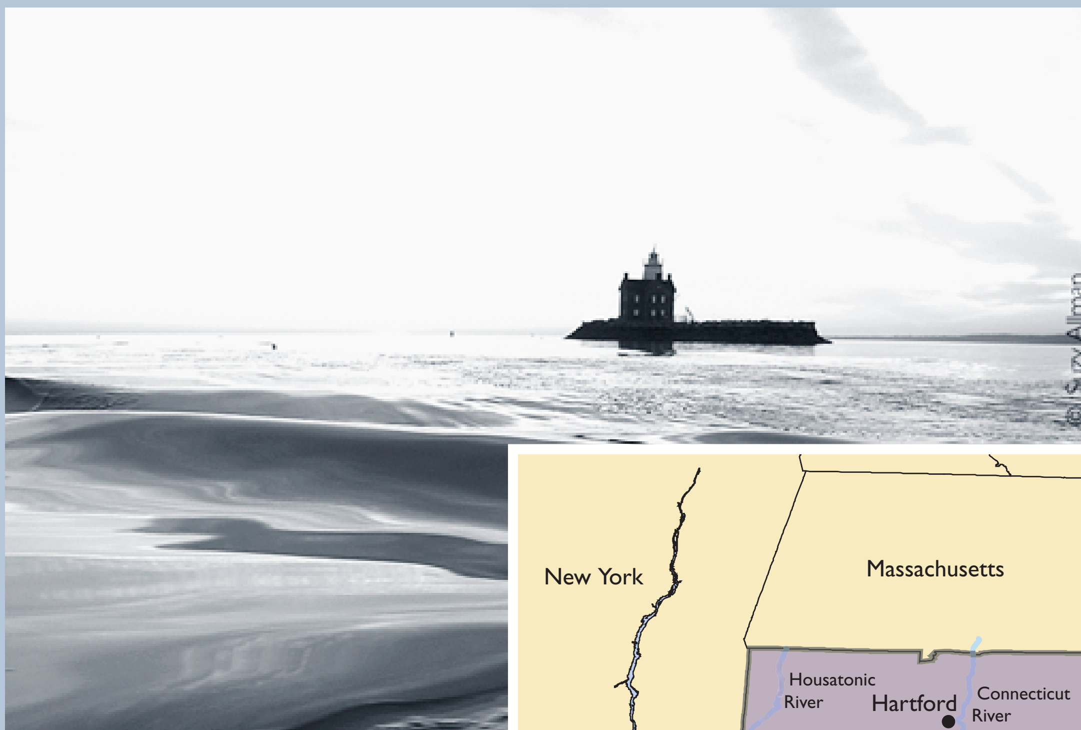
This document contains overall and specific condition of the Long Island Sound Study from the National Estuary Program Coastal Condition Report. The entire report can be downloaded from ***http://www.epa.gov/owow/oceans/nepccr/index.html***

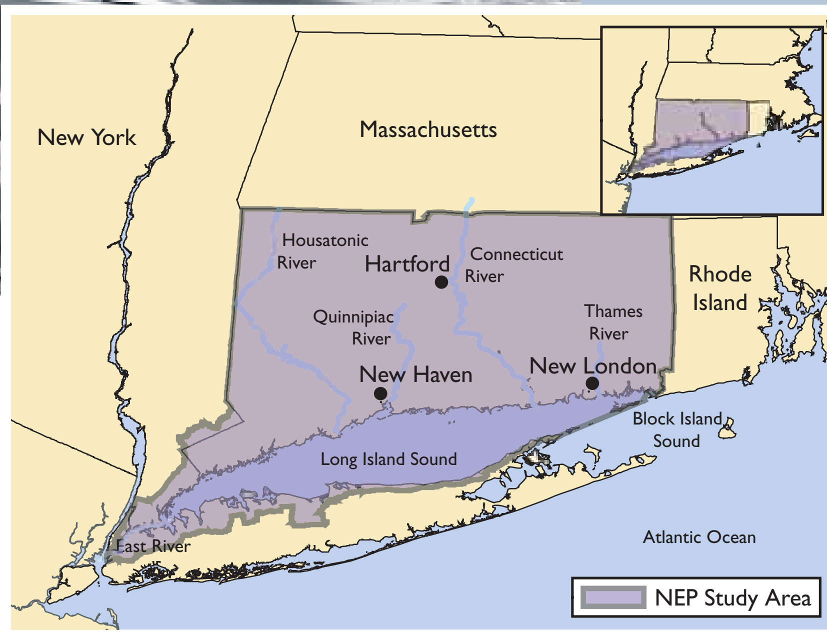
National Estuary Program Coastal Condition Report

Chapter 3: Northeast National Estuary Program Coastal Condition, Long Island Sound Study

June 2007

Long Island Sound Study





www.longislandsoundstudy.net

Background

Long Island Sound is one of the most significant coastal areas in the nation, with a watershed that includes an area of more than 16,000 mi^2 and that traverses all of Connecticut and parts of New York, Massachusetts, New Hampshire, Rhode Island, and Vermont (LISS, 1994). Four major rivers (Connecticut, Housatonic, Quinnipiac, and Thames) deliver fresh water to the Sound, which is approximately 110 miles long and is bounded by Connecticut and New York's Westchester County to the north, by New York City to the west, and by Long Island to the south.

