



RESEARCH ON CHESAPEAKE BAY
AND
CONTIGUOUS WATERS OF THE
CHESAPEAKE BIGHT
OF THE
VIRGINIAN SEA

AT THE
VIRGINIA INSTITUTE OF MARINE SCIENCE
GLOUCESTER POINT, VIRGINIA
AND
WACHAPREAGUE, VIRGINIA

by
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STAFF AND PROJECTS RELATED TO THE
ENVIRONMENTS AND RESOURCES OF
THE CHESAPEAKE BAY
AND
ADJACENT WATERS OF THE CONTINENTAL SHELF

These brief status reports are provided to assist those who wish to know the scope and nature of VIMS' programs pertinent to the Chesapeake Bay and contiguous waters of the Continental Shelf. More detailed information may be obtained from the unit or principal investigator involved. Basic elements in the report were provided, of course, by the program coordinator or the chief investigator.

Status statements are intentionally short and sometimes contain information which has not been published or, in some cases, not even reported upon. Accordingly, care must be taken in quoting the materials.

These programs and projects represent that part of the research program or "research matrix" in which there is current activity. Other programs and projects to complete the matrix remain to be funded or planned.

This reporting of research in progress has been undertaken in concert with the other members of the Chesapeake Bay Research Council -- the Chesapeake Biological Laboratory of the University of Maryland and the Chesapeake Bay Institute of The Johns Hopkins University. Though there is some dissimilarity of format between the reports of the several

institutions, these differences will diminish in the second generation of reports. In the meantime, we have chosen to make the reports available rather than to delay further until uniformity could be attained.

Some purposes of these reports, which will be issued from time to time as warranted, are (a) to inform ourselves and others, especially planning and management agencies, of our research programs, (b) to facilitate better coordination of research, and (c) to facilitate research planning on Chesapeake Bay.

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Robert J. Huggett, M.S., Assistant Marine Scientist
H. D. Slone, M.S., Assistant Marine Scientist
Jimmy R. Green, Laboratory Specialist
Miles W. Booth, Laboratory Technician
James O. Towell, Jr., Laboratory Technician
Donald M. Axelrad, M.S., Graduate Student
Thomas Barnard, Jr., B.S., Graduate Assistant
Donald F. Boesch, B.S., Graduate Assistant
Thomas D. Cain, B.S., Graduate Assistant
Robert Diaz, B.S., Graduate Assistant
David Dressel, B.S., Graduate Student
Thomas K. Duncan, B.A., Graduate Student
Irving Mendelssohn, B.S., Graduate Assistant
Kenneth Moore, B.S., Graduate Assistant
Robert J. Orth, B.S., Graduate Assistant
Richard Peddicord, B.S., Graduate Assistant
Edward J. Tennyson, M.S., Graduate Assistant
Phillip Witherington, M.S., Graduate Student

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: IMPROVED MANAGEMENT AND UTILIZATION OF
ESTUARINE RESOURCES

INVESTIGATORS:

John L. Wood, Associate Director
William J. Hargis, Jr., Institute Director

PROJECT SUMMARY:

Projects for support in 1970-71 include:

- (1) Administer the program.
 - (a) Improve coordination with other VIMS programs.
 - (b) Get better understanding of resources and interacting uses.
 - (c) Continue study of current management systems.
- (2) Improve fisheries.
 - (a) Pilot scale tests of clam protection.
 - (b) Pilot scale rearing of bay scallops.
 - (c) Further mariculture facilities development.
 - (d) Continuation of hybrid perch rearing.
 - (e) Study of techniques of soft crab production and crab biology.
- (3) Larvae, food, diseases.
 - (a) Improve methods of handling shellfish larvae.
 - (b) Work on interrelationships of food and water quality for larvae.
 - (c) Improve methods of handling young adults (nursery phase).
 - (d) Monitor diseases, if they appear.
- (4) Advisory services.
 - (a) Continue information dissemination by Information bulletins, leaflets, etc.
 - (b) Start of extension field agent service.

Projects proposed for support in 1971-72 include:

- (1) Sea Grant Program administration, planning, and coordination.
 - (a) Administer Sea Grant Program and plan for future.
 - (b) Coordinate and integrate the Sea Grant Program with other programs at VIMS.

Virginia Institute of Marine Science
Director's Office

PROJECT SUMMARY (Cont'd):

- (2) Coastal Resources Management.
- (3) Research on biological resources.
 - (a) Improvement of fisheries for crustaceans.
 - (b) Improvement of fisheries for mollusks.
 - (c) Management of larvae, supply of food.
 - (d) Microbiology and pathology of commercially important species.
- (4) Research on environmental resources.
 - (a) Eastern Shore wetlands productivity study.
 - (b) Study of ocean wave refraction for Virginia's coastline.
 - (c) The mineral resources of the Continental Shelf off Chesapeake Bay.
- (5) Advisory Services.
 - (a) Extension Agent services.
 - (b) Publications and public information.

STATUS: Active. See the subprojects listed under various Departments.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: MARINE EXTENSION SERVICE

INVESTIGATOR:

Victor G. Burrell, Jr., Associate Marine Scientist

PROJECT SUMMARY:

Problems of the seafood industry are being determined and efforts to solve several are underway. Major effort is being expended in the following areas:

- (1) Irregular supplies of product.
 - (a) New markets for over-abundant species are being sought.
 - (b) Help with location of supplies to processing firms when local supplies are short.
- (2) Uses of unexploited and under-exploited species sought.
- (3) Means of diversification in seafood industry investigated.
 - (a) Promotion of pot fishery for Black Sea Bass is being investigated for out of season occupation for crab dredge boats and party fishing boats.
 - (b) Sand shrimp fishery is also being investigated for the same reasons.
- (4) Mechanization is being stressed.
 - (a) An oyster steaming plant has been pushed for sea side Eastern Shore.
- (5) New methods of aquaculture are being introduced to the industry.
- (6) New fishing gear is being investigated.
 - (a) Floating pound nets.
 - (b) Modified Sea Bass pots.

STATUS: This project is a subproject of the Sea Grant Program.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: THE CHESAPEAKE BAY - A COORDINATED RESEARCH
PROGRAM - THE RANN-NSF PROGRAM

INVESTIGATOR:

William J. Hargis, Jr., Institute Director

PROJECT SUMMARY:

Proposed is the establishment of the Chesapeake Research Consortium by the Virginia Institute of Marine Science, The Johns Hopkins University, and the University of Maryland. Major attention will be directed toward the construction of a data bank for storage and retrieval of information classified according to the inventory methodology designed to identify all the significant entity interactions of the Bay, their respective processes and characteristics.

The second objective is the application of systems analysis to the Bay and its components for a comprehension of its dynamics, its characteristics, and its probable fate according to choices made in the management process.

The third objective is the initiation of an integrated research program in Biology, Physics, Chemistry, Economics, Sociology, Behavioral Science, and Institutions including government and law.

In addition, specific problem areas and case studies will be the subject of interdisciplinary research.

STATUS: Active. Projects include: (1) Inventory Extension Project, (2) Marine Environments and Resources Research and Management System Project, (3) Coordinated, Interdisciplinary Studies on Wetlands, (4) Flux of Materials at the Mouth of Chesapeake Bay, (5) Special Studies on Distribution of Heavy Metals in Lower Chesapeake Bay, (6) Baseline Studies on Phyto- and Zooplankton in Lower Chesapeake Bay, and (7) Aquaculture - Studies of Genetics and Diseases of Oysters in Lower Chesapeake Bay.

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: INVENTORY EXTENSION PROJECT - RANN-NSF PROGRAM

INVESTIGATORS:

William J. Hargis, Jr., Institute Director
John J. Norcross, Senior Marine Scientist
John B. Pleasants, Assistant Marine Scientist

PROJECT SUMMARY:

This project will contribute to the development of the inventory concerning natural entities of the Bay by accumulating details regarding relevant biological, chemical, geological, physical, and meteorological parameters. Original data as well as analytical results will be included.

Gathering and processing of relevant information will be coordinated with other institutions. Efforts to assure compatibility of computers (hardware) and information and programs (software) have already begun with several meetings between Schulz and Kohlenstein of The Johns Hopkins University and Norcross and Hargis of VIMS. This project will also contribute to "Development of the Data Bank."

Fisheries statistics will be one aspect of entrepreneurial activities attended to in this project. We plan also to encompass such information as outfall location and type, aerial extent of condemnation zones, location, nature and extent of wetlands, shorelines, and shallows.

STATUS: Active. This is a project of "The Chesapeake Bay - A Coordinated Research Program."

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: MARINE ENVIRONMENTS AND RESOURCES RESEARCH
AND MANAGEMENT SYSTEM PROJECT - RANN-NSF PROGRAM

INVESTIGATORS:

William J. Hargis, Jr., Institute Director
John J. Norcross, Senior Marine Scientist
John B. Pleasants, Assistant Marine Scientist

PROJECT SUMMARY:

This project includes several activities which include:

- (1) Development of the Chesapeake Bibliography - A few copies of the first volume, "The James River," have been prepared and distributed.
- (2) Development of a special management and research library of charts, aerial photography, data reports and papers for use in planning and management of marine resources and in research, itself.
- (3) Development of hardware and software for handling such information.
- (4) Design of evaluation methods.

This project encompasses two other activities, Development of an Information System and the Organizational or Institutional Studies phase. Project MERRMS is designed to enable technical advisors to make better environmental impact statements and predictions for planners and managers as well as to assist research administrators in following progress of research and in designing better and more relevant environmental and resource-use research.

This project will be made compatible with similar activities elsewhere. Exclusivity and absence of duplication is assured, in part, by the initial emphasis on the lower half of the Bay and its tributaries, except for certain subprojects such as the Chesapeake Bay Bibliography. Immediate utility and application is assured in that the Institute, as part of its official duties, makes environmental impact statements and advisory statements to the planning and management activities agencies of the Commonwealth and to others.

STATUS: Active. This is a project of "The Chesapeake Bay - A Coordinated Research Program."

Virginia Institute of Marine Science
Director's Office

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: STATUS OF ENVIRONMENTS AND RESOURCES OF THE
JAMES RIVER

INVESTIGATORS:

William J. Hargis, Jr., Institute Director
John B. Pleasants, Assistant Marine Scientist

PROJECT SUMMARY:

Designed to develop an understanding of the current status of the environments and resources of the tidal James, this project will result in a series of reports to NASA-Langley to be used in their James River summer study.

STATUS: Active. Intermittent Special Reports are planned.

FINANCIAL SUPPORT:

National Aeronautics and Space Administration
(Langley Research Center)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: TRANSPORT AND MOVEMENTS OF OYSTER LARVAE IN
THE JAMES RIVER

INVESTIGATORS:

Langley H. Wood*
William J. Hargis, Jr., Institute Director

PROJECT SUMMARY:

A study of the mechanisms of movement and transport of larval stages of Crassostrea virginica in the James estuary, a two-layered estuarine system. Samples have been collected and analyzed; corollary laboratory experiments on factors affecting movements of larvae have been completed; and reports are currently being prepared.

STATUS: Active. One paper is in press, and a second is in preparation.

FINANCIAL SUPPORT:

Department of the Interior
(Bureau of Commercial Fisheries)
Virginia Institute of Marine Science

*Langley H. Wood, University of New Hampshire

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: CHESAPEAKE BAY RESEARCH PLANNING AND MANAGEMENT*

INVESTIGATOR:

William J. Hargis, Jr., Institute Director
Edwin B. Joseph, Assistant Director
Robert J. Byrne, Associate Marine Scientist

PROJECT SUMMARY:

This study is designed to re-examine the elements and research needs of the lower Chesapeake Bay System and the adjacent inshore waters of the Atlantic Ocean as well as contiguous littoral and lagoonal systems.

Significant attention is being focused on the problems of the Coastal Zone and its systems. This will lead to the development of statements of research and goals.

Also involved would be an inventory of the scientific and technical capabilities extant in the lower Bay and adjacent areas.

Of special value will be statements of informational needs from agencies legally responsible for planning for and management of the marine and estuarine resources solicited from those agencies.

STATUS: Active.

FINANCIAL SUPPORT:

National Science Foundation
(Research Applied to National Needs)
Virginia Institute of Marine Science

*Complete title: Inventory and systems study of lower Chesapeake Bay, adjacent continental shelf waters and littoral reaches of the Eastern Shore and the Virginia beaches and outer banks.

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: EASTERN SHORE ECONOMIC STUDY OF SEAFOOD INDUSTRY

INVESTIGATORS:

William J. Hargis, Jr., Institute Director
Edwin B. Joseph, Assistant Director

PROJECT SUMMARY:

Two phases are planned for this project. These are:

- (1) Review of natural systems and evaluation of living marine resources of Accomack and Northampton counties, consideration of relevant activities and potentialities for enhancement and development, consideration of special problems relating to use, repletion, and conservation of those resources, and
- (2) Elements of marine ecology of Eastern Shore.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Department of State Planning and Community
Affairs
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Director's Office

PROJECT TITLE: SURVEYS AND INVESTIGATIONS TO DETERMINE SOURCES, CAUSES, EFFECTS, MOVEMENT OR DISPERSION OF OIL AND HAZARDOUS SUBSTANCES SPILLED IN THE COASTAL AND ESTUARINE ZONES

INVESTIGATOR:

Edwin B. Joseph, Assistant Director

PROJECT SUMMARY:

This project offers to the EPA a highly qualified Technical Response Team capable of responding on short notice to conduct the necessary surveys and investigations outlined below.

Fully qualified personnel, representing a broad range of technical disciplines and experience comprise the Technical Response Team. They are supported with laboratory facilities and personnel to collect samples and do the required analysis.

Detailed tasks include (1) collection, evaluation, and analysis of meteorological and oceanographic data, (2) movement/dispersion prediction and spill estimates, (3) spill estimates and monitoring spill movement, (4) collection of chemical and physical samples, and (5) biological analysis [benthos, phytoplankton, zooplankton, commercial mollusks, fish, and birds].

STATUS: Active. VIMS personnel are on call when spills occur.

FINANCIAL SUPPORT:

Environmental Protection Agency through
Deepsea Ventures, Inc., Gloucester
Point, Virginia 23062

Virginia Institute of Marine Science
Director's Office
Department of Data Processing and
Statistical Services

PROJECT TITLE: TRANSPORT OF OYSTER LARVAE IN THE JAMES
ESTUARY: DEVELOPMENT OF METHODS

INVESTIGATORS:

John J. Norcross, Department Head and Senior
Marine Scientist

Langley H. Wood*

William J. Hargis, Jr., Institute Director

PROJECT SUMMARY:

The goal of this project was a statistical evaluation of two methods used for sorting and counting bivalve larvae contained in plankton samples collected from the James River. It was found that a new method, developed by VIMS, yielded greater accuracy than the traditional method commonly employed by planktologists.

STATUS: Completed. A manuscript has been developed and is currently awaiting review by VIMS' editorial staff. It is a subproject of "Transport and Movements of Oyster Larvae in the James River."

FINANCIAL SUPPORT:

Department of the Interior
(Bureau of Commercial Fisheries)
Virginia Institute of Marine Science

*Langley Wood, University of New Hampshire

Virginia Institute of Marine Science
Director's Office
Department of Data Processing and
Statistical Services

PROJECT TITLE: DEVELOPMENT OF YOUNG BLUEFISH (POMATONUS
SALTATRIX) AND DISTRIBUTION OF EGGS AND
YOUNG IN VIRGINIAN COASTAL WATERS

INVESTIGATORS:

John J. Norcross, Department Head and Senior
Marine Scientist
Sally B. Leonard, Graduate Assistant
Edwin B. Joseph, Assistant Director
William H. Massmann*

PROJECT SUMMARY:

This paper describes the development of young bluefish by line drawings and descriptive text. The distributions of eggs and larvae are related to distributions of water properties. Possible pathways of transport of eggs and young are discussed.

STATUS: The first draft of the manuscript has been completed and awaits review by VIMS' editorial committee.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*William H. Massmann, National Marine Fisheries Service,
Washington, D. C., former VIMS employee

Virginia Institute of Marine Science
Director's Office
Department of Data Processing and
Statistical Services

PROJECT TITLE: THE BATHYMETRIC DISTRIBUTION OF PHYTOPLANKTON
IN VIRGINIAN COASTAL WATERS

INVESTIGATORS:

Richard A. Mulford*
John J. Norcross, Department Head and Senior
Marine Scientist

PROJECT SUMMARY:

A submersible pump was used to collect phytoplankton samples at depth across the Continental Shelf. Species composition, abundance, and seasonal succession were noted.

STATUS: A manuscript has been completed and accepted and is in press.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Richard A. Mulford, Benedict Estuarine Laboratory, Benedict, Maryland, former VIMS employee

Virginia Institute of Marine Science
Director's Office
Wachapreague Laboratory

PROJECT TITLE: STUDIES ON MARICULTURE OF BAY SCALLOP,
ARGOPECTEN IRRADIANS

INVESTIGATORS:

William P. Duggan, Assistant Marine Scientist
Michael Castagna, Associate Marine Scientist

PROJECT SUMMARY:

The purpose of this project is to develop methods that are practical to the seafood industry to farm bay scallops from brood stock to marketable product. Phases include:

- (1) Develop inexpensive culture methods for handling eggs and growing larvae,
- (2) Develop practical methods of growing post set juveniles to size adequate for field planting, and
- (3) Develop protection and containment methods adequate and practical for growing scallops to market size.

STATUS: Active. A cooperative experiment with industry is being conducted.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Director's Office
Wachapreague Laboratory

PROJECT TITLE: STUDIES ON MARICULTURE OF HARD CLAM, MERCENARIA
MERCENARIA

INVESTIGATORS:

Michael Castagna, Associate Marine Scientist
William P. Duggan, Assistant Marine Scientist

PROJECT SUMMARY:

The objective of this project is to develop methods that are practical to the seafood industry to farm hard clams from brood stock to marketable product.

Phases include:

- (1) Develop culture methods to spawn and grow clams from eggs to juveniles,
- (2) Develop methods of growing post set juveniles to a size large enough for field plantings, and
- (3) Develop protection methods to grow clams in the field to market size without serious predation losses.

STATUS: Active. Cooperative experiments with the industry are presently being run. One report and several talks have been given.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

DIVISION OF BIOLOGICAL AND FISHERIES OCEANOGRAPHY

Edwin B. Joseph, Division Head

Virginia Institute of Marine Science
Division of Biological and Fisheries
Oceanography

PROJECT TITLE: BASELINE STUDIES ON PHYTO- AND ZOOPLANKTON
IN LOWER CHESAPEAKE BAY - RANN-NSF PROGRAM

INVESTIGATORS:

Edwin B. Joseph, Division Head
George C. Grant, Associate Marine Scientist
Department of Ichthyology
John L. Dupuy, Associate Marine Scientist
Department of Microbiology-Pathology
Paul L. Zubkoff, Senior Marine Scientist
Department of Environmental Physiology

PROJECT SUMMARY:

VIMS is developing an integrated plankton program for the Virginia waters of Chesapeake Bay and the saline waters of its major tributaries. The participants include general ecologists, phytoplankton specialists, zooplankton specialists, and a biochemist. In addition to introducing new elements, the program will bring together scattered efforts already in being.

The project described here is being designed so that it will make a major contribution to the inventory of Biological Entities, and in the identification of interactions at lower and intermediate trophic levels.

The objectives will be:

- (1) To identify the major phytoplankton and zooplanktonic elements of the plankton communities of the lower Bay.
- (2) To describe the seasonal and spatial distribution of the dominant plankters.
- (3) To investigate some of the biochemical phenomena related to or responsible for triggering the numerous red-tide blooms that appear to have serious ecological and economic consequences in lower Chesapeake Bay.
- (4) To determine the role and position of the dominant plankton species in the estuarine food web, with attention to the efficiency of food conversion between trophic levels and the nutritional value of prey species to primary and higher order consumers.

Active collaboration and coordination will be sought with participants in Maryland. For example, the food chain aspects of the program will provide much pertinent data to

Virginia Institute of Marine Science
Division of Biological and Fisheries
Oceanography

PROJECT SUMMARY (Cont'd):

the food chain modeling efforts proposed at the University of Maryland.

Both biological and hydrographic data obtained in the plankton program will be fed directly into the inventory and data bank efforts of other participants in the overall program.

STATUS: Active. This is a project of "The Chesapeake Bay - A Coordinated Research Program."

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: DEVELOPMENT OF ESTIMATES OF RELATIVE ABUNDANCE
OF JUVENILE AND ADULT CRABS

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Mark E. Chittenden, Jr., Associate Marine Scientist

PROJECT SUMMARY:

Monthly trawl surveys are made using R/V PATHFINDER at stations in the York (9 stations), James (6 stations), and Rappahannock (7 stations) Rivers, and Chesapeake Bay (2 stations) to obtain estimates of relative abundance of juvenile and adult blue crabs. Additional information is obtained that may be used to make estimates of: seasonal distribution, longitudinal distribution, sex composition, growth and mortality, and movements of blue crabs. General hydrographic data is obtained at each station.

