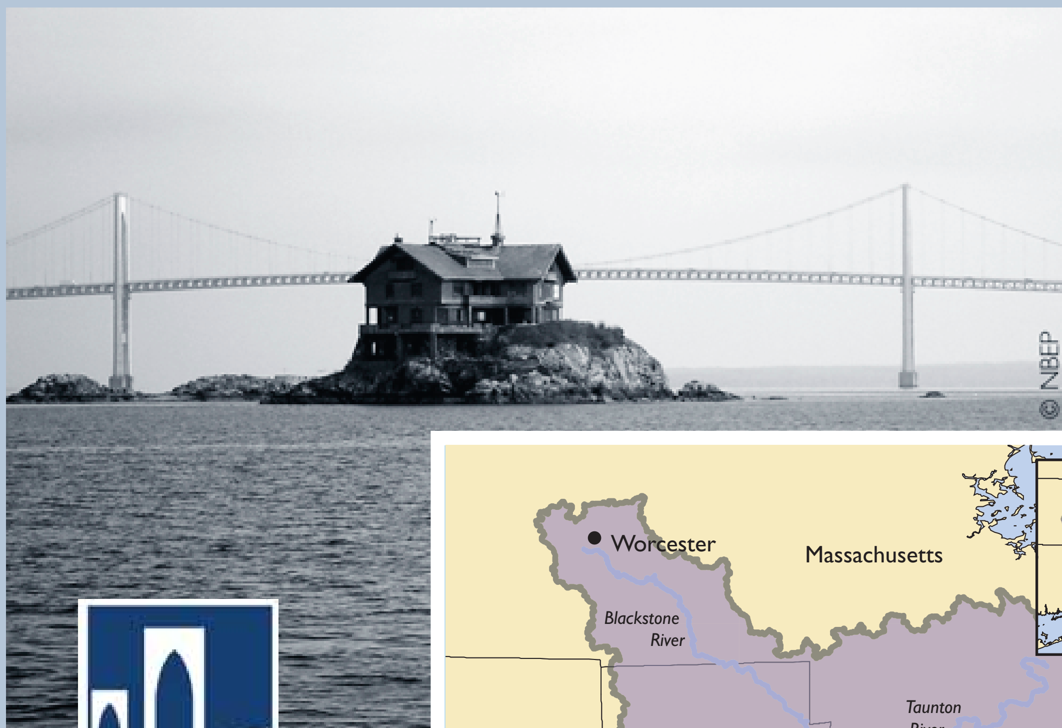
*This document contains overall and specific condition of Narragansett Bay Estuary Program from the National Estuary Program Coastal Condition Report. The entire report can be downloaded from* ***http://www.epa.gov/owow/oceans/nepccr/index.html***

# National Estuary Program Coastal Condition Report

## Chapter 3: Northeast National Estuary Program Coastal Condition, Narragansett Bay Estuary Program

June 2007

# Narragansett Bay Estuary Program




NARRAGANSETT BAY ESTUARY PROGRAM

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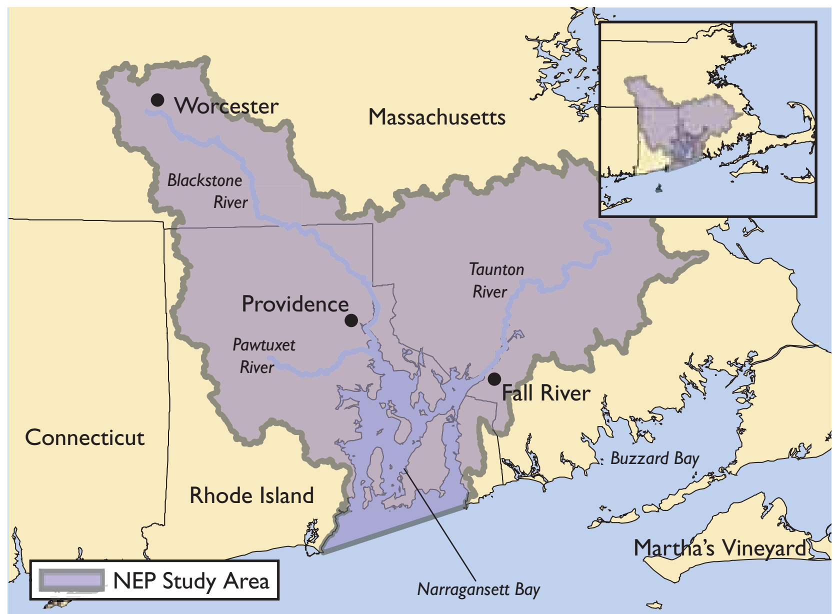



## Background

Narragansett Bay is located primarily in Rhode Island; however, 60% of the Bay's watershed area is located in Massachusetts. The Narragansett Bay watershed area covers 1,650 mi$^2$ and is one of the most densely populated watersheds in the United States, with almost 1,000 people/mi$^2$ (RIDEM et al., 2000; U.S. Census Bureau, 2001). Worcester and Fall River, MA, and Providence, RI, are major cities within this watershed, and the Blackstone, Taunton, and Pawtuxet rivers provide the majority of fresh water that flows into the Bay. Narragansett Bay has approximately 147 mi$^2$ of surface water, with an average depth of 30 feet (NOAA, 1985). The Bay supports approximately 3,600 acres of various types of salt marshes and 570 acres of tidal flats (RIDEM et al., 2000) and contributes billions of dollars to Rhode Island's economy through fisheries, tourism, and marine industries. Quahog (hard clam), lobster, bluefish, striped bass, and flatfish are sought after as recreational and commercial fisheries species in Narragansett Bay (Martin et al., 1996).