Research shows that at least $5 billion is generated annually in this region from boating, commercial and sport fishing, and beach tourism (LISS, 1994). More than 170 species of finfish can be found in the Sound, including at least 50 species that spawn in the Sound and 21 tropical species that stray into this region on a seasonal basis (LISS, 2006). Species such as winter flounder, tautog, bluefish, diamondback terrapins, and many others have been over-harvested to the point where resource management is critical to maintaining stocks (LISS, 2003c).

The Long Island Sound Study (LISS) began in 1985 as an innovative effort by EPA, New York, and Connecticut to restore and protect Long Island Sound. Two years later, under the newly established NEP, Congress designated Long Island Sound as an Estuary of National Significance. In its early years, the LISS Management Conference, composed of EPA scientists, representatives from other federal agencies, New York and Connecticut state partners, citizens, and local business representatives, worked together to draft a CCMP to guide efforts to manage the Sound. Completed in 1994, LISS's *The Comprehensive Conservation and Management Plan* (LISS, 1994) identified specific priority issues for the LISS, including low dissolved oxygen levels (hypoxia), pathogen contamination in swimming waters and shellfish-harvesting areas, declining populations of living resources, degradation of coastal habitats, contamination of bottom sediments by toxics, and increasing volumes of floatable trash and debris.

Environmental Concerns

Environmental concerns in Long Island Sound include hypoxia, toxic substances, and land-use changes. Low levels of dissolved oxygen have caused significant adverse ecological effects in the bottom-water habitats of Long Island Sound and affected the area's living resources (LISS, 1994). Since 1987, the areal extent and temporal duration of hypoxia in the Sound have exhibited improving trends, due in part to nitrogen-reduction efforts, such as sewage treatment plant (STP) upgrades. Toxic substances, including metals and organic chemicals, enter the Sound from manufacturing sources, stormwater runoff, household cleaning and pest-control products, and automobile and power plant emissions. Although releases of many contaminants in the watershed have declined since the late 1980s, contaminants continue to pose a threat to living resources in Long Island Sound (LISS, 2003c). The loss of wetlands, forests, farm areas, and other open spaces to increased population, development, and urban sprawl has increased pollution and stormwater runoff, altered land surfaces, decreased natural areas, and restricted access to the Sound (LISS, 1994; LISS, 2003c).

Population Pressures

The population of the 15 NOAA-designated coastal counties in New York and Connecticut coincident with the LISS study area increased by only 14% during a 40-year period, from 12.9 million people in 1960 to 14.6 million people in 2000 (Figure 3-49) (U.S. Census Bureau, 1991; 2001). This rate of population growth for the LISS study area is roughly half the population growth rate of 24% for the collective NEP-coincident coastal counties of the Northeast Coast region. In 2000, the population density of these 15 coastal counties was 2,170 persons/mi^2, more than twice as high as the population density of 1,055 persons/mi^2 for the collective NEP-coincident coastal counties of the Northeast Coast region (U.S. Census Bureau, 2001) and second only to New York/New Jersey Harbor in population density (3,097 persons/mi^2). Population pressures for this study area are high because the Sound serves the population of New York City and its surrounding suburban communities—the largest center for commerce on the Northeast Coast.

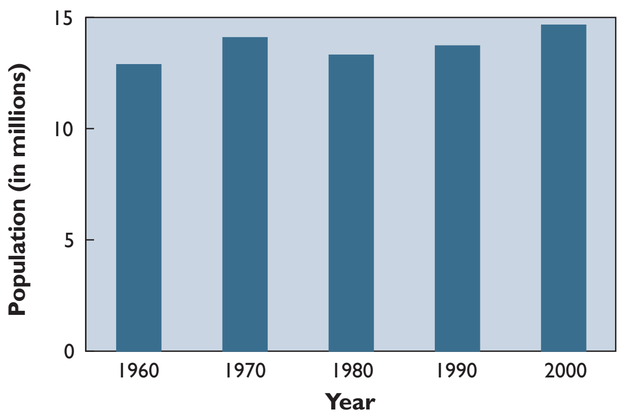


Figure 3-49. Population of NOAA-designated coastal counties of the LISS study area, 1960–2000 (U.S. Census Bureau, 1991; 2001).

NCA Indices of Estuarine Condition—Long Island Sound

The overall condition of Long Island Sound is rated poor based on the four NCA indices of estuarine condition (Figure 3-50). The water quality index for Long Island Sound is rated fair, and the sediment quality, benthic, and fish tissue contaminants indices are each rated poor. Clear gradients in most parameters were evident in the Sound, with more degraded conditions noted in the western, more urbanized portion of the Sound. Figure 3-51 provides a summary of the percentage of estuarine area rated good, fair, poor, or missing for each parameter considered. This assessment is based on data from 86 NCA sites sampled in the LISS estuarine area in 2000 and 2001.

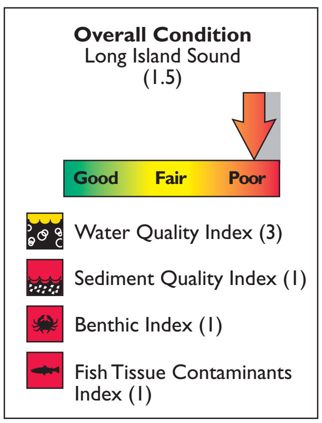


Figure 3-50. The overall condition of the LISS estuarine area is poor (U.S. EPA/NCA).