Weekly pushnet surveys are made during April-November at stations located on VIMS' beach to obtain estimates of relative abundance of juvenile blue crabs. General hydrographic data is obtained each sampling day.

Data is tabulated and transferred to IBM cards which will allow computer processing.

STATUS: This project is funded by the Sea Grant Program at the present, but is a continuing, long-term project.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: STUDY OF THE VIRGINIA WINTER DREDGE FISHERY
FOR BLUE CRABS

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Mark E. Chittenden, Jr., Associate Marine Scientist

PROJECT SUMMARY:

The objective of this project is to determine the effects of the Virginia winter dredge fishery on blue crab stocks of the Chesapeake Bay.

The winter dredge fishery of 1969-1970 was investigated and described to serve as a guide for development of a research program. A series of possible programs was drawn up to estimate costs and benefits of different studies.

A program was selected, and this is currently underway to provide information on population size, total catch, and fishing mortality of blue crab stocks vulnerable to the winter dredge fishery in Chesapeake Bay. Data are being tabulated and transferred to IBM cards to permit computer analysis when the study is complete.

STATUS: Continuing.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: DEVELOPMENT OF TECHNIQUES FOR PREDICTION OF
BLUE CRAB STOCKS

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Mark E. Chittenden, Jr., Associate Marine Scientist

PROJECT SUMMARY:

The objective of this program is to use estimates of relative abundance obtained from trawl surveys to make predictions of blue crab stocks.

VIMS' current and historical trawl survey data have been tabulated, keypunched, verified, and printed out. This is being examined to develop procedures to predict blue crab stocks mathematically, to investigate parent-progeny relationships, and to investigate (long-term) causes of fluctuations in blue crab abundance. Most necessary computer programs have been obtained, and some are ready for use. Data will be analyzed for annual, monthly, and longitudinal differences in blue crab abundance as a first step toward modeling blue crab relative abundance estimates.

Experimental trawl and dredge survey programs are being conducted to improve sampling techniques and to provide knowledge prerequisite to interpretation of trawl survey data.

STATUS: A paper entitled "Effect of a Tickler Chain and Tow Duration on Trawl Catches of the Blue Crab, Callinectes sapidus" has been prepared and submitted for publication in Transactions of the American Fishery Society. This is a long-term, continuing project, presently funded in part by the Sea Grant Program.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: EXPLORATION OF METHODS FOR IMPROVING THE PRODUCTION OF SOFT CRABS, CALLINECTES SAPIDUS

INVESTIGATORS:

Paul A. Haefner, Jr., Associate Marine Scientist
W. A. Van Engel, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

The objective of this study is to define the criteria for the efficient production of soft crabs. The study is involved with the following:

- (1) Demonstrating to industry the feasibility of shedding crabs in tanks laid out on piers or over land, with running or re-circulated salt water.
- (2) Developing plans for physical plants.
- (3) Developing guidelines for acceptable levels of water quality: temperature, salinity, speed of water flow, dissolved oxygen, dissolved nitrogenous substances, pH, for example.
- (4) Developing guidelines for quality and quantity of crabs that can be held.
- (5) Developing a program for studying mortalities among crabs, to explain their causes and, ultimately, to control them.

STATUS: This is a continuing project, presently funded in part by the Sea Grant Program.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: A STUDY OF THE FEASIBILITY OF PRODUCING
MARKETABLE QUANTITIES OF SOFT ROCK CRABS,
CANCER IRRORATUS IN VIRGINIA

INVESTIGATORS:

Paul A. Haefner, Jr., Associate Marine Scientist
W. A. Van Engel, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

Chesapeake Bay is within the southern limit of the range of the rock crab, a fact obvious from their presence in the catch of winter dredge fishery for blue crabs.

The rock crab's potential utilization as peeler crabs to shed into soft crabs during the winter months will be studied. This investigation will follow guidelines similar to those followed in the soft blue crab subproject, Sea Grant Program.

STATUS: This is a subproject funded by the Sea Grant Program.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: BLUE CRAB BIBLIOGRAPHY

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Paul A. Haefner, Jr., Associate Marine Scientist

PROJECT SUMMARY:

Revision of the bibliography on the blue crab,
Callinectes *sapidus* and other species of the Genus Callinectes
has been initiated. The revision will result in publication
of a working KWIC index or an annotated bibliography, or both.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: BIOLOGY OF CRANGON SEPTEMSPINOSA

INVESTIGATORS:

Paul A. Haefner, Jr., Associate Marine Scientist
W. A. Van Engel, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

Information on various aspects of the biology of the sand shrimp is presently available for populations in the waters of Newfoundland, Maine, and Delaware. Investigation of Chesapeake Bay would make it possible to detect latitudinal differences in temperature and salinity tolerance, osmotic regulation, reproductive biology, age and growth, and relationships that exist with other carideans (Palaemonetes spp., Hippolyte spp., e.g.).

Field sampling of both shallow and deeper waters of the southern part of Chesapeake Bay and the York River will be undertaken to locate and determine size of available stocks of sand shrimp with the prospect that this species may be a potential resource.

STATUS: Various aspects of the biology of this shrimp will be studied as the situation dictates.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: DETERMINATION OF SALINITY TOLERANCE OF BLUEBACK
HERRING, ALOSA AESTIVALIS

INVESTIGATOR:

Mark E. Chittenden, Jr., Associate Marine Scientist

PROJECT SUMMARY:

Analysis and preparation of data on salinity tolerance of blueback herring obtained inadvertently while studying salinity tolerance of American shad is the purpose of this project. Young blueback herring were subjected to salinity increase to 28 parts per thousand. No mortality occurred with gradual salinity increase. One fish died with abrupt salinity increase, but death was attributed to a delayed effect from handling stress. Euryhaline tolerance permits this species to use saltwater and freshwater nurseries. Thus, population size is not so dependent upon the nursery potential of limited freshwater areas.

STATUS: A paper entitled "Salinity Tolerance of Young Blueback Herring, Alosa aestivalis" has been prepared and submitted to Transactions of American Fishery Society.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: STATUS OF STRIPED BASS, MORONE SAXATILIS, IN
THE DELAWARE RIVER

INVESTIGATOR:

Mark E. Chittenden, Jr., Associate Marine Scientist

PROJECT SUMMARY:

Analysis and preparation of data on status of striped bass in the Delaware River obtained while studying American shad in the Delaware River is the purpose of this project.

The Delaware River was historically an important spawning and nursery area for striped bass, particularly in and near tidal fresh water. Collections of fishes throughout the freshwater sections from 1963 to 1966 by techniques that included continuously fishing traps and large and small meshed seines contained no striped bass, and few specimens were collected in rotenone surveys from 1960 to 1962.

Gross pollution of the tidal freshwater area has destroyed its potential as a spawning and nursery area, has resulted in the virtual extirpation of the striped bass from there and upstream waters, and is the probable cause of the decline in abundance of this species in the Delaware River. Major restoration of striped bass would occur if pollution is decreased, so that the tidal freshwater section can resume its former importance as a spawning and nursery area.

STATUS: A paper entitled "Status of Striped Bass, Morone saxatilis, in the Delaware River" has been submitted to Chesapeake Science.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: SEASONAL DISTRIBUTION OF CALANOID COPEPODS IN
THE YORK RIVER

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Victor G. Burrell, Jr., Associate Marine Scientist

PROJECT SUMMARY:

Twelve monthly stations, 5 to 10 miles apart, have been made from 10 miles seaward from the Chesapeake Bridge Tunnel to 50 miles up the York system. DO, salinity, temperature, and pH were determined for two depths (1 meter below surface, 1 meter above bottom). Turbidity was measured. Atmospheric conditions and tide stage were recorded. Tows with a Clarke-Bumpus Quantitative Plankton Sampler fitted with a #6 mesh net (0.239 mesh aperture) at 1 meter below the surface and 1 meter above the bottom were made at each station. All major groups of zooplankton were recorded by tow, and calanoid copepods were identified to species and recorded in numbers per liter per tow.

STATUS: This project represents Burrell's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: MORPHOLOGY OF DECAPOD LARVAE FROM PLANKTON
SAMPLES OF CHESAPEAKE BAY WITH EMPHASIS ON
THE DISTRIBUTION OF EMERITA TALPOIDA AND
LEPIDOPA (ANOMURA)

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
H. Ellen Hunter, Graduate Student

PROJECT SUMMARY:

Plankton samples were sorted with separation of all Emerita talpoida and Lepidopa and certain other decapods. Data of E. talpoida occurrence was used in structuring thesis work on problems relating to the distribution of E. talpoida larvae and recruitment to the benthic (sandy beach) population.

STATUS: This project represents Hunter's preliminary thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: THE MORPHOLOGY AND DISTRIBUTION OF THE DECAPOD
MEGALOPAE OF THE CHESAPEAKE BAY AREA

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Chae E. Laird, Graduate Student

PROJECT SUMMARY:

The species of brachyurans and anomurans (decapoda) found in the Chesapeake Bay area are to be determined. The descriptions of the megalopae of these and other species are to be obtained primarily through literature research or from original descriptions based on material from rearing studies (VIMS-Sandifer). From the descriptions, a key to family or genera (if possible) is to be developed for use as a means to identify the megalopae found in plankton samples from the Bay. On the basis of preexisting samples, an attempt will then be made to determine the distribution of the megalopae in the Bay.

STATUS: This project represents Laird's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science
National Science Foundation (Traineeship)

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: MORPHOLOGY AND ECOLOGY OF CHESAPEAKE BAY
DECAPOD LARVAE

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Paul Sandifer, Graduate Student

PROJECT SUMMARY:

This study has been designed to provide answers to the following three questions concerning the Chesapeake Bay decapod larvae.

(1) What do the larvae of the various decapod species of the Bay "look like", and what characters can be used for distinguishing the larvae of each species in plankton collections? This portion of the study involves the laboratory culture and description of unknown or poorly known larvae from the Chesapeake Bay and adjacent continental shelf waters and the preparation of an identification scheme for all the decapod larvae of the Chesapeake Bay.

(2) How are the decapod larvae of the York River system and adjacent Chesapeake Bay area distributed in relation to certain environmental conditions (primarily temperature and salinity)? This portion of the study consists of the analysis of plankton samples collected by Mr. V. G. Burrell, Jr. in his study of the calanoid copepods of the region. Surface and bottom samples were taken monthly over a two-year period (December 1967 - December 1969) from 12 stations spread over a distance of about 55 miles between fresh water and sea water. The collections were made with a Clarke-Bumpus Quantitative plankton sampler.

(3) What effects may different temperature and salinity combinations have on the larval development of selected Bay decapods? In this portion of the study, an experiment has been run to determine the effects of temperature and salinity on the survival and development of laboratory-cultured Palaemonetes vulgaris larvae. The results of this study and similar studies in the literature will provide a basis for understanding the distribution of certain larvae observed in Part 2 above.

STATUS: This project represents Sandifer's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: DISTRIBUTION, ABUNDANCE, AND ECOLOGY OF THE
ROCK CRAB (CANCER IRRORATUS) IN VIRGINIA
COASTAL WATERS

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist

Lewis R. Shotten, Graduate Student

PROJECT SUMMARY:

Cancer irroratus is abundant in the Chesapeake Bay during the cold months. As warm weather approaches, it is hypothesized that C. irroratus migrates first to deeper water within the Bay and then into the ocean. Also, there is a noticeable absence of female C. irroratus in the Bay population during the winter months. This thesis project will be to study the distribution, abundance, and ecology of the rock crab (Cancer irroratus) in Virginia coastal waters.

STATUS: This project represents Shotten's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: POST-LARVAL GROWTH AND REPRODUCTIVE BIOLOGY OF
NEOPANOPE TEXANA SAYI

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist
Richard Swartz, Graduate Student

PROJECT SUMMARY:

This project's objective is to correlate the growth and reproduction biology of Neopanope, a xanthid mud crab. Particular attention has been given to the seasonal cycles of molting, copulation, vitellogenesis, spawning, and hatching in relation to environmental factors such as temperature, salinity, and light. Size discrimination in agonistic and copulatory behavior, sexual dimorphism and maturation, autotomy and handedness, and molting behavior have also been examined.

STATUS: This project represents Swartz' dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Crustaceology Department

PROJECT TITLE: RELATIVE GROWTH, REPRODUCTION, AND DISTRIBUTION
OF THE ROCK CRAB, CANCER IRRORATUS, IN
CHESAPEAKE BAY

INVESTIGATORS:

W. A. Van Engel, Department Head and Senior Marine
Scientist

Roy T. Terretta, Graduate Assistant

PROJECT SUMMARY:

This research is primarily concerned with answering questions that may be asked if the rock crab becomes a commercial species in the Chesapeake Bay winter dredge fishery such as: distribution of rock crabs, size at sexual maturity, season of molting and mating, average size, and ratio of rock crabs to blue crabs.

STATUS: This project represents Terretta's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Environmental Physiology

PROJECT TITLE: A MULTIDISCIPLINARY STUDY OF THE SCYPHOZOAN
JELLYFISHES OF LOWER CHESAPEAKE BAY

INVESTIGATORS:

Edwin B. Joseph, Head, Division of Biological and
Fisheries Oceanography
Dexter S. Haven, Head of Department of Applied
Marine Biology
Reinaldo Morales-Alamo, Research Assistant
Department of Applied Marine Biology
Dale R. Calder, Associate Marine Scientist,
Department of Environmental Physiology
Kenneth L. Webb, Associate Marine Scientist,
Department of Environmental Physiology
Robert Black, Summer Professor

PROJECT SUMMARY:

The phases for this project period include the following objectives:

- (1) To further clarify the problems of identity of the several life stages of the abundant jellyfishes of Chesapeake Bay,
- (2) To investigate further the process of strobilization as a possible weak link in the jellyfish life cycle,
- (3) To explore the utility of natural toxins and diseases as control agents,
- (4) To identify substances that are capable of inhibiting strobilization, inducing it out of season, or causing direct mortality to any stage of the life cycle, and
- (5) To clarify further the ecological role of jellyfishes with special reference to their position in the food chain.

STATUS: Active.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

PROJECT TITLE: CONTROL MEASURES FOR CHESAPEAKE BAY JELLYFISHES:
BIOCHEMICAL STUDIES

INVESTIGATORS:

Paul L. Zubkoff, Department Head and Senior Marine
Scientist
Jeanne D. Joseph, Research Assistant

PROJECT SUMMARY:

The identification and quantitation of the lipid components of jellyfish polyps and newly liberated ephyrae will be continued. Studies on the proteins and lipoproteins of jellyfish membranes will be initiated. Biosynthetic mechanisms of actively regenerating tissues of jellyfish will be studied.

STATUS: The major classes of neutral lipids have been separated by thin layer chromatography and gas liquid chromatography. A preliminary report was presented at the 6th MARM, American Chemical Society, February 3-5, 1971. This is a subproject of "A Multidisciplinary Study of the Scyphozoan Jellyfishes of Lower Chesapeake Bay."

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Environmental Physiology

PROJECT TITLE: CONTROL MEASURES FOR CHESAPEAKE BAY JELLYFISHES:
PHYSIOLOGICAL STUDIES

INVESTIGATORS:

Kenneth L. Webb, Associate Marine Scientist
Marsha Dietz, Graduate Assistant *
Janet Olman, Graduate Assistant **

PROJECT SUMMARY:

Energetic requirements of Chrysaora polyps and metabolic inhibitors which interfere with known respiratory mechanisms are under study.

Salinity and temperature relationships in Chrysaora are being extended to obtain insight into the metabolic changes occurring within the organism during the processes of pre-strobilization and strobilization.

Observations on the neurosecretory cells in Chrysaora are being made during the various stages of polyps growth and development.

STATUS: This project is a subproject under "A Multidisciplinary Study of the Scyphozoan Jellyfishes of the Lower Chesapeake Bay." It represents Dietz' and Olman's thesis research projects.

*Thesis title: Ultrastructural changes during strobilization in scyphistomae of Chrysaora quinquecirrha (with special reference to neurosecretory cells)

**Thesis title: Salinity-temperature relationships affecting metabolic processes in jellyfish

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

PROJECT TITLE: SERUM CHEMISTRY OF THE COMMERCIALY IMPORTANT MARINE ORGANISMS

INVESTIGATORS:

Kenneth L. Webb, Associate Marine Scientist
Maurice P. Lynch, Graduate Assistant*

PROJECT SUMMARY:

Variations in some of the serum constituents of the blue crab, Callinectes sapidus, are being studied for the purpose of determining if any of these various constituents can be used as indicators of physiological condition of the blue crab populations and sub-populations in Chesapeake Bay.

Periodic (monthly) samples of blue crab serum from the York Spit area are analyzed to determine seasonal trends in various constituents. Sampling in conjunction with routine summer travel surveys has provided information on effects of environmental salinity on some of the constituents.

Spot sampling at various locations in Virginia has provided information from high salinity areas and areas subjected to unusually high blue crab mortalities.

Some laboratory studies are bringing out variations in some serum levels due to thermal stress. Constituents being studied are chloride, protein, amino acids, total ninhydrin positive substances, glucose, total osmotic concentration, serum transaminases, and lipids.

STATUS: This project is representative of Lynch's dissertation research and is funded as a subproject under the Sea Grant Program:

*Thesis title: Variations in some serum constituents of the blue crab, Callinectes sapidus.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

PROJECT TITLE: NEUTRON ACTIVATION ANALYSIS OF CHESAPEAKE BAY
SEDIMENTS

INVESTIGATORS:

Paul L. Zubkoff, Department Head and Senior Marine
Scientist
J. Ernest Warinner, III, Assistant Marine Scientist
Walter E. Carey*

PROJECT SUMMARY:

Selected sediments from tributary rivers of the
Chesapeake Bay will be subjected to a neutron flux of
 2×10^{11} neutrons $\text{cm}^{-2} \text{sec}^{-1}$ for either 5 minutes or 2 hours.

The resulting gamma-ray spectra will be analyzed
using NaI (Tl) crystal for the measurement of Na, Mn, La,
and Sc content.

These samples will be used for the preparation
of radioactive sediment particles for exploring mechanisms
of particulate injection by invertebrates.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Walter E. Carey, Director, Nuclear Reactor Laboratory, Ohio
State University, Columbus, Ohio

Virginia Institute of Marine Science
Department of Environmental Physiology

PROJECT TITLE: HETEROCYCLIC COMPOUNDS AND LIPIDS ASSOCIATED
WITH "RED TIDE" ORGANISMS

INVESTIGATORS:

Paul L. Zubkoff, Department Head and Senior Marine
Scientist
Jeanne D. Joseph, Research Assistant

PROJECT SUMMARY:

Water samples obtained from the lower Chesapeake Bay will be analyzed for lipid and heterocyclic constituents. Emphasis will be directed to the changes in levels of these components which occur in the estuarine waters before, during, and after the appearance of "red water". These samples will be compared with media obtained from organisms growing in pure culture.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Environmental Physiology

PROJECT TITLE: PRODUCTIVITY MEASUREMENTS OF THE LOWER CHESAPEAKE BAY

INVESTIGATORS:

J. Ernest Warinner, III, Assistant Marine Scientist
Paul L. Zubkoff, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

The primary productivity of the Lower Chesapeake Bay, particularly a transect of the York Spit area and of Mobjack Bay, are under surveillance in conjunction with studies on the "red water" occurrence and development.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: DISTRIBUTION AND ABUNDANCE OF DISSOLVED FREE
AMINO ACIDS (DFAA) IN MARINE SYSTEMS

INVESTIGATOR:

Kenneth L. Webb, Associate Marine Scientist

PROJECT SUMMARY:

This project was designed to determine the quantities of DFAA in the marine and estuarine environments and their possible variation in time. Sampling was to be performed in the world's oceans at various depths as opportunities were presented and at weekly intervals from the VIMS pier for two years.

STATUS: Data gathering has been completed, a methods paper has been published and another utilizing the method. Data is grouped into two sections for publication: York River seasonal variation and world ocean values by depth and latitude. York River data has been presented at a national meeting.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: FLUX OF DISSOLVED FREE AMINO ACIDS (DFAA) IN MARINE SYSTEMS

INVESTIGATOR:

Kenneth L. Webb, Associate Marine Scientist

PROJECT SUMMARY:

The intent of this project is to determine the relationship between the environmental pools of DFAA and the individual organisms. The project is intimately interrelated with Projects "Distribution and Abundance of DFAA" and "Internal Mechanisms of DFAA Regulation in Marine Organisms" and is designed to determine which organisms release and which organisms remove DFAA from the environmental pool, at what rates, and which compounds are of greater significance.

