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Overview 1996-1998 Virginia Institute of Marine Science

Virginia Institute of Marine Science

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A large, stylized graphic of a wave on the left side of the page, rendered in shades of gray and black with white highlights, curving from the top left towards the bottom center.

Overview

Coastal Ocean and Estuarine Science

1996-1998

WILLIAM & MARY
VIMS
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE

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Administration

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David A. Evans Associate Dean of Graduate Studies
Eugene M. Burreson Director for Research and Advisory Services
Carolyn Ridgway Cook Director for Planning and Budget
Page Hayhurst Associate Director for Development
Hugh W. Ducklow Chair, Department of Biological Sciences
Morris H. Roberts, Jr. Chair, Department of Environmental Sciences
John E. Graves Chair, Department of Fisheries Science
Steven A. Kuehl Chair, Department of Physical Sciences
Carl H. Hershner Chair, Department of Resource Management and Policy
Mark W. Luckenbach Director, Eastern Shore Laboratory

Virginia Institute of Marine Science Council

The Virginia Institute of Marine Science Council is an advisory body composed of Virginia's business and industry leaders as well as private citizens interested in the continuing vitality of VIMS through the Institute's roles in research, education and advisory service.

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Hudgins, Virginia

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Vice Chairman of the Council
Chairman Emeritus
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Richmond, Virginia

Mrs. Cynthia C. Andrews
Secretary of the Council
Hampton, Virginia

Mr. Charles R. Amory, Jr.
L.D. Amory & Company, Inc.
Hampton, Virginia

Mr. C. C. Ballard
Ballard Fish & Oyster Company, Inc.
Norfolk, Virginia

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Vice President of
Environment, Safety and Health
Fort James
Lincolnshire, Illinois

Mrs. Sara M. Boyd
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Dominion Terminal Associates
Newport News, Virginia

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Yorktown, Virginia

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NationsBank Center
Norfolk, Virginia

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Germany

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Graham & Rollins
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Mr. Arthur W. Helwig
Richmond, Virginia

Ms. Dianne N. Hoppes
Richmond, Virginia

Mr. Scott Kauffman
Topping, Virginia

Mr. Donald Parus
Amoco Oil Company
Yorktown Refinery
Yorktown, Virginia

The Honorable John O. Marsh, Jr.
Winchester, Virginia

Mr. John R. Miles
J.H. Miles & Company, Inc.
Norfolk, Virginia

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Architects, Inc.
Newport News, Virginia

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Gloucester, Virginia

Mr. David L. Peebles
Gloucester, Virginia

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Gloucester Point, Virginia

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Dr. Jane C. Webb
Department of Physics and
Computer Science
Christopher Newport University
Newport News, Virginia

Mr. William S. Wells, III
Wells Scallop Company
Seaford, Virginia

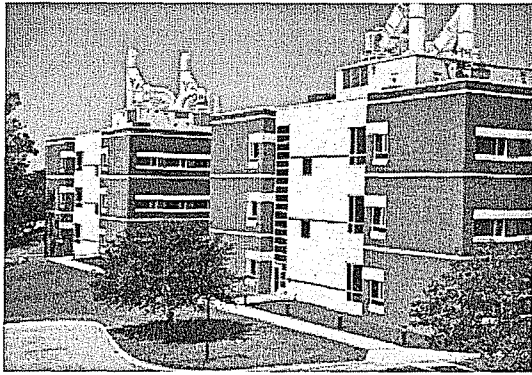
Mr. Martin H. Wilcox
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Mr. Henry C. Wolf
Norfolk Southern Corporation
Norfolk, Virginia

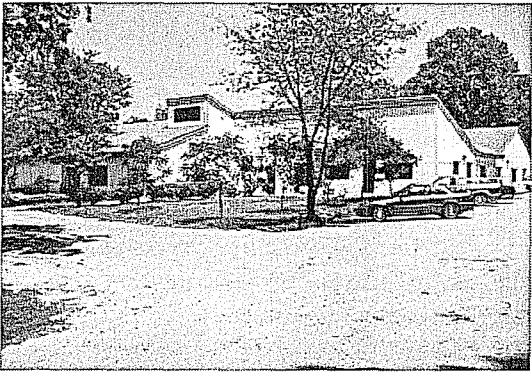
Chairman Emeritus

Mr. George W. Roper, II
Chairman, 1982-1997
Hampton Roads Maritime
Training Center
Norfolk, Virginia

Message from the Dean and Director



Chesapeake Bay Hall



Fisheries Science Laboratory



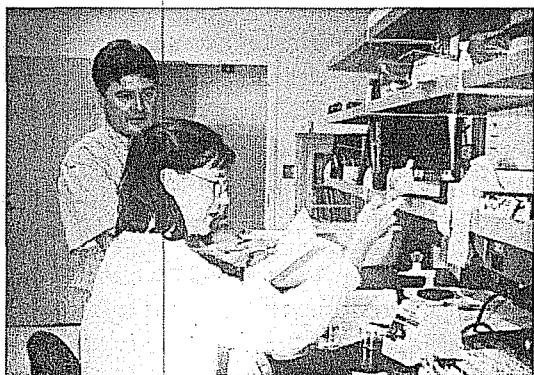
Dr. Kimberly Reece, genetics researcher

We entered the 1996 - 1998 biennium a little more than one week after our new Fisheries Science complex was dedicated and left it in the middle of the *Year of the Ocean*. Much happened over the course of those two years to change the complexion of VIMS and SMS. Since the Institute's Strategic Plan was approved by the College's Board of Visitors in late 1995, many of the objectives have been implemented or accomplished while the subsequent evolution of marine science and related societal needs has led to the identification of new objectives. Some accomplishments of the last biennium include the following:

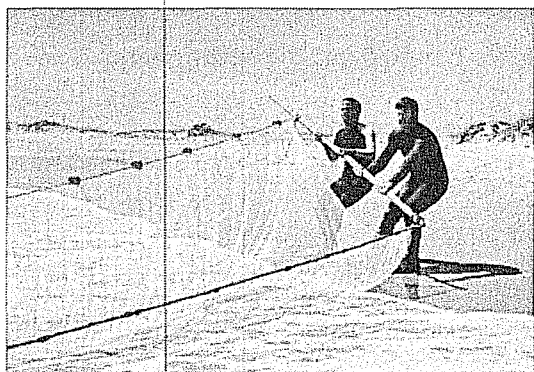
- The graduate marine science curriculum has continued to evolve and improve in substantive ways.
- A set of interdisciplinary core research and advisory service programs, which serve the institute's mandates, promote the generation of cutting-edge, new knowledge and enhance graduate education has been defined and implemented.
- Seven new faculty members and three senior administrators have been recruited bringing new blood into the institute.
- Two new, state-of-the-art laboratory facilities, Chesapeake Bay Hall and the new Fisheries Science complex have come on line.
- Two parcels of property contiguous with the Institute have been acquired.
- The nation's first Aquaculture Genetics and Breeding Technology Center has been established at VIMS.
- In April 1997, Jack and Boots Kauffman gave VIMS its largest private gift ever.
- VIMS' activities in support of economic development have been greatly expanded.
- Substantive international partnerships have been forged that will greatly enhance the ability of VIMS to accomplish its three missions and to nurture the intellectual development of faculty and students.
- The challenge of *Pfiesteria piscicida* first presented itself in summer of 1997 and was met head on by VIMS scientists acting in concert with other state agencies through the Virginia Pfiesteria Task Force.

The exciting developments of 1996-1998 seem to have been a springboard launching us through the last biennium of the century and into the new millennium. New technologies, evolving scientific paradigms and emerging issues of profound socioeconomic importance will stimulate new discoveries. It is our outstanding faculty, staff and students who will rise to these challenges and make the advances that we will report in the future. The combination of scientists and facilities that VIMS now enjoys has never been equaled.

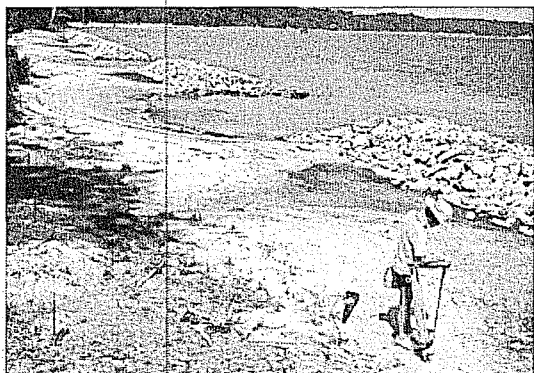
Overview



Toxicology lab in Chesapeake Bay Hall



Seine survey



Shoreline studies

The Virginia Institute of Marine Science/School of Marine Science (VIMS/SMS) of the College of William and Mary has three equally important missions: to provide cutting-edge research, education and advisory service in marine science. The Institute focuses largely, though not exclusively, on coastal and estuarine marine environments with emphasis on the Chesapeake Bay, its adjoining tributaries and the Middle Atlantic Bight. Since 1940, VIMS/SMS has evolved to become the largest marine center in the nation focused on coastal and estuarine science. The Institute is committed to generating new knowledge of coastal and marine processes; providing practical management, engineering and policy solutions to complex sets of marine-related problems and needs; and providing the highest quality graduate marine science education available anywhere.

Research and education programs are based in five departments: 1) Biological Sciences; 2) Environmental Sciences; 3) Fisheries Science; 4) Physical Sciences; and 5) Resource Management and Policy. Within each department, scientists from related disciplines maintain programs that support departmental objectives. Program research focuses on areas such as disease in fish and shellfish, plankton and nutrient processes, ecology of marine plants and animals, processes of pollutant fate and transfer, water quality, shoreline processes and structures, wave dynamics, and marine geology and geochemistry. This diversity reflects the varied expertise of the scientific staff.

Increasingly, scientific questions in need of solutions are interdisciplinary and require the integration of biological, chemical, physical, and geological oceanography as well as ocean engineering.

The comprehensive research plan includes Core Research Programs. These programs are designed to evolve and change in response to emerging issues. Scientists from various disciplines provide research to support different aspects of each program. VIMS defines Core Research on the basis of issues or problems rather than by department or discipline; all Core Programs are interdisciplinary.

Advisory service provides a major avenue for conveying scientific and technical information to clients and the general public. Faculty, students and staff apply their knowledge to natural resource issues through interactions with government agencies, localities, businesses, industries, and the general public. Institute scientists serve as advisors on numerous regional, national and international advisory panels and committees.

Highlights

International Partnerships

Over the past two years, VIMS has established formal memoranda of agreement with the New Zealand Institute of Water and Atmospheric Research (NIWA); the School of Ocean Science, University of Wales-Bangor; the Korea Ocean Research and Development Institute (KORDI); and the Institute of Estuarine and Coastal Research of the East China Normal Institute. A similar agreement with the Ocean University of Qindao China has been in place since 1987. These partnerships provide avenues for exchange of scientists, administrators and students as well as data and collaborative research. Partnerships such as these reflect the global nature of coastal zone issues and VIMS role as an internationally recognized leader in coastal and estuarine science.

Awards

The Thomas A. Graves, Jr. Award for excellence in teaching was awarded to Dr. Jack Musick, Professor of Marine Science, Department of Fisheries Science. Dr. Musick joined the VIMS faculty in 1967 and has served as major professor for 30 masters and 34 doctoral students. He is internationally recognized for his research on sharks, sea turtles and rays and has been instrumental in conservation management plans for these endangered marine species.

Dr. William J. Hargis, Jr., VIMS Director from 1959-1981, received the Mathias Medal for lifetime contributions to advancing knowledge of the Chesapeake Bay.