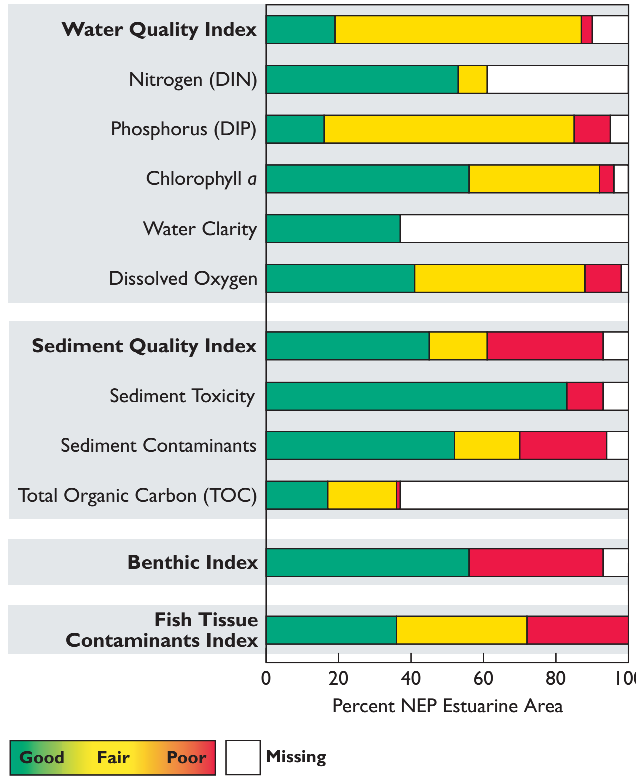


Figure 3-51. Percentage of estuarine area achieving each rating for all indices and component indicators — Long Island Sound (U.S. EPA/NCA).

The Nissequogue River flows north into Long Island Sound (Eileen Keenan, NY Sea Grant).

Water Quality Index

The water quality index for Long Island Sound is rated fair (Figure 3-52). This index was developed using data on five component indicators measured by the NCA: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen.

Dissolved Nitrogen and Phosphorus | Long Island Sound is rated good for DIN concentrations. Fifty-three percent of the estuarine area was rated good for DIN concentrations, and 9% of the area was rated fair. None of the estuarine area was rated poor for DIN, and NCA data on DIN concentrations were unavailable for 39% of the LISS estuarine area.

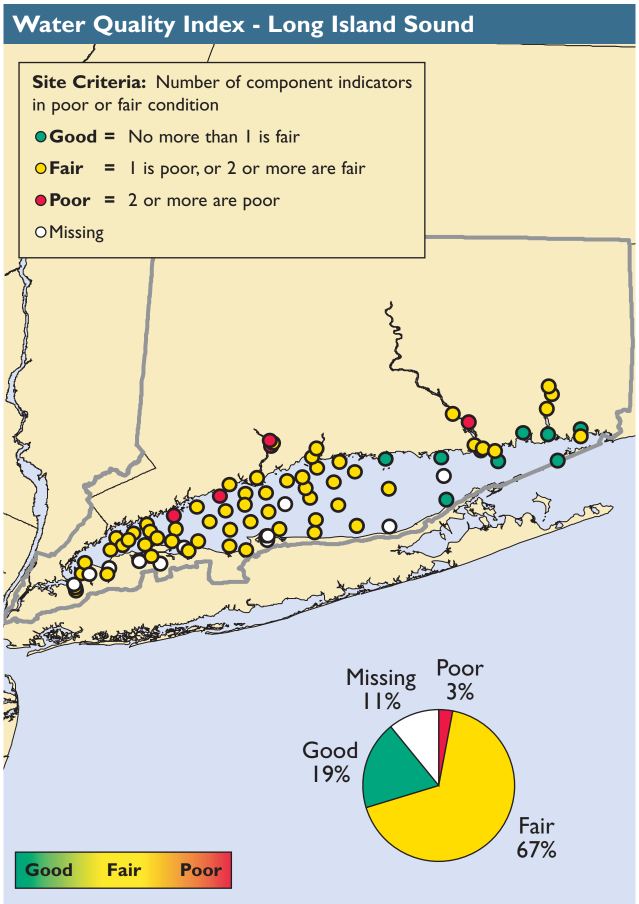


Figure 3-52. Water quality index data for Long Island Sound, 2000–2001 (U.S. EPA/NCA).

Long Island Sound is rated fair for DIP concentrations. High to moderate DIP concentrations were common throughout the Sound, particularly in the tributaries and offshore waters of Connecticut. DIP concentrations were rated good in only 16% of the estuarine area and fair in 69% of the area. Ten percent of the estuarine area was rated poor for this component indicator, and NCA data on DIP concentrations were unavailable for 5% of the LISS estuarine area.

Chlorophyll a | Long Island Sound is rated good for chlorophyll *a* concentrations. Relatively large areas of the Sound had moderately elevated concentrations of chlorophyll *a* that were distributed uniformly throughout the estuarine area. Fifty-six percent of the estuarine area was rated good for chlorophyll *a* concentrations, 36% was rated fair, 4% was rated poor, and NCA data were unavailable for 4% of the LISS estuarine area.

Water Clarity | Water clarity is rated good for Long Island Sound. Water clarity was rated poor at a sampling site if light penetration at 1 meter was less than 10% of surface illumination. No area of the Sound was rated poor or fair for water clarity; however, NCA data on water clarity were unavailable for 63% of the LISS estuarine area.

Dissolved Oxygen | Long Island Sound is rated fair for dissolved oxygen concentrations. A large area of the Sound had depleted levels of dissolved oxygen in bottom waters, with 47% of the estuarine area rated fair for this component indicator and 10% of the area rated poor. The oxygen-depleted waters were largely restricted to the western portions of the Sound. NCA data on dissolved oxygen concentrations were unavailable for 2% of the LISS estuarine area.

