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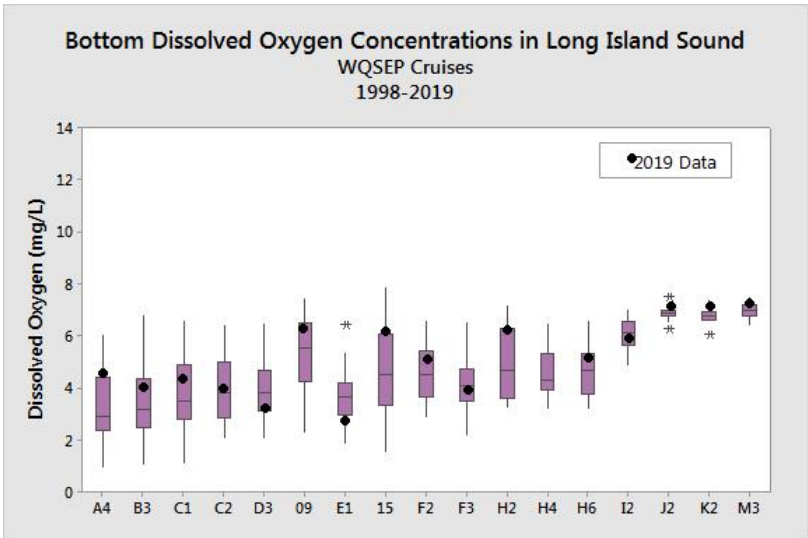

WQSEP19 Summary

2 Stations under 3.0 mg/L

Long Island Sound Water Quality Monitoring Program

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CT DEEP sampled 41 stations during the WQSEP19 survey that was conducted 27-30 August 2019. The lowest dissolved oxygen (DO) recorded during this survey was at Station E1 with a concentration of 2.74 mg/L. Only one other station (Station 14) had a DO less than 3 mg/L. Three stations were less than 3.5 mg/L, and 10 additional stations were under the 4.8 mg/L threshold.
Data are available in an Excel spreadsheet format.

Between 1998 and 2019, DO levels in the bottom waters of Long Island Sound during the WQSEP surveys were consistently below 3.0 mg/L; concentrations were only above 3.0 mg/L on 10 occasions and only twice were they above 4.8 mg/L. On two occasions, the bottom waters were less than 1 mg/L (Table 1).

The DO at Station A4 during the WQSEP19 survey (4.56 mg/L) was above its average (3.35 mg/L) and median (2.95 mg/L) values from all WQSEP surveys conducted by CT DEEP between 1998 and 2019 (n=21), where the DOs at Station A4 ranged from 0.93 mg/L (WQSEP04) to 6.08 mg/L (WQSEP00). The WQSEP19 survey was the first time since WQSEP14 that Station A4 did not have the lowest DO. In fact, this was the first time since WQSEP10 that the lowest DO was not observed in Western Long Island Sound. The cause of this is likely due to the weather conditions that were observed previous to and during the survey, which is elaborated upon in the Weather section of the summary. **

During the WQSEP19 survey, there were 52.6 km^2 of bottom water that had DO concentrations less than 3.0 mg/L, and an additional 646.4 km^2 of bottom water with DO concentrations less than 4.8 mg/L. The areal estimates below 3.0 mg/L for WQSEP surveys from 1998-2019 average 125.1 km^2.

