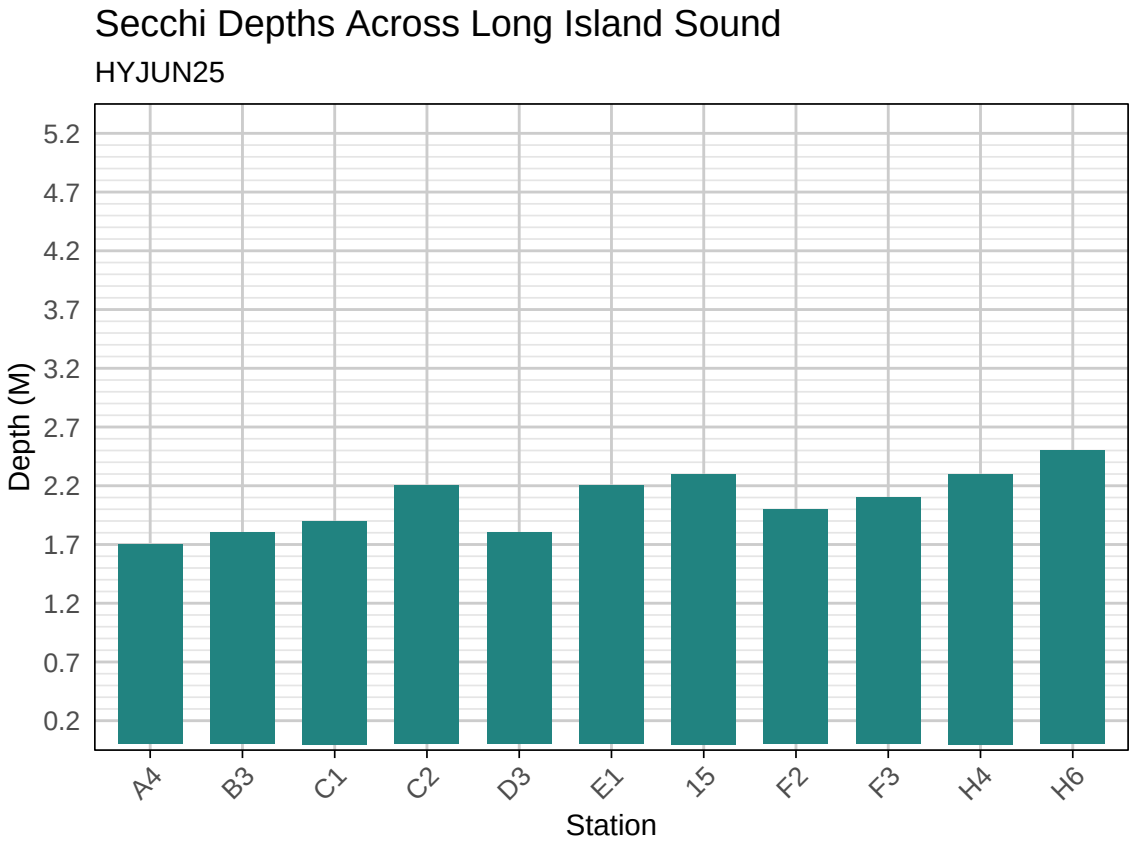


Secchi Disk Depth

Secchi disks are used to measure the transparency of a water body. They are lowered into the water until they are no longer visible to the observer. The depth of disappearance, also called the Secchi depth, is indicative of the water clarity.[7] Clarity is reduced as the presence of suspended solids, plankton, and organic matter increases.

The average secchi disk depth from all stations across the LIS during the HYJUN25 survey was 2.1 m. The greatest disk depth was 2.5 m at station H6. The lowest disk depth was 1.7 m at Station A4.

This survey's secchi disk depths at different stations across the Long Island Sound



The Long Island Sound Report Card developed by Save the Sound through the LIS partnership utilizes the following thresholds:[5]