Sediment Quality Index

The sediment quality index for Long Island Sound is rated poor, with 32% of the estuarine area rated poor and 16% of the area rated fair for sediment quality condition (Figure 3-53). Ten percent (8 sites) of the Sound's estuarine area had sediments that were toxic to amphipods; however, there was little co-occurrence of toxicity and sediment contamination at the impaired sites, which were grouped in the western and far eastern ends of the Sound. A similar distribution was noted for sites contaminated by moderate and high concentrations of metals and DDT. TOC conditions were not well characterized for Long Island Sound because data were unavailable for two-thirds of the LISS estuarine area.

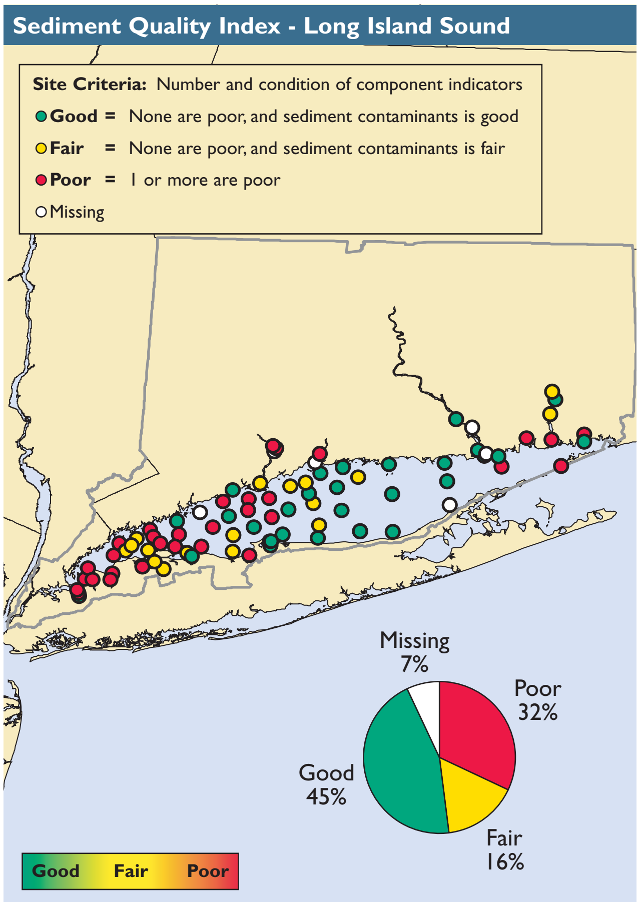


Figure 3-53. Sediment quality index data for Long Island Sound, 2000–2001 (U.S. EPA/NCA).

Sediment Toxicity | Long Island Sound is rated poor for sediment toxicity, with 10% of the estuarine area rated poor for this component indicator. NCA data on sediment toxicity were unavailable for 7% of the LISS estuarine area.

Sediment Contaminants | Long Island Sound is rated poor for sediment contaminant concentrations, with approximately 24% of the estuarine area rated poor for this component indicator and 18% of the area rated fair.

Total Organic Carbon | Long Island Sound is rated good for sediment TOC. Seventeen percent of the estuarine area was rated good for TOC concentrations, and 19% was rated fair. Only 1% of the estuarine area was rated poor for TOC concentrations; however, NCA data on TOC concentrations were unavailable for 63% of the LISS estuarine area.

Benthic Index

Benthic community diversity in Long Island Sound is rated poor based on the Virginian Province Benthic Index (Figure 3-54). The east to west gradient that was noticeable in other parameters is absent in the results for the benthic index. Rather, the best results are clustered in the western and central portions of the Sound, and the poorest results are grouped in the nearshore waters and tributaries in New York and Connecticut. Consequently, there was a poor correlation between benthic condition and measures of sediment contaminant impairment.

Fish Tissue Contaminants Index

The fish tissue contaminants index for Long Island Sound is rated poor. Relatively few fish samples (13) from Long Island Sound were analyzed for contaminant concentrations; however, roughly a third fell into each of the good, fair, and poor categories (Figure 3-55). High levels of PCBs were responsible for nearly all of the samples rated poor, similar to conditions in other NEP estuaries of the Northeast Coast region.

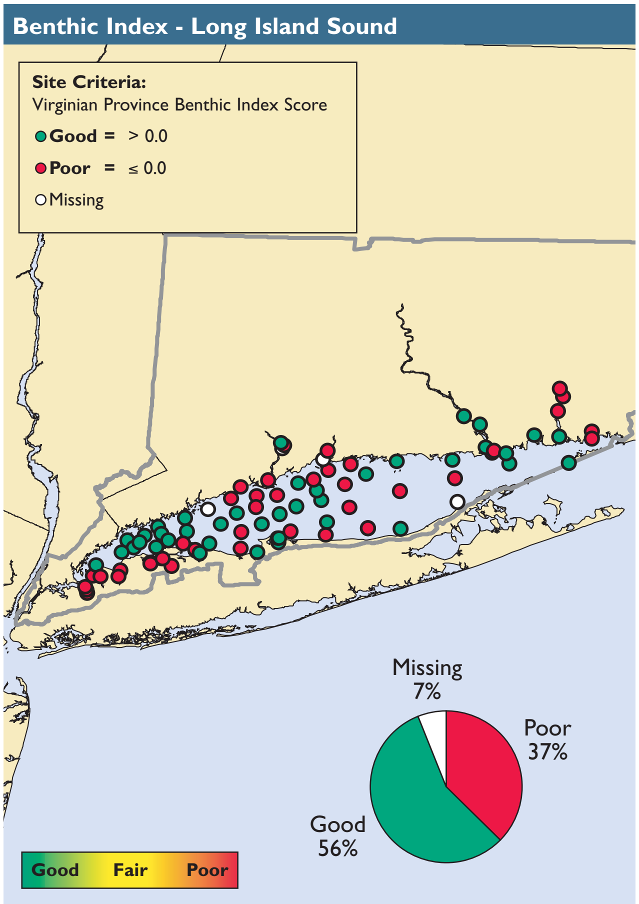


Figure 3-54. Benthic index data for Long Island Sound, 2000–2001 (U.S. EPA/NCA).