Flux between the DFAA pool and abiotically bound amino acids will also be considered.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: INTERNAL MECHANISMS OF DFAA REGULATION IN
MARINE ORGANISMS

INVESTIGATOR:

Kenneth L. Webb, Associate Marine Scientist

PROJECT SUMMARY:

This project is to determine some of the major relationships affecting the internal pools of free amino acids (FAA) in marine organisms. Major first emphasis is on the relationship with environmental salinity and the sources and fates of FAA that increase or decrease in concentration with salinity.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: PHYSIOLOGY OF MARINE TARDIGRADES

INVESTIGATORS:

Kenneth L. Webb, Associate Marine Scientist
Maxine Bayly, Graduate Student*

PROJECT SUMMARY:

Proposed research concerns a group of physiologically phenomenal animals, tardigrades. In freshwater and terrestrial environments, these microscopic animals are able to undergo desiccation under anhydrous conditions and live a "viva minima" for a period of years (Pigon & Weglarska, 1953, 1955). On the addition of water, they resume natural activity. While in this cryptobiotic state, they are resistant to extreme ranges in temperature, mass doses of irradiation, and other stresses.

Although work is being done on freshwater and terrestrial tardigrades, little is being done on marine species. These microscopic animals live in-between sand grains on beaches where environmental conditions are apt to be extremely variable and may reach stress conditions. There is evidence that marine tardigrades, like their terrestrial relatives, can withstand periods of desiccation and extreme environmental stress; however, this has never been demonstrated.

Initial interest in tardigrades is directed toward their physiology. In working with a little known phylum, it is necessary to become taxonomically competent. Although taxonomic work will continue, major emphasis will be on physiology; this will necessitate learning to culture the marine forms prior to physiological investigations.

STATUS: This project represents Bayly's dissertation research:

*Title: Cryptobiosis and related physiological parameters of marine tardigrades.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: THE METABOLISM OF FREE AMINO ACIDS INVOLVED IN THE ISOSMOTIC INTRACELLULAR REGULATION OF MARINE BIVALVE MOLLUSKS

INVESTIGATORS:

Kenneth L. Webb, Associate Marine Scientist
William DuPaul, Graduate Assistant

PROJECT SUMMARY:

The primary objective is to determine how free amino acids (FAA) are synthesized for isosmotic intracellular regulation in marine invertebrates. Three marine mollusks (Mercenaria mercenaria, Mya arenaria, and Spisula solidissima) all accumulate alanine when subjected to conditions of increased salinity, and this accumulation is related to the available aspartic acid. Thus, the main direction of this research project is to determine how aspartic acid is involved in the synthesis of alanine when the latter is being used as an isosmotic effector. The most practical approach to this problem involves the use of C-14 labelled compounds in delineating the metabolic pathways involved.

The research involves three parts. First, it must be determined if isolated gill tissue incubated in artificial sea water at both 18 and 30% salinity behave as gill tissue in intact animals. The FAA in isolated gill tissue will be measured after short periods of incubation in artificial sea water to determine if significant quantities of FAA can be accumulated. Also, it would be a good opportunity to determine the effects of anaerobic conditions on the process of FAA accumulation, as both Mya and Mercenaria are frequently subjected to such environmental conditions.

Second, enzyme systems that may be implicated in the process of isosmotic intracellular regulation will be investigated. The following enzyme systems will be investigated and the effects of salinity noted: Glumatic-Oxaloacetic transaminase, Glutamic-Pyruvic transaminase, Aspartate decarboxylase, Pyruvate Carboxylase, Phospho-enol pyruvate carboxy kinase, Pyruvate kinase, and Malic Dehydrogenase.

Lastly, gill tissues will be incubated with C-14 labelled aspartic acid. Because of the implicated decarboxylation of aspartic acid or its keto precursor oxaloacetic acid, the use of differentially labelled (C-1 and C-4) aspartic acid will be of value in tracing the metabolic pathway involved.

Virginia Institute of Marine Science
Department of Environmental Physiology

STATUS: This project represents DuPaul's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: ULTRAPLANKTON HETEROTROPHY IN CHESAPEAKE BAY

INVESTIGATORS:

Kenneth L. Webb, Associate Marine Scientist
Leonard Haas, Graduate Assistant

PROJECT SUMMARY:

Various lines of evidence indicate that a much overlooked assemblage of organisms, the ultraplankton, because of their large numbers and small size, may make a greater metabolic contribution to the plankton community than the larger net plankton which are easier to observe. Their small size, 0.5-10 microns, and fragile nature have resulted in almost a complete lack of information regarding their taxonomy, ecology, and physiology.

Although much recent work of Wright and Hobbie (Ecology, 1966, 47: 457-464), as well as others, indicates that bacteria and not algae are responsible for the uptake of dissolved organics from sea water; the ultraplankton are comparable in size to some bacteria and have similar surface-to-volume ratios. They may thus be competitive in membrane phenomena such as uptake of dissolved materials. The reports of apparently viable, pigmented phytoplankton below the photic zone (e.g., Fournier, 1966, Science 153: 1250-1252) are difficult to explain if they are not heterotrophs living on dissolved organic matter.

Exploratory evaluations of the role of estuarine ultraplankton in the cycling of dissolved organic matter, especially free amino acids, in estuarine waters will be made. Cultures of some of the more common ultraplankton species will be developed. The cultured organisms will then be evaluated for their ability to remove C-14 labelled dissolved substrates (i.e. amino acids) from solutions containing the substrates at naturally occurring concentrations.

STATUS: This project represents Haas' dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: FEASIBILITY OF INCREASING STRIPED BASS
POPULATIONS BY STOCKING OF UNDER-UTILIZED
NURSERY GROUNDS

INVESTIGATORS:

George C. Grant, Associate Marine Scientist
John V. Merriner, Associate Marine Scientist
C. E. Richards, Assistant Marine Scientist
W. H. Kriete, Jr., Research Assistant

PROJECT SUMMARY:

Principal objectives include the following:

- (1) Selection of one or more tributaries having suitable nursery grounds for striped bass, but inadequate or unutilized spawning grounds,
- (2) Experimental stocking of a selected tributary and assessment of survival and growth of stocked striped bass,
- (3) Refinement and adoption of existing techniques for rearing striped bass larvae, and assessment of optimal size for stocking,
- (4) Experimental stocking of additional tributaries,
- (5) Evaluation of stocking in under-utilized nursery grounds of Virginia as a management tool, and
- (6) Estimation of expected benefits from its implementation.

Also included in this project is the monitoring of age composition and mortality within lower Chesapeake Bay striped bass populations, continuing previous studies.

STATUS: Active.

FINANCIAL SUPPORT:

Bureau of Sport Fisheries and Wildlife
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: BIOLOGY AND MANAGEMENT OF RIVER HERRING AND SHAD

INVESTIGATOR:

W. Jackson Davis, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

Objectives of this project are:

- (1) To measure fishing effort and estimate catch per unit of effort in the fishery for river herring and shad in lower Chesapeake Bay and its tributaries,
- (2) To estimate mortality rates and population sizes of each species of Alosa in each of four river systems,
- (3) To determine an index of the number of juveniles in the nursery of each river system each year, and to evaluate the index as a predictor of fishing success in future years,
- (4) To elucidate the relative importance to alosids of various kinds of food organisms and the significance of interrelationships, such as predator-prey interactions, by describing the community structure and trophic dynamics of the nurseries,
- (5) To develop reliable methods of hatching fertilized eggs of Alosa spp., of culturing the larvae through the sac-fry stage to metamorphosis, and of holding juveniles under laboratory conditions,
- (6) To measure the ability of various life history stages to withstand the changes in water quality that can be expected from pollution, riparian development, and other environmental changes, and
- (7) To find a practical method of identifying adult Alosa spp. with their parent streams.

STATUS: Active.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: BIOLOGY AND MANAGEMENT OF RIVER HERRING AND
SHAD - II

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
Walter Eanes, Graduate Assistant

PROJECT SUMMARY:

This project's projected goal is to determine by biochemical means the racial structure of the Chesapeake populations of alosids. Samples will be collected from the four main Virginia tributaries in conjunction with sampling of commercial catches. Pertinent enzymes and proteins will be separated and analyzed to gel electrophoresis. Polymorphism and their genetic controls will be determined and applied to realizing any racial differences that may exist. Juveniles and Atlantic populations will be sampled summer 1971.

STATUS: This project represents Eanes' thesis research. It is a subproject of the major grant project of the same title.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: GROWTH, ABUNDANCE, FEEDING BIOLOGY, AND
ENERGETICS OF YOUNG-OF-THE-YEAR BLUEBACK
HERRING IN THE JAMES RIVER, VIRGINIA

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
Richard Burbidge, Graduate Assistant

PROJECT SUMMARY:

Samples were collected from 5 channel stations in the James River from June through November, 1969. Fish were collected with a 15' modified Cobb trawl and plankton with a Clarke-Bumpus. Water samples were also taken. Twelve fish samples were collected at each station.

Fish were weighed and measured and a subsample saved for stomach analysis. Data on fish length and weight have been analyzed with A.O.V., A.O.CoV., and Duncan's New Multiple Range tests to determine differences between mean lengths and length-weight relationships between stations and months. Numbers of fish collected have been analyzed to estimate relative abundance at each station by month.

Two 24 samples have been analyzed to determine feeding chronology of the species. Stomachs will be examined and correlated with plankton abundance to determine degree of selectivity (using Ivlev's Electricity Index).

Plankton species have been identified, and samples will be examined to determine standing crops of plankton present at time fish were collected. An attempt will be made to develop a scheme of energy flow between prey and predator.

An energy budget for the species is now being determined. Respiration experiments are almost complete. Egestion experiments will be undertaken shortly.

STATUS: This project represents Burbidge's dissertation research. It is a subproject of "Biology and Management of River Herring and Shad."

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: CALANOID COPEPODS OF NORFOLK CANYON

INVESTIGATORS:

Victor G. Burrell, Jr., Associate Marine Scientist
George C. Grant, Associate Marine Scientist
John A. Musick, Associate Marine Scientist

PROJECT SUMMARY:

Seasonal trips are being made to Norfolk Canyon to sample plankton at several depths and locations. A fall trip has been made (Albatross IV 1968), and a trip has just been completed this spring (Eastward 1971). Hydrographic data are recorded, bottom profiles determined, and plankton samples with Miller high speed samples (0.212 mesh aperture nets) are taken at several depths from 1 meter below the surface to just above the bottom.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: ZOOPLANKTON OF NORFOLK CANYON

INVESTIGATORS:

George C. Grant, Associate Marine Scientist
Victor G. Burrell, Jr., Associate Marine Scientist

PROJECT SUMMARY:

A qualitative and quantitative study of the as yet undescribed zooplankton communities existing in the waters of Norfolk Canyon is the purpose of this project. A preliminary series of plankton tows, 0-400 meters in depth, were obtained in August 1969 on board the R/V Albatross IV (NMFS). These were repeated at six-hour intervals over a 24-hour period. Initial examination revealed the presence (in summer) of an unsuspected boreal fauna at depth.

Spring fauna will be sampled in April 1971 via the R/V Eastward (an attempt to reach the area in November 1969 on this vessel failed), and winter sampling is planned for the early months of 1972 by use of the R/V Eastward.

Evidence for upwelling will be sought in April 1971 by making a series of Nansen casts down the axis of the canyon and examining the resulting temperature, salinity, and dissolved oxygen profiles.

STATUS: At present, this project is inadequately funded and preliminary in nature. Additional support is required.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: ANALOG COMPUTATION AND FISH POPULATION STUDIES

INVESTIGATOR:

C. E. Richards, Assistant Marine Scientist

PROJECT SUMMARY:

This project is involved with simulation of population dynamics.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: COBIA TAGGING STUDY

INVESTIGATOR:

C. E. Richards, Assistant Marine Scientist

PROJECT SUMMARY:

Twenty cobia were tagged, with four returns after 24-370 days out. All returns were from Chesapeake Bay and within 36 nautical miles of release and all by sport gear.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: BLACK DRUM (POGONIAS CROMIS) AGE, GROWTH
AND DISTRIBUTION

INVESTIGATOR:

C. E. Richards, Assistant Marine Scientist

PROJECT SUMMARY:

The age, growth, and distribution analyses of
black drum (Pogonias cromis) have been completed.

STATUS: A paper is being written for publication in
Transactions of the American Fisheries Society.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: RED DRUM (SCIAENOPS OCCELLATA) AGE, GROWTH,
AND DISTRIBUTION

INVESTIGATOR:

C. E. Richards, Assistant Marine Scientist

PROJECT SUMMARY:

Data tabulation and analysis are underway for
age-growth study for Sciaenops ocellata.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: AN ANALYSIS OF THE WHITE MULLET (MUGIL CUREMA)
IN VIRGINIA

INVESTIGATOR:

C. E. Richards, Assistant Marine Scientist
Michael Castagna, Associate Marine Scientist

PROJECT SUMMARY:

This project is a study of growth, predation, and distribution of the white mullet, Mugil curema, in Virginia including Chesapeake Bay and Seaside Eastern Shore.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: MULTIVARIATE STATISTICS IN TAXONOMY

INVESTIGATOR:

George C. Grant, Associate Marine Scientist

PROJECT SUMMARY:

Exploration of multivariate statistical procedures, such as discriminant functions, canonical analysis, and distance functions, in relation to possible application to problems of taxonomy is the purpose of this study. Of particular interest is the relation of "distance" between two sets of multiple measurements to taxonomic heirarchy, especially the species level.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: ASPECTS OF THE LIFE HISTORY AND COMMENSAL
BEHAVIOR OF A NEW SPECIES OF THE GENUS
LIPARIS (CYCLOPTERIDAE) FROM THE WESTERN
NORTH ATLANTIC

INVESTIGATORS:

John A. Musick, Associate Marine Scientist
Kenneth Able, Graduate Student

PROJECT SUMMARY:

A new species of cyclopterid fish in the genus Liparis differs from its congeners in a number of morphological characters and in the commensal association which it establishes with the mollusk, Placopecten magellanicus. Past references to this association which have referred to other species of Liparis have apparently been in error. More than 6000 specimens collected from scallops between Nova Scotia and Cape Hatteras are this new species. Spawning occurs in the spring. The eggs are demersal and adhesive. The pelagic larvae descend to the bottom at about 10 mm in length and enter live Placopecten. Laboratory and field observations indicate the Liparis occupies scallops during the day and forages at large at night. Sexual maturity is attained in one year. The species has spawned in the laboratory, and the eggs and yolk-sac larvae have been documented. Also, plankton collections have yielded yolk-sac and later larval stages and small juveniles.

STATUS: This project represents Able's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: THE ROLE OF CHEMICAL STIMULI IN THE PRE-
SPAWNING BEHAVIOR OF CHASMODES BOSQUIANUS

INVESTIGATORS:

John A. Musick, Associate Marine Scientist
Lynn Haines, Graduate Assistant

PROJECT SUMMARY:

Pheromone has been discovered to be released during courtship by males of Chasmodes bosquianus. Females react to this pheromone and may be attracted to it. Olfaction is believed to be used by the female in detecting the pheromone. If the pheromone is stored for 24 hours, it is no longer effective in evoking a response from the female.

STATUS: This project represents Haines' thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: EFFECTS OF UNBLEACHED KRAFT PULP AND PAPER MILL
EFFLUENT ON THE OPOSSUM SHRIMP NEOMYSIS AMERICANA

INVESTIGATORS:

George C. Grant, Associate Marine Scientist
Fred Jacobs, Graduate Assistant

PROJECT SUMMARY:

This will be a laboratory bioassay of the effects of various concentrations of Kraft mill effluent on the mysid Neomysis americana, an important prey species for anadromous fishes in the estuarine nursery grounds. Previous studies of the effects of paper mill effluents on various organisms have reached mixed conclusions, mostly due to daily variation in composition of the effluent. The present study will allow for such changes and estimate the range of lethality to be expected from each of various concentrations of effluent.

Effluent will be obtained from the Chesapeake Corporation plant at West Point, Virginia. In view of that plant's proposed expansion to bleaching operations (with a likely increase in toxicity of effluents), this study may provide timely baseline information.

STATUS: This project represents Jacobs' thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: MANAGEMENT OF CATFISHES IN THE JAMES RIVER,
VIRGINIA

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
James A. Lanier, Graduate Assistant

PROJECT SUMMARY:

A study of age, growth, mortality, and population size of three species of catfishes in the James River, Virginia is the purpose of this project. Those studied are: the channel catfish, Ictalurus punctatus, the white catfish, I. catus, and the brown bullhead, I. nebulosus. Economic potential of the channel catfish population as a source of live immature fishes was compared to its value if only adult fishes were harvested.

STATUS: This project represents Lanier's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: DEVELOPMENT OF CITHARICHTHYS ARCTIFRONS AND
ETROPUS MICROSTOMUS IN CHESAPEAKE BAY

INVESTIGATORS:

Edwin B. Joseph, Assistant Director
Sarah B. Leonard, Graduate Assistant

PROJECT SUMMARY:

This project will describe the development of Citharichthys arctifrons and Etropus microstomus from early stage larvae to adults including:

- (1) Changes in pigmentation,
- (2) Osteological development, and
- (3) Morphometric changes.

Also included is a discussion of occurrence in Chesapeake Bight and taxonomic implications of such work.

STATUS: This project represents Leonard's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: AGE AND GROWTH OF THE NORTHERN PUFFER,
SPHOEROIDES MACULATUS, FROM CHESAPEAKE BAY

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
Joanne Lyczkowski, Graduate Student

PROJECT SUMMARY:

This project was undertaken to develop a technique for age determination for the demersal estuarine fish, Sphoeroides maculatus. The growth rate, age at sexual maturity, fecundity, time of spawning, and weight-length relationships have also been determined.

STATUS: The field work and aging are complete. Analysis of data is in progress, and the writing was begun in February. This project represents Lyczkowski's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: A COLLECTION OF SLOPE FISHES FROM THE WESTERN
NORTH ATLANTIC WITH NOTES ON THEIR BIOLOGY AND
ECOLOGY

INVESTIGATORS:

John A. Musick, Associate Marine Scientist
Douglas Markle, Graduate Assistant

PROJECT SUMMARY:

All material involved in the project was collected aboard the Albatross IV cruise 69-8, in August 1969. Work has been done solely on preserved specimens brought back from this cruise and the data sheets, i.e. this project is based on a collection of fish which Markle has identified and catalogued, without remuneration, in the VIMS museum.

With some of the rarer and taxonomically difficult specimens, extensive taxonomic and morphological data has been taken. Other significant biological data, including what food habits and gonadal development data that can be gathered, has also been collected along with length frequencies of all specimens.

Species association, diversity, indices, and as much ecological data as can be reasonably justified are being compiled. Most of these calculations will be manual, although Data Processing may be used.

STATUS: This project represents Markle's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: BIOLOGY AND DISTRIBUTION OF SEVEN SPECIES OF SKATES (RAJA) OF THE CONTINENTAL SHELF OF THE EAST COAST OF NORTH AMERICA (CAPE HATTERAS TO THE GULF OF ST. LAWRENCE)

INVESTIGATORS:

John A. Musick, Associate Marine Scientist
John D. McEachran, Graduate Assistant

PROJECT SUMMARY:

All of the data to be used in this study has been collected and transferred to IBM cards. The National Marine Fisheries Service Laboratory at Woods Hole, Massachusetts has furnished the data on skates collected during groundfish surveys from 1965 through 1970. These data consist of print-outs and IBM cards which list coordinates, depths, and temperatures where skates were captured and length frequencies and total weights of each species of skate at each station. The Woods Hole Lab also permitted participation in eight groundfish cruises from March 1969 to March 1970. During these cruises, 300 specimens of the species Raja erinacea and R. ocellata were collected for a taxonomic study, and 1500 stomachs from six species of skates were obtained for food studies.

Additional data were obtained from the Fisheries Research Board of Canada, St. Andrews Station. The station furnished distribution data on skates collected on groundfish surveys off Nova Scotia from 1958 to 1970. Groundfish surveys of northern Scotian Baulks were made during the summer of 1970. Specimens of five species of skates were obtained from this cruise.

All 300 specimens of the sybling species have been examined, and the taxonomic study should be completed within several months. About one-third of the stomachs have been examined, and contents have been sorted into major taxa. A program for determining mean abundance of each species by degree temperature and depth stratum has been written, and other programs needed for the distributional study are on file at VIMS. The data analysis should be completed in six months.