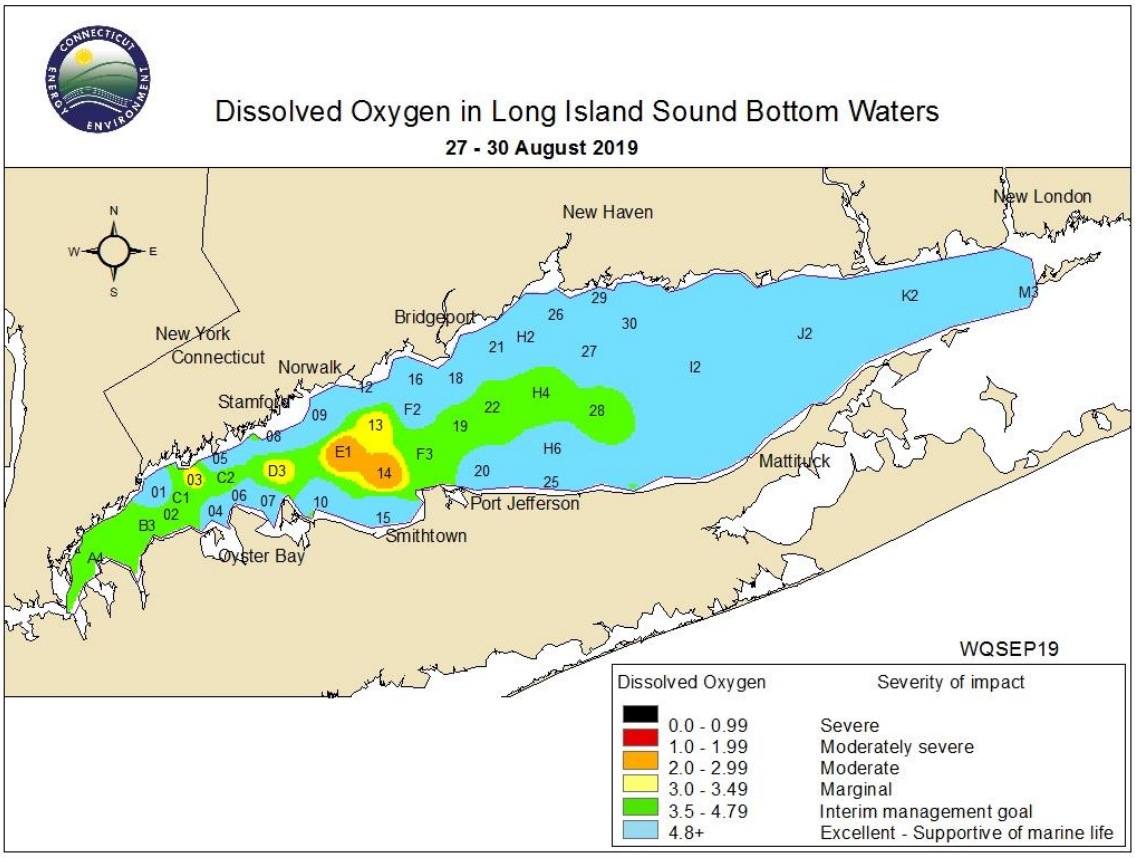


Table 1. Minimum Dissolved Oxygen Concentrations and Areal estimates for WQSEP Cruises Conducted from 1998-2019 by CT DEEP.

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**

Weather

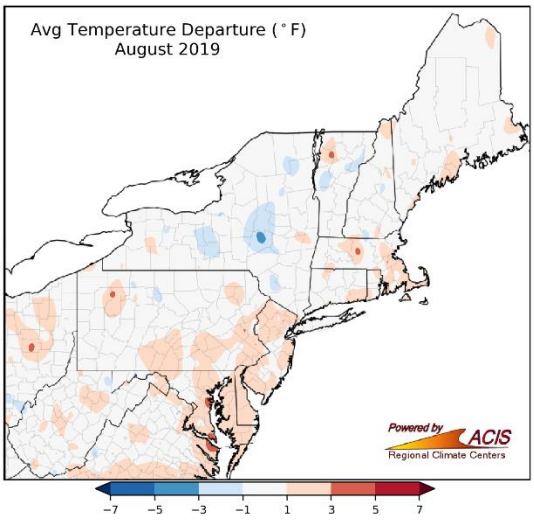
Temperatures during the WQSEP19 cruise (27-30 August) varied. The first two days continued an already cool week, staying in the low-70s as recorded in Bridgeport, CT and Islip, NY. The temperature hit the mid-70s at LaGuardia Airport, NY. The last two days, on the other hand, averaged in the mid-80s in those same locations. Overall, though, the month of August temperatures were right on the 30-year normal around Long Island Sound, and the image to the top right (Average Temperature Departure) demonstrates this with all its lack of color.

The second day of the cruise, August 28, was rather rainy with 1.82 inches of precipitation falling in Centerport, NY (Long Island), 1.30 inches in Bridgeport, and 0.10 inches at LaGuardia. As a whole, August was drier than usual; LaGuardia and Bridgeport were an inch short of their respective normals, and Islip was down by half an inch. Most of the rainfall was focused towards the middle of the month.

