Hypoxia Summary Report

HYJUN26

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.

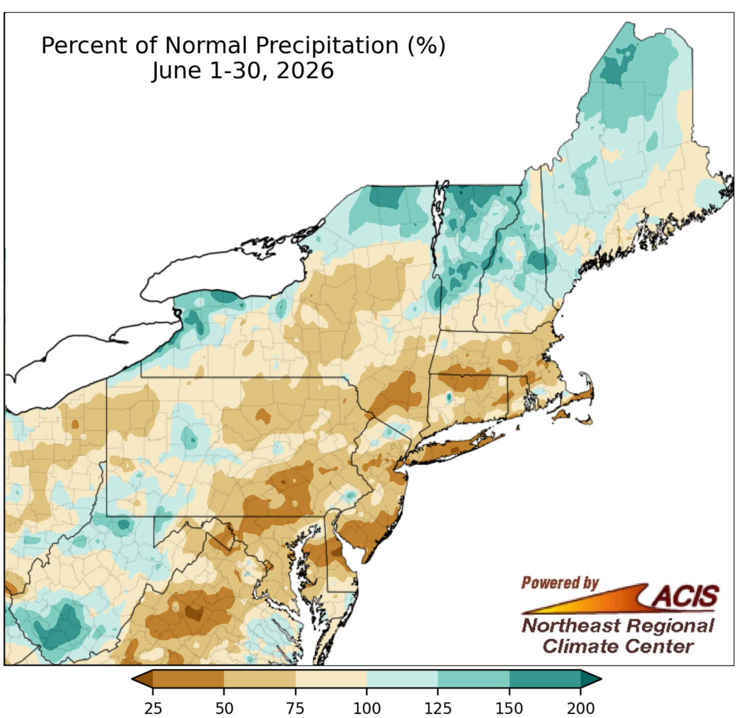
Here we present the results of the HYJUN26 survey that was conducted 22-23 June 2026 aboard the R/V John Dempsey. A total of 35 stations were sampled.

Weather

Precipitation and temperature are important factors that influence both the environment and human safety. 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. Higher temperatures lead to increased forest fire risk, and can fuel more intense storms that endanger coastal communities. Drought conditions could also also potentially assist hypoxia management efforts by reducing nutrient inputs and improving nutrient removal efficiency at waste water treatment plants; however, this has yet to be shown conclusively for LIS.

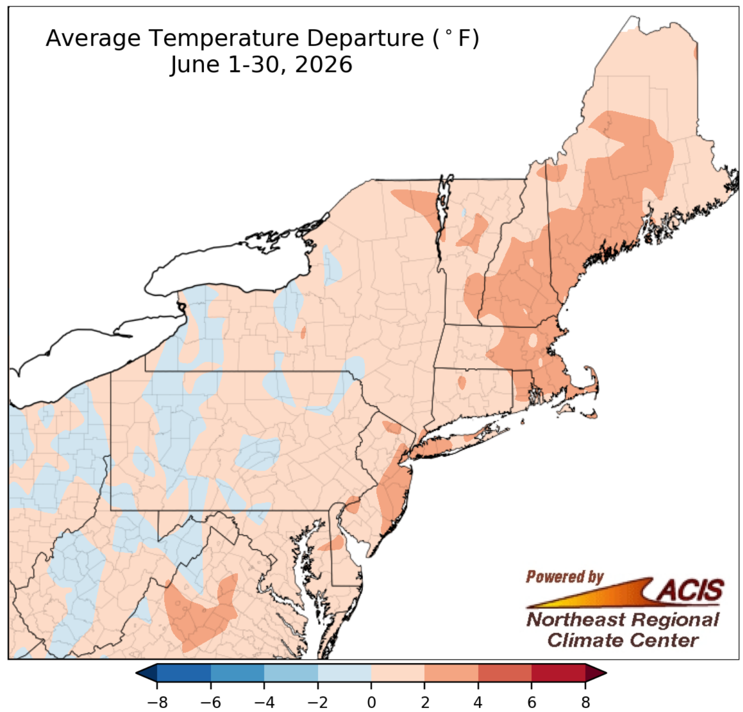
A summary of weather conditions across the coastal portion of the Long Island Sound watershed follows to provide context for CTDEEP's surveys and the formation and progression of hypoxic conditions.

