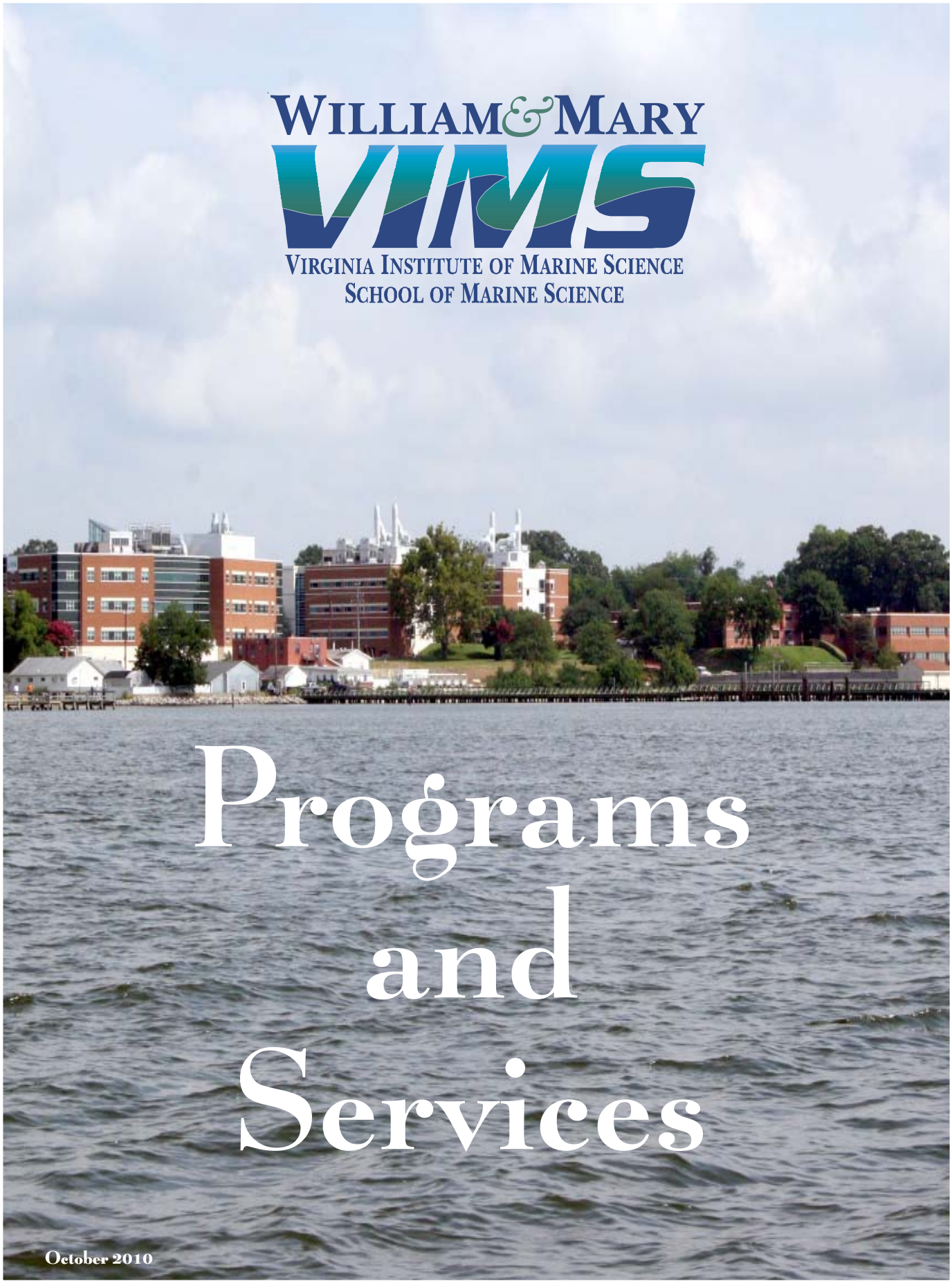
WILLIAM & MARY
VIMS
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE
Programs
and
Services
October 2010

Table of Contents

The Virginia Institute of Marine Science (VIMS), founded in 1940 as the Virginia Fisheries Laboratory, has grown to become one of the nation's largest marine science centers focused on coastal and estuarine research. In addition to the 40-acre main campus at Gloucester Point near the mouth of the York River, VIMS operates the Kauffman Aquaculture Center on the Rappahannock River and a campus at Wachapreague on Virginia's Eastern Shore. Each campus is strategically located to provide rich living laboratories for research and teaching and easy access to Chesapeake Bay, its tributary rivers and surrounding wetlands, and to the coastal ocean.

