what about the right whale?

Endangered northern right whales, when visiting Massachusetts and Cape Cod Bays, will be exposed to lower amounts of toxic pollutants and pathogens because of improved wastewater treatment. Hypothesized effects of nutrients on plankton that are food for the right whale are being carefully monitored.

The northern right whale (*Eubalaena glacialis*) is the world's most endangered large whale. From an original population size of at least 10,000 animals, extensive hunting for more than 800 years drove the species to near-extinction. Only about 300 individuals remain in the North Atlantic; fewer in the North Pacific. Despite an international ban on hunting right whales since 1949, the population is increasing at a very slow rate, in contrast to other protected whales which have recovered more quickly.

The explanation of this slow recovery is not known. Natural causes such as competition with other species, or genetic factors like inbreeding, or behavioral factors may be important. Human-induced mortality includes collisions with ships and entanglement with fishing gear. Finally, habitat degradation has been identified as a potentially important cause of the whale population's low rate of increase. Reduction in food availability, physical interference with whales through shipping, mining and dredging activities, and pollution impacts are factors that could degrade whale habitat.

Cape Cod Bay and Stellwagen Bank are important late winter/spring feeding areas for these migratory animals, and have been identified by the National Marine Fisheries Service (NMFS) as critical habitat to be protected. Therefore potential pollution sources like the MWRA outfall must be reviewed under the Endangered Species Act, although the long outfall discharge is distant–more than 16 miles–from identified right whale habitat.

In 1993, EPA conducted a comprehensive Biological Assessment on the potential impact of the MWRA outfall on endangered species and NMFS issued a Biological Opinion. The conclusion was that the outfall was not likely to jeopardize the species. Nevertheless, the critical status of the right whale requires special and continued consideration. Issues that have received ongoing scrutiny include the potential for impacts from pathogens, toxic chemicals, and nutrients, as described below.

Will the whales be threatened by infectious bacteria, viruses or protozoans in the effluent?

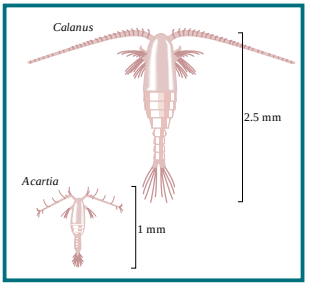
Secondary treatment is highly effective at removing pathogens from the wastewater. Secondary-treated effluent is also disinfected more effectively than primary effluent. Improved removal combined with higher dilution will significantly decrease the levels of pathogens in both the Harbor and the Bays. The microbiological water quality will meet human swimming standards and the much more stringent shellfishing standards. These standards should be sufficiently protective of the whales as well.

What about toxic and bioaccumulation effects of metals and PCBs?

Levels of these contaminants in the discharge will be so low (page 10) that short-term, acute toxic effects are not a concern. The focus is on average levels of contamination Bay-wide and the effects of long-term chronic exposure, such as bioaccumulation, and the potential for sublethal effects like decreased fertility. Measurements of organochlorine compounds, like PCBs, in right whales indicate relatively low tissue levels compared to other marine mammals. Although exposure to toxic chemicals may possibly be a factor in right whale reproductive failure, moving the outfall location from within the Harbor to the 9.5-mile location offshore will not increase the risk to whales because the inputs of these contaminants to the Bays system will not be increased. Rather, secondary treatment will substantially decrease any toxic chemicals MWRA contributes to the Bays system.

Will increased nutrients cause decreased food availability?

In order to better understand nutrient issues, it helps to know something about the feeding biology of the northern right whale (see illustration, Figure 22). Right whales are baleen whales; they feed by swimming open-mouthed through patches of zooplankton, straining millions (about one ton a day) of tiny crustaceans, called copepods, from the water. In the spring, right whales feed in Cape Cod Bay and Stellwagen Bank, where there are intense blooms of large and nutritious copepods like *Calanus finmarchicus*. The whales feed in dense *Calanus* patches, created by wind and current patterns as well as copepod swimming behavior.

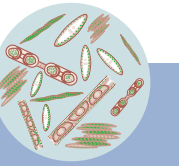


Offshore *Calanus* zooplankton communities differ from their nearshore counterparts. Nearshore zooplankton are typified by species like *Acartia*, which are smaller, less nutritious, and apparently do not form the dense patches required to

sustain a feeding whale. Different types of copepods eat different kinds of phytoplankton. It has been suggested that the nutrients discharged by the new outfall could cause the Bay environment to favor zooplankton like *Acartia*—not good food for right whales.

Another nutrient-related whale-feeding concern is nuisance algal blooms: will the outfall cause blooms of *Phaeocystis*, which seems to interfere with whale feeding, or brown or red tides which might be toxic? Blooms of *Phaeocystis* and *Alexandrium* have occurred in the Bays, so the question is whether the outfall could worsen them.

To help address both of these food availability issues, MWRA has used the Bays Eutrophication Model (page 16). The model shows that we can expect to see effects of nutrient discharges limited to the immediate area of the outfall, so it is unlikely that there would be any outfall-related changes as far away as right whale habitat. If any changes in phytoplankton or zooplankton do result from the discharge, they would first occur near the outfall. Therefore, MWRA is monitoring intensively for changes in plankton composition there. MWRA also monitors Cape Cod Bay for any significant changes.



plankton

phytoplankton

Tiny floating plants (algae), especially diatoms, that are carried about with ocean currents. These plants (illustrated at right) grow most abundantly near the surface of the water, where they receive maximum light. At the base of the marine food web, phytoplankton grow using nutrients in the water, and are eaten by zooplankton.

zooplankton

Tiny floating animals, including juvenile forms of fish, jellyfish, and shellfish. Very small crustaceans, the copepods (see drawings on left), are often abundant in zooplankton. Zooplankton eat phytoplankton, and in turn are eaten by fish and other marine animals, including northern right whales.

Figure 22. Feeding northern right whale. High springtime nutrient levels in the water, combined with wind and current patterns, stimulate the abundant growth of phytoplankton and *Calanus* copepods in Cape Cod Bay and Stellwagen Bank. The nutritious copepods are found in dense patches, favored by filter-feeding northern right whales. The whales feed in Massachusetts and Cape Cod Bays in the spring before continuing their migration north to the Bay of Fundy. MWRA monitoring will detect changes in phytoplankton or zooplankton communities. (Illustration by S. Hussey, after S. Landry, courtesy of New England Aquarium).