The second part of June continued to be dry across the region. For the month, June 2026 ranked as the 14th driest on record for Hartford. Only 1.59 inches of precipitation fell in Hartford, amounting to only 37% of the normal 4.28 inches. Bridgeport received 2.52 inches (67% of normal) and Islip received only 0.82 inches (21% of normal; 4th driest on record).



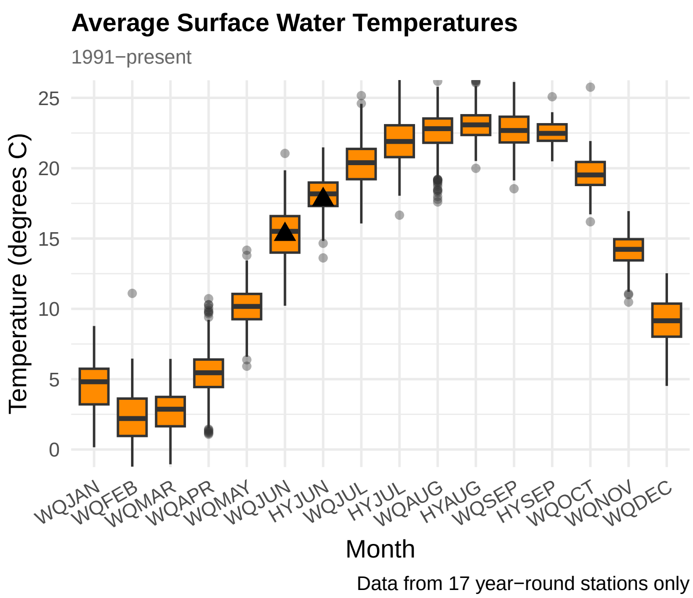
The latter half of June continued to be warmer than normal; Hartford averaged 70.4 °F for the month, a 1.5 degree increase above normal. Bridgeport air temperatures averaged 71.3°F, 1.7 degrees above normal and 7th warmest June on record. While Islip temperatures averaged 71.1°C 2.1 degrees above normal, also the 7th warmest June on record.

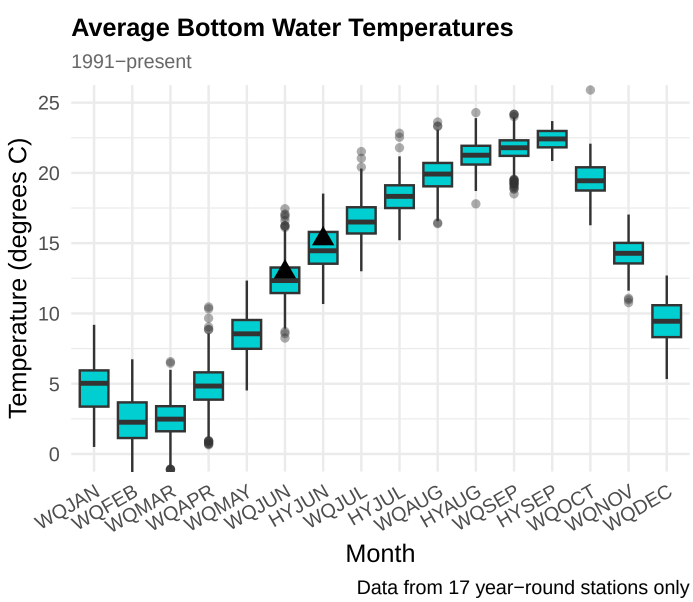
All data and images were from the Northeast Regional Climate Ceneter's Website. Furthermore, to see the average temperature and precipitation of other areas in the Northeast please read the blog located at https://www.nrcc.cornell.edu/.



Water Temperature

The graph below displays the range and median of the average monthly surface (orange boxes) and bottom (blue boxes) water temperature of Long Island Sound as recorded by CTDEEP during the year-round water quality surveys from 1991-present. The graph also displays the average temperature for the current survey (orange and blue triangles).

