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7. Summary of Conditions

Conducting an environmental assessment of estuaries is far from a precise exercise. In a large part, this reflects the complexity of estuarine processes and the experimental nature of the assessment procedure itself. As we have tried to emphasize, no assessment indicator is perfect. And the "snap-shot" nature of the MAIA sampling strategy limits the interpretation of some results. Still, valuable insights are available from an unbiased, concurrent view of conditions in neighboring but diverse estuaries.

In past chapters, we have used a variety of methods to summarize estuarine conditions. Maps offer a visual comparison, and associated charts provide quantitative estimates of the extent of impairment and distribution. Also, summaries based on a "preponderance of evidence" (Figures 4-13 and 5-7) provide appraisals that compensate in part for the limitations of individual indicators.

In this chapter, we offer an additional summary of overall conditions: a report card based on the extent of environmental impairment. Finally, we review how conditions in the mid-Atlantic estuaries have changed since the 1990-1993 EMAP study was conducted in the region.

Environmental Report Card

Figure 7-1 is an environmental report card for the mid-Atlantic estuaries based upon the percentage of estuarine area showing impaired conditions. The criteria for impairment are listed near the bottom of the report card (and are the same thresholds used throughout the report). A red-yellow-green color scheme is used to indicate conditions for those indicators with well-established criteria for impairment. Neutral colors are employed to designate conditions in cases for which the assessment criteria are still under evaluation (i.e., for total nitrogen, total phosphorus, and total organic carbon in sediments).

In the report card, conditions are considered to be good (or better) if less than 20% of the estuarine area exhibits impairment, colored green or blue. Yellow indicates that 20 to 40% of the estuarine area is impaired, and red and orange are used to designate poorer conditions in which more than 40% of the estuarine area fails the indicated impairment guidelines. A version of this report card complete with estimates of impaired areas is included in Appendix H.

A glance at the report card reveals that high-nutrient conditions are prevalent in the Delaware Estuary tributaries, in several Chesapeake Bay tributaries, as well as in the coastal bays. Carbon-rich sediments are common in the Delaware Estuary and the APES. Chlorophyll *a* concentrations (a sign of excessive algal biomass) and poor water clarity are common in most estuaries. Depleted levels of DO are largely restricted to the mainstem and adjacent sections of the Chesapeake Bay tributaries. In short, ample signs of eutrophication are evident throughout the mid-Atlantic region.

The report card further indicates that contamination of sediments by metals and organic toxicants is commonplace throughout the region, except for the Delaware Bay and parts of the coastal bays. Metals exceed the impairment criteria more often than organics. There is little indication of sediment toxicity (as measured by the amphipod survival assay).

The benthic community index, a measure of the diversity and health of the estuarine sediment community, indicates that nearly all of the region exhibits moderate to extensive impairment. In

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* Intensively-sampled systems

Better conditions

Worse conditions

Less than 20% of estuarine area exhibits high values or impairment
20% to 40% of area exhibits high values or impairment
More than 40% of area exhibits high values or impairment

Note regarding color schemes: The thresholds used to define assessment categories for TN, TP, and TOC are developmental and are under evaluation. Neutral colors are used to characterize these indicators, and interpretation as "high" or "low" may be more appropriate than "good" or "poor". Categories for other indicators are based on established criteria and may be interpreted as "impaired" or "unimpaired".

Figure 7-1. Environmental Report Card for mid-Atlantic estuaries based on the percentage of estuarine area that exceeds the designated impairment threshold. Warm colors (red or orange) indicate a greater incidence of impaired conditions or excessively high concentrations of a substance.

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some estuaries, e.g., the Schuylkill, Patuxent, Potomac, South, and Severn Rivers, the low index rating coincides with extensive signs of eutrophication and sediment contamination. However, low ratings are also evident for estuaries with low or moderate levels of degradation, e.g., York River, St. Jerome Creek, and Cherrystone Inlet.

Change in Conditions: 1990-93 to 1997

The EMAP conducted an environmental assessment of estuaries along parts of the Atlantic seaboard during the summers of 1990-93. We may, therefore, look for changes that occurred over time at locations included in both programs and for parameters measured by comparable methods.

The EMAP-VP and MAIA-E programs overlapped only in parts of the Chesapeake Bay and the Delaware Estuary. Estuaries in common included the Delaware River and the Delaware Bay in the Delaware Estuary, and the Chesapeake mainstem, and the Potomac, Rappahannock, and James Rivers in the Chesapeake Bay. Analyses performed by comparable methods in both studies included DO in bottom water, exceedance of ERM limits in sediments for metals and organic toxicants, sediment toxicity (amphipod survival), and benthic community condition (benthic index).

Both programs used the same probability-based sampling strategy and weighted the results in proportion to the area represented by the station. This permits the appraisals of the condition to be expressed with estimates of reliability (95% confidence intervals). Only changes greater than the combined uncertainties were considered to be statistically robust.

