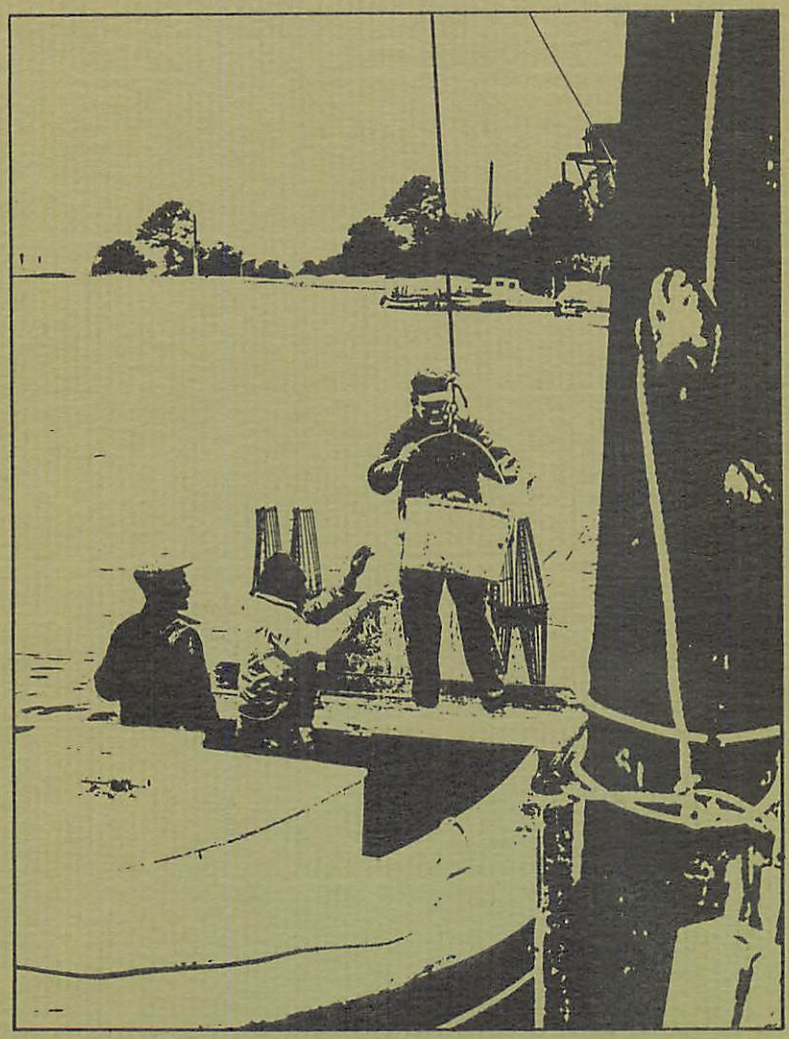
1978
ANNUAL REPORT
Virginia Sea Grant Program



Virginia Institute of Marine Science
Gloucester Point, VA 23062

Photographs courtesy of VIMS/Sea Grant publications

1978
ANNUAL REPORT
Virginia Sea Grant Program

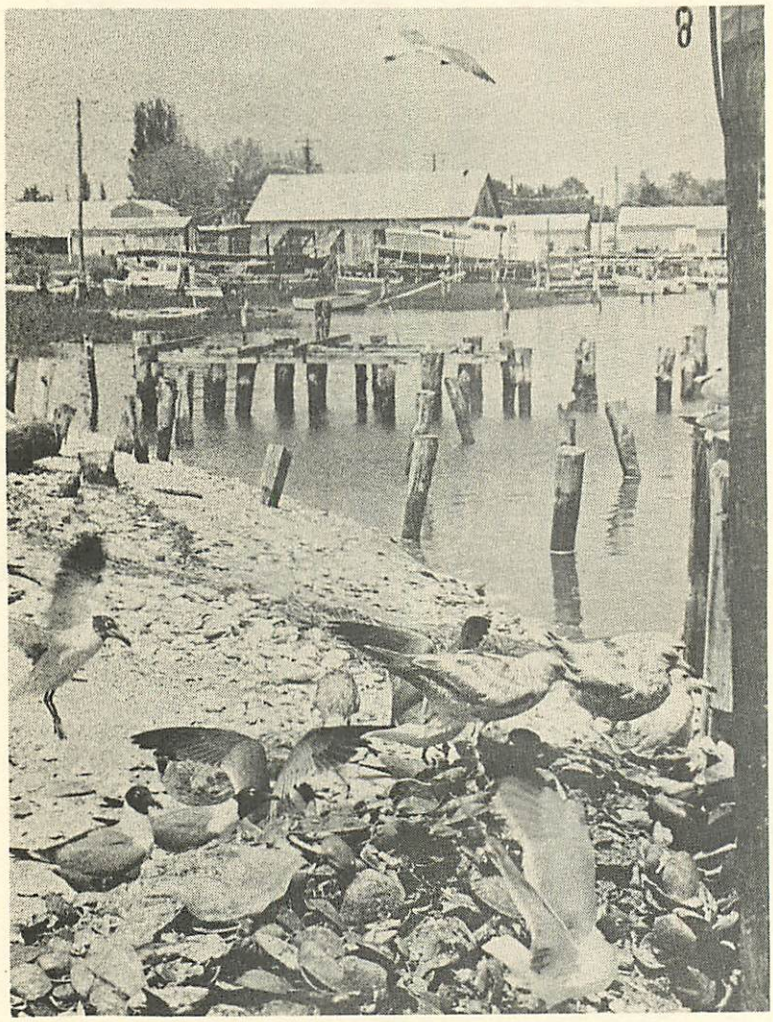
Cooperating Institutions:

COLLEGE OF WILLIAM AND MARY
GEORGE MASON UNIVERSITY
MARSHALL-WYTHE SCHOOL OF LAW
OLD DOMINION UNIVERSITY
UNIVERSITY OF VIRGINIA
VIRGINIA INSTITUTE OF MARINE SCIENCE

A report on the
Virginia Sea Grant Program
for January 1 - December 31, 1978

Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

Dr. Maurice P. Lynch
SEA GRANT DIRECTOR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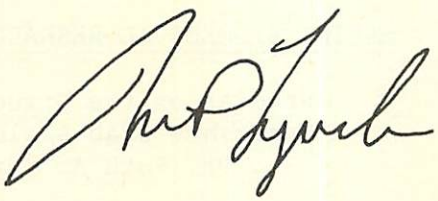
INTRODUCTION

This Annual Report marks a decade of service to the citizens of Virginia and the nation performed by the Virginia Institute of Marine Science through support from Sea Grant. What began in 1968 as essentially shellfish research augmented by advisory services has expanded into a major program involving as many as five principal institutions of higher learning, the state community college system and numerous federal, state, regional and local offices.

From its establishment in 1940 by action of the Virginia General Assembly, VIMS has continued to provide the Commonwealth with innovative advice on and answers to problems of the coastal environment. Through a unique arrangement of support from Virginia's legislative and executive branches in combination with the ability to obtain contractual working arrangements with other organizations both public and private, the Institute remains a source of technical expertise accessible to all levels of government, private enterprise and citizenry, nationally and internationally.

The Sea Grant Program has provided maximum opportunity for the acquisition and utilization of coastal zone data. Research supported by Sea Grant has made valuable contributions toward the solving of marine problems facing the state, the nation and the world, especially in the area of culturing marine organisms for human consumption. Work in the field of marine education from pre-school to post-retirement has made the public aware of the vulnerability and dangers to, as well as the economic opportunities offered by the marine environment. Advisory Services - a focal point of the VIMS Sea Grant Program - has provided visible evidence to the public that something is indeed being done for them; and in a very valuable, cost-effective manner.

With the submission of this Annual Report, the Virginia Institute of Marine Science offers a synopsis of accomplishments in 1978, with the realization that the veil of complex coastal and marine problems has only begun to be lifted, and with the hope that the next ten years will be as productive as those past.



Maurice P. Lynch
Sea Grant Director

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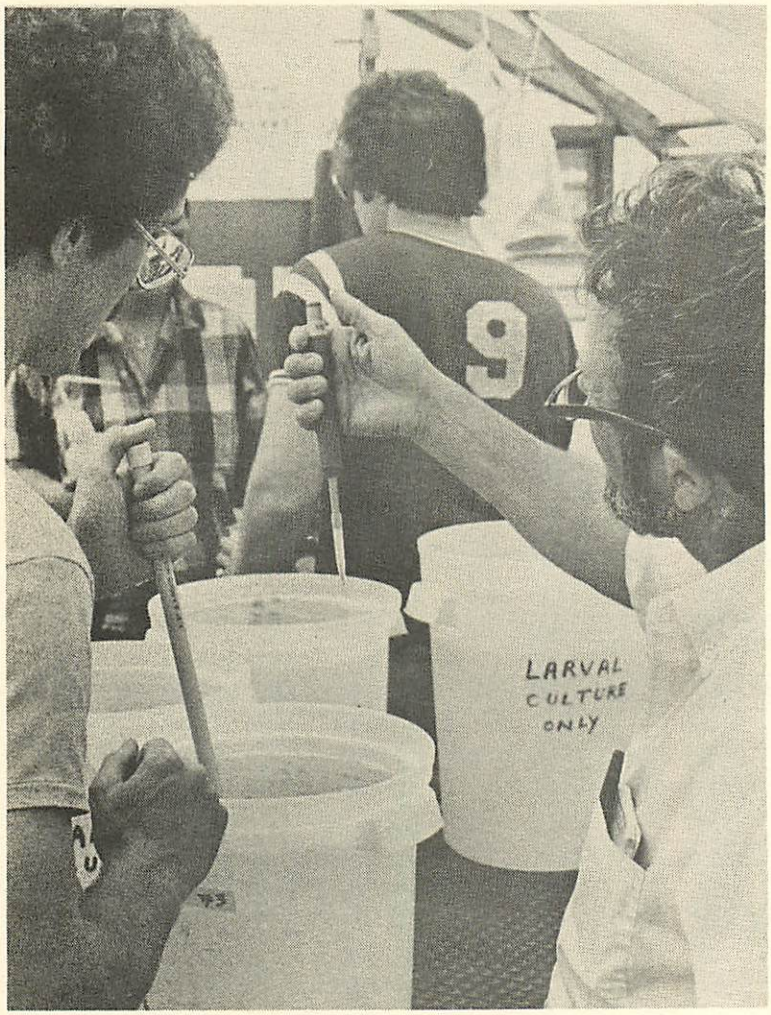
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LARVAL
CULTURE
ONLY

MARINE RESOURCES DEVELOPMENT

Mariculture of Shellfish-Nutrition

Dr. John L. Dupuy
Virginia Institute of Marine Science

One of the most pressing national and international problems of today is production of food. The oceans are increasingly being viewed as a potential solution to a major part of this problem through progressively larger harvests of naturally occurring populations and through the mariculture of high yield, nutritious species of sea life. It is in the direction of the latter that Sea Grant has supported VIMS' Marine Culture Department in an effort to develop an efficient method for the induced spawning, setting (attaching to a solid medium) and growth of oyster (Crassostrea virginica) larvae.