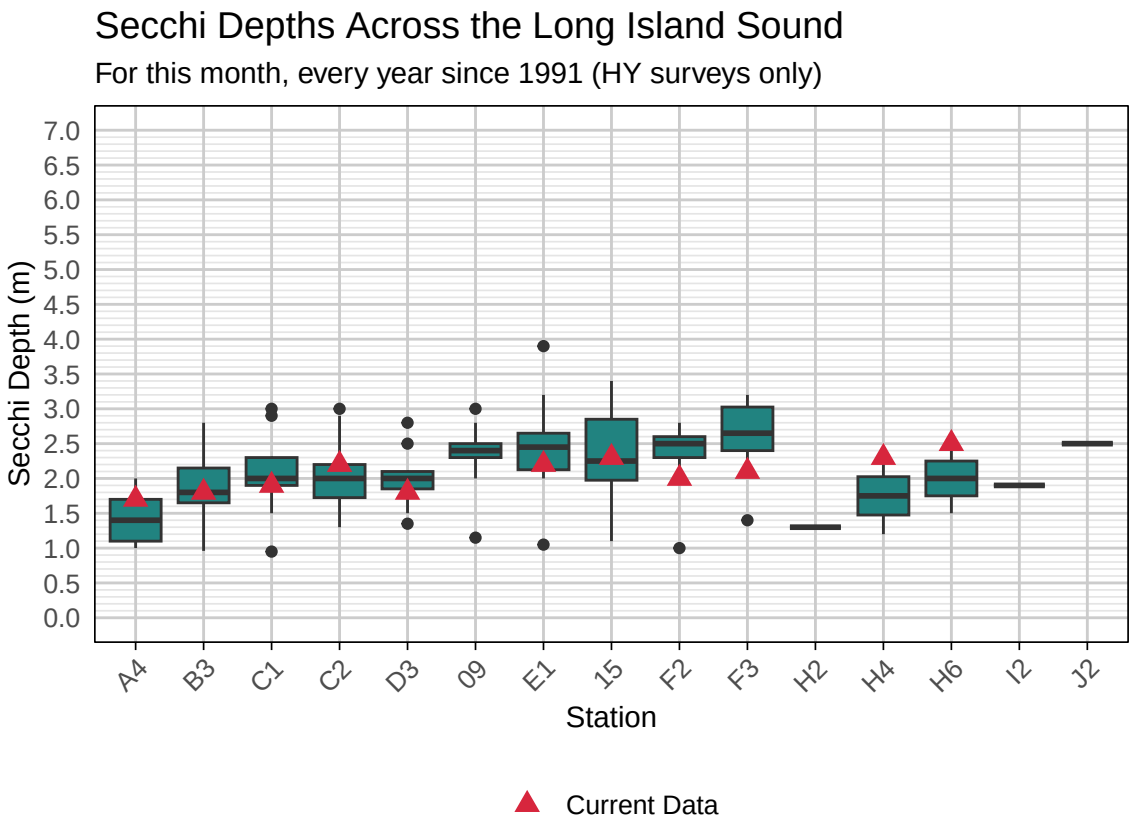
Secchi Depth Grading Thresholds

Grade	Depth Range (meters)	Score Equivalent
A	> 2.28	90–100%
B	2.12 – 2.28	80–90%
C	1.95 – 2.12	70–80%

Grade	Depth Range (meters)	Score Equivalent
D	1.80 – 1.95	60–70%
F	< 1.80	< 60%

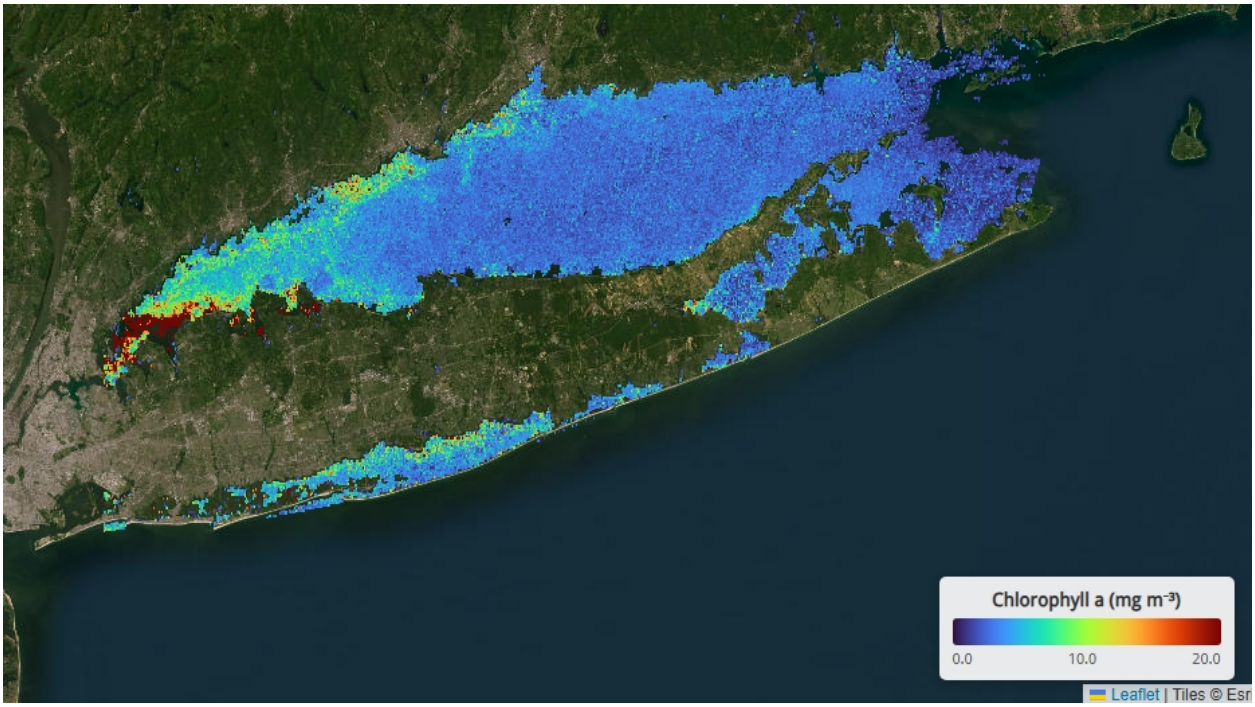
In the HYJUN25 survey, 3 stations received a grade of A, 2 stations received a grade of B, 2 stations received a grade of C, 1 station received a grade of D, 3 stations received a grade of F.

