CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 Elm Street, Hartford, CT 06106-5127

MONITORING LONG ISLAND SOUND HYPOXIA 2004

Gina McCarthy, Commissioner

Monitoring Hypoxia in LIS

Hypoxia is the condition of low dissolved oxygen concentrations (< 3.0 ppm) in the waters of Long Island Sound (LIS) . Hypoxia impacts up to half of the Sound's bottom waters each summer, rendering hundreds of square miles of bottom habitat unsuitable for healthy fish and shellfish populations (Figure 1). Since 1990, CTDEP and New York State Department of Environmental Conservation (NYSDEC) have been implementing a Nitrogen Reduction Program to alleviate hypoxia in (LIS). In cooperation with the EPA Long Island Sound Study (LISS), the states have found that nitrogen is the pollutant most directly responsible for hypoxia because it stimulates algal growth in LIS. Algae settle to the bottom waters of LIS, die and eventually decay, driving down oxygen levels in the process.

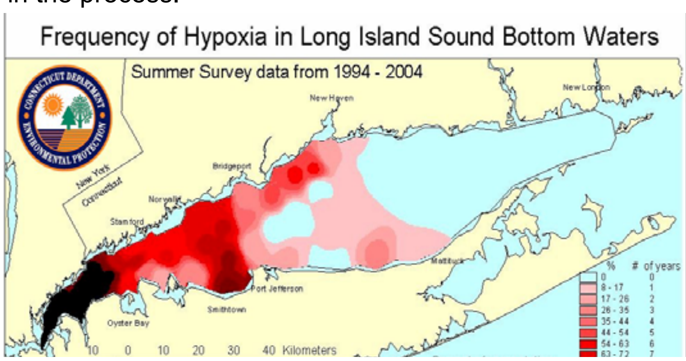

Figure 1. Area of the Sound impacted by hypoxic conditions.

In 2001, a Total Maximum Daily Load plan was approved by EPA, which commits CTDEP and NYSDEC to reduce their states' nitrogen loads by 58.5% by 2014. To determine if progress to date has yielded the desired benefits for LIS, a water quality monitoring program has been in place since 1987.

CTDEP has led this intensive year-round monitoring program since 1991. Monthly water samples are collected from more than forty sites by staff aboard CTDEP's Research Vessel *John Dempsey*.

Monitoring data quantify and identify annual trends and changes in water quality parameters relevant to hypoxia, especially nutrients, temperature and chlorophyll.

Water samples taken near the surface and near the bottom at each station are analyzed for nitrogen, phosphorus, silica content, chlorophyll a, and total suspended solids. In the field, sophisticated instruments measure temperature, salinity, dissolved oxygen, and light penetration throughout the water column. Dissolved oxygen measurements are used to map the area of hypoxia (Figure 3) and to measure its duration.

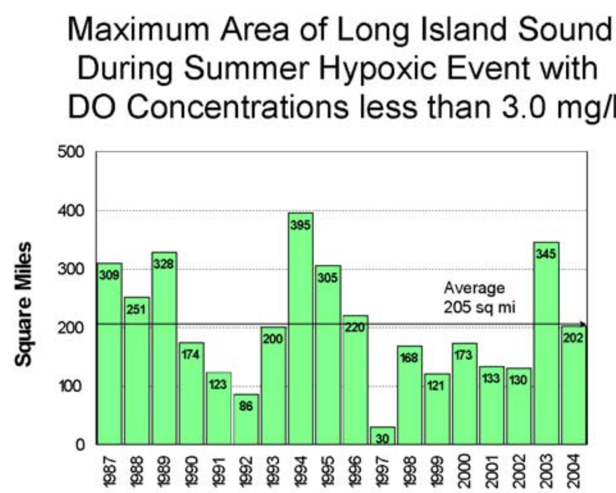

Figure 2. Maximum area of LIS during the summer hypoxic event with DO concentrations less than 3.0 mg/L

Summertime Monitoring and Trends

During the summer, CTDEP conducts additional summer hypoxia surveys at bi-weekly intervals to better define the areal extent (Figure 2) and duration (Figure 3) of hypoxia. Bi-weekly cruises generally begin in early June and end in the middle of September. In 2004, 160 stations were sampled during 7 cruises. The data provide the necessary specificity to quantify the areal extent, the severity (how low dissolved oxygen concentrations fall), and duration of hypoxia.

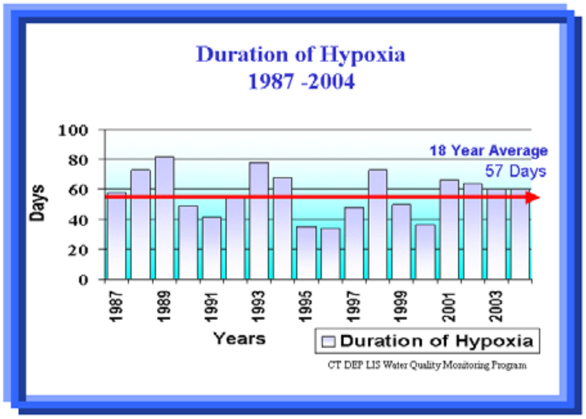

Figure 3. Durational estimates of summer hypoxic conditions in LIS 1987-2004

How Severe was Hypoxia in 2004?