Dr. Jay Andrews, Professor Emeritus, Department of Fisheries Science received the David A. Wallace Award from the National Shellfish Association. The award is presented periodically to recognize individuals whose careers reflect an unusual concern for programs in shellfisheries, aquaculture and conservation.

Year Of The Ocean

To increase awareness of the importance of healthy marine environments, the United Nations designated 1998 the *International Year of the Ocean*.

In January, Dean and Director Don Wright was invited to participate in a workshop sponsored by the Heinz Foundation to define ocean agenda.

Dr. Wright addressed issues specific to the coastal zone. In June, Dr. Wright, former director, Dr. William J. Hargis, and marine educator Lee Larkin, were invited to attend the National Oceans Conference in Monterey, California. VIMS was one of 16 participants in the National Science Foundation's Year of the Ocean Symposium highlighting *50 Years of Ocean Discovery* (in October, 1998). Kimani Kimbrough, a student in the Department of Physical Sciences, was selected to participate as a panelist in discussions during the three day symposium.

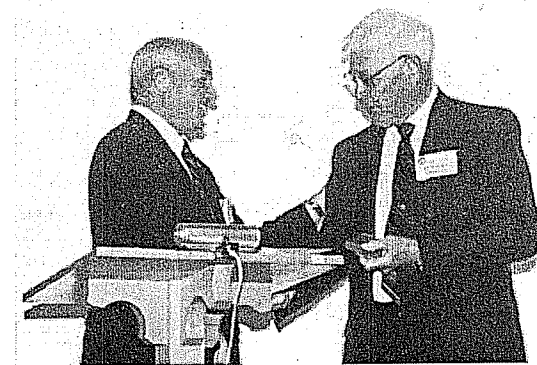
In support of the Year of the Ocean, VIMS sponsored activities throughout the year. The Crestar Lecture Series brought nationally and internationally recognized speakers to address scientific, policy and educational issues related to marine environments. Speakers included, Dr. William Kessler, NOAA Pacific Marine Environmental Laboratory;



Admiral James D. Watkins, USN (Ret.)



Rt. Hon. James Bolger New Zealand Ambassador to U.S. and Dr. Rick Pridmore, NIWA



Mathias Medal recipient, Dr. William J. Hargis

Dr. Rebecca Lent, National Marine Fisheries Service; and Dr. John Simpson, School of Ocean Sciences, University of Wales-Bangor, UK.

In addition, Rep. Sam Farr, D-CA spoke on the Oceans Act 1997, Dr. Tom Pyke, Head of the NOAA GLOBE Program spoke on Environmental Education in the age of the Internet and Admiral James Watkins, USN (Ret.), President of the Consortium of Oceanographic Research and Education, discussed the Year of the Ocean as a gateway to opportunity for future advances in oceanographic research.

Additional events included a campus-wide open house, lab tours and a series of lectures presented by VIMS scientists at the Science Museum of Virginia in Richmond and the Mariners Museum in Newport News. More than 3,000 people participated in the VIMS Year of the Ocean activities. A ten-minute video of VIMS that includes history as well as current research was produced.

An Exciting Day

April 25, 1997 was an exciting day for the Institute. After nearly eight years in planning and construction, Chesapeake Bay Hall, the \$12 million research facility was dedicated. The 60,000 square-foot, state-of-the-art building is designed to support advanced research in toxicology, environmental chemistry, aquatic disease, immunology and genetics among other programs. The building also provides an additional teaching lab and conference rooms. Admiral James D. Watkins, USN (Ret.) President of the Consortium of Oceanographic Research and Education (CORE), delivered the Keynote Address during which he commended the College of William

and Mary and the Commonwealth of Virginia for this visible commitment to marine science research and education for the future.

During the ceremonies, President Timothy Sullivan announced that Mr. and Mrs. Jack Kauffman had made a gift of their house on seven acres of land on the Rappahannock River with an endowment for the maintenance of the property.

The property will be used to establish an estuarine research center and for visiting scientists. In May, 1998, the first visiting scholar to stay at the Kauffman property was Dr. Sarah Culloty, a post-doctoral research scientist from Cork, Ireland who spent four months at VIMS studying oyster disease.

Aquaculture Genetics and Breeding Technology Center

In 1997, the Virginia General Assembly allocated start-up funds to establish the nation's first Aquaculture Genetics and Breeding Technology Center. The mission of the new center is to develop, adopt and maintain an array of innovative and applied technologies for genetics and breeding of aquaculture species in service to industry and science. Dr. Stan Allen, formerly of Rutgers University was hired as director of the center. The Center has begun to establish a network of cooperative industry partners for developing and testing strains of hard clam and oysters. Research in the Center will focus on genomics - the study of genes and their organization. Basic genetic studies of this kind are equally applicable to finfish and shellfish. Dr. Kimberly Reece will lead the genetic research aspect of the Center. Additional hatchery facilities have been

constructed at the Eastern Shore Laboratory in Wachapreague, Virginia.

Non-Native Whelk - *Rapana venosa*

During a routine trawl survey in the summer of 1998, VIMS scientists discovered a veined rapa whelk, *Rapana venosa*. Identification was confirmed by Dr. Yuri Kantor a visiting Russian scientist at the Smithsonian Institution. The *Rapana*, a native of the Sea of Japan, was introduced to the Black Sea in the 1940s and has since spread to the Aegean and Adriatic Seas. Dr. Roger Mann, Department of Fisheries, is conducting field and laboratory studies of the whelk to gain understanding of the distribution of the whelk in Bay waters, their salinity tolerance ranges and spawning and larval development. In September, Dr. Mann and others presented a detailed briefing to Secretary of Natural Resources, John Woodley and staff.

Pfiesteria piscicida

The toxic dinoflagellate *Pfiesteria piscicida* appeared in Chesapeake Bay in the summer of 1997. Scientists at VIMS are actively involved in *Pfiesteria* research, monitoring and public policy. Drs. Eugene Burreson, Leonard Haas and Wolfgang Vogelbein serve on the Virginia *Pfiesteria* Task Force. This group is responsible for planning and implementing state monitoring and response activities for *Pfiesteria* outbreaks as well as advising managers on policy considerations. The VIMS Fisheries Science Department is responsible for monitoring fish lesions in the Chesapeake Bay attributable to *Pfiesteria*, as well as providing specific fish lesion monitoring support for a health study of watermen by the Virginia Department of

Health. VIMS has also established a dinoflagellate culture and identification facility to support ongoing research by VIMS scientists and state monitoring/response activities. *Pfiesteria* research by VIMS scientists includes determining the cause and progression of lesions on juvenile menhaden, the development of sensitive and specific molecular diagnostic techniques for the rapid identification of toxic dinoflagellate species, and a comprehensive ecological study in the Great Wicomico River to examine the relationships among fish lesions, toxic dinoflagellates, and a variety of environmental parameters such as nutrient and chlorophyll concentrations, salinity, and organic carbon.

VIMS and Economic Development

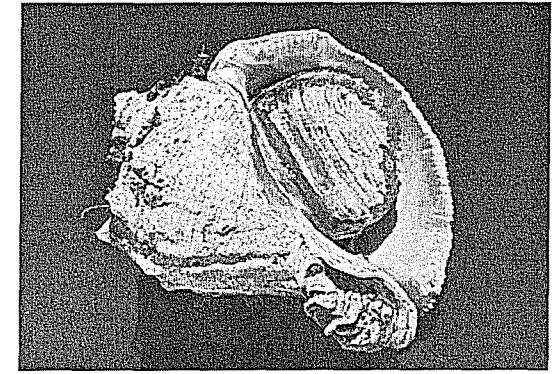
VIMS is leading a project to leverage the unique marine science assets in Hampton Roads to attract marine technology firms to the region, and develop a critical mass of research and development jobs. The project, funded by the Hampton Roads Partnership, will develop a strategy to establish a synergy between our existing world class applied research and technology capability in marine science at VIMS and other regional institutions and marry them with firms that would seek to apply these technologies. Some of the areas of expertise at VIMS that may be leveraged to support economic development include genetics research and aquaculture; marine acoustics; coastal engineering and protection; water quality and environmental modeling; water quality monitoring and chemical analytical laboratories; information technology and marine database access; commercial and recreational fisheries development and ecotourism opportunities.

On The Horizon

The National Science Foundation has awarded Dr. Fu-Lin Chu (Environmental Sciences) \$245,704 to study lipid metabolism in the oyster parasite *Perkinsus marinus*. Through a series of laboratory experiments, Dr. Chu plans to explore the lipid biochemistry of this parasite with the goal of developing a host-parasite model. One long-term benefit of the study will be its role as a baseline for future development of effective means of controlling the parasite.

The Environmental Protection Agency awarded a \$310,974 grant to Dr. Kim Reece (Fisheries Science), Dr. Gene Burreson (Fisheries Science), and Nancy Stokes to undertake a three-year project to developing a DNA-based diagnostics as an alternative to scanning electron microscopy for use in screening cultures and environmental samples for *Pfiesteria*.

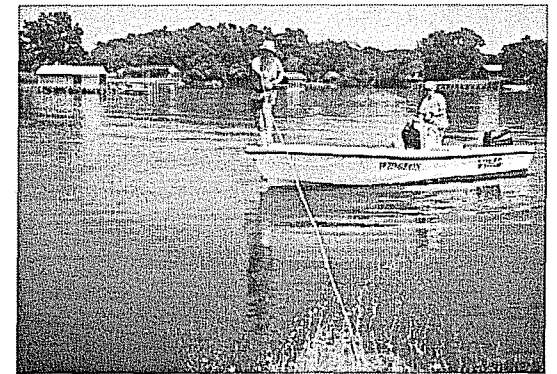
The National Science Foundation has awarded Dr. Steve Kuehl (Physical Sciences) \$157,885 for a year-long study to test the hypothesis that, contrary to classic theories, at least half of the sediment from the Ganges-Brahmaputra River load is being sequestered in the floodplain and delta plain. The goal of the project is to construct a conceptual model of deltaic evolution. Better understanding of this process will contribute to a rational strategy for development of one of the most densely populated, low-lying areas of the world.



Rapana vernosa, the veined Rapa whelk



The Eastern Shore Lab aquaculture staff



*Sampling menhaden in shallow tidal creeks
Pfiesteria field work 1998*



Adm. Watkins and Dean Wright, CBH dedication



VIMS faculty participate in White House conference on global change



Dr. Linda Schaffner, Mini School of Marine Science tour

Drs. Mike Newman (Environmental Sciences), Mory Roberts (Environmental Sciences), Mark Luckenbach (Biological Sciences), and Mike Unger (Environmental Sciences) have assembled a multi-disciplinary team to address the fate and ecological consequences of crop protectant chemicals applied to tomato fields on the Eastern Shore, through laboratory studies, protectant transport modeling, and an evaluation of toxicant amounts in the watershed. The goal of the project is to link the findings to conservation practices available to farmers in a manner which might provide guidance on reducing their impacts. The Virginia Department of Agricultural and Consumer Services has awarded them \$370,209.

Drs. Mike Newman, Wolfgang Vogelbein (Environmental Sciences), Mike Unger, and others received an EPA grant of \$727,255 to support a three-year study of molecular genetic traits of the mummichog, *Fundulus heteroclitus*, in order to explore the degree to which genetic diversity and differentiation may indicate population level effects of pollution.

With a \$335,248 grant from the Office of Naval Research through the National Ocean Partnership Program (NOPP), Lee Larkin (Marine Advisory Services) and Vicki Clark (Marine Advisory Services) are developing a novel, web-based resource center and clearinghouse that brings together marine educators, academia, private industry, and government in support of quality marine education. The Bridge will provide educators with a comprehensive source of accurate and useful information on global, national, and regional marine science topics, and will serve researchers as a contact point for their

educational efforts. Visit the Bridge website at <http://www.vims.edu/bridge>.