During the past eight years considerable progress has been made in the areas of: oyster spawning (now routinely accomplished in any season), the use of cultured planktonic algae as food for oyster larvae and the development of techniques and equipment designed to optimize setting, growth and healthy conditioning of oysters, from larvae to spawning age.

In 1978, research was aimed primarily at the development of a completely artificial diet for oyster larvae based on the protein, lipid and carbohydrate components of certain species of algae. The algal species Pyramimonas virginica, Pseudoisochrysis paradoxa and Chlorella sp. have been found to promote growth and setting of oyster larvae 6 to 10 days earlier with a 30 to 40% better success rate than other species of algae (Monochrysis and Isochrysis) which in the past have been standard larval foods; thus the coded species' designation as "good" as opposed to "mediocre" foods and the resulting concentration of effort on their chemical analysis.

The analysis of proteins, amino acids, lipids and fatty acids has been completed and the results indicate that fatty acids based on molecular chains 16, 18 and 22 carbon atoms in length (denoted as C-16, C-18 and C-22 series) are predominant. Based on the results of VIMS' studies of fatty acids (Chu and Dupuy, 1978) and amino acids (Chu et. al. 1977, unpublished results) the compositions of 4 algal species utilized as food sources by oyster larvae are qualitatively similar. It appears, however, that there are quantitative differences in the essential fatty acids such as C-16:0 (no unsaturated bonds), 16:1w7 (1 unsaturated bond at the w7th position), 16:2w6 16:3w3, 18:0, 18:1w7, 18:2w6, 18:3w3, 18:4w3, 20:5w3 and 22:6w3 that are found in the "good" foods as opposed to the "mediocre" foods. Further quantitative analysis of fatty acids in each category of food is required in order to confirm the apparent difference.

Present analyses also indicate that the larger quantity of neutral

lipids found in the three "good" species may be an important factor which separates our superior food from the past standard "mediocre" larval foods.

This research, in combination with that in the fields of hatchery design and disease resistance will aid significantly in the effort to produce large numbers of marketable cultch-free seed oysters.

Genetic Studies of Scallops and Clams

Dr. J. R. Wall and Mrs. S. W. Wall
George Mason University

Allied with studies on the mariculture of oysters are investigations into the genetic makeup of populations of scallops and clams. In the past, the directed breeding of these shellfish to attain populations of fast growing, disease resistant organisms has been based primarily on visual observations and assumed historical trends for the selection of parental stock. To alleviate this problem of phenotype selection, and because it is desirable to broaden the genetic base in a breeding program, populations of high genetic variability must be identified in order to avoid the wasteful practice of selective breeding within populations of low variability.

Since 1976, Sea Grant has supported research on the genetics of scallops and clams which promises to not only hasten the development of superior parental stock, but also to insure the long term viability essential to shellfish hatcheries.

To date, the geographical, and to some degree the ecological distribution of genetic variation in the bay scallop, Argopecten irradians has been largely determined with genetic variation being found in four regional groups. This variation and genetic distance has been measured for all subspecies of the bay scallop by the allozyme analyses of 1360 individuals representing 13 populations. Allozyme analysis by gel electrophoresis is a process by which the genetic variation between individual organisms is determined by the examination of differing "gene-product" or enzymatic movements on a gel medium subjected to an electric current. After the water-soluble proteins have been extracted from shellfish tissue, enzymes are separated by adjusting the pH of the medium which changes their isoelectric properties. Enzymes then appear on the gel as specifically stained bands of differing mobility in response to the electric current. By the differentiation between these bands, their mobilities and locations, genetic distance between individual organisms, and thus between populations, may be ascertained.

Also during 1978, a similar study was conducted using populations of the American oyster Crassostrea virginica, but concentrating on 4 genetic loci which have more than one identifiable gene product. These enzymes were LAP-1 (leucine aminopeptidase - the "1" indicating that it is the faster in gel mobility of at least two products), LAP-2, PGM-1 (phosphoglucomutase) and PGI (phosphoglucoisomerase).

As was the case with Argopecten irradians, this research will aid considerably in the effort to produce superior broodstock by directed recombination among diverse genotypes.

Mariculture of Shellfish- Disease Resistance

Drs. John L. Dupuy and
Frank O. Perkins
Virginia Institute of Marine Science

During 1978, VIMS pursued a program of intensive breeding of potentially disease resistant oysters obtained from selected beds in Maryland Chesapeake Bay waters. The offspring produced by these parents can be tested for resistance to the disease Perkinsus marinus (Dermo) in the laboratory because the infective agent can be cultured. Eleven strains or groups of potentially resistant oysters were produced for this testing program as the first stage of the selection process. Further selection of the most resistant sibling groups to the disease will continue and these groups will then be used to obtain resistant strains that can then be bred not only for resistance, but also for good shape and fast growth.

The availability of disease resistant lines will allow the production of seed oysters by hatcheries for use in areas where mortalities from the disease "Dermo" creates serious problems of production for the oyster industry. In the future, the interbreeding of known MSX (Minchinia nelsoni) resistant strains and "Dermo" resistant strains will be the final goal. This will result in the production of superior oysters and will aid in revitalizing the oyster industry in the lower Chesapeake Bay where disease has greatly hampered production since 1958.

Mariculture of Shellfish- Hatchery Design

Dr. John L. Dupuy
Virginia Institute of Marine Science

In the recent past, oyster seed hatcheries have been greatly underutilized. The economics of hatchery operation has generally dictated that seed oysters could be grown to only 3/4" in size, and even then the seed had to be sold at a high, non-competitive price. Oyster seed smaller than 1 inch is generally not salable in the Chesapeake Bay area because of the inherent risk involved in small seed oysters which have a low survival rate on natural oyster grounds.

However, in 1978, with the support of Sea Grant, modification and testing of a new oyster setting tank incorporating the Maheo collector (named after Mr. Guy Maheo of France, its developer) was completed one year ahead of schedule. The collector, which was developed in Europe for oyster ground bottom culture, as modified and mechanized in the VIMS hatchery system, will allow for the setting of over one-half million spat (seed) within a three hour period. Field testing has also indicated that fouling and crab predation do not seem to present significant problems to oysters which have been set on the Maheo collector.

The results of these tests seem to indicate that superior oyster seed may be grown to a size of one inch economically and sold to oyster growers at a price near to that of natural seed.

These developments in hatchery design, as well as those in nutrition and disease resistance, may supply the means for reversing the decline of oyster seed availability in the

Chesapeake Bay area which has occurred during the last five years, thus providing an avenue for the restoration of the oyster industry in Virginia to its traditional importance.

Investigations of the Cause and Epizootiology of Mortalities in Soft and Shedding Blue Crabs

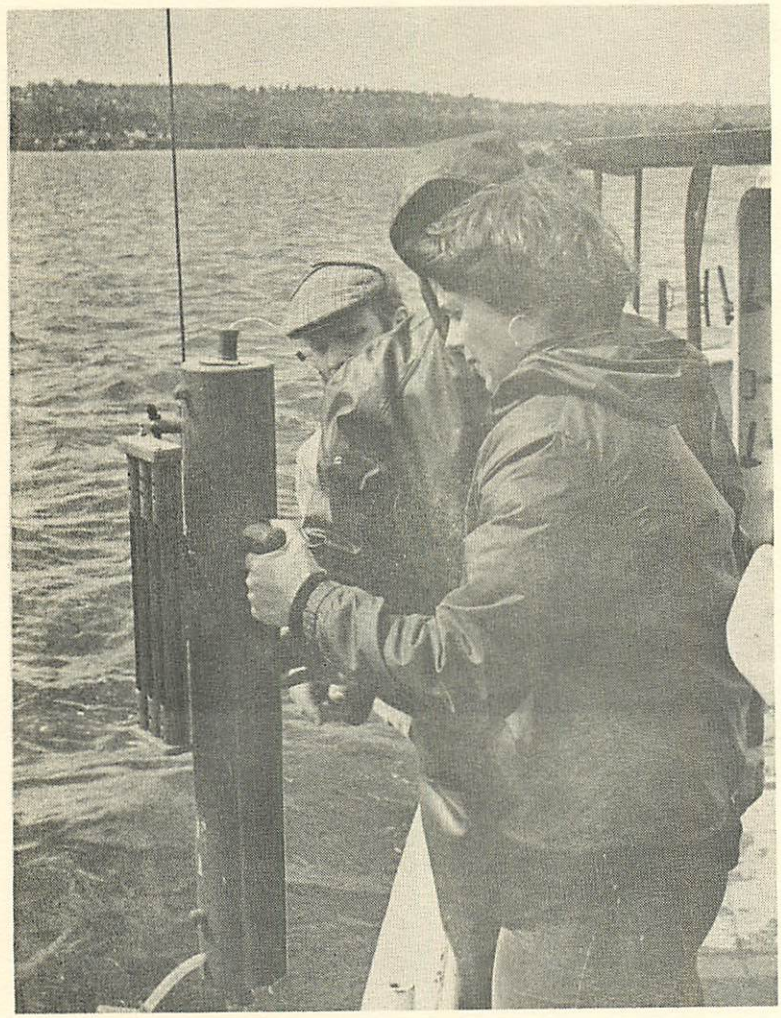
Mr. W. A. Van Engel and
Dr. F. O. Perkins
Virginia Institute of Marine Science

Blue crab shedding operations in Virginia were studied in an effort to determine the extent and possible causes of costly crab mortality during operation and to determine if and by what means these causes may be spread from one crab to another. Biological, chemical, and physical characteristics of four shedding systems were observed from May to September, 1978. The following parameters were monitored: heterotrophic bacterial levels in crab hemolymph (circulatory fluid), heterotrophic bacterial levels in tank water, crab histopathological conditions, air temperatures, water temperatures, dissolved oxygen levels, concentrations of nitrites and ammonia, and salinity levels. The results of these tests provided an assessment of the changing conditions occurring throughout the shedding season, and allow for the correlation of sets of conditions with reported periods of high mortality at each location.

The occurrence of high bacterial counts in crab hemolymph was found to increase with each successive shedding stage from "green sign crabs" (the earliest stage peeler) to "red sign crabs" (the latest stage, just before the shell begins to crack), and to decrease in "buster crabs" (when the crab is backing out of the old shell, and the rear of the shell is elevated) and "soft crabs." This pattern of bacterial counts shows a close correlation with mortality information which indicates that death rates increase as crabs approach the buster stage then decrease during buster and soft stages. As a group, male crabs showed a greater frequency of high bacterial counts than did female crabs. This also correlates well with mortality data which indicate greater survival rates among female peelers. It may be hypothesized that the presence of bacteria in crabs approaching a molt constitutes an added stress on the crab during an already difficult period. The magnitude of the stress, its variation with environmental changes, and its role in mortality are currently under study. Numbers of heterotrophic bacteria in tank water were monitored during July, August, and September of 1978, but showed no correlation to the numbers of bacteria found in the crab hemolymph. Microscopic examinations of crab muscle, hemolymph, hepatopancreas, and gill tissues yielded no evidence of internal protozoan, fungal or viral pathogens. Numbers of peritrichous ciliates (ciliated protozoans) on gill surfaces varied markedly; however, it is not known at the present time whether the ciliates influence mortality rates.