In 2004, hypoxia (waters with less than 3.0 mg/L (parts per million) of dissolved oxygen) was just about average severity measured by duration and area (Figures 2 and 3). For reference, 3.0 ppm is less than half the amount of dissolved oxygen that might be observed under natural conditions and is the concentration below which there are severe impacts on aquatic life in LIS. The estimated onset date was July 20th and the end date was September 18th with the event lasting 60 days. The maximum area with bottom dissolved oxygen below 3 ppm was 202 square miles. (Figure 2) This relatively later onset of hypoxia was due in large part to cool, calm weather at the beginning of the summer. Hypoxia was most severe in western LIS, with only two hypoxic stations in central LIS and the remaining 15 hypoxic stations located in the western Sound. Hypoxia peaked in late August (Figure 4), as is fairly common.

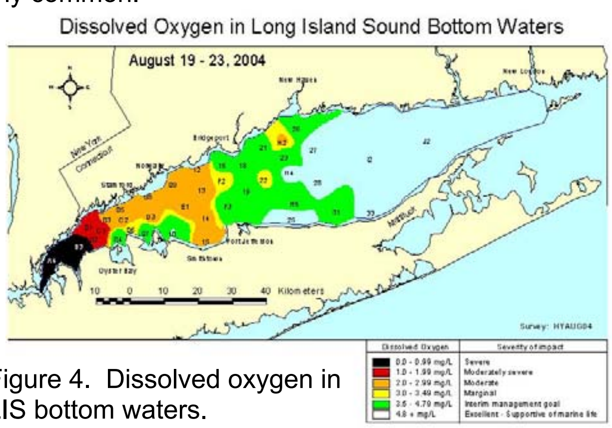

Figure 4. Dissolved oxygen in LIS bottom waters.

Over the years, there has been a pattern of severe and moderate hypoxic conditions that appear to be related to weather conditions. Weather can have a large impact on hypoxia severity because hot, dry summers with mild breezes allow LIS to stratify, sealing off the bottom layer of water. Stratification prevents mixing of oxygen-rich surface waters with oxygen-depleted bottom waters.

Calm summers cause a longer period of stronger stratification, with more severe hypoxia as a consequence. During 2002, an especially warm and dry year, the total area below 1.0 mg/L (108 km^2) was the largest recorded since the monitoring program began in 1987. There appears to be growing evidence that warm winters result in warmer LIS bottom temperatures coming into the summer followed by an early onset of hypoxia; 2002 appeared to fit this pattern.

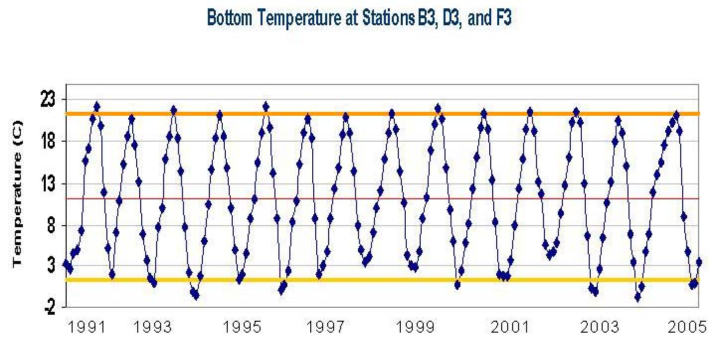

Figure 5. Bottom temperature trends in western LIS.

In addition to water temperatures, the amount and timing of rainfall may also affect when hypoxia occurs and how long it lasts. In 2002, rainfall in CT was 4.3 inches below the 30-year average by the end of August, second only to 1999 rainfall that was 6.5 inches below the 30-year average (Figure 5.). Low rainfall can greatly reduce the amount of nonpoint source pollution and nutrients from stormwater runoff to LIS. Rainfall in 2003 was a little higher than average, and hypoxic area was higher than in the drier 2002, but the relationship is somewhat inconsistent. Timing of rainfall, and the combined effect of stratification strength, make these relationships less than straightforward.

This information is essential to make better decisions on nutrient management. The goal to minimize the extent of hypoxia, and anticipate future severity related to climatological and seasonal impacts benefits from this fuller understanding of these combined human and natural roles.

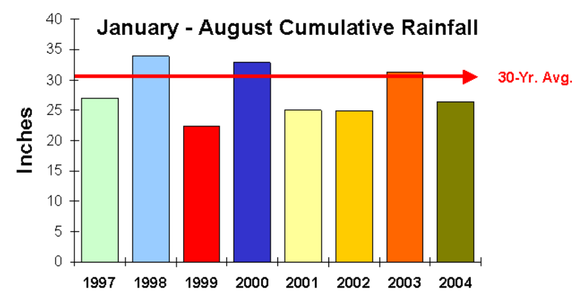

Figure 5. Connecticut precipitation trends for 1997 - 2004

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