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Agency

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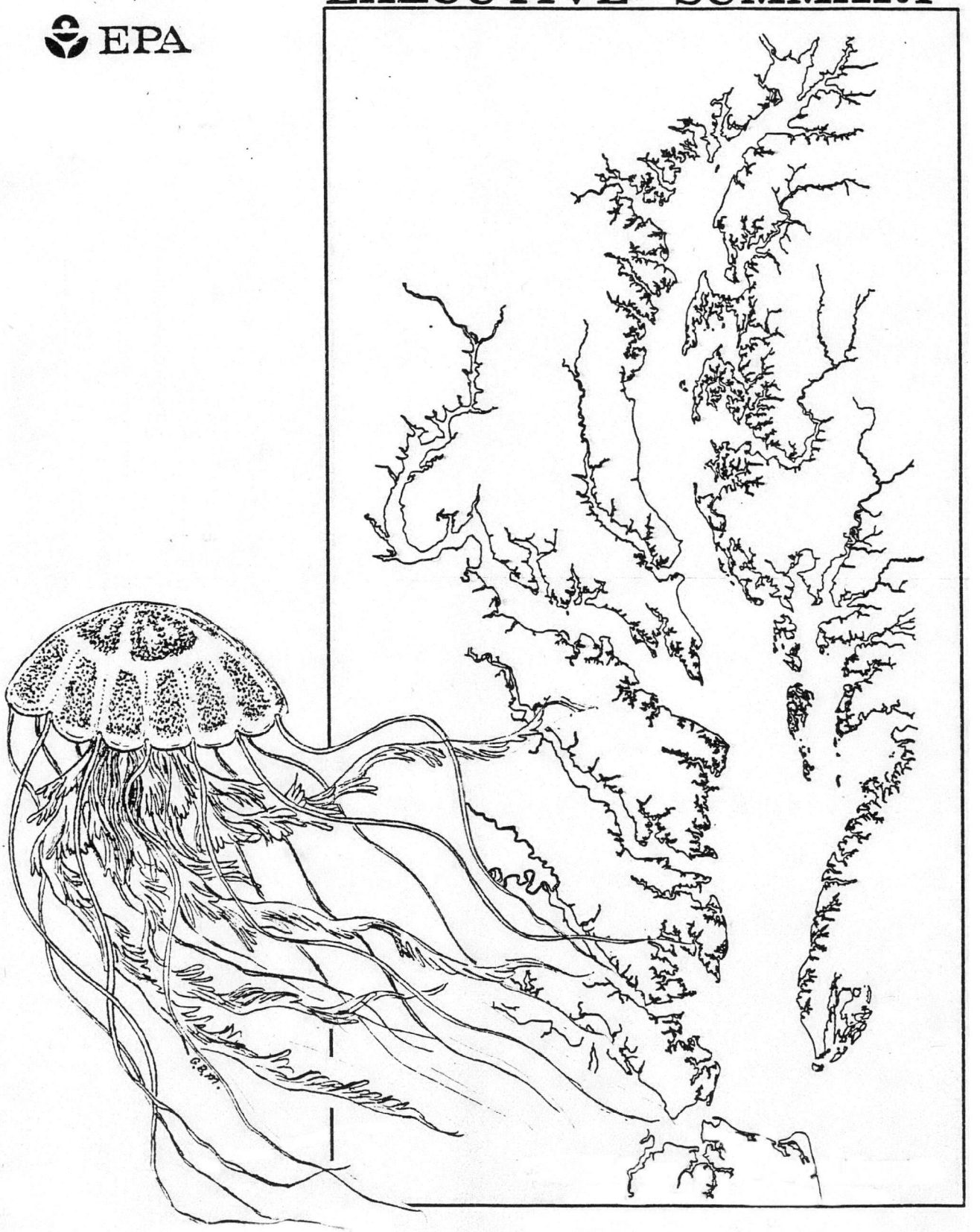
CHESAPEAKE BAY PROGRAM: EXECUTIVE SUMMARY

EPA



FOREWORD

In July of 1975, the Senate Committee on Appropriations directed the Environmental Protection Agency (EPA) to conduct an in-depth study of Chesapeake Bay and complete the following tasks:

- Assess the principal factors having an adverse impact on the environmental quality of Chesapeake Bay.
- Analyze all environmental sampling data presently being collected on Chesapeake Bay.
- Establish a continuing capability for collecting, storing, analyzing, and disseminating such data.
- Institute a sampling program.
- Determine what units of government have management responsibility for the environmental quality of Chesapeake Bay.
- Review ways to improve existing Chesapeake Bay management mechanisms and new alternatives.