VIMS is unusual in its melding of three essential public functions: advisory and outreach services, basic and applied research, and formal and informal education. The strengths of the Institute are in its diverse faculty, interdisciplinary approach to complex scientific questions, and provisions of practical solutions to problems in the marine environment. VIMS fosters an approach that encourages and facilitates synergistic interactions among its core disciplines that focus on scientific problems that range widely in scale from global to molecular. Much of the work at VIMS is directly applicable to current and emerging management and policy issues that are important to the State's economy and to the health and sustainability of the Commonwealth's natural resources.

With over 500 employees (350 scientists, technicians and students), the Institute is large enough to assemble a competitive multidisciplinary research team from within the VIMS community. Nearly every marine science discipline and sub-discipline is represented on the faculty, including marine biology and ecology, marine geology, marine chemistry and geochemistry, physical oceanography, computer modeling, aquaculture, genetics, immunology, toxicology, and coastal management and policy. Examples of current programs of research and advisory service are in areas of water quality, benthic habitat, phytoplankton ecology, shellfish and finfish diseases, fisheries stock assessment, estuarine processes, shoreline evolution, numerical modeling, sediment transport, contaminant monitoring, risk assessment, ocean observing system technology, polar oceanography, and global climate change.

VIMS is organized into four academic departments (Biological Science, Fisheries Science, Environmental and Aquatic Animal Health, and Physical Sciences) and two mission-oriented centers (Aquaculture Genetics and Breeding Technology Center; Center for Coastal Resources Management). The institution has a strong network of research collaborations with universities and management agencies throughout the nation and formal partnerships with universities around the world. Several Federal programs serving the Commonwealth are administered through the Institute including the Chesapeake Bay National Estuarine Research Reserve, Virginia Sea Grant, and the Cooperative Marine Education and Research Program of the National Marine Fisheries Service. We are working to establish and expand our interactions with private industry thereby extending the scope of our research and advisory outreach and contributing to the area's economic development.

VIMS aspires to be, and indeed in many respects is, a world-renowned center of excellence in marine science, attracting the very best students and scholars in the nation; expanding the frontiers of knowledge through research and discovery; and, making an impact on the state, nation and the world by sharing and applying this knowledge. The elements of world class scholarship require that VIMS 1) address cutting edge scientific questions, 2) develop and apply technologically-advanced approaches to these questions, 3) communicate research results and new technologies to both professional and public audiences, 4) provide consultative assistance to facilitate the application of new knowledge to practical problems, and 5) train future generations of young scientists to continue this tradition.

John T. Wells
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Virginia Institute of Marine Science Foundation Board of Directors

Incorporated in 2000 as a 501 (c) (3) non-profit organization, the VIMS Foundation was created to support the mission of VIMS and the School of Marine Science.

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Virginia Institute of Marine Science Council

Established in 1982, the Virginia Institute of Marine Science Council is an advisory and supportive body composed of business and industry leaders as well as private citizens interested in the continuing vitality of VIMS.

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Thomas Blackburn
Carroll W. Owens, Jr.
W. R Phillips, Jr.
James E. Rogers
Mr. George W. Roper, II
Mr. Robert P. Roper, Jr.