Examinations of physical and chemical characteristics of the shedding operations over the sampling period permitted some generalizations. Increases and decreases in water temperature often coincided with fluctuations in the number of crabs caught, reports of heavy silt loads in the water often occurred during periods of high crab mortalities, and dissolved oxygen, as would be expected, showed an inverse relation to air and water temperatures. Dissolved oxygen, salinity, and nitrates and ammonia varied throughout the study but were judged to be within limits for crab survival.

The results of this research will not only help the operators of shedding plants to increase production, but will also add to the knowledge of the effects of stress on blue crabs in natural environments.



MARINE ENVIRONMENTAL RESEARCH

Quantitative Prediction of Shoreline Changes

Dr. Victor Goldsmith
Virginia Institute of Marine Science

In 1971, the U.S. Army Corps of Engineers stated that 74% of the Mid-Atlantic shoreline was eroding, with 20.8% in a critical eroding condition. The cost of remedial measures for the critical areas only was then estimated at $675 million. This project was undertaken in 1977 with Sea Grant support in response to these conditions, and to satisfy the need for methods to predict the effects to the shoreline resulting from mammals' alterations to offshore bottom topography as well as from natural events.

Work during the first year was very successful and resulted in the computerization of historical shoreline changes in the Mid-Atlantic region, compilation of a model using these data to predict future shoreline changes, an annotated bibliography on bottom topography changes resulting from deliberate human activities, and a bottom topography chart of the Chesapeake Bay. In addition, area and storm-specific wave data were provided to several organizations to aid in studies on erosion, overwash and effects of altered bottom topography.

Over the past year, work has continued on refining the data gathered in 1977 and in comparing recent shoreline changes with historical records.

Historical shoreline changes were plotted and digitized from original hydrographic sounding sheets (some from as early as the 1840's) for the area between Cape Hatteras, North Carolina, and Montauk Point, Long Island, completing the approximate 150 year record of change, and filling in the available shoreline data from Cape Hatteras to Cape Henlopen, Delaware. Using these data, regional variations in past shoreline trends were evaluated in order to suggest future trends. The historical shoreline trends were compared with previously computed wave data (in various combinations) using linear correlations, moving averages and other appropriate statistical techniques.

Wave characteristics were hindcasted from historical storms along the Outer Banks of North Carolina for statistical comparisons with shoreline changes resulting from these storms. (The shoreline changes were delineated from aerial photography and closely spaced beach profile data).

Specific relationships were found to exist between shoreline wave parameters, such as wave height, wave ray spacing, (used in the computer plotting of waves as an expression of their density) and deliberately altered bottom topography. A second goal was achieved in this phase by altering the bottom topography in the model to resemble dredge holes, spoil mounds and other continental shelf activities.

As a result of these accomplishments, an "Atlas" of all historical shoreline changes, from 1836 to the present, from Sandy Hook, New Jersey to Cape Hatteras, is being prepared for publication. Short reports have been prepared for specific aspects of the research, providing analyses of historical shoreline changes and estimates of future changes. These reports are available upon request. Investigation of erosion and overwash occurrences has led to several publications dealing with degrees of risk of shoreline erosion along Cape Hatteras National Seashore. In cooperation with the National Weather Service Techniques Development Laboratory, wave refraction analysis has provided data which now facilitate the forecasting of storm related beach erosion along the U.S. East Coast.

Nutrient Mass Balance Studies of Mesohaline Marshes in the Lower Chesapeake Bay

Drs. R. Wetzel, K. L. Webb,
and M. E. Bender
Virginia Institute of Marine Science
Dr. J. L. Zieman
University of Virginia

The objective of this project is to extend man's knowledge of mesohaline (middle salinity) marshes and to pursue a promising line of research in examining the influence of oxygen on nutrient cycling in marshes. This research is designed to determine the identity and exchange rate of inorganic nutrients moving between mud flat and marsh surfaces and the overlying water. The aim is to determine the effect of tidal flow variations, storm events and oxygen concentrations on these processes.

The research has permitted completion of studies of the mesohaline marsh and the gathering of similar information at the salinity extremes, i.e. fresh and haline. This research is providing information on processes controlling nutrient cycling in saltmarsh and mudflat ecosystems by providing quantitative information on sources and sinks for limiting nutrients, quantifying rates of uptake/release by various parts of the systems studied, describing daily, seasonal and annual cycles of nutrient dynamics controlling marsh productivity and, identifying critical processes for the maintenance of the natural marsh ecosystem. The net effect of the study and data analysis will be to provide necessary scientific knowledge for effective management policies for marsh systems in Virginia.

Analysis of data gathered thus far indicates that oxygen concentrations may be providing control for release and uptake of phosphorus by the marsh. This observation provides a theoretical process upon which to focus future research efforts and if, in fact, the initial evaluation is supported, this study will indicate that application of materials to marsh surfaces which increase oxygen demand will indirectly greatly increase export of phosphate and possible nitrite and thus increase the eutrophication process in the adjacent estuary.

Tidal Inlet Management and Research in the Chesapeake Bay System

Drs. R. J. Byrne and J. D. Boon III
Virginia Institute of Marine Science

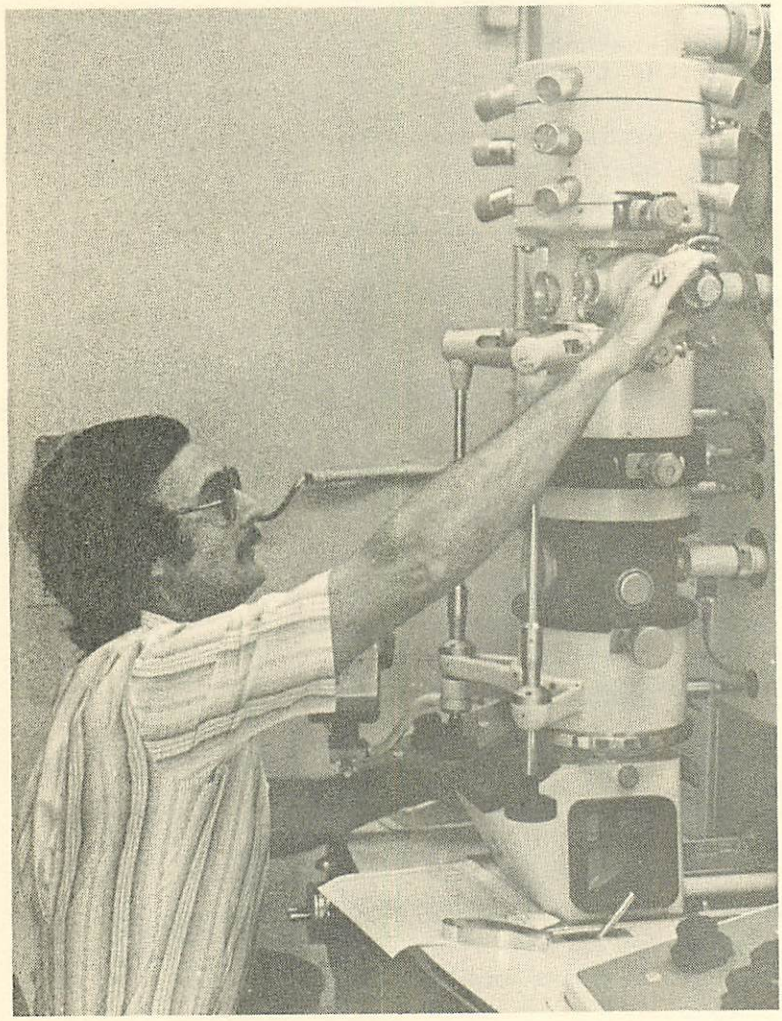
The intent of this project is to develop the data for understanding the tidal hydraulics of relatively small tidal inlet-basin systems fringing the

shores of the Chesapeake Bay System and, via analysis of that data base, to compare the results with those derived from studies of larger scale oceanic inlet systems, and to learn how the larger inlet-basin systems within the Chesapeake Bay System have evolved during the Holocene transgression of sea level. This work will provide the foundation for understanding inlet-basin systems within the Bay and comparable systems. An additional goal is to prepare an engineering assessment of a select few of those systems under pressure for development so that the flexibility, constraints, and impacts of inlet modifications are determined for the user community (developers, planners and environmental management agencies). The user-oriented reports will serve as a pilot study to test the utility and effectiveness of the approach.

One principal benefit anticipated is that developers, planners and environmental managers will be informed of the constraints and flexibility regarding navigability after land purchase and/or construction of the infrastructure. Most of the proposed modifications reflect an awareness of potential impacts of optimum design.

The principal scientific benefit from the project has been the extension of our understanding of inlet system to include the transition between "mode" and "oceanic" scales. The study, when complete, will either verify existing formulations derived from the "oceanic" systems or develop broader relationships.

During the year 1978 the inlets of the Chesapeake Bay System have been inventoried. Of the 480 inlets identified about 30 are of sufficient size to be likely to come under pressure for development. Investigation of a subset of small inlet systems has demonstrated that the tidal prism-inlet area relationship derived for oceanic inlets does not predict the conditions for smaller inlets. The results do show another functional relationship which represents a continuum between "model" scale inlets and oceanic counterparts. These findings are important to the theoretical investigation of inlet stability.



MARINE BIOMEDICAL RESEARCH

Studies on the Structure and Biological Properties of the Horseshoe Crab Agglutinin

Dr. Ruth A. Kaplan
George Mason University

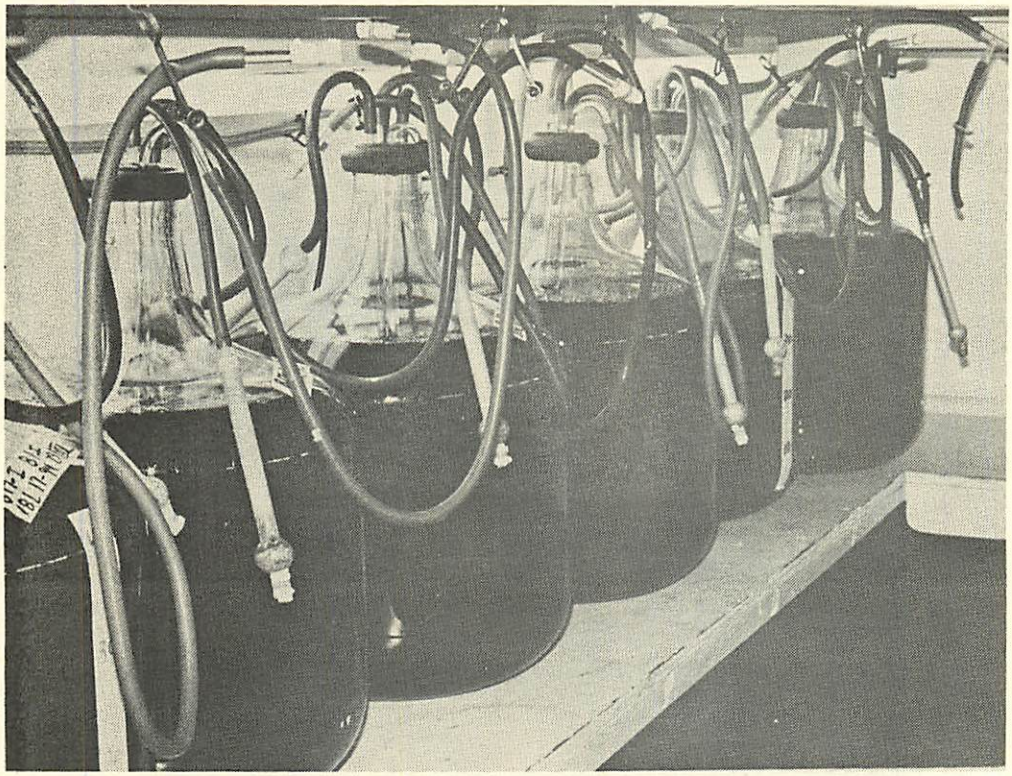
The fluids of circulatory systems in many invertebrate species are known to contain agglutinins, that is, naturally occurring proteins which cause particles such as blood cells or bacteria to flocculate (clump together) in a liquid medium. As one result of this ability to cause flocculation and the specificity involved in recognizing foreign bodies, these aggulutinins (which specifically combine with antigens, but are not antibodies in the true sense) are useful in the study of cell surface structure and in the determination of red blood cell (RBC) type. In that the recognition of foreign particles is a critical first step in the defense system of invertebrates or vertebrates, it is suspected that agglutinins may play a crucial role in immune reactions. The fact that some invertebrate agglutinins have been found to amplify the processes involved in the ingestion, destruction and removal of foreign particles underscores the critical part which agglutinins may play in the defense process.