STATUS: This project represents McEachran's dissertation research.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Fisheries Research Board of Canada
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: EFFECTS OF METHOXYCHLOR ON THE CONDITIONING
OF STRIPED BASS TO AN OLFACTORY STIMULUS

INVESTIGATORS:

John A. Musick, Associate Marine Scientist
Gregory Murray, Graduate Assistant

PROJECT SUMMARY:

Three groups of striped bass will be used--one control and two experimental groups. The two experimental groups will be exposed to concentrations of 5 and 10 ppb methoxychlor. One-half of each group will be positively-conditioned to the introduction of an odor. The other half will be negatively-conditioned. Differences in response to the stimulus and time required for conditioning will be looked for. Some histological work may be done.

STATUS: This project represents Murray's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: THE COMPARATIVE ECOLOGY OF TWO SPECIES OF
PIPEFISH IN THE YORK RIVER

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
Linda Pushee, Graduate Assistant

PROJECT SUMMARY:

The objectives of this study are to study the distribution of the two species of pipefish, Syngnathus fuscus and S. floridae, occurring in the York River, to compare their reproduction, growth, and feeding habits, and to determine the associated species and relative abundance.

The study will be carried out over a 12-month period. Samples will be collected once a month at approximately 20 stations selected randomly from the mouth of the York River to Penniman Spit. The R/V Brooks will be used to sample with a 16-foot otter trawl along with seining in the shallows. Ancillary data will be obtained from the monthly river surveys made by the Alosa and striped bass projects.

STATUS: This project represents Pushee's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: AGE AND GROWTH OF SILVER PERCH (BAIRDIELLA
CHRYSURA)

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
Scott F. Rhodes, Graduate Assistant

PROJECT SUMMARY:

Specimens of silver perch were collected from June through October of 1970. These samples were taken in trawls made by vessels which were being used by other projects at the time. Scale samples and pertinent data were taken and recorded. Scales were examined on laboratory scale projectors. The computer facilities at VIMS were used to process and analyze the data.

STATUS: This project is near completion. It represents Rhodes' thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: AGE, GROWTH, AND MORTALITY OF THE WHITE PERCH
IN THE JAMES AND YORK RIVERS

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
Richard A. St. Pierre, Assistant Marine Scientist

PROJECT SUMMARY:

The age, growth, and mortality of the white perch
in the James and York Rivers, Virginia, are being studied.

STATUS: This project represents St. Pierre's dissertation
research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: PREDATOR-PREY RELATIONSHIPS, GROWTH RATES,
AND ENERGY TRANSFORMATIONS IN JUVENILE
ATLANTIC MENHADEN (BREVOORTIA TYRANNUS) IN
THE YORK RIVER, VIRGINIA

INVESTIGATORS:

W. Jackson Davis, Department Head and Senior Marine
Scientist
James E. Weaver, Graduate Student

PROJECT SUMMARY:

The objectives of this project are to determine:

- (1) Quantitative abundance and production rates of phytoplankton,
- (2) Growth of juvenile menhaden,
- (3) Food and feeding habits of juvenile menhaden, including predator-prey relationships, and
- (4) An annual energy budget for juvenile menhaden by assessing ingestion, egestion, respiration, and possibly excretion rates.

Preliminary work will include:

- (1) Choice of sampling gear for collection of juvenile menhaden,
- (2) Designation of sampling areas,
- (3) One or more 24-hour sampling experiments to determine:
 - (a) Feeding periodicity and
 - (b) General aspects of food preferences to determine the equipment and procedures needed for assessment,
- (4) Choice and testing of sampling gear to collect phytoplankton for identification and enumeration, and
- (5) Selection of a method for assessing primary production and experimental determination of the number of samples for a valid estimate.

STATUS: This project represents Weaver's dissertation research. It is in its preliminary stage.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Ichthyology Department

PROJECT TITLE: ASPECTS OF THE SYSTEMATICS AND BIOLOGY OF THE
AMERICAN EEL, ANGUILLA ROSTRATA (LE SUEUR)

INVESTIGATORS:

John A. Musick, Associate Marine Scientist
Charles A. Wenner, Graduate Assistant

PROJECT SUMMARY:

The following studies are being made:

- (1) Morphometrics, meristics, and description of vertebral anomalies of elvers collected in Bracken's Creek (off the York River) during March, April, and May of 1970 and February, March, April, and May of 1971,
- (2) Morphometrics and fecundity of female silver eels purchased from a dealer on the Eastern Shore,
- (3) Morphometrics and gonadal sections (histological) of male silver eels purchased on the Eastern Shore,
- (4) Morphometrics and gonadal sections of yellow eels (freshwater and estuarine forms) from various river systems in the Chesapeake Bay, and
- (5) Morphometrics, meristics, and gonad states of silver eels captured by otter trawl on the continental shelf by the Albatross IV and the Seabreeze.

STATUS: This project is nearing completion. It represents Wenner's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Malacology Department

PROJECT TITLE: BREEDING AND TESTING OF SUPERIOR LINES OF OYSTERS
WITH RESISTANCE TO DISEASES, ESPECIALLY MSX
AND DERMOCYSTIDIUM

INVESTIGATORS:

Jay D. Andrews, Department Head and Senior Marine
Scientist
Michael Friermann, Research Assistant

PROJECT SUMMARY:

An epizootic of MSX (Minchinia nelsoni) in 1959 decimated private and public beds in lower Chesapeake Bay in about two years. Annual cycles of infection and mortality on oyster beds and in trays of oyster were determined, and a series of publications describing areas of occurrence and timing of epizootics has been completed.

Search for resistant stocks led to discovery of acquired immunity by early exposure in MSX areas regardless of selection or lack of exposure of parents. Further proof of this type of immunity and continued breeding for genetic immunity are in progress.

The program has been broadened to include selection for quality oysters with emphasis on growth, shape, and disease resistance. This is a long-term project, for oysters must be grown two to four years before progeny testing and selection clearly indicate the superior oysters for subsequent breeding. The program includes monitoring several rivers for changes of susceptibility of stocks, intensity and distribution of diseases, especially in seed areas, and intensity of epizootics each year.

The objective is to obtain highly selected lines of brood stocks for hatchery, pond, and eventually open water culture.

STATUS: Oysters resistant to MSX have been used to breed third and fourth generation progeny with resistance. Selection for growth and size has been followed but will be intensified. Old brood stocks from 6 to 12 years old are available for breeding including some sibling lots. Progeny breeding and selection have been favored over mass breeding and selection because a relatively high resistance has already been obtained.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Malacology

PROJECT TITLE: AQUACULTURE - STUDIES OF GENETICS AND DISEASES
OF OYSTERS IN LOWER CHESAPEAKE BAY -
RANN-NSF PROGRAM

INVESTIGATORS:

Jay D. Andrews, Department Head and Senior
Marine Scientist
John L. Dupuy, Associate Marine Scientist,
Department of Microbiology-Pathology

PROJECT SUMMARY:

The objectives of this project are to continue our efforts in selective breeding of oysters to achieve a high level of resistance to the oyster disease designated as MSX. The principal investigator now has third and fourth generation stocks that show significantly increased disease resistance when compared with susceptible control stocks.

Selected pairs or "lots" of oysters are bred in the VIMS culture laboratory. The larvae are reared on uni-algal cultures and set using the VIMS technique to produce cultch-free spat. When the spat have reached an appropriate size, they are placed in trays and exposed to infection in areas of lower Chesapeake Bay where the MSX disease is still prevalent. Susceptible control lots are treated in the same fashion.

Selection for disease resistance will be coupled with selection for high growth rates and uniform shell shape. All of these characteristics are of vital importance in the development of a more advanced state of aquaculture. The effort at VIMS complements the efforts of the University of Maryland where participants are engaged in the mechanical aspects of aquacultural support systems.

STATUS: Active. This is a project of "The Chesapeake Bay - A Coordinated Research Program."

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Virginia Institute of Marine Science
Malacology Department

PROJECT TITLE: LARVAL DISTRIBUTION, ABUNDANCE, AND TRANSPORT
SYSTEMS

INVESTIGATOR:

Jay D. Andrews, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

Field work was completed in 1965 and counting of
oyster larvae in 1966. The manuscript is about half completed
The material contains important, but controversial, findings
about bivalve transport and dispersal.

STATUS: The project is completed except for the write-up
which is half complete.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Malacology Department

PROJECT TITLE: OYSTER SETTING PATTERNS IN VIRGINIA

INVESTIGATOR:

Jay D. Andrews, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

Irregular records of setting on weekly, seasonal, and annual basis were kept for a two-year period. The basic data were turned over to Mr. Haven (Department of Applied Marine Biology) in February 1970 for a comprehensive review of the oyster industry. The data has been tabulated as collected, but no explanation and summary have been written except for the first few years. The data contains information on setting patterns, fouling, changes in population, predation, and is related mostly to public beds.

STATUS: The data are organized by rivers, and most tables have been completed. Write-up of this data is partially completed.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Malacology Department

PROJECT TITLE: MSX AND SALINITY IN JAMES RIVER SEED AREAS

INVESTIGATOR:

Jay D. Andrews, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

This work was completed and the manuscript written in 1965. It describes the distribution of MSX in 1964 and 1965, a year of maximum penetration of the seed area, and the effects of spring salinities in permitting oysters to reject MSX infections.

STATUS: The manuscript awaits publication in the monograph on the James River.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: MANAGEMENT OF LARVAE, SUPPLY OF FOOD, AND
SETTING OF LARVAE

INVESTIGATORS:

John L. Dupuy, Associate Marine Scientist
Franklin D. Ott, Assistant Marine Scientist
Samuel Rivkin, Research Assistant

PROJECT SUMMARY:

Objectives of this project are:

- (1) Development of methods to produce and handle oyster, clam, Bay scallop, and Calico larvae to post-setting juveniles for field use,
- (2) Development of methods to fatten, condition, and spawn parent stocks,
- (3) Development of two methods for obtaining cultch-free oyster spat,
- (4) Bioassay of phytoplankton isolates for foods for invertebrate larvae, and
- (5) Bioassay of "red water" organisms with invertebrate larvae.

STATUS: Continuing.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
Virginia Institute of Marine Science

PROJECT TITLE: ULTRASTRUCTURAL STUDIES OF BACTERIA GROWN IN AQUEOUS AND SEMISOLID MEDIA WITH EMPHASIS ON INTERCELLULAR SPACIAL ORIENTATION IN UNIFORM AND ZERO GRAVITY FIELDS

INVESTIGATOR:

Frank O. Perkins, Department Head and Senior Marine Scientist

PROJECT SUMMARY:

Attempts are being made to determine accurately (1) the spatial and size distribution of viable coccoid bacteria (Staphylococcus aureus) growing in liquid and semi-solid media within uniform and zero gravity fields, (2) the intercellular components, if any, which influence cellular spacing patterns, and (3) the mechanisms for producing the patterns. Freeze-etch techniques are being used to determine spatial relationships, because there is a minimum probability of intercellular reorientation during specimen preparation. Fixed and thin-sectioned cells are used to determine the structure of intercellular components.

It has been necessary to modify the freeze-etch plant so that frozen columns of cells can be fractured. This has been accomplished, and data is being accumulated on intercellular distributions.

STATUS: Active.

FINANCIAL SUPPORT:

National Aeronautics and Space Administration
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: VARIATION IN MORPHOLOGY OF THE ENDOBIOTIC
SYSTEM OF PHLYCTOCHYTRIUM, A MARINE CHYTRID

INVESTIGATOR:

Frederick Y. Kazama, Associate Marine Scientist

PROJECT SUMMARY:

The most important morphological feature separating the genus Phlyctochytrium from Rhizophydium is the presence or absence of an expanded portion of the rhizoidal system termed the apophysis. Preliminary studies indicate that the apophysis may not be a consistent feature of the Chytridiaceous fungus originally identified as Phlyctochytrium on its "natural" substrate, Bryopsis plumosa. Here, an apophysis is present, but when the fungus is grown in axenic culture on agar, the presence of the organelle is variable.

In broth culture, the apophysis is very rarely observed. It is hypothesized that the mechanical resistance of the substrate may be partially responsible for the development of the apophysis, the more resistant the substrate the more apt that an apophysis will be formed. Currently, the ultrastructure of the endobiotic system is being studied while the fungus is growing on "natural" substrates and on agar. Later, silica gels of various mechanical strengths will be prepared and the fungus inoculated on these gels. These inoculated pieces of gels will be floated on nutrient media. The answer as to whether the mechanical resistance of the substrate is responsible for apophysis formation should then be forthcoming.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: ACID PRODUCTION OF PHLYCTOCHYTRIUM SP., A
MARINE CHYTRID

INVESTIGATOR:

Frederick Y. Kazama, Associate Marine Scientist

PROJECT SUMMARY:

When Phlyctochytrium is grown on a defined seawater medium, copious amounts of an acid are produced as indicated by a drop in pH to approximately 5.0 from an initial pH of 7.6. The two possible carbohydrate sources are glucose and monosodium-glutamate which are incorporated into the media. There is a strong possibility that the acid is lactic acid or perhaps, though less likely, glutamic acid which is formed after the deamination of the monosodium-glutamate. It has been observed that greater amounts of the acid are produced in standing cultures than in shake cultures.

We have initiated studies to determine lactic dehydrogenase and alcohol dehydrogenase activity. If the level of lactic dehydrogenase is high, we propose to look for various forms of the enzyme under various salinities as well as to study the effect of salinity on enzyme activity. A comparison of the isozymes of the marine Phlyctochytrium with those reported for closely related terrestrial fungi may prove to be interesting.

STATUS: This project was begun in February, 1971.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: TISSUE CULTURES OF ROCCUS SAXATILIS

INVESTIGATOR:

Frederick Y. Kazama, Associate Marine Scientist

PROJECT SUMMARY:

Using standard tissue culture techniques and commercially available growth media, we have been able to obtain primary monolayer cultures of trypsinized gonadal tissue. These cells have proven to be refractory to further subculturing and we have not been able to establish any continuing cell lines.

STATUS: Intermittent experiments are being conducted.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: ECOLOGICAL, LIFE HISTORY, AND ULTRASTRUCTURAL
STUDIES OF MARINE FUNGI IN THE LOWER CHESAPEAKE
BAY

INVESTIGATOR:

Frederick Y. Kazama, Associate Marine Scientist

PROJECT SUMMARY:

Selected biflagellate and uniflagellate fungi of the Class Phycomycetes are being studied on a continuing, long-term basis. Seasonal distributions as a function of substrate, temperature, and salinity are being observed. The cell biology, with emphasis on ultrastructure as a means of elucidating the taxonomy, is being studied. Life histories are being determined from accumulated data.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: ULTRASTRUCTURE OF THE ZOOSPORES OF PHLYCTO-
CHYTRIUM SP., A MARINE UNIFLAGELLATE FUNGUS

INVESTIGATOR:

Frederick Y. Kazama, Associate Marine Scientist

PROJECT SUMMARY:

A marine chytrid was recently isolated from the green alga, Bryopsis plumosa. The zoospores showed a marked positive phototactic and chemotactic response. In order to determine whether there is a detectable morphological basis for these responses, an ultrastructural study has been undertaken. Preliminary observations indicate that there is present a heretofore undescribed organelle within the zoospores which may be partially responsible for the tactic responses. The organelle appears to be a fenestrated system of membranes possessing a regular hexagonal array. This organelle is located just beneath the surface of the zoospore.

Presently, the origin of the organelle as well as its eventual fate is being studied. Ultrastructural techniques such as negative staining, thin-sectioning, and freeze-etching are being used.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: ECOLOGICAL, LIFE HISTORY, AND ULTRASTRUCTURAL
STUDIES OF MARINE PROTOZOA IN THE LOWER
CHESAPEAKE BAY

INVESTIGATOR:

Frank O. Perkins, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

Marine protozoa of the lower Chesapeake Bay with emphasis on pathogenic species are being studied. The seasonal distribution with respect to host or other substrate and the ultrastructure are being considered. Information derived from these studies is being used to determine the life histories of the organisms.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: ULTRASTRUCTURE OF RHIZOIDAL SYSTEMS IN MARINE
MONOCENTRIC FUNGI

INVESTIGATOR:

Frank O. Perkins, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

The fine structure of rhizoids in marine monocentric fungi is being studied in an attempt to elucidate the taxonomy of the heterogeneous group and to contribute to an understanding of the cell biology of primitive motility in these forms.

Rhizoids of members of this group and the labyrinthulids are similar in the mechanism by which they are formed.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: ULTRASTRUCTURE OF THE PARANUCLEAR BODY OF
PARAMOEBA PEMAQUIDENSIS

INVESTIGATOR:

Frank O. Perkins, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

The fine structure of the organism or organelle found in the holozoic amoeba, Paramoeba pemaquidensis, is being studied. Mitosis in the eucaryotic portion is being examined closely, and attempts are being made to determine if the paranuclear body forms phagosomes. P. pemaquidensis may be identical to P. perniciosa, the causative agent of gray crab disease.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: THE EFFECT OF SALINITY ON THE ENZYMES OF A
MARINE FUNGUS

INVESTIGATOR:

Frederick Y. Kazama, Associate Marine Scientist
James P. Amon, Graduate Assistant

PROJECT SUMMARY:

A marine chytrid fungus which has been isolated from the alga Bryopsis is being investigated to determine how salinity (sodium and magnesium concentration) affects its enzyme systems. This fungus is capable, by present observations, of producing large quantities of what probably is lactic acid. The investigation is intended to show how much of the enzyme lactate dehydrogenase is present, what its isozyme composition is, and how salinity affects the isozyme pattern. If initial work indicates a strong relationship of the enzyme to salinities, an analysis of how this affects RNA synthesis will be made.

This fungus is probably an active decomposer in the marine environment. Therefore, this study can be used as an indication of how various salinities affect the ability of a marine organism to decompose organic material.

STATUS: Cultures have been initiated and analysis materials ordered.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: THE LIFE CYCLE AND SPORULATION OF LABYRINTHULA SP.

INVESTIGATORS:

Frank O. Perkins, Department Head and Senior Marine
Scientist
James P. Amon, Graduate Assistant

PROJECT SUMMARY:

The fungus Labyrinthula is being investigated to determine the factors affecting its sporulation and life cycle. Labyrinthula is a problematic genus of marine fungi which has been implicated in the wasting disease of eelgrass (Zostera sp.). In a previous study, methods for maintaining sporulating colonies of Labyrinthula were worked out. The exact parameters which affect the timing and intensity of sporulation were not clear at that time. An attempt is presently being made to carefully eliminate each character which does not affect the sporulation. Analysis of the natural host conditions is being made in hope that inducer conditions might be found. The study should tell much about the physiology of the organism and possibly define how environmental factors could influence the reproductive potential of the organism. Progress thus far has shown: (1) a complex relation between the condition of the host and the initiation of sporulation, (2) a minimum moisture requirement, and (3) a new part of the life cycle possibly showing both haploid and diploid nuclei in different individual cells.

STATUS: This project represents Amon's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: VERTICAL DISTRIBUTION OF PHYTOPLANKTON IN
RELATION TO THE EFFECTS OF SURFACE ADSORPTION
OF MONOMOLECULAR FILMS

INVESTIGATORS:

John L. Dupuy, Associate Marine Scientist
Victoria R. Gibson, Graduate Assistant

PROJECT SUMMARY:

Vertical distribution of estuarine phytoplankton in the surface microlayer and at one meter and fluctuations caused by surface adsorption of monomolecular films in lower Chesapeake Bay and the York River are being studied in this project.

STATUS: This project represents Gibson's thesis research.
A publication is in press.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: VERTICAL DISTRIBUTION, STRUCTURE, AND DIVERSITY-
PRODUCTIVITY RELATIONSHIPS OF AN ESTUARINE
DIATOM COMMUNITY

INVESTIGATORS:

John L. Dupuy, Associate Marine Scientist
John Manzi, Graduate Assistant

PROJECT SUMMARY:

This study will involve an intensive 18 month sampling program along a four station transect of the lower York River estuary. At each station, the water column will be sampled at five depths (surface microlayer to bottom) over 24-hour periods. A number of quantitative analytical methods for identifying and describing the structure of diatom communities will be applied to these samples. In addition, the samples will be analyzed for nitrates, phosphates, ammonia, and silicon, as well as standard physical parameters. The ^{14}C light-dark bottle technique will be used to determine rates of primary productivity on replicate samples throughout the program.

Results from preliminary sampling indicate distinct diatom diversity differences between the surface microlayer and the remainder of the water column. This study will attempt to establish the temporal and successional character of this diversity difference as well as supply spatial and temporal vertical diversity profiles of the diatom population in the lower York River. Diatom energy-depth relationships will be studied through productivity and light intensity measurements. In addition, comparisons will be made between the components of diversity and the nutrient levels and physical parameters with depth at each station.