More detailed weather information can be viewed on the Northeast Regional Climate Center's website.

** In the two weeks prior to and including the date CT DEEP sampled stations in western Long Island Sound for the WQSEP19 survey (August 28), western LIS experienced seven days of wind coming from an easterly direction, which ranged from an average speed of 7.4 mph (August 28) to 16.1 mph (August 25) (Table 2). This is important because as research done by O'Donnell et al. (2008) and Wilson et al. (2015) suggests, axial winds from the east reduce stratification while axial winds from the west promote stratification. According to further research by Bratton et al. (2015) on the subject, winds coming from between 30° and 110° (from between NNE and ESE directions) are preferable to induce mixing of western LIS. Thus, we believe that the wind events leading up to the cruise helped bring the DO at Station A4 back up to a concentration of 4.56 mg/L.

The wind data from Table 2 came from the LaGuardia's Daily Climate Report provided by the National Weather Service Forecast Office in New York. More specific data is also provided by UConn's LISICOS Buoys, which take samples of wind speed and many water quality parameters at 15 minute intervals. Recent wind information for the Western Sound Station (corresponding to CT DEEP's Station C1) can be found here.



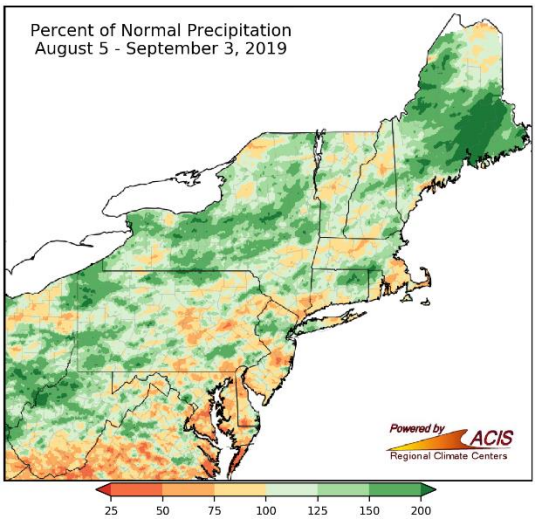
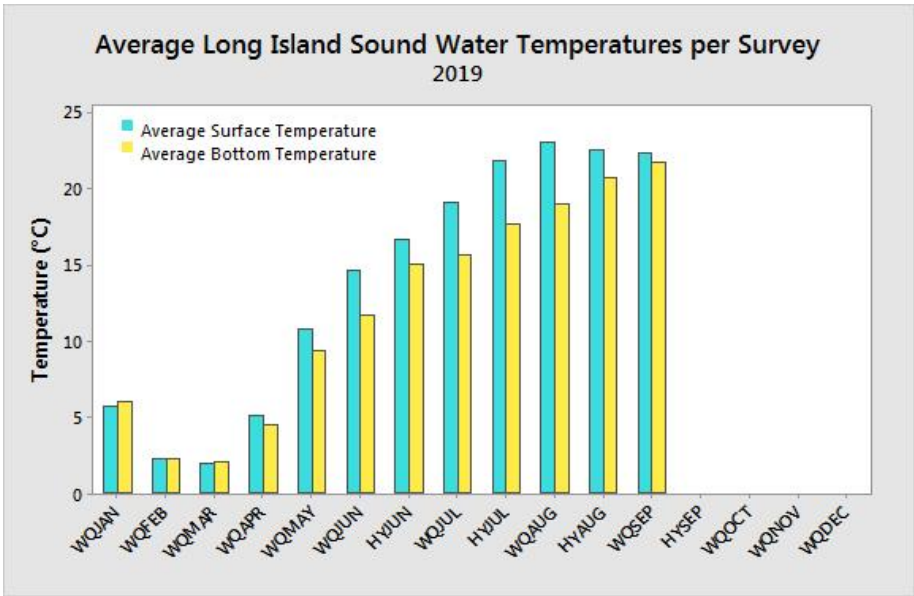
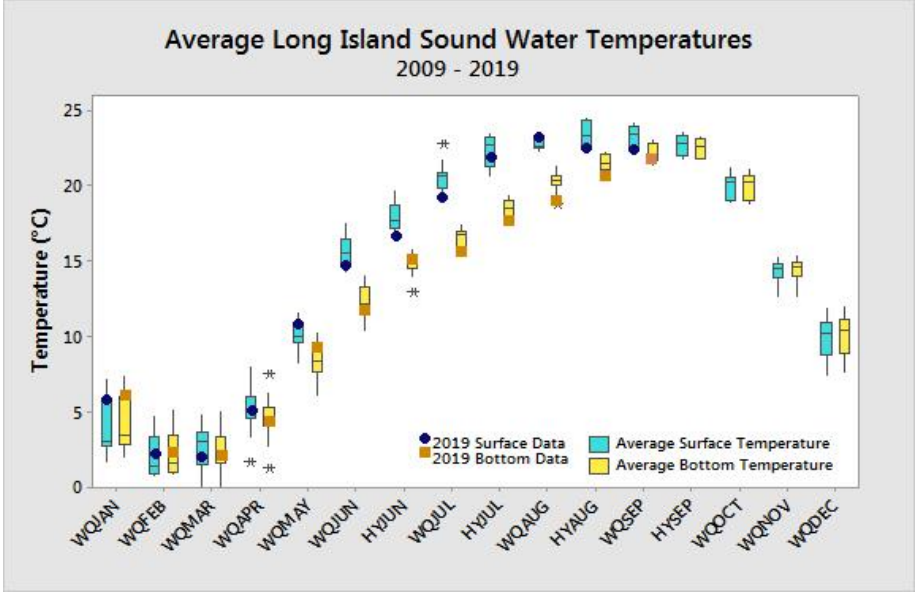