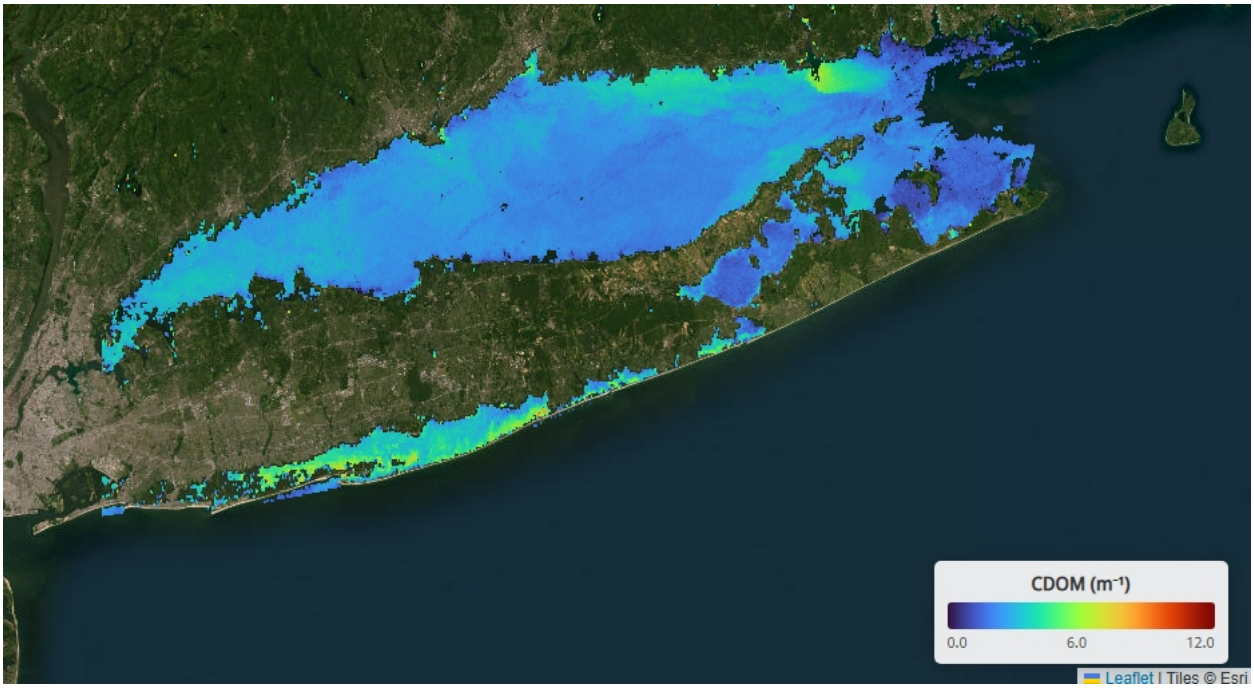
Looking at historical Secchi depth values across the Long Island Sound