STATUS: This project, which is in its preliminary stage, represents Manzi's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: VARIATIONS IN SEASONAL FLUCTUATIONS AND VERTICAL DISTRIBUTIONS OF THECATE DINOFLAGELLATES IN THE MOBJACK BAY AND YORK RIVER AS DETERMINED BY SPECIES OBSERVED, POPULATION DENSITY, AND SPECIES DIVERSITY, AND THE IDENTIFICATION, DELINEATION, AND TRACKING OF "RED WATERS" OCCURRING IN THE INVESTIGATION AREA

INVESTIGATORS:

John L. Dupuy, Associate Marine Scientist
Paul Stofan, Graduate Assistant

PROJECT SUMMARY:

The research includes the preparations of a check list of thecate dinoflagellates observed and the annual fluctuations of species as well as population changes described by densities and diversities. The relative importance of the dinoflagellates in total phytoplankton population will be examined for annual fluctuations. Variations in the vertical distribution of the dinoflagellates is being determined for the surface (top 150 μ), $\frac{1}{2}$ meter, and 1 meter depths. The occurrence of "red water" will be observed to determine if there is any uniformity in the factors inducing the blooms, areas of occurrence, direction of movement, and size of blooms, as well as the species involved in the bloom.

STATUS: Continuing. This project represents Stofan's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department

PROJECT TITLE: BIOLOGY OF A MARINE BACTERIOPHAGE

INVESTIGATORS:

Frank O. Perkins, Department Head and Senior Marine
Scientist

Arthur Zachary, Graduate Assistant

PROJECT SUMMARY:

An attempt is being made to isolate and study a bacteriophage whose host is either an estuarine or marine bacterium. At present, a phage and host have been isolated from mollusk fecal material. Once grown to sufficiently high titer, the phage will be characterized (size, shape, nucleic acid, etc.), and its replicative cycle will be studied using EM techniques. Attempts will be made to isolate other bacteriophages and to evaluate the use of filter feeders as a means of virus collection in aquatic habitats. Ultimately, some insight into the ecological significance of marine viruses may result from this study.

STATUS: This project represents Zachary's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: A STUDY OF CERTAIN ASPECTS OF HOST-SPECIFICITY,
ZOOGEOGRAPHY, AND PHYLOGENY OF MONOGENETIC
TREMATODES

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Adrian R. Lawler, Graduate Assistant
E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

Ectoparasites of the order Monogenea exhibit a high order of host-specificity. As a result, it seems probable that more thorough study of the order will yield interesting information concerning host-specificity, zoogeography, and phylogeny of both hosts (fishes and some reptiles and amphibians in general) and parasites.

To accomplish this, pertinent data extracted from a comprehensive literature survey, as well as from our own taxonomic work on monogenetic trematodes collected from around the world, are recorded in a Key-Sort card catalog. Analysis of the data in the Key Sort "memory core" will conceivably yield:

- (1) An understanding of the distribution patterns of monogeneid species,
- (2) Elucidation of the distribution of monogenetic trematodes,
- (3) Paleodistribution and histories of isolated populations of fishes as indicated by occurrence of monogeneids in contemporary species,
- (4) The possible phyletic origin and evolution of monogeneid flukes, and
- (5) Possible applications of host-specificity patterns of monogeneids in clarifying the relations of the fish hosts.

By-products of this research have resulted in the translation and publication of numerous important foreign works on the Monogenea, the compilation of a bibliography, and many collections from various localities.

STATUS: VIMS funds are supporting accessioning of literature on Monogenea and its processing for inclusion in the

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

STATUS (Cont'd):

key-sort card system. A dissertation based on some of this data is the subject of a separate report. Maintaining the library and "data bank" is a continuing operation.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: BIBLIOGRAPHY OF THE MONOGENETIC TREMATODE
LITERATURE OF THE WORLD, 1758 TO PRESENT

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Adrian R. Lawler, Graduate Assistant

PROJECT SUMMARY:

A necessary tool and natural product of any comprehensive literature review is an accurate, up-to-date bibliography. Such a bibliography has resulted from the Parasitology Section's taxonomic work on monogenetic trematodes [Platyhelminthes: Trematoda] and as a consequence of data accessioning for an analysis of the host-specificity of this interesting group of parasites. The publication of a complete bibliography on these parasites is a valuable aid to their study. Since the basic Bibliography was published in September 1969, it has received wide acclaim from workers in the field. It is hoped to keep the Bibliography current with annual supplements. Supplement 1 to the Bibliography was published in February 1970, and Supplement 2 is ready for press now.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: MONOGENETIC TREMATODES OF AMPHIBIANS AND REPTILES OF VIRGINIA

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Claude Combes *
Adrian R. Lawler, Graduate Assistant

PROJECT SUMMARY:

Very little work has been done on the monogenetic trematodes from amphibians and reptiles of Virginia. As most of our studies have been on parasites of fishes, an examination of the parasite fauna of amphibians and reptiles should prove both enlightening and interesting. Collections of 758 host individuals representing 73 species were made in 1959. At present, these parasites are being worked up, and the host-parasite data will be added to our host-specificity file.

STATUS: Collection is now in the hands of Professor Combes who will co-author with Dr. Hargis.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Professor Claude Combes (Maitre de Conférences, C.S.U., Avenue de Villeneuve, 66 Perpignan, France),
Co-investigator with Dr. Hargis.

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: PARASITES OF CHESAPEAKE BAY FAUNA

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director

David E. Zwerner, Assistant Marine Scientist

Adrian R. Lawler, Graduate Assistant

E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

Knowledge of the parasite fauna of marine vertebrates and invertebrates from the waters of the Chesapeake Bay is sparse. This Section undertakes various parasitological projects in their assistance to other VIMS departments and to others outside of VIMS. Most of these projects involve the identification of parasites or parasite caused problems. Examples are parasites of Morone saxatilis and various parasites of mollusks which serve as intermediate hosts for many helminths.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: STUDIES OF LARVAL MONOGENEA OF FISHES FROM
THE CHESAPEAKE BAY AREA

INVESTIGATORS:

N. Kingston*
W. A. Dillon*
William J. Hargis, Jr., Section Head and Institute
Director

PROJECT SUMMARY:

Little research had been done on larvae of monogenetic trematodes of North American fishes. Knowledge of the taxonomy of larvae of known adult Monogeneids would provide much information on the ontogeny and phylogeny of the group and determine to a greater or lesser degree if the base of our taxonomy of adult worms is sound.

Adult monogenetic trematodes, collected from Chesapeake Bay area fishes, were placed into small dishes of sterile sea water and allowed to deposit eggs. Upon hatching, larvae were studied both alive and in fixed preparation under a monobjective microscope. Photographs and drawings were made to facilitate study.

In 1969, a portion of the work conducted by the principal investigator during several summers at VIMS was published. Additional information resulting from these studies is being readied for publication.

STATUS: At least one more paper can be expected from the data in hand.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Dr. Newton Kingston: Division of Microbiology and Veterinary Medicine, Box 3354, University Station, University of Wyoming, Laramie, Wyoming, Participant in VIMS Summer Program

*Dr. William A. Dillon: University of Tennessee at Martin, Martin, Tennessee, former VIMS employee

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: MONOGENETIC TREMATODES OF FISHES OF THE
WESTERN NORTH ATLANTIC

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Adrian R. Lawler, Graduate Assistant

PROJECT SUMMARY:

The goals of this study are essentially the same as those for other fish collections made by this Section, namely the systematics, phylogeny, and host-specificity of monogenetic trematodes. Based on a master plan of world wide collections of Monogenea and their subsequent systematic work-up, data on both the systematics of the host and parasite together with pertinent ecological data are entered into a Key-Sort card catalog for future analysis.

Collections of fishes from Chesapeake Bay and Atlantic coastal areas have been made from time to time by Section personnel either individually or during organized collecting trips or cruises. An example was the R/V Delaware cruises made in 1958 and 1959 in conjunction with the Fish and Wildlife Service's Exploratory Fishing and Gear Development Program. The Monogenea from these collections are being processed and examined for inclusion in our world-wide survey. The Monogenea and other parasites from the Chesapeake Bay area are presently being worked-up for inclusion in a VIMS Checklist of invertebrates. Many new host and locality records have been made.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: TRANSLATIONS OF MONOGENETIC TREMATODE LITERATURE

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
John E. Simmons*
Adrian R. Lawler, Graduate Assistant

PROJECT SUMMARY:

In conjunction with a comprehensive literature survey on the host-specificity and taxonomy of the Monogenea, it has been necessary to translate many foreign works on the subject, most of them in Russian. To date, the Section has caused 45 foreign papers to be translated; 40% of these have been edited by Section personnel and published for use by other scientists.

At the present time, Dr. John E. Simmons is editing two rather lengthy translations (Ivanov, 1952 and Bychowsky, 1937) for inclusion in our VIMS Translations Series.

Another long translation (Gussev, 1955) is being readied by Section personnel for publication in the not too distant future.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Dr. John E. Simmons, Department of Zoology, University of
California, Berkeley, California 94720

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: STUDIES ON PARASITIC DINOFLAGELLATES OF
CYPRINODONTIDS OF VIRGINIA AND NORTH CAROLINA

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
Adrian R. Lawler, Graduate Assistant
Jiri Lom*
Gail Makiernan*

PROJECT SUMMARY:

The following studies are being made under this
project:

- (1) Oodinium cyprinodontum Lawler, 1967 found on
the gills of Fundulus majalis, F. heteroclitus,
F. luciae, Cyprinodon variegatus, Lucania parva,
- (2) With Makiernan, a description of dinospore
formation which is in progress,
- (3) With Lom, EM study of attachment and relation
to host tissue,
- (4) With Lom, a redescription of Oodinium cyprinodontum
and a discussion of its taxonomic position, which
is in progress, and
- (5) Papers in progress by Lawler on: (a) Incidence
and intensity of infestation of each host species
in Virginia and North Carolina, (b) seasonality
of infestation, (c) life-history, and (d) other
miscellaneous smaller papers.

STATUS: Three papers have been published. One is in the
final stages, and several more are in progress.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Dr. Jiri Lom, Institute of Parasitology, Czechoslovakia
*Gail Makiernan, George Washington University

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: POLYCLAD OYSTER ASSOCIATES

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
Adrian R. Lawler, Graduate Assistant
Dexter S. Haven, Senior Marine Scientist, Department
of Applied Marine Biology
James P. Whitcomb, Assistant Marine Scientist,
Department of Applied Marine Biology

PROJECT SUMMARY:

One paper has been published on Coronadena mutabilis
(Verrill) in Virginia. A paper is planned with Haven on
polyclads of the James River.

STATUS: The collection of polyclads of the James River has
already been made. Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: ZOOGEOGRAPHY AND HOST-SPECIFICITY OF THE
SUPERFAMILY CAPSALOIDEA

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
Adrian R. Lawler, Graduate Assistant

PROJECT SUMMARY:

Very little extensive work has been done on the host-specificity and zoogeography of monogenetic trematodes. Individual species of Monogenea have been observed by various workers to exhibit a strong degree of host-specificity, but no major group of these parasites has been well studied.

The members of the superfamily Capsaloidea Price, 1936, exhibit the widest range of habitats and widest range of hosts of monogenetic trematodes of marine fishes. They are found in the following places on their hosts: (1) gills and/or mouth, (2) skin, (3) cloaca, (4) coelom, (5) spiral intestine, (6) rectal gland, (7) nasal chamber, and (8) carapace of parasitic copepods. They are found on fishes of the major groupings Elasmobranchii, Holocephali, Chondrostei, and Teleostei.

Each species of the superfamily Capsaloidea Price, 1936, will be studied with respect to its synonyms, location of host, host, location of collection, host synonyms, host classifications, and host distribution by review of the original literature.

This study should help clarify our understanding of (1) host-specificity of monogenetic trematodes, (2) host-parasite relationships, (3) natural taxonomy of both hosts and parasites, and (4) zoogeography of monogenetic trematodes.

STATUS: This project represents Lawler's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: INFECTIOUS DISEASES OF MARINE FISHES: THEIR SYMPTOMS AND CONTROLS, TOGETHER WITH A GLOSSARY AND A BIBLIOGRAPHY OF CONTROLS OF DISEASES OF MARINE FISHES

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Adrian R. Lawler, Graduate Assistant

PROJECT SUMMARY:

The infectious diseases of marine fishes were investigated through review of the literature. Special emphasis was placed on the symptoms exhibited by the host and on the different methods of control of a parasite that have been used to date.

A glossary of terms applicable to fish diseases was prepared to benefit the layman. In addition, a fairly comprehensive bibliography on controls of diseases of marine fishes was included.

This work will soon be put out as a Special Scientific Report of this Institute.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: MONOGENETIC TREMATODES OF STROMATEID FISHES
OF THE WORLD

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Michael H. Horn*

PROJECT SUMMARY:

Dr. Horn, a systematic ichthyologist, worked on the stromateid fishes of the world for his Ph.D. dissertation. During his studies, he managed to collect the monogenetic trematodes from these fishes. Since the systematics of the hosts have been worked out, it is planned to work out the systematics of the parasites in order to gain information concerning the phylogeny of both host and parasite based on host-specificity observations.

STATUS: The Section has just received Dr. Horn's collection, and the project has been started on a "time available" basis.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Dr. Michael H. Horn, California State College at Fullerton,
800 North State College Boulevard, Fullerton,
California 92631

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: MONOGENETIC TREMATODES OF MENHADEN

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
Adrian R. Lawler, Graduate Assistant
E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

A detailed collection of juvenile and adult clupeids (primarily of the genus Brevoortia) was made from many stations along the Atlantic and Gulf coasts in order to check seasonal, geographic, host age variability of infestation, intraspecific, intrageneric, and intrafamilial parasite distribution, and thus derive a more detailed understanding of some of the factors acting in host-parasite relationships.

This study is expected to yield information concerning:

- (1) The incidence of parasites with respect to season,
- (2) The time of infestation of host by the parasite,
- (3) The geographical areas and biological conditions under which initial infective contact is made,
- (4) The continuing relationship between juvenile and adult fishes and the infective, post-infective, and adult stages of the parasites,
- (5) The use of parasites as natural tags in order to distinguish species or populations, and
- (6) The aspects of ontogeny of the host-parasite relationship in the clupeids.

STATUS: This project is inactive at the present time. VIMS funds are used for maintaining the collection.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

DIVISION OF PHYSICAL, CHEMICAL, AND GEOLOGICAL OCEANOGRAPHY

William J. Hargis, Jr., Acting Division Head

Virginia Institute of Marine Science
Division of Physical, Chemical, and
Geological Oceanography

PROJECT TITLE: FLUX OF MATERIALS AT THE MOUTH OF CHESAPEAKE
BAY - RANN-NSF PROGRAM

INVESTIGATORS:

Robert J. Byrne, Acting Department Head and
Associate Marine Scientist, Department
of Geological and Chemical Oceanography
C. S. Fang, Acting Department Head and Associate
Marine Scientist, Department of Physical
Oceanography and Hydraulics
Albert Y. Kuo, Associate Marine Scientist,
Department of Physical Oceanography and
Hydraulics
Evon P. Ruzecki, Associate Marine Scientist,
Department of Physical Oceanography and
Hydraulics

PROJECT SUMMARY:

There is wide recognition of the need to know the net flux of various materials at the Bay mouth. Such studies will have direct bearing on the interpretations given to the U. S. Corps of Engineers Chesapeake Bay hydraulic model as it will indicate the renewal characteristics at the Bay mouth. It will, of course, give the much needed information as to the extent to which the Bay System acts as a contaminant source for the continental shelf. Flux studies should include total water chemistry, particulate materials, and pelagic biota as well as flow. The sampling design should include the effects of extreme events and seasonality.

Both VIMS and CBI have, over the recent years, performed near-entrance shelf studies, and these have served to depict the generalized hydrographic conditions on a seasonal basis. Additional work needs to be done to arrive at a sound sampling design for the determination of fluxes. The execution of flux measurements will require the pooling of all the available personnel and vessels of the Bay institutions and agencies.

The work proposed for the first year will focus on acquiring information needed for a meaningful flux study design and on the formulation of a mathematical model of Bay mouth circulation. Specifically, these studies are:

- (1) Field studies to verify the existence and persistence of large nearshore eddies on the sides of the Bay mouth.
- (2) Development of a theoretical model of the Bay mouth as a pulsating jet orifice; the model

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Division of Physical, Chemical, and
Geological Oceanography

PROJECT SUMMARY (Cont'd):

to include effects of buoyancy and regional drift currents on the shelf. This initial emphasis on model formulation is important, as it will focus attention on the sampling design needs for verification. Also programmed are those field measurements which will give gross insights into the entrainment of shelf water and the influence of stratification on entrainment.

STATUS: Active. This is a project of "The Chesapeake Bay - A Coordinated Research Program."

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: HYDROGRAPHIC STUDIES OF CHESAPEAKE BAY-
COLLECTION OF HYDROGRAPHIC DATA ON CHESAPEAKE
BAY AND TRIBUTARIES

INVESTIGATORS:

William J. Hargis, Jr., Acting Division Head and
Institute Director
C. S. Fang, Acting Department Head and Associate
Marine Scientist
Evon P. Ruzecki, Associate Marine Scientist

PROJECT SUMMARY:

The Virginia Institute of Marine Science will collect hydrographic data on the Rappahannock River and Mobjack Bay, Virginia. The data to be gathered will consist of measurements of tidal elevation, current velocity, and salinity. They will install, operate, and maintain a temporary tide gauge network in the Rappahannock River and Mobjack Bay, and, at the same time, operate and maintain those tide gauges of the permanent tide gauge network, installed by the U. S. Coast and Geodetic Survey, within Virginia waters. Starting June 1, 1971, VIMS will collect hydrographic data on the James River, Virginia.

STATUS: Continuous.

FINANCIAL SUPPORT:

U. S. Army Corps of Engineers
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: FATE OF WASTE HEAT DISCHARGED INTO THE JAMES
RIVER ESTUARY BY THE SURRY NUCLEAR POWER
STATION AT HOG POINT, SURRY COUNTY, VIRGINIA

INVESTIGATORS:

William J. Hargis, Jr., Acting Division Head and
Institute Director
C. S. Fang, Acting Department Head and Associate
Marine Scientist
Wyman Harrison, Senior Marine Scientist
Robert Bolus, Assistant Marine Scientist
S. N. Chia, Research Assistant

PROJECT SUMMARY:

Field studies to determine temperature profiles in the vicinity of the mixing zone of the plume will be made. The collected data will be digitized and recorded on computer-compatible magnetic tape. The surface temperature patterns previously obtained by Pritchard and Carpenter in their model study will be compared to those obtained in this field study for similar wind and flow conditions. Both the correspondence of the boundary of the water of excess temperature and the correspondence of surface thermal gradients in the plume will be examined. In the second year's work, the relevance of the model study in inferring heat distribution in the prototype will be evaluated in terms of the effects of winds on the thermal patterns. The importance of winds on movement of the thermal effluent will be carefully evaluated.

STATUS: Active.

FINANCIAL SUPPORT:

U. S. Atomic Energy Commission
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: STUDY OF THE PHYSICAL EFFECTS OF THERMAL
DISCHARGES INTO JAMES RIVER BY SURRY NUCLEAR
POWER PLANT

INVESTIGATORS:

C. S. Fang, Acting Department Head and Associate
Marine Scientist
S. N. Chia, Research Assistant

PROJECT SUMMARY:

A mathematical model is developed to predict the temperature distribution of the plume in James River which is caused by the discharging of the cooling water of VEPCO's Surry County nuclear power plant. Based on the river condition and the geometry of the James River, two and three-dimensional models will be developed. Three data collecting systems - the moving boat system, in situ (tower) system, and an over-fly system, are constructed to take field data. From the measured data, several physical parameters such as heat exchange coefficient, equilibrium temperature, and cloudiness ratio, will be evaluated such that the prediction of the model is available. Statistical analysis, analysis of variance or regression analysis, for the moving boat system data, and time-series analysis of the tower system data are also included to make the data more useful.

STATUS: This project represents Chia's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: INVESTIGATION OF THE WATER TABLE IN A TIDAL BEACH

INVESTIGATORS:

Wyman Harrison, Senior Marine Scientist
C. S. Fang, Acting Department Head and Associate
Marine Scientist
S. N. Wang, Research Assistant

PROJECT SUMMARY:

The objectives of this project are;

- (1) To collect a 30- to 60-day time series of observations of:
 - (a) elevations of the water table in a beach
 - (b) elevations of the local ocean surface
 - (c) elevations of the foreshore at reference points
 - (d) the position of the top of the swash
 - (e) the breaker height and trough depth
 - (f) local rainfall
 - (g) runup characteristics
 - (h) atmospheric pressure,
- (2) To analyze the field data by appropriate time-series computer programs,
- (3) To document the interactions between the water table and the environmental variables that cause it to fluctuate,
- (4) To document the effect of the water table on the stability of the foreshore,
- (5) To elucidate the characteristics of the damped tide wave in the water table and the mechanism by which it is propagated through the sand prism, and
- (6) To advance recommendations, if possible, for the control of day-to-day (non-storm) changes in tidal beaches by artificial alteration of beach water tables.