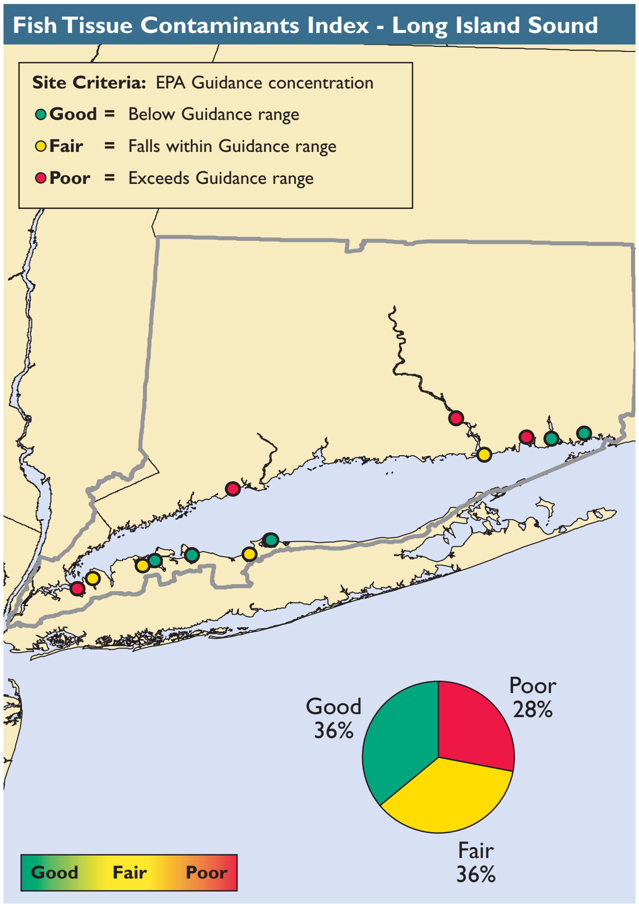


Figure 3-55. Fish tissue contaminants index data for Long Island Sound, 2000–2001 (U.S. EPA/NCA).

Long Island Sound Study

Tidal Marsh Loss in Long Island Sound

Throughout the Northeast, tidal marshes are turning into mudflats, resulting in the loss of important vegetated habitats for wading birds, juvenile fish, and invertebrates (LISS, 2004b). Tidal marsh loss—the loss of elevation relative to sea level and the conversion of vegetated marsh to mudflat— has been observed in Long Island Sound since the 1980s; however, recent studies indicate that the magnitude and distribution of these losses, which primarily occur in the western Sound, are far greater than previously realized (LISS, 2003b). At a 130-acre site on the Quinnipiac River, for example, nearly half of the brackish marshes have disappeared since 1974. The LISS is working to gain an understanding of and draw attention to this phenomenon (LISS, 2004b).

Significant areas of tidal wetland loss within Long Island Sound and of coastal wetlands elsewhere in New England have prompted scientists to investigate changes in these marshes with respect to relative sea-level rise. In 2001, Dr. Nels Barrett of the NRCS-Connecticut proposed establishing a long-term program to monitor the elevation dynamics of tidal marshes using surface elevation tables (SETs), a technique promoted by Dr. Don Cahoon of the U.S. Geological Survey (USGS) Pawtuxent Wildlife Research Center. SETs are tools for measuring changes in marsh surface elevation and sedimentation. With funding from the Long Island Sound Fund— a grant program administered by the Connecticut Department of Environmental Protection (CT DEP)— Dr. Barrett partnered with Dr. Cahoon and Dr. R. Scott Warren of Connecticut College to establish SET arrays at Barn Island in Stonington, CT. The nine SET benchmarks were constructed as a first step toward an envisioned network of SETs throughout the Sound. To help gather baseline information on marsh health, a network of 15 SETs is being established around the Sound. The CT DEP's Office of Long Island Sound Program, with funding from Connecticut's Coastal Zone Management Program, has purchased an additional 20 SET arrays that will be deployed in Connecticut marshes in 2005. The LISS has also provided support for the New York State Department of Environmental Conservation (NYSDEC), in partnership with the Marine Sciences Research Center at Stony Brook University, to install and monitor SETs in New York marshes (Barrett and Warren, 2005; LISS, 2005b).

In June 2003, the LISS and the NYSDEC held a workshop to share information regarding the possible causes of tidal marsh loss in the Sound. The participants highlighted the need to gather baseline information on the health and spatial distribution of the Sound's marshes and identified priority research topics. The LISS is helping to address these recommendations by supporting projects to examine coastal wetland trends in the Sound and to investigate potential causes of the observed subsidence (LISS, 2004b).

A researcher collects a sediment core at Sherwood Island in a patch of *Spartina alterniflora* surrounded by a mudflat (Suzy Allman).

A researcher takes SET elevation measures at Barn Island (Dr. R. Scott Warren).