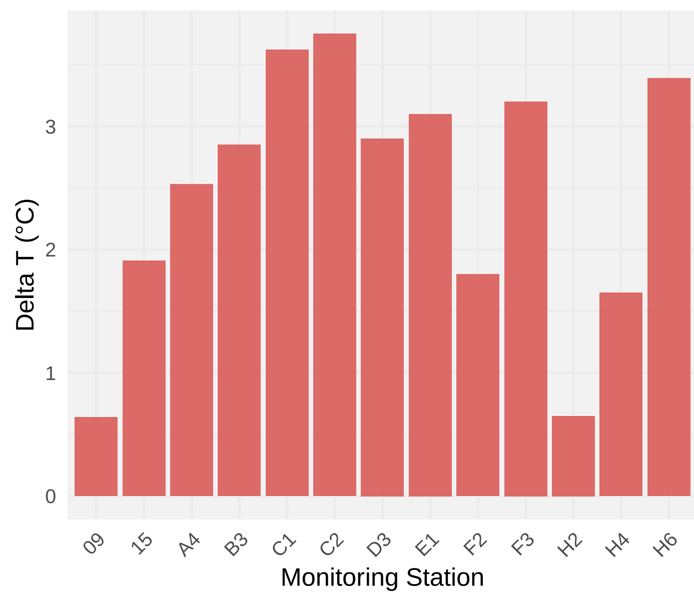




During the HYJUN26 survey, the average surface temperature was 17.77 °C and the average bottom temperature was 15.26 °C. The highest surface temperature was 18.4 at Station B3, and the lowest surface temperature was 16.36 at Station 09. The highest bottom temperature was 17.43 °C at Station H2 and the lowest bottom temperature was 14.33 at Station F3.

Delta T

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 smaller 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.



The average delta T (Surface minus Bottom) was 2.46 °C (Median = 2.85 °C, SD = ±1.05 °C). The minimum temperature difference observed was 0.64 °C at station 09, representing a well-mixed water column. The maximum Delta T was 3.75 °C at station C2, indicating a highly stratified water column structure.

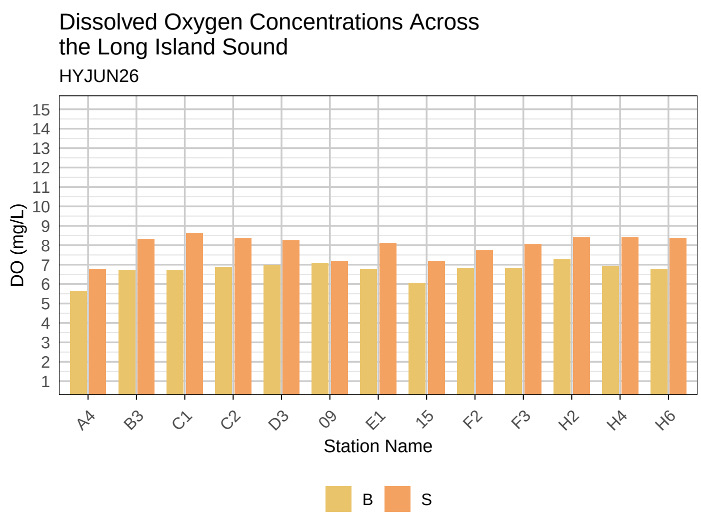
Dissolved Oxygen

Dissolved oxygen is essential for the survival of aquatic organisms, and therefore an important indicator of water quality. Dissolved oxygen (DO) concentrations in the bottom waters of Long Island Sound remained well above 5 mg/L through the June Hypoxia Survey.

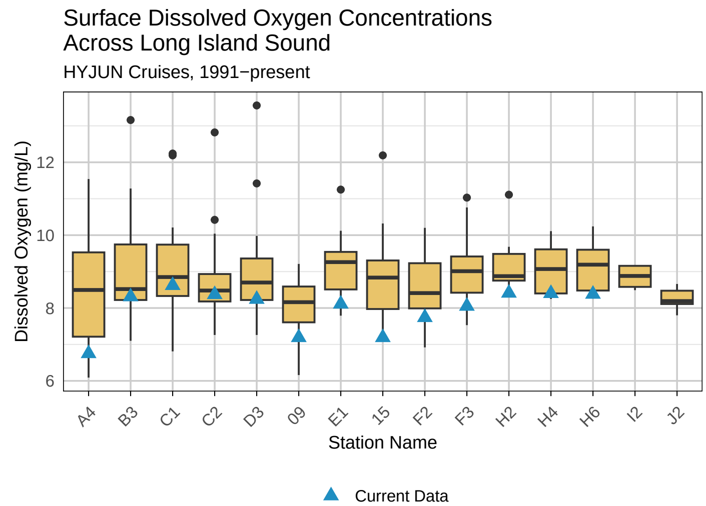
Spatial Distribution of Bottom Water Dissolved Oxygen Levels

