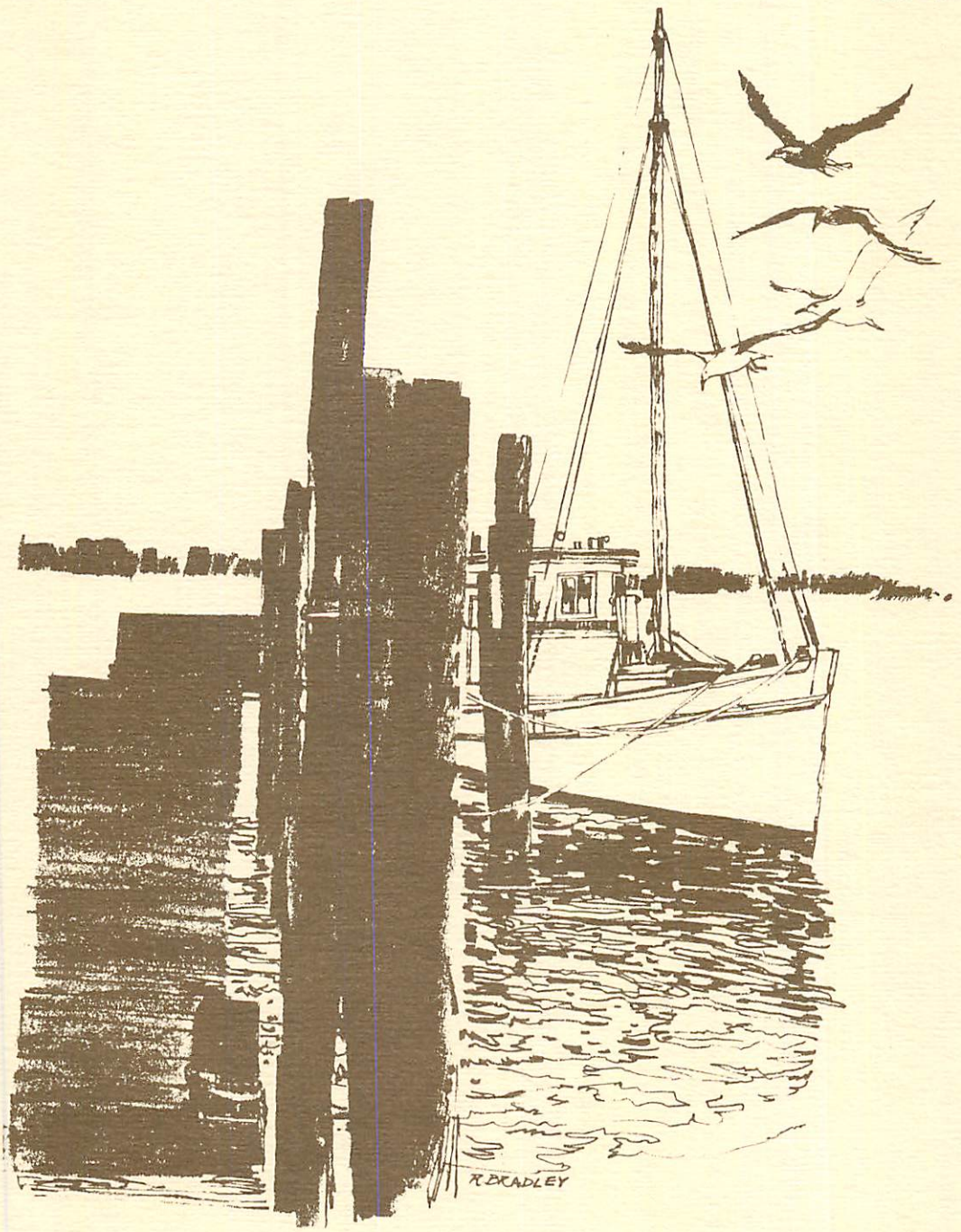
SEA GRANT ANNUAL REPORT 1974



A REPORT ON THE VIRGINIA INSTITUTE OF MARINE SCIENCE
SEA GRANT PROGRAM FOR JANUARY 1 - DECEMBER 31, 1974

VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia 23062

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A Report on the Virginia Institute of Marine Science
Sea Grant Program for January 1 - December 31, 1974

Special Report No. 88
in Applied Marine Science and Ocean Engineering

Sea Grant Program

VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia 23062

Dr. William J. Hargis, Jr., Director

Table of Contents

Introduction

From its earliest days, the Virginia Institute of Marine Science (VIMS), the principal marine program of the Commonwealth of Virginia, has been involved in marine research, advisory services and education. With the advent and development of P.L. 89-688, Sea Grant's founding legislation, VIMS has worked through Sea Grant to pursue tasks long recognized, but for which there had not been sufficient support or funds. With this support, the Institute has been able to strengthen and broaden its ability to work on goals common to both Sea Grant and the Commonwealth.

Since December of 1968, the Institute's Sea Grant Program has had a set of long-term goals. In essence, these have not changed, though their scope has continued to expand. The goals are to:

- Understand uses of estuarine resources and their interactions.
- Evaluate effects of human activities on the marine environment, particularly as related to economically important species.
- Develop improved methods of managing estuarine resources.
- Improve methods of rearing, processing and marketing commercially valuable species.
- Explore for new estuarine, coastal and offshore living and non-living resources.
- Domesticate and improve, through selective breeding, useful wild stocks.
- Provide both formal and informal education programs at all levels.
- Disseminate knowledge acquired through personal contact and a diversified information program.

Of the goals, those receiving the heaviest support in 1974, and throughout the history of the program, have been those related to aquaculture, fisheries resources, education and advisory services.