The LISS is funding efforts by the CT DEP and NYSDEC to determine the rates of tidal marsh loss in the Sound. Through an agreement with the CT DEP, the FWS is interpreting wetland boundaries from archival aerial photographs taken between 1974 and 2000 of strategic coves and tidal rivers in the Connecticut portion of the western Sound. In New York, the NYSDEC will acquire aerial infrared photography of tidal marshes and will examine wetland trends by comparing these images with aerial photographs taken in 1930 (LISS, 2005b).

With support from an LISS research grant, Dr. Daniel Civco of the University of Connecticut and Dr. Martha Gilmore of Wesleyan University are collaborating on a project to identify and delineate coastal marshes and to distinguish various types of marsh vegetation. In addition, they are developing a cost-effective way to track changes in the condition of wetlands over time using remote-sensing satellite imagery coupled with in situ radiometry and other field data collection. These data sets and protocols can help provide coastal resource managers, municipal officials, and researchers with baseline information for current land management and long-term monitoring of habitat changes (LISS, 2004b).

One hypothesis formulated at the tidal wetlands-loss workshop was that excessive loading of nutrients, such as nitrogen and phosphorus, plays a role in causing marsh loss. In 2004, the LISS awarded a research grant to Dr. Shimon Anisfeld of Yale University to investigate the possible role of nutrients in contributing to marsh drowning. Dr. Anisfeld's research focuses on whether high levels of nitrogen, while increasing above-ground plant production, might actually decrease the growth of below-ground material, such as roots. Dr. Anisfeld is also testing a theory that, as nutrients increase in the marsh peat, bacteria increase and consume more organic matter. Dr. Anisfeld is assessing site conditions and factors, including nutrient levels, at three Connecticut marshes: a degraded marsh at Sherwood Island State Park in Westport, a stable marsh at Hoadley Creek in Guilford, and a restored marsh at Jarvis Creek in Branford (LISS, 2004b).

These efforts to monitor trends in the Long Island Sound's coastal habitats and investigate potential causes of tidal marsh loss are critical to understanding the changes occurring in the Sound's marshes. The partnerships fostered by the LISS provide a unique opportunity for the States of Connecticut and New York, local researchers, and federal agencies to work together to develop strategies to minimize tidal marsh loss and protect coastal habitats.

For more information, visit http://www.longislandsoundstudy.net.

Long Island Sound Study Indicators of Estuarine Condition

The LISS uses more than 40 specific environmental measures to assess the ecological condition of Long Island Sound (LISS, 2003c). These indicators are primarily associated with water and sediment quality, habitat restoration and protection, and fish and wildlife concerns.

Water and Sediment Quality

The following indicators have been formalized as measures used by the CT DEP and NYSDEC to evaluate water and sediment quality in the Long Island Sound estuarine area:

- Hypoxia (areal extent and duration of hypoxic zones, with dissolved oxygen levels less than 3 mg/L)
- Nitrogen concentrations in several constituent forms in tributaries and from both point and non-point sources
- Total phosphorus concentrations in tributaries
- Chlorophyll *a* concentrations
- Number of beach closure days (New York and Connecticut)
- Total fecal coliform counts in tributaries.

Hypoxia is most severe and prevalent in the western portion of Long Island Sound (NYSDEC, 2006). Since 1991, the CT DEP has conducted a comprehensive water quality monitoring program in the Sound that allows the LISS to track how hypoxia varies from year to year. Between October and May, water quality samples are collected once a month from 17 sites. Bi-weekly hypoxia surveys start in mid-June and end in September, with up to 36 sites being sampled in each survey (LISS, 2004b). The Interstate Environmental Commission (IEC) conducts additional monitoring of the western Sound for dissolved oxygen levels during the summer months. The area and duration of hypoxic occurences in the Sound have fluctuated from year to year, but appear to have improved since the late 1980s (NYSDEC, 2006) (Figure 3-56).

Trends in nitrogen concentrations in tributaries to the Sound have varied between 1971 and 1998. In general, total nitrogen increased from 1975 to 1988 and began to decline thereafter (Trench and Vecchia, 2002). In the Connecticut River, which discharges 70% of fresh water to the Sound, downward trends in total nitrogen since 1988 are most likely the result of improved nitrogen removal at municipal WWTPs, but could also relate to changes in land use (i.e., agricultural to residential or forest) (Mullaney, 2004). Reductions in nitrogen concentrations in the Connecticut River are likely not related to atmospheric sources because wet deposition of nitrogen oxides in precipitation has remained relatively unchanged since the 1980s (Driscoll et al., 2001). Figure 3-57 shows a decreasing trend in overall nitrogen loading to the Sound between 1991 and 2001. In general, Sound-wide nitrogen loads from point sources have also decreased (LISS, 2003a). For example, improvements to STPs in New York and Connecticut reduced the amount of nitrogen entering the Sound by 28% between 1994 and 2003 (LISS, 2003b).

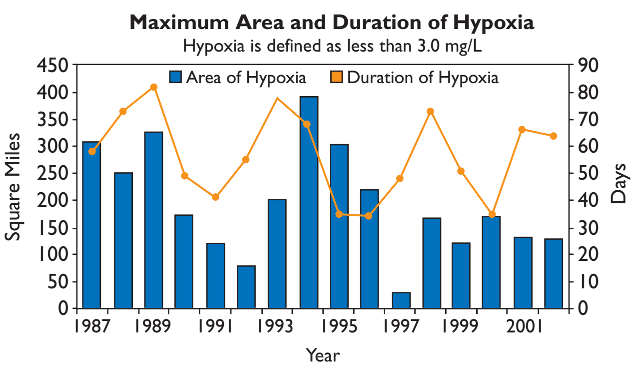


Figure 3-56. Hypoxia in Long Island Sound appears to have generally improved since 1987 (data obtained from CT DEP).