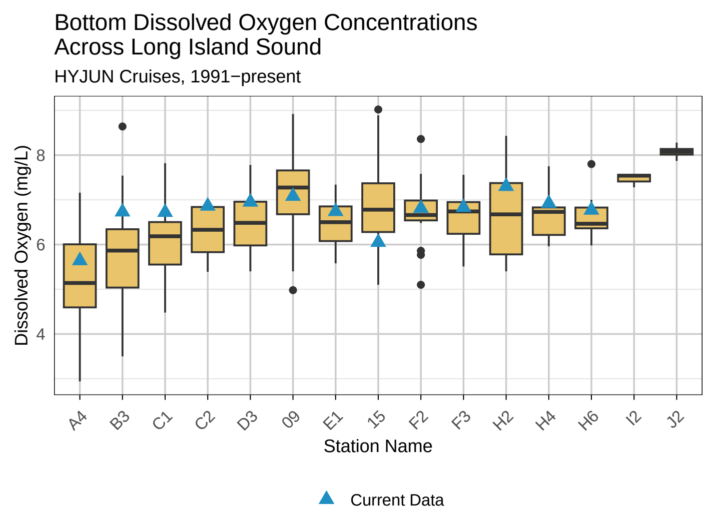
During the HYJUN26 survey, the average surface dissolved Oxygen (DO) concentration was 8.01 mg/L and the average near bottom DO concentration was 6.76 mg/L. The highest surface DO concentration was 8.69 at Station 03, and the lowest surface DO was 6.75 at Station A4. The highest bottom DO concentration was 7.62 mg/L at Station 25 and the lowest bottom DO was 5.54 at Station A4. 0 stations had a surface or bottom dissolved oxygen concentration below 3 mg/L, which is considered hypoxic.

During the HYJUN26 survey, monitoring revealed 35 stations with excellent conditions. No area estimates were calculated as all dissolved oxygen concentrations were above 5 mg/L.



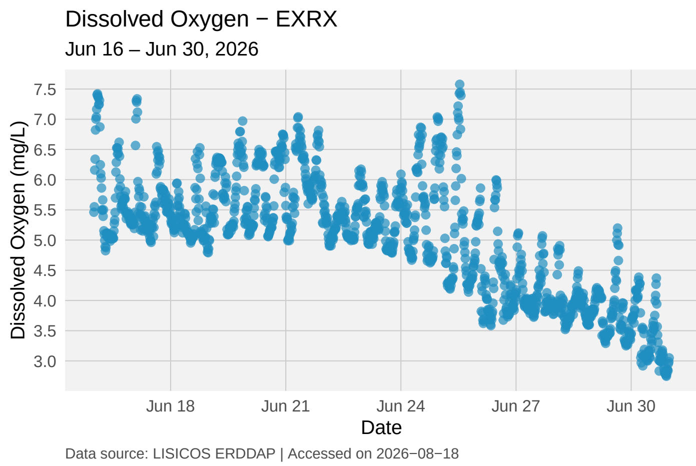
Comparing the average Long Island Sound DO values Measured During HYJUN surveys since 1991