Between 1985 and 1992, more than 100 people representing 45 federal, state, and local government agencies; non-profit organizations; universities; marine trade organizations; industry; communities; and citizens met under the direction of the Narragansett Bay Estuary Program (NBEP) to develop ways to preserve and restore Narragansett Bay. *The Narragansett Bay Conservation & Management Plan* (RIDEM, 1992) was completed in 1993 and is being implemented by the NBEP, which is now affiliated with the University of Rhode Island (URI) Coastal Institute. In addition, Rhode Island legislation created a Coordination Team in 2004 for the management of Narragansett Bay. This team formalizes the coordination among key state agencies with respect to the Bay and its watershed. Information on this and other Bay issues is available at http://www.ci.uri.edu/RIBayTeam/default.html.

## Environmental Concerns

Eutrophication, nutrient loading, and pathogens are some of Narragansett Bay's major environmental concerns. Although relatively well mixed and less susceptible than other NEP estuaries to eutrophication, Narragansett Bay is exhibiting an increasing array of eutrophic-associated symptoms, including low dissolved oxygen levels, fish kills, eelgrass loss, macroalgae blooms, benthic community changes, and a shift in the Bay's dominant fish community from bottom-dwelling to water-column-dwelling species (RIDEM, 2003). These symptoms have led the NBEP to focus on nutrient inputs to the Bay, particularly nitrogen. Currently, secondary treatment at WWTPs does not reduce the high levels of nitrogen associated with sewage (RIDEM et al., 2000). Excess nitrogen appears to have caused episodes of oxygen depletion and fish kills in fairly wide areas of the upper Bay, especially during neap (very weak) summer tides, impairing habitat quality and function (RIDEM, 2003). As for pathogens, CSOs have been the major source of fecal coliforms to the Bay in recent years, contributing annual coliform loads nearly 4 orders of magnitude higher than those from WWTPs and approximately 200 times the estimated annual loading from separate storm drains (Governor's Narragansett Bay and Watershed Planning Commission, 2004a). Communities with older, failing septic systems also contribute significantly to bacterial and nutrient-loading. Together, these sources leave approximately 20% of Narragansett Bay permanently or conditionally closed to shellfish harvesting because of actual or suspected contamination from sewage-derived bacteria and viruses (RIDEM, 2002).

## Population Pressures

The population of the 10 NOAA-designated coastal counties coincident with the NBEP study area increased by 28% during a 40-year period, from 3.8 million people in 1960 to almost 4.9 million people in 2000 (Figure 3-42) (U.S. Census Bureau, 1991; 2001). This rate of population growth for the NBEP study area is equivalent to 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 10 coastal counties was 984 persons/mi$^2$, slightly lower than 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). Population pressures for this NEP are likely high because this estuary serves as a major metropolitan area and a center of commerce and industrial development.

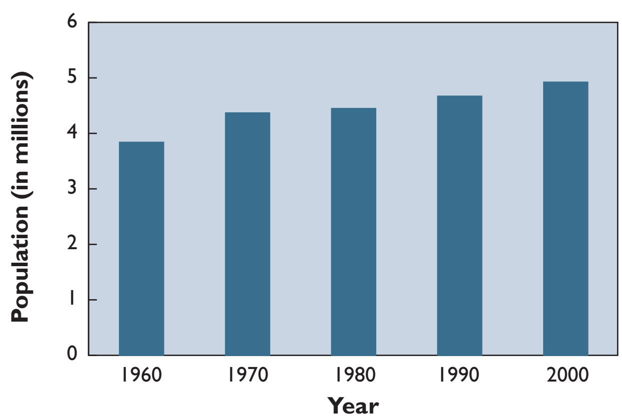



**Figure 3-42.** Population of NOAA-designated coastal counties of the NBEP study area, 1960–2000 (U.S. Census Bureau, 1991; 2001).

## NCA Indices of Estuarine Condition—Narragansett Bay

The overall condition of Narragansett Bay is rated poor based on the four NCA indices of estuarine condition (Figure 3-43). The water quality index for Narragansett Bay is rated fair, the benthic index is rated fair to poor, and the sediment quality and fish tissue contaminants indices are both rated poor. Figure 3-44 provides a summary of the percentage of estuarine area rated good, fair, poor, or missing for each parameter considered. Please refer to Table 1-24, 1-25, and 1-26 (Chapter 1) for a summary of the criteria used to develop the rating for each index and component indicator. By several measures, Narragansett Bay is a transitional estuary that is more similar to estuaries further south in the region. The Bay is distinct from estuaries in the Acadian Province (north of Cape Cod), which are characterized by higher tidal amplitude and tidal flushing rates. This environmental assessment is based on data from 56 NCA sites sampled in the NBEP estuarine area in 2000 and 2001.

