Major Findings of the 1984 - 2002 CBP Zooplankton Monitoring Program

Zooplankton status in Chesapeake Bay is generally not good, although there are improving trends in anadromous fish spawning and nursery areas. Water quality improvements in the future are expected to create more favorable habitat conditions for zooplankton communities bay-wide. Zooplankton such as copepods are food for important fish species in Chesapeake Bay, and healthier zooplankton communities will support more fish. Resource management strategies must balance the improving capacity of the Bay to support zooplankton with increasing food demands of restored fish stocks.

Status and trends in the upper Bay mainstem and upper tributary reaches ...

- Significant increases in mesozooplankton abundance occurred, indicating an improving trend in the overall food base for fish in these areas (see Figure). Increases were strongest where water quality significantly improved, as in the Patuxent River.
  - ➢ These areas are seasonal spawning and nursery habitat of migratory fish, and zooplankton food is important to their recruitment and growth. Blueback herring, alewife, and shad rely on mesozooplankton food their entire lives. Striped bass, white perch, and yellow perch depend on meso- and micro zooplankton as larvae, and shift to larger prey as they grow.

- The Food Availability Index (FAI) assesses total zooplankton food for larvae of migratory fish. During 1999-2002, Patuxent and Choptank had optimal FAI. Potomac had borderline minimal/below-minimal FAI. The upper Bay, and the James, York, and Rappahannock had below-minimal FAI.
  - ➢ Despite universal improving trends, zooplankton food levels for migratory fish larvae are currently inadequate in most major spawning/nursery areas.

... and in the middle and lower Bay mainstem and lower tributary reaches

- Sharp declines in mesozooplankton abundance occurred at almost all stations in these areas (see Figure). In contrast, abundances of the smaller microzooplankton increased in the mid Bay.
  - ➢ The overall zooplankton food base for important forage fish such as bay anchovy, menhaden, Atlantic silversides, and immature stages of other resident species is declining and shifting to smaller sizes.

- The Zooplankton Index of Biotic Integrity (IBI) changed from Fair in the late 1980's to Poor in 1999-2002. The IBI combines multiple indicators of zooplankton community health, such as total abundance and taxonomic composition, into a single index that can be scored.
  - ➢ The zooplankton component of the Bay's food web is not healthy and its condition is worsening.

Linkages to water quality and predators

- Zooplankton status and trends are not related in a straightforward way to a single factor such as phytoplankton food quantity, or fish or jellyfish predator abundance, although the Bay mainstem declines parallel declines in water clarity.

- The 1999-2002 drought did not reverse the downward mesozooplankton trends in the mainstem. It may have reinforced the improving mesozooplankton trends at some tidal fresh stations.
  - ➢ Changes in freshwater flows are apparently not the primary cause of the trends. Possible effects of climate-related temperature changes cannot be explored because winter zooplankton monitoring data is lacking.

- Microzooplankton are closely correlated with total phytoplankton food biomass (expressed as chlorophyll *a*) while mesozooplankton are more closely correlated with specific phytoplankton groups such as diatoms.

Types of Zooplankton

Megazooplankton (20 cm - 2 m)
- cnidarian "true" jellyfish

Macrozooplankton (20 mm - 20 cm)
- ctenophore "comb" jellyfish
- shrimp
- amphipods
- euphausiids
- larval fish

Mesozooplankton (0.2 - 20 mm)
- copepods
- cladocerans
- benthic invertebrate larvae, or meroplankton

Microzooplankton (20 um - 0.2 mm)
- rotifers
- protozoans, such as ciliates
- copepod nauplii

➢ Phytoplankton food quality, which is influenced by water quality, appears to be an important factor affecting mesozooplankton. High phytoplankton biomass does not necessary produce high mesozooplankton abundances.

➢ Rotifer and ciliate microzooplankton are increasing in areas experiencing more frequent algal blooms.

- Ctenophore "comb" jellyfish, which are significant predators on mesozooplankton and fish larvae, have gradually increased in the middle Bay while populations of the forage fish species that eat zooplankton have been declining. Saltier conditions during the 1999-2002 drought period did not reverse these trends.

  ➢ The combined effect of increasing ctenophore and decreasing forage fish may have resulted in no significant change in overall predation pressure on mesozooplankton in the last two decades.