Table 2. Average wind speed, highest wind speed, and direction of the highest wind (degrees from North) as recorded from LaGuardia Airport, NY.

Date	Average Wind Speed (mph)	Highest Wind Speed (mph)	Highest Wind Direction
8/14/19	8.2	16	NE (40)
8/15/19	8.6	15	SE (150)
8/16/19	8	13	SE (150)
8/17/19	8.6	15	NE (50)
8/18/19	7.1	22	NW (310)
8/19/19	7.2	22	S (160)
8/20/19	8.1	16	S (170)
8/21/19	8.3	20	S (200)
8/22/19	7.6	38	NW (310)
8/23/19	7.8	15	NW (320)
8/24/19	8.8	16	N (10)
8/25/19	**16.1**	26	**NE (60)**
8/26/19	**10.9**	21	**NE (50)**
8/27/19	7.1	14	S (190)
8/28/19	**7.4**	16	**NE (40)**

Water Temperature





Over the course of the spring and summer surface and bottom water temperatures rose steadily beginning with the WQMAR19 cruise. However, HYAUG19 marked the first cruise of the 2019 hypoxic season in which CTDEEP recorded a decrease in the average temperature of the surface waters, despite the average temperature of the bottom waters continuing to increase. This trend continues for the WQSEP19 survey: the average bottom temperature increased by 0.94°C (20.77°C TO 21.71°C), and the average surface temperature decreased by 0.21°C (22.53°C to 22.32°C) from HYAUG19 to WQSEP19.

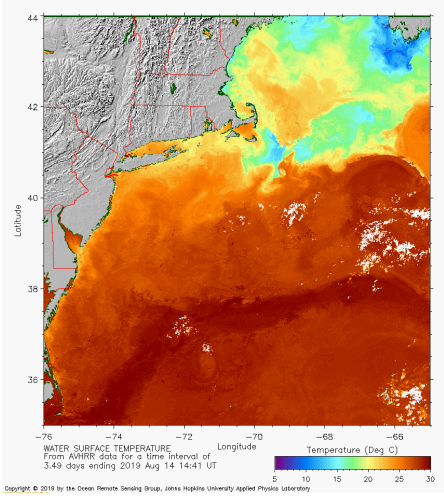
The maximum surface water temperature during the WQSEP19 survey occurred at Station H2 (23.34°C), while the maximum bottom water temperature occurred at Station A4 (22.81°C).