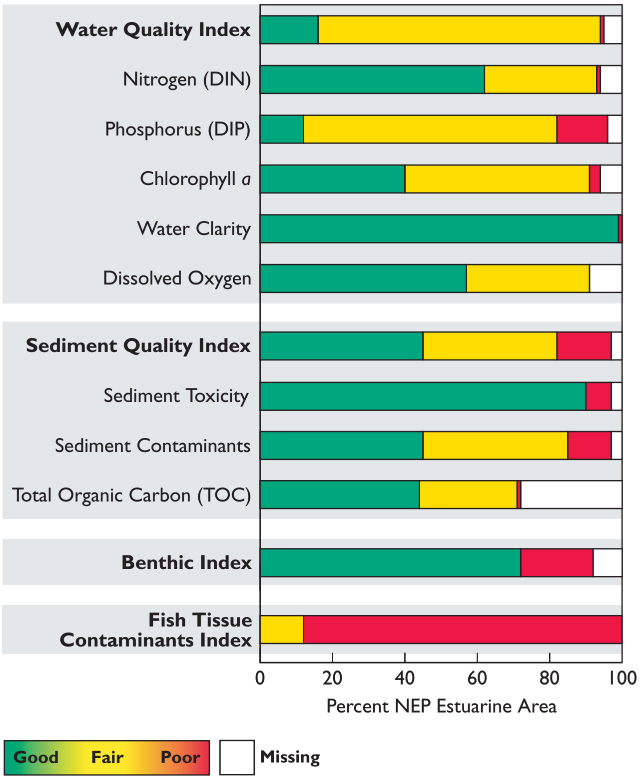



**Figure 3-44.** Percentage of estuarine area achieving each rating for all indices and component indicators — Narragansett Bay (U.S. EPA/NCA).

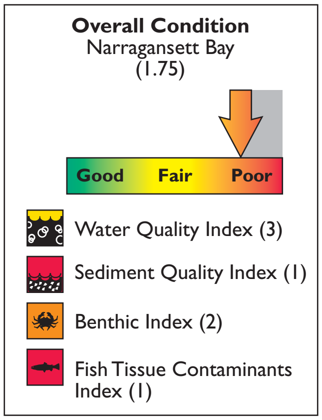



**Figure 3-43.** The overall condition of the NBEP estuarine area is poor (U.S. EPA/NCA).


Wickford Harbor on the west shore of Narragansett Bay (NBEP).

## Water Quality Index

The water quality index for Narragansett Bay is rated fair (Figure 3-45), with 78% of the Narragansett Bay estuarine area rated fair for water quality condition. This index was developed using NCA data on five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. Relatively large areas of the Bay had elevated concentrations of nutrients and chlorophyll *a*—greater than neighboring bays to the north and similar to estuaries further south in the region. Narragansett Bay's pronounced signs of eutrophication are probably attributed in part to the confined nature of the estuary and the extensive urbanization in upper Narragansett Bay. Water clarity was satisfactory everywhere in the Bay, and low dissolved oxygen levels were identified in a third of the Bay, predominantly in the deeper portions of upper Narragansett Bay.

*Dissolved Nitrogen and Phosphorus* | Narragansett Bay is rated good for DIN concentrations, with 31% of the estuarine area rated fair and only 2% of the area rated poor. NCA data on DIN concentrations were unavailable for 5% of the NBEP estuarine area. DIP concentrations for Narragansett Bay are rated fair, with 69% of the estuarine area rated fair and 14% of the area rated poor. NCA data on DIP concentrations were unavailable for 5% of the NBEP estuarine area.

*Chlorophyll a* | Narragansett Bay is rated fair for chlorophyll *a* concentrations, with 51% of the estuarine area rated fair and 4% rated poor for this component indicator. NCA data on chlorophyll *a* concentrations were unavailable for 5% of the NBEP estuarine area.

*Water Clarity* | Narragansett Bay is rated good for water clarity. Water clarity was rated poor at a sampling site if light penetration at 1 meter was less than 10% of surface illumination. Only 1% of the Bay's estuarine area was rated poor for water clarity, and 99% of the area was rated good.

*Dissolved Oxygen* | Narragansett Bay is rated good for dissolved oxygen concentrations. Fifty-seven percent of the estuarine area was rated good for dissolved oxygen concentrations, and 34% of area was rated fair. None of the NBEP estuarine area was rated poor for this component indicator, and NCA data on dissolved oxygen concentrations were unavailable for 9% of the area. Although no area of the Bay was rated poor on the NCA sample dates, transient episodes of dissolved oxygen at concentrations less than 2 mg/L are known to occur in upper Narragansett Bay, often following periods of minimal tidal mixing. Such events have been documented by programs other than the NCA surveys, using moored instrumentation and targeted sampling. Results of these targeted oxygen and chlorophyll *a* monitoring programs are available through the links at http://www.nbep.org.