Dr. Jack Musick (Fisheries Science) and Mark Patterson (Biological Sciences) have received \$109,873 from Newport News Shipbuilding. Their research will explore the relationship between underwater skin friction and the resulting boundary layer of water turbulence in sharks, dolphins, and squids. The researchers will study the application of adaptive flow technology that will enable the turbulent flow around a ship's hull to be formed so that skin friction is minimized. Successful development and application of this technology will have a major impact on marine vehicles, especially small underwater craft, with potential application to aircraft as well.

Education

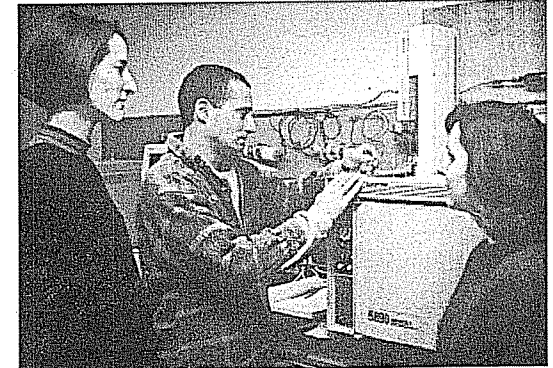
School of Marine Science

Problems affecting estuaries and the coastal ocean seem to be accelerating as coastal areas become more populated and conflicting needs and human pressures on these fragile environments increase. Our ability to cope with these problems depends in large part on the activity and involvement of appropriately trained scientists, managers and policy makers. This necessitates that schools, such as the School of Marine Science, produce students optimally trained to study and understand the coastal environment.

Currently, 125 students are enrolled in our graduate program. They are roughly equally divided between Masters of Science and Ph.D. candidates. Our students are drawn from a wide variety of colleges and universities nationwide, and encompass a range of ages and professional experience. International students comprise about 12% of the student body.

Because coastal and estuarine research requires an interdisciplinary knowledge of the environment, most first-year students take a series of core courses designed to provide broad-based knowledge in marine science. Advanced students may take a wide variety of lecture, seminar and laboratory courses, generally in their field of research interest. In addition, William and Mary programs, such as the College's Environmental Science and Policy Cluster, provide opportunities for students to work directly with faculty in the Law School, the Public Policy Institute, and other groups within the social and natural sciences.

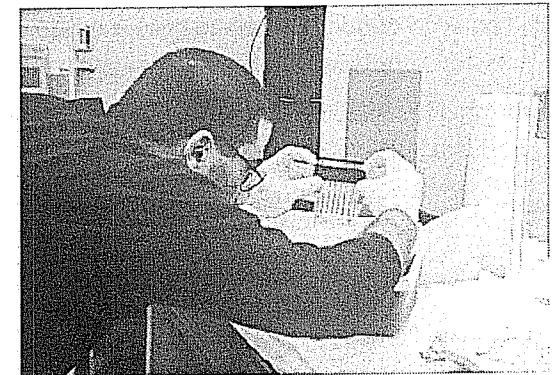
Internships at VIMS/SMS provide students with excellent real-world experience and interdisciplinary education. In recent years several of our Resource Management and Policy students have received Knauss fellowships to intern in agency and legislative offices in Washington. Other students have had both research and teaching internships at various labs and schools around the country.



Dr. Elizabeth Canuel with chemistry students



Class discussions with Dr. John Graves



Student genetics research

Student Awards and Achievements

Rebecca Boger: Knauss Fellowship, 1998-99.

Giancarlo Cicchetti: Recipient of the first CBNERRVA Fellowship. After completion of his doctoral work he was accepted as a Post-doctoral Fellow at the EPA Fisheries Lab in Narragansett, Rhode Island.

Lynn Dancy: NOAA Coastal Resource Management Fellowship, 1997-99.

Timothy Dellapenna: Matthew Fontaine Maury Award for Outstanding Student Research in Interdisciplinary Marine Science, 1998.

Kea Duckenfield: EPA Star Graduate Student Fellowship, June, 1998; GSA minigrant, April, 1998.

Lance Garrison: National Research Council Postdoctoral Fellowship, 1997.

Jim Gelsleichter, Ph.D., Department of Fisheries Science: Organized the 1997 American Elasmobranch Society symposium on Endocrinology of Sharks, Skates, and Rays. Jim is also the principle co-editor of the book published from the symposium papers.

Steven Goodbred: National Science Foundation, Japan Summer Institute Internship, Summer 1997; Geological Society of America, Grant and Outstanding Student Research Award, 1997; Sigma Xi Scientific Research Society, Grant and Membership, 1997.

Jason Goldberg: Internship with Chesapeake Bay Foundation in Richmond, VA, 1998.

Kevin Hovel: Received four monetary awards for sole-authored grants: Sigma Xi, Lerner-Gray, Chesapeake Bay Restoration Fund, and VIMS GSA mini-grant, 1997.

Monica Lara: Exxon Teaching Fellowship.

Tyler Lindstrom: SMS outstanding first year student.

Jennifer Reid: NOAA Coastal Resources Management Fellowship, 1998-2000.

Ruben Rios: Fulbright Scholarship for doctoral studies at VIMS.

David Spencer: Internship with National Park Service in Atlanta, GA, 1996-98.

Michael Wagner: Atlantic Estuarine Research Society; Best Student Paper Award, 1997.

Graduates 1996-1998

Doctor of Philosophy

Christopher P. Buzzelli, 1996
Peter Stockton Cooper, 1996
Douglas Arthur Dixon, 1996
Lance P. Garrison, 1997
Pablo D. Glorioso, 1997
Baek Oon Kim, 1996
Patrick Winfield Lay, 1996
Kewen Liu, 1996
Siddhartha Mitra, 1997
Thomas C. Mosca, III, 1997
David A. Nelson, 1996
Adele Jean Pile, 1996

Sarah Elizabeth Rennie, 1998
Rochelle Diane Seitz, 1996
Jian Shen, 1996
Zhaoqing Yang, 1996

Master of Arts

Susan Lovejoy Armknecht, 1996
Sandra D. Brooke, 1996
Jeffrey Clark Brust, 1996
John Cary Buie, 1996
Michael Lawrence Chasey, 1996
Cynthia L. Cooksey, 1996
Katherine L. Farnsworth, 1997
Kathleen Anne Garreis, 1996
Elizabeth Kathleen Hinchey, 1996
Michele A. Horvath, 1997
Ing Wei Khor, 1997
Tong Li, 1996
Renee Augusta Pardieck, 1996
Jessica L. Schulman, 1996
Mark Richard Terwilliger, 1996
Geoffrey Gordon White, 1996

Masters of Science

George Randall Cutter, 1998
Amanda Maxemchuk Daly, 1998
Lynn M. Dancy, 1997
Sarah Kathleen Gaichas, 1997
William Mason Jones, III, 1998
Amanda McKenney Mueller, 1997
Daniel Otis Redgate, 1997
Christine Helen Scanlon, 1998
David Randolph Spencer, 1998
Andrei V. Suntsov, 1997
Clifford M. Wagner, 1997
Heather Ann Yarnall, 1998

Additional Education Programs

Summer Intern

The autumn of 1998 will see the ninth year of our Summer Intern Program to increase the participation of historically under-represented minorities in marine science. Aided by funds from the National Science Foundation Research Experience for Undergraduates (REU) Program and private support, our Summer Intern Program brings together juniors and seniors from a wide variety of colleges and universities for ten weeks each summer. About half of these students come from under-represented minority groups. A recent grant from the National Science Foundation has allowed us to fund several such students each year in our graduate program. We are presently seeking private funds to begin our inreach-outreach program, by which professors from historically minority schools can spend sabbatical leaves at SMS/VIMS (inreach), and we can send our graduate students to historically minority schools to gain teaching experience (outreach). Once this program is in place, we will have one of the premier programs for under-represented minorities in the country.

Governors School

Each summer, The Virginia Institute of Marine Science's Sea Grant Marine Advisory Program hosts select students who have demonstrated an interest in and an aptitude for marine science to participate in the VIMS/NASA Governor's School. This five-week summer residential program is coordinated through the Virginia Department of Education.

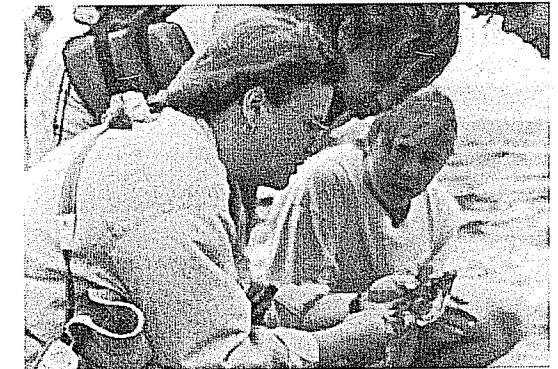
Structured as an apprenticeship, this highly competitive program offers a broad variety of marine research experiences as each student works with a faculty sponsor on current VIMS research. This year, five students from across the state participated in projects varying from studying methods to release undersized croaker from pound nets to sequencing the large subunit ribosomal RNA gene of the *Pfiesteria* complex organism.

F.I.R.S.T. Program

The Female Initiation into Research in Science and Technology (F.I.R.S.T.) program supported by funding from the Ocean Sciences Division of the National Science Foundation, provides research experience in chemical and geological oceanography where females have traditionally been under-represented. Dr. Elizabeth Canuel, Dept. of Physical Sciences, heads the six-week summer program for high school juniors and seniors. Students participate in field and lab work under the supervision of a female graduate student and a faculty mentor. In consultation with their mentors, students complete a research project that complements the mentor's research program. Over the past two years, twelve students have participated in this program.



F.I.R.S.T. students in field



Summer interns on Eastern Shore mud flat



Governors School student in Environmental Sciences lab

Advisory Services and Outreach

The role of VIMS is to provide accurate information upon which informed decisions can be made. Through advisory service and outreach activities, new knowledge and understanding is transferred to policy makers, resource managers, industry, educators and the general public. All faculty contribute in an advisory capacity which ranges from a telephone conversation with a concerned citizen to positions on regional, national and international panels or advisory boards. Some current activities are listed here.

Dr. Herb Austin, Department of Fisheries Science; Mid-Atlantic Fisheries Management Council; Bluefish and Summer Flounder Fisheries Management Plan Monitoring Committee.

Dr. John Boon, Department of Physical Sciences; member, Circle A Advisory Group, U.S. Army Corps of Engineers Navigation Management Plan for the Port of Hampton Roads, Virginia.

Drs. Eugene Burreson, Department of Fisheries Science; *Wolfgang Vogelbein*, Department of Environmental Sciences; and *Dr. Larry Haas*, Department of Biological Sciences; Virginia *Pfiesteria* Task Force.

Dr. Elizabeth Canuel, Department of Physical Sciences; Rapporteur for Education at Future of Chemical Oceanography in the U.S. (FOCUS) Workshop. Sponsored by the Ocean Sciences Division of the National Science Foundation.

Dr. Hugh Ducklow, Department of Biological Sciences; Advisor, NATO Challenges for Modern Society Black Sea Program.

Dr. William D. DuPaul, Department of Fisheries Science; New England Fishery Management Council; Sea Scallop Plan Development Team.

Dr. John Graves, Department of Fisheries Science, Advisory Committee Chairman, United States National Section to the International Commission for the Conservation of Atlantic Tunas.

