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

MONITORING LONG ISLAND SOUND HYPOXIA 2002

March 2003

Arthur J. Rocque, Jr., Commissioner

Monitoring Hypoxia in LIS

Hypoxia is the condition of low dissolved oxygen concentrations in the waters of Long Island Sound. 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. Since 1990, CTDEP, in cooperation with EPA and New York State Department of Environmental Conservation (NYSDEC), through the Long Island Sound Study (LISS) partnership, have been implementing a Nitrogen Reduction Program to alleviate hypoxia in Long Island Sound (LIS). Nitrogen is the pollutant most directly responsible for hypoxia because it stimulates algal growth in LIS. Algae settles into the bottom waters of LIS, die and eventually decay, driving down oxygen levels in the process. 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 the management program is yielding the desired benefits for Long Island Sound, a water quality monitoring program has been in place since 1987.

CTDEP has been the lead agency for this intensive year-round water quality monitoring program on Long Island Sound since 1991. Water samples are collected once a month from more than forty sites by staff aboard CTDEP's Research Vessel *John Dempsey*. Monitoring data are used to quantify and identify annual trends and differences in water quality parameters relevant to hypoxia and the general condition of LIS waters.

Water samples are taken near the surface and near the bottom of LIS at each station and 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 1) and to measure its duration.

Summertime Monitoring and Trends

During the summer, CTDEP also conducts summer hypoxia surveys at bi-weekly intervals to better define the areal extent (Figure 1) and duration (Figure 2) of hypoxia. During the summer of 2002, for example, *surveys* began in early June and ended by the middle of September representing 284 stations sampled during seven cruises. This intensity of field sampling allows fairly detailed mapping of hypoxic conditions each summer (Figure 3).

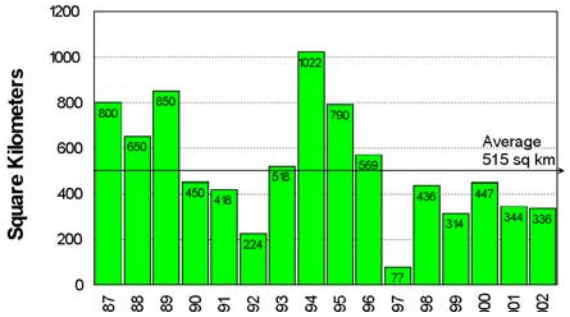

Figure 1. Maximum area of LIS during the summer hypoxic event with DO concentrations less than 3.0 mg/L

How Severe was Hypoxia in 2002?

In 2002, hypoxia (waters with less than 3.0 mg/L (parts per million) of dissolved oxygen) was less severe in duration and smaller in area than was observed in 2001. 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 of hypoxia was June 26, 2002 and it lasted approximately 64 days until August 28, the fifth longest event since 1990 (Figure 2). Hypoxia was observed at eleven stations during the summer. Only two stations in central LIS were hypoxic the remaining nine stations exhibiting hypoxia, were located in the western Sound. Hypoxia peaked in late August (Figure 3).