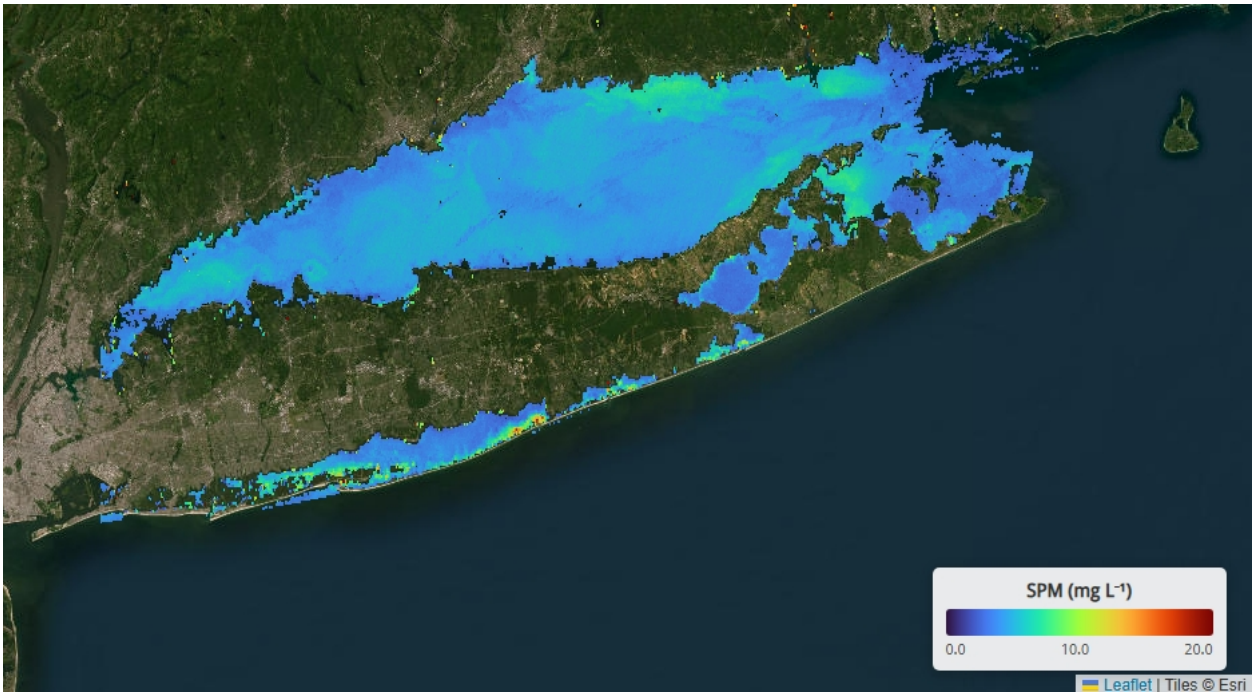


Remote sensing- CHLA, CDOM, SPM

The LIS Ocean Color Website curated by the Tzortziou Bio-optics Lab at the City University of New York displays Long Island Sound optimized chlorophyll (CHLA), colored dissolved organic matter (CDOM), and suspended particulate matter (SPM) remote sensing imagery. The images below were collected during the HYJUN survey and excerpted from the website. CHLA imagery provides a measure of plankton biomass. CDOM and SPM provide a measure of turbidity.


Chlorophyll a (mg m⁻³)
0.0
10.0
20.0
Leaflet | Tiles © Esri


CDOM (m⁻¹)
0.0
6.0
12.0
Leaflet | Tiles © Esri



For more information: Please visit the Long Island Sound Water Quality and Monitoring Program website at:

Or contact us: Katie.Obrien-Clayton@ct.gov 79 Elm Street Hartford, CT 06106 (860) 424-3176

References

[1] "Climate Change Indicators: Weather and Climate." Environmental Protection Agency, U.S. EPA, 26 Mar. 2025, www.epa.gov/climate-indicators/weather-climate.

[2] "Climate Explained: Ocean Acidification." Save the Sound, Save the Sound, 30 Oct. 2023, www.savethesound.org/2023/10/23/climate-explained-ocean-acidification/.

[3] "Learn More: Dissolved Oxygen." Sarasota County Wateratlas, USF Water Institute, 2001, sarasota.wateratlas.usf.edu/library/learn-more/learnmore.aspx?toolsection=lm_dissolvedox.

[4] "Life in an Estuary." National Ocean and Atmospheric Association, U.S. Department of Commerce, 25 Mar. 2025, www.noaa.gov/education/resource-collections/marine-life/life-in-estuary.

[5] "Long Island Sound Report Card." Save the Sound, www.savethesound.org/report-card. Accessed 13 June 2025.

[6] Van Patten, Peg, et al. "Sound Facts." UConn.Edu, Connecticut Sea Grant, 2009, seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/09/SoundFactsFinal.2009.pdf.

[7] "What Is a Secchi Disk?" The Robert Carlson Secchi Dip-In, North American Lake Management Society (NALMS), www.nalms.org/secchidipin/monitoring-methods/the-secchi-disk/what-is-a-secchi-disk/. Accessed 13 June 2025.