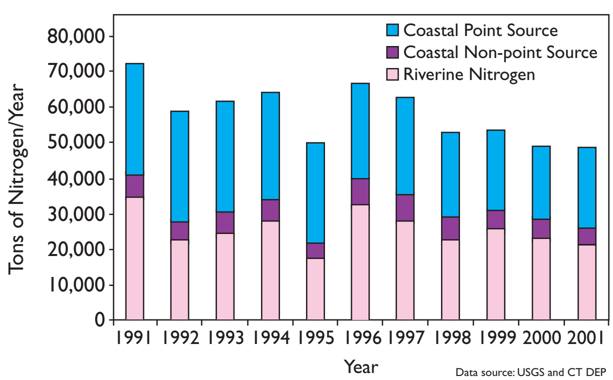


Figure 3-57. Trends in nitrogen loading to Long Island Sound (data obtained from USGS and CT DEP).

Total phosphorus concentrations are measured in the tributaries of Long Island Sound to assess the effect of total loading on overall nutrient balance and eutrophication. Phosphorus inputs are having far less impact than nitrogen inputs from point source and non-point sources in this system. Total phosphorus levels showed a declining trend in Long Island Sound tributaries between the years 1981 and 1988, most likely due to improvements at municipal STPs and the declining use of phosphate-based detergents (Trench and Korzendorfer, 1997).

Chlorophyll *a* levels are monitored closely to evaluate nutrient over-enrichment and to observe the effects of point and non-point source loadings of nitrogen to the Sound. In recent years, chlorophyll *a* measures have demonstrated erratic results, but high concentrations have coincided with large algal bloom events. These events have been detrimental to the growth of eelgrass and other SAV and have led to conditions of hypoxia in near-bottom waters. In 2003, chlorophyll *a* levels in western Long Island Sound were recorded as high as 25 µg/L, with average levels around 15 µg/L. Both peak and average chlorophyll *a* levels were higher between 2001 and 2003 than they were between 1998 and 2000 (LISS, 2003a).

One of the key indicators for pathogen contamination in Long Island Sound is the number of beach closure days associated with bacteria levels in water. New York, Connecticut, and EPA coordinate to test waters at 240 swimming beaches to determine whether water is safe from disease-causing pathogens. Sewage pump station overflows accounted for some beach closures, whereas all other closures were caused by rain or high bacteria levels. Beach closures during the past 10 years do not indicate any trend in pathogen contamination in Long Island Sound (Figure 3-58).

Total fecal coliform counts are also measured in Long Island Sound tributaries to help evaluate pathogen contamination from a variety of sources. Results of monitoring for fecal coliform have been highly variable in the past few years.

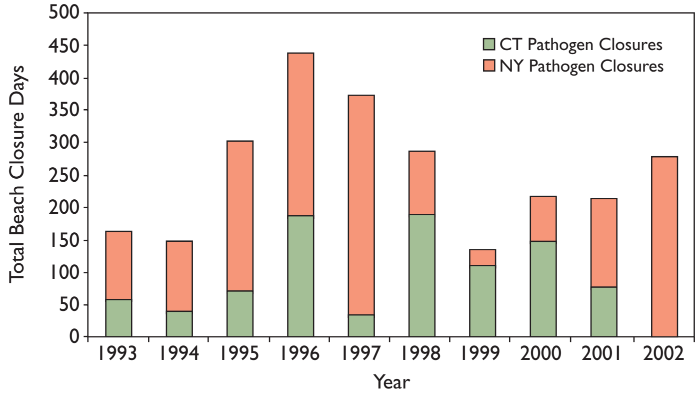


Figure 3-58. Trends in beach closures in Long Island Sound (1993–2002) (data obtained from CT DEP and NYSDEC).

Habitat Quality

The following two measures are used as indicators to determine the success or failure of habitat restoration and protection efforts implemented by state agencies and EPA in Long Island Sound:

- Acres of coastal habitat restored
- Number of river miles restored for anadromous (migratory) fish passage (LISS, 2005a).

In 1998, Connecticut, New York, and EPA created the LISS Habitat Restoration Initiative (HRI) and adopted goals to restore 2,000 acres of the Sound's coastal habitat by the year 2008. The majority of restoration projects in Long Island Sound have targeted tidal wetlands that were degraded by human development or tidal restrictions. Between 1998 and 2003, almost 500 acres of coastal habitat were restored through the HRI (LISS, 2003c).

The HRI also uses the number of river miles restored for anadromous (migratory) fish passage as a major indicator for the success of habitat restoration. In 1998, the LISS adopted a goal of restoring 100 miles of migratory river corridors for anadromous fish by 2008. As of 2003, 52 miles of stream had been restored for fish migration, and as a result, species such as striped bass, blueback herring, and American shad are now swimming into formerly inaccessible streams (LISS, 2003c; LISS, 2004a). Rebuilding riverine migratory corridors creates huge benefits for both recreational and commercial fisheries in this region.