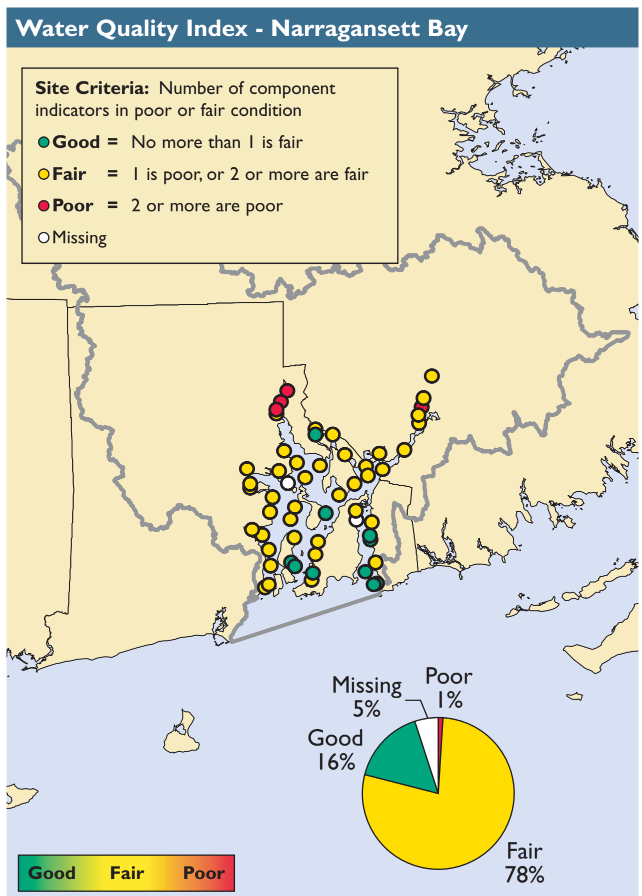



**Figure 3-45.** Water quality index data for Narragansett Bay, 2000–2001 (U.S. EPA/NCA).

## Sediment Quality Index

The sediment quality index for Narragansett Bay is rated poor, with 15.3% of the estuarine area classified as poor, just slightly greater than the 15% threshold used to define this category (Figure 3-46). Sediment toxicity was observed at two sites in Narragansett Bay, both of which displayed sediment contamination. Moderate and high concentrations of metals and organochlorine chemicals, such as DDT and PCBs, were measured in about half the Bay's sediment samples, with the highest levels evident in the upper Bay tributaries (e.g., Taunton and Providence rivers) and Greenwich Bay. Moderate levels of TOC were also measured, again predominantly in upper Narragansett Bay.

**Sediment Quality Index - Narragansett Bay**

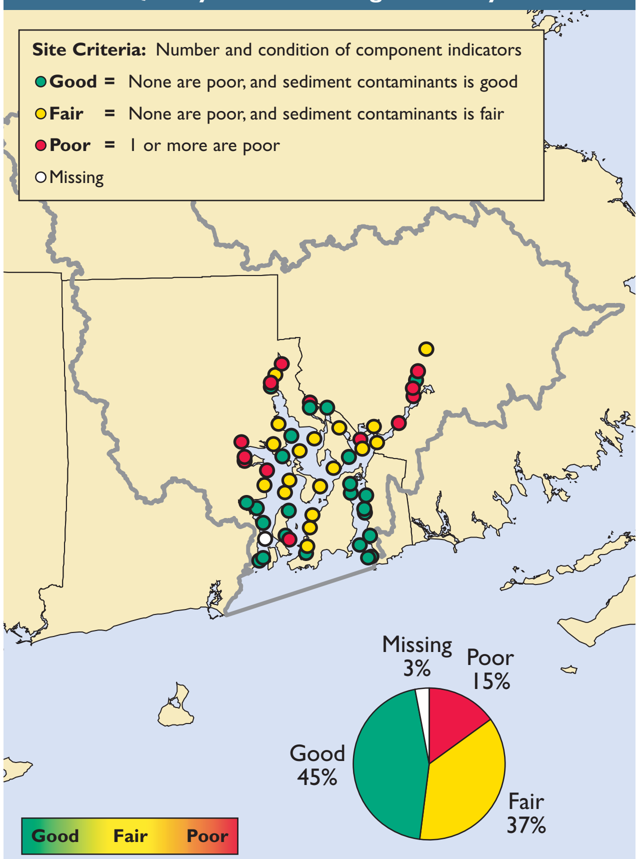



**Figure 3-46.** Sediment quality index data for Narragansett Bay, 2000–2001 (U.S. EPA/NCA).

*Sediment Toxicity* | The sediment toxicity rating for Narragansett Bay is poor. Seven percent of the Bay's estuarine area was rated poor for sediment toxicity, and NCA data were unavailable for 3% of the NBEP estuarine area.

*Sediment Contaminants* | Narragansett Bay is rated fair for sediment contaminant concentrations, with 45% of the estuarine area rated good for this component indicator and approximately 12% of the area rated poor.

*Total Organic Carbon* | Narragansett Bay is rated good for sediment TOC. Forty-four percent of the estuarine area was rated good for TOC concentrations, 27% of the area was rated fair, and only 1% of the area was rated poor. NCA data on TOC concentrations were unavailable for 28% of the NBEP estuarine area.


College students studying icthyology at a salt pond in Bristol, RI (NBEP).

## Benthic Index

Benthic condition in Narragansett Bay is rated fair to poor, with 20% of the area receiving a poor designation using the Virginian Province Benthic Index (Figure 3-47). Similar to the results for the water quality and sediment quality indices, the impaired sites in the Bay were largely restricted to upper Narragansett Bay and the Bay's tributary rivers. Most of the sites designated as impaired also had elevated levels of contaminants in the sediments and can experience intermittent, but severe, hypoxic events.