Figure 7-2 illustrates the changes that occurred from 1990-93 to 1997. There was considerable degradation of the Delaware River sediments by organic contaminants over this time period. More than a third of the estuarine area was contaminated in 1997, a large increase above the 1990-93 estimate. One possible explanation that bears further examination postulates that these findings reflect the dispersal of highly-contaminated sediments throughout a larger fraction of the river over time.

Similarly, a larger portion of sediments in the Chesapeake Bay (particularly the mainstem and Potomac River) showed increased metal contamination in the sediments.

The condition of the benthic community in the Chesapeake Bay worsened, as is indicated by the benthic community index. A moderately greater percentage of the Bay showed diminished diversity in the composition of the community.

Sediment toxicity, as measured by the amphipod survival assay, decreased slightly in the Chesapeake Bay overall and in the Chesapeake mainstem.

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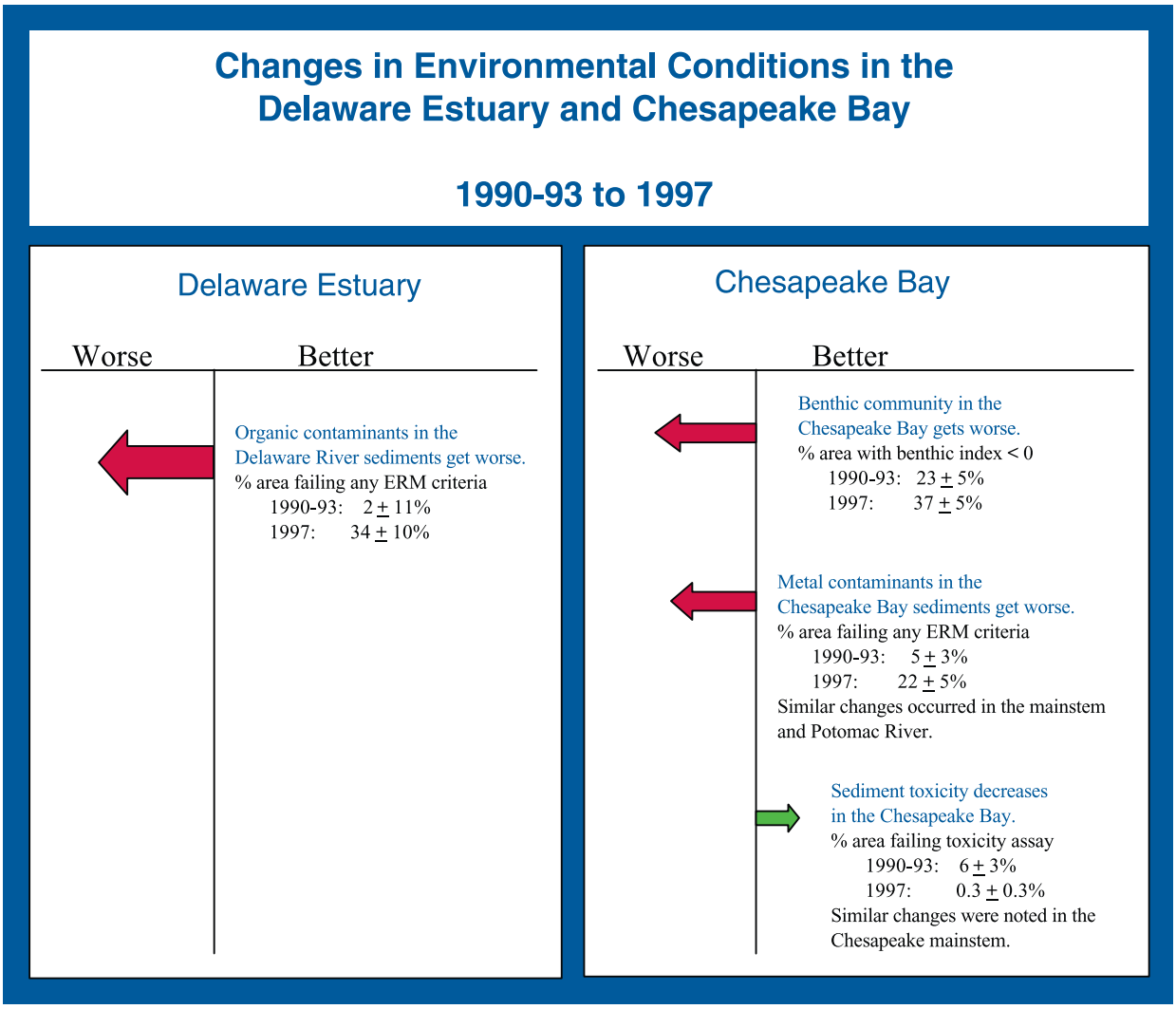

Figure 7-2. Changes in Environmental Conditions: 1990-93 to 1997. Arrows show changes in environmental conditions evident between the 1990-93 EMAP and 1997 MAIA studies. Comparisons are performed for locations and parameters common to both studies. Values reported are the percent of the estuarine areas displaying degraded condition ± 95% confidence intervals.

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