Obviously, some of these goals and areas of effort have been more heavily supported than others, a condition we expect to improve as the program progresses. New ideas and goals continue to develop, thus providing direction. We anticipate that an orderly progression from project to project, area to area, and goal to goal will help us to identify and fill programmatic gaps. Increased Sea Grant and institutional support in the future will enable us to expand the program and make it more complete.

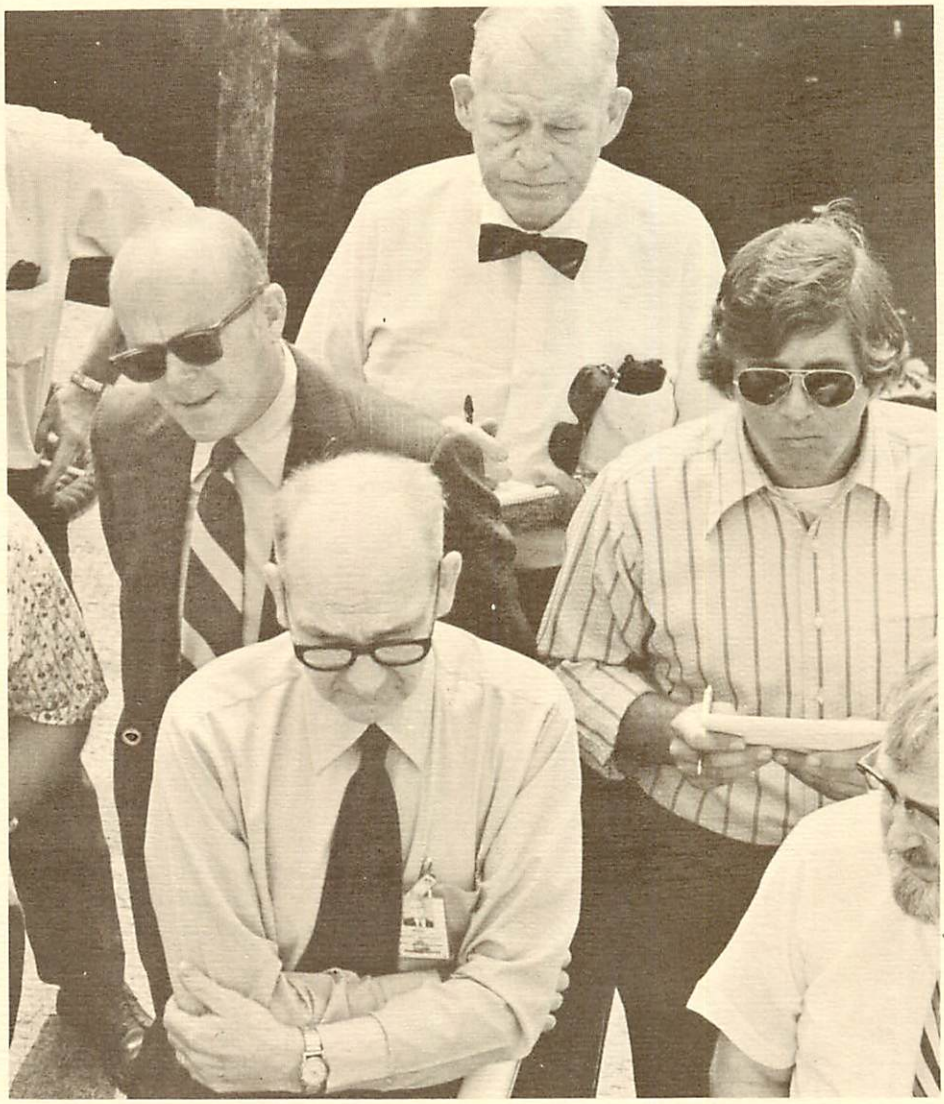
The VIMS Sea Grant Program becomes most apparent when one considers results across individual project lines and takes into account interactions

of the program with the entire spectrum of activities of the Institute. The Sea Grant Program is totally integrated within VIMS. For example, the advisory services projects assess the value of research and development activities on an immediate basis and focus results on the ultimate users. Thus, many projects not specifically supported by Sea Grant can find their outlet to users through advisory services activities which receive priority funding.

New links between government and marine-related industries are built, and more productive pipelines between marine research institutions and the resource users are established. At VIMS, this means relevancy, a factor which has been used to multiply the effort and speed research results and know-how in meaningful language to users in Virginia and elsewhere.

This annual report on the sixth year of activity reflects the progress of 1974 with notes toward the future. In accordance with its mandate, VIMS plans to take the lead in asking other institutions and agencies in Virginia to join in an effort to expand the Sea Grant Program in the state. Specifically, on behalf of Virginia, VIMS will seek Sea Grant Institutional status in the immediate future, a move to broaden the program and encompass new responsibilities.

In the pages which follow, accomplishments to date and plans for the future are revealed. Aquaculture, fisheries resources, ocean technology, education and advisory services are the major efforts. Beyond these centers, however, are thousands of contacts and responses of Sea Granters working to better manage and utilize the marine resources of the Commonwealth and its coastal neighbors.



Advisory Services

General and Field Services

The Virginia Institute of Marine Science has a mandate to serve the people of Virginia not only in research and education, but also in advisory services. Since its establishment in 1940, these advisory activities have drawn upon the expertise at the Institute—primarily in fisheries, environmental quality, wetlands and related areas of marine science. In 1974, these advisory activities were considerably expanded. New areas of expertise implemented into the Sea Grant advisory program included coastal zone management, shoreline processes, and economic and management assistance.

Informal activities during 1974 included over 5,000 contacts with coastal resource users and managers by advisory service personnel. Responses to information requests fell into several categories, including commercial fishing, biology of marine species, aquaculture, legislation and regulations, seafood processing, workman's compensation insurance, fuel allocation, availability of recreational facilities and VIMS programs.

