CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 Elm Street, Hartford, CT 06106

LONG ISLAND SOUND SUMMER HYPOXIA

April 2001

Arthur J. Rocque, Jr., Commissioner

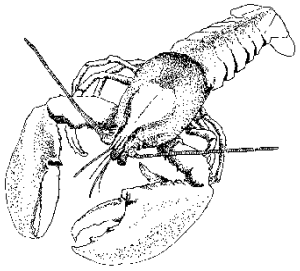
What is Hypoxia?

Hypoxia is the condition of low dissolved oxygen (DO) in the bottom waters of Long Island Sound (LIS) that restricts habitat availability for bottom dwelling creatures during summer. Just as people need oxygen in the air they breathe to live, most aquatic life, including fish and shellfish, require dissolved oxygen in the water to survive. When oxygen falls below certain levels, fish must either migrate to new areas or perish. Presently, DO levels regularly fall below 1 mg/L (part per million) in areas where normal levels would be expected to exceed 5 mg/L. Research shows that oxygen levels would have to remain above 3.5 mg/L to protect most aquatic life in the Sound.

Why does Hypoxia occur?

Hypoxia occurs when a natural condition (stratification) is coupled with the addition of nutrients such as nitrogen. During summer, calm surface waters warm up, forming a barrier between the cooler (slightly saltier) bottom waters and the warmer (less salty) surface waters. This barrier or "pycnocline " prevents the two layers from mixing. Without mixing, there is little chance for re-oxygenation of the bottom waters from the surface where photosynthesis and wave activity replenish the oxygen. The longer stratification is maintained by calm, warm summer conditions, the more severe the hypoxia.

Microscopic plants, called algae or phytoplankton, grow in the sunlit surface waters. When phytoplankton die they sink into the bottom waters and as they decompose, DO is used up. Because human activity has added so much extra nitrogen to LIS there is an over abundance of algae and DO levels in the bottom waters today fall well below natural conditions. Sewage treatment plant discharges are a major source of the nitrogen load but atmospheric deposition and stormwater runoff also contribute significantly. The load of nitrogen to the Sound is several times the amount that existed in pre-Colonial days.

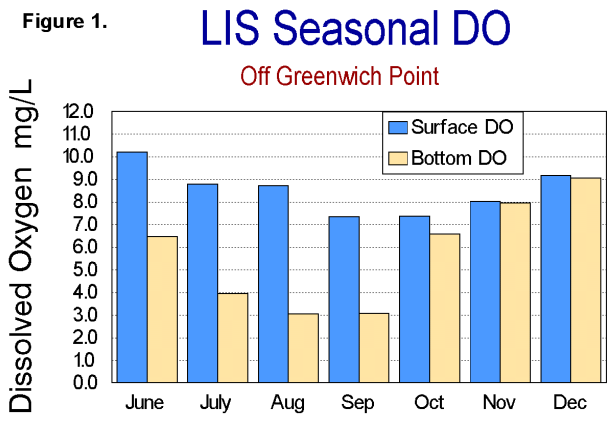


As you might imagine, if there is little or no DO in the water then lobsters, crabs, and other bottom dwelling creatures capable of movement will leave the area or become stressed. Under severe hypoxic conditions sensitive species can die as is seen in fish kills.

When does Hypoxia occur?

While hypoxia in the Sound varies annually, the dissolved oxygen concentrations in LIS show consistent annual patterns. The highest DO concentrations occur during the coldest winter months and the lowest DO levels occur during the hot summer months.

Figure 1.



Hypoxia is typically a bottom water summer phenomenon, present in LIS by early July. Observed onset has ranged from July 1 in 1994 to as late as August 10 in 1996 (Figure 2). Additionally, the duration of hypoxia varies annually, ranging from a minimum duration of 34 days in 1996 to a maximum of 82 days in 1989 over the 14 years (1987-2000) of sampling (Figure 3). Hypoxia duration has averaged 56 days during the summer. In both1999 and 2000, hypoxia began about July 2 and in 1999 ended on August 21 (a duration of about 50 days) but in 2000 ended on August 6 (a duration of 35 days).

Figure 2.

