Phytoplankton and Zooplankton of Boston Harbor, Massachusetts and Cape Cod Bays, 1992-1999, Within a Regional Context

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Setting and Background

The MWRA sampling area (Figure 1) is connected to and shares features with adjacent areas of the Gulf of Maine as well as Buzzards Bay (Figure 2). Thus, patterns and processes in the MWRA sampling area should be placed within the regional context of these contiguous waters.

Massachusetts and Cape Cod Bays, the Gulf of Maine and Buzzards Bay all undergo dramatic seasonal changes in water temperature, and consequently in quantity and composition of phytoplankton and zooplankton. There can be high variability in composition and abundance of both phytoplankton (Figure 4) and zooplankton (Figure 5) within surveys, between surveys, and over seasonal or interannual time scales.

Phytoplankton

- Microflagellates are the usual numerical dominants throughout the year, and their abundance generally tracks water temperature, being most abundant in summer and least abundant in winter.

- As in other coastal waters of New England and the temperate zone, the annual cycle of phytoplankton abundance in Massachusetts and Cape Cod Bays is typically dominated by a “winter-spring bloom” in response to increasing nutrients and light (Figure 4a, 4b).

- This winter-spring bloom is typically composed of abundant diatoms (assorted species of Chaetoceros, and Thalassiosira) except during years such as 1992 and 1997 when there are spring blooms of the gelatinous nuisance alga Phaeocystis.

- In summer microflagellates are at peak abundance, with various chamosomous diatoms such asSkeletonema costatum, Leptocylindrus danicus, Rhizosolenia delicatula, Ceratium hirundinella, and various Chaetoceros species abundant.

- In autumn the same assemblage as in the summer usually dominates, with additional, sometimes massive blooms of the diatom Asterionellopsis glacialis, as in 1993.

- Occurrences or blooms of nuisance taxa such as Phaeocystis, and potential toxic species of the diatom genus Pseudonitzschia are intermittent and sporadic with no strongly predictable pattern. In some cases, such as the Phaeocystis bloom of spring 1992, or the Asterionellopsis glacialis bloom in fall of 1993, blooms that occurred in Massachusetts and Cape Cod Bays also occurred, to a lesser extent, in Buzzards Bay.

- Screened-water phytoplankton assemblages of dinoflagellates are usually dominated by the same non-toxic taxa each year, including Ceratium longipes and C. reinhardtii. These do not occur in abundances as high as have been associated with toxixity elsewhere.

- Despite the differences in oceanography, stratification, and depth between Massachusetts and Cape Cod Bays, phytoplankton assemblages in these two areas are generally similar in composition and seasonal patterns.

Zooplankton

- There is a broad envelope-of-variability of zooplankton abundance in the MWRA sampling area, with increasing abundance throughout the winter and spring to high levels in summer, with declines in the fall (Figure 5a, 5b).

- Zooplankton assemblages throughout the nearfield and most of the farfield, with the exception of Boston Harbor, were composed primarily of a few repeatedly and perennially dominant taxa. These include nauplii (larvae) and copepodes (juveniles) of a few abundant species of copepods such as:

  - Oslenia similis
  - Pseudocalanus elongatus and P. moultoni
  - Calanus finmarchicus
  - Temora longicornis
  - Paracalanus parvus
  - Centropages typicus and C. hamatus

- In addition to copepods, meroplankton (planktonic larvae of benthic invertebrates) such as larval polychaetes and barnacles, or veliger larvae of gastropods or brachiopods can contribute heavily to total zooplankton abundance.

- Pulses of meroplankton abundance are ephemeral and likely more related to reproductive cycles of their benthic parents than to processes in the plankton.

Summary

- Patterns of community composition, abundance and seasonal variability of phytoplankton and zooplankton in Massachusetts and Cape Cod Bays are variable in time, on scales from daily (within a survey), to monthly (between surveys), to interannual.

- Spatial patterns of community composition are generally similar within a given survey for areas outside Boston Harbor, but the harbor is usually distinct from adjacent offshore areas.

- Plankton patterns both within Boston Harbor and offshore in Massachusetts and Cape Cod Bays are generally similar to those in contiguous areas such as the upstream Gulf of Maine and adjacent areas to the south such as Buzzards Bay, New Bedford Harbor, and Georges Bank.