## Fish Tissue Contaminants Index

The fish tissue contaminants index for Narragansett Bay is rated poor because 91% of all fish tissue samples analyzed for this estuary were rated poor (Figure 3-48). All fish samples surveyed contained quantities of PCBs that exceeded or fell within EPA's Advisory Guidance values for fish consumption. High concentrations of PCBs are commonly observed in fish from estuaries in the Northeast Coast region.

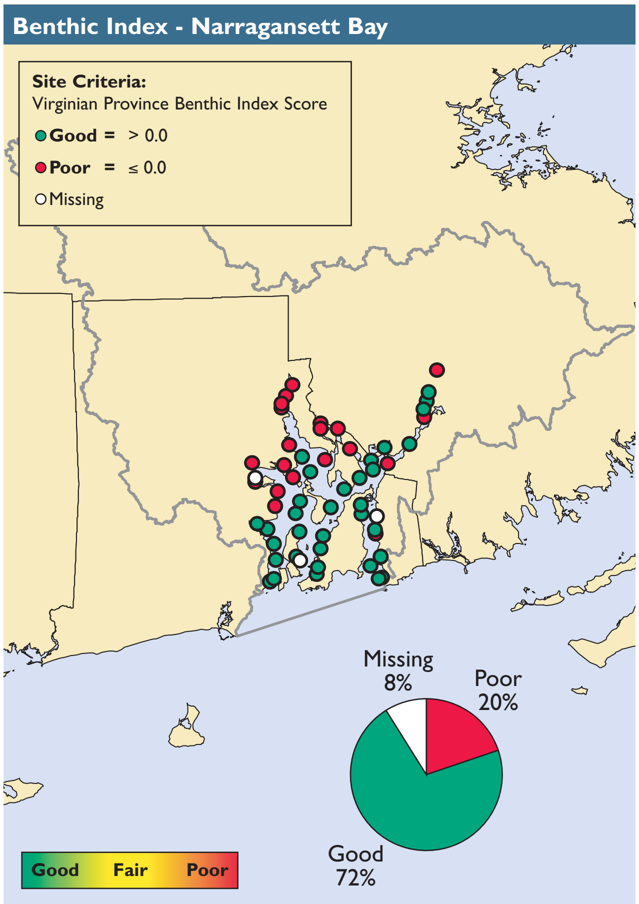



**Figure 3-47.** Benthic index data for Narragansett Bay, 2000–2001 (U.S. EPA/NCA).

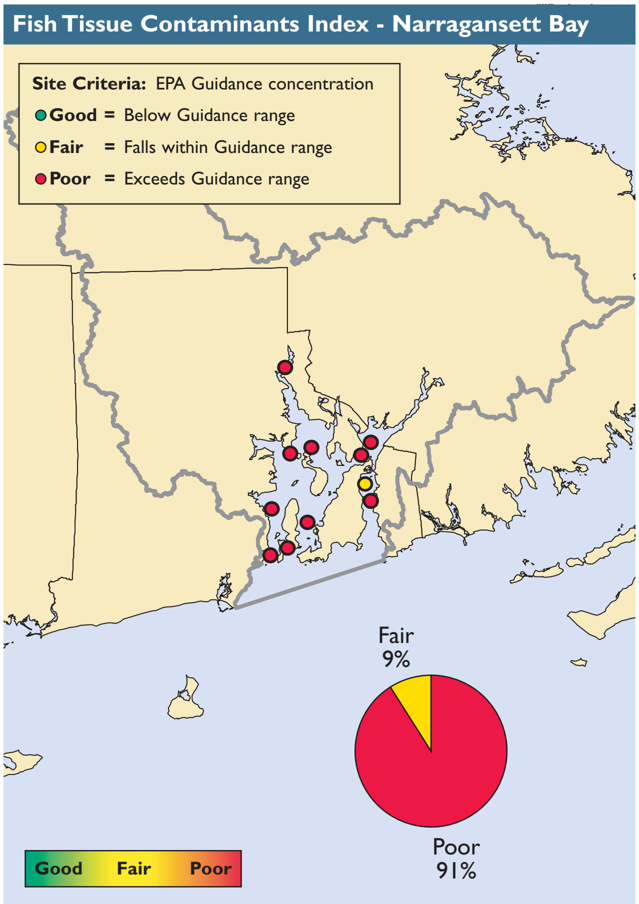



**Figure 3-48.** Fish tissue contaminants index data for Narragansett Bay, 2000–2001 (U.S. EPA/NCA).

# Narragansett Bay Estuary Program Indicators of Estuarine Condition

## Water and Sediment Quality

Few long-term, Bay-wide data sets exist for assessing water quality trends in Narragansett Bay. Until very recently, Rhode Island limited its environmental monitoring to fish population and bacterial surveys, such as those used to certify shellfish-harvesting waters. Although federal and university scientists have also engaged in research and monitoring, these efforts were for purposes other than management decision-making. This has resulted in a critical data gap in management-oriented, long-term water quality data for the Bay, especially with respect to excess nutrients, low dissolved oxygen levels, and shifts in phytoplankton blooms (RIDEM et al., 2000).