Dr. Roger Mann, Department of Fisheries Science; Mid-Atlantic Fisheries Management Council, Subcommittee on Invertebrate Stock Assessment;

Industry Collaboration, National Fisheries Institute, Surf Clam and Ocean Quahog Research and Stock Assessment Committee; EPA Chesapeake Bay Program, Artificial Reef Restoration Committee.

Dr. Jack Musick, Department of Fisheries Science; International Union for the Conservation of Nature, Co-Chair Species Survival Commission, Shark Specialist Group and Delegate to Conservation on International Trade to Endangered Species.

Dr. Carl Hershner, Department of Resource Management and Policy; Chair, Wetlands Workgroup, EPA Chesapeake Bay Program; Member, Virginia Chesapeake Bay Interagency Staff Committee.

Dr. John Hoenig, Department of Fisheries Science; Overfishing Definition Review Panel; New England Fishery Management Council and the Mid Atlantic States Fishery.

Dr. James E. Kirkley, Department of Resource Management and Policy; Food and Agriculture Organization (FAO); Fisheries Capacity Reduction Advisory Committee

Dr. Al Kuo, Department of Physical Sciences; member, Hydrodynamic Modeling Committee, EPA Chesapeake Bay Program

Dr. Rom Lipcius, Department of Fisheries Science, Mid-Atlantic Fishery Management Council, Statistical and Technical Committee, Chesapeake Bay Commission; Technical Work Group, Bi-State Blue Crab Advisory Committee.

Dr. Mark Luckenbach, Department of Fisheries Science; Virginia Task Force on Plaquiculture and Water Quality.

Dr. James Perry, Department of Resource Management and Policy; Board of Directors, Society of Wetland Scientists, Chair, South Atlantic Chapter.

Dr. Mory Roberts, Department of Environmental Science, member, Corps of Engineers Steering Committee, Feasibility Study for Elizabeth River Sediment Remediation; Member, Toxics Subcommittee of the EPA Chesapeake Bay Program.

Dr. Linda Schaffner, Department of Biological Sciences; Estuarine Research Federation Governing Board, Member-at-Large; Environmental Protection Agency, *National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division*, Review Panel Member, 1997.

Dr. Harry Wang, Department of Physical Sciences; member, Hydrodynamic Modeling Committee, EPA Chesapeake Bay Program; Advisor to Upper Chesapeake Bay Island Displacement Project, Maryland Department of the Environment.

Dr. L. Donelson Wright, Dean and Director of VIMS, testified on *Pfiesteria piscicida* before the U. S. House of Representatives/Committee on Resources/Subcommittee on Fisheries Conservation, Wildlife and Oceans on October 9, 1997. He also testified before the U.S. Senate Committee on Commerce, Science and Transportation, Subcommittee on Oceans and Fisheries on May 20, 1998 in relation to the Harmful Algal Bloom Research and Control Act.

Drs. L. Donelson Wright, Department of Physical Sciences; *Hugh Ducklow*, Department of Biological Sciences; *Jim Bauer*, Department of Physical Sciences; White House Conference on Global Climate Change.

Other outreach and extension activities over the past two years have included:

Tidal Wetlands Workshop

The annual tidal wetland seminar provides technical information on basic ecological, management and procedural issues central to effective management of the Commonwealth's tidal wetland resources.

The seminar targets the county wetland boards, local and state regulatory agencies, consulting engineering firms, local civil agencies, and the general public. Attendance at the 1998 seminar was 98.

Annual York River Watershed Conference

The York River Watershed brought together stakeholders within the watershed to discuss relevant issues pertaining to watershed management, resources, planning, and protection. VIMS Comprehensive Coastal Inventory Program (CCI) co-sponsored this workshop with York River Watershed Council, Tidewater Soil and Water Conservation District and the Chesapeake Bay Foundation. CCI develops GIS based resource planning tools to support watershed level management. Workshop participants include representatives from state and local government agencies,



Drs. Wright and Burreson provide testimony to U.S. House of Representatives



Wetlands education class



Dr. Roger Mann instructs teachers during workshop

planning and resource management personnel, non-government organizations, commercial enterprises, watershed associations, and private citizens. Nearly 200 people attended the 1998 workshop.

Master Oyster Gardening Workshop

In cooperation with the Tidewater Oyster Gardeners Association, VIMS developed the first Master Oyster Gardeners education program. Twenty experienced oyster gardeners participated in the three-day advanced education program. These Master Oyster Gardeners will serve as a community resource for other oyster gardeners.

Annual Game Fish Tagging Workshops

The Virginia Game Fish Tagging Program is co-managed with the Virginia Saltwater Fishing Tournament to enhance marine angler involvement in more effective catch and release fishing while simultaneously producing tagging data which can aid research and management of marine fisheries. Annually 4-5 tagging workshops are held in various coastal areas. Hundreds of anglers have been trained to tag eight species targeted by the program. Since 1995, over one thousand tag returns have been entered into the data base demonstrating previously unknown movement patterns and, in certain instances movement rates, for juvenile and adult red drum, black drum, gray trout, speckled trout, cobia, tautog, spadefish and black sea bass.

International Coastal Society Meeting

In July, the 16th International Conference of The Coastal Society was hosted by CBNERRVA and VIMS. Conference plenaries highlighted the regional approach to coastal resource management being taken by the Elizabeth River Project, the need to develop a vision incorporating all stakeholders in resource management issues, and the importance of communicating coastal resource issues through television and print media. The Honorable Elsie L. Munsell, Deputy Assistant Secretary of the Navy, delivered a luncheon address on the Department of the Navy's environmental programs in the coastal US.

A workshop "Teaching Coastal Zone Management Through Distance Education," was held in conjunction with the Conference. This workshop brought together graduate faculty from marine affairs and policy programs from around the US to discuss innovative ways of using distance education technologies to improve graduate and professional training.

Mini-School of Marine Science

The seven week Mini-School provides a broad-based overview of coastal ocean and estuarine science for general audiences.

VIMS faculty present 12-hours of instruction on the basic processes affecting coastal marine environments and current VIMS research. Participants spend 6 hours touring related labs for demonstrations, exhibits and hands-on activities. Approximately 250 people attended the Mini-School in 1998.

Additional sessions are planned for 1999.

Teacher Workshops

Mini-School Workshop

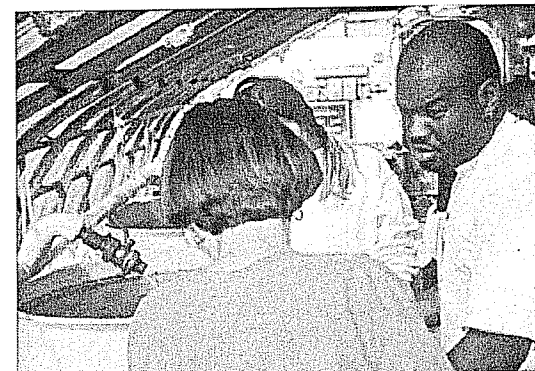
The Sea Grant Marine Advisory Program educators held a workshop for middle and high school teachers in conjunction with the Mini-School of Marine Science. VIMS scientists and educators provided a full day of supplemental demonstrations and activities for teachers to take back to the classroom.

Oyster Reef Workshop

The Virginia Sea Grant Marine Advisory Program and the Molluscan Ecology group of the Fisheries Department conducted an Oyster Reef Ecology workshop at VIMS for 35 science educators in July 1998. The teachers took part in laboratory, field, and classroom activities that focused on oyster reef ecology, oyster biology, and VIMS's oyster reef restoration work.

Benthic Workshop

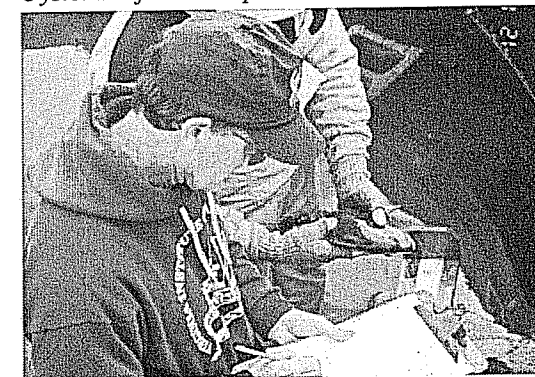
The National Geographic film, *Lifestyles of the Wet and Muddy*, which was filmed at and near the VIMS laboratory in Wachapreague, Virginia, was the centerpiece of a Virginia Sea Grant Marine Advisory Program/VIMS workshop in March 1997 attended by 47 science educators. In addition to viewing and discussing the film with one of the filmmakers, the educators participated in laboratory and classroom activities that provided additional scientific background on benthic ecology.



Graduate student Roy Pemberton with Mini-School participants



Oyster Reef Workshop



Jon Lucy working with the Virginia Game Fish Tagging Program

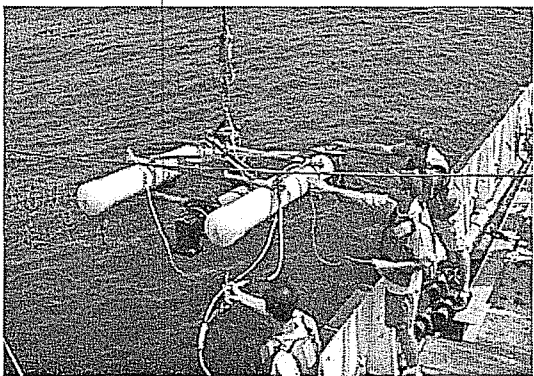
New Faculty 1996-1998



Dr. Stan Allen surveying oyster beds



Dr. Walker Smith in Antarctica



Dr. Carl Friedrichs aboard research vessel

Standish K. Allen, Jr.

Professor of Marine Science, Department of Fisheries Science; B.S. Franklin and Marshall College, M.S. University of Maine - Orono, Ph.D. University of Washington

Research interests lie in the application of biotechnology to fisheries management and aquaculture.

James L. Anderson

Visiting Professor of Marine Science, Department of Resource Management and Policy; B.S. William and Mary, M.S. University of Arizona, Ph.D. University of California

Research interests include aquaculture development and policy; the role of market institutions in natural resource management; environmental damage assessment; international trade and the environment; fisheries management; and environmental and natural resource policy modeling and forecasting.

John E. Anderson

Research Scientist, Department of Research Management and Policy; M.S. George Mason University, Ph.D. George Mason University

Primary research interests include the use of field methods and remote sensing to measure and characterize changes in the plant, soil, and water components associated with wetlands and aquatic environments. Courses: Introduction to Remote Sensing of Aquatic Resources, Digital Remote Sensing

Carl T. Friedrichs

Assistant Professor of Marine Science, Department of Physical Sciences; B.A. Amherst College, Ph.D. Massachusetts Institute of Technology/Woods Hole Oceanographic Institution

Research interests are the physical oceanography of tidal estuaries and the inner continental shelf, and the impact of hydrodynamics on geomorphology, benthic biology and particle transport.

Courses: Tidal Marsh Sedimentation, Coastal and Estuarine Processes, Fluid Mechanics, Ocean Dynamics and Intro Physical Oceanography.

John M. Hoenig

Associate Professor of Marine Science, Department of Fisheries Science; B.S. Cornell University, M.S. University of Rhode Island, Ph.D. University of Rhode Island
Research involves development of methods for studying population dynamics and assessing fisheries including determination of appropriate management options. Use of statistical theory to develop methods for interpreting tagging, survey, catch, effort, and age data.