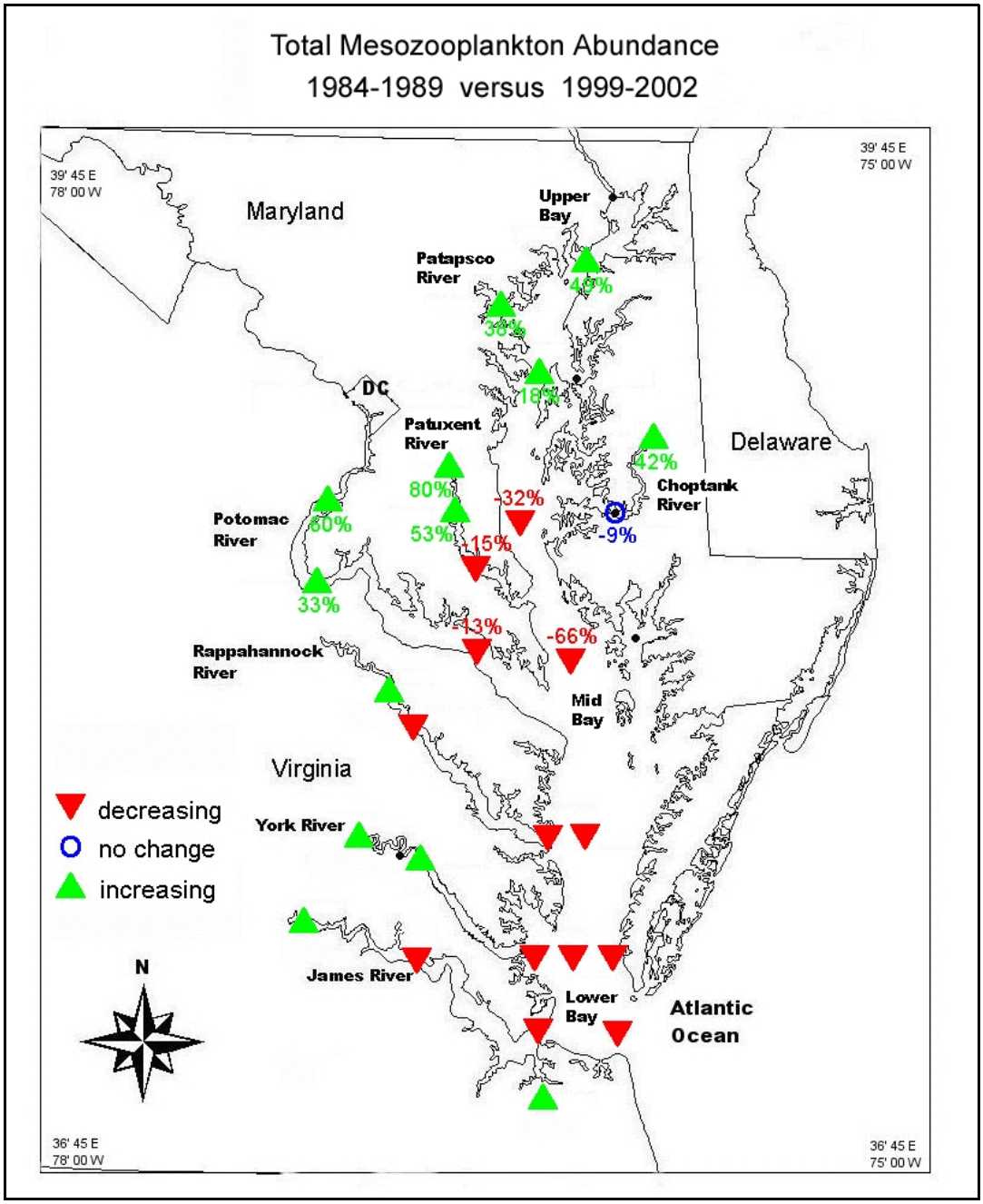
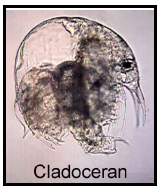


Figure. Comparison of mean (geometric) mesozooplankton abundances at the beginning (1984 - 1989) and end (1999 - 2002) of the previous CBP zooplankton monitoring program in Chesapeake Bay and its tidal tributaries. Declines occurred at almost all stations in the middle and lower Bay mainstem and lower tributary reaches (mesohaline and polyhaline waters), while increases occurred at all stations in the upper Bay and upper tributary reaches (tidal fresh and oligohaline waters). This pattern was becoming apparent as early as 1997, and the trends have persisted across wet and dry periods. Note: Changes in Virginia laboratory methodology during the monitoring program preclude calculation of absolute % change, but allow determination of a general trend.



Contact Mike Fritz, Living Resources Subcommittee (LRSC) Coordinator (fritz.mike@epamail.epa.gov) or Claire Buchanan, Co-Chair of the LRSC Monitoring and Modeling Workgroup (cbuchan@icprb.org) for further information.