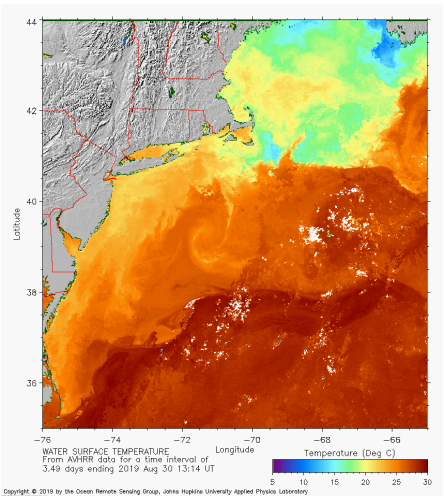
As we move into the fall season, cooler air temperatures and increased wind events contribute to decreased surface water temperatures, increased mixing and the weakening of stratification. The average ΔT (difference between surface and bottom water temperatures) for WQSEP19 was 0.61°C, a decrease of 1.15°C from the HYAUG19 average of 1.76°C and an even greater decrease of 3.51°C from the WQAUG19 average of 4.12°C. WQSEP19's ΔTs ranged from 0.01°C (Station 09) to 1.47°C (Station H6).

Note: The surface and bottom water temperatures discussed and graphed reflect data from only the 17 year-round water quality stations.

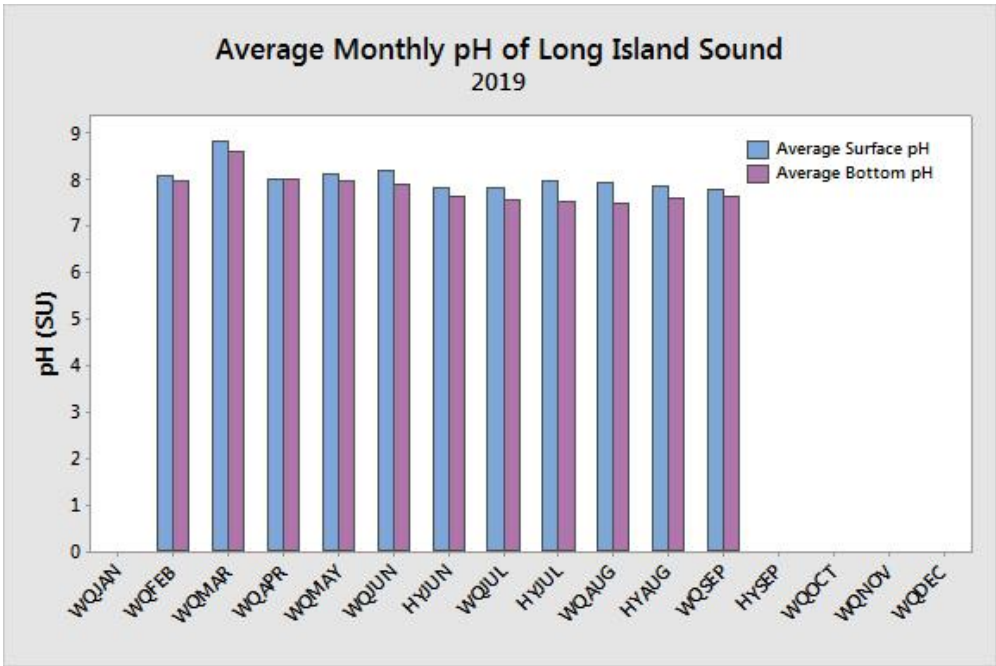
Sea surface temperature (SST) data from Johns Hopkins University Applied Physics Lab illustrate how currents and fronts impact water temperatures in Long Island Sound and offshore. A strong cold front pushed through the region 29 August into 30 August and merged with Tropical Storm Erin. The two 3-day composites shown here are from the end of the HYAUG19 survey (14 Aug, left) and the end of the WQSEP19 survey (30 Aug, right). Over the two-week timeframe, noticeably cooler water penetrated south into, and beyond, LIS from the Gulf of Maine and Georges Bank.

More information about sea surface temperature can be found on the Johns Hopkins APL Ocean Remote Sensing website: http://fermi.jhuapl.edu/avhrr/gs_n/averages/index.html.