Courses: Stock Assessment Methods, Marine Fisheries Science

Kenneth A. Moore

Research Assistant Professor, Department of Biological Sciences; B.S. Pennsylvania State University, M.S. University of Virginia, Ph.D. University of Maryland
Research interests include studies of the ecology of estuarine aquatic angiosperms and the relationships between these aquatic macrophyte systems and environmental factors that limit their growth, survival and restoration.

Courses: Seagrass Ecosystems

Michael C. Newman

Professor of Marine Science, Department of Environmental Sciences; B.S. University of Connecticut, M.S. University of Connecticut, M.S. Rutgers University, Ph.D. Rutgers University
Research interests include factors, affects, and models of toxicity and bioaccumulation, as well as quantitative methods for ecological risk assessment.
Courses: Quantitative Ecotoxicology, Environmental Risk Assessment

William G. Reay

Research Assistant Professor, Department of Resource Management and Policy; B.S. George Mason University, M.A. William and Mary, Ph.D. Virginia Polytechnic and State University
Research interest in sediment nutrient dynamics and hydrology; a recent project demonstrates the beneficial uses of riparian vegetation and development of GIS protocols to identify shorelines at risk of groundwater contaminant loadings to surface waters.

Kimberly S. Reece

Assistant Professor of Marine Science, Fisheries Science; B.S. University of Rochester; Ph.D. Cornell University
Research interest include aquaculture breeding technologies, molecular genetic analysis of marine organisms including shellfish and shellfish disease agents, tunas and billfish.
Courses: Marine Molecular Genetics and Marine Molecular Genetics Laboratory.

Walker O. Smith, Jr.

Professor of Marine Science, Department of Biological Sciences; B.S. University of Rochester, Ph.D. Duke University
Research interest in phytoplankton of the Chesapeake Bay and surrounding habitats, particularly the role that episodic algal outbreaks play in the ecology of the Bay.

Harry Wang

Assistant Professor of Marine Science, Department of Physical Sciences; B.S. National Taiwan University, Ph.D. Johns Hopkins University
Research involves the use of numerical computational methods to simulate current, water level, salinity, and temperature, and their consequences for environmental conditions.
Courses: Estuarine Hydrodynamics

Ting Dai

Assistant Research Scientist, Department of Biological Sciences; B.S. Nanjing University, M.S. Nanjing University, Ph.D. University of Georgia
Research interests are watershed and ecosystem modeling, scientific software development, and wetland ecology.

Post Doctoral Research Fellows**Andrew Dacanay**

Post-Doctoral Research Assistant, Department of Environmental Sciences; B.S. University of East London, Ph.D. University of Aberdeen

David B. Carlini

Post-Doctoral Research Assistant, Department of Fisheries Science; B.A. University of California, Santa Barbara, M.S. Florida Institute of Technology, Ph.D. College of William and Mary

Shaban Kotob

Post-Doctoral Research Associate, Department of Environmental Sciences; B.S. University of Cairo, M.S., Ph.D. University of Maryland, College Park

Phillippe Soudant

Post-Doctoral Research Assistant, Department of Environmental Sciences; M.S. University of Rennes, Ph.D. University of Brest, French Institute of Ocean Research

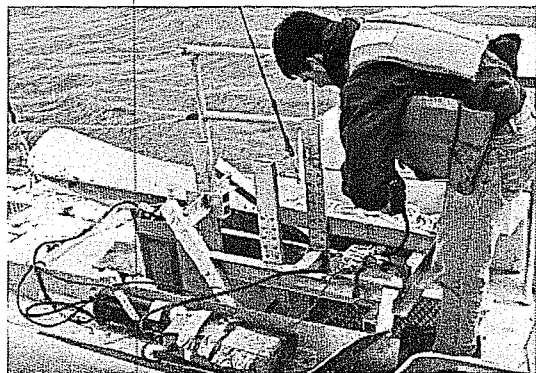
Sylvie Mathot

Post-Doctoral Research Associate, Department of Biological Sciences; B.S., M.S., and Ph.D. University of Brussels, Belgium

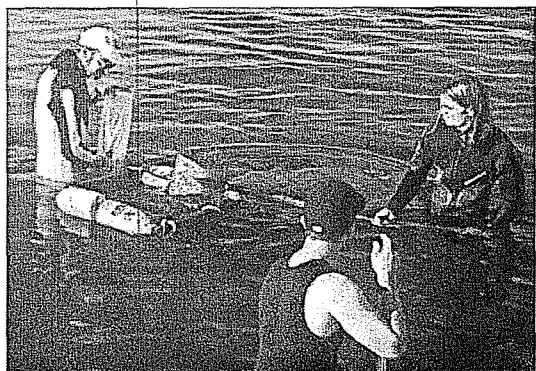
Quanqi Zhang

Post-Doctoral Research Assistant, Department of Fisheries Science; B.S., M.S. Ocean University of Qingdao, China, Ph.D. Hiroshima University, Japan

Programs & Faculty



Field studies in benthic biology



Monitoring seagrass beds



Surface water studies

Department of Biological Sciences

The Department of Biological Sciences brings together biologists and ecologists from several subdisciplines including microbiology, taxonomy, and ecosystem modeling. Faculty are engaged in research aimed at elucidating patterns and processes in benthic and planktonic systems over both space and time. Research is geared toward understanding the basic forces in these communities on the local and global scales. Results are often used to assist managers with problems of local, national, and international significance.

Faculty

Hugh W. Ducklow (Chair)
Loretta and Lewis Glucksman Professor
Iris C. Anderson
Professor
Robert J. Diaz
Professor
J. Emmett Duffy
Assistant Professor
Leonard W. Haas
Associate Professor
Kenneth A. Moore
Research Assistant Professor
Robert J. Orth
Professor
Mark R. Patterson
Associate Professor
Linda C. Schaffner
Associate Professor
Walker O. Smith, Jr.
Professor

Richard L. Wetzel
Professor
Ting Dai
Assistant Research Scientist
Helen L. Quinby
Faculty Research Associate
Sylvie Mathot
Post-Doctoral Research Associate

Emeritus Faculty

Michael Castagna
Professor Emeritus
George C. Grant
Professor Emeritus
William J. Hargis, Jr.
Professor Emeritus
Kenneth L. Webb
Chancellor Professor Emeritus

Major Programs

Benthic Ecology: Examines the major processes governing the structure and function of benthic systems. Conducts ongoing studies of processes influencing recruitment, growth and production of benthic organisms, and the function and role of benthic communities in fate and transfer of organic matter and sediments.

Nutrient Cycling: Focuses on spatial and temporal control of phytoplankton production by phosphorus or nitrogen and the impact of various processes on the food web. Sediment-related processes and exchange with overlying water studies form a portion of this program.

Macrophyte Ecology: Concentrates on submersed and emergent macrophyte species in shallow subtidal, intertidal marine, brackish, and freshwater areas. Current studies focus on plant distribution and abundance, restoration ecology, dispersal mechanisms and plant response to environmental variability and related factors.

Physical Biology: Interdisciplinary studies investigate food capture, bio-energetics, primary and secondary production, and allometry in invertebrates and algae. Involved in ongoing collaborative work with institutes in the Chesapeake Bay, Gulf of Maine, Caribbean and Lake Baikal, Russia.

Ecosystem Modeling: Development of digital computer simulation models as integrative and synthetic tools for ecosystem analysis to address basic and applied management questions.

Biological Oceanography: Emphasis on examining the fundamental processes underlying primary and secondary production in marine ecosystems, primarily offshore systems. Studies focus on understanding the physical processes supporting primary production, plankton dynamics, biotic interactions structuring communities, vertical and horizontal distributions, foodweb structure,

and the ecological roles of higher and lower trophic levels and benthic-pelagic coupling.

Marine Plankton Ecology: Examines the interactions among various plankton groups (phytoplankton, bacteria, zooplankton) and the environmental factors which influence their growth (nutrients, irradiance, trace metals). Particular emphasis is placed on the fluxes of carbon and nitrogen within the various organic and inorganic pools (both dissolved and particulate), on the biotic processes regulating these transformations, and on the ecology of harmful algal blooms.



Immunology studies



Environmental assessment field work



Aquatic disease research

Department of Environmental Sciences

The Department of Environmental Sciences combines the expertise of chemists and biologists to study the fate and effects of hazardous substances and pathogenic organisms in estuarine and marine systems. Faculty expertise includes environmental chemistry, biochemistry, toxicology, ecotoxicology, environmental microbiology, pathobiology, histopathology, immunology, and risk assessment. Collaboration within this multidisciplinary group provides the opportunity to obtain a more complete understanding of how toxic chemicals and pathogens move through the environment, what reactions they undergo, and how toxic chemicals and pathogens interact to affect organisms from the molecular to the population level of organization. This information can be used for ecological risk assessment and thereby made available to environmental managers in the Commonwealth, the Chesapeake Bay region and the nation in a readily usable form.

Faculty

Morris H. Roberts, Jr. (Chair)
Professor
Mohamed Faisal Abdel-Kariem
Associate Professor
Fu-Lin E. Chu
Associate Professor
Robert C. Hale
Associate Professor
Stephen L. Kaattari
Professor
Howard I. Kator
Associate Professor
Michael C. Newman
Professor
Martha W. Rhodes
Instructor
Jeffrey D. Shields
Assistant Professor
Craig L. Smith
Associate Professor
Michael A. Unger
Assistant Professor

Peter Van Veld
Associate Professor
Wolfgang K. Vogelbein
Associate Professor
Andrew Dacanay
Post-Doctoral Research Assistant
Shaban L. Kotob
Post-Doctoral Research Associate
Philippe Soudant
Post-Doctoral Research Assistant

Emeritus Faculty

Henry Aceto, Jr.
Professor Emeritus
Rudolf H. Bieri
Professor Emeritus
William J. Hargis, Jr.
Professor Emeritus
Robert J. Huggett
Professor Emeritus
J. Ernest Warinner
Professor Emeritus

Major Programs

Environmental Chemistry: Sources, distribution, transport, fate, and bioavailability of organic and elemental pollutants are studied in marine and estuarine environments. Recent research has focused on such issues as sediment partitioning, association with dissolved organics, and photolysis of anthropogenic chemicals. Interactions of toxic chemicals with marine life are explored through collaboration of chemists and biologists within the department. New techniques are being developed to separate, purify, and identify various anthropogenic compounds and their breakdown products. Organic compounds examined include antifoulants such as tributyltin, complex mixtures of polycyclic aromatic hydrocarbons, and brominated fire retardants.

Environmental Microbiology: This diverse program

1) focuses on the consequences of introduced indicator microorganisms (bacteria and virus) and human pathogens in waters used for recreation, aquaculture, and shellfish industries; 2) seeks to develop and validate methods for detection of allochthonous microorganisms of public health significance, and to understand their fate and autecology in aquatic environments; 3) identifies processes in watersheds that contribute to eutrophication and microbial contamination of receiving waters;

4) engages in collaborative research to understand the role of bacteria in diseases of feral and aquacultured species of fish. Ulcerative diseases attributed to *Mycobacteria* and *Pfiesteria* are the focus of current collaborative studies.

Aquatic Toxicology: Toxicity effects are measured as 1) responses of individuals and populations to contaminated water and sediment; 2) uptake and elimination of pollutants by individual organisms; and 3) cellular, histological, subcellular, and molecular mechanisms of uptake, internal distribution, biotransformation, and clearance of hazardous chemicals. Through collaboration with the pathobiologists, the effects of chemicals on

disease resistance are being identified. Linking the responses of organisms to the various levels of organization is being attempted in order to develop a basis for predicting population effects from the subcellular and molecular effects that can be observed at concentrations below those at which ecological effects are identifiable.