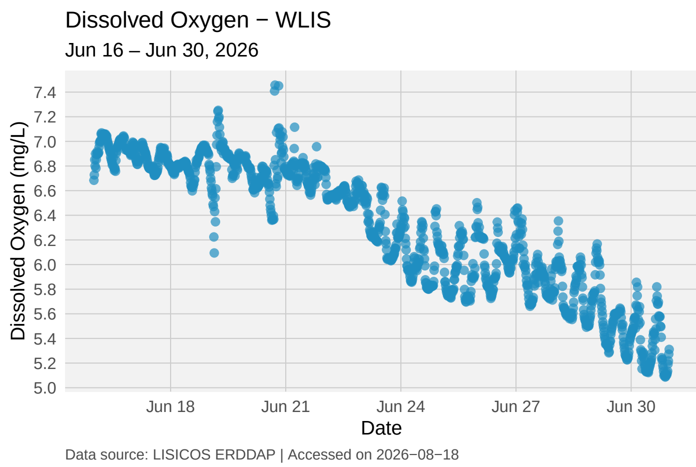


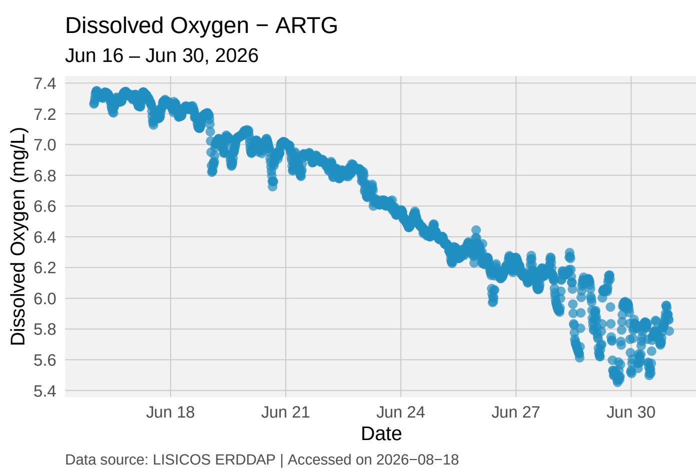


Recent Dissolved Oxygen Levels at EXRX, WLIS, and ARTG Stations

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 WQJUN26 survey.