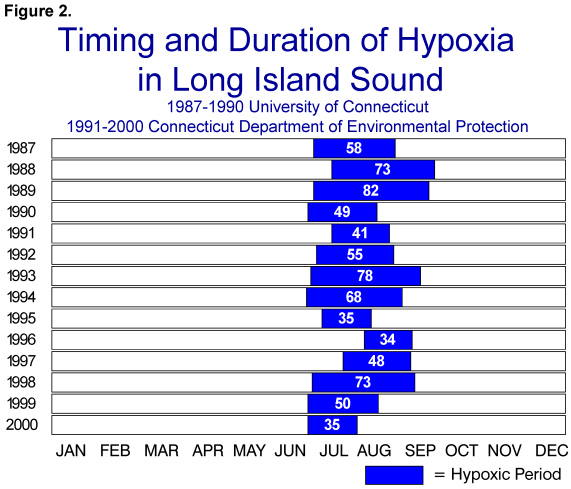
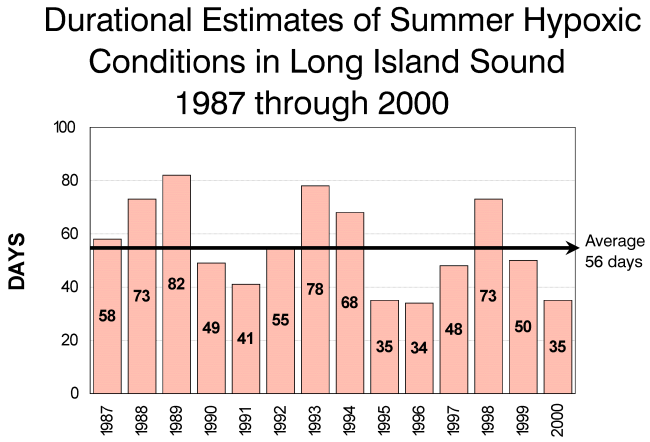


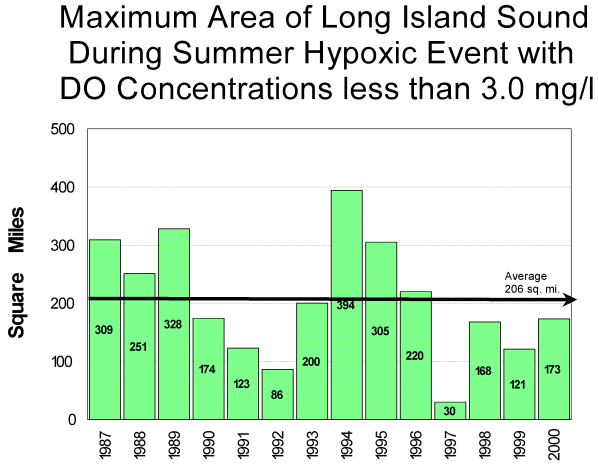
Figure 3.



How much of LIS is impacted by Hypoxia?

The area of LIS bottom waters affected by DO less than 3.0 mg/L varies annually (Figure 4). The maximum area of hypoxia observed in the past ten years occurred in 1994 when 394 square miles were impacted. In 1997, only 30 sq.mi. of LIS's bottom waters were hypoxic. On average, about 206 sq.mi. of LIS turns hypoxic during the summer.

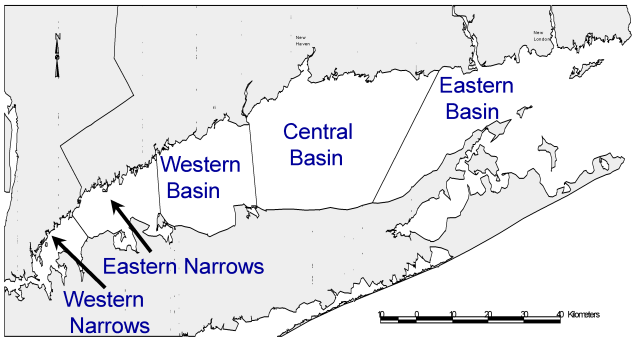
Figure 4.



Where is Hypoxia most prevalent?