Pathobiology: Major projects focus on infectious diseases of fish and oysters, effects of *Pfiesteria*, and non-infectious diseases of fish. A variety of immunological, cytological, histological, and biochemical techniques are being applied to determine the mechanism(s) by which pathogens (such as *Perkinsus marinus*) cause disease in the host organisms (e.g. the oyster) and to examine how the hosts attempt to deal with the invasion. Collaborative studies involving researchers from all departmental programs seek to understand the impact of toxic materials on the host parasite interactions. The pathobiology group is developing an Aquatic Animal Disease Diagnostic Laboratory using traditional histological and modern molecular techniques to identify diseases observed in feral animals.

Ecological Risk Assessment: Assessment tools are applied to evaluate the risk associated with exposure to hazardous chemicals, pathogens, bacterial agents, both individually and collectively in complex mixtures. The goal is to provide a conceptual framework and quantitative tools that will improve environmental management by allowing resource agencies to focus their limited resources on those issues of greatest importance, which are most likely to be improved measurably by effective management.

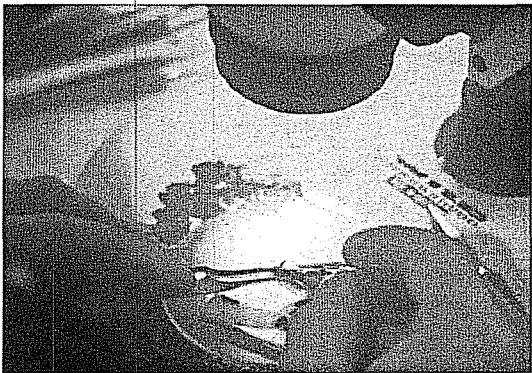
The research programs of the department are grounded in two institutional core programs: Risk Assessment and Hazard Evaluation, and Marine Diseases. There are significant interactions with the Fate and Transport, Water Quality, and Aquaculture Core Programs.



Tagging juvenile shark



Trawl survey



Fisheries Science aging and reproductive studies

Department of Fisheries Science

The Department of Fisheries Science supports studies in ecology, population and molecular biology, pathology, and genetics. Programs focus on stock assessment and life history of commercially valuable fish, crab and mollusc species. The fishery genetics program investigates regional and global problems, while the development of DNA probes complements established methods and provides new avenues for research on diseases that continue to decimate regional oyster populations.

Faculty

John E. Graves (Chair)
Professor

Standish K. Allen, Jr.
Professor

Herbert M. Austin
Professor

Eugene M. Burreson
Professor

Mark E. Chittenden, Jr.
Professor

William D. DuPaul
Professor

John M. Hoenig
Associate Professor

Romuald N. Lipcius
Associate Professor

Mark W. Luckenbach
Associate Professor

Jon A. Lucy
Instructor

Roger L. Mann
Professor

John A. Musick
Professor

John E. Olney
Associate Professor

Jacques van Montfrans
Instructor

Kimberly S. Reece
Assistant Professor

David Carlini
Post-Doctoral Research Assistant

Quanqi Zhang
Post-Doctoral Research Assistant

Emeritus Faculty

Jay D. Andrews
Professor Emeritus

Dexter S. Haven
Professor Emeritus

Joseph G. Loesch
Professor Emeritus

Frank O. Perkins
Professor Emeritus

Willard A. Van Engel
Professor Emeritus

Frank J. Wojcik
Professor Emeritus

Major Programs

Crustacean Ecology: Studies examine the behavioral ecology, population dynamics and recruitment mechanisms of the blue crab in the Chesapeake Bay and spiny lobster in the Caribbean. Emphasis is on predator-prey interactions, population and fisheries modeling, ecology of natural and artificial reef systems, and ecology of tropical fish and queen conch.

Bivalve Ecology: Studies focus on recruitment of bivalves, particularly oysters; the effects of the environment on physiology and behavior of larval oysters and other bivalves; oyster population assessments; and the development of disease-resistant hybrids.

Fisheries Oceanography: Focuses on the effects of environmental variables (weather and climate) on the survival, recruitment, and distribution of fishes and other marine organisms.

Fish and Shellfish Pathology: Ongoing research focuses on the systematics, life cycles, ecology, pathology, and control of important disease agents in the Chesapeake Bay region. Current emphasis is on protozoan parasites of oysters, blue crabs, and fishes.

Finfish Ecology: Studies of the dynamics, recruitment, stock structure, and life history of marine, estuarine, and anadromous fishes based on sampling fisheries landings, surveys, and tagging studies. Data generated by this program is directly applied to stock assessment and fisheries management by state and regional agencies.

Chondrichthyan Biology: Continuing studies into the comparative morphology of sharks and their relatives; population dynamics, reproduction, feeding strategies and energetics of coastal and deep-sea sharks, and shark fishery management problems.

Sea Turtle Ecology: Long-term research conducted on the distribution, abundance, ecology, and energetics of sea turtles; current behavior and migration studied using sonic, radio and satellite tracking as well as nesting and sex ratio studies.

Systematics: Focuses on the morphology, evolution, taxonomy, and zoogeography of various finfish groups.

Fisheries Genetics: Examines the application of molecular genetic techniques to address problems in fisheries science. Studies focus on analysis of stock structure, use of molecular characters to identify early life history stages of marine organisms, and the evaluation of taxonomic and biogeographic hypotheses with molecular genetic information.

Commercial Fisheries Development: Research includes gear selectivity and bycatch as well as management and regulatory strategies for seafood production, processing and utilization.

Marine Resource Economics: Studies focus on marine resource and environmental economics, resource management, statistics, game theory, risk and uncertainty, and operations research analysis. In addition, international trade, economic development, population dynamics and the economics of recreational fishing are examined.



Ph.D. student, Steve Goodbred, with undergraduates



Physical scientists deploying instrumented pod



Running computational modeling sequences

The Department of Physical Sciences

The Department of Physical Sciences includes the subdisciplines of physical, chemical, and geological oceanography. Many of the education and application aspects of quantitative methods are incorporated here. This union facilitates a new level of interdisciplinary synergy, appropriate to rapidly evolving needs and emphases. The global objective of the department is to generate, communicate, and apply knowledge concerning physical, chemical, and geological processes that operate in the coastal ocean and estuaries.

Faculty

Steven A. Kuehl (Chair)
Professor
James E. Bauer
Associate Professor
John D. Boon, III
Professor
John M. Brubaker
Associate Professor
Elizabeth A. Canuel
Assistant Professor
Catherine J. Chisholm-Brause
Assistant Professor
Rebecca M. Dickhut
Associate Professor
David A. Evans
Associate Professor
Carl T. Friedrichs
Assistant Professor
Carl H. Hobbs, III
Associate Professor
Sung-Chan Kim
Visiting Assistant Professor

Albert Y. Kuo
Professor
Jerome P.-Y. Maa
Associate Professor
William G. MacIntyre
Professor
John D. Milliman
Professor
Harry Wang
Assistant Professor
L. Donelson Wright
Chancellor Professor
Robert A. Gammisch
Marine Scientist Supervisor
C. Scott Hardaway
Marine Scientist Supervisor

Emeritus Faculty

Robert J. Byrne
Professor Emeritus
Maynard M. Nichols
Professor Emeritus
Evon P. Ruzbecki
Professor Emeritus

Major Programs

Chemical Fate and Transport: Examines the physical-chemical properties, and the naturally-occurring transport and transformation pathways, for chemical contaminants within aquatic ecosystems.

Surface Geochemistry: Studies focus on reactions of anthropogenic (e.g., triazine herbicides, organic compounds, chlorinated hydrocarbons, radioactive and toxic metal contaminants, and refined fuels) and natural products at the mineral-water, sediment-water, and suspended particle-water interfaces.

Biogeochemistry: Studies focus on interdisciplinary science and chemistry of the Earth's surface, including interactions among the atmosphere, oceans, crustal minerals, and living organisms.

Organic Geochemistry: Examines organic matter, including factors controlling its production, transformation, and ultimate fate.

Small Scale Physical Processes: Studies focus on coastal fronts, internal waves (including internal tides), and the development and breakdown of density stratification to understand vertical and horizontal fluxes in estuaries and on the shelf.

Continental Shelf Dynamics: Emphasis is on understanding the physical mechanisms that cause across-shelf transport of particles.

Estuarine Dynamics: Addresses both large-scale, long-term transport processes and smaller-scale, often localized, short-term processes, using observation, and theoretical and computational tools.

Sediment Geochemistry and Geochronology: Study of seabed processes which determine the ultimate fate of particulate materials and chemical species in estuarine and coastal environments.

Sediment Environments and Stratigraphy: Examines the long-term (hundreds of years) integration of the consequences of shelf, including estuarine and riverine, processes.

Shoreline Studies: Works toward developing proper responses to shoreline erosion at specific sites via beach nourishment and/or stabilization to avoid the loss of highly valued coastal property, and in some cases, living coastal resources.

Dispersal of River Sediments in Coastal Seas: Focuses on the transfer processes and fate of river-derived sediment in coastal seas.

Sediment Erosion and Deposition Processes: Various methods are employed to quantify the erosion and deposition rates of sediment at the water-sediment interface.

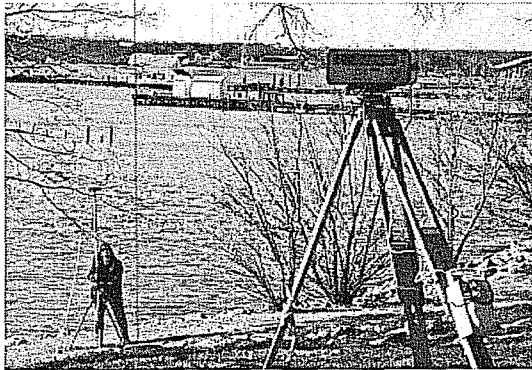
Coastal and Estuarine Numerical Modeling: Emphasizes the use of numerical computational methods to simulate the current, water level, salinity, and temperature and their consequences on environmental conditions such as water quality, sediment, and larval transport.

Water Waves: Focuses on transformation processes and nearshore wave climate prediction.

Bottom Boundary Layer Dynamics: Observational and theoretical studies of turbulence, mixing, stress, stratification, and sediment and velocity profiles within the lowest few meters of the water column.



Wetland plant diversity sampling



GPS equipment used in shoreline mapping



Constructing an artificial marsh

The Department of Resource Management and Policy

The Department of Resource Management and Policy's interdisciplinary research covers the spectrum of basic and applied science on coastal resources. Scientists work closely with estuarine and marine industries, the public, and state and federal agencies to integrate sound scientific principles into the management of coastal resources. Research in the department is conducted by both faculty and professional scientific staff.

Faculty

Carl H. Hershner, Jr. (Chair)
Associate Professor
James L. Anderson
Visiting Professor
John E. Anderson
Research Scientist
Thomas A. Barnard, Jr.
Assistant Professor
Kevin P. Kiley
Instructor
James E. Kirkley
Associate Professor
Maurice P. Lynch
Professor
James E. Perry, III
Assistant Professor

Walter I. Priest, III
Instructor
William G. Reay
Research Assistant Professor
Gene M. Silberhorn
Professor
Dennis L. Taylor
Professor
N. Bartlett Theberge, Jr.
Professor
Arnold F. Theisen
Adjunct Professor

Major Programs

Wetlands Program: This program provides basic and applied research on tidal and nontidal wetlands, with advisory support and outreach education for local, state, and federal wetlands managers. Current research focuses on methods for assessment of wetland functions, including applications of remote sensing technologies, development of targeting protocols for wetlands preservation and/or creation, and basic ecology of nontidal wetlands.