Living Resources

Living resource indicators tracked by the LISS include finfish and shellfish abundance in Long Island Sound. In the late 1980s and early 1990s, several marine fish stocks were declining in the Sound, and as a result, management actions to limit exploitation and rebuild stocks were instituted. Scup and striped bass have responded well to management efforts, and populations of these species are rebounding; however, species that favor cold water temperatures, such as winter flounder, continue to experience declines. Traditionally, the most economically important shellfish harvested in the Sound have been oysters and lobsters. The harvesting of Long Island Sound oysters has declined significantly since the peak year of 1992 due to two deadly parasitic diseases, MSX and Dermo. The Sound's lobster harvests, which had developed into a $40 million a year industry by 1997, have also dropped dramatically as the result of a variety of infections and diseases (LISS, 2003c). The poor health of the Sound's lobsters and oysters has affected the Sound's marine economy, recreational fishers, and the ecosystem.

Bird populations around the Sound are threatened by habitat loss and by human and predator intrusion into nesting areas. The LISS bird population indicators focus on osprey, least terns, and piping plovers. As a result of efforts to build nesting platforms and to protect nests, the number of osprey and piping plover nesting adults is increasing around the Sound (LISS, 2003c); however, the number of nesting least tern adults has declined since the 1980s (LISS, 2003a).

Environmental Stressors

More than 8 million people live in the Long Island Sound watershed, and more than 20 million live within about an hour's drive of the Sound. Approximately 60% of total nitrogen inputs to the Sound come from STPs, and stormwater runoff carries contaminants from roads, parking lots, and construction sites to the Sound (LISS, 2003c).

The primary sources of bacterial pathogens in the Sound's waters are CSOs, malfunctioning STPs, illegal connections to storm sewers, malfunctioning septic systems, and discharges from marine vessels. Pathogen contamination has impacted the commercial economy of the region and has led to closings at many Long Island Sound beaches and shellfish-harvesting areas (LISS, 2003a). In New York alone, more than 48,000 acres of shellfish beds were completely closed or restricted from harvest in 1990 due to pathogen contamination (U.S. EPA, 2006c).

Progress continues to be made in reducing bacterial pathogens in Long Island Sound. In 2002, 134 marine vessel pump-out stations were servicing the Sound (compared to just 43 in 1995), and new stations continue to be built (LISS, 2003a). Fecal coliform counts in Long Island Sound tributaries displayed a recognizable downward trend over time between 1981 and 1988, possibly due to better agricultural practices and improvements at municipal STPs (Trench and Korzendorfer, 1997).

Current Projects, Accomplishments, and Future Goals

Some of the current projects and recent accomplishments of the LISS are summarized below:

- The total point-source nitrogen load to the Sound continued a 14-year declining trend through 2003. The total 2003 load from New York and Connecticut point sources is estimated at 159,969 lbs/day, a decrease of more than 50,500 lbs/day from the 1990s baseline (LISS, 2003a).
- As of December 2003, 30 municipal STPs in Connecticut have completed upgrades, including nitrogen removal, at a cost of more than $340 million (LISS, 2004a).
- Of the nine LISS-funded research projects awarded in 2000 and 2002, five have been completed and four are ongoing. Completed projects include studies of the causes and extent of lobster morbidity and mortality; isotope tracers of nitrates in the Sound to help distinguish sources of pollution; metal contaminant concentrations in Long Island Sound sediments over time; bottom water and sediments at critical sites in Long Island Sound; and the effects of trace metals, organic carbon, and inorganic nutrients in surface waters

on phytoplankton growth. Projects that are ongoing include studies of phytoplankton dynamics to determine shifts in primary productivity, water column oxygen production, and consumption; new approaches for assessing mutagenic risk of contaminants in Long Island Sound; and the status and productivity of salt marsh breeding sparrows.

Future goals outlined in the LISS CCMP include the following:

- **Low dissolved oxygen concentrations** – Reduce nitrogen from STPs and other point sources; reduce nitrogen loads from non-point sources; continue the management of hypoxia; fund implementation of hypoxia management plans; and monitor and assess hypoxic conditions in the Sound.
- **Pathogens** – Control pathogen contamination to Long Island Sound from CSOs, non-point sources, STPs, vessel discharges, and individual on-site systems/discharges; provide public education regarding causes of contamination; and improve monitoring and assessment methods.
- **Toxic substances** – Control and prevent toxic contamination from all sources; address sediment contamination; improve human health risk management; monitor and assess toxic contaminants; and conduct research to investigate toxic contamination.
- **Floatable debris** – Control floatable debris from CSOs and storm sewers and increase floatable debris cleanup efforts.
- **Habitats** – Restore and enhance aquatic and terrestrial habitats; protect and acquire habitat; develop inventories and management strategies for aquatic and terrestrial habitats; manage endangered and threatened species, harvested species, and exotic and nuisance species; educate the public; develop databases; conduct Sound-wide and site-specific research and monitoring; and conduct living resources and habitat research.

Conclusion

The overall condition of Long Island Sound is rated poor based on the four NCA indices of estuarine condition. Based on LISS findings, the most significant environmental priorities in Long Island Sound are low dissolved oxygen levels in bottom waters (hypoxia); pathogen contamination in swimming waters and shellfish-harvesting areas; declines in finfish and commercial shellfish populations; loss of coastal habitat; and increases in floatable debris. Since 1991, there has been a reduction in overall nitrogen loadings to the Sound, as well as in inputs from point sources. Upgrades to municipal STPs have had a major impact on reducing nitrogen discharges from coastal and tributary sources. Construction of pump-out stations has helped to reduce discharges of vessel sewage and the levels of pathogens in near-coastal areas of Long Island Sound. Protection of oyster beds and the lobster population is still an extremely critical priority for the economic viability of the fishing industry in Long Island Sound.