This summary highlights the technical findings, describes related benefits, and explains how the information will be used. The last task is addressed in the management study which will be transmitted under separate cover.

The reports attached to this summary are:

- Chesapeake Bay: Introduction to an Ecosystem--explains important ecological relationships.
- A Summary of Chesapeake Bay Program Technical Studies: A Synthesis--summarizes and explains the technical knowledge gained from the research projects funded by this Program in the areas of nutrient enrichment, toxic substances, and submerged aquatic vegetation.
- Chesapeake Bay Program: Technical Project Summaries--announces the availability of technical research projects from the National Technical Information Service and presents summaries of each.

During the next phase of the program, EPA Region III will expand on the original tasks. EPA will relate the scientific findings on water quality in the Chesapeake Bay to shifts in living resources in the Bay in an attempt to characterize the past and present state of the Bay. These relationships will be presented in Chesapeake Bay Program: A Profile of Environmental Change. EPA will also identify potential control alternatives for point and non-point sources of pollutants and begin to examine management structures or systems which could most effectively implement recommendations.

TECHNICAL FINDINGS

Research conducted on the Bay through EPA Chesapeake Bay Program (CBP) grants was designed to increase our knowledge in three priority problem areas: nutrient enrichment, toxic chemicals, and declining submerged aquatic vegetation (SAV). These areas were selected in October 1977 by representatives from Virginia, Maryland, EPA, the Bay scientific community, and citizen/user groups. This group identified ten major areas of environmental quality concern for the Bay, and in subsequent meetings established the three priority areas. Work plans were designed and implemented by EPA through grants to Bay research insititutions. Technical guidance was provided from this point to grant completion by teams of scientists who monitored progress to assure that the research was on target.

A Program Management System was designed to show the milestones and timelines necessary to relate the basic research products to the final program products. The plan, used in conjunction with the Project Tracking System, enabled EPA Region III managers to both maintain a perspective of the relationships of each grant to the end products and, at the same time, monitor progress of each grant and contract.

NUTRIENT ENRICHMENT

Nutrient enrichment has changed the Bay's water quality. Over the past 20 years, certain areas have become nutrient enriched showing algal blooms and containing low levels of oxygen and light. These effects vary in their intensity and are controlled by season, the movement of nutrients in the estuary, and the chemical form in which they appear. An objective of the Program was to identify and understand the sources of nutrient enrichment and nutrient processes to help the States and EPA better manage water quality and resources.

Key findings to date include:

- The upper Bay, mid Bay, and several major western and eastern shore tributaries are either severely or moderately nutrient enriched compared to historic trends.
- Nonpoint sources, predominantly agricultural cropland, are a major significant source for nutrient enrichment, particularly nitrogen (N).
- Point sources are the major source of phosphorus (P) for severely enriched areas.
- Major rivers such as the James, Potomac, and Susquehanna are important contributors of nutrients, metals, and toxic compounds.
- The lower Bay has remained relatively unaffected by nutrient enrichment.

- Organic material, such as algae, can accumulate in the water column, causing decreased transparency, and decreased levels of dissolved oxygen. Decreased transparency can inhibit photosynthesis by plants and sight feeding by fish. Decreased levels of dissolved oxygen can cause some living organisms to suffocate.
- Both nitrogen and phosphorus enter the Bay from the atmosphere, fluvial or nonpoint sources, point sources, sediments, and the ocean.

TOXIC SUBSTANCES

Toxic substances constitute the second of three critical areas studied under the CBP. Most of the research focused on determining the status of both metals and organic compounds in Chesapeake Bay. Investigators looked at the concentrations of these substances primarily in bed sediments, suspended sediments, and some bivalves, such as oysters. Sources of metals and organic compounds were also investigated. A limited amount of research was performed on assessing the toxicity of metals and organic compounds.

Toxic substances are usually defined as chemicals that can harm plants and animals, including humans, or impair physical or chemical processes. The two classes of toxic substances are inorganic and organic compounds. Inorganic materials are metals such as arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), and zinc (Zn). Many of the organic compounds are a product of human activities. The main classes are pesticides, phthalate esters, polynuclear aromatic hydrocarbons (PNA's), and other chlorinated hydrocarbon compounds (DDT, Kepone and industrial PCB).