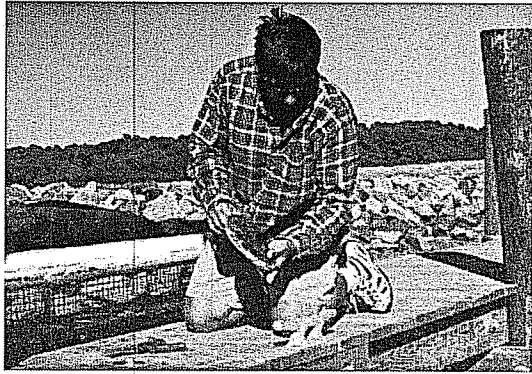
Comprehensive Coastal Inventory Program: Studies focus on inventory and monitoring of wetlands, shorelines and natural/cultural resources in the coastal plain; basic and applied research in Geographic Information Systems; and remote sensing for natural resource management. Current research focuses on development of use suitability analysis protocols, habitat restoration targeting protocols, and watershed level land use planning/management.

Ocean and Coastal Law: Provides graduate educational and advisory support to state agencies and the Virginia General Assembly, and conducts research on resource management issues pertinent to Virginia. Current research focuses on shore zone land ownership issues.

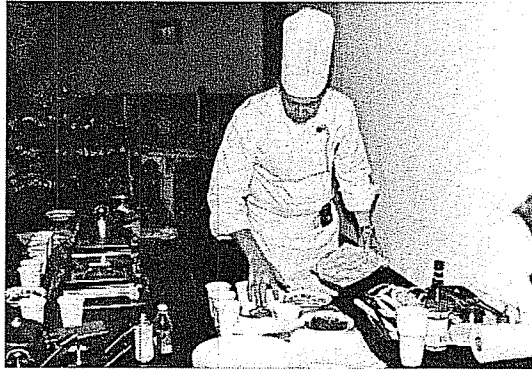
Coastal Ecosystems and Remote Sensing Program (CERSP): Conducts basic and applied research on detection and characterization of changes in the coastal environment. The program emphasizes development of field and remote sensing models and algorithms necessary to assess coastal ecological phenomena such as erosion/deposition, plant community compositional changes, effects on biota, and changes in water quality. CERSP strives to provide an interface between science and policy by ensuring that sound research is followed by development of useful management and policy protocols.

Center for Coastal Management and Policy: This center is an administrative vehicle for managing interdisciplinary projects involving personnel from the Department of Resource Management and Policy, VIMS/SMS, the College of William and Mary, and other institutions.

Coastal Resource Economics: Provides advice and conducts research on state, regional, national and international fisheries management issues. Special interests include aquaculture, fishery infrastructure assessment, market analysis, and resource valuation. Graduate education and outreach training are offered on topics including application of economic models and management/policy analysis. Ongoing activities include coordination with graduate training in the Schools of Law and Business and the Public Policy Program of the College.



Hooking mortality field experiments comparing conventional and circle hooks



Annual Chefs Symposium at VIMS



Dr. William DuPaul and Georges Bank scallops

Marine Advisory Services/ Sea Grant

Among our mission-specific programs is Marine Advisory Services (MAS). This program, which is heavily supported by Sea Grant, is devoted to public service and economic development with emphasis on maritime industries and K-12 education. The program actively engages VIMS scientists in the promotion of sustainable fisheries, commercial fisheries development, seafood utilization, and marine aquaculture; and provides outreach education at all levels.

Recognizing that subsequent generations of scientists must solve the hitherto unimagined scientific questions of 2020 and beyond, VIMS is playing a leading role in introducing K-12 students to coastal marine science. Educators in the MAS program recently received a grant from the National Ocean Partnership Program to develop a national web-based resource center for marine education: the Virtual Marine Education Center is one mechanism we are using to communicate with primary and secondary school students.

Recently, Marine Advisory Services expanded its traditional outreach education for the blue crab industry by initiating a training program for soft shell crab producers to assist them in complying with newly implemented mandatory federal seafood safety guidelines—Hazard Analysis and Critical Control Point (HACCP). Over half of the 535 licensed soft crab producers in Virginia have participated in these training sessions.

Current Research

Historically productive scallop fishing grounds from New England's Georges Bank to areas offshore of Virginia Beach have been closed due to the concern for finfish stocks or large concentrations of juvenile scallops. On Georges Bank, three areas have been closed to scallop fishing in order to protect groundfish for nearly five years. Only in the past three months, scientists from the National Marine Fisheries Service (NMFS), the University of Massachusetts, Dartmouth and the Virginia Institute of Marine Science (VIMS) conducted an Experimental Fishery (Commercial fishing vessels operating outside existing fishery regulations must obtain an Experimental Fishery permit from the Federal Government.) with six commercial scallop vessels to survey the scallop resources in one of the closed areas as a prerequisite for a larger commercial opening. These six vessels alone landed over \$480,000 worth of sea scallops which contributed \$1.2 million in economic impact to the ports of New Bedford, Massachusetts, Point Pleasant, New Jersey and Hampton, Virginia. Funding for the survey has been provided by the scallop industry and from state and federal sources for survey logistics and data analysis. As expected, large quantities of scallops were found during the survey, and the data is currently being analyzed for the purpose of a commercial opening after July 1999. The opening of the closed areas on Georges Bank will be of tremendous help to the scallop industry both in New England and Virginia. Bill DuPaul, and students Dave Rudders and Dave Kerstetter participated in the survey spending a cumulative total of over 50 days on Georges Bank.

Chesapeake Bay National Estuarine Research Reserve

The Chesapeake Bay National Estuarine Research Reserve (CBNERR) in Virginia, managed by the Virginia Institute of Marine Science, is one of 25 National Estuarine Research Reserves established under the Coastal Zone Management Act. The Research Reserves form a protected area network which serves to promote informed management of the nation's estuarine and coastal habitats through the promotion of research, monitoring and education.

CBNERR participates in the National Estuarine Research Reserves system wide monitoring program. At present two data loggers (one at Taskinas Creek and one at Goodwin Islands) continuously record water quality data, and a meteorological station collects weather and climate data at Taskinas Creek. A second weather station was established at Sweet Hall Marsh in the fall of 1998.

A \$600,000 educational facility is under construction at Taskinas Creek. The Reserve education program is also developing coastal environmental programs for a wide variety of audiences including coastal managers, decision-makers and non-science professionals in the fields of business and law.

CBNERRVA, in cooperation with the York River State Park and funded by a grant from DEQ's Coastal Resources Management Program, is currently planting an extensive array of native and riparian buffer plants, summer grasses other plants as a Native Plant Arboretum. These plantings will highlight native plants that can be used to enhance

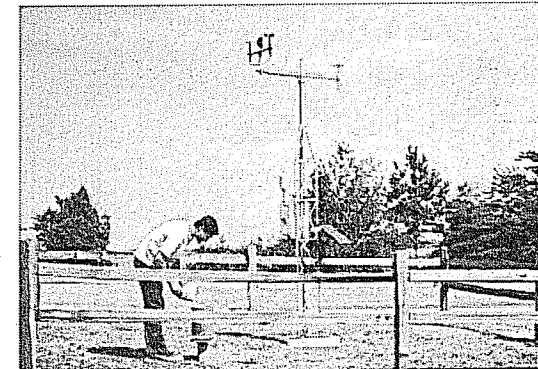
migratory and resident songbird habitat, and provide butterfly habitat. The arboretum will be used to demonstrate native plant uses for conservation plantings, to address erosion control, and will demonstrate a variety of plants to be used under various light and soil moisture regimes.

CBNERRVA has received a grant from NOAA to fully develop, and pilot, a "Coastal Science for Lawyers" program at five sites across the United States. The program is designed to give law students an introduction to basic concepts of coastal science to help them make "informed decisions" as they develop in their professional careers.

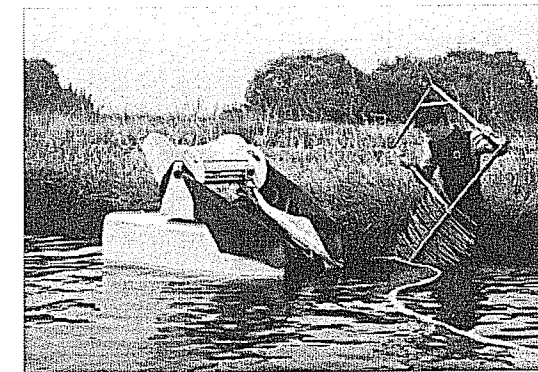
Program Reviewed by NOAA

The Chesapeake Bay National Estuarine Research Reserve in Virginia underwent a review of the past four years of activities in September 1998. The review, mandated under §312 of the federal Coastal Zone Management Act, was led by Ms. Maggie Ernst from NOAA's Office of Ocean and Coastal Resource Management (OCRM). The team interviewed scientists, students and administrators from VIMS, the College of William & Mary, York River State Park, The Virginia Coastal Program, the Virginia Department of Environmental Quality, the Virginia Department of Conservation and Recreation and many individuals outside of government who routinely interact with the Research Reserve.

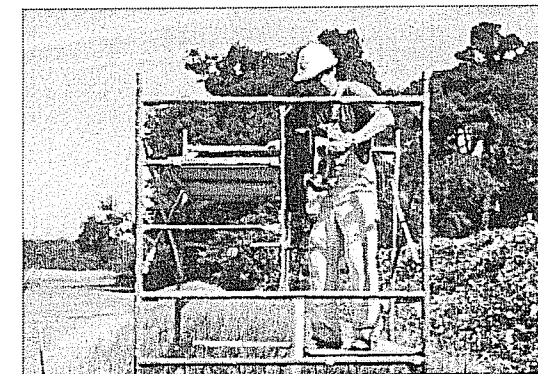
The review team was pleased with the performance of the program over the past four years, particularly the efforts of Research Reserve staff to encourage and support student research in its sites. A formal report of the visit is expected early in 1999.



Taskinas Creek meteorological station

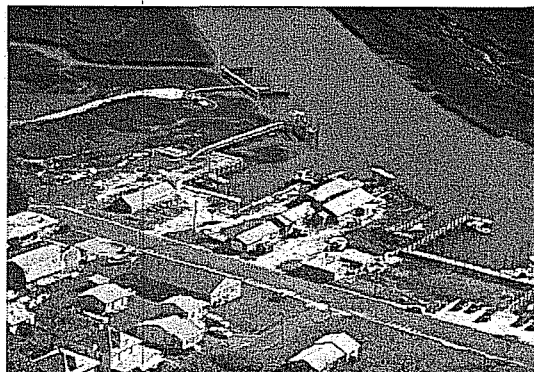


Net boat for catching large fish

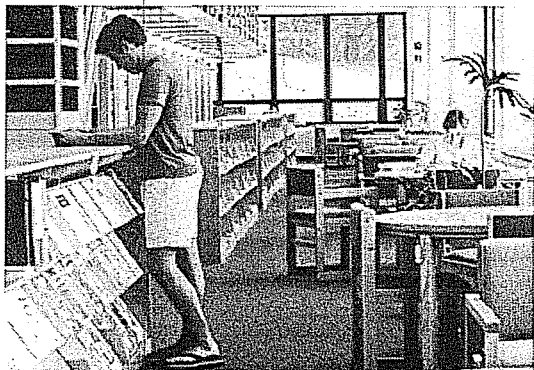


Eastern Shore groundwater work

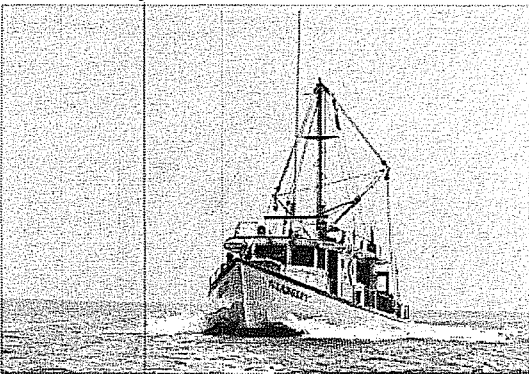
Institute Resources



VIMS Eastern Shore Lab



VIMS Library



R/V LANGLEY

Eastern Shore Laboratory

The VIMS Eastern Shore Laboratory (ESL), located in the seaside village of Wachapreague, serves as a field station for research, teaching, and advisory activities. This area is uniquely suited for field research into coastal processes, and provides convenient access to the eastern portion of the Chesapeake Bay and the barrier island, salt marsh-lagoonal systems along Virginia's Atlantic shore.