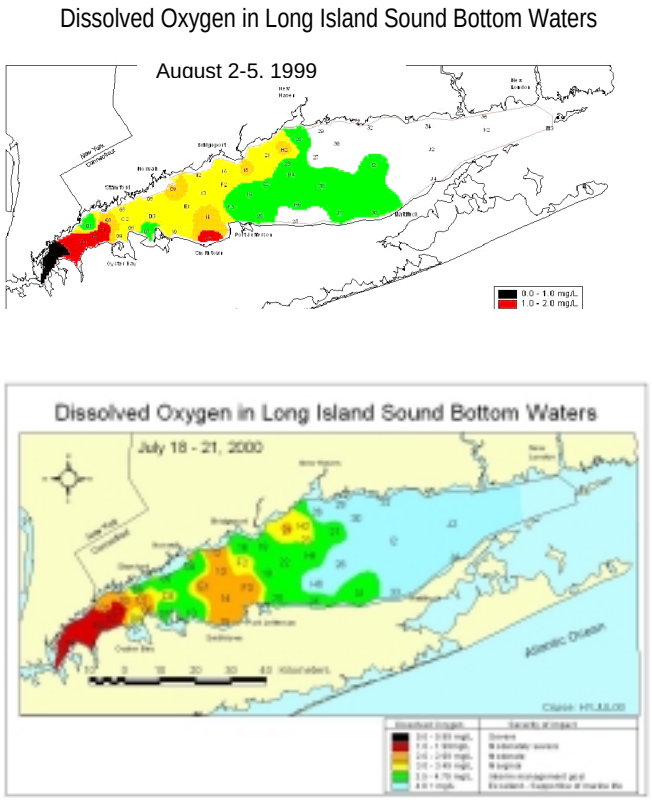
Typically, Western LIS has the lowest dissolved oxygen concentrations during the summer (Figure 5) and is affected by hypoxia for the longest period of time. Areas in Central LIS do not become hypoxic every year.

Figure 5. Major Basins of Long Island Sound



The Eastern Sound has the highest dissolved oxygen concentrations due to its proximity to the Atlantic Ocean, which has cooler, well-oxygenated water, less stratification, and lower nutrient and phytoplankton concentrations. Although the pattern of hypoxia varies annually (Figure 6.), the east-west distribution of conditions remains relatively the same.

Figure 6. Hypoxic areas observed during the summers of 1999 & 2000



What Needs to Be Done to Control Hypoxia?

Progress Controlling Hypoxia

Municipal sewage treatment plant (STP) upgrades are being implemented to reduce the level of nitrogen in their treated discharges to LIS waters.

Data from Connecticut and New York STPs in the LIS drainage basin indicate that nitrogen discharges have fallen in recent years (Figure 7). With fewer nutrients to fuel excess phytoplankton and zooplankton growth, less oxygen is consumed during decomposition in the bottom waters of LIS resulting in a shorter hypoxia duration and a smaller impacted area. This downward trend in loading is contributing to oxygen improvements in LIS.

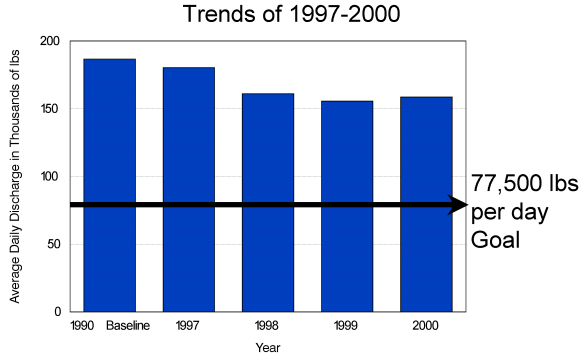
What can be done?

The states of Connecticut and New York are implementing nutrient reduction programs for Long Island Sound formalized in the recently approved Total Maximum Daily Load (TMDL) for nitrogen. A TMDL is the legal process to establish how much of a pollutant, in this case nitrogen, should be allowed to enter a water body from human sources. Connecticut and New York have set an ambitious goal of removing nearly 60% of the human-caused load of nitrogen by the year 2014.

There is much that people can do to reduce the nutrient impact on Long Island Sound, too. For example: use fertilizers carefully and don't fertilize lawns and shrubs after September 15th. Put leaves and organic debris into bags or containers for proper disposal or composting. Do not rake leaves into the street or storm drains. Cover open soil and sand piles with plastic or hay to prevent erosion runoff. Be involved in the decision making process for sewage treatment plant upgrades at the town and city level of government.

The CT DEP believes the aggressive program of nutrient removal established for LIS will set the standard for further reductions and be an example for other estuary watersheds around the country.

Figure 7. Nitrogen Load from Sewage Treatment Plants



Data from CT DEP and NYS DEC

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