Watermen's Hall

VIMS Campus Locations

Memoranda of Agreement

★ East China Normal Institute in Beijing; ★ Korea Ocean Research and Development Institute; ★ University of China;
★ New Zealand Institute of Water and Atmospheric Research; ★ Tasmanian Aquaculture and Fisheries Institute;
★ University of Wales, Bangor

Programs and Faculty

Biological Sciences

www.vims.edu/bio

Faculty

Kenneth A. Moore (Chair), Professor
Iris C. Anderson, *Professor*
Donna M. Bilkovic, *Research Assistant Professor*
Mark J. Brush, *Assistant Professor*
Robert J. Diaz, *Professor*
J. Emmett Duffy, *Loretta and Lewis Glucksman Professor*
Marjorie A. M. Friedrichs, *Research Associate Professor*
Carl H. Hershner, Jr., *Professor*
Mark W. Luckenbach, *Professor*
Robert J. Orth, *Professor*
Mark R. Patterson, *Associate Professor*
James E. Perry, III, *Professor*
Linda C. Schaffner, *Professor*
Rochelle D. Seitz, *Research Associate Professor*
Walker O. Smith, Jr., *Professor*
Deborah K. Steinberg, *Professor*
Kam W. Tang, *Robert F. and Sara M. Boyd Term Distinguished Associate Professor*

The Department of Biological Sciences includes a diverse group of biologists working in a range of research areas from biogeochemical cycling to physiological, population, and community ecology to whole ecosystem modeling using state-of-the-art approaches. Scientists in the department study benthic nektonic and planktonic organisms and the temporal and spatial patterns and processes that control their distribution and ecological functioning in estuarine, coastal and open ocean regimes.

Major Programs

Antarctic Oceanography

The Antarctic continent and the Southern Ocean together regulate the Earth's weather, and the Southern Ocean, a major component of the planetary carbon cycle, is a key engine of global climate change, a source of rich fisheries, and haven for marine birds and mammals. VIMS/SMS programs provide an opportunity for graduate and undergraduate students to live and work in the Antarctic and on icebreakers; and to carry out research on production, nutrient cycling, organic matter diagenesis and ecosystem change. VIMS researchers work primarily in the Ross Sea (McMurdo Station) and the West Antarctic Peninsula (Palmer, Antarctica Long Term Ecological Research site). These programs also emphasize public education and outreach as important components of our work.

Benthic Ecology & Biodiversity

Studies focus on the processes governing structure and functioning of benthic communities, and ecosystems. Current research includes: experimental and observational studies of recruitment, growth, and production; role of benthic organisms and communities in the fate and transfer of nutrients, organic matter, energy and sediments; effects of natural and anthropogenic disturbances on benthic community structure and functioning; consumer-prey relationships and benthic support of higher trophic levels; systematics and biodiversity of benthic animals and evolutionary ecology. Scientists in the department employs diverse research approaches including molecular genetics field experimentation biogeochemical analyses, remote sensing and a range of modeling techniques. Most research focuses on benthic systems of the land-sea margins, including tidal freshwater, estuarine and coastal regions, and coral reefs.

Biological Oceanography/Plankton Processes

Research is focused on biological populations and processes as integral components of the

dynamic, interconnected marine biosphere that provides half the food and absorbs half the anthropogenic carbon dioxide on the planet. Our research emphasis is on lower trophic levels in estuarine, coastal and oceanic foodwebs, including bacteria, phytoplankton, micro-, meso- and gelatinous zooplankton, harmful algal blooms and marine snow. Processes studied in all ecological provinces of the global ocean include fluxes of carbon and nitrogen between the various organic and inorganic pools, nutrient limitation, organic matter (dissolved and particulate) cycling, and biogenic trace gas production and consumption. The biotic processes regulating these transformations, the physical mixing and circulation mechanisms affecting their transport and redistribution, and the linkages and feed backs between the water column and all its boundaries (benthos, atmosphere, land margins) are emphasized. Collaborative research aimed at understanding the links between plankton dynamics and recruitment of economically important fisheries populations is also pursued.

Ecosystem Modeling

The ecosystem modeling program develops and employs numerical simulation models as integrative and synthetic tools for ecosystem analysis to address basic science and applied management questions. Current efforts include modeling studies of coastal and watershed carbon and nutrient cycling, estuarine eutrophication, submerged aquatic vegetation, multispecies trophic interactions, regional ocean ecosystem models and climate-related ecosystem changes. Studies involving optimal methods for combining in situ and satellite-based biological data with numerical models are also ongoing. Working with hydrodynamic, fisheries, and water quality modelers, an over-arching goal of the program is to develop cross- disciplinary models that address both basic and applied ecological research questions.