Limulin, an agglutinin present in the circulating fluid of the horseshoe crab (Limulus polyphemus), is a glycoprotein which has been found to bind specifically to sialic acid, and possibly other carbohydrates such as D-glucuronic acid and N-acetyl-D-glucosamine. The efforts to fully understand the characteristics and properties of limulin are aimed at determining its usefulness in the fields of blood-typing, affinity chromatography (as an adsorbent for purifying glycoproteins which will bind to it specific ally), and especially as an aid in the differentiation between normal and malignant cells through membrane studies. In addition, if the agglutinin is a factor in the horseshoe crab's defense against infection, knowledge of its activity in vivo would aid the study of invertebrate immunity.

In 1978, limulin was isolated from 30 horseshoe crabs by a method involving gel filtration and ion exchange chromatography. Additionally, the use of horse red blood cell membranes to adsorb the biologically active fraction of the concentrated limulin was attempted. After several washings, centrifugations and agitation in a solution void of Ca^{++} ions, the limulin was broken down into smaller molecular units and became free of the horse red blood cell membrane - thus isolated and concentrated in solution. Tests using the agglutination of, again, horse red blood cells as indication of biological activity showed that the final solution contained all of the active fraction and that specific activity had increased to greater than 300 fold over the starting material.

There is also an inactive fraction of the limulin which studies have shown to be physically the same, on a gross scale, as the active portion. Knowledge of the reason for this difference in activity would also be an important key in discerning its biological mode of action. Preliminary experimentation using gel electrophoresis seems to indicate that there is indeed a discernible difference resulting in dissimilar banding patterns (which indicate differing bioelectrical response).

Hopefully, future research will reveal this reason, thus allowing mankind another tool to work with in understanding the immune response system of invertebrates and the evolution of his own immune response system.



MARINE EDUCATION & INFORMATION

Cooperative Education Program in Laws and Science

Mr. N. B. Theberge
Virginia Institute of Marine Science
Mr. S. C. Whitney
Marshall-Wythe School of Law

Since 1976, the Virginia Institute of Marine Science, in cooperation with the College of William and Mary, has offered an innovative educational approach to problem solving at the administrative and managerial level in marine affairs. This program, supported by Sea Grant, has been designed to bridge the gap between marine science and marine law by offering interdisciplinary graduate level coursework.

Graduate Courses

Five courses were taught successfully at the graduate level during 1978. The courses, "Environmental Law and Marine Affairs I & II," "International Law and the Environment" and "Environmental Law I & II" were open to students of either discipline. Also, by providing public education through seminars, publications and student memoranda, resource managers and the public have had access to the program on an ongoing basis, at little or no cost.

Nineteen student memoranda were prepared by VIMS & W&M students and submitted to:

Virginia Department of Commerce and Resources
Virginia Attorney General's Office
Virginia Marine Resources Commission
Virginia Water Control Board
Virginia Institute of Marine Science
Robert W. Knecht
Assistant Administrator for Coastal Zone Management
National Oceanic & Atmospheric Administration

These memoranda were entitled:

1. "State Water Control Board's Authority to use Special Orders to Implement on-point Source Pollution Control," by Jocelyn West and Robin Strickler.

2. "Eastern Water Use Law and Energy Facility Siting," by Robert Brink.

3. "Virginia Coastal Study Commission Recommendations and Accompanying Proposed Legislation - Do They Satisfy Federal CZM Requirements?," by Joan C. Skeppstrom.

4. "An Analysis of the Approved CZM Programs: Washington, Oregon, and California," by Craig John Smith and Thomas Horn.

5. "Reasonableness in Zoning Ordinances: An Analysis of Virginia Case Law," two independent papers, one by William S. Fields and the other by Barry L. Jenkins.

6. "An Analysis of Municipal Charters for Special Authority Granted With Respect to Planning and Jurisdiction over Waters and Subaqueous Bottoms," four independent papers by William G. Norton, Elizabeth Snyder, A. Gary Thompson and Craig Lane, and Bary D. Grant.

7. "Proposals for Managing Shoreline Erosion in Virginia," by Craig G. Lukin.

8. "Coastal Erosion: Need for Effective Regulation," by Michael Stuart.

9. "A History of Public Rights in the Seashore: Implications for Modern-Day Virginia," by S. Craig Lane.

10. "The Coastal Construction Set-Back Line: Valid Regulation or a Taking Requiring Compensation?," by Kevin M. Brunick.

11. "The Virginia Coastal Zone Program and the Problem of Inverse Condemnation," by Craig John Smith.

12. "Program Development Requirements of the Coastal Zone Management Act and Current Virginia Statutes Operating in the Coastal Area," by Carrol H. Kinsey, Jr.

13. "Existing Laws Relating to Non-point Pollution in Virginia," by Gary F. Anderson and George R. Mapp, IV.

14. "Ownership of Artificial Islands Created by Dredge Spoil Deposits," by Douglas Plank.

15. "Territorial Sea Fisheries Control," by Larry W. Davis.

16. "Virginia Coastal Zone Management Enforcement Authorities Proposals," by Suzanne S. Brannan.

17. "Enforcement Provisions of Virginia Senate Bill 403 and House Bill 1126 for Fulfilling Federal Requirements of a Coastal Resources Management Program," two independent papers by Robert J. Liptake and Jeffrey L. Minks, respectively.

18. "American Petroleum Institute v. Knecht: The First Direct Challenges under the CZMA and their Lessons for Virginia," by Craig Smith.

19. "Federal Lands and Federal Consistency in the Coastal Zone," by James R. Cox.

Cooperating Organizations

Federal Office of Coastal Zone Management

U.S. National Marine Fisheries Service

U.S. Coast Guard

Virginia Marine Resources Commission

Virginia Office of Commerce and Resources

Zapata-Haynie (Commercial Fishing Company)

University of Virginia Oceans and Policy Center

National Aquaculture Information System

Mr. James A. Lanier
Virginia Institute of Marine Science

The National Aquaculture Information System was conceived to be the central source of informaton on the culturing of aquatic life for man's own benefit. This computerized file can now be easily utilized from many terminals in the United States by anyone needing this type of information.

VIMS has increased the information base of the National Aquaculture Information System in 1978 and has been active in assisting scientists, students, service agencies, and private entrepreneurs and interested citizens of the United States and many foreign countries in obtaining useful information.

Begun in 1973 as a pilot project including 384 articles, the number of articles procured and indexed for inclusion in the NAIS had reached 4,950 by the end of 1978. Information on the culturing and economics of many species of freshwater, brackish or marine organisms was retrieved for 234 requestors in 1978. Forty of these were directly assisted by VIMS in the acquisition of publications appropriate to their needs.

Information sheets describing the service provided by the NAIS and directions for use of the system were distributed to many new and potential users. Correspondence and telephone conversations were used to request new articles to add to the system and to obtain permission to copy these articles in the form of microfiche. Many investigators are now routinely sending in appropriate material. Microfiche copies of several articles were supplied directly to persons requesting them.

Errata sheets for the "Aquaculture Thesaurus" which is an hierarchical arrangement of terms and associated cross-references to related terms was prepared, printed and distributed to thesaurus owners in May and September. Also in May, a list of 222 new terms to be added to the "General Descriptors" section of the thesaurus was mailed out to the thesaurus owners. By the end of the year a list of approximately 500 new entries to the "Cultured Organisms" section of the thesaurus had been prepared in rough draft form to be distributed early in 1979.

Requests for 115 copies of the Aquaculture Thesaurus were also answered this year.

MARINE ADVISORY SERVICES

Dr. William D. DuPaul, Head,
VIMS Marine Advisory Services

Commercial Fisheries

The Sea Grant Marine Advisory Services (MAS) provided a focal point for information transfer between the commercial fishing and seafood industries and the scientific community in 1978.

This exchange of information is maintained by the MAS agent's attendance at industry organization meetings, personal contact, and through mail requests. This continuing contact is essential if research is to be responsive to industry needs and if industry is to benefit from previous Sea Grant research. MAS personnel are in a rather unique position because of this close contact, and consequently, become aware of user problems or needs as they arise. The flexibility of the Sea Grant program allows for immediate action by personnel to deal with such crisis situations.

VIMS MAS personnel continued the collection, compilation, and synthesis of basic data on Virginia's Seafood industry, specifically on crab, finfish and oyster fisheries. This information was made available to private and governmental agencies to facilitate management decisions affecting the quality and availability of Virginia's Marine Resources.

Information has been gathered concerning the development of a new shad roe extraction tool which is being hailed by shad fishermen in other states as the most significant development in the industry in 30 years. This information will be made available to Virginia's shad fishermen in the form of a VIMS MAS Advisory Bulletin.

VIMS MAS is embarking on a major effort to import fisheries technology developed in other states and foreign countries to assist Virginia's rapidly expanding offshore fisheries and our declining Bay fisheries. Technology for mid-water and bottom pair trawling and for Scottish seining is needed for the offshore fisheries. The technology for floating pound-nets is needed to help revitalize the declining Bay fisheries.

During 1978, the following Fisheries related conferences/workshops were conducted by VIMS MAS in conjunction with other federal and state organizations:

August 1978 Hampton, Va.	Virginia's Coastal Resources Management Program: How It Might Affect Your Community. Conference. General Public and Local Municipalities.
September 1978 Hampton, Va.	Fisheries Exporting Workshop. Ed Smith, NMFS Pascagula, Miss. Workshop. Seafood Processors and Buyers.

November 1978 Yorktown, Va.	Opportunities in the Fishing Industry Program. High School Students.