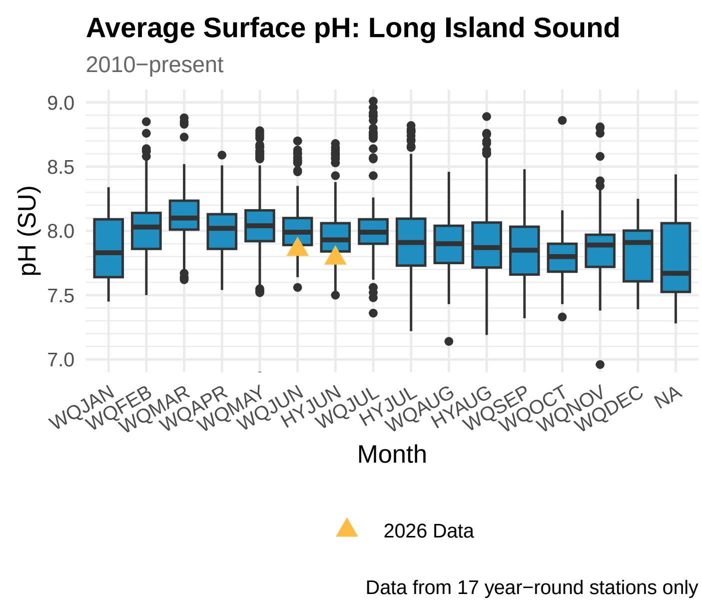


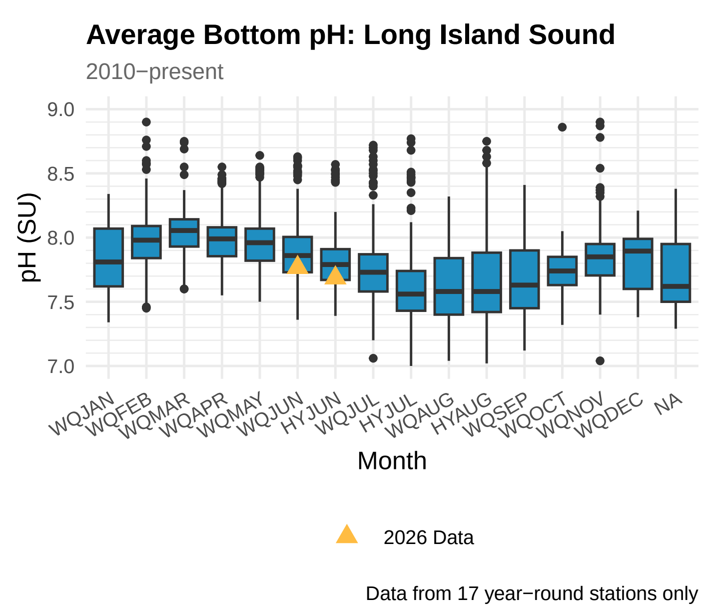
pH

Ocean acidification refers to the process in which the pH of ocean waters decreases over time due to the absorption of atmospheric carbon dioxide (CO2). 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 HYJUN26 survey were 7.77 and 7.67 respectively. The highest surface pH was 7.9 at Stations H6 and H4, and the lowest surface pH was 7.5 at Station A4. The highest bottom pH was 7.78 at Station H2 and the lowest bottom pH was 7.49 at Station A4.





Salinity

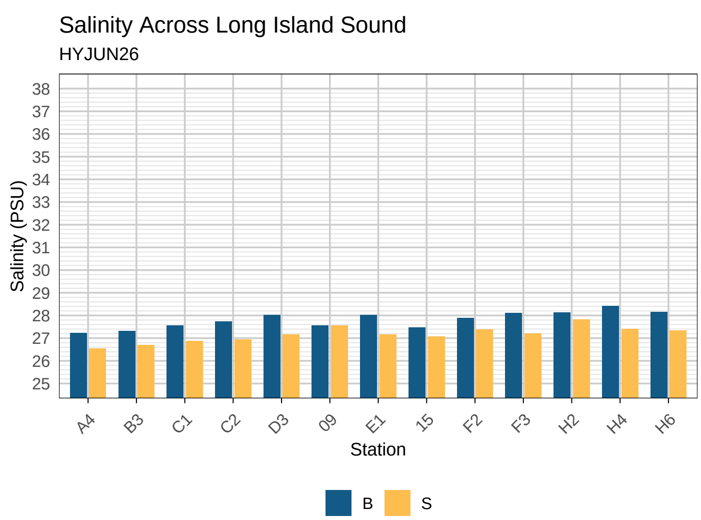
The Long Island Sound is an estuary, meaning its waters are a mix of both fresh and salt water. This is referred to as brackish water. The salt water is supplied by the Atlantic Ocean, while the majority of LIS fresh water comes from three major Connecticut Rivers: the Thames, the Connecticut, and the 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.

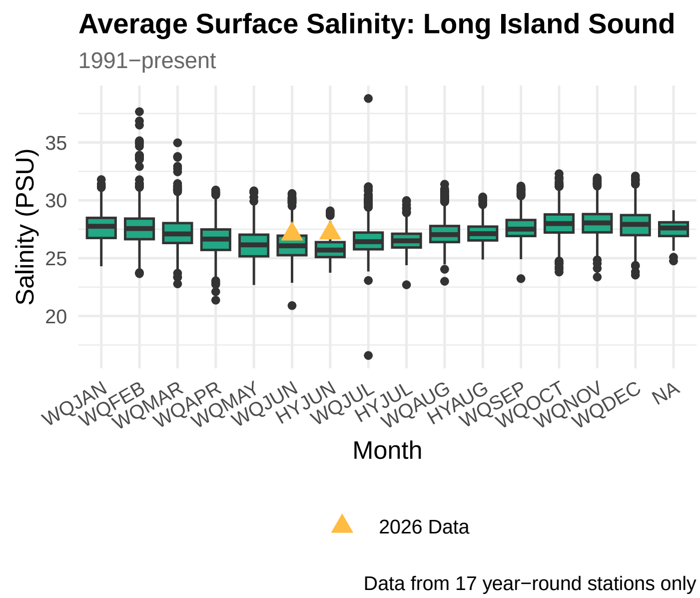
The average surface and bottom salinities from all stations across the LIS during the HYJUN26 survey were 27.14 PSU and 27.8 PSU respectively. The highest surface salinity was 27.84 PSU at Station H2, and the lowest surface salinity was 26.56 PSU at Station A4. The highest bottom salinity was 28.42 PSU at Station H4 and the lowest bottom salinity was 27.23 PSU at Station A4.