Macrophyte Ecology

Studies in this program concentrate on submerged and emergent macrophyte species that dominate shallow subtidal and intertidal marine, brackish, and freshwater areas. Current research includes studies on plant distribution and abundance, restoration ecology, plant dispersal mechanisms, plant responses to environmental variability, plant growth and productivity, carbon and nitrogen cycling, plant-herbivore interactions and ecosystem simulation modeling. The program encourages multi-investigator and multi-institutional collaborative efforts.

Nutrient Cycling

Studies focus on the fate of nutrients in benthic and pelagic ecosystems and on the role they play in regulating primary and secondary production. Nutrient cycling is studied in habitats ranging from intertidal marshes and mudflats to shallow subtidal, littoral zone systems, coastal embayments, riverine systems, large estuaries such as Chesapeake Bay, and to the coastal ocean including that adjacent to Antarctica.

Facilities and Equipment

The department is well equipped with state-of-the-art equipment for conducting field and laboratory research, including laboratories in the recently completed Andrews Hall. Major facilities include several light-, temperature- and humidity-controlled environmental chambers, a greenhouse with running seawater and temperature controlled tanks for aquatic macrophyte photosynthesis-related studies and plant restoration work, an expansive wet laboratory facility completed in Fall 2007, and a large array of flow-through seawater mesocosm tanks. Laboratory instrumentation includes gas chromatographs fitted with various detectors, high performance liquid chromatograph, infrared gas analyzer, elemental analyzer, scintillation counter, a Lachat auto-analyzer for nutrient analyses, computer-assisted image analysis hardware and software, biosafety hoods, fluorometers,

spectrophotometers, various microscopes including access to electron microscope facilities, a Coulter Altra flow cytometer, a FLOWCAM imaging cytometer, Total Organic Carbon and Total Nitrogen analyzer, Elzone particle counter/sizer, and microelectrode microprofiler.

An excellent assortment of field sampling gear is maintained by the department. Bottom samplers include an assortment of box corers; grab samplers, and piston-type corers. Sediment-profile and surface cameras as well as a bottom sled with profiling plow, video, and still photography capabilities allow rapid bottom mapping. A variety of nets are available for plankton sampling. A Fetch-class Autonomous Underwater Vehicle (equipped with CTD, 600 kHz sidescan sonar, underwater video, fluorometer/turbidity sensor, and fast response dissolved oxygen sensor), a vertical profiler and towed sensor packages including a towed undulating vehicle along with a variety of data sondes, fluorometers, dissolved oxygen sensors allow continuous, under-way and fixed station monitoring of riverine and estuarine water quality. The department also has access to state-of-the-art facilities for molecular genetic analyses, including automated DNA sequencers and environmental chemistry laboratory facilities.

The Department of Biological Sciences maintains close contacts and shares instrumentation with the other departments at VIMS. Also available are computer facilities with support of both Windows and Macintosh platforms ranging from in-lab laptop units, to work stations supporting LANs, to an institute-wide network.

SAV Sea Level Rise Studies

Environmental and Aquatic Animal Health

www.vims.edu/env

Faculty

Howard I. Kator (Chair), *Associate Professor*
Ryan B. Carnegie, *Research Assistant Professor*
Robert C. Hale, *Professor*
Stephen L. Kaattari, *CSX Professor*
Michael C. Newman, *A. Marshall Acuff, Jr. Professor*
Kimberly S. Reece, *Professor*
Jeffrey D. Shields, *Professor*
Michael A. Unger, *Associate Professor*
Peter A. Van Veld, *Associate Professor*
Wolfgang K. Vogelbein, *Professor*

The dominant mission of the Department of Environmental and Aquatic Animal Health is to identify and affect the health of important aquatic organisms and surrounding human populations. Our research emphasizes understanding the fates of contaminants and pathogens in estuarine and marine environments and their effects on important species as well as humans. A diverse faculty consisting of environmental chemists, toxicologists, ecotoxicologists, biochemists, immunologists, microbiologists, molecular geneticists, and pathobiologists collaborate to achieve these goals. Research questions are pursued at all levels of biological organization from the molecular and cellular to the organismal and population levels. Our activities reflect a strong commitment to provide technical support to environmental managers and stakeholders who regulate and protect the waters and natural resources of the Commonwealth regional and federal management agencies, and marine-related industries.