Oyster Mortalities

Complaints of oyster mortalities on private leased bottoms were investigated by MAS personnel. The growers believed agricultural spraying to be the culprit. VIMS oyster biologists refuted this since adult oysters are not susceptible to poisoning by low levels of pesticides. The MAS will continue to provide this service to oyster growers.

Virginia Waterman's Association

The Commerical Fisheries Specialist maintains contact with the Virginia Waterman's Association by attending the monthly meetings of the board of directors. The Association asked the MAS to examine icing conditions this past winter. The information gathered was presented to the State Department of Emergency and Health Services. No relief was made available because the Department felt the extent of the problem was not sufficient to warrant disaster declaration.

In view of this, the specialist is working with the Association to investigate insurance plans which will compensate watermen for time lost due to extraordinary weather conditions.

Other activities with the VWA have included the introduction of board members to Bob Barlow, Manager of the Massachusetts Lobsterman's Association. Barlow's Association has its own insurance program and board members were interested in its possible applications in Virginia.

Patent Tonging Demonstration for New York Sea Grant

New York watermen, fishery managers, researchers and Sea Grant personnel were introduced to Virginia patent tongers to observe the use of this equipment. New York fishery people are considering licensing this gear in certain waters and wanted a first hand look at how it works. New York Sea Grant arranged the trip and VIMS-MAS coordinated the demonstration by Virginia Watermen.

Closed System for Shedding Crabs

Mortalities in floats and recirculating systems used for shedding blue crabs can run high. Overnight mortalities in some areas ran close to 100% at times. It is likely these were the result of drastic environment changes (i.e. fresh water runoff, or decreased available oxygen). These parameters can be controlled in a recirculated system. MAS Commercial Fisheries Specialists contacted Sea Grant personnel in Maryland and made arrangements for some crab shedders and researchers to view this operation. The shedders were impressed and one plans to build a recirculating system himself. VIMS-MAS assistance will monitor his production and provide technical assistance when necessary.

Marine Recreation

1978 was marked by continued progress on projects associated with the marine trades and boating public while a significant expansion in effort occurred with sport fishing audiences. In addition, a project was developed involving information on hazardous marine animals for beach users and others using coastal waters.

Marine Trades - Seminars and Conferences

A Marine Trades Seminar addressing the pros and cons of boat titling and administration of the state's boat registration program was

conducted in the southwest area of the state. This was the first such program conducted at an inland location and was cosponsored with the Southwest Virginia Boat Dealers Association. Key marina operators and boat dealers from around the state attended the session. As a result of the seminar, the industry is now implementing a study of boat titling as it looks towards possible legislative action in the coming year.

Several additional seminars aimed at the trades were conducted cooperatively with other organizations. A seminar entitled "Shoreline Erosion and Permits for Piers, Bulkheads and Dredging Projects" was conducted for marina operators and individual shoreline property owners. This seminar was conducted with the Continuing Education Program of the Rappahannock Community College. In cooperation with the Maryland Sea Grant Program, Maryland Department of Natural Resources and three Maryland-Virginia marine trade associations, VIMS MAS planned a Marine Trades Industry Conference for boat dealers at the Washington International Boat Show.

The major marine trades event for the year was a two day Marina Design and Environmental Impact Conference held in Alexandria, Virginia. A good mix of marina operators, marine contractors, engineers, regulatory agency representatives and interested citizens from New York to Georgia attended the sessions. Topics included wet and dry stack storage facility planning, floating breakwaters, sediment movement and erosion control processes, fixed and floating dock systems, ice damage problems, federal regulatory agencies' perspective on marina impacts, and the results of a recent Maryland study of marina impacts on water quality. The conference was highlighted by Dallas Miner, Office of Coastal Zone Management, addressing the question "Where Do Marinas Fit Under CZM?"

Boating Public - Information Efforts

Through articles in the Marine Resource Bulletin, Chesapeake Bay boatmen were kept informed of the court battle between Virginia marina operators and the State Health Department over requirements for installation of sewage pumpout facilities. Developments on this subject originating from cooperative action by the Coast Guard and Army Corps of Engineers were also kept before boatmen and marina operators with Bulletin articles.

A significant information void has been filled with a comprehensive publication on weather patterns and related phenomena of Chesapeake Bay. Entitled "Wind and Weather To Boat on Chesapeake Bay," this effort was a cooperative venture with the National Weather Service. The publication will be of use to individual boatmen and to Coast Guard Auxiliary and U.S. Power Squadron instructors teaching boating safety courses.

Another direct link to the boating public has been achieved by the recreation specialist serving as VIMS representative to the Virginia Boating Advisory Committee. The Committee was formed to keep the state's executive and legislative branches apprised of the impacts of all proposed state legislation and regulations directly affecting the boating public. The Committee serves as a focal point for evaluation of boating issues by a cross section of experienced agency and citizen representatives. Projects involving an economic impact study of recreational boating in Virginia and the introduction of boating safety courses into secondary school curricula are in the early planning stages.

Swimmers and Other Beach Users - Publications and Video Program

A request from Yorktown officials for information on hazardous marine

animals, to be included in the town's lifeguard manual, prompted MAS to expand the material gathered for Chesapeake Bay into a publication covering the middle Atlantic states. This VIMS MAS Educational Series publication covers common marine animals encountered along beaches that can cause discomfort or injury to unwary swimmers and fishermen. Brief descriptions and illustrations of the organisms are presented as well as advice on how to avoid potential problems and how to treat injuries if they occur. Jellyfish, sharks, stingrays, crabs and certain finfish are addressed.

The material on hazardous marine animals in Chesapeake Bay was used by the Sea Grant Communicator to develop a script for a video program on the subject. In addition to furnishing the script for the production, MAS also collected color slides to be used in the video production. These slides will also be used to develop a more comprehensive slide and lecture program on dangerous marine animals than presently available from MAS for school and civic groups.

Recreational Fishing - Tournaments, Expositions and Conferences

Some progress has been made in initiating a recreational fishing tournament calendar. In addition, contact with angling clubs concerning their respective tournaments has resulted in VIMS fishery scientists and the recreation specialist attending tournament weigh-ins and obtaining basic data (length, weight, scales, gonad tissue samples, etc.) on the fish landed. This enables VIMS scientists to document the results of intensive, species specific fishing effort as well as to work side by side with anglers in learning more about important fish populations.

Impact of Sea Grant Marine Resource Bulletin Articles

In the September/October 1978 Bulletin the recreation specialist presented information on the availability of limited numbers of rather unique Hurricane Awareness Maps for most coastal areas of Virginia. An additional purpose of the article was to point out the considerable cooperation between NOAA's National Ocean Survey and National Weather Service in Norfolk and Virginia's Department of Energy and Emergency Services that occurred to produce the extremely useful maps.

Upon reading the article, the Chief of Disaster Preparedness for the National Weather Service in Silver Spring, Maryland contacted the Virginia agency. The suggestion was made that the agency seek assistance from the Head of National Ocean Survey's Coastal Mapping Section in printing more copies of the maps. As a result of the referral to National Ocean Survey, NOS is both exploring ways to assist Virginia in reprinting the existing maps and is changing its current mapping priorities to more rapidly complete base maps of the unmapped Virginia coastal areas. This realignment of priorities will soon allow Virginia to have its entire coast covered by the Hurricane Awareness Map system.

Shoreline Erosion

The VIMS MAS Shoreline Erosion specialist responded to more than 40 requests for assistance in 1978.

The MAS Shoreline Erosion program has been and will continue to be one of the most rewarding advisory efforts. It has received extensive local and regional recognition and in terms of dollar values, one of our most productive. During 1978, the erosion advisory program, working with private land owners and municipalities, provided advisory assistance on $1.5 million worth of structures designed to curtail

erosion. These structures, properly designed and installed, have a life expectancy of 20 years. Land owners, businesses, and municipalities can expect a direct amortization of 60-70% of the structures' initial cost within the first 3-5 years. This estimate is based on one or all of the expected results: (a) saving of valuable shoreline property, (b) prolonging the lifespan of previously installed structures and, (c) advising people to install the correct structure the first time rather than installing an ineffective structure without advice.

Marine Education

The Marine Education Program has provided services to both formal and continuing educational activities at all levels since 1940. Under Sea Grant auspices K-12 formal education has been given emphasis since 1977. In this area of Marine Education, the VIMS-Sea Grant program is a national leader, providing programs, advice, and assistance designed to improve public understanding of the marine environment and its resources.

Marine education specialists lead field trips to beaches, marshes, and on VIMS research vessels. Presentations were made on a variety of marine topics both at VIMS and elsewhere in the Commonwealth. An exhibit room with aquaria and displays was maintained at VIMS, and educational materials such as curricula and filmstrips were produced. The VIMS-Sea Grant Marine Education Center provided access to a large collection of marine education aids, including publications and audio-visual materials.

Since 1977 the Marine Education Materials System (MEMS) has been a valuable part of this effort. MEMS provides a growing collection of curricula, field guides, and laboratory manuals through a nationwide distribution network.

While continuing to provide programs on request on a large scale, specialized support is also being provided for teacher education, teacher services, elementary education and continuing education through museums, public aquariums, and exhibits. Progress was made in all these areas, and they all received attention in the media and in the national marine education community during 1977.

The VIMS-Sea Grant Marine Education Center has become the central mail drop for both the National Marine Education Association (NMEA), and its local chapter, the Mid-Atlantic Marine Education Association (MAMEA). The first two annual meetings of MAMEA were organized, and VIMS Marine Education played a key role in its organization and acceptance as the first NMEA chapter. Educators in Delaware, the District of Columbia, Maryland, Virginia, and North Carolina are now active in MAMEA.

The VIMS-Sea Grant Marine Education Program has been active in many other state, regional, and national activities which are outlined below. The program has evolved from one which merely responded to as many requests as possible into a comprehensive effort in which the broad goals of Marine Education in the United States are actively pursued.

National, Regional, and State Coordination

The Marine Education Program Director served on the Board of Directors of the National Marine Education Association, is the current President of the Mid-Atlantic Marine Education Association, a member of the Marine Education Committee of the Sea Grant Association, immediate past Chairman of the Virginia Resource Use

Education Council, a member of the Virginia Science Supervisors Association and the Virginia Association of Science Teachers, and the primary VIMS liaison with the Department of Education of the Commonwealth of Virginia.

VIMS Marine Education Staff are also active in the work of Virginia's Council on the Environment, the State Science Teachers' Conference, local and regional science fairs, the American Association of Zoological Parks and Aquariums, the Virginia Wildlife Federation, Gloucester County School Board, Peninsula Nature and Science Center, Yorktown Victory Center and Maymont Park, and are assisting in the development of new facilities and programs for the Mathematics and Science Center (Richmond) and a marine center for the City of Norfolk.

Program Coordination

Progress Since September 1978. In the first three months of 1979, well over 180 requests for programs and educational assistance were received by the marine education program coordinator. Although the fulfillment of program requests received each year usually is more than staff and facilities can accommodate, every effort is made to provide some type of assistance and support. Between September 1978 and June 1979 7,154 students participated in VIMS Marine Education programs - 2,149 at VIMS and 5,005 at other locations throughout the state.