For the second year, it is proposed to:

- (1) Develop a data-report for the entire time series of observations made at Fort Storm during the previous summer,
- (2) Undertake regression analysis of the relationship between changes in volumes of groundwater and corresponding changes in the volume of foreshore sand, and

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT SUMMARY (Cont'd):

- (3) Complete the numerical analysis of the water table data.

STATUS: Active.

FINANCIAL SUPPORT:

Office of Naval Research
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: VEPCO YORK RIVER STUDY--FIELD STUDIES FOR
CALIBRATION OF HYDRAULIC MODEL

INVESTIGATORS:

Wyman Harrison, Senior Marine Scientist
C. S. Fang, Acting Department Head and Associate
Marine Scientist
Evon P. Ruzicki, Associate Marine Scientist

PROJECT SUMMARY:

The objectives of this project are to obtain the following information for transmission to VEPCO for construction of the sectional model of the lower York River:

- (1) Bathymetric data along indicated transects and adjacent to the proposed outfall, and
- (2) Hydrographic data from indicated stations.

STATUS: Complete.

FINANCIAL SUPPORT:

Virginia Electric and Power Company (VEPCO)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics
Systems Analysis

PROJECT TITLE: DEVELOPMENT OF A RAPID ACCESS DATA STORAGE
AND RETRIEVAL SYSTEM

INVESTIGATOR:

Richard W. Moncure, Computer Systems Analyst

PROJECT SUMMARY:

A Master Indexed Sequential Data File will be created. Rapid access will be provided through the use of keys. Maximum utilization will be made of existing data handling facilities of the System 360 Operating System and Sort/merge utilities.

A control program will be developed to provide retrieval by any parameter or combination of parameters desired. Facilities will be provided for rejecting or accepting a retrieved record based on pre-defined conditions. Options will be included to allow for sorting of retrieved data and for saving retrieved data on magnetic tape for analysis.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: STEADINESS AND REPEATABILITY IN AN ESTUARINE
HYDRAULIC MODEL.

INVESTIGATOR:

Paul V. Hyer, Associate Marine Scientist

PROJECT SUMMARY:

Experiments were conducted using the James River Hydraulic Model to determine if that model can maintain a steady state of salinity distribution, given a constant tidal amplitude, constant freshwater discharge, and a constant sump salinity. Statistical methods were used to determine the variability of salinity at a given point in space at a given stage of the tide. Statistical methods were used also to compare the salinity distribution in two separate tests under the same conditions.

STATUS: This was a subproject of a major project entitled "Utilization of Physical and Mathematical Models in Marine Waters Resources Research and Management." The project has been completed, and this subproject has submitted a paper for publication.

FINANCIAL SUPPORT:

Office of Water Resources Research
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: DATA COLLECTION AND PROCESSING FOR STATE
COOPERATIVE MATHEMATICAL MODEL (ESTUARINE
COMPUTER MODELING OF SALINITY AND DISSOLVED
OXYGEN DISTRIBUTION - RAPPAHANNOCK RIVER)

INVESTIGATORS:

William J. Hargis, Jr., Acting Division Head and
Institute Director
C. S. Fang, Acting Department Head and Associate
Marine Scientist
P. V. Hyer, Associate Marine Scientist
A. Y. Kuo, Associate Marine Scientist

PROJECT SUMMARY:

To develop mathematical models and verify operational computer programs for prediction of the salinity distribution and dissolved oxygen concentration in the Rappahannock River, from Fredericksburg to a certain distance downstream of Tappahannock is the purpose of this project. This distance has been chosen to be sufficient to establish sump conditions for the system under study, and encompass the detectable influences of sanitary and industrial discharges.

The dissolved oxygen model will be capable of predicting, to known levels of confidence, the variation of dissolved oxygen with time, given initial temperature and river discharge conditions, and tidal amplitude. The salinity distribution will be able to predict, to known confidence limits, the high-water salinity distribution given the initial salinity distribution and freshwater runoff.

STATUS: Active.

FINANCIAL SUPPORT:

Cooperative State Agencies
(Division of Water Resources)
(State Water Control Board)
(Virginia Institute of Marine Science)

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: DATA COLLECTION AND PROCESSING FOR STATE
COOPERATIVE MATHEMATICAL MODEL (COMPARISON
OF NUMERICAL METHODS FOR THE SOLUTIONS OF
THE COMPLETE EQUATION OF UNSTEADY FLOW)

INVESTIGATORS:

C. S. Fang, Acting Department Head and Associate
Marine Scientist
S. N. Wang, Research Assistant

PROJECT SUMMARY:

Computer-oriented mathematical models for numerical analysis of water movement in estuaries are being developed. These are based on the numerical integration of the complete equations of continuity, momentum, and mass balance for unsteady flow. The equations will be solved by three independent different methods, the finite difference method, finite element method, and MAC method. Identical sets of field data obtained from summer hydrographical surveys for the James River (or Rappahannock River) will be used for each of the three methods of solution.

STATUS: This project represents Wang's dissertation research.

FINANCIAL SUPPORT:

Cooperative State Agencies
(Division of Water Resources)
(State Water Control Board)
(Virginia Institute of Marine Science)

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: DATA COLLECTION AND PROCESSING FOR STATE
COOPERATIVE MATHEMATICAL MODEL (MATHEMATICAL
MODELING OF RAPPAHANNOCK RIVER)

INVESTIGATORS:

A. Y. Kuo, Associate Marine Scientist
Mary Ann Orzech, Graduate Assistant

PROJECT SUMMARY:

A dynamic mathematical model, representing the complex hydrodynamic behavior of the Rappahannock River in temporal and spacial detail, is composed of a network of one-dimensional channel elements. The equations of motion and the equation of continuity are combined to produce a dynamic model predicting tidal level and horizontal velocity with tides and hydrologic fluxes imposed at the boundaries. Values of discharge, velocity, area, and tidal elevations are determined for each channel element or node and are utilized as input information in the formulation of a water quality model.

Water quality behavior is predicted by solving the mass balance equations for conservative and non-conservative materials at the nodes, using the results of the dynamic model. The water quality model can predict the distribution of the concentrations of such substances as dissolved oxygen under the influence of tidal motion.

STATUS: This project represents Orzech's thesis research.

FINANCIAL SUPPORT:

Cooperative State Agencies
(Division of Water Resources)
(State Water Control Board)
(Virginia Institute of Marine Science)

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: NUMERICAL MODELING INVESTIGATION OF FORCES
ON CYCLONIC GULF STREAM EDDIES

INVESTIGATORS:

Paul V. Hyer, Associate Marine Scientist
Robert Pickett, Graduate Assistant

PROJECT SUMMARY:

An attempt to understand and explain recent observation of cyclonic eddies shed from the Gulf Stream is being made. Questions to be answered are: Why do these eddies move, change shape and change size? Mathematical modeling is used to observe the effects of various initial conditions and geophysical parameters on the subsequent motion of an eddy.

STATUS: This project represents Pickett's dissertation research.

FINANCIAL SUPPORT:

U. S. Naval Oceanographic Office
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Physical Oceanography
and Hydraulics

PROJECT TITLE: CIRCULATION AND MIXING IN THE AREA OF THE VIRGINIA CAPES

INVESTIGATORS:

C. S. Fang, Acting Department Head and Associate
Marine Scientist
A. Y. Kuo, Associate Marine Scientist
Evon P. Ruzecki, Associate Marine Scientist

PROJECT SUMMARY:

The goal of the program is to develop a mathematical model of the coastal sea around the bay entrance and adjacent continental shelf area. The model should be able to describe the general distributions of current, temperature, salinity, given wind stress, and heat flux on the sea surface, together with some conditions on the bottom and boundaries. After being proved to be a satisfactory model, it can be used for oceanographic forecasting such as the invasion of long waves from the ocean, the distribution of pollutants, the effect of dredging and beach erosion, etc.

STATUS: This project represents Ruzecki's dissertation research. Additional support is currently being sought from NSF.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: HISTORICAL AREAL CHANGES OF EASTERN SHORE
MARSHES

INVESTIGATORS:

Robert J. Byrne, Acting Department Head and
Associate Marine Scientist

PROJECT SUMMARY:

The topographic surveys of 1852-70 have been compared with the planimetric surveys of 1962. These data indicate areas of marsh erosion and growth. Approximately 11% reduction of marsh area has occurred since 1852.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: CIRCULATION IN EASTERN SHORE MARSH-LAGOON
COMPLEX

INVESTIGATORS:

Robert J. Byrne, Acting Department Head and
Associate Marine Scientist

PROJECT SUMMARY:

The goal of this project is to elucidate the gross circulation within the inlet-lagoon-marsh channel complex on Virginia's Eastern Shore Atlantic Coast. The studies thus far have concentrated on the northern half of the system from Wachapreague Inlet to Wallops Island. Field measurements include tidal range and phase in the system and tidal discharge in the inlets and major conveyance channels within the system. Aside from using the data to detail areas for intensive study, the field data will be used to develop formulations on the hydraulic geometry of inlets and marsh channels.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: EROSION OF BARRIER ISLANDS - HISTORICAL

INVESTIGATORS:

Robert J. Byrne, Acting Department Head and
Associate Marine Scientist

PROJECT SUMMARY:

The erosion rates for the barrier islands have been determined using U. S. Coast and Geodetic Survey data from historical topographic and hydrographic surveys which were initiated in 1852. The shoreline position plots have supplied acreages lost due to erosion and zones of accretion.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: RESPONSE CHARACTERISTICS OF TIDAL INLETS
(THE EFFECT OF HYDRAULIC FORCES AND SEDIMENT
SUPPLY)

INVESTIGATORS:

Robert J. Byrne, Acting Department Head and
Associate Marine Scientist

PROJECT SUMMARY:

The goal of the proposed research is to document the response of inlet configuration to short term variations in hydraulic input and littoral drift and to relate the observed responses to the relative variability of the input processes. Wachapreague Inlet, an inlet within the barrier island complex of Virginia's Eastern Shore, has been selected for study.

STATUS: Active.

FINANCIAL SUPPORT:

Office of Naval Research
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: STORM-WAVE AND STORM-SURGE MODIFICATION OF
VIRGINIA'S OCEAN COAST

INVESTIGATOR:

Wyman Harrison, Senior Marine Scientist

PROJECT SUMMARY:

The objective of this research is to relate changes in beach profiles and high-water shorelines to the characteristics of specific North Atlantic storms. The hope is to develop a correlation model such that for any initial beach conditions and input conditions for storm surge, storm intensity, direction of travel, and storm duration, it will be possible to predict the magnitude and direction of shoreline changes and modifications of foreshore profiles.

Second year projects include the following: Analysis of information gathered during the first year's work indicates that swell data from ship reports and breaking-wave data, obtained visually by those profiling the beaches, will be inadequate for model development. No such data are to be gathered during the forthcoming year. Also, photographic data of shoreline changes will only be useful for studying the effects of very great storms. Thus, our efforts over the coming two years will be directed toward the development of predictor equations.

STATUS: Active.

FINANCIAL SUPPORT:

U. S. Army Corps of Engineers
(Coastal Engineering Research Center)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: DEVELOPMENT OF THE TURBIDITY MAXIMUM IN A
COASTAL PLAIN ESTUARY

INVESTIGATORS:

Maynard M. Nichols, Associate Marine Scientist

PROJECT SUMMARY:

The purpose of the proposed study is to determine how suspended sediment accumulates in the fresh-salt transition of an estuary to form a turbidity maximum.

The net transport of water and sediment will be examined through several cross-sections at five or more stations in a 30-mile reach of the upper Rappahannock Estuary, Virginia. Field measurements will be made at mean tide over eight tidal cycles (100 hours), at each station, first at low river inflow in August, then at low river inflow in March.

The objective of this study is to determine how the turbidity maximum is generated and maintained by dynamic processes. An attempt will be made to measure the net or residual transport of water and sediment and to calculate what excess quantity of suspended material is supplied to the maximum. A second objective is to discover what new, time-dependent tidal or exchange processes may be active in concentrating suspended sediment.

STATUS: Active.

FINANCIAL SUPPORT:

U. S. Department of the Army
(U. S. Army Research Office - Durham)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: SEDIMENT TRANSPORT IN LOW-ORDER TIDAL MARSH CHANNELS

INVESTIGATORS:

Robert J. Byrne, Acting Department Head and
Associate Marine Scientist
John Boon, Assistant Marine Scientist

PROJECT SUMMARY:

The research proposed will involve a number of field studies of low-order, tidal marsh channels with the emphasis on sediment transport processes via fluid suspension. The area chosen for study is situated near Wachapreague, Virginia.

Goals of the studies include (1) specific insights into the distribution patterns of fluid velocity and suspended sediment concentration in time and space as revealed by detailed measurements; (2) comparison of these distributions with those predicted by theoretical formulations in classical fluid dynamics; (3) hydraulic geometry of marsh channels; and (4) marsh channel evolution. The latter will be investigated by computation of net suspended sediment discharge values over a tidal cycle at several channel cross-sections.

STATUS: A part of this project represents Boon's dissertation research.

FINANCIAL SUPPORT:

National Science Foundation Grant for Improving
Doctoral Dissertation Research in the
Environmental Sciences
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: STORM EROSION PREDICTION ON VIRGINIA'S
ATLANTIC SHORELINE

INVESTIGATORS:

Wyman Harrison, Senior Marine Scientist
Paul Bullock, Graduate Assistant

PROJECT SUMMARY:

An examination of the feasibility of constructing a statistical model to predict beach erosion using predicted water levels and wind values is being made. Centers around erosion activity at 16 points on the Virginia coast, 6 below Cape Henry, and 9 on the barrier islands. Included is an investigation of relation between profile stations and characteristics of reactions to similar storm types. Basin prediction equation of form is:

$$\Delta V = f(U_1, V_1, U_2, V_2 \dots U_m, V_m, W)_{1-N}$$

ΔV is beach volume change, U, V wind components, W is water level, 1-N are time logs.

STATUS: This project represents Bullock's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science
Corps of Engineers (Student Research Assistantship)

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: EFFECTS OF HURRICANE CAMILLE ON WATER STRUCTURE
AT BAY MOUTH

INVESTIGATORS:

Robert J. Byrne, Acting Department Head and
Associate Marine Scientist
Robert Elder, Graduate Student

PROJECT SUMMARY:

The purpose of this study is to determine the effect of an atypically high amount of freshwater discharge on the temperature and salinity pattern of the Chesapeake Bight. An attempt will be made to establish a "normal" temperature and salinity pattern as a basis of comparison. It will further be attempted to relate the temperature and salinity pattern caused by Hurricane Camille discharge water to other factors such as the wind distribution, tides, and prevailing current pattern.

STATUS: This project represents Elder's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography
Chemical Oceanography Section

PROJECT TITLE: INVESTIGATION OF SURFACE FILMS - CHESAPEAKE
BAY ENTRANCE

INVESTIGATOR:

William G. MacIntyre, Associate Marine Scientist

PROJECT SUMMARY:

Research on oily water-surface films inside the entrance to Chesapeake Bay has three objectives: (1) the development of prediction equations for the motion of films in response to various wind, wave, and current regimes; (2) determination of the composition and relative percentages of mineral-oil versus biologically-produced film materials; and (3) investigation of the feasibility of detection and differentiation of the two types of films by remote-sensing techniques.

The motion of films in response to various wind, wave, and current conditions will be studied by artificially introducing harmless film-forming materials in the vicinity of the Chesapeake Bay bridge-tunnel structure and following the films by boat. Empirical prediction equations for the motion of oil films will be derived using techniques similar to those developed by the Project Director for predicting the motion of surface waters off the Chesapeake Bight.

For the second year, continuation of VIMS' research on the fate of oil inside the entrance to Chesapeake Bay has the following objectives: (1) continued sampling and analysis of naturally-occurring films along the Chesapeake Bay bridge-tunnel; (2) documentation of the fate and compositional changes of planned releases of Bunker C and No. 2 Fuel Oil slicks as various components of the oil are vaporized, dissolved, advected over the surface, or mixed into the upper few meters of the water column; (3) documentation of the abundance of plankton in film versus non-film areas (and at the one-meter depth) where the films are naturally-occurring; and (4) analysis of the effects of the planned oil releases on plankton from the surface to the one-meter depth.

STATUS: Active.

FINANCIAL SUPPORT:

Federal Water Quality Administration
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography
Chemical Oceanography Section

PROJECT TITLE: CONCENTRATION OF CHLORINATED HYDROCARBON
PESTICIDES IN SURFACE FILMS

INVESTIGATORS:

William G. MacIntyre, Associate Marine Scientist
James Lake, Graduate Student

PROJECT SUMMARY:

The objective of this study is to find the role the surface slick environment has in concentrating pesticides by identifying and determining the concentrations of chlorinated hydrocarbon pesticides in the surface film and at the one-meter depth at sample areas in the Chesapeake Bay.

STATUS: This project represents Lake's thesis research. It is a subproject of "Investigation of Surface Films - Chesapeake Bay Entrance."

FINANCIAL SUPPORT:

Federal Water Quality Administration
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography
Chemical Oceanography Section

PROJECT TITLE: CHEMICAL COMPOSITION OF SURFACE WATERS
(60 MICRON LAYER)

INVESTIGATORS:

William G. MacIntyre, Associate Marine Scientist
John Windsor, Jr., Graduate Assistant

PROJECT SUMMARY:

Through the use of thin-layer and gas chromatography, an attempt is being made to chemically differentiate between oil slicks and naturally-occurring surface films, e.g., fish oils, etc. This is done by comparing the relative quantities of fatty acids and hydrocarbons in samples taken with a new rotating drum type device, which has never been used for any chemical analyses.

STATUS: This project represents Windsor's thesis research. It is a subproject of "Investigation of Surface Films - Chesapeake Bay Entrance."

FINANCIAL SUPPORT:

Federal Water Quality Administration
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography
Chemical Oceanography Section

PROJECT TITLE: DISSOLUTION STUDIES OF CLAY MINERALS INTO
SEA WATER

INVESTIGATORS:

William G. MacIntyre, Associate Marine Scientist
Carol Lake, Graduate Assistant

PROJECT SUMMARY:

A study of the rate and reaction mechanisms of the dissolution of clay minerals, associated with the marine environment such as kaolinite, montmorillonite, and illite, is being made. The clay mineral is allowed to dissolve into synthetic sea water. Aliquots of the solution are removed at specific time intervals and analyzed for dissolved silica and certain cations (Na^+ , K^+ , Mg^{++}). From this procedure, determination of the reaction kinetics and an understanding of the dissolution mechanism can be made. The dissolution will also be made at different temperatures (5° , 10° , 20°C) to ascertain possible changes in the dissolution rate due to temperature.

STATUS: This project represents Lake's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography

PROJECT TITLE: EXPERIMENTAL APPLICATION OF REMOTE-SENSING
METHODS TO COASTAL ZONE LAND-USE AND WATER
RESOURCE MANAGEMENT

INVESTIGATORS:

H. Grant Goodell*
Maynard M. Nichols, Associate Marine Scientist

PROJECT SUMMARY:

This research is a feasibility study and demonstration project using high altitude photography to establish a data base for monitoring land use changes from ERTS-A and for detecting related environmental phenomena within the coastal zone. Special attention will be given to the interacting man-land processes.

In this program, we plan to consider the rapid assessment of human and natural response to long-term degradation and extreme events (storms) in the mid-Atlantic coastal zone, relationships between these events, and use changes, and processes of the fringing waters, and the feasibility of monitoring the rate of changes of land use categories, including the impact of human development programs within the coastal zone.

STATUS: Active.

FINANCIAL SUPPORT:

U. S. Geological Survey through University of
Virginia Subgrant

*H. Grant Goodell, University of Virginia

Virginia Institute of Marine Science
Department of Geological and
Chemical Oceanography
Remote Sensing Laboratory

PROJECT TITLE: ANALYSIS AND EVALUATION OF REMOTE-SENSOR
DATA FOR MARINE-SCIENCE APPLICATIONS

INVESTIGATOR:

John C. Munday, Jr., Associate Marine Scientist

PROJECT SUMMARY:

The scope of this program is to analyze and evaluate data obtained from multispectral sensor overflights by NASA aircraft of the Chesapeake Bay entrance along the Chesapeake Bay bridge-tunnel structure and nearby estuaries to include the James, York, and Rappahannock Rivers and the wetlands of the Eastern Shore of Virginia. It also shall encompass collecting and correlating appropriate field data with the remote sensor data received from the overflights.

