Into the 21st Century...

Marine Science for Virginia, The Nation and the World

Virginia Institute of Marine Science
School of Marine Science
College of William and Mary
Our Changing Marine Environment

Coastal marine environments are changing constantly in response to nature and man. Estuaries and coastal zones are profoundly influenced by weather, tides, currents and land-based activities. Understanding the numerous processes affecting these fragile but highly productive environments is increasingly important. Sound, timely research provides the vital link between preserving marine resources and maintaining sustainable marine-based economies.

Estuarine waters provide protected habitats for spawning as well as nursery areas for juveniles of many species.

More than 60 years ago, Dr. Donald W. Davis, of the College of William and Mary, championed the need for marine science research in Virginia. His dedication and persistence led to the establishment of the Virginia Fisheries Laboratory in 1940. The Laboratory was charged with an unusual tripartite mission to provide research, education and advisory service in marine science. From this evolved the College of William and Mary's Virginia Institute of Marine Science and its graduate education component, the School of Marine Science (VIMS/SMS).

The unique mission provided a framework for the development of an institute rich in scientific inquiry and scholarship enhanced by synergistic connections with marine industries, policy makers, and regulatory and stewardship agencies.

Today, VIMS/SMS is the largest marine center in the nation focused on coastal ocean and estuarine science.
More than half the world's population lives in the coastal zone.

Why study coastal oceans and estuaries?

Estuaries are bodies of water where freshwater and saltwater mix.

The coastal zone extends from the mouths of coastal rivers to the continental slope—a region varying in width from 20 to more than 100 miles. From tidal marshes to mud flats, to coastal waters in Antarctica, Institute researchers are actively involved with marine scientists world-wide seeking solutions to problems that are unique to the coastal zone.
The Institute's 450 scientists, technicians, graduate students, and staff push the boundaries of modern marine science, seeking new solutions to challenges facing our marine resources today.

Advancing the Frontiers of Marine Science

The 35-acre main campus in Gloucester Point, Virginia is situated near the mouth of the York River, with easy access to tributaries extending inland, the Chesapeake Bay and Atlantic Ocean. A second campus, the Eastern Shore Laboratory located in Wachapreague, Virginia, borders salt marshes, barrier beaches, embayments and the coastal ocean. These sites provide rich living laboratories for research in all aspects of coastal ocean and estuarine science.
The Institute maintains a fleet of more than 36 vessels outfitted with a variety of special instruments needed to support diverse areas of coastal and estuarine research.

Understanding and evaluating complex marine ecosystems requires knowledge from many scientific disciplines. As increased technology and development place additional pressures on marine environments, sound, basic research remains necessary to develop reliable, practical solutions for long-term resource management.

The role of the Institute is to provide objective information based on sound scientific inquiry to assist policy makers, regulatory agencies and industry in managing and developing marine resources.
The Institute's strength lies in its diverse faculty and its commitment to interdisciplinary research. Research and academic programs are based in five departments. Scientists within each department are drawn from a variety of interacting disciplines. Departmental research addresses both basic research aimed at gaining new knowledge and applied research seeking practical solutions to current issues and future problems.

Research and academic departments:
- Biological Sciences
- Environmental Sciences
- Fisheries Science
- Physical Sciences
- Resource Management and Policy

"The work . . . is not to render judgement unnecessary, but to provide a significant basis of information on which more reliable judgement may be based."

Dr. Donald W. Davis, Founder of VIMS
Science
October 24, 1930
Interdisciplinary Research

At VIMS, a team of benthic ecologists, marine geologists, physical oceanographers and computational modelers are examining the movement and life-span of contaminant particles in estuarine and coastal waters. Benthic (bottom dwelling) organisms, currents and tides play important interrelated roles in this process. Sediment records provide insight into what happened in the past. To enhance data-gathering, VIMS scientists have developed and built an underwater video sediment-profile camera. The camera's image is so highly defined, that individual sand grains are visible. Scientists compile data to build models that simulate probable reactions within defined parameters.
Core Research Programs

The Institute's Core Research Programs are designed to provide basic scientific information critical to wise management of the coastal zone and its living resources. They will evolve to meet emerging issues. Scientists from various disciplines provide research to support related aspects of each program. These programs are allied closely with the graduate education and advisory programs. Currently there are eleven core research areas.