The increasing number of state and federal regulations led to an accelerated effort during the year to keep audiences informed throughout their planning and implementation processes. Noteworthy activities included collection, synthesis and dissemination of information on Environmental Protection Agency (EPA) effluent guidelines for seafood processing plants, boat and oil pollution regulations, marine pump-out and sanitation requirements and coastal zone management criteria.

Compilation of data on the state's fishing and recreational industries was continued and included catch statistics, employment characteristics and customer activity patterns at marinas.

In 1974, VIMS advisory personnel hosted or participated in the planning of "Fish Expo 74" (Norfolk), "Wetlands Symposium for Members of the Bench and Bar" (at VIMS) and the "Eutrophication Workshop" (Colonial Beach). In addition, planning assistance for 1975 meetings was provided to "Seafood 75" (Ocean City, Maryland), a water quality modeling workshop for the State Water Control Board (Richmond), the annual meeting of the Citizens Program for the Chesapeake Bay (Hampton) and the national advisory committee of the U.S. Office of Education on marine careers (VIMS-Williamsburg)

Many of these activities were jointly sponsored by both Sea Grant and Coastal Zone Management. This was facilitated by operating all or part of these programs by VIMS personnel. Planning for other workshops and seminars was initiated on subjects including marina business management, the herring industry, marine education and training, water quality modeling and aquaculture.

Assistance was provided in the preparation of articles and reports dealing with fuel allocation, discharge permits, oil pollution regulations, shedding of blue crabs and the state and federal permit system for shoreline modification projects. Interviews with news media representatives resulted in the publication of widely circulated articles on oyster hatcheries, jellyfish problems and holding tank information.

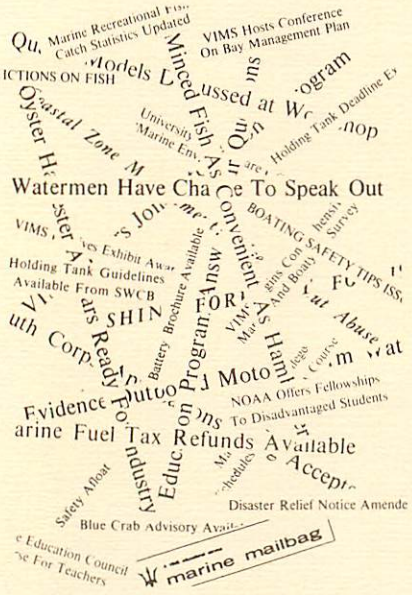
Tours and presentations were given on oyster research and hatcheries, crab fishing and shedding methods, seafood processing and Virginia's seafood industry. A Federal Register advisory was initiated for state agencies and industry, along with plans for increased representation in trade shows through VIMS program exhibits. A new VIMS exhibit emphasizing advisory activities was prepared for "Fish Expo 74" in Norfolk. A second exhibit was prepared for the boat shows which circulate through Tidewater.

The need for regional advisory programs was answered by closer cooperation with Maryland state agencies, the University of Maryland, Sea Grant programs in New York, Delaware and North Carolina, plus affiliation with private organizations like the Chesapeake Bay Foundation.

Joint research, education and advisory services programs were initiated, with advisory services being a lead agent in concert with program management. Included were cooperation with the state and federal Outer Continental Shelf (OCS) programs, assistance to Mexican oyster fisheries in cooperation with Texas A&M University, seafood marketing programs with the Virginia Seafood Council, education programs with the State Department of Education, and cooperative publication efforts with the Marine Resources Commission.

Advisory Services

Publications; Information and Education



As advisory services have grown and expanded at VIMS, three basic, interrelated functions have emerged: to seek information on marine resource needs at the local level; to initiate response either from the advisory program itself, or by supplying input to the research and educational programs; and to distribute marine resource information to the people who can use it.

In implementing the third phase of the program functions, the publications arm of advisory services has developed a variety of published materials written in easily understood language, designed to transfer technical or scientific information to specifically identified user audiences.

Two publications, the *Marine Resource Information Bulletin* and the *Marine Resources Advisory Series,* are compiled, edited and printed by the Department of Information and Education and distributed to more than 4,000 readers in 39 states and 16 foreign countries.

The broad cross-section of users, developers and managers of coastal resources who receive this information include commercial and recreational fishermen, marine engineers, marina operators, coastal miners, public administrators, legislators, educators, students, the mass media, and the general public.

The *Bulletin* covers a broad range of subjects including both Sea Grant research and information from other sources which we feel is useful to the audiences we serve. The *Advisory Series* is a more specialized publication; each issue treats one subject in detail.

During the report period the format of the *Bulletin* was changed from a four-page tabloid newspaper style to the more conventional eight-page 8½" x 11" newsletter. In addition to seven regular issues, one special *Bulletin* summarizing the 1974 annual oyster spatfall results was distributed.

A 14-page *Advisory,* "Methods of Handling and Shedding Blue Crabs, *Callinectes sapidus*", by Paul A. Haefner, Jr. and David Garten, also was published during the report period. In terms of total number of requests for this publication, this has been one of the most popular *Advisories* in the series.

Perhaps the most significant publication during the report period was "Legal Symposium on Wetlands, An Executive Summary", by Roger D. Anderson, David Garten and Ted Smolen. To date, most of the emphasis in the wetlands area has been placed upon the ecological aspects of the marshes. However, considerable interest and concern regarding other issues, particularly legal implications of wetlands, were brought to the attention of VIMS staff members. In response to this interest, a Wetlands Symposium for Members of the Bench and Bar was held at the Institute in September 1974. In cooperation with the Virginia Bar Association, Marine Resources Commission and the Division of State Planning and Community Affairs, over 5,000 recipients (primarily lawyers, judges and planners) received the eight-page executive summary.