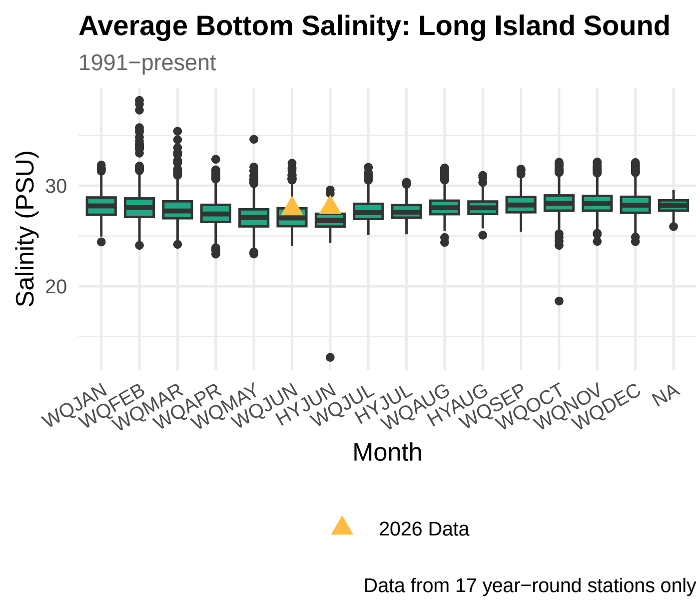
Average salinity across Long Island Sound by station

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



Changes in salinity throughout the year

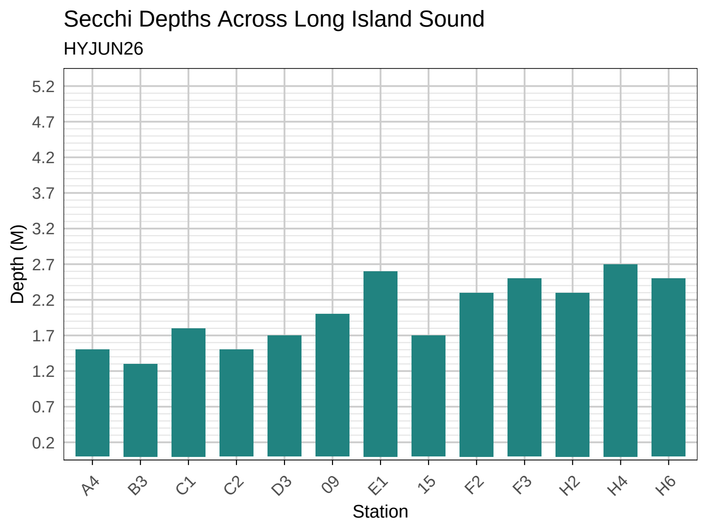




Secchi Disk Depth

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 HYJUN26 survey was 2 m. The greatest disk depth was 2.7 m at station H4. The lowest disk depth was 1.3 m at Station B3.



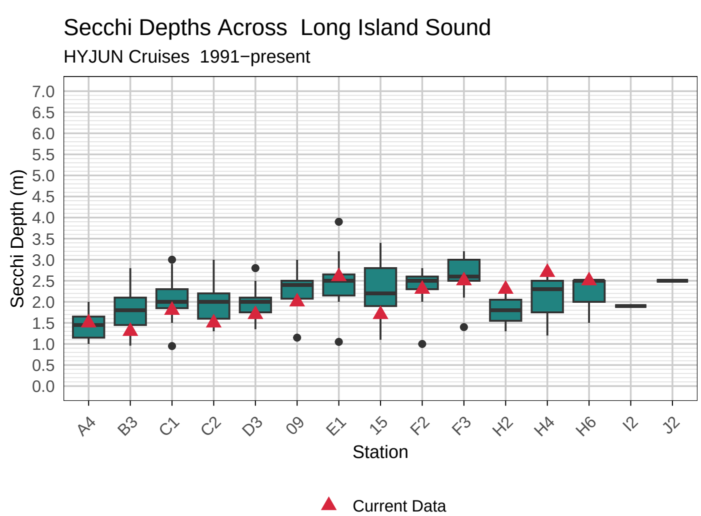
The Long Island Sound Report Card developed by Save the Sound through the LIS partnership utilizes the following thresholds:[5]

Table 1: Secchi Depth Grading Thresholds

Grade	Depth Range (m)	Score Equiv.
A	> 2.28	90–100%
B	2.12 – 2.28	80–90%
C	1.95 – 2.12	70–80%
D	1.80 – 1.95	60–70%
F	< 1.80	$<$ 60%

