1. Executive Summary

Welcome to the Summary Report on the Mid-Atlantic Integrated Assessment Estuaries (MAIA-E). In this report we present a summation of data collected in the environmental assessment of mid-Atlantic estuaries conducted during the summers of 1997-98. Over a dozen state and federal environmental organizations participated in the assessment and in the preparation of this report. We hope this collaboration has helped produce a summary that is relevant and useful.

The main objective of this report is to present environmental data measured in the MAIA-E program. We focus on several issues of widespread interest: How prevalent is eutrophication in mid-Atlantic estuaries? How contaminated are the sediments? Are estuarine communities in the sediments and water column disrupted by human practices? Are the fish and shellfish we eat contaminated?

The summary was written with three distinct audiences in mind: (1) environmental managers who are responsible for identifying and fixing problems in estuaries; (2) concerned citizens who are curious how estuaries operate and are concerned how "their" estuary compares with neighboring systems; and (3) researchers who wish to know what type of data are available from the MAIA program. Thus, a second objective of the report is to present the MAIA assessment information in a manner useful to all readers.

The mid-Atlantic estuaries fall naturally into four geographical regions: the Delaware Estuary; the Chesapeake Bay; the coastal bays in Maryland and Virginia; and the Albemarle-Pamlico Estuarine System (APES). In addition, twelve smaller estuaries were monitored more intensively to focus attention on a local scale. Following are the main conclusions regarding the environmental conditions in the mid-Atlantic estuaries.

Eutrophication

There are ample signs of eutrophication in the mid-Atlantic estuaries. In the region overall, about 15-20% of estuarine area is affected by high concentrations of nutrients, organic-rich sediments, and oxygen-depleted waters. A third of the estuarine area shows elevated concentrations of chlorophyll *a*, and water visibility is less than arm's length in half of the estuaries. These symptoms of eutrophication vary widely among estuaries.

In the Delaware Estuary, the urban Delaware, Schuylkill, and Salem Rivers have high levels of nutrients that are two to three times greater than elsewhere in the mid-Atlantic region. High levels of chlorophyll *a* are evident in parts of the Delaware and Salem Rivers. But the pigment is generally low in Schuylkill River and much of Delaware Bay, perhaps because of limited light availability. Oxygen depletion is not a major issue in the Delaware Estuary.

In Chesapeake Bay, nutrient concentrations are high in the Patuxent, Potomac, Severn, and South Rivers. Most estuaries in Chesapeake Bay show elevated levels of chlorophyll *a*, an indication of extensive algal blooms. Chesapeake Bay also displays the highest incidence of oxygen depletion in the mid-Atlantic region — over half of the area in the mainstem and Severn, South, and Patuxent Rivers report oxygen values below 5 mg/L (in many places, below 2 mg/L).

Other eutrophication "hot spots" include Sinepuxent Bay and parts of the Neuse River, where elevated levels of nutrients and organic matter are evident. The coastal bays are nutrient-rich and especially turbid, but signs of organic enrichment are generally absent. Otherwise, estuarine systems with easy access to the sea, e.g., Delaware Bay, the lower Chesapeake mainstem,

and open parts of Albemarle-Pamlico Sounds, are relatively less affected by the symptoms of eutrophication.

Sediment Contamination

Most of the mid-Atlantic estuaries have sediments that are contaminated with metals and toxic organic compounds. In the MAIA region overall, 30 to 40% of estuarine area exceeds effects range-low (ERL) or effects range-median (ERM) limits (ecologically-based guidelines) for metals and organic toxicants.

The Delaware, Schuylkill, and Salem Rivers, the upper Chesapeake mainstem, and the Severn and South Rivers are especially polluted by metals. Arsenic, nickel, mercury and zinc are the metals most often exceeding ERL or ERM limits. Mercury contamination is evident in Chowan River and other parts of the APES.

Harmful concentrations of polycyclic aromatic hydrocarbons (PAHs), pesticides, DDT, and polychlorinated biphenyls (PCBs) are present in regions of the Delaware and Schuylkill Rivers, the upper Chesapeake mainstem, and the Severn and South Rivers. The organic toxicants are less pervasive than metals throughout the region.

Only 1% of the region's sediments are characterized as toxic, based on the survivability of sediment organisms exposed to the sediments. Toxicity is noted in the heavily contaminated Delaware and Schuylkill Rivers, and in the moderately polluted Chowan River. Other highly contaminated systems, such as the Severn and South Rivers are not characterized as toxic by this test.

Condition of the Living Resources

The MAIA program places particular emphasis on the condition of communities in the water and sediments — the living resources. A "benthic community index", based on the diversity of organisms and abundance of pollution tolerant organisms in sediments, is used to evaluate the condition of estuaries. The index rated as "poor" several of the estuaries that also show extensive signs of eutrophication and sediment contamination, including Schuylkill, Severn, South, and Potomac Rivers. But the list also includes estuaries which show low or moderate environmental degradation.

Over 3000 fish from 76 sites were examined for signs of pathology. Only five abnormalities are noted. However, when the edible portions of fish and shellfish from the same sites were analyzed for concentrations of metals and organic toxicants, 65% of the tests revealed levels large enough to present risk to human consumers. Arsenic and PCBs were the only toxicants found in harmful amounts.

Changes Over Time

The Environmental Monitoring and Assessment Program (EMAP) conducted a similar environmental study in the Virginian Province (VP) in the summers of 1990-93. This study region included part of the region surveyed by the MAIA program in 1997-98. For estuaries assessed in both the EMAP and MAIA studies, it is therefore possible to look for changes that occurred between 1990-93 and 1997-98. In most cases, the uncertainty in the respective measurements is too large to permit drawing clear conclusions. However, the following conclusive changes are evident:

Organic contamination in the Delaware River sediments worsened. The percentage of estuarine area failing any organic ERM criteria increased from 2 ± 11% in 1990-93 to 34 ± 10% in 1997. It is not certain whether this increase represents recent contamination or the dispersal of prior contamination over additional area.

Metal contamination in the Chesapeake Bay sediments worsened. The percentage of estuarine area failing any ERM criteria increased from 5 ± 3% in 1990-93 to 22 ± 5% in 1997. Similar changes occurred in the Chesapeake mainstem and Potomac River.

The benthic community in the Chesapeake Bay sediments showed increased degradation. The percentage of estuarine area with a benthic index < 0 (an indication of degradation) increased from 23 ± 5% in 1990-93 to 37 ± 5% in 1997.

Sediment toxicity diminished slightly in the Chesapeake Bay. The percentage of estuarine area failing the amphipod survival assay decreased from 6 ± 3% in 1990-93 to 0.3 ± 0.3% in 1997. Similar changes are noted in the Chesapeake mainstem.