Since effort was made to present information in the form and through the media most appropriate to subject and audience, news releases also were an important phase of advisory services. Articles pertinent to marine resource users

and managers were distributed to nearly 650 recipients, including newspapers, technical periodicals, tv and radio stations and interested agencies and individuals.

During 1974, 1636 requests for *Bulletin* and *Advisory* subscriptions, publications and informational services were processed by the publications unit.

Just as dissemination of information is a necessary tool in implementing meaningful advisory work, so are the education activities which help round out advisory services.

During the report year emphasis in the Education Program shifted slightly as fewer classes visited VIMS while more programs were provided at schools around the state.

Increased efforts were made to reach teachers with information and advice on inclusion of marine science in their programs. In a joint presentation with a science supervisor from a nearby city, teachers at the State Elementary Science Conference were taught simple chemical oceanographic techniques and collecting methods for beach and marsh.

VIMS will also cooperate with the State Department of Education in coordinating a two-way communications system for the improvement of secondary science. Earth sciences will receive the initial emphasis in this program, but eventually all sciences will be included.

A two-day section on marine life was taught as a part of the Conservation Short Course offered to teachers at Madison College, the College of William and Mary and Virginia State College, along with many visits to assist individual teachers.

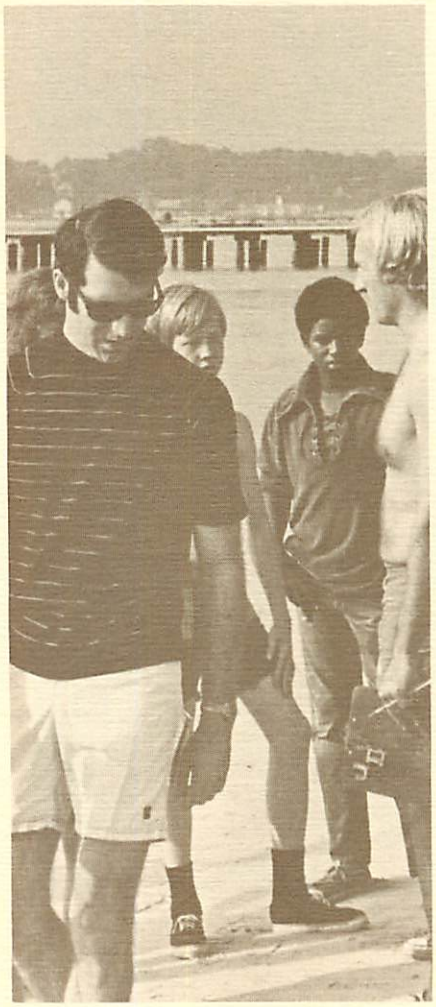
About 250 requests for audio-visual materials were filled, with 16 mm films being the most popular. Over 1,300 letters were answered and several teachers came to VIMS to use the collection of curricula and laboratory manuals, most of which are difficult to obtain elsewhere.

Judges were provided for several local science fairs, as well as for the large Tidewater Regional Congress. The VIMS exhibit of wetlands plants and mounted algae won an award as the best educational exhibit in the Williamsburg Garden Club Show.

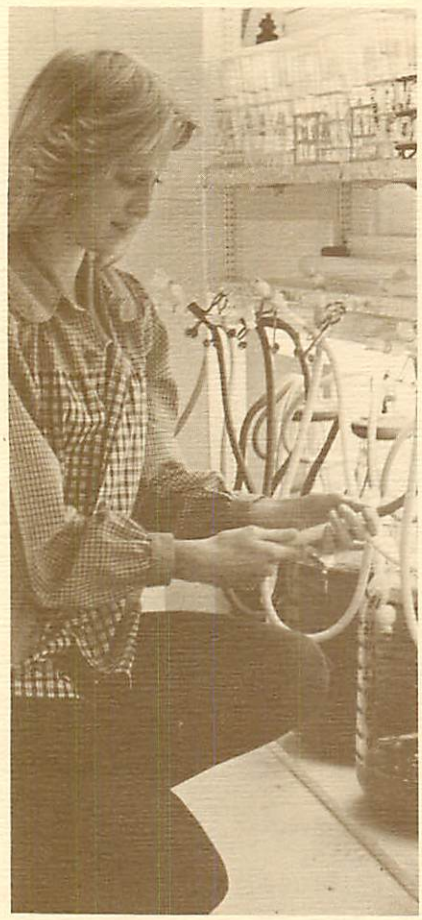
National Aquaculture Information System

Work continued on development of an information base in aquaculture for the National Oceanographic Data Center. Over 1,000 additional articles were indexed on computer cards, and the thesaurus of subject index terms was organized into more usable form. Microfiche copies were made of all articles for which permission has been granted by the copyright holders.

During the report period, the coverage of easily available articles became complete enough so that more effort could be made to collect information directly from recognized authorities in the field.



Marine Bivalve and Algal Culture



For the past six years the Virginia Institute of Marine Science has been involved in the spawning, rearing and setting of oyster larvae for the purpose of producing selected strains of fast growing, well-shaped and disease resistant oysters to be used by oyster industry in the Chesapeake Bay area.

In addition to the genetics program, an intensive effort has been made to apply the laboratory research results to the design and implementation of a large hatchery system. Much of this activity has been supported by Sea Grant.

The approach taken has been that commercial marine culture systems require efficient and automated salt water systems in order to properly regulate broodstocks and grow their offspring. The major thrust is a system which delivers high quality temperature-regulated salt water in more than sufficient quantities to meet the demand of the organism to be cultured.

Procedures and the design of new hatchery type equipment integrated with available industrial equipment for obtaining successful fattening, conditioning and spawning of Chesapeake Bay oysters in four to six weeks on a year-round basis were developed in modular form.