A more comprehensive monitoring network was initiated in 1999 and involves a collaborative effort among the Rhode Island Department of Environmental Management (RIDEM) Division of Fish and Wildlife, RIDEM Office of Water Resources, NBEP, Narragansett Bay Commission, NOAA's National Marine Fisheries Service (NMFS), EPA, National Estuarine Research Reserve (NERR) at Prudence Island, URI, Brown University, and Roger Williams University (RIDEM et al., 2000). Infrastructure development and data collection for this network include the following:

- Monthly neap-tide water-column surveys of dissolved oxygen levels, salinity, and temperature during the summer season are being coordinated by the NBEP and mapped using GIS by Brown University researchers.
- Continuous water quality monitoring stations at 10 sites have been strategically positioned around Narragansett Bay. These stations have two continuous monitoring probes: one set at a depth just off the bottom of the Bay and a second set just below the surface. Both probes measure salinity, temperature, dissolved oxygen concentrations, pH, and tidal amplitude. The near-surface probe also measures chlorophyll *a* to track phytoplankton blooms. Additional information on these stations is available at: http://www.dem.ri.gov/bart/stations.htm.
- Surface sediment samples have been collected from 43 sites in the Bay and analyzed for concentrations of heavy metals and organic contaminants (RIDEM et al., 2000). Bay-wide surveys of sediment contamination have been conducted by the NBEP in 1988 and 1989, as well as by URI in 1992, 1995, and 1998. Researchers have completed three major studies to determine the extent of sediment contamination in the Bay and the coastal salt ponds of Rhode Island's South Shore. Maps of sediment contamination and trend information have been developed for levels of copper, lead, and mercury in surface sediments and are available at http://www.narrbay.org/d_projects/rised/default.html.

An important step in enhancing Rhode Island's water quality information is the recent development of a statewide monitoring strategy. This strategy is being prepared under the review of a legislatively mandated environmental monitoring collaborative and a Science Advisory Committee, both of which have provided input to target monitoring priorities for new funding in the state's budget. Additional information on this environmental monitoring is available online at http://www.ci.uri.edu/Projects/RI-Monitoring/OnlineResources.html.

The current and historic concentrations of man-made pollutants (e.g., metals, nutrients, organic waste, and other constituents) in Narragansett Bay's water and sediments have demonstrated a clear north to south gradient, with levels in the main Bay channels decreasing towards the mouth of Bay. The highest pollutant levels are located in the urbanized Providence/Seekonk tidal rivers and the Fall River/Taunton River area, although poorly flushed coves and harbors sometimes experience localized impacts from pollutants. Since 1988, metals concentrations have decreased in surface sediment samples collected from the heavily urbanized portions of the study area and have remained constant or increased slightly in samples from the mid-Bay region (RIDEM et al., 2000).

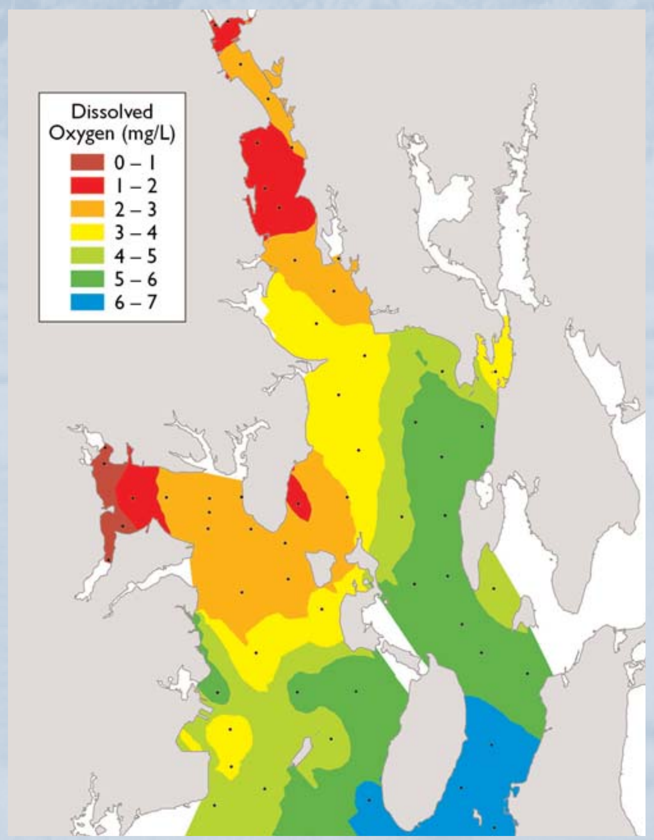
*Narragansett Bay Estuary Program*


## Fact-Based Findings in Narragansett Bay

Rhode Island residents awoke on August 20, 2003, to reports of a mass die-off of more than one million fish in the state's Greenwich Bay. The stunning fish kill affected not only menhaden, but also other finfish, eels, crabs, and, in particular, soft shell clams. This kill—the worst in 50 years—was the result of prolonged oxygen depletion, and while it was unexpected, it was not a surprise. A report to the Governor prepared by RIDEM and the NBEP subsequently documented that the fish kill was not a simple or isolated event. Rather, it was part of a much larger event going on in Greenwich Bay and other parts of Narragansett Bay that year, as well as part of a continuing trend observed in many preceding years (RIDEM, 2003).