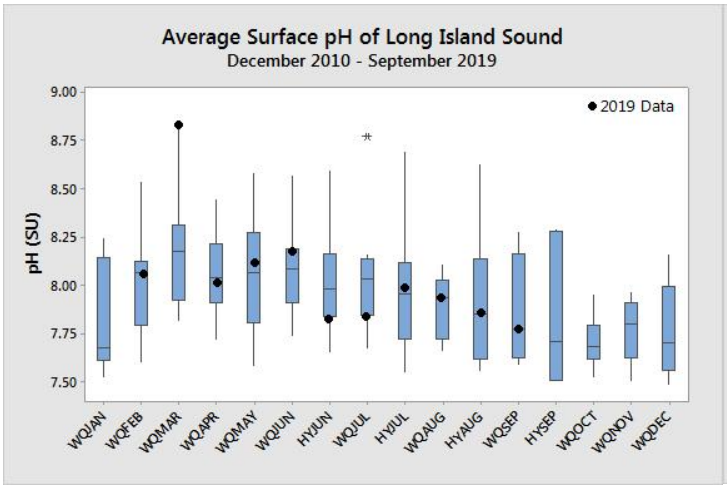
pH

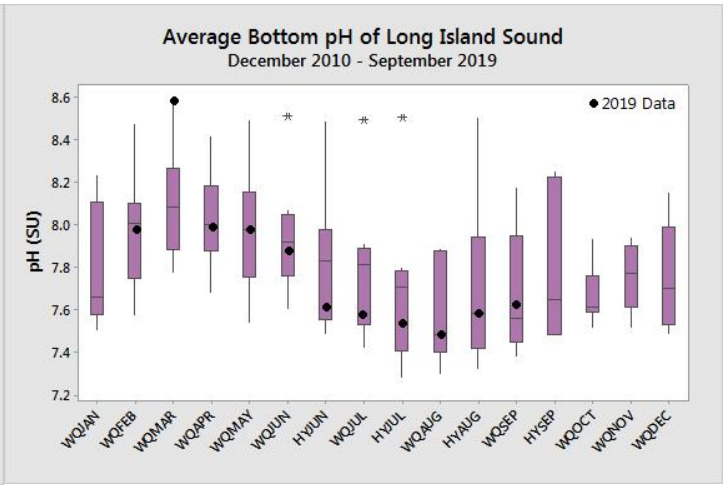


During the WQSEP19 survey, the surface pH averaged 7.77 SU, and the bottom pH averaged 7.62 SU. This is slightly below the average surface and bottom pHs (7.85 SU and 7.67 SU, respectively) for all WQSEP surveys from 1998 to 2019 (n=21).

Stations H6 and I2 were both sites of the highest surface pH (7.95 SU), while the lowest surface pH value (7.52 SU) occurred at Station A4. Bottom pHs ranged from 7.41 SU at Station E1 to 7.88 SU at Station J2 for WQSEP19; bottom pHs for all WQSEP surveys range from 7.12 (WQSEP13 and WQSEP14) to 8.41 (WQSEP15).

Note: The surface and bottom pHs discussed and graphed reflect data from only the 17 year-round water quality stations.