The recent isolation, culture, and sequential feeding of four new, easily grown algal species as food for oyster larvae in order to obtain setting in 9 to 11 days, coupled with a new system to obtain pasteurized algal medium in a continuous flow system, has not only allowed the utilization of mass cultures (185-250 gal) but also permitted the growth and setting of oyster larvae on a year-round basis at a reduced cost.

The design and implementation of a setting and oyster spat system to efficiently produce ¾ inch cultch-free spat in three months in the Chesapeake Bay area was achieved with consideration to the handling of heavy sediment and organic loads. In addition, conservation of space to hold the maximum number of oysters efficiently in terms of cost effectiveness was achieved.

The total system design in basic modular units has been utilized with success at VIMS and has been applied successfully to the design and operation of a commercial oyster seed hatchery. The goal of this private venture, located in Ridge, Maryland, will be the production of 48 to 80 million seed oysters per year.

Production of Superior Oysters for Mariculture

The Virginia oyster industry has declined steadily since 1960 when a disease caused by the pathogen MSX (*Minchinia nelsoni*) decimated over half the oyster beds. As a result, oyster planting ceased in high-salinity areas and seed production has dropped to about 10 percent of the pre-epizootic levels. To offset increased costs of artificial seed production, interest has been stimulated in hatchery techniques and the development of superior oysters.

Between 1964 and 1970, strains of laboratory oysters with high genetic resistance to MSX were obtained in laboratory-bred stocks. Methods of avoiding another serious disease *(Dermocystidium)* were discovered, and in 1972 the Hurricane Agnes greatly restricted the abundance and range of spat predators called oyster drills. The combination of conditions was never more favorable in lower Chesapeake Bay for development of hatchery and nursery methods of seed-oyster production.

Emphasis in the oyster breeding program has gradually been shifted to attainment of superior broodstocks for hatcheries and other controlled systems of producing and rearing seed oysters. Superior oysters are those growing to market size in 18 to 24 months with uniform desirable shapes for machine shucking or half-shell trade and retaining resistance to diseases and predators. The ultimate objective is high meat yields in the shortest possible time whether oysters are grown suspended off the bottom or planted on oyster beds.

The discovery of free-spat production methods in the late 1960's eliminated the need for cultch and greatly simplified hatchery and nursery handling. It also permits easy attainment of uniformly-shaped oysters, whether suspended or on natural bottoms.

The basic approach to genetically superior broodstocks has been intensive selection of inbred and outbred lots by tray monitoring in natural waters. Wild and laboratory-bred native oysters were used as controls for comparisons. Initially a few thousand spat are selected from millions of larvae. From these, a few superior oysters are chosen for line breeding and maintenance.

Over 200 laboratory-bred lots have been produced; about 160 have been monitored for growth, shape, meat quality and the effects of inbreeding and out-crosses on these traits. About 10 strains are being maintained as superior broodstocks—mostly from Chesapeake Bay stocks.

In March 1974 Sea Grant organized a panel of geneticists to review the breeding program. Based on results of three to five

generations of inbreeding (often of pairs of sibling oysters), we reported inbreeding depression expressed by stunting, poor fertility, and failure of some larval broods.

Inbreeding did produce one line of distinctive "cupped oyster" which exhibited exceptional growth vigor, and both cupping and vigor persisted in outcrosses to wild oysters. These oysters had thin shells and reached market size (three inches) in 13 months.

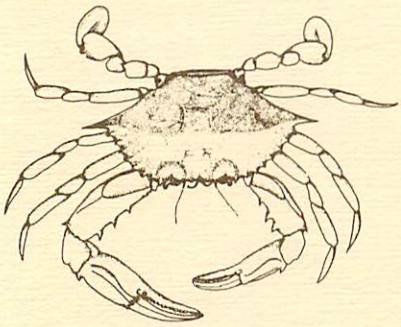
Considering the great fecundity of oysters, the panel of geneticists advised mass crosses and continued heavy selection. They also urged breeding stocks from wider areas and gene pools than Chesapeake Bay alone, some of which ha been initiated.

Several hundred brood oysters have been furnished hatcheries for trial. There has been little demand for disease-resistant seed because most oyster culture is now done in low-salinity waters. After the genetic meeting, ten mass spawnings were carried to spatfall of the 22 lots produced by VIMS Invertebrate Culture Laboratory in 1974.

Emphasis in the future will be on searching for superior genetic combinations from mass outcrosses of both existing and new lines that are being maintained.

Phenotypic markers, other than disease resistance, growth rates and shape are scarce in oysters. Efforts to obtain isozyme analyses of genotype diversity in our strains and native oysters have only begun. This appears to be the only way to characterize lines, as the geneticists advocated, with any hope of defining loci and understanding genotypes.

Improvement of Fisheries for Crustaceans



In 1974 research was centered on improving the recirculated seawater system for molting blue crabs, *Callinectes sapidus.* To a lesser extent, information on molting, reproduction and distribution of rock crabs, *Cancer irroratus,* in the Chesapeake Bay and Chesapeake Bight, collected by several investigators over a period of years, was summarized.

SOFT BLUE CRAB

Earlier work (VIMS Sea Grant Report 1971, 1972) resulted in the development of a recirculated river water system consisting of a crab holding tank with an aerobic, granular, dolomite filter and protein skimmer. It was capable of supporting low biomass levels of peeler blue crabs (40 crabs/250 gallons of water), 75 % of which survived to produce soft crabs. The system was capable of nitrifying ammonia, which was toxic, and removing some dissolved organic materials. It was incapable of removing high concentrations of nitrite and nitrate that gradually accumulated.

The system was further modified early in 1974. The dolomite filtration unit was replaced with a 300-gallon tank equipped with vinyl-core filter modules. These honey-comb modules provide a large surface area for the growth of nitrifying bacteria without impeding water flow. A counter current flow of air was added to provide the dual service of aeration and protein skimming.