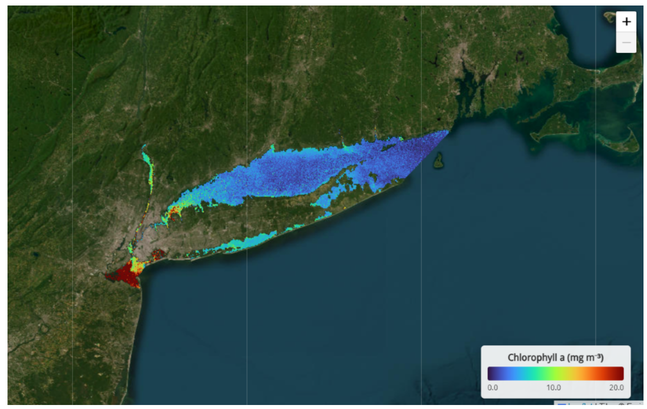
In the HYJUN26 survey, 6 stations received a grade of A, 1 station received a grade of C, 6 stations received a grade of F.

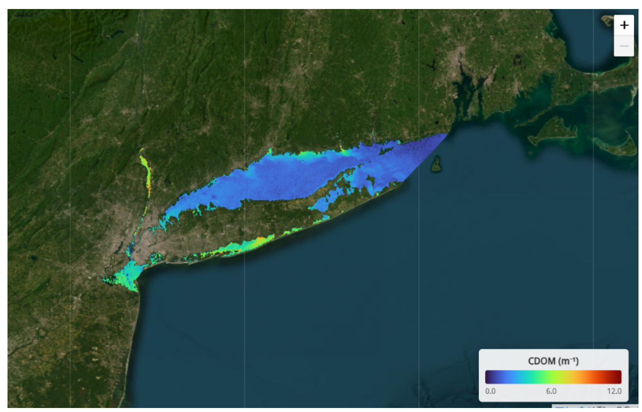
Looking at historical Secchi depth values across the Long Island Sound

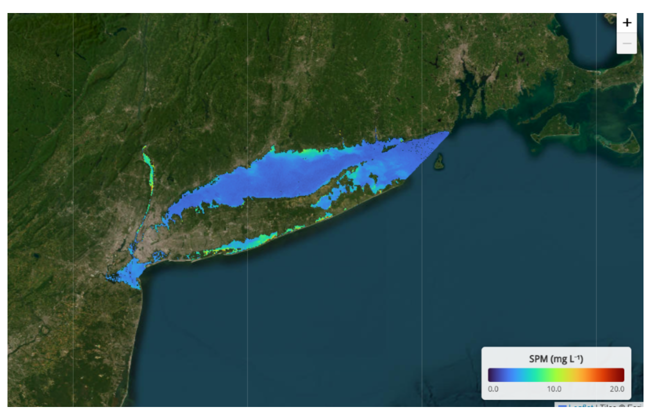


Remote sensing- CHLA, CDOM, SPM

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 are from 9 June 2026, one day following the WQJUN26 survey and excerpted from the website. CHLA imagery provides a measure of plankton biomass. CDOM and SPM provide a measure of turbidity.







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.

Li, M., Y. J. Lee, J. M. Testa, Y. Li, W. Ni, W. M. Kemp, and D. M. Di Toro (2016), What drives interannual variability of hypoxia in Chesapeake Bay: Climate forcing versus nutrient loading?, Geophys. Res. Lett., 43, 2127–2134, doi:10.1002/2015GL067334.

Hagy III, James & Boynton, W. & Keefe, Carolyn & Wood, Kathryn. (2004). Hypoxia in Chesapeake Bay, 1950–2001: Long-term change in relation to nutrient loading and river flow. Estuaries. 27. 634-658. 10.1007/BF02907650.

Contact Us

Katie.Obrien-Clayton@ct.gov
79 Elm Street Hartford, CT 06106
860-424-3176

Visit the Long Island Sound Water Quality and Monitoring Program website at: https://portal.ct.gov/deep/water/lis-monitoring/lis-water-quality-and-hypoxia-monitoring-program-overview