Hypoxia, or low dissolved oxygen levels, is often caused by blooms of phytoplankton. Rapid phytoplankton growth occurs in response to an increase in nutrients, especially nitrogen, in estuarine systems and can result in large algal blooms. Although heavy rainfall can lead to significant increases in nutrient loading via stormwater, WWTPs are typically the major nutrient source in densely populated areas. Other weather factors, such as water temperature and wind direction and strength, also play a roll, either by providing favorable conditions under which blooms can develop and persist, or by disrupting the process through the mixing and oxygenating of the water. Shallow bays and coves may have poor circulation and flushing rates. These waters are more vulnerable to nutrient loading, phytoplankton blooms, and hypoxic conditions (RIDEM, 2003).

Hypoxia can have a wide range of negative impacts on the biological community. Severe hypoxia is associated with fish kills and the mass mortality of benthic invertebrates and can have a structuring influence on depth-specific zones for benthic communities. Even moderate hypoxia can reduce growth rates of marine organisms, cause shifts in the bottom-dwelling and water-column-dwelling community structure, and alter predator-prey interactions. Where hypoxia is a recurrent problem, marine communities tend to shift dominance from large, long-lived species to more tolerant or opportunistic, short-lived species (Deacutis, 1999).




Bottom dissolved oxygen levels measured during an evening neap tide on July 31, 2001. Areas with dissolved oxygen concentrations less than 3 mg/L were exhibiting hypoxia (Emily Saarman, Brown University).

In the upper half of Narragansett Bay, low dissolved oxygen levels have occurred nearly every summer for at least the past 10 years. As early as 1998, scientists began systematically collecting evidence that suggested that low dissolved oxygen problems were more widespread than previously believed (RIDEM, 2003). This discovery went against conventional wisdom that tidal energies in the Bay were strong enough to preclude the development of hypoxic conditions beyond the confines of the Providence River in upper Narragansett Bay. For example, studies to predict the sensitivity of various U.S. estuaries to nutrient inputs had concluded that Narragansett Bay was only moderately susceptible to high levels of nitrogen inputs, with few demonstrated impacts, such as hypoxia and loss of SAV. These findings were due to a lack of any historical oxygen monitoring data or published evidence of loss of SAV. Recent work coordinated by the NBEP has now filled in this gap.

To test the hypothesis that significant portions of the Bay were experiencing summer hypoxic conditions, the NBEP organized a team of scientists and technically trained volunteers (the "Insomniacs") to conduct nighttime surveys of dissolved oxygen during the hours from midnight to 7 a.m. in the upper half of the Bay. Beginning in 1999 and extending through 2004, a flotilla of borrowed work boats and research vessels conducted the monitoring from the Providence hurricane barrier in the north to the northern tip of Conanicut (Jamestown) Island in the south. Survey dates were chosen to coincide with projected weak neap tides, when physical conditions were most conducive to the onset of hypoxia (e.g., warm water, stratified water column, evening hours). Station placement was determined based on bathymetry, and a mix of deep and shallow water stations were sampled.

The results of these evening oxygen surveys confirmed that broad areas of upper Narragansett Bay are subject to intermittent periods of hypoxia during summer months, with probable ecological consequences to benthic communities in these areas (RIDEM, 2003). It is now known that specific areas of the Bay are under temporary, but extreme stress from low-oxygen conditions. Although most of these events do not result in fish kills, such conditions can become harmful to the Bay's ecology, driving fish out of the upper Bay, stunting juvenile fish growth, and killing sensitive, bottom-dwelling organisms that cannot escape. Areas such as the Providence River, which experiences frequent low-oxygen events, end up with altered benthic communities where only the hardiest species survive (Deacutis, 2004).

The evidence provided by these surveys also indicated that although the contributing factors are numerous and complex, a primary cause of the problem is excess nutrient loading to the Bay. An analysis of the 2001–2002 data by the NBEP and Brown University scientists (see map) showed that high-runoff, low-salinity surface water was not required to produce very low dissolved oxygen values, only a low-energy situation (i.e., very weak neap tide and low winds) was required. Nutrients are the source of the problem; algae provide the organic "fuel" to the bacteria; and the weak neap tides maintain the layering (stratification) necessary to decrease oxygen in the lower water layers. This is why weak neap tides are the periods of maximum risk for hypoxic events in Narragansett Bay (RIDEM, 2003).

Although researchers cannot control the tides or the weather, they can use information documented through meticulous monitoring to better manage nutrient inputs and make hypoxic events less frequent. The fish kill was the wake-up call, but it was the data from the dissolved oxygen surveys that laid the foundation for unprecedented state legislation requiring nutrient reductions of least 40% to 50% from WWTPs discharging to upper Narragansett Bay (Governor's Narragansett Bay and Watershed Planning Commission, 2004b). Without another fish kill, the challenge now is to maintain this level of monitoring to document improvements in dissolved oxygen concentrations.

## Habitat Quality

Using aerial photography and GIS applications, collaborative efforts are being undertaken to map and restore seagrass beds, salt marshes, shellfish beds, and other critical estuarine habitats. Eelgrass in the Bay has declined since the early 1950s as a result of water pollution, coastal development, harbor dredging, and other factors. In 1996, less than 100 acres of eelgrass remained in Narragansett Bay, and eelgrass has decreased 41% in coastal ponds due to increased nitrogen loads. No significant eelgrass beds occur north of Southern Prudence Island or in Greenwich Bay or the Palmer River (RIDEM et al., 2000). SAV in Narragansett Bay is currently being monitored by a partnership consisting of the NBEP, Save The Bay, the U.S. National Resource Conservation Service (NRCS), and URI. Links to maps of eelgrass, including NBEP maps of all significant beds in the Bay, can be found at http://www.nbep.org.

## Living Resources

A variety of living resources are used as indicators of ecological condition in Narragansett Bay, including invertebrate assemblages; the abundance and health of finfish, oysters, scallops, colonial nesting birds, mammals, amphibians, and reptiles; fish kills; and the diversity of benthic organisms and macroinvertebrates (Kleinschmidt Energy and Water Resource Consultants, 2003).

Several different types of finfish and shellfish are monitored in Narragansett Bay. In recent years, the populations of the Bay's native bottom-dwelling fish, such as winter flounder and tautog, have demonstrated declining trends. Other water-column-dwelling species have shown population increases. Scup and striped bass stock have increased since the 1980s (Ardito, 2003b). Scallop landings in the Bay have decreased from 300,000 bushels per day to negligible levels due to eelgrass declines (Ardito, 2003a). After reaching record levels in the 1990s, lobster landings are also decreasing (Ardito, 2003b). Quahogs collected from the Providence River have exhibited a low meat-to-shell ratio, which may indicate that these shellfish are experiencing stress due to low dissolved oxygen levels (RIDEM et al., 2000).

Since data collection began, fish kills have been reported in Greenwich Bay every year, except for 2000. In August 2002, despite a severe drought, low oxygen levels covered almost half of the Bay, including the Providence River, East Passage, Upper Bay, and West Passage. Although Greenwich Bay was not directly measured, researchers working in the area at the time corroborate that a severe low oxygen event also occurred at this location in 2002. The severe hypoxia in the 2002 event was clearly not due to rainfall, but to baseline conditions driven by nutrients from the point sources (e.g., WWTPs) and groundwater entering the Bay due to low river flow (RIDEM, 2003).

## Environmental Stressors

An estimated 160 private marinas, yacht clubs, boat yards, town docks, and launching ramps operated in the Bay in 1989, with more than 40,000 boats registered in Rhode Island (RIDEM, 1992; NBEP, 2002). Recognizing the need for additional pump-out facilities to maintain water quality standards, improve water quality, and protect open shellfish beds, NBEP staff developed the *Marina Pumpout Siting Plan for Narragansett Bay, RI* (NBEP, 1993). The result of this plan was the 1998 designation of Rhode Island's coastal waters as a No-Discharge Zone for boat sewage and the development of 30 additional pump-out facilities in the Bay for marine toilets (up from 14 in 1993), with several more under development (RIDEM et al., 2000).


Wetlands and yachts in Wickford Harbor (NBEP).

## Current Projects, Accomplishments, and Future Goals

The upgrading of municipal WWTPs has reduced biochemical oxygen demand (RIDEM et al., 2000), and construction of a giant storage system (at a cost of more than $300 million) is underway and will eventually prevent the discharge of some 62 million gallons of untreated sewage to the Bay via CSOs during heavy rains (NBEP, 2005). Pretreatment requirements have radically reduced the amount of metals discharged in wastewater, as has the elimination of lead from gasoline (RIDEM et al., 2000). In addition, a law was passed in 2004 committing the State of Rhode Island to a 50% decrease in recorded 1995–1996 levels of nitrogen loads from major WWTPs to the Bay by 2008 (*An Act Relating to Waters and Navigation–Water Pollution*, H-8638). Finally, Rhode Island has committed to the initiation of a comprehensive monitoring program and adoption of a suite of indicators for the Bay and its watersheds that will track such ecosystem characteristics as land cover/use, demographics, water and sediment quality, hydrology, habitat quality and quantity, productivity, and species assemblages and relative abundance (RIDEM et al., 2000; Kleinschmidt Energy and Water Resource Consultants, 2003).

The NBEP will continue to serve as a coordinating entity for Bay actions and for organizing and creating collaborative efforts to meet common goals. The program will focus on expanding its partnership activities with municipalities, agencies, and non-profit organizations; securing the scientific data needed to support policy initiatives and develop effective management strategies; providing outreach on the Bay and watershed ecosystem through workshops, conferences, and educational events; securing additional funding for CCMP implementation; addressing priority water quality and living resource issues in the Bay; and identifying and analyzing emerging Bay issues (e.g., introduced species).

## Conclusion

Based on the four indices of estuarine condition used by the NCA, the overall condition of Narragansett Bay is rated poor. Although relatively well mixed and less susceptible than other estuaries to eutrophication, Narragansett Bay is exhibiting an increasing array of eutrophic-associated symptoms, including low dissolved oxygen levels, fish kills, eelgrass loss, macroalgae blooms, benthic community changes, and a shift in the Bay's dominant fish community from bottom-dwelling to water-column-dwelling species. Workshops held in 2001 concluded that monitoring in Narragansett Bay remains under funded, that significant data gaps exist, and that there is a lack of coordination of monitoring efforts and a lack of integration and analysis of existing data. Since the workshops, the process of addressing these concerns is well underway, with a significant investment in both Bay monitoring and in the reduction of nutrients entering the Bay.

High school students having fun while cleaning up a beach at Conimicut Point on upper Narragansett Bay (NBEP).