Early in the year, it was realized that an anaerobic denitrifying filter could not be installed during 1974 without considerable engineering input. As an alternative method of dentrification, a 150-gallon, illuminated tank equipped for life support and growth of sea lettuce, *Ulva* sp., was installed.

Peeler blue crabs were introduced to this system from April through August to evaluate the response of the vinyl-core filter and the algae to the nitrogenous wastes. The chemical composition of the water became typical of that of a recirculated system that gradually becomes "conditioned" to biomass loading. It was similar to the composition exhibited when dolomite was used as a filter medium. Ammonia initially reached a high and then declined to very low levels. Nitrite and nitrate were initially present in small amounts. Nitrite concentration reached a peak several weeks after ammonia, but it later fell as the nitrate moiety increased.

There were some indications that *Ulva* was removing some of the accumulated nitrate, but the algae gradually died, probably a result of the absence of micronutrients such as phosphate. The lack of an effective denitrification mechanism prevented the attainment of excellent water quality conducive to high survival and production of soft crabs.

Soft crab production in 1974 was restricted to 50-56% of the peeler crabs held in the system. This yield was achieved at essentially the same biomass load as that reported in 1972, i.e., 40 crabs per 250 gallons of water per day. No reason is apparent for the decline from 75% yield achieved earlier.

"Methods of handling and shedding blue crabs, *Callinectes sapidus*", by Paul A. Haefner, Jr., and David Garten, was published in 1974 (Marine Resource Advisory Series No. 8) and distributed to the blue crab industry.

A paper describing studies of the oxygen consumption of molting blue crabs was prepared by Elizabeth G. Lewis and P. A. Haefner, Jr. It is intended for publication in 1975.

ROCK CRAB

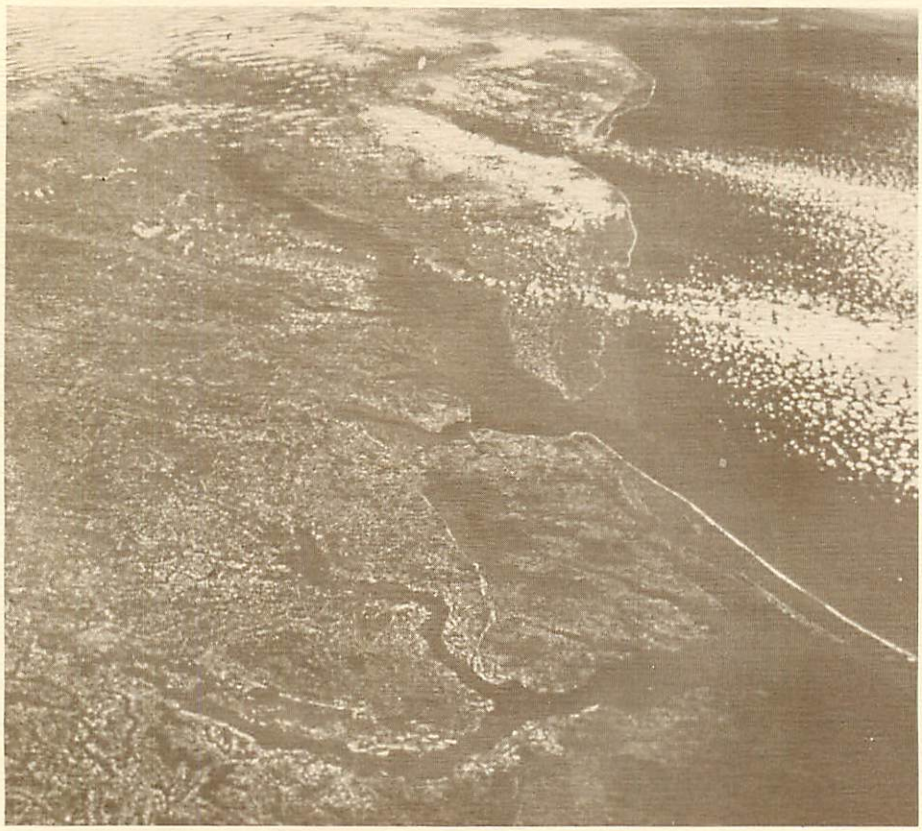
Research on the rock crab, *Cancer irroratus,* was relegated to the compilation of existing data and the preparation of manuscripts. "Aspects of molting in rock crabs, *Cancer irroratus*" by P. A. Haefner, Jr., and W. A. Van Engel and "Distribution, molting and reproduction of rock crabs, *Cancer irroratus,* in the Mid-Atlantic Bight" by P. A. Haefner, Jr., have been submitted for publication.

Synthesis and Application of Ocean Wave Refraction Data

Our research efforts in 1974 were concentrated in three major areas:

1) Continued synthesis of the computer output from our Virginian Sea Wave Climate Model, specifically, the computation of shelf wave contour maps and shoreline histograms of key wave parameters, and preparation of several publications which will appear in 1975.

2) The development of a Chesapeake Bay Wave Climate Model, entailing modifications of the original model in order to allow for the limited fetch conditions of the Bay.



3) Applications of the two Models to such diverse problems as prediction of "overwashing" on the Outer Banks (in cooperation with John Fisher of the University of Virginia for the National Park Service); geological development of Chesapeake Bay beaches (in cooperation with Peter Rosen who is writing his Ph.D. dissertation on the subject); the development of a beach erosion forecast equation for the National Weather Service (in cooperation with W. S. Richardson, at VIMS on paid leave from the National Weather Service to write his M.S. thesis on the subject); the shelf and shoreline effects of dumping millions of cubic yards of spoil, from dredging the Chesapeake Bay mouth, onto the shelf off Dam Neck, Virginia (in cooperation with Dr. Jack Ludwick and W. Saumsiegle of Old Dominion University), and historical studies of the survey accuracies required by the U.S. Coast Survey (now NOAA) to develop the methodologies, limitations and applications of historical bathymetric chart comparisons.