The ground truth data will be obtained which will include the following: (a) water temperature--surface and subsurface, (b) salinity--surface and subsurface, (c) dissolved oxygen, (d) surface oil film--biological and petroleum, (e) current speed and direction, (f) turbidity, and (g) particle suspension--organic and petroleum. Substantive evaluation of (a) detection and characterization of oil films at the Chesapeake Bay entrance, (b) description of the thermal structure of waters at the Chesapeake Bay entrance and in nearby estuaries, and (c) mapping of marsh plant communities and boundaries will also be made.

STATUS: Active.

FINANCIAL SUPPORT:

National Aeronautics and Space Administration
Wallops Station
Virginia Institute of Marine Science

DIVISION OF APPLIED MARINE SCIENCE AND OCEANIC ENGINEERING

Morris L. Brehmer, Division Head

Virginia Institute of Marine Science
Department of Applied Marine Biology

PROJECT TITLE: AN INVESTIGATION INTO COMMERCIAL ASPECTS OF
THE HARD CLAM FISHERY AND DEVELOPMENT OF
COMMERCIAL GEAR FOR THE HARVEST OF MOLLUSKS

INVESTIGATORS:

Dexter S. Haven, Department Head and Senior Marine
Scientist
Joseph G. Loesch, Associate Marine Scientist
James B. Whitcomb, Assistant Marine Scientist

PROJECT SUMMARY:

Objectives of this project are:

- (1) Investigate the distribution of hard clams in the Mobjack Bay region and other nearby localities with a hydraulic esculator dredge,
- (2) Sample hard clams in relatively deep water with a hydraulic tow dredge in the lower Chesapeake Bay region,
- (3) Study rates of growth in various sectors of the lower Chesapeake Bay region,
- (4) Evaluate hard clam farming in the York River,
- (5) Determine predators of small hard clams, and
- (6) Modify a Maryland type hydraulic esculator for the harvest of oysters.

STATUS: Active.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(National Marine Fisheries Service)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Applied Marine Biology

PROJECT TITLE: SURVEY OF PUBLIC OYSTER GROUNDS IN THE STATE
OF VIRGINIA AND MONITORING SPAT FALL

INVESTIGATOR:

Dexter S. Haven, Department Head and Senior Marine
Scientist

PROJECT SUMMARY:

This study monitors the public oyster racks in Virginia to evaluate quantities of shell, oysters, and spat. Data are recorded in terms of spat, shells, or oysters per bushels. Data are also collected on predators such as Urosalpinx cinerea and mortalities based on box counts.

A second aspect of this program is the monitoring of oyster spatfall in the rivers and tributary creeks. Data are collected weekly at over 30 locations each year beginning in June and ending in October by placing strings of shells in representative locations. After being in the water a week, the shells are removed and taken to the laboratory where attached spat are counted. Results of this study are published weekly and mailed to over 1500 persons.

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Applied Marine Biology

PROJECT TITLE: AN INVESTIGATION OF THE EFFECTS OF STARCH
SUPPLEMENTS ON THE GLYCOGEN CONTENT OF RIBBED
MUSSELS AND HARD CLAMS

INVESTIGATORS:

Dexter S. Haven, Department Head and Senior Marine
Scientist
Kathleen Harleston, Graduate Assistant

PROJECT SUMMARY:

The ribbed mussel Modiolus demissus and the hard clam Venus mercenaria are being held in the laboratory in troughs of flowing sea water, and fed concentrations of corn starch at rates ranging from 1 to 5 ppm. At the end of periods ranging from 1 to 2 months, animals are killed and glycogen content measured. Results show that mussels receiving as little as 1 ppm starch accumulate significantly more glycogen than controls. The hard clam does not seem to accumulate glycogen to the same extent.

STATUS: This project represents Harleston's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PROJECT TITLE: SEASONAL AND ECOLOGICAL SUCCESSION OF BENTHIC
MACROINVERTEBRATES IN NATURAL SUBSTRATES

INVESTIGATORS:

Joseph P. Loesch, Associate Marine Scientist
Peter F. Larsen, Graduate Assistant

PROJECT SUMMARY:

The purpose of this study is:

- (1) To establish existence and manner of succession in the benthic marine environment, and
- (2) To determine the means of recolonization of a "new" substrate, i.e., by setting of larvae or by immigration from adjoining areas.

The methods to be used include the following:

- (1) A series of cores containing natural substrate, that has been voided of living organisms will be placed on several environments.
- (2) The cores will be pulled up at periodic intervals and analyzed. The fauna associated with each core will be compared with the other cores and with the community, which is known to exist in each area.
- (3) Subtopics related to the above include the determination of:
 - a. The depth of the various components of the benthic community.
 - b. Periodicity and density of setting of benthic fauna.
 - c. Survival rates of larvae in several sediment types.

STATUS: This project represents Larsen's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Applied Marine Biology

PROJECT TITLE: STUDY OF THE ECOLOGY OF THE SOFT CLAM, MYA
ARENARIA

INVESTIGATORS:

Dexter S. Haven, Department Head and Senior Marine
Scientist

Jon Lucy, Graduate Assistant

PROJECT SUMMARY:

The ecology of the soft clam, Mya arenaria, is being studied at two stations in the York River, Virginia. One aspect of this study is to investigate time of setting and the abundance of juveniles during the first year. Also, included in the program are an investigation of the gonadal cycle and a study of the relation between the substrate and depth of burial. Growth studies are also included.

STATUS: This project represents Lucy's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: PESTICIDE MONITORING PROGRAM IN VIRGINIA'S
ESTUARIES

INVESTIGATORS:

Michael E. Bender, Department Head and Senior Marine
Scientist
Robert J. Huggett, Assistant Marine Scientist

PROJECT SUMMARY:

Two sampling stations have been established in the Rappahannock, York, and James Rivers, and one each in the Lynnhaven, Elizabeth, Machipongo, and Cherrystone systems. Oysters are collected monthly, processed, and analyzed by gas chromatography for the chlorinated hydrocarbons and polychlorinated biphenyls.

Rangia and Mercenaria clams, blue crabs, fin fish, and estuarine sediments are also sampled during the summer period when application operations are in progress.

STATUS: Active.

FINANCIAL SUPPORT:

Environmental Protection Agency
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: ENVIRONMENTAL STUDY OF HAMPTON ROADS

INVESTIGATOR:

Morris L. Brehmer, Head, Division of Applied Marine
Science and Oceanic Engineering

PROJECT SUMMARY:

This will be a comprehensive benthic animal study intended to yield valuable data relative to waste treatment needs in the Hampton Roads area. It will be conducted by VIMS graduate students working under the supervision of senior staff members of the Institute.

Subprojects include: (1) Benthic macroinvertebrate communities as indicators of pollution in Hampton Roads, Virginia, and (2) Distribution and structure of benthic communities in the Hampton Roads area, Virginia.

STATUS: Active.

FINANCIAL SUPPORT:

Hampton Roads Sanitation District Commission
Virginia Institute of Marine Science

PROJECT TITLE: DISTRIBUTION AND STRUCTURE OF BENTHIC COMMUNITIES IN THE HAMPTON ROADS AREA, VIRGINIA

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Donald F. Boesch, Graduate Assistant

PROJECT SUMMARY:

Sixteen stations in the Hampton Roads area were sampled in February, May, and August, 1969. Three replicates were taken at each station with a Petersen grab in February and a Van Veen grab later. Contents were sieved through a 1.0 mm sieve and the retained fraction examined after preservation.

A total of 175 macrofaunal invertebrates was recognized, 164 being identified to species. Dominant species in Hampton Roads were mostly those not abundant in other parts of the Chesapeake system. Seasonal periodicity was prominent at sand stations, but little change in population levels occurred at mud stations.

Diversity was generally high, although lower for mildly polluted areas in the Elizabeth River. Continued use of benthic organisms as biological indicators of pollution was recommended.

STATUS: This is a subproject of "Environmental Study of Hampton Roads."

FINANCIAL SUPPORT:

Hampton Roads Sanitation District Commission
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: BENTHIC MACROINVERTEBRATE COMMUNITIES AS
INDICATORS OF POLLUTION IN HAMPTON ROADS,
VIRGINIA

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Michael D. Richardson, Graduate Student

PROJECT SUMMARY:

Three replicate grabs were obtained from 12 stations in the Elizabeth River during three sampling periods in 1969. Six stations were sampled in January with a 0.06 m² Petersen grab. A 0.07 m² Van Veen grab was used to sample 11 stations in May and 12 in August. All samples were sieved through a 1.0 mm screen, the remaining fraction being preserved in 10% formalin. Sediment samples for particle size analysis as water samples for DO were obtained in August.

In the 87 grab samples, 22,404 animals in 123 taxa were obtained, with three species of polychaetes being dominant. Non-selective deposit feeders were reduced, but the overall diversity was as high as in some unpolluted temperate areas. Diversity was lowest in May, probably because of recruitment of certain short-lived species.

STATUS: This project represents Richardson's thesis research. The final report is nearly completed. It is a sub-project under "Environmental Study of Hampton Roads".

FINANCIAL SUPPORT:

Hampton Roads Sanitation District Commission
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: VEPCO - SURRY PRE- AND POST-OPERATIONAL
STUDIES

INVESTIGATORS:

Michael E. Bender, Department Head and Senior Marine
Scientist
Richard Peddicord, Graduate Assistant
Thomas Cain, Graduate Assistant
Edward J. Tennyson, Graduate Assistant
David Dressel, Graduate Assistant

PROJECT SUMMARY:

Pre- and post-operational studies on the benthic fauna of the James River have been conducted since May 1969. At present, these studies have been modified to the collection of benthic organisms at 16 stations on a quarterly basis. Laboratory studies have been and are being conducted on several aspects of the thermal problem by various graduate students. These studies are outlined in their reports. Early this spring, we will initiate field studies on the zooplankton populations and determine the levels of primary production in this reach of the James.

Further investigations in the area are at present in the planning stage. These include methodology to establish zones of passage for migrating fishes and the effect of entrainment on larval fishes (thesis problem of Mr. James Lanier in Ichthyology).

STATUS: Active.

FINANCIAL SUPPORT:

Virginia Electric and Power Company
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: STUDY OF THE FAUNA OF THE UPPER JAMES ESTUARY

INVESTIGATORS:

Michael E. Bender, Department Head and Senior Marine
Scientist
Thomas D. Cain, Graduate Assistant
Richard K. Peddicord, Graduate Assistant

PROJECT SUMMARY:

The objective of this project is to quantitatively and qualitatively describe the benthic fauna of the James River, Virginia, in the region of the Virginia Electric and Power Company Surry Nuclear Power Station at Hog Island. The study will provide a basis for comparison with a future study to be made after the plant is in operation. Samples are taken with a Van Veen grab and washed through a 1.0 mm screen. Species are identified and counted in the laboratory. Hog Island is in an area of widely fluctuating salinity and thus is a rather marsh environment. Species diversity is rather low, with the dominant organism being the brackish-water clam, Rangia cuneata.

STATUS: This is a subproject of "VEPCO - Surry Pre- and Post-Operational Studies."

FINANCIAL SUPPORT:

Virginia Electric and Power Company
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: REPRODUCTIVE CYCLE AND LARVAL TOLERANCES OF
RANGIA CUNEATA (PELYCEPODA)

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Thomas D. Cain, Graduate Assistant

PROJECT SUMMARY:

The principal objectives of this study are:

- (1) To determine from histological gonadal slides, the annual reproductive cycle of Rangia cuneata in the James River,
- (2) To investigate, from the analysis of field data, two factors (temperature and salinity) which may initiate gametogenesis and spawning,
- (3) To determine which factors will induce spawning in the laboratory, and
- (4) To study the effects of salinity and temperature on survival and growth of embryos and larvae.

Clams will be collected biweekly at three stations and their gonads dissected out for histological preparation and staining. Substantiation of the reproductive cycle will also come from the biweekly examination of set collectors placed at the same stations. Larvae will be raised under different combinations of temperature and salinity within the normal environmental range.

STATUS: This project represents Cain's dissertation research. It is a subproject of "VEPCO - Surry Pre- and Post-Operational Studies."

FINANCIAL SUPPORT:

Virginia Electric and Power Company
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: VEPCO - EFFECTS OF THERMAL SHOCK ON MOLLUSK LARVAE

INVESTIGATORS:

Morris L. Brehmer, Head, Division of Applied Marine
Science and Oceanic Engineering
Robert J. Diaz, Graduate Student

PROJECT SUMMARY:

Larvae of estuarine mollusks are exposed to short duration thermal shocks comparable to that received in passing through a condenser system of a steam electric station. Control populations are passed through an identical system but not subjected to heat.

Treated and untreated populations are fed and reared to the setting stage. Data on initial and accumulative mortalities, growth and development, and time and success of setting are recorded. Difference as influenced by age at the time of treatment and levels of thermal shock are evaluated.

STATUS: This project represents Diaz' thesis research. It is a subproject of "VEPCO - Surry Pre- and Post-Operational Studies".

FINANCIAL SUPPORT:

Virginia Electric and Power Company
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: THE EFFECTS OF CHLORINE AND THERMAL SHOCK ON ESTUARINE COPEPODS

INVESTIGATORS:

Morris L. Brehmer, Head, Division of Applied Marine
Science and Oceanic Engineering
David M. Dressel, Graduate Assistant

PROJECT SUMMARY:

The objectives of this research are to develop techniques to establish the effects of chlorine and thermal shock on local mixed populations of copepods Acartia tonsa and Acartia clausi in the York River adjacent to VIMS.

Acartia is the dominant zooplankton in the York River as well as most of the Chesapeake Bay estuary. An increase of Steam-Electric Systems on estuaries necessitates studying the effects of chlorine and thermal shock on copepods due to their importance in the food chains of finfish.

Laboratory conditions simulating SES operations will be employed. Local copepods will be collected and subjected to "slug" chlorination and thermal shock to determine TL 50's. Techniques and equipment to be developed and tested include: (1) a device for subdividing large numbers of live copepods into equal sized samples for bioassay experiments, (2) Browne plunger jar systems to be installed in acclimation and experimental holding tanks, (3) a heat exchanger capable of producing a delta T of 8°C above ambient with a 5 second passage time, (4) a rapid, reliable method for determining death on a large number of copepods, i.e., staining.

STATUS: This project represents Dressel's thesis research. It is a subproject of "VEPCO - Surry Pre- and Post-Operational Studies."

FINANCIAL SUPPORT:

Virginia Electric and Power Company
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: GROWTH AND DISTRIBUTION OF RANGIA CUNEATA GRAY

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Richard Peddicord, Graduate Assistant

PROJECT SUMMARY:

This project will study the distribution of R. cuneata in the James River, Virginia, its growth rate, and the effects of temperature and salinity on its ability to feed. The density and size distribution of populations will be determined in relation to salinity and substrate. Growth rates will be determined on the bases of linear dimensions, weight, and meat yield. Growth rates will also be related to substrate, salinity, size, and age, and interactions of these factors. Studies of the effects of temperature and salinity on filtering will be conducted in the laboratory in two parts. Clams acclimatized to summer conditions in the river will be collected and subjected to variations in temperature and salinity and filtering rates measured. During the winter months, clams will be collected from the same areas when acclimatized to winter conditions and subjected to temperature and salinity variations.

STATUS: This project represents Peddicord's thesis research. It is a subproject of "VEPCO - Surry Pre- and Post Operational Studies."

FINANCIAL SUPPORT:

Virginia Electric and Power Company
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: EFFECTS OF ABOVE AMBIENT TEMPERATURE ON THE
CHRONIC TOXICITY OF PCB'S

INVESTIGATORS:

Michael E. Bender, Department Head and Senior
Marine Scientist
Edward J. Tennyson, Graduate Assistant

PROJECT SUMMARY:

The objectives of this research project are: (1) to conduct a chronic bioassay on an estuarine fish using a compound of ecological significance, i.e., to establish water quality for PCB's on the striped blenny; (2) to evaluate several enzyme and physiological parameters which might be used to circumvent such costly and laborious long term tests; and (3) to identify the products or at least quantitate the breakdown rate of PCB's in fish.

Measurement of response: The major variable to be measured as a function of PCB concentration in the chronic test will be reproductive success. This will entail not only eggs produced but probably more importantly fry survival. Growth will be evaluated by determining initial weight of the fish in each experimental unit, determining the weight of any fish lost from the unit, and a final weight determination on the unit after spawning. This procedure is very inaccurate, but it is believed minimal disturbance of the animals will lead to more valuable data from the reproductive studies. Oxygen consumption has been indicated by Bender and Merna (1970) as increasing as a function of pesticide concentration during long term bioassays. The mechanisms to account for this observation are not known, but it may have important physiological manifestations since, along with increased oxygen consumption, anomalies in digesting were noted. To evaluate if, in fact, oxygen consumption is affected by chronic PCB exposure, the separate study described in the methods section will be conducted. Enzyme determinations on several constituents will be used to study the responses of the fish to chronic PCB exposure.

STATUS: This project represents Tennyson's dissertation research. It is a subproject of "VEPCO - Surry Pre- and Post-Operational Studies."

FINANCIAL SUPPORT:

Virginia Electric and Power Company
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: SPECIAL STUDIES ON DISTRIBUTION OF HEAVY METALS IN LOWER CHESAPEAKE BAY - RANN-NSF PROGRAM

INVESTIGATORS:

Michael E. Bender, Department Head and Senior Marine Scientist
Robert J. Huggett, Assistant Marine Scientist

PROJECT SUMMARY:

The objective of this project is to describe the distribution of heavy metals in sediments and in shellfish in a relatively unmodified estuary (the Rappahannock River) and to relate that distribution to physical-chemical parameters.

Heavy metals, e.g., Hg, Cu, Cd, and Zn, which reach the estuarine environment, follow characteristic pathways depending on their chemical nature (charge, charge density, etc.) and the biological transformations that they undergo, i.e., Hg^{++} to CH_3H^+ . Preliminary investigations at VIMS on the distribution of the heavy metals (Cd, Cu, and Zn) in oysters indicate that concentration of metals is a function of the salinity of the growing area. We hypothesize that this phenomenon can be explained by the effect that salinity and pH have on the adsorptive properties of clays. The clay minerals make up a large fraction of the suspended and bottom sediments of coastal plain estuaries.

Atomic adsorption spectrophotometry and anodic stripping voltametry will be principal analytical tools used. Neutron activation analysis may also be used if suitable arrangements can be made.

The distribution and concentrations of metals that are determined will contribute to the inventory of chemical-physical entities and characteristics and, when coupled with the results of other participants, will provide a widespread background of baseline levels.

The understanding that we hope to achieve in terms of explaining the distribution will assist in separating the results of natural occurrence of metals from point sources of contamination.

STATUS: Active. This is a project of "The Chesapeake Bay - A Coordinated Research Program."

Virginia Institute of Marine Science
Department of Ecology-Pollution

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: COORDINATED, INTERDISCIPLINARY STUDIES ON
WETLANDS: RANN-NSF PROGRAM, ALSO WITH
NASA AND OWRR

INVESTIGATORS:

Department of Ecology-Pollution Subproject:
Michael E. Bender, Department Head and
Senior Marine Scientist
Marvin L. Wass, Associate Marine Scientist
Kenneth L. Marcellus, Associate Marine Scientist

Department of Geological and Chemical Oceanography
Subproject:
Robert J. Byrne, Acting Department Head and
Associate Marine Scientist
John Boon, Assistant Marine Scientist

PROJECT SUMMARY:

The long range goal of this project, really a program, is to gain the capability to state, with known confidence, the total biological value of any given plot of wetlands and to evaluate the economic value of that given plot in terms of its value for uses other than healthy wetland, i.e., to be able to state the feasibility and ecological and economic significance of alternate usages.

During the first year of the coordinated program, six subprojects are proposed which are directed toward determination of the value of wetlands as well as to the establishment of an inventory which can be continued. The proposed subprojects are (with other funding sources identified):

- (1) Inventory of wetlands, shorelines, and shallows of lower Chesapeake Bay and its tributaries - a quantitative and qualitative inventory. (VIMS-RANN)
- (2) Wetlands flora inventory of species and their acreage, utilizing field and aerial photography. (with VIMS and NASA)
- (3) Productivity, nutrient, and detritus flux as a function of marsh type (polyhaline, mesohaline, oligohaline). (with OWRR and VIMS)
- (4) Sediment (organic and inorganic) transport processes in low order marsh channels. (RANN-VIMS)
- (5) Shoreline erosion rates and marsh changes of Virginia's Bay shore and tributary rivers (1852-1940). (VIMS-RANN)

Virginia Institute of Marine Science
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PROJECT SUMMARY (Cont'd):

- (6) Erosion characteristics of marsh surfaces;
headward erosion and bald areas. (RANN-VIMS)

These studies will be integrated with the ongoing and planned activities within the State of Maryland. The necessary interactions with the personnel and agencies responsible for economic-social-legal studies of marshland will also be initiated. The goal here is to formulate the design and work plan necessary to evaluate marshlands from these viewpoints.

