

how healthy is the marine ecosystem of the Bays?

The Bays system supports a rich and diverse ecosystem of normal plant and animal communities, but signs of stress are evident. Stress results from multiple causes, including overfishing and contamination. The highest levels of contamination are nearshore—sources include rivers, the atmosphere, sewer overflows, treatment plants, and past use of disposal areas.

An overview of the Bays system

At the southern end of the Gulf of Maine, the Massachusetts/Cape Cod Bay system extends from the New Hampshire border to the tip of Cape Cod, encompassing about 1650 square miles.

A strong southward coastal current and a large flow of water from the Merrimack River produce an average flow south through the Bays, exiting to the open Atlantic (Figure 15). Strong tide and wind effects produce circulation patterns that are highly variable from day to day.

Rich resources and multiple stressors

The beaches, wetlands, rocky shores, and deep offshore waters of the Bays provide important habitat for many plant and animal communities including commercially important species of fish and shellfish, and rare or endangered animals and birds.

There are a variety of environmental stressors in the Bays system: historical whale hunting and ongoing commercial fishing; disappearance of habitat such as salt marshes; dams that hinder fish migration and spawning; commercial shipping and boating activities; and pollution.

Many sources of pollution, past and present

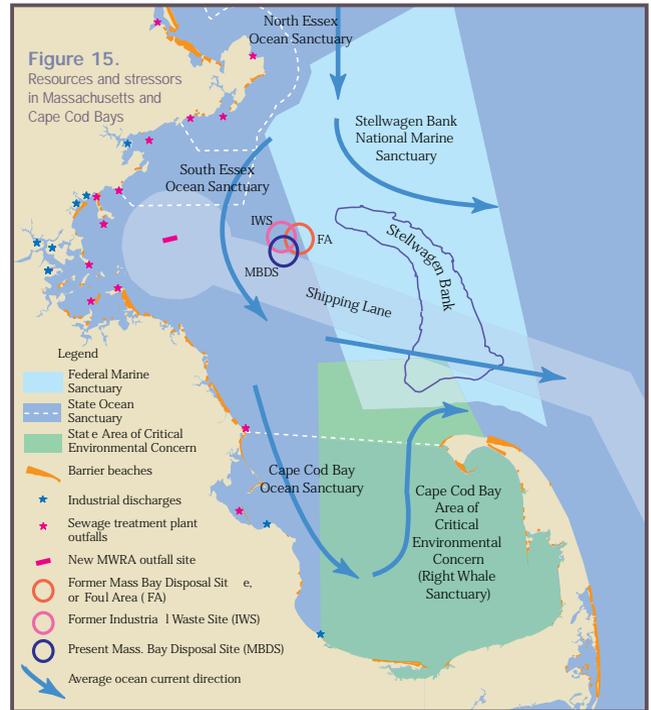
Bacterial contamination of beaches

and shellfish beds is a concern along most of the Bays' coastline. The chief sources of this contamination are sewer pipe overflows, stormwater runoff and leaks from septic systems. Treatment plants are a relatively minor source of contamination.

Levels of toxic contaminants in the water are highest near the coast and, except for a few pollutants like polychlorinated biphenyls (PCBs), generally meet water quality standards throughout the Bays. However, the sediments near urban shorelines like Boston Harbor, Salem Sound, and Broad Sound have significant levels of contamination.

In sediments, as in the water column, contaminant levels decrease with distance from shore except at former waste disposal sites in Massachusetts Bay. Contamination in offshore sediments is not high enough to cause detrimental ecological effects, according to National Oceanic and Atmospheric Administration standards. In fact, monitoring has shown that the bottom-dwelling animal communities are typical of the Gulf of Maine ecosystem.

Toxic organic compounds and metals have many sources. Three examples illustrating this are chlorinated pesticides (especially DDT and its breakdown products), PCBs, and mercury. DDT was banned in 1972 and PCBs were phased



Multiple sources of toxic contaminants to the Bays

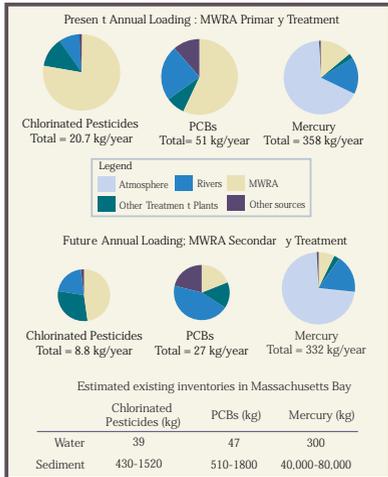


Figure 16. Annual inputs (loadings) of chlorinated pesticides and PCBs to Massachusetts Bay are small compared to the existing inventory accumulated from past sources. The source of mercury is primarily atmospheric. Secondary treatment will reduce the quantities contributed by MWRA. The area of the pie charts reflect the relative amounts of present vs. future loads. (Annual loading data from Mitchell et al. 1997, Massachusetts Bay estimates of existing inventory from data by Shea, 1993, 1996 in prep.; Bothner et al. 1993. Estimates based on model in Shea 1995).

out of production beginning in 1971. These contaminants can bioaccumulate in marine mammals and fish.