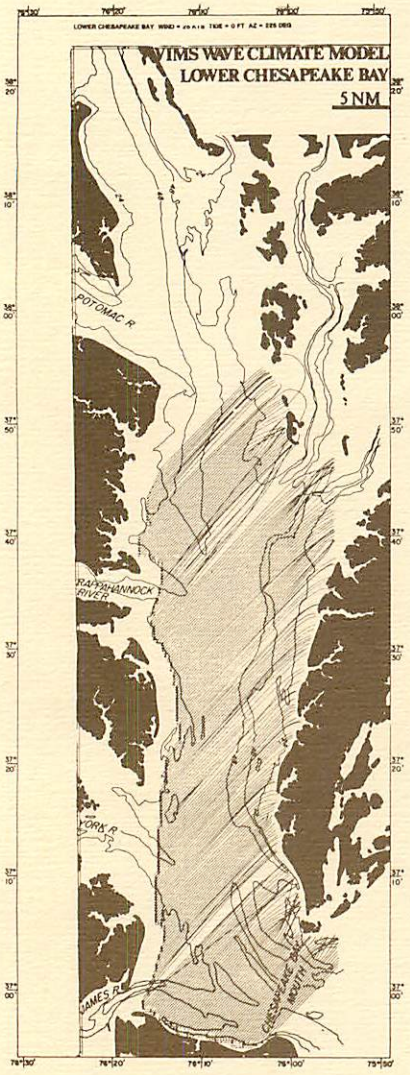
Other 1974 studies not funded by Sea Grant or VIMS, but partially related to Sea Grant projects, include the extension of the First Order depth grid (0.5 nm) and development of a Second Order depth grid (0.25 nm) to 40°N latitude (funded by NASA-Langley) and a C.E.R.C.-sponsored study of long term (up to 15 years) changes at 18 beach profile locations in Southeastern Virginia. The amount of shoreline changes at these beach profile locations will be compared with the computed shoreline wave energy for this area.

CONTINUED SYNTHESIS OF DATA

There are 30 distinct wave conditions for which shelf contour maps of wave height and maximum bottom orbital velocity, shoreline histograms of wave height, wave energy and wave power gradient are computed. A joint publication presenting this data is now in the writing stage.

A test of the computer Model was made with Dr. S. C. Farrell of Stockton College, New Jersey, by using waves shown in a U.S. Geological Coast and Geodetic Survey (USC&GS) vertical aerial photograph of Saco Bay, Maine. The computed waves showed an excellent correlation with the complex wave patterns (including numerous caustics) delineated in the aerial photograph.

Nine publications resulted from this 1974 work.



CHESAPEAKE BAY WAVE CLIMATE MODEL

Depth information in the form of two depth grids encompassing a total of 44,535 depths of 0.25 nm intervals, was completed and checked early in 1974.

These depth grids have been contoured at six foot contour intervals and represent the most detailed compilation of depth information available for Chesapeake Bay. Moreover, because these depths have been accumulated on a westward extension of the Transverse Mercator Map Projection specially constructed for the Virginian Sea Wave Climate Model, they are a more precise representation of this portion of the round earth than is usually the case.

The second major input to the Chesapeake Bay Wave Climate Model, wave information, is being fed into the Model within three distinctly different formats. The latter two types of formats represent major changes from the earlier Virginian Sea Wave Climate Model (VSWCM).

The first type of wave information was input at the Chesapeake Bay mouth and was computed in the VSWCM. As was noted in the 1973 report and several other publications, one of the more interesting phenomena observed in our study was the concentration of wave rays at the Bay mouth from nearly all offshore wave approach directions.

These output wave data from the VSWCM are now being used as input to the Chesapeake Bay Wave Climate Model. Results indicate that most waves refract to the northwest. There are major exceptions, with some waves, for example, refracting around to the eastern shore of the Bay.

The two other input wave formats involve continuous computation of wave parameters based on the limited fetch conditions that inhibit the growth of overly large "ocean-size" waves in the Bay. The wave size (length and height) is made to continually increase under the direct influence of the wind, as the waves travel across the Bay (and the fetch increases), while at the same time the waves may decrease under the influence of wave refraction and bottom friction.

The particular Bay wave input conditions are being closely coordinated with the Bay shoreline studies of both Dr. R. J. Byrne and Peter Rosen, who is doing an exhaustive dissertation study on the various Bay shoreline types and their geological development through late Holocene time.