Key findings to date include:

- The highest concentrations of metals in bed sediments are in Baltimore Harbor and the Elizabeth River.
- In the Bay, the highest metal concentrations in sediment occur in the northern Bay, particularly on the western shore. Analysis also showed that at least half of the metal loads for Cr, Cd, Cu, and lead (Pb) come from human sources.
- The northern Bay shows high concentrations of metals in suspended material. The suspended sediments in near-surface water in the central Bay are enriched in metals.
- Concentrations of organic compounds are highest in the northern Bay with a concentration maximum occurring in the vicinity of Baltimore Harbor and the Susquehanna River mouth. They tend to increase up the Bay from the Potomac River mouth toward Baltimore Harbor. North of Baltimore the concentration, although still significant, decreases somewhat, but then increases to another maximum concentration level at the Susquehanna River mouth.

- In the southern Bay, the highest concentrations of organic compounds are found at the river mouths. These concentrations are higher in the Patapsco and Elizabeth Rivers than in the main Bay.
- Atmospheric, riverine, and point sources contribute most of the potentially toxic metals to Chesapeake Bay. There is also a very substantial contribution of trace metals from the sediment to water column. Contributions from three major rivers (Susquehanna, James, and Potomac at the fall line) account for over 40 percent of the load for Cr, Pb, Cu, Zn, and Fe. These river loads include municipal, nonpoint, and industrial sources above the fall lines.
- The Susquehanna River contributes a greater proportion of total metals than the Potomac or the James, but the concentration levels are about the same. The Susquehanna River load is higher because of greater total flow. The Susquehanna is most significant because the loads at its mouth directly enter the Bay, and are not trapped in the sub-estuary like the James and Potomac.
- Industrial and municipal inputs below the fall line are major contributors of metals to the Bay.
- Sources of organic compounds to the Bay are human-related. In particular, organic compounds in northern-Bay sediments come from the Susquehanna River, and possibly from the Patapsco River.
- Toxic chemical concentrations that cause mortality in aquatic life were found in the Bay.
- The highest mortalities occur in samples from the upper reach of the Patapsco and Elizabeth Rivers, and the northern Bay. From these sediment toxicity studies, EPA feels the Bay north of Baltimore is enriched in excess of naturally occurring levels.

SUBMERGED AQUATIC VEGETATION

Submerged aquatic vegetation (SAV) has, in the past, been very abundant throughout Chesapeake Bay. Current evidence indicates a pattern of SAV decline that includes <u>all</u> species in virtually <u>all</u> sections of the Bay. A marked decline has occurred throughout the estuary since the mid-1960's. Present abundance of Bay grasses is at its lowest level in recorded history.

The Bay grasses are of vital importance to the Bay because of their value as high primary producers, a food source for waterfowl, a habitat and nursery area for many forage fish and juvenile blue crabs, a control for shoreline erosion, and a mechanism to buffer negative impacts from excess nutrients.

Key findings to date include:

- Present abundance of Bay grasses is at its lowest level in recorded history.
- SAV declines are highly correlated with changing water-quality conditions, such as decreasing water clarity resulting from increased nutrient enrichment or higher loads of suspended sediments from dredging or land runoff.
- Sediment composition and light availability are the important factors controlling the distribution of SAV within regions of the Bay.
- The decline of SAV parallels historical increases in nutrients and chlorophyll a concentrations in the upper Bay and major tributaries.
- Herbicides are generally not available to SAV in toxic levels, and their presence alone probably did not cause the SAV decline. However, herbicide-induced impacts could, in concert with the other major stresses (such as from light limitation), create intolerable conditions for SAV existence.

RELATED BENEFITS

The EPA funded research on Chesapeake Bay has produced several benefits which were not anticipated at the time. They include the establishment of an approach to water quality and resource management, and an unparalleled data base and statistical analytical capabilities.

The management approach has been a committee with representatives from Maryland, Virginia, and Pennsylvania, the Citizens Program for the Chesapeake Bay (CPCB), and the scientific/technical community. The Committee has met monthly since the beginning of the Program and is characterized by an atmosphere which encourages an open exchange of views and positions.