The overall project with its subprojects will contribute to the Inventory Project and will be immediately integrated into planning and management of wetlands, shorelines, and shallows in the Bay region.

STATUS: Active. This is a project of "The Chesapeake Bay-A Coordinated Research Program."

FINANCIAL SUPPORT:

National Science Foundation
[RANN (IRRPOS) Program]
Virginia Institute of Marine Science
The Johns Hopkins University
University of Maryland

Also, the National Aeronautics and Space Administration and the Office of Water Resources Research, U. S. Department of the Interior, as indicated above.

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: POSSIBLE ROLE OF MARSHES IN PREVENTING
EUTROPHICATION OF ESTUARIES

INVESTIGATORS:

Michael E. Bender, Department Head and Senior Marine
Scientist
Marvin L. Wass, Associate Marine Scientist
M. M. Nichols, Associate Marine Scientist, Department
of Geological and Chemical Oceanography
E. P. Ruzecki, Associate Marine Scientist, Department
of Physical Oceanography and Hydraulics
Harold D. Slone, Assistant Marine Scientist
Donald Axelrad, Graduate Assistant

PROJECT SUMMARY:

Completed and current estuarine studies indicate that the nutrient budget of a highly enriched tidal system cannot be followed from the source of enrichment to the mouth. Analytical and physical data indicate that nitrogen and phosphorus compounds are "lost" within the system and cannot be accounted for in soluble, suspended, or deposited forms. The data indicate that adjacent marsh lands may be serving as nutrient sumps, thus preventing environmental degradation and aquatic nuisance conditions in estuaries.

This study is designed to investigate the hydrography, chemistry, geology, and biology of a marsh adjacent to a highly enriched estuary and a marsh off a relatively unmodified system. Emphasis will be placed on water and soil chemistry with the necessary associated effort on classification, productivity, and hydrography.

Water samples will be collected at 2-hour intervals during spring and neap and dry weather and freshet periods. Complete chemical analyses of the samples will determine if the marshes serve as Purdy described the Washington D. C. tidal pools, like lungs which purify on each tidal cycle.

The data will be analyzed in view of estuarine systems "with and without" associated marsh systems. The results should aid those agencies charged with decisions regarding the expendability of salt marshes.

STATUS: Active. This project is, in part, the subject of Axelrad's thesis research.

FINANCIAL SUPPORT:

Office of Water Resources Research
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: STUDY OF NEARSHORE SUBSURFACE CURRENTS OFF
VIRGINIA BEACH, VIRGINIA

INVESTIGATORS:

Morris L. Brehmer, Head, Division of Applied Marine
Science and Oceanic Engineering
Robert J. Huggett, Assistant Marine Scientist
Thomas Barnard, Jr., Graduate Assistant

PROJECT SUMMARY:

Sea-bed drifters are released biweekly, at two-mile intervals, on a transect three miles off the coast from Cape Henry to False Cape, Virginia. The data derived from the recovered units are used to determine the net set of the bottom currents in this area.

Sea bed drifter trajectory data are correlated with wind vectors and Chesapeake Bay salinity data in an attempt to develop predictor equations for the currents of the reach.

STATUS: Active.

FINANCIAL SUPPORT:

U. S. Corps of Engineers
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: STUDY OF ATLANTIC OCEAN SURFACE CURRENTS OFF
DAM NECK, VIRGINIA

INVESTIGATORS:

Morris L. Brehmer, Head, Division of Applied Marine
Science and Oceanic Engineering
Robert J. Huggett, Assistant Marine Scientist
Thomas Barnard, Jr., Graduate Assistant

PROJECT SUMMARY:

This study is designed to evaluate the surface current patterns in the Atlantic Ocean off Dam Neck, Virginia.

Surface drifter devices are released at stations 3,000 and 5,000 feet off the beach under varying wind and weather conditions. The data derived from the recovered units are used to describe the general surface current patterns in the area. The second phase of the study will utilize tracer dye releases to determine the diffusion and dispersion characteristics after a point source release.

STATUS: This project is in its terminal phase.

FINANCIAL SUPPORT:

Hampton Roads Sanitation District Commission
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: GLOUCESTER COUNTY SHORELINE SURVEY

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Kenneth Marcellus, Associate Marine Scientist
Thomas Duncan, Graduate Student
Lewis Shotten, Graduate Student

PROJECT SUMMARY:

A survey of Gloucester County, Virginia, conducted in January, 1971, located 10 severe erosion sites, 133 bulkheads with a combined length of 48,580 feet, 9 marinas, 3 public landings, and 11 seafood houses along the 334 miles of shoreline.

U. S. Geological Survey topographic maps and infrared aerial photographs were used to locate high and low shoreline, residential areas, and recent changes in marshes. Over 90 percent of the bulkheading was along high shoreline, areas where the 5 foot land contour came within 200 feet of the mean high waterline.

The York River, comprising 13 percent of the shoreline, had over 90 percent of the bulkheading. Approximately 42 percent of the York River bulkheading was within the Perrin River, Sarah's Creek, and VIMS' marina.

Groins were frequently associated with bulkheads exposed to a fetch of over one mile.

Spartina spp. were instrumental in shoreline stabilization. Areas without vegetation were generally eroding. Some areas, by the nature of their location, would be in a constant state of erosion were it not for bulkheads being present.

Bulkhead failure was due to cracks between boards, insufficient footing, anchors, and lack of adequate end protection.

STATUS: This project is nearing completion. It will be used as a model for a future project, "Inventory and Ranking of Wetlands, Shorelines, and Shallows of Virginia," if funds permit.

FINANCIAL SUPPORT:

National Oceanic and Atmospheric Administration
(Office of Sea Grant Programs)
National Science Foundation
(Research Applied to National Needs)
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: HEAVY METALS IN SEDIMENTS AND OYSTERS

INVESTIGATORS:

Robert J. Huggett, Assistant Marine Scientist
Michael E. Bender, Department Head and Senior
Marine Scientist
Harold D. Slone, Assistant Marine Scientist

PROJECT SUMMARY:

This project is designed to assess the distributions and concentrations of cadmium, copper, lead, mercury, and zinc in the southern Chesapeake Bay and its major tributaries.

The Eastern Oyster (Crassostrea virginica), the brackish water clam (Rangia cuneata), and bottom sediments are being taken from numerous locations in the James, York, Rappahannock, Elizabeth Back, Poquoson, Piankatank Rivers as well as Mobjack and Lynnhaven Bays. The areas between these tributaries, in the Chesapeake Bay, are also being sampled.

Analyses are being performed by Atomic Absorption and Aniodic Stripping Voltametry.

STATUS: Active. This project represents, in part, Huggett's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: STANDING CROP STUDIES IN VIRGINIA MARSHES

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Robert J. Orth, Graduate Assistant

PROJECT SUMMARY:

To date, 77 square meter samples of wetlands vegetation have been clipped and oven-dried to obtain estimates of standing crops of ferns, grasses, and forbs. By this work, we hope eventually to obtain data sufficient to allow characterization and evaluation of wetlands. Samples obtained thus far indicate that annual crops of higher plants produce from 1 to 8 tons/acre, with the average probably over 4 tons/acre. The 3 Spartina species are among the most productive, but the presence of 2 crops per year in much freshwater marsh also makes those areas productive and ecologically interesting.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: DETRITUS FLUX IN TIDAL MARSHES

INVESTIGATORS:

Michael E. Bender, Department Head and Senior
Marine Scientist
Robert J. Orth, Graduate Assistant
Kenneth Moore, Graduate Assistant

PROJECT SUMMARY:

The objectives of this study are to determine:

- (1) flux of detritus during the tidal cycle in
and out of the marsh,
- (2) seasonal changes in detritus loads, and
- (3) the composition of the detrital matter.

To accomplish these objectives, we are measuring three fractions of the materials, coarse, fine, and nanno and determining their weights. Dissolved carbon and oxygen are also being followed as a function of tidal flow. These studies are presently combined with those being conducted on nutrient flux under a grant from the OWRR.

STATUS: Active. This project represents, in part, Moore's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: THE ROLE OF AN ANADROMOUS FISH, THE ALEWIFE
(ALOSA PSEUDOHARENGUS, WILSON) IN PESTICIDE
TRANSPORT

INVESTIGATORS:

Morris L. Brehmer, Head, Division of Applied Marine
Science and Oceanic Engineering
Thomas A. Barnard, Jr., Graduate Assistant

PROJECT SUMMARY:

Recent studies indicate that the world ocean is becoming a vast sump for the persistent organochlorine pesticides. Marine organisms show higher pesticide concentrations than their freshwater counterparts.

This study is designed to investigate the transport of pesticides between estuary and ocean during the spawning run of anadromous fish. It will also yield information concerning age--pesticide concentration ratios, concentration differences between sexes and average levels of pesticide in the gonads and other organs of the alewife.

STATUS: Active. This project represents Barnard's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: COMMUNITY DISTRIBUTION AND STRUCTURE OF BENTHOS
IN A GRADIENT ESTUARY

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Donald F. Boesch, Graduate Student

PROJECT SUMMARY:

The phenomenon of the diminution in the numbers of marine taxa and concomitant reduction in species diversity as one proceeds up estuaries is widely known; however, this has not been adequately quantified. This investigation involves sampling of soft-bottom benthic organisms along the length of the Chesapeake Bay-York River-Pamunkey River estuary, a long, stable "gradient" estuary. Description of the distribution assemblages of benthic species is being undertaken via a number of objective discriminatory analyses. Community structure is being analyzed in terms of species diversity and its components, dominance, and other structural attributes. The knowledge of community structure throughout the range of estuarine conditions in a relatively unpolluted estuary is essential to the use of structural measures as biological water quality indicators.

STATUS: This project represents Boesch's dissertation research.

FINANCIAL SUPPORT:

Environmental Protection Agency - Fellowship
Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: ESTUARINE BENTHIC RECRUITMENT IN DREDGED
AREAS

INVESTIGATORS:

Michael E. Bender, Department Head and Senior Marine
Scientist
Thomas K. Duncan, Graduate Assistant

PROJECT SUMMARY:

Four areas in Hampton Roads with differing ages in respect to time of dredging will be studied for nine months. Sampling will be conducted at monthly intervals, utilizing a modified van Veen grab. The samples will be analyzed as to their faunal content, organic carbon content, and sediment composition.

It is hoped that some idea of the changes in the faunal content of these areas with time and the relationship of these changes to the establishment of a stable benthic community will be obtained.

STATUS: This project represents Duncan's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: MARSH PLANT PRODUCTIVITY AS A FUNCTION OF SALINITY

INVESTIGATORS:

Kenneth L. Marcellus, Associate Marine Scientist
Michael E. Bender, Department Head and Senior Marine Scientist
Irving Mendelsohn, Graduate Assistant

PROJECT SUMMARY:

The determination of wetland value to estuaries requires a knowledge of the extent and productivity of dominant plant species. The productivity of many species has been determined, but not over their entire habitat range. Salinity does influence plant distribution, growth, and community structure as well as nutrient concentrations. Consequently, the application of production values from marshes in a specific salinity regime to all other marshes along an estuarine salinity gradient may not be valid.

The proposed study will analyze marsh plant productivity and the nitrogen and phosphorus concentrations of marsh soils as a function of the salinity in the adjacent waters.

Data collected periodically throughout the year from three marshes in each of three salinity regimes will be statistically evaluated. The results will be applied to a marsh value equation currently being developed.

STATUS: Active. This project represents Mendelsohn's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: BENTHIC INFAUNA OF ZOSTERA BEDS

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Robert J. Orth, Graduate Assistant

PROJECT SUMMARY:

Of 30 species of flowering plants known to occur in the sea, eelgrass, Zostera marina, is of outstanding ecological importance in shallow seas and estuaries of the temperate zone. Attempts to describe the fauna associated with eelgrass beds have either been quantitative or concerned with the epifauna. This study involved sampling the infauna of eelgrass beds over the range of its growth found in the Chesapeake Bay-York River estuarine system on a winter-summer basis. Objective statistical tests will be used to analyze faunal homogeneity among the sampling locations and community structure will be examined with diversity analysis and its components.

STATUS: This project represents Orth's thesis research.
The thesis paper is being written.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

PERSONAL RESEARCH IN OTHER
GEOGRAPHIC AREAS

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: PARASITIC COPEPODS FROM MARINE FISHES OF NEW ZEALAND AND AUSTRALIA

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director

G. C. Hewitt*

David E. Zwerner, Assistant Marine Scientist

PROJECT SUMMARY:

Numerous parasitic copepods were collected in conjunction with the Parasitology Section's survey of the monogenetic trematodes of New Zealand and Australia under the direction of Dr. W. J. Hargis, Jr. Parasitic copepods are as interesting as they are economically important and, though not as host specific as monogenetic trematodes, may prove valuable in studying some aspects of host-parasite relationships.

In view of their potential aid in the study of the total parasitic fauna of fishes and for their own sake as ectoparasites, a systematic study was undertaken. Processing, involving whole mounts, dissections, and systematic descriptions is underway.

STATUS: Continuing.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

*Dr. G. C. Hewitt, Victoria University of Wellington, Wellington, New Zealand, is to co-author one or two papers with Zwerner.

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: MONOGENETIC TREMATODES OF THE INDIAN OCEAN
AREA, THEIR SYSTEMATICS, ECOLOGY, AND PHYLOGENY

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Adrian R. Lawler, Graduate Assistant
E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

Even though several Indian workers are actively engaged in work on monogenetic trematodes, considerable ignorance exists concerning the parasite fauna of coastal and deep-sea fishes of the Indian Ocean. Increased knowledge of the Monogenea from these important areas is essential to the Parasitology Section's project on the systematics, host-specificity, zoogeography, and phylogeny of the Monogenea. Many of the trematodes from fishes of these areas will undoubtedly be new to science and their systematic innovations will shed much light on the relations of one group to another.

Thus, from March 1963 through November 1964, our field collectors participated in IIOE cruises 1, 2, 4, 5, and 8. Collections were made using the mass collection techniques developed by Hargis. The great amount of material resulting from these collections has to be processed for study.

An additional collection was made from waters around the island of Madagascar by Dr. Roger F. Cressey (now at the U. S. National Museum, Washington, D. C.). This material, when worked up, will make an interesting addition to our other parasites from the Indian Ocean.

Dr. Robin M. Overstreet (Gulf Coast Research Laboratory, P. O. Drawer AG, Ocean Springs, Mississippi 39564) will work on the digenea of this collection as soon as the material can be culled out and outstanding host identifications made.

STATUS: A proposal to process and work up the systematics of this collection was turned down. VIMS funds are used to maintain and cull out the collection.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: MONOGENETIC AND DIGENETIC TREMATODES OF THE
MIDDLE CONTINENTAL SHELF OFF WEST AFRICA

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
Adrian R. Lawler, Graduate Assistant
E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

Information on the parasite fauna of fishes from the western, southern, and eastern coasts of Africa is very sketchy, especially data on monogenetic trematode parasites of the deep water fishes known to be found in those areas. Knowledge of the Monogenea from this area should fill in a great deal of the gaps that exist in the taxonomy of these parasites and shed much light on host and parasite relationships, so important to our present study of host-specificity. Fortunately, the co-investigator was given the opportunity to participate in the Equalant I program, collecting fishes on cruise 2 of the R/V Geronimo in the fall of 1963.

A total of 1044 fishes was collected utilizing the mass collection technique developed by Hargis. As it now stands, 46% of the hosts have been examined yielding about 660 monogenetic trematodes, not to mention the other parasites found. This good collection from previously unexamined hosts and localities when finally worked up will do much in elucidating the systematic scheme of the Monogenea as well as providing important data for host-specificity studies. Work continues as funds become available.

STATUS: No outside funds are available to process the collection. VIMS funds are used to maintain the collection.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: MONOGENETIC TREMATODES OF FISHES OF PUERTO RICO

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
Adrian R. Lawler, Graduate Assistant
E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

In order to obtain additional knowledge of the Monogenea of fishes from the waters surrounding North America, a collection of fishes and their parasite complement was made in the marine waters of Puerto Rico. Many of the trematodes obtained from these fishes will undoubtedly be new to science, and their systematic innovations will shed much light on the relations of one taxon to another.

Collections were made using the mass collection technique developed by Hargis. Much of the material resulting from this collection was processed for study. Host-parasite data will be incorporated into our host-specificity file enabling us to better understand the Monogenea as a whole.

STATUS: Only a part of the monogenetic trematode specimens have been mounted for study. This collection has a low priority and work involves maintenance of the collection.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: PARASITES OF VERTEBRATES (MOSTLY FISHES) FROM
THE ANTARCTIC AND SOUTHERN PACIFIC OCEANS WITH
EMPHASIS ON THE SYSTEMATICS AND HOST-SPECIFICITY
OF MONOGENETIC TREMATODES

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director
David E. Zwerner, Assistant Marine Scientist
Adrian R. Lawler, Graduate Assistant
E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

Knowledge of the parasitic fauna of the marine vertebrates from the waters around Antarctica and near the surrounding land masses is very sparse. Since monogenetic trematode parasites of fishes are quite host specific and, in view of the indicated ancient geographic relationships of these land masses, studies here should prove fertile and measurably increase our understanding of the paleodistribution of both host and parasite. Studies of taxonomy and host-specificity should add to our knowledge of both host and parasite phylogeny.

Extensive collections of host material have been made from the following areas utilizing the "mass collection technique" developed by Hargis: McMurdo Sound, Antarctica - 1958, 1959, 1964, 1965; New Zealand - 1960; Wildmill Islands, Wilkes Station, Antarctica - 1961-62; Australia - 1962; Chile and Drakes Passage - 1962; Palmer Station, Antarctica Peninsula - 1967-68.

All of the collections, with the exception of the most recent Palmer Station collection, have been processed for study (Monogenea stained and mounted on slides) and taxonomic study of the worms is in various stages of completion. To date, eight publications, two M. S. theses, and one Ph.D. dissertation have resulted. One paper is being prepared for the Editorial Committee and two others are rapidly nearing completion. The systematics and ecology of the Palmer Station ectoparasites is the topic of an M. A. thesis soon to be completed.

STATUS: All of the Monogenea from McMurdo, Wilkes Station, and New Zealand have been worked up systematically. The Australian Monogenea and all the ectoparasites from Palmer Station are receiving most of the attention

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Microbiology-Pathology Department
Parasitology Section

STATUS (Cont.):

now. The Chile and Drakes Passage Monogenea have not received systematic attention.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Microbiology-Pathology Department
Parasitology Section

PROJECT TITLE: ECTOPARASITES FROM FISHES OF ARTHUR HARBOR,
ANTARCTICA

INVESTIGATORS:

William J. Hargis, Jr., Section Head and Institute
Director

E. Lynn Suydam, Graduate Assistant

PROJECT SUMMARY:

A total of 441 fishes representing three families, four genera, and nine species was collected by Suydam (with the assistance of his co-collector, J. K. Lowry, formerly of VIMS) during his year at Palmer Station (Arthur Harbor, Antarctic Peninsula), 1967-68. Of these, two genera and four species are new to VIMS' collection of Antarctic fishes. Skin parasites were taken from fresh specimens and preserved while the remainder of the specimens were captured utilizing the "mass collection technique" developed by Hargis (1953). Parasite specimens were separated from host material and processed for taxonomic determination and study. During this study, a notation of the sites of attachment of many of the parasites was made thereby furnishing micro-ecological data.

STATUS: Monogenetic trematodes, isopod, copepod, and leeches are being included in this taxonomic and ecological work. This project represents Suydam's thesis research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

Virginia Institute of Marine Science
Department of Ecology-Pollution

PROJECT TITLE: DESCRIPTION OF PAGURIDAE COLLECTED BY THE
INTERNATIONAL INDIAN OCEAN EXPEDITION

INVESTIGATORS:

Marvin L. Wass, Associate Marine Scientist
Philip Witherington, Graduate Student

PROJECT SUMMARY:

This project consists of the examination and description of the specimens of Paguridae collected by the International Indian Ocean Expedition, principally by the R/V "Anton Bruum", Cruises 7, 8, and 9. These specimens were processed by the Smithsonian Oceanographic Sorting Center and shipped to Dr. M. L. Wass, VIMS. A resumé of the species and collecting localities will be compiled. Descriptions of new species will be provided and a complete analysis of the zoogeographical aspects of the Indian Ocean Paguridae will be attempted.

STATUS: This project represents Witherington's dissertation research.

FINANCIAL SUPPORT:

Virginia Institute of Marine Science

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