Existing facilities were recently renovated to establish a quarantine hatchery facility used for a series of experiments on two non-native oyster species. In addition, to providing additional hatchery space for the new Aquaculture Genetics and Breeding Technology Center.

Current research activities include investigations into nitrogen cycling in salt marshes, disease transmission between mollusks, population dynamics of finfish and shellfish, and the chemical induction of settlement in invertebrates. A large-scale research project on habitat restoration of oyster reefs and seagrass beds is continuing. The ESL has also expanded its capabilities in land use patterns in selected watersheds on the Eastern Shore utilizing GIS and digital aerial photography, to relate water quality and living resources in coastal and estuarine marine environments.

VIMS Library

The Library utilizes powerful full-text indexing software, providing more than 738,000 bibliographic records to patrons at VIMS and at the Main Campus. This tool, combined with our Web interface, also gives us a growing presence on the Internet, as we offer a bibliography of 30,000 items on the World Wide Web. We also have a large number of books which are not yet represented in the database. As we add these and acquire other records, our bibliography will continue to grow. Our fine journal collection has remained stable in spite of sharp increases in subscription rates.

Library Holdings:

Periodical Subscriptions: 527

Monographic Titles: 22,650

Bound Volumes (books and periodicals):

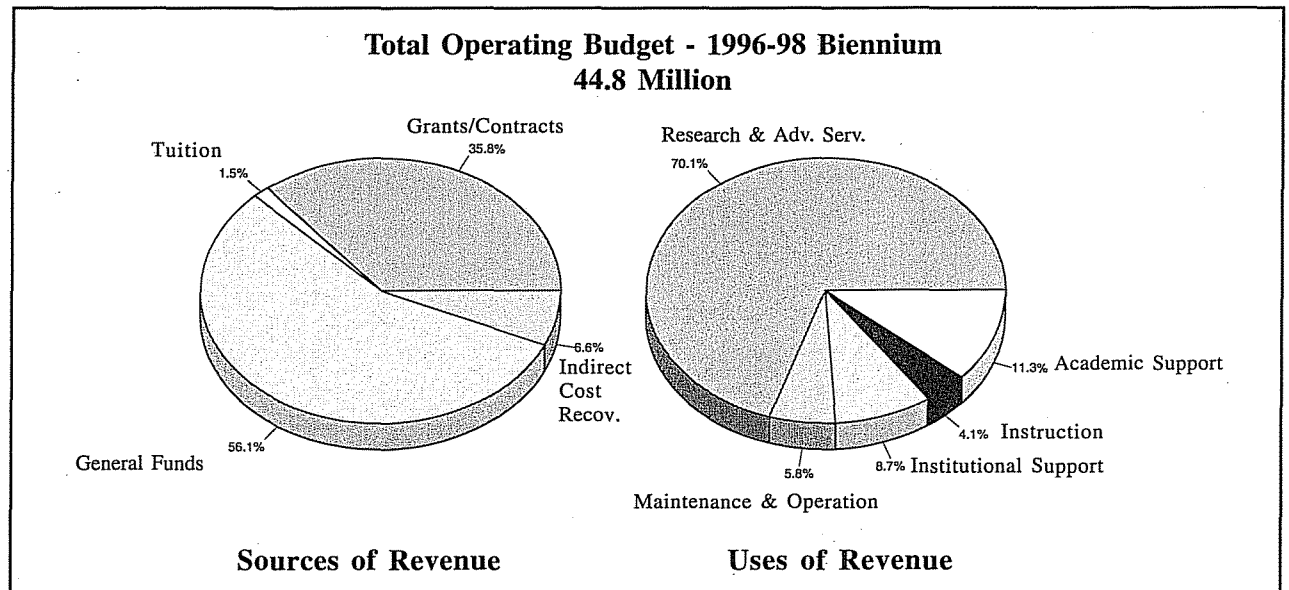
51,868 Maps and Charts: 4,775

Vessels Center

Much of the Institute's field work involves locations within the Chesapeake Bay. This research is generally performed aboard one of VIMS' three larger vessels. These include the 65' R/V *BAY EAGLE* and the 44' R/V *LANGLEY*, both equipped to deploy large scientific equipment, and the 30' R/V *FISH HAWK* specially equipped for trawl survey work. This group of vessels is operated by Coast Guard licensed crews.

1996-98 Financial Activity

The 1996-98 biennium brought both challenge and opportunity to the Institution. Resources were aligned to support the growing research, advisory, and instructional missions while decreasing the portion of the institutional budget allocated to administrative and support services. In addition, several major capital projects afforded VIMS an opportunity to substantially increase and improve research facilities.



VIMS' quest for external support during the 1996-98 biennium emphasized the institution's commitment to the constituencies represented in its tripartite mission: Research, Education, and Advisory Service. Research efforts were worldwide and included studies of the black marlin in the Indian and Pacific Oceans, marine leeches in Australia, and bacteria in Antarctica. Projects such as those describing the marine geology of the Gulf of Bohai and the Noah Yellow Sea and modeling tropical storm surges in Korea expanded the university's horizons and provided opportunities for international collaborations.

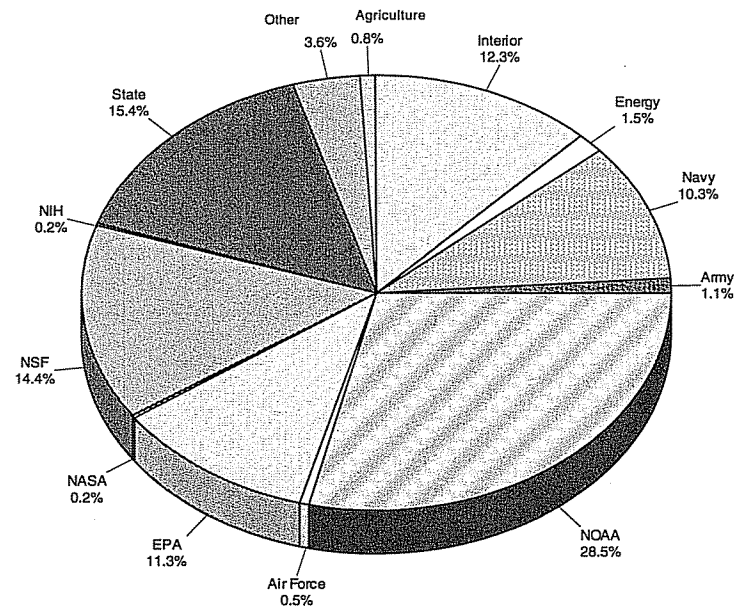
In Virginia, VIMS continued to address issues facing the Commonwealth's recreational and commercial fishing communities and worked to design and implement intense research and monitoring programs to address the challenges brought by the proliferation of harmful algal species such as *Pfiesteria piscicida* in the waters of the Chesapeake Bay.

Between 1996-98, the VIMS Office of Sponsored Program managed external awards totaling \$43,221,595; expenditures exceeded \$15.8 million; 457 proposals solicited more than \$48 million in funding.

Active Grant & Contract Awards

Biennium	# Awards	Award Total
1988-90	402	\$21,749,437.
1990-92	467	26,371,507.
1992-94	542	31,829,435.
1994-96	601	38,971,981.
1996-98	746	43,221,595.

Total Grant/Contract Expenditures 1996-1998 Biennium



Agency	Millions
NOAA	\$4.54
State	\$2.45
NSF	\$2.28
Navy	\$1.63
Interior	\$1.95
EPA	\$1.79
Other	\$0.57
Energy	\$0.24
Army	\$0.17
Agriculture	\$0.13
Air Force	\$0.08
NASA	\$0.04
NIH	\$0.03

Donor Information

Private gifts play an increasingly important role in the quality and availability of research, education and outreach programs at VIMS. In the 1998 fiscal year, more than \$656,000 was contributed by corporations, foundations, graduate alumni and friends of the Institute. This represents a 16% increase over 1997 fund totals with a 40% increase in the number of donors. Corporate gifts represented 20% of the total, foundations 20% and the remaining 60% was contributed by individuals. Approximately 78% of the funds were for restricted purposes.

Pathfinders

VIMS is pleased to recognize the following individuals, corporations and foundations that have generously supported its work with lifetime gifts of \$100,000 or more.

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Norfolk Southern Foundation
Moses D. Nunnally Charitable Trust
Elis Olsson Memorial Foundation
Mr. and Mrs. Alan M. Voorhees

The Maury Society

Named for Matthew Fontaine Maury, the "Pathfinder of the Seas," the Maury Society recognizes donors who make an annual gift of \$1,000 or more. This group of dedicated patrons helps VIMS to continue Maury's tradition of scientific discovery.

Bay Eagles (\$10,000 +)

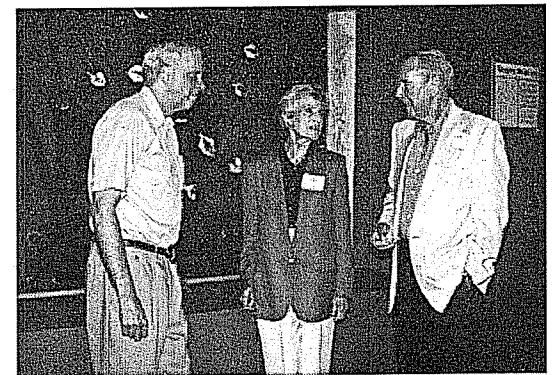
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Dedication of CBH plaza



Presentation of Amoco minority scholarship award



Dr. Wright with Mr. and Mrs. John P.D. Kauffman

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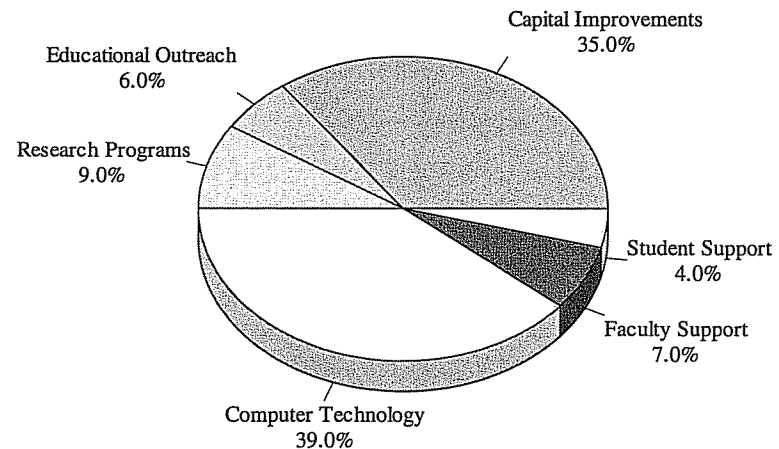
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**How are donations used?
 FY98 Private Gift Designations**



Publications

Journal and Book Contributions

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