Program requests come from many sources, encompassing both continuing education and formal education. Some of the groups requesting assistance last year included: hospitals, scouts, science clubs, 4-H, science fairs, civic groups, the Virginia Advisory Boating Safety Committee, church groups, mental health groups, the Virginia Wildlife Federation, the Yorktown Victory Center, career education programs, and numerous school groups of all ages.

Teacher Training

In 1978 the VIMS - Sea Grant Marine Education Program began presenting organized teacher workshops, called "Seashops". Most of these last one-half day, and they are usually presented at schools or teachers' meetings in response to requests by administrators.

Three basic content areas are usually included in Seashops: (1) hands-on activities that are easy to repeat under average classroom conditions; (2) dissemination of marine education materials, including an introduction to the Marine Education Materials System (MEMS); and (3) instruction on marine topics. Presentations in these three areas are carefully selected to meet the needs of participants. All members of the VIMS - Sea Grant Marine Education staff have participated in these activities, and the assistance of other scientists and educators has been used from time to time.

In each case content was developed and presented to meet the needs of participating teachers. Topics included the following: creative marine-oriented activities for young children; the VIMS - Sea Grant Marine Education Materials System (MEMS); using brine shrimp in process-oriented science lessons; seafood; marine aquaria; classification; using marine materials; and audio-visual materials useful for marine education.

Marine Education Center (including MEMS)

The VIMS-Sea Grant Marine Education Center plays a significant role in the dissemination efforts of

the marine education staff. The Center houses a variety of publications (books, curriculum materials, a vertical file of marine-related articles, laboratory, and field guides); a fairly extensive audio-visual library including 37 films, 82 filmstrips, 14 film loops, 6 slide programs, and 2 records; a general 35 mm slide collection; and the Marine Education Materials System (MEMS) which is used by the staff and other educators in "marinating" their curricula.

Equipment available for use by the staff, visiting teachers, and administrators includes a microfiche reader, projectors (16mm, 35mm, filmstrip, and film loop), tape recorders, a record player, and a film inspection machine. There are also study carrels for independent work and a conference area for small meetings.

New materials and teaching aids are constantly previewed for purchase and inclusion in our collection. These provide assistance in all academic disciplines, including history, language, art, social studies, music and home economics.

In addition to continuing the expansion of the marine education center and providing marine programs to school groups, teachers, civic groups and the general public, the coordinator of the center regularly answers requests for information and coordinates the dissemination efforts of MEMS on a national basis.

Gifted Student Education

The major activity of the year was the initiation of the Gloucester Enrichment Program for the gifted and talented. Fifty-five students, grades two, three, four and five, have been participating in a weekly one hour program. This program is offered at Achilles Elementary, Botetourt Elementary and the Gloucester Middle School. The students have been working on basic scientific skills of observing, inferring, experimenting, measuring, predicting, and data recording.

Students have been exposed to such topics and concepts as setting up an aquarium, plankton, marsh plants and animals, populations, habitats, shoreline processes, brine shrimp, classification, and photosynthesis.

Students are making a video-tape on "How to do Fishprinting". This tape will be used at teacher workshops and conferences by both VIMS and other educators.

For the remainder of the year, emphasis will be placed on physical and geographical topics.

Programs in Marine Science for the Handicapped Student

As in the case of most educational movements, the initial thrust of Marine Education focused on the average, "normal" student. There are 10 million handicapped students who have largely been neglected. According to recent federal regulations all phases of education supported by federal funding must allow for participation by, and include, the handicapped student.

As evidenced by the volumes of material on educating the handicapped, methods of instruction in reading, writing, and language have been studied in great depth. Materials on science instruction for students with disabilities are, however, relatively limited.

The sciences present unique problems in developing materials and methods of instruction. How do orthopedically handicapped students handle scientific equipment or climb a rocky beach? How do blind students learn the anatomy of a marine animal? Field experiences and hands-on activities are essential to marine education.

Museum and Aquarium Project

During the past year, several cooperative projects have been initiated, continued and executed. The VIMS-Sea Grant Museum/Aquarium Coordinator engages in six main activities:

1. Providing ideas and objects for marine education programs, displays, publications and facilities that other science centers, museums, aquariums and nature centers desire to develop and offer themselves. Examples of such cooperative efforts are: regularly scheduled marine studies programs, such as "Exploring the World of Water" (for elementary students at the Peninsula Nature and Science Center); teacher idea booklets; a wetlands utilization project with the Yorktown Victory Center; ideas and specimens for the Math and Science Center aquarium; technical support, ideas, and specimens for Maymont Nature Center and Virginia Science Museums, Richmond and Roanoke; ideas for displays and programs as requested by planners for the Cousteau marine center, York River State Park, and the Medical College of Virginia adolescent hospital.

2. Providing displays that represent VIMS-Sea Grant activities or other marine-related topics. Selected examples are: the VIMS - Sea Grant Virginia State Fair booth that was frequented by 35,000 individuals, Maymont Nature Center aquarium display, Fish Expo display, Sport Fish Expo display, boat show displays, career days, VIMS - Sea Grant Gloucester County Fair booth (which won a blue ribbon), and teacher workshops.

3. Providing marine education programs, and docent training, in cooperation with other museum-aquarium facilities. For example, at the Peninsula Nature and Science Center, Maymont Nature Center, Math & Science Center, Yorktown Victory Center, and the College of William and Mary Museum Education Seminar.

4. Developing and maintaining displays for the VIMS Exhibit room which all visiting groups to VIMS see. Construction of a VIMS-Sea Grant display should be completed by the end of 1979. This display is an interpretation of the research, education and advisory services activities at VIMS, supported by Sea Grant. The aquarium display of the aquatic animals of Tidewater should also be fully interpreted by the end of the year.

5. Designing and/or writing materials for use in museums, aquariums and similar facilities. Most of these are in draft and prototype form, and are still being tested and evaluated. Examples include kits, worksheets and booklets.

6. News and media coverage in local papers and on local television. Proposed projects for the remainder of this year include developing new display materials for the VIMS Exhibit Room and VIMS-Sea Grant Marine Education brochure covers, (being designed by Virginia Commonwealth University graphic arts students); supervising a National Trust for Historic Preservation Summer Intern in developing the "Yorktown's Maritime Heritage" program (to be used by VIMS, Gloucester Gifted Program, Peninsula Nature and Science Center, Yorktown Victory Center and Mariners Museum); and supervising the internship of a community education graduate student at VIMS in the Marine Education Center. New materials are always being designed to keep the traveling display current.

Communications/ Publications

The Communications and Publications section of the Department of Marine Advisory Services is responsible for the production of news stories, magazine articles, video presentations etc. for use in marine education endeavors and for public and governmental use; maintenance of a coded computer-oriented mailing list for disseminating information and publications to targeted audiences; and distribution of Sea Grant publications to libraries and depositories as directed.

In addition, a close working relationship is maintained with the scientific staff and MAS advisory and education personnel to develop timely material for publication, and contacts with media representatives are maintained to facilitate airing of Sea Grant related projects to the public through newspapers, radio and TV.

Finally the production of all books, brochures, program announcements and other publications associated with the VIMS/Sea Grant Program and the maintenance of an up-to-date illustration file containing photographs and original artwork on marine-related subjects are additional responsibilities.

The publication division of MAS has the important task of disseminating the results of Sea Grant Research. Users of the research vary in sophistication in marine science from novice to expert. This broad range of knowledge must be considered when scientific and technical data are edited and prepared for distribution to all or a portion of this evidence.

Press releases, newsletters, and Marine Advisory Bulletins are a few of the means used to disseminate information to marine users, including commercial and sport fishermen, industries and enterprises, governmental agencies, and others using and managing marine resources for profit or service. Brief descriptions of some of these publications follow:

Marine Resources Bulletin

This non-technical publication contains feature articles about research and advisory activities at VIMS, seafood recipes, reviews on recent publications, a seasonally apropos publications list and selected news shorts. Illustrations include black and white photos and line drawings, both products of the MAS effort. Response to the "Bulletin", measured by an ever-increasing mailing list, is excellent. Bimonthly circulation is now more than 7,200.

Wavelets

A one-page insert to the Marine Resources Bulletin, "Wavelets" is fostering an interest in the marine environment among the 10-14 year old age group. "Wavelets" has proved a success in its first year of publication. It is being used in science programs in an increasing number of Virginia schools, and since it goes with the Bulletin, is generating new exposure for this publication. Publicity on "Wavelets" through the Virginia Journal of Education has increased demand substantially.

Subjects featured in "Wavelets" in 1978 were: saltwater aquarium set-up Part II, aquarium fishes of Chesapeake Bay, marine geology, salt marshes, brackish marshes and freshwater marshes.

Focus

A one-page circular, produced on an as-needed schedule, used to announce important marine-related

events that require public awareness and/or participation. "Focus" is sent out to publicize meetings, conferences and workshops on a select target group basis. Issues in 1978 have covered a legislative meeting on Coastal Resources Management; notice of public hearings for the Senate Committee on Agriculture, Conservation and Natural Resources; and a Marina Design and Environment Impact Conference.

Marine Resource Advisory

Monograph on a special topic, varying in length and technical detail, depending upon subject. One Advisory is currently in preparation: No. 15, "A New Roe Knife." Produced on an as-needed basis.

Fishery Flash

A new information sheet, produced when the need arises, covering specific topics dealing with research activities of the VIMS Fisheries Department. In 1978 subjects have included "Bluefin Tuna Regulations" and 1978 dispatches of "Virginia Marine Game Fish Records."

Fish Brochures

VIMS MAS is continuing its cooperative effort with the Virginia Seafood Council to produce leaflets on abundant and edible sport and commercial fish species common to the Virginia coastal areas. To date, shad, bluefish, spot and black sea bass have been featured, and croaker and weakfish (grey trout) are now in production. Content of the fish brochures includes biology, methods of capture, effective utilization of the resource and selected recipes. Response continues to be very favorable.

New Publication Releases

Releases were sent out on the following major publications in 1978 or are in the late stages of preparation:

"Storm Surge-Wave Interaction Model: Literature Review of Surge Models, Model Descriptors and Results of the Virginian Sea Model." Michael J. Carron and Victor Goldsmith. SRAMSOE No. 110, 33 p. plus 3 app.

"The Oyster Industry of Virginia: Its Status, Problems and Promise." Dexter S. Haven, William J. Hargis, Jr. and Paul C. Kendall. Special Report No. 4. 1,078 p.

"Offshore Pipeline Corridors and Landfalls in Coastal Virginia." Vol. I and II. Ann Hayward Rooney-Char and Ronald Page Ayres. SRAMSOE No. 190. 80 p. plus app.

"Sensing the Sea." A Curriculum guide in marine science for grades kindergarten and one. Ellen Odell-Fisher, Ronald N. Giese and Mary E. Sparrow, contr. ed. Educational Series No. 23. 44 pp.

"Sensing the Sea." A curriculum guide in marine science for grades two and three. Ellen Odell-Fisher, Ronald N. Giese, and Mary E. Sparrow, contr. ed. Educational Series No. 21. 53 pp.

"Guide to the Marine Educational Materials System (MEMS)." Susan C. Gammisch and James A. Lanier. Educational Series No. 22. 130 pp.