Figure 16 shows that the present inputs to Massachusetts Bay from all sources combined of PCBs and chlorinated pesticides are a small fraction of the amounts that have accumulated from past inputs, when the chemicals were being used in large amounts. Secondary treatment will greatly reduce MWRA's contribution of PCBs to Massa-

Distribution of silver in surface sediments

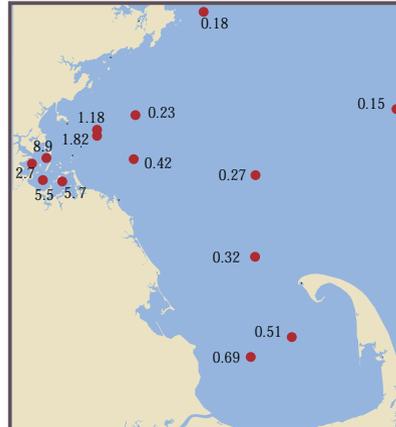


Figure 17. Sediment silver concentrations (measured as parts per million of the mud fraction of sediment) decrease with distance from the coast. Cape Cod Bay has somewhat higher silver concentrations than more northern locations; this may reflect sediment resuspension and transport by currents to Cape Cod Bay (data from Bothner et al. 1993).

achusetts Bay. The amounts of PCBs and chlorinated pesticides entering the Bays will continue to decrease in the future, and are slowly degrading in the environment.

Historical contamination signals

MWRA's monitoring program has revealed that past sewage discharges into Boston Harbor have contributed contaminants to broad areas of Cape Cod Bay as a result of tidal flushing. Past inputs of sewage and sludge in Boston Harbor contained silver, which was historically discharged in large amounts by the photographic industry. A gradient of

silver extends from the Harbor to Cape Cod Bay (Figure 17), with higher concentrations in parts of Cape Cod Bay than in other offshore waters. Because the Harbor apparently was the source, these silver concentrations correspond quite well to the modeled dilution of the effluent dispersed into Massachusetts Bay from the existing Harbor outfalls (Figure 12a).

Despite the pattern of silver (and other sewage tracers not shown), the contaminants are not causing significant impacts on the health of marine life in Cape Cod Bay. Bottom-dwelling animal communities in the Bay are typical for the Gulf of Maine as a whole. Data gathered on winter flounder (Figure 18) show that conta-

Winter flounder liver disease rates

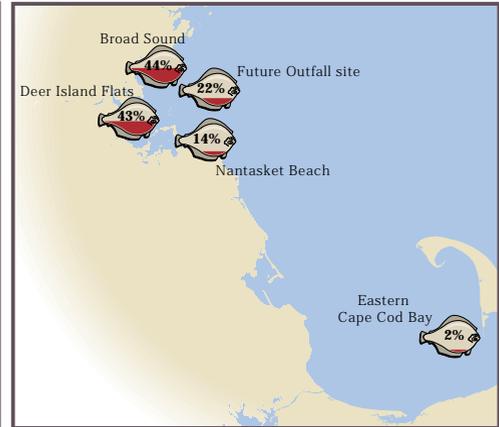


Figure 18. Flounder liver disease is high in Boston Harbor and Broad Sound, and low in Cape Cod Bay. The percentage of flounder showing early liver disease decreases with distance from Boston Harbor—flounder at the new outfall site may be affected by toxic pollutants from the coastal sources or from old waste disposal sites. Improved treatment, continued source reduction, and improved dilution and dispersion at the new location will minimize flounders' exposure to the contaminants (PAHs, pesticides, and PCBs) thought to cause this disease (data from Mitchell et al. 1996).

minant-related liver disease is at very low levels in Cape Cod Bay compared to the area close to Boston Harbor.

Future decreases in contamination

As MWRA's contribution of toxic pollutants continues to decrease due to source reduction and treatment improvements, the existing gradient of pollutants in the Bay should gradually lessen. In addition, moving the effluent discharge to the new outfall site (see page 9) will reduce the concentration of dissolved contaminants reaching Cape Cod Bay from Boston.