Aquaculture

Aquaculture development includes industry expansion; improvements in economic efficiency; and product enhancement and diversification. VIMS/SMS has pioneered successful programs in hard clams, oysters and bay scallops, with research in hatchery technology and grow-out strategies. Current and future efforts are focused on the biology of new species for shellfish and finfish aquaculture, with emphasis on genetics and breeding programs, disease control, domestication of brood stock, and a well-defined technology transfer program.
Environmental Risk Assessment and Management
These studies provide the data required to make decisions concerning resource management practices.

Risk assessment studies enable scientists to estimate the probability of an effect resulting from exposure to something under specified conditions. A substantial amount of data must be acquired through careful research for these studies to provide reliable estimates of risk.

Shoreline and Wetlands Processes and Management
In the face of rapid development, wetlands and shoreline process research provides essential information on status and trends as well as practical management methods. A key element is the capacity to translate technical information into practical guidance for resource managers, local and state agencies and involved citizens.
Fisheries Stock Assessment, Population Dynamics and Management

Accurate stock assessment is critical for wise management of all living marine resources. Integrating knowledge of finfish and shellfish communities, population genetic structures, aging and reproductive processes, disease and response to anthropogenic factors is necessary to develop sound, long-term management strategies.

Ecosystem Processes and Modeling

Computer modeling enables scientists to integrate diverse sources of information to build a visual image that simulates the behavior of principal components and processes in an ecosystem. VIMS/SMS initiated a program in 1991 to study estuarine environments, integrating emergent and submerged vegetation, water column-benthic exchange, plankton processes and chemical fluxes to produce effective predictive models of ecosystems.
Disease Research and Marine Biotechnology

Understanding natural disease processes, host/parasite interactions, and the effects of pollutants in living marine resources is essential for successful management. Recent advances by VIMS/SMS include the continuous in vitro culture of oyster pathogens and the development of molecular probes for the diagnosis of pathogens. One expanding new area of research is the relationship between pollutants and diseases in fishes and oysters.

Water Quality Monitoring

Water quality is generally described in terms of chemical and biological characteristics. Monitoring conditions in the water column helps scientists understand the underlying processes. Ultimately, researchers are working to simulate these processes and build predictive models that can guide water quality management programs. Equally important, modeling identifies serious knowledge gaps and provides insights into the relative importance of different processes.
Material Fluxes and Fates
This program examines the transport, transformation and ultimate fate of materials, especially contaminants, as they move from land or from streams and rivers through estuaries to the coastal ocean and across the continental shelf to the deep sea. Research also addresses broader questions of fluid, sediment and larval transport, and the processes involved in exchange across the air-water interface. The X-ray radiograph at right demonstrates the importance of biological activity in materials being cycled in the upper few centimeters of the sea bed.

Benthic Biology
The diverse invertebrate communities that live on or in the benthic layer—the interface between the water and the upper levels of sediment—play a vital role in marine ecosystems. Understanding these complex communities is essential to predicting responses of estuarine areas to anthropogenic disturbances and global climate change. Much of the research activity in benthic biology is directed at understanding how the benthos function in the context of estuarine processes. For example, how benthic dynamics affect the abundance of crabs, finfish and shellfish, and the regeneration of nutrients.
Plankton and Nutrient Dynamics
Minute plant and animal life—phytoplankton and zooplankton—play critical roles in the food web. In estuarine systems from the Antarctic to Chesapeake Bay, plankton activity is closely related to benthic processes and reproduction activities of higher level species. Plankton are dramatically affected by anthropogenic activities, and some can be used as environmental indicators. Understanding the processes that govern their lifecycle, therefore, is critically important.