"Marine Turtle Stranding Report." Molly Lutcavage. Marine Resources Advisory No. 16.

"Discharge Effluent Guidelines for Seafood Processers." Walter Priest. Marine Resources Advisory No. 17.

"A Report to the Oyster Industry of Virginia on the Biology and Management of the Cownose Ray (Rhinoptera bonasus Mitchell) in Lower Chesapeake Bay." John V. Merriner and Joseph W. Smith. SRAMSOE No. 216.

Special Projects, Articles and News Releases

Two feature articles were prepared and sent to Sea Grant 70's magazine at the request of the editor. One concerned the clam culture course being offered through VIMS MAS at Wachapreague, Virginia; the other dealt with the oyster nutrition and disease resistance work being done by John Dupuy here at VIMS. Virginia Wildlife magazine has used several of our products, including a feature story completed with photos on marine environmental camping (December 1978). This same article, with photos to suit specific circulation regions, was used in the the Richmond News Leader, Norfolk Virginian Pilot, Daily Press, Fredericksburg Free-Lance Star, Roanoke Times and the newsletter of the Virginia Wildlife Federation.

A video program on harmful Chesapeake Bay marine organisms was recently completed in cooperation with Thomas Nelson Community College, Hampton, Virginia. This production, a first for VIMS MAS, was adapted from an existing manuscript soon to be released as "Handle with Care --- Some mid-Atlantic Marine Animals that Demand Your Respect." The video package will be tested on cable TV and used in the MAS marine education effort.

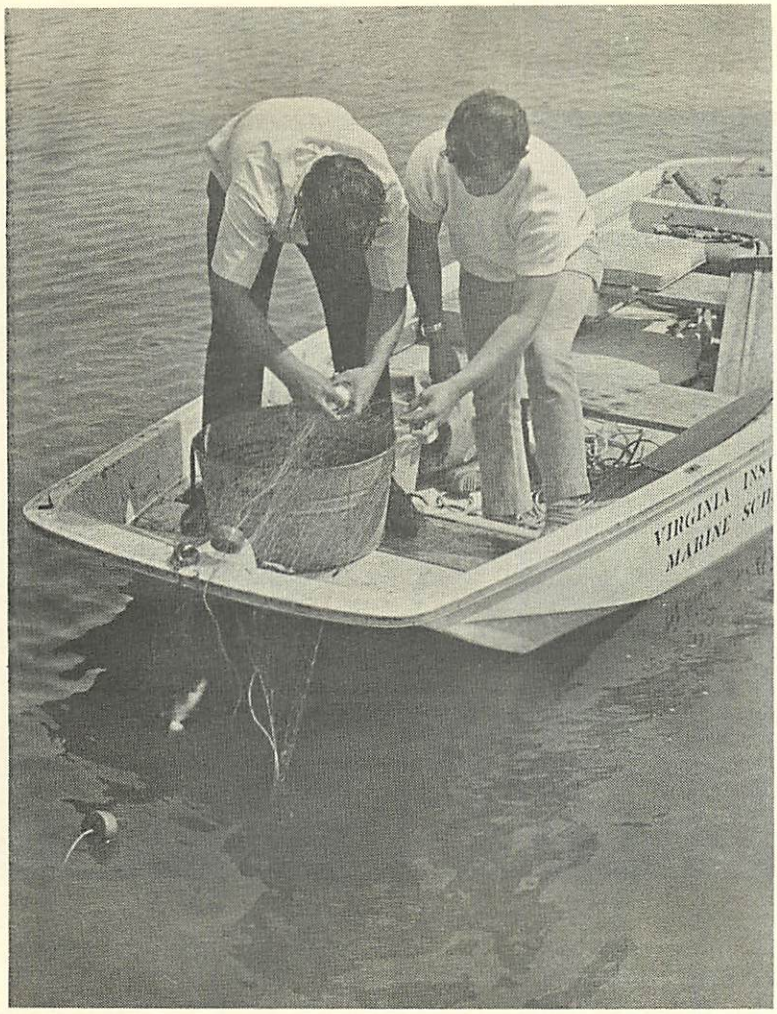
Additional news releases which gained publicity for MAS were on clam culture, international Sea Grant wave study project (with photo) and fish stock estimates (to Log of Commercial Fishing and Maryland Waterman's Gazette).

Publication Distribution

To maximize the efficiency and impact of VIMS Sea Grant publications, extensive work has been done to update and expand the capability for reaching the general public and certain special interest groups or organizations. The computerized mailing list has over 7,200 entries and is coded into 22 retrievable categories. These include News Release, Environmental Interests, Sea Grant, News Media, Delegates, Senators, Wholesale Dealers, State Agencies, Shellfish Shippers, Oyster Ground Leasers, Boat Docks and Marinas, Sport Fishing Facilities, Tidewater Planning Districts, Saltwater Sportfishermen, Wetlands Contractors, Wetlands Boards, Camping Facilities, Freshwater Marinas, Marine Sales and Service. Education. Coastal Zone Management and Local Governmental Agencies.

In addition to the above mentioned general mailing list, a separate list of "target" groups and organizations has been established. The purpose of this arrangement is twofold. First, it gives the MAS an efficient and cost-effective access to important user groups on a personal basis; second, it enables VIMS MAS to offer the service of supplying printed mailing labels (at cost) to the groups. This relatively simple service has been well received, and in return, VIMS MAS has obtained membership lists that were previously unattainable. A list of the special interest groups are Virginia Seafood Council, Virginia Writer's Association, Salt Water Sport Fishing Organizations, Virginia Charter Boat Captains, Virginia Watermen's Association, VPI & SU Extension Agents, Virginia Federation of Marine Trades, SCUBA Divers, Southern Maryland Marine Trades Association, Aquaculture, National Marine Education Association, Sea Grant Directors, Communicators and Coordinators, Mid-Atlantic Marine Education Association and the Board of Visitors for the College of William and Mary.

The Communications and Publications section responds to requests for information and VIMS Sea Grant publications. This section is also responsible for the bookkeeping transactions, as there is a charge for some of the publications. About 6,400 requests were received by mail during the past 12 months.



PROGRAM ADMINISTRATION

Program Administration, Planning and Development

Dr. M. P. Lynch, Sea Grant Director
Dr. W. J. Wardle, Assistant Sea Grant Director for Research Development Programs
Virginia Institute of Marine Science

The major institution in Virginia dealing with coastal, estuarine and marine research is the Virginia Institute of Marine Science. As such, VIMS may be charged with the direction of related multidisciplinary projects to be administered throughout the Commonwealth. As the principal Virginia Sea Grant program, VIMS has the responsibility of overseeing the total operation within the state through its Division of Special Programs.

VIMS' role as Sea Grant Leader implies other objectives which must be achieved if the program is to be cost-effective. The establishment and maintenance of lines of communication between VIMS and other state and regional agencies, institutions and industries has been necessary in order to aid each other in research as well as prevent duplication of effort. Allied with this research coordination is the direction of supporting sciences, such as communications and publication assistance to all Virginia Sea Grant related projects.

Participation in the Sea Grant Program by organizations other than VIMS has been encouraged over the past ten years, and personnel from Old Dominion University, University of Virginia, the College of William and Mary, George Mason University, and the Community College System have been regular contributors to the effort. In 1978, two new institutions, Virginia State and Norfolk State University were added to those institutions which proposed projects for 1979.

For the grant year 1978, Sea Grant in Virginia was awarded $496,600 from the Office of Sea Grant and a supplemental grant of $21,000 for improvement of the Marine Education Program. The Commonwealth of Virginia provided $329,700 in support of the program which was well above the minimum 50% of federal funds figure required by the National Sea Grant Office. This funding level permitted an increase of from ten projects in 1977 to thirteen full Sea Grant projects in 1978 and enabled support of several projects at the developmental stage which are summarized below.

Ecology and Distribution of Benthic Foraminifera from the Atlantic Continental Shelf

The intent of this study was to add to the general understanding of the benthic fauna and specifically to investigate parameters affecting the distribution and ecology of the ubiquitous marine Protozoa of the order Foraminifera which show promise for future use as biological indicators of ecological conditions. This was to be done by determining the

effects of environmental factors on the distribution of benthic Foraminifera and the causes for differential distribution on ridges and swales (undersea hills and valleys). A temporal pattern for the recolonization of Foraminifera after disturbance was to be formulated to relate to existing theory in population dynamics.

Although the sampling and counting is completed, analysis of the information is continuing with completion expected in May of 1979. Forthcoming published results on the recolonization of Foraminifera will provide the first quantitative information on the role of disturbance on deep water benthic invertebrates. The ridge and swale analysis is also proceeding and a corresponding publication will provide data on differential sorting of Foraminifera and the subsequent population distribution.

Economic Study of Virginia's Offshore Scallop Fishery

This project was initiated in order to satisfy the need for better information to be utilized in evaluating the effects of offshore fishery regulation and in response to the desires of major scallop fishery operators to quantify the effects of their industry on Virginia's economy. A method was therefore developed to measure the total 1977-1978 economic impact of the sea scallop fishery, and to provide an economic analysis of Virginia based scallop operations.

The report, which relates the profitability of different types of vessels to various abundance and regulatory conditions, has been completed and copies sent to both the New England and the Mid-Atlantic Regional Fisheries Management Councils (upon their request).

The scallop fishery was found to have a substantial effect on Virginia's economy. This finding and others have had an influence on the apportionment of City of Hampton (Virginia) docking facilities among competing users. The findings have also been utilized by the Bank of Virginia in its decision concerning the financing of a shore facility.

Two publications dealing with the sea scallop fishery are currently in preparation.

Virginia Marina Study

Marina development, and especially location, has traditionally been a controversial subject in Virginia and decision-makers at all levels of government have long been aware of the lack of relevant information upon which to base their decisions. In 1978, Sea Grant supported a study designed to survey current facilities provided to the boating public through commercial marinas, to determine the demand for facilities and to assess public use characteristics. Gross revenues, employment and payroll attributed to the marina industry were ascertained, and the numerous problems which face the industry were identified.

An advisory publication now in progress entitled "An Analysis of Virginia's Marina Industry," will be used by industry and management agencies to define the nature of the industry and aid in deciding on questions of continued facility expansion.

Marine Educational Materials Development

In 1978, through the development and field testing of prototype inquiry-oriented marine education materials, the teaching of marine subjects has been improved. The VIMS Sea Grant Marine Education staff has incorporated methods and strategies used in process-oriented science

education materials into its own program. Through these advancements, marine literacy at all levels has been improved, with a concentration of effort, however, at the very beginning stages of the public educational process.

Marine Affairs - Literature Survey

This project, accomplished through graduate student support, will facilitate the research and teaching of Marine Affairs. A catalogue of marine affairs literature available at VIMS was prepared as well as a regional Marine Affairs Bibliography.

Prostaglandins from Jellyfish: Supplemental Analyses

The jellyfish Chrysaora quinquecirrha has long been a pest in the waters of Chesapeake Bay. Since a method for decreasing populations of jellyfish which is effective and compatible with other uses of the bay has not been developed, it was hoped that commercially important chemicals would be isolated and identified from the organism, thus creating a market for jellyfish. The establishment of this market would mean that jellyfish could be profitably harvested thus creating a new industry as well as increasing the recreational enjoyment of Virginia's coastal waters due to the removal of jellyfish in large numbers.