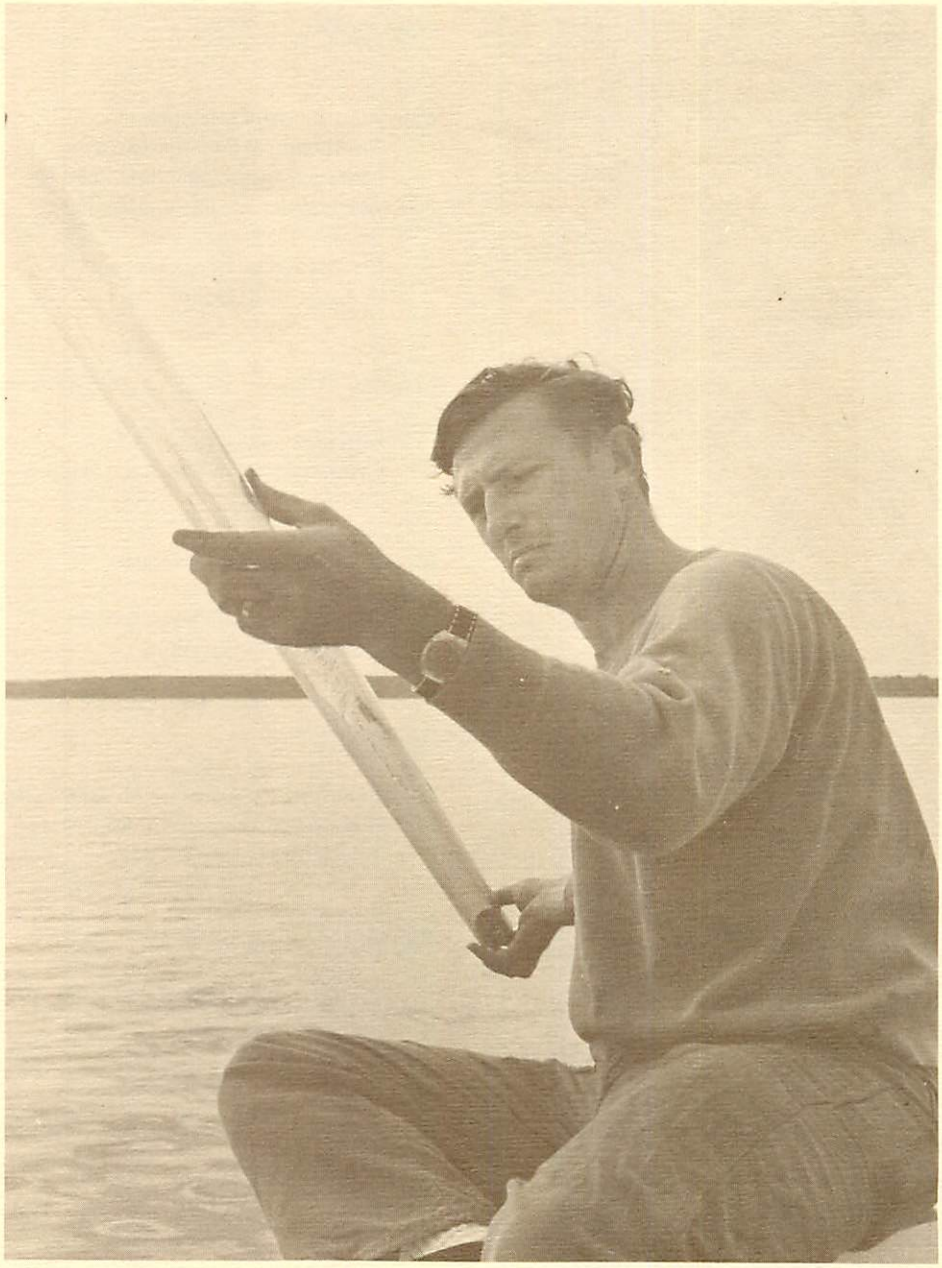
A major aim of these two shoreline studies, with which this Chesapeake Bay model is an integral part, is to increase our understanding of the causes of the severe beach erosion in the Bay in order to develop a range of environmentally sound tools that could be prescribed for these erosion problems.

APPLICATIONS

Despite the delays in the formal presentations of our Virginian Sea Wave Climate Model data due to an exhaustive editorial process, a host of applications involving the use of these data have already developed. During 1974 these applications involved direct Sea Grant supported work at VIMS as well as our cooperation in furnishing the data to other users involved in intra- and inter-institutional studies.

Several major publications of this 1974 work are expected to be published in 1975. These include two joint VIMS NASA-Langley reports, a paper on the proceedings of the 14th International Coastal Engineering Conference (June, 1974), an invited paper for a special symposium at the National American Association of Petroleum Geologists meeting (April, 1975), a joint paper with John Fisher and Leif Gulbrandsen of the University of Virginia at the Ocean Engineering meeting in Delaware, and several VIMS special reports. The data are also being used in five student theses at the University of Virginia and Old Dominion University.

Thus, in addition to the widespread uses and applications of the Virginian Sea Wave Climate Model data in our 1974 research efforts, it is expected that greater utilization will result from the increased exposure of these data in the new publications.



Fiscal Year 1974
VIMS Coherent Program Summary

Program Area	January 1, 1974 to December 31, 1974
Marine Resources Development	
Production of Superior Oysters, Management of Larva and Food for Mariculture; Dupuy and Andrews	C
Preparation of an Information Base in Aquaculture; Lanier	C
Marine Technology Research and Development	
Improvement of Fisheries for Crustaceans; Van Engel and Haefner	C
Marine Environmental Research	
Applied Physical Oceanography, Goldsmith and Byrne	C
Advisory Services	
Extension Programs, Publications and other Advisory Services; Anderson, Biggs and Hargis	C
Program Management and Development	
Program Administration; Hargis, Wood and Anderson	C

C—Project Continuing into 1975

Sea Grant Activity Budget-1974

	NOAA Grant Funds	VIMS Matching Funds	Totals
Marine Resources Development			
Aquaculture—Molluscs	$ 85,000	$ 88,637	$173,637
Information Base	30,000	3,105	33,105
Marine Technology Research and Development			
Commercial Fisheries—Technology	52,300	24,200	76,500
Marine Environmental Research			
Applied Physical Oceanography	32,000	8,500	40,500
Advisory Services			
Extension Programs and Other Advisory Services	119,700	45,200	164,900
Program Management and Development			
Program Adminstration	36,000	3,700	39,700
Totals	$355,000	$173,342	$528,342

Sea Grant Publications and Papers

Anderson, R. D., D. Garten and T. Smolen. 1974. Legal symposium on wetlands, an executive summary. VIMS Special Report.

Anderson, R. D. 1974. Advisory services: people, people, people. Sea Grant 70's 5(2):4-6.

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