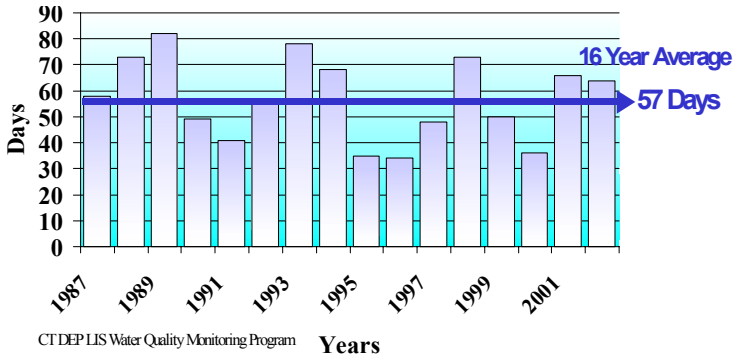

Figure 2. Durational estimates of summer hypoxic conditions in LIS 1987-2002

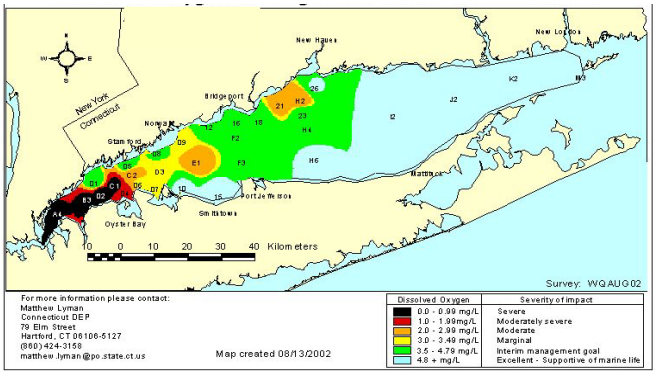

Figure 3. Dissolved oxygen in Long Island Sound bottom waters.

Over the years, there has been a pattern of severe and moderate hypoxic conditions that appear to be related to weather conditions. Weather has a large impact on hypoxia severity for a number of reasons. 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.

In response to summers that are especially calm, the Sound experiences 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, surpassing the 73 km^2 observed in 1994. 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, with 2002 fitting this pattern (Figure 4).

This lack of rainfall greatly reduces the amount of nonpoint source pollution from stormwater runoff to LIS and also reduces the cooling effect that cloud cover and rainwater would have on the Sound.

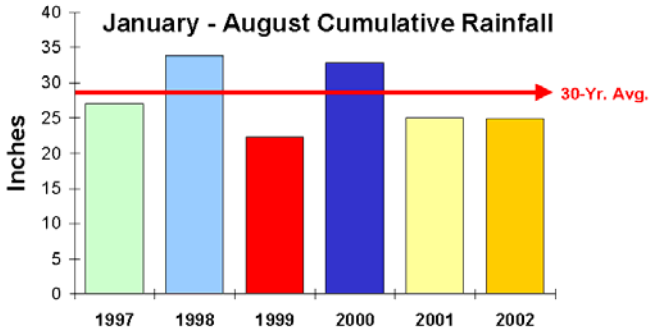

Figure 5. Connecticut precipitation trends for 1997 - 2002

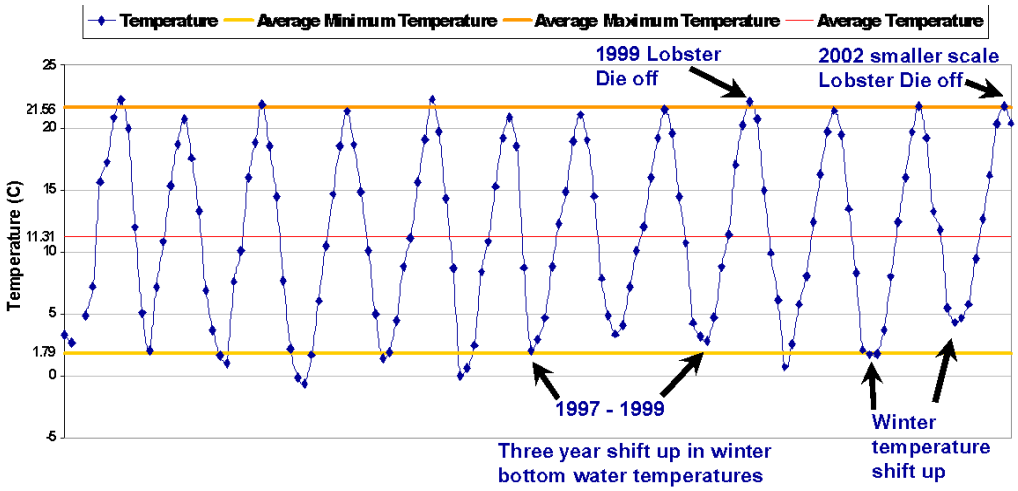

Figure 4. Bottom temperature trends in western LIS.

In addition to water temperatures, the amount and timing of rainfall may also affect when hypoxia occurs and how long it lasts. The summer of 2002 proved to be one of the driest years on record. 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.).

Data collected from these monitoring efforts helps us better understand what is going on in the Sound.

This information can help us make better management decisions on nutrient loading to Long Island Sound, minimize the extent of hypoxia, and anticipate severity due to climatological and seasonal impacts.

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