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Edited by

Bruce J. Neilson

Virginia Institute of Marine Science
and

L. Eugene Cronin

Chesapeake Research Consortium

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PREFACE

Estuaries are eternally enriched. Their positions at the foot of watersheds and their convenience as receiving bodies for the wastes of cities, towns and farms results in continuous addition of nutrients - those elements and compounds which are essential for organic production. Such materials must be added to these complex bodies of water to sustain production, since there is a net loss of water and its contents to the oceans. Enrichment from land and the ocean and the subsequent cycling of the original chemicals or their derivatives contribute to the extraordinarily high values of estuaries for human purposes. Many estuaries are able to assimilate large quantities of nutrients despite the great fluctuations which occur with variations in the flow from tributaries. The nutrients can be stored, incorporated in standing crops of plants, released, cycled and exported - and the system frequently achieves high production of plants and animals without creation of any undesirable results of enrichment.

Excessive enrichment with the same elements and compounds can, however, be highly detrimental to estuaries and their uses. Coastal cities are usually located on the estuaries which provided a harbor for them - and which now receive partially treated sewage and other wastes from the expanding population and industrial activity. Conversion of woodlands to agricultural use and the extensive application of fertilizers have resulted in the flow of large quantities of nutrients down the hill or slopes and eventually into the estuary.

The results of excessive enrichment can be dramatic and serious. As phytoplankton populations increase, they can change qualitatively so that a rich system feeding many components in the food web becomes a jungle, with massive production of species of little value in the energy systems.

Recognition that nutrient loading into the Chesapeake Bay system had been and was the source of serious and extensive damage to parts of the estuary - and that the resident population is projected to double within a few decades - resulted in the identification of excessive enrichment as one of the three areas of principal attention in the 5-year Chesapeake Bay Program conducted by the U.S. Environmental Protection Agency in cooperation with the State of Maryland and the Commonwealths of Pennsylvania and Virginia. Under a grant to the Chesapeake Research Consortium, Inc., to develop the background for our present state of knowledge about enrichment of estuaries, an **International Symposium on the Effects of Nutrient Enrichment in Estuaries** was convened at Williamsburg, Virginia on May 29-31 of 1979. Forty-four papers were presented and discussed. Of these, thirty-three survived the rigors of review and editing, and the demands on the time of the authors, and are presented in this volume.

Papers are arranged in four sets. *Invited Review Papers* were solicited from recognized experts in various aspects of estuarine enrichment to provide the overview and summary so necessary for the education of all scientists and managers concerned with nutrient questions. The series is presented as it was at the Symposium, with broad background papers followed by reviews in specific areas. Six *Case Studies* are reported to illustrate problems and experiences in several parts of the world. *Contributed Papers* included a variety of reports on recent research, with a group of four papers derived from an interesting cooperative approach to a single estuarine area.

We hope that these papers will be of value. That value may appear in many forms - in improved management in the Chesapeake Bay area and in other estuaries, in stimulation of further advance in comprehension of estuaries and the questions of adequate and excessive enrichment, in guidance for the expenditure of sufficient funds for prevention of serious problems without wastage because of ignorance, and in improved knowledge among managers, scientists and citizens concerned with achievement and maintenance of the wisest balances in our environment.

We are pleased to acknowledge many essential contributions to this volume. The authors are the most important source, followed closely by the Chesapeake Bay Program of EPA for its financial support through Grant R 806 189010 and for professional support of the effort. The Planning Committee - L. Eugene Cronin, Donald R. Heinle, Andrew J. McErlean, Bruce J. Neilson and Thomas H. Pfeiffer - labored productively in planning and arranging the Symposium and in assuring excellent peer review and quality control without intended injury to the freedom of the authors. Peers from many fields of science and management provided constructive review and comments on manuscripts.

Mr. Eric Rellihan worked hard and well as manager of the Symposium. Ms. Maxine Smith has been highly conscientious in preparing camera-ready copy. Ms. Linda Kilch provided intelligent assistance in preparing a Symposium brochure, advertisements of the Symposium and other useful materials. Wright Robinson performed the tedious and difficult tasks of preparing the Index. Finally, Humana Press has been most patient and courteous during completion of our material.

To these and to all of the others who participated in the Symposium, we express our sincere appreciation.

Bruce J. Neilson

L. Eugene Cronin