Major Programs

Environmental Chemistry

Research addresses the sources, transport, fate, bioavailability and impacts of contaminants in marine and estuarine systems. Some recent efforts include the behavior of anti-foulants, use of geographic information systems (GIS) for modeling spatial distributions of environmental data and development of environmentally friendly analytical procedures. Emerging contaminants are a particular interest. The faculty collaborates with international researchers, federal and state agencies (e.g. EPA, NOAA, DOE, and VA Dept of Environmental Quality VA Dept. of Health) and private industry. Recent student research has examined the binding of pesticides to natural organic matter and subsequent impact on bioavailability and toxicity; bioremediation of tributyltin-contaminated sediment in a created wetland; factors influencing the degradation rate of crop protectants in natural waters; the utility of supercritical fluid extraction for the determination of flame retardants in fish.

Environmental Microbiology

This program studies indicator or pathogenic microorganisms in waters used for recreation, aquaculture, and shellfish industries. Research includes development and validation of new methods for detection of microorganisms of human health significance in marine environments, and studies to understand processes that contribute to eutrophication and microbial contamination of receiving waters. A particular strength of this program is multidisciplinary research on microorganisms that are pathogenic to fish.

Toxicology

Effects of toxic chemicals in water and sediment are measured at the molecular to population levels. Endpoints include 1) uptake and elimination of pollutants by individual organisms, 2) vital processes (mortality, growth, reproduction), and 3) mechanisms of internal distribution,

biotransformation, and clearance of hazardous chemicals. Molecular, cellular, and whole organism responses are being evaluated as a basis for predicting population effects at sublethal concentrations.

Diseases of Marine Animals

Research in this field 1) focuses on infectious and noninfectious diseases of fish and shellfish, 2) determines the mechanism(s) by which pathogens cause disease in the host organisms, 3) examines pathological consequences of exposures of estuarine animals to contaminants, 4) studies etiology and epidemiology of pathogens in estuarine and marine organisms, 5) investigates host defense mechanisms in order to develop diagnostics, therapeutics and vaccines for use in aquaculture, and 6) seeks to understand the impact of toxic materials on disease processes. The pathobiology group has developed an Aquatic Animal Disease Diagnostic Laboratory using modern histological, microbiological, immunological, and molecular techniques to study diseases in shellfish and fish. Additional studies focus on marine genomics and disease mechanisms, molecular phylogenetics, population genetics and the development of molecular diagnostics for pathogens.

Molecular Genetics

Studies focus on genomic analyses of marine and estuarine animals and pathogenic organisms. Environmental water quality studies involve molecular detection, identification and examination of the effects of environmental parameters on harmful algal bloom (HAB) organisms and human pathogens. Phylogenetic, population genetic, and genomic research targets shellfish, finfish, as well as parasites and quatic pathogens.

Environmental Risk Assessment

Risk 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 that will improve environmental management by allowing resource agencies to focus their limited resources on those issues of greatest importance.

Facilities and Equipment

Laboratories of the Department of Environmental and Aquatic Animal Health are located in Chesapeake Bay Hall and in new facilities in Andrews Hall. The Department laboratories in Chesapeake Bay Hall are equipped with state-of-the-art instrumentation for studies on environmental chemistry, toxicology, immunology, electron microscopy, pathobiology, and microbiology.

Analytical instrumentation is available to identify and quantify a wide range of organic and inorganic contaminants in water, sediment and biota. This allows faculty and students to develop new analytical methodologies, detect emerging contaminants and track pollutants in the environment at trace levels. For example, an atomic absorption spectrophotometer is available for measuring heavy metals at low ambient concentrations. Gