

What is the Quality of the Waters of Casco Bay?

Answer: Overall, water quality is good. There are a few areas where low dissolved oxygen is a concern.



Why Is it Important to Monitor the Water Quality of Casco Bay?

The water quality of Casco Bay is an important indicator of the overall health of the bay's ecosystem. The levels of dissolved oxygen and nutrients, for example, have a major impact on the health of the biological community. Assessments of these parameters help us to determine whether the bay can support a full and diverse range of marine life and uses. Friends of Casco Bay (FOCB), with support from CBEP, has successfully conducted the ongoing Citizens Water Quality Monitoring Program in the bay for the past twelve years. The program is carried out with the aid of more than 100 citizen volunteers who sample surface waters at 80 shore-based stations. They also assist FOCB professional staff with sampling at 10 profile stations located throughout Casco Bay. Measurements include temperature, salinity, pH, water clarity, and dissolved oxygen. In the last 4 years, the program was expanded to include measurements for chlorophyll fluorescence and dissolved inorganic nutrient concentrations.

Overall Findings

Evaluations of the twelve years of water quality data (1993 to 2004) indicate that overall water quality in Casco Bay is generally good. Dissolved oxygen (DO) is usually well above State standards and not close to levels that would impair biological processes. DO concentration in coastal waters is a dynamic property that varies spatially and temporally depending on physical, seasonal, biotic, and anthropogenic influences. A few areas of concern were found in locations with potentially heavy nutrient loading either directly from point sources (Portland Harbor) or indirectly from riverine and other non-point sources (Royal River, Presumpscot River, and Harraseeket River) and also in waters where restricted circulation may exacerbate DO conditions (New Meadows River and Quahog Bay). Nevertheless, low DO events tend to be exceptions rather than the rule in Casco Bay waters (FOCB and CBEP 2005).

Summary Statistics for All Casco Bay Surface Data

	Water Depth (m)	Temp (°C)	Salinity (ppt)	DO (mg/l)	DO (% saturation)	pH	Secchi Depth* (m)
Mean	7.25	12.95	29.03	9.20	103.5	7.94	2.98
SD	7.68	5.36	4.48	1.48	12.1	0.19	1.42
Minimum	0.1	-3.0	0.0	2.6	33.9	6.0	0.2
Maximum	55.0	30.0	34.0	14.9	177.5	8.6	15.3
Count	7022	8408	8329	8214	8126	7966	3808

*Secchi depth is a measure of water clarity. For Secchi depth, the summary statistics were calculated from 40 selected sites.

Source: Friends of Casco Bay and Casco Bay Estuary Partnership 2005

Data Summary

Summary statistics for all Casco Bay surface data are presented in the table above. The minimum and maximum values for each of the parameters provide a good representation of the variability among sites, across the bay, and over time. Overall, the monitoring data indicate the following:

- 🌀 The shallowest water depth was measured in Anthoine Creek and the deepest depth was consistently measured at Halfway Rock.
- 🌀 The coolest temperatures were measured at the sites that are sampled year-round, while the warmest single water temperature was found at the Cousins River site in front of the Muddy Rudder Restaurant during the summer of 1995.
- 🌀 During the summer, the warmest waters were consistently observed at the Presumpscot River site. For swimming, Wolf Neck State Park offered some of the most inviting waters with an August mean temperature of 20°C (68°F).
- 🌀 Willard Beach in South Portland had one of the lower August mean temperatures at 16.5°C (62°F).
- 🌀 Sites near Custom House Wharf and in the upper New Meadows River consistently had some of the lowest DO levels and these low levels are likely associated with point or non-point source nutrient inputs and associated eutrophication effects.
- 🌀 Water clarity was at a minimum at a number of shallow, inshore sites while the clearest water was found at Halfway Rock.

New Parameters: Chlorophyll and Nutrients

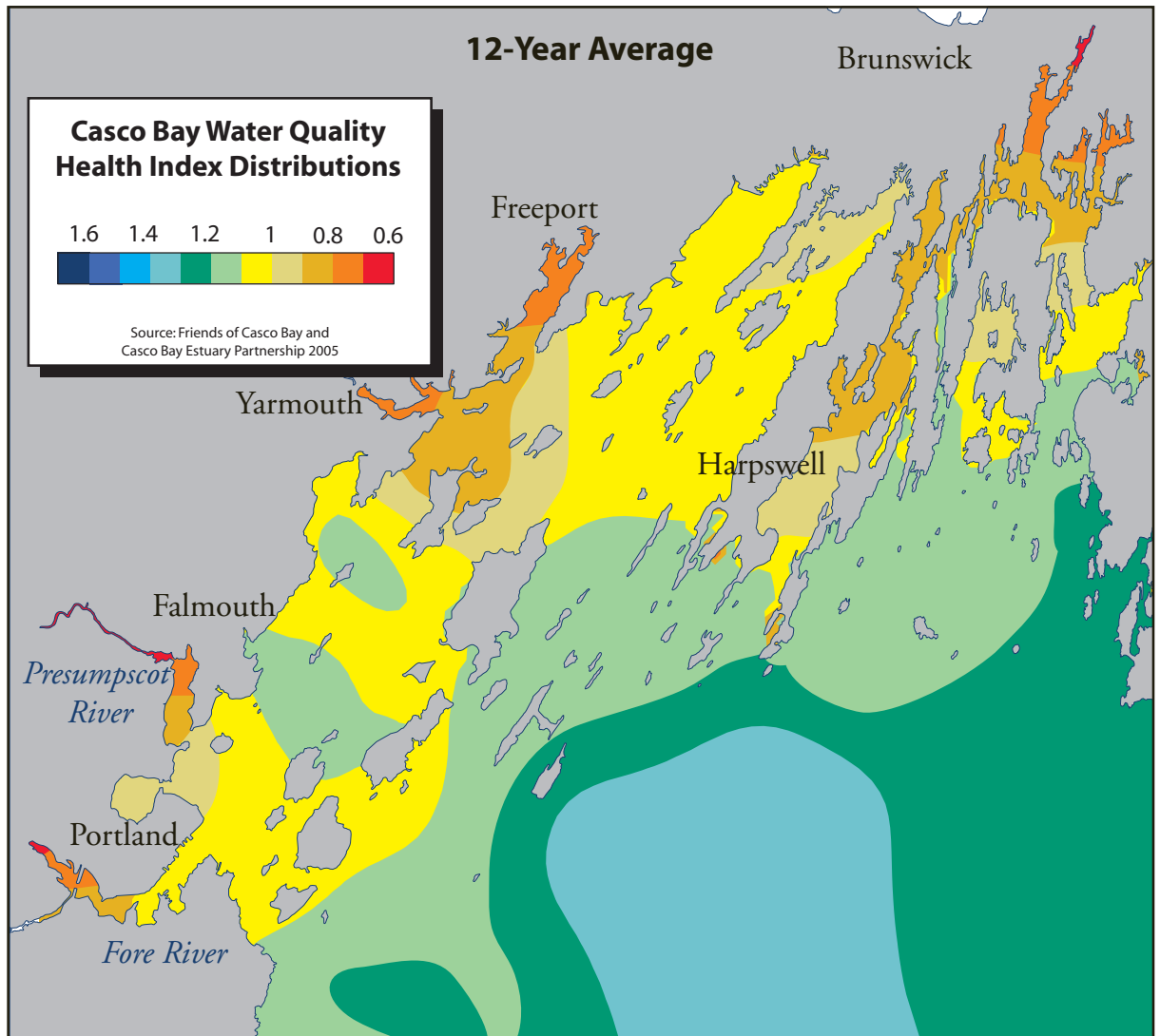
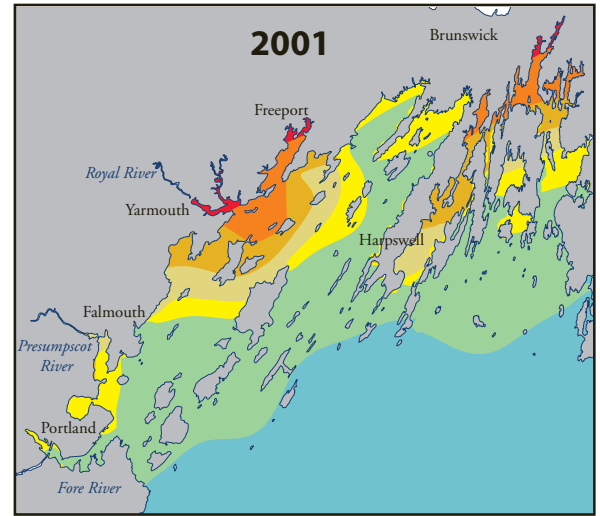
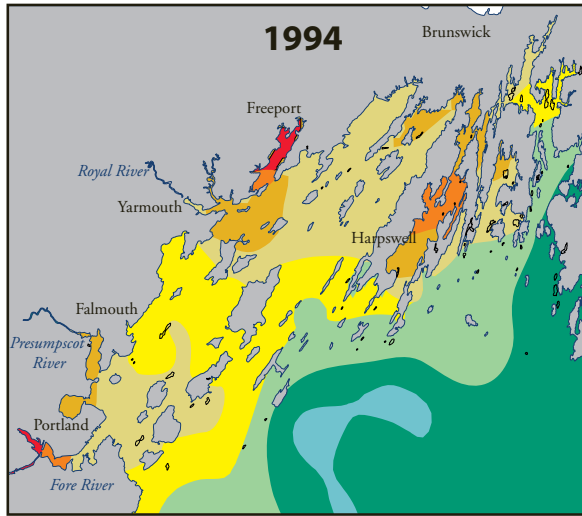
Fluorescence of chlorophyll (a plant pigment) and dissolved inorganic nutrient measurements were added to the FOCB monitoring program in 2001. Chlorophyll fluorescence is a measure of chlorophyll concentrations and an indirect

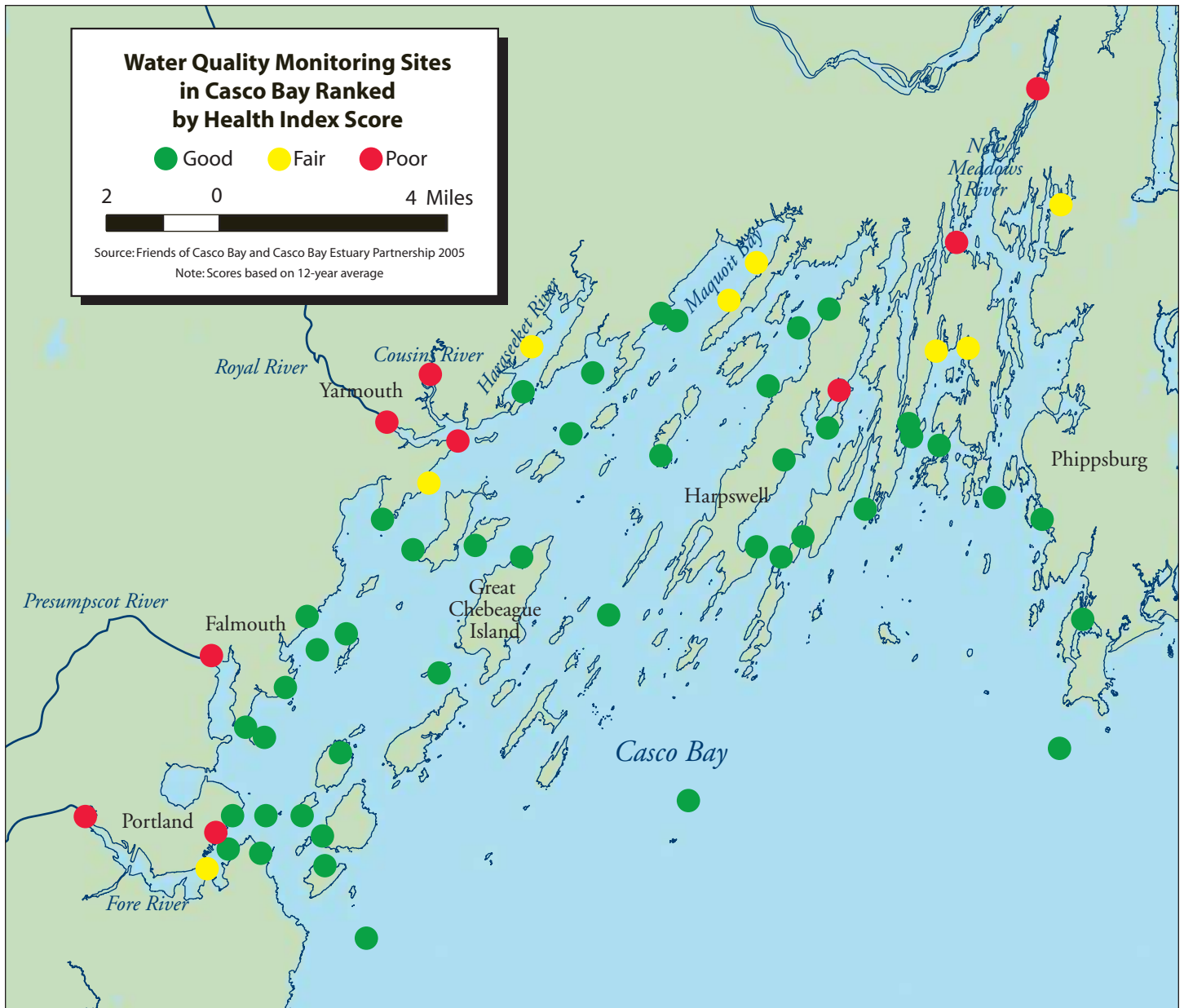
estimate of the amount of phytoplankton (single celled plants) in the water column. Dissolved inorganic nutrients are crucial ingredients in the biogeochemical functioning of an estuarine system. However, too much of a good thing, in this case nutrient inputs related to human activities, could drive the system towards excessive growth of phytoplankton (eutrophication) which can lower bottom water dissolved oxygen levels. The mean nutrient concentrations for nitrate plus nitrite ($\text{NO}_3 + \text{NO}_2$), ammonia (NH_4), silicate (SiO_4), and phosphate (PO_4) are typical of northeastern coastal waters, but the highest values measured suggest anthropogenic and riverine inputs. The addition of these critical parameters to the monitoring program will allow environmental managers to make more informed planning decisions.

Casco Bay Health Index

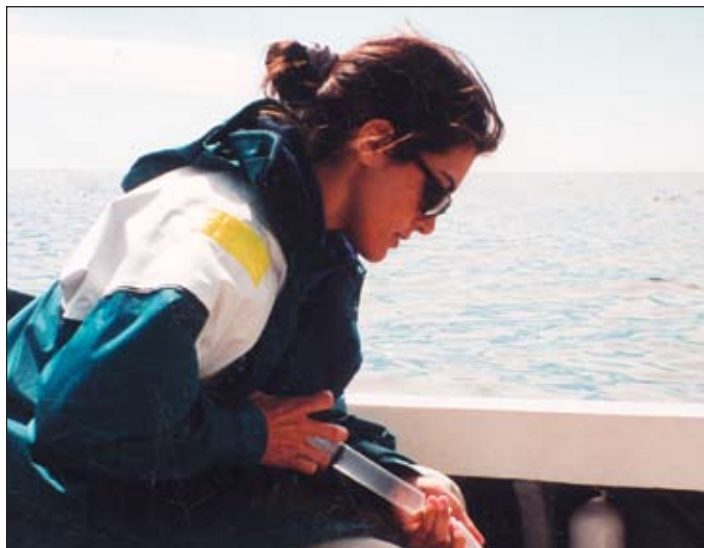
The twelve years of monitoring data have been used to develop the Casco Bay Water Quality Health Index (see figure on following page). The index combines several of the water quality parameters to provide a reliable, uncomplicated indicator of the bay's overall quality. The index is calculated based on DO (as percent saturation) and the clarity of the water. Both of these parameters are strong measures of water quality and the impacts of eutrophication. For each monitoring site, the summer means of these two parameters are scored based on their relative position between conservatively set low and high thresholds (65 to 95% and 0.5 to 3.5 m). The mean of these two values is the final index score. By summarizing these environmental parameters into one score, sites can be ranked, areas of concern identified, and trends in water quality may become more apparent over time. FOCB has used the Casco Bay Water Quality Health Index to rank each of the sampling sites in the Citizens Water Quality Monitoring Program as Good, Fair or Poor (see map on page 39).

Casco Bay Water Quality Health Index distributions. The poorest water quality is indicated by a score of 0.6 (red), the best by a score of 1.6 (blue). On average, the lowest scores are found in Portland Harbor, in the vicinity of the Presumpscot and Royal Rivers, and in the restricted embayments in northeastern Casco Bay. There is a clear inshore to offshore increase in the index with the highest scores consistently calculated for the site near Halfway Rock. This is due to both higher DO levels and greater water clarity the further a site is removed from anthropogenic and riverine inputs. Year-to-year variability is evident in the distribution of the index as indicated by the plots for 1994 and 2001. In 1994, low DO concentrations were observed at numerous sites along the northeastern coastline and are depicted here as lower scores being seen further offshore. In 2001, water quality was better throughout much of Casco Bay, though low scores were still seen at a few of the areas of concern. Note that most of the sites score ≥ 1 indicating that even when using relatively conservative low and high thresholds, water quality appears to be good throughout most of Casco Bay (FOCB and CBEP 2005).





A water quality rank has been assigned to each of the Friends of Casco Bay monitoring sites based on the Casco Bay Water Quality Health Index.



Reference

Friends of Casco Bay and Casco Bay Estuary Partnership. 2005. *Twelve-Year Water Quality Data Analysis for Casco Bay: 1993 - 2004*.