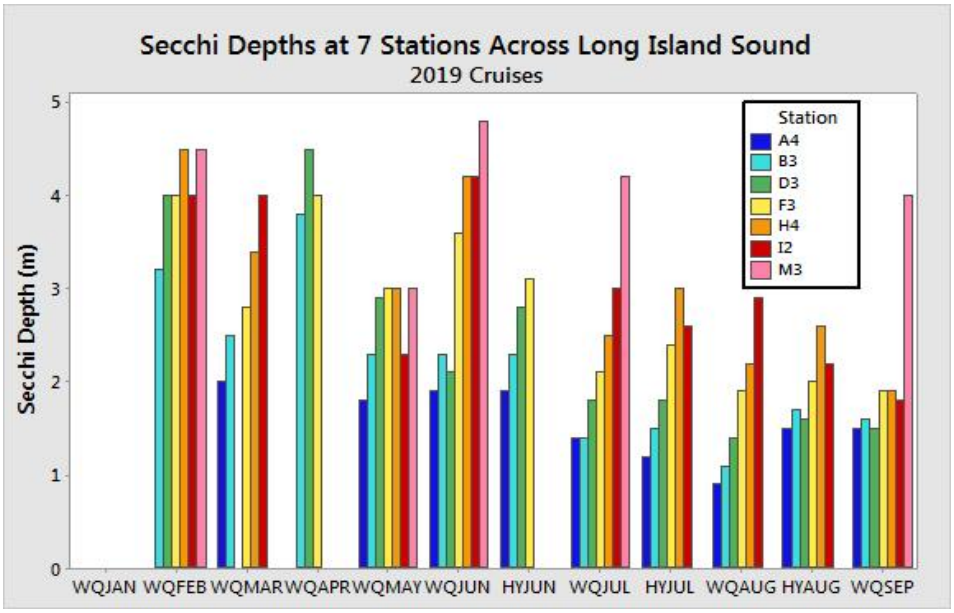


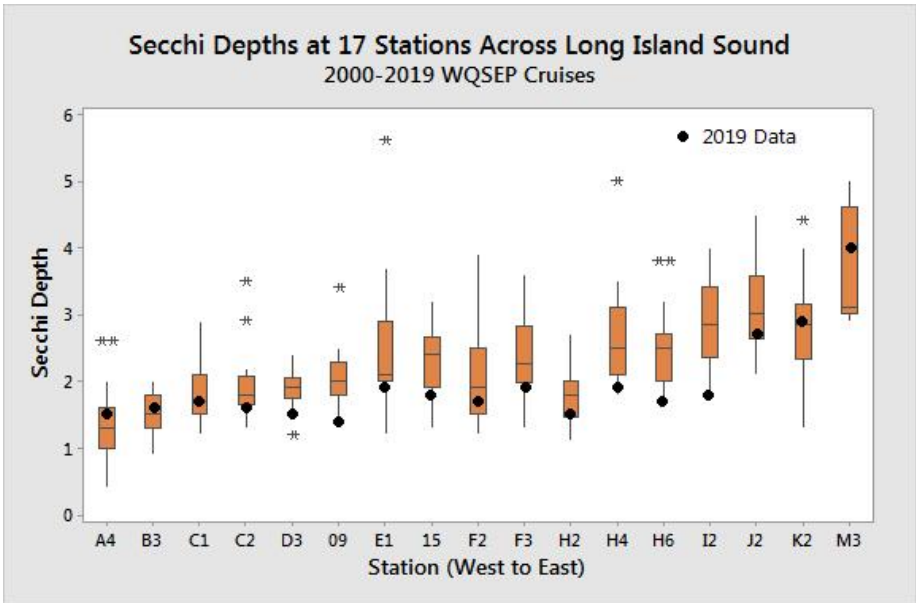


Secchi Disk Depths

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

In order 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 41 stations during the WQSEP19 survey; these depths ranged from 1.3 meters (Station 07) to 4.0 meters (Station M3).

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

1. >2.28 (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. <1.8 (F; <60)

Of the 41 stations measured this survey, 3 were in the A-range, 4 were in the C-range, 12 were in the D-range, and 22 failed.

SPOTLIGHT!

Dr. Dianne Greenfield, PhD, Associate Professor, CUNY, Advanced Science Research Center and Queens College

It has been a delight to have Dr. Dianne Greenfield join the crew of the R/V John Dempsey on multiple cruises throughout the summer of 2019! Dr. Greenfield is a biological oceanographer who studies phytoplankton, microscopic organisms that form the base of aquatic food webs and generate approximately half of the world's oxygen through photosynthesis. Her research goal is to understand the complex feedbacks involving phytoplankton in coastal environments, with an emphasis regarding the influence(s) of global change stressors (urbanization, eutrophication, and climate) on ecological and biogeochemical processes. This includes, but is not limited to, studying harmful algal blooms (HABs), species that can impact ecosystem and public health through the production of toxins or other adverse effects. On board, Dr. Greenfield conducted in situ phytoplankton community composition and nutrient (nitrogen and phosphorous) analyses as part of a project with Dr. Tzortziou and Dr. Goes funded by a Long Island Sound Study grant. The goal of this project is to compare water quality data acquired by remote sensing with analyses of in situ (shipboard) collections. Dr. Greenfield is also investigating the extent to which the varying oxygen levels in Western Long Island Sound are associated with plankton and nutrient spatial and temporal dynamics. When possible, Dr. Greenfield's efforts are partnered with molecular methods to further characterize and quantify algal and microbial community and population dynamics.

Next Survey

Our next survey is scheduled for 10 September (HYSEP19) aboard the R/V Patricia Lynn.
The schedule for the remainder of 2019 is available on our website.

Connecticut Department of
ENERGY & ENVIRONMENTAL PROTECTION