Resource and Habitat Status and Trends
Most of the Institute’s ongoing and future efforts to understand the nature and causes of environmental changes over time, as well as our ability to predict or anticipate future outcomes depends on the acquisition and analysis of long-term data sets. This accurate, objective information is essential to all programs at the Institute and is of great value to scientists in other agencies and institutions as well as to resource managers.
The School of Marine Science (SMS) is a professional graduate school of the College of William and Mary. The school awarded its first masters degree in 1943 and inaugurated a doctoral program in 1964. The SMS has awarded advanced degrees to more than 500 marine scientists. Graduates find work in research, education, management and regulatory agencies at the local, state and federal level, and in the corporate and private sectors.

Currently 130 graduate students are working toward degrees in the school. Students are drawn from colleges and universities nationwide and international students make up 12% of the student body. Successful completion of the degree program includes a research-based thesis or dissertation.

Students maintain a primary affiliation in one department, but cross-over and interdisciplinary studies and research are encouraged and accommodated.
Students have full access to the School's diverse and dynamic faculty, advanced scientific technology, and to additional resources available through the College of William and Mary's university system. Required core courses provide a comprehensive base of knowledge in various marine science disciplines.

The quality of the school's educational program is reflected in the number of grants and stipends awarded to students. These include awards from the National Science Foundation, National Oceanic and Atmospheric Administration, EPA, Office of Naval Research, and Department of Education as well as many private foundations and organizations. SMS students are regularly honored for outstanding presentations at national and international scientific meetings.
The Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA) manages 4,435 acres at 4 sites. CBNERRVA provides study sites for estuarine research, outdoor "classrooms," and ecology presentations.

Sharing Knowledge for Greater Discovery

VIMS faculty, students and staff, in fulfilling the advisory service role of the Institute, provide accurate information, objective analysis and advice on marine related issues to meet the needs of government, industry, educational groups and the general public. In partnership with commercial and recreational fishermen, the seafood industry, local, state and federal governments, and development groups, scientists seek solutions to problems and ways to enhance economic development.

Through the Sea Grant Marine Advisory Program, Bay Team teachers provide educational material and classroom programs for K-12 students in Virginia. The VIMS aquarium and touch tank offers educational programs to adults and students.
Scientists work closely with the commercial fishing industries in areas such as fisheries economics, gear selectivity and bycatch, and aquaculture development.

Scientists demonstrate sophisticated Global Positioning Systems (GPS) technology to resource managers, developers, engineers and interested citizens. Educational seminars and workshops on technology utilization, botany and shoreline protection methods are provided through the Wetlands Program.

Marine recreational industry programs include boating safety, tag and release programs for the recreational fisherman, cold water survival, and marine business management.
Looking to the 21st Century

Today, 50% of the world's population lives in the coastal zone. It is estimated that by 2010, 75% of the U.S. population will live within 50 miles of a coast. The implications are clear: we must recognize that the problems facing coastal zones are global, not regional, and we must balance our needs against our resources.

With a long history of experience and expertise, VIMS is recognized as a world leader in coastal and estuarine science. The Institute's dedication to innovative research, cutting-edge technology, quality education and industry partnerships will lead international coastal ocean and estuarine research into the next century. Remaining in the forefront of the worldwide community of marine science is crucial to assuring a healthy future for all coastal ocean and estuarine ecosystems.
With your help, the College of William and Mary's Virginia Institute of Marine Science/School of Marine Science can continue to advance knowledge and discovery in marine science.

As a VIMS Associate you can become part of the Institute’s continuing efforts to seek solutions that will benefit us all.

Information on current research, faculty profiles, weekly seminars, educational programs, and internships is available on the Internet at http://www.vims.edu.

For additional information, contact the Development Office at (804) 684-7099.

VIMS/SMS has a long history of excellence and innovation in marine science. Today, the Institute is poised to assume an even greater leadership role as we move into the 21st century.