Experimentation has shown prostaglandins to be present in extracts of Chrysaora quinquecirrha. Gas chromatographic analyses of lipid fractions have shown a minimum of four sterols present, including cholesterol.

Whether or not an industry develops, one benefit has already accrued. The method for separation of small amounts of lipid material has been developed as a result of this study.

ACTIVITY BUDGET

	NOAA GRANT FUNDS	MATCHING FUNDS	TOTAL
MARINE RESOURCES DEVELOPMENT	$129,997	$106,508	$236,505
Mariculture of Shellfish-Nutrition	34,985	23,710	58,695
Genetic Studies of Scallops and Clams	25,064	13,759	38,823
Mariculture of Shellfish-Disease Resistance	20,505	19,987	40,492
Mariculture of Shellfish-Hatchery Design	8,834	17,685	26,519
Mortalities in Soft and Shedding Blue Crabs	25,003	14,879	39,882
Properties of Horseshoe Crab Agglutinin	15,606	16,488	32,094
MARINE TECHNOLOGY RESEARCH	53,555	54,417	107,972
Quantitative Prediction of Shoreline Changes	28,850	30,495	59,345
Tidal Inlet Management and Research	24,705	23,922	48,627
MARINE ENVIRONMENTAL RESEARCH	29,823	21,256	51,079
Nutrient Studies of Marshes	29,823	21,256	51,079
MARINE EDUCATION AND TRAINING	89,844	61,815	151,659
Cooperative Education in Law & Science	9,444	23,115	32,559
Improvement of Marine Education Program			
A Supplementary Grant I, Aug. 1977 - Aug. 1978	58,400	29,200	87,600
B Supplementary Grant II, Aug. 1978 - Aug. 1979	22,000	9,500	31,500
ADVISORY SERVICES	182,071	86,347	268,418
National Aquaculture Information System	12,944	2,299	15,243
Marine Advisory Program	169,127	84,048	253,175
PROGRAM MANAGEMENT AND DEVELOPMENT	70,678	27,574	98,252
Program Administration, Planning and Development	70,678	27,574	98,252
TOTAL	555,968	357,917	913,885

PROGRAM SUMMARY

C = Continuing into 1979
T = Terminated in 1978

MARINE RESOURCES DEVELOPMENT

Mariculture of Shellfish-Nutrition
J. L. Dupuy . . . . . T

Genetic Studies of Scallops and Clams
J. R. Wall and S. W. Wall . . . . . T

Mariculture of Shellfish-Disease Resistance
J. L. Dupuy and F. O. Perkins C

Mariculture of Shellfish-Hatchery Design
J. L. Dupuy . . . . . T

Mortalities in Soft and Shedding Blue Crabs
W. A. Van Engel and F. O. Perkins C

Properties of Horseshoe Crab Agglutinin
R. A. Kaplan C

MARINE TECHNOLOGY RESEARCH

Quantitative Prediction of Shoreline Changes
V. Goldsmith . . . . . T

Tidal Inlet Management and Research
R. J. Byrne and J. D. Boon C

MARINE ENVIRONMENTAL RESEARCH

Nutrient Studies of Marshes
R. L. Wetzel, K. L. Webb, M. E. Bender and J. L. Zieman . . . C

MARINE EDUCATION AND TRAINING

Cooperative Education in Law and Science
N. B. Theberge and S. C. Whitney . . . . . T

Improvement of Marine Education Program
J. A. Lanier . . . . . T

ADVISORY SERVICES

National Aquaculture Information System
J. A. Lanier . . . . . T

Marine Advisory Program
W. D. DuPaul C

PROGRAM MANAGEMENT AND DEVELOPMENT

Program Administration, Planning and Development
M. P. Lynch and W. J. Wardle C

PUBLICATIONS

Carron, Michael J. and Victor Goldsmith. 1978. Storm Surge-Wave Interaction Model. SRAMSOE No. 110. 33 p. plus 3 app.

Cook, R. A. (Editor) Marine Resource Bulletin 1978. Virginia Institute of Marine Science Sea Grant Marine Advisory Service. Bi-monthly. 8 p.

Cornell, E. A. 1978. Teacher Idea Kit. VIMS-Sea Grant Marine Education Program/Peninsula Nature and Science Center. 33 pp.

Federal Register Service. A weekly listing of new developments in environmental law and marine affairs excerpted from Federal Register. Provided to VIMS scientists and students and selected entities outside VIMS. Begun in the Fall of 1976.

Gammisch, Sue. 1978. Publications List, VIMS-Sea Grant Marine Education Center. VIMS-Sea Grant Program. 10 pp.

Gammisch, Susan C. and James A. Lanier. 1978. Guide to the Marine Education Materials System (MEMS). VIMS-Sea Grant Program. Educational Series No. 22. 130 pp.

Goldsmith, V. 1978. Coastal Dunes, Chapter 4, pp. 171-236 in Coastal Sedimentary Environments. R. A. Davis (ed.). Springer Verlag.

Haas, T. J. 1978. Chromatographic analysis of lipid extracts of Chrysaora quinquecirrha. M. S. Thesis, Old Dominion University, Norfolk, Virginia. 50 pp.

Haven, Dexter S., William J. Hargis, Jr. and Paul C. Kendall. 1978. The Oyster Industry of Virginia: Its Status, Problems and Promise. SRAMSOE No. 4. 1,078 p.

Lanier, J. A. 1978. Aquarium Fishes of Chesapeake Bay. Wavelets - Marine Schoolhouse Series No. 3. VIMS-Sea Grant Marine Advisory Services. 2 pp.

Lawrence, F. L. 1978. VIMS-Sea Grant Marine Education Program - Teacher Leaflet. VIMS-Sea Grant Program. 12 pp.

Odell-Fisher, E., R. N. Giese, and M. E. Sparrow. 1978. Sensing the Sea - A Curriculum Guide in Marine Education for Grades Kindergarten and First. VIMS-Sea Grant Program. Educational Series No. 23. 44 pp.

Odell-Fisher, E., R. N. Giese, and M. E. Sparrow. 1978. Sensing the Sea - A Curriculum Guide in Marine Education for Grades Two and Three. VIMS-Sea Grant Program. Educational Series No. 21. 53 pp.

Peebles, Pamela. 1978. Sediments and Sea Level. Wavelets - Marine Schoolhouse Series No. 4. VIMS-Sea Grant Marine Advisory Services. 2 pp.

Rooney-Char, A. H. and Ronald P. Ayers. 1978. Offshore Pipeline Corriders and Landfalls in Coastal Virginia. Vol. I and II. SRAMSOE No. 190. 80 p. plus app.

Smith, Joseph W. and J. V. Merriner. 1978. Biology and Identification of Rays in the Chesapeake Bay. 22 p.

Sparrow, M. E. 1978. Adventures in "Inner Space" Part I. Wavelets - Marine Schoolhouse Series No. 1. VIMS-Sea Grant Marine Advisory Services. 2 pp.

Sparrow, M. E. 1978. Adventures in "Inner Space" Part II. Wavelets - Marine Schoolhouse Series No. 2. VIMS-Sea Grant Marine Advisory Services. 2 pp.

Theberge, N. B. (ed.) 1977. New Directions in United States Ocean Policy. Symposium Proceedings. William and Mary Law Review 19(1). Fall 1977.

Theberge, N. B. (ed.) 1978. Extended Jurisdiction - International and Domestic Implications. Symposium Proceedings, Marshall-Wythe/VIMS Cooperative Program on Environmental Law and Marine Affairs, Williamsburg, Virginia.

VIMS/Sea Grant Program. No date. Exploring the world of water aquarium worksheet.

Whitney, S. C. 1978. Environmental impact statements for federally permitted exports: The coup de gras for the U.S. Foreign trade. International Relations. Fall 1978.

Whitney, S. C. 1978. The Trade Act Revisited: The need for further reform. Boston College Journal of Industrial and Commercial Law. Summer 1978.

Whitney, S. C. and N. B. Theberge. 1978. Virginia's Coastal Zone Management Program: A Legislative Crisis. Virginia Bar Association Journal. January 1978. pp. 25-28.

STUDENT PARTICIPATION

Student Support provided by Virginia Institute of Marine Science - College of William and Mary Sea Grant Program during 1978

Student	VIMS S/G Project No.	Degree Sought	Institution	Major Field of Study
Bittenbring, L. M.	(R/ME-1)	B.S.	G.M.U.	Biology
Bornstein, P. H.	(E/L-1)	(Law)	W&M	Law
Brokaw, J. D.	(M/PA-1)	M.A.	W&M	Marine Affairs
Buffkin, M. F.	(Pr. Dev.)	B.S.	ODU	Biology
Cox, J. R.	(E/L-1)	(Law)	W&M	Law
Davis, C. R.	(E/L-1)	(Law)	W&M	Law
Dillon, T. M.	(M/PA-1)	Ph.D.	W&M	Biological Ocn.
Farrell, K. M.	(A/EP-1)	M.A.	W&M	Geological Ocn.
Fisher, E.	(A/EP-1)	M.A.	W&M	Education
Fredericks, J. D.	(R/A-1)	M.A.	W&M	Biological Ocn.
Frisch, A. A.	(R/EM-1)	M.A.	W&M	Geological Ocn.
Gammisch, R. A.	(R/EM-3)	M.A.	W&M	Geological Ocn.
Ginivan, W. J.	(E/L-1)	(Law)	W&M	Law
Haas, T. J.	(Pr. Dev.)	M.S.	ODU	Biochemistry
Holden, F. J.	(E/L-1)	M.A.	W&M	Marine Affairs

Jenkins, Jan J.	(R/A-2)	M.S.	G.M.U.	Biology
Kowalski, M. S.	(R/EM-2)	M.A.	W&M	Marine Science
Laird, C. E.	(M/PA-1)	Ph.D.	W&M	Biological Ocn.
Lanier, J. A.	(A/AS-1)	Ph.D.	W&M	Education
Mangum, S.	(Pr. Dev.)	B.S.	ODU	Biology
Marshall, A. R.	(A/EP-1)	M.A.	W&M	Marine Science
McBride, N. A.	(E/L-1)	(Law)	W&M	Law
McGovern, D. L.	(Pr. Dev.)	M.S.	ODU	Biochemistry
Mitler, D. J.	(Pr. Dev.)	M.S.	UVa.	Environ. Sci.
Peck, G. E.	(Pr. Dev.)	M.S.	UVa.	Environ. Sci.
Rose, R. L.	(R/A-2)	M.S.	G.M.U.	Biology
Thompson, A. D.	(R/EM-2)	M.S.	W&M	Marine Science
Wolaver, T. J.	(R/EM-2)	Ph.D.	UVa.	Environ. Sci.

Abbreviations:

G.M.U. - George Mason University

ODU - Old Dominion University

UVa. - University of Virginia

W&M - College of William & Mary

(Pr. Dev.) - Program Development Project

1978
ANNUAL REPORT
Virginia Sea Grant Program

Virginia Institute of Marine Science
Gloucester Point, VA 23062