A second major benefit is the development of an unparalleled data base. EPA researchers realized immediately that the only way to understand a system as complex as the Bay was to develop a computer-based data management system. The system designed in 1978 and presently in operation is the largest refined data base on water quality and resources for a single estuary known to exist anywhere.

Chesapeake Bay Program scientists first developed an initial inventory of data bases relevant to the priority program areas. Next, scientists from major research institutions and universities in the Bay area were asked to identify data and research not on the CBP inventory, and to recommend an optimum data baseline. After the data were identified as priority data, they were catalogued by subject (water quality variable), location on the Bay, and time of year the observation was made. This information was placed on a grid to help CBP scientists and managers identify both data concentrations and data voids.

Datasets that were identified by CBP staff Bay researchers as having sufficient size to warrant inclusion were obtained and put on-line on the CBP computer network. After intensive quality assurance evaluation, the datasets were analyzed to establish, where possible, trends and past and present conditions.

The data base creation and more importantly, its use by scientists and planners alike, is an outstanding achievement not only for the Bay community, but for scientists, managers, and interested public anywhere who are concerned about relationships between estuarine system use, and water quality and resources.

TRANSFER OF TECHNICAL FINDINGS

CONTROL STRATEGIES

The CBP effort to determine the condition of the Bay indicates that the northern Bay, Potomac and James Rivers, and the upper western tributaries in general are enriched with nutrients and are sites of current problems; the mid Bay and eastern shore are less enriched but could become problem areas in the future. Baltimore Harbor and the Elizabeth River are enriched in excess of naturally occurring levels with toxic compounds and the upper Bay has relatively high levels of organic materials and metals. In light of these findings, the Management Study is exploring area alternative control strategies to reduce pollutant loading to these areas. These strategies include both point and nonpoint control options.

Nutrient control options include a range of effluent phosphorus and nitrogen limits on sewage treatment plants, a phosphorus detergent ban, and agricultural nonpoint source control practices such as minimum tillage, strip contouring, etc. Watershed model runs indicate that the effectiveness of a given control practice varies from area to area. For example, nutrient point source controls are most effective in the James and Patuxent Rivers whereas nonpoint controls have the greatest impact in the Susquehanna River Basin. Therefore, the CBP management study emphasizes:

- Nonpoint source control strategies to alleviate the upper Bay problem, and
- point source control strategies to alleviate the nutrient enrichment problem in the James and Patuxent Rivers.

Toxic control options include more stringent effluent control on industry and urban runoff controls. In both Baltimore Harbor and Elizabeth River, industries are making a concerted effort to reduce effluent concentrations and communities are working to reduce urban runoff. Research has shown that these areas are fairly efficient traps for toxic compounds. However, modeling efforts also indicate that certain metals such as cadmium appear to remain in a soluble form and migrate out of the harbors. In light of these findings, the management study emphasizes careful dredge disposal practices and greater efforts to control specific problem compounds.

To assess the social, political, and economic feasibility of alternative management strategies, the CBP relied on advice from several groups including the Citizens Program for the Chesapeake Bay and its Resource Users Team, State Water Quality Managers Teams, the Bi-State Working Committee, and the Chesapeake Bay Legislative Commission.

Last, appropriate management of a system as complex as the Bay requires careful monitoring. The characterization effort has defined existing and potential problem areas that should be carefully watched. Modeling efforts have identified existing and future sources of pollutant loading and their potential impact. Given this information, the CBP will propose a monitoring strategy that will provide an ongoing evaluation of pollutant sources, transport, fate, and effects.

FUTURE MANAGEMENT

The findings of the technical studies underscore the fact that the Bay is not only composed of unique areas, it is also an ecosystem that ignores State boundaries. Actions in any part of the watershed of the Chesapeake Bay may result in water quality degradation and impacts on aquatic resources downstream and in the Bay itself. Effective management of Chesapeake Bay must be based on an understanding of the entire Bay ecosystem.

The findings also imply that both the States and the Federal government need to exert additional control over point and nonpoint sources of nutrients and toxic substances. Both must continue to coordinate their activities to assure that the control options posed by the Bay characterization effort, and supported by the model production runs, will be given adequate public and technical exposure. There is a clear need for some management system to maintain the interstate perspective and to ensure that Federal, State, and private strategies are coordinated. EPA Region III remains committed to assisting in this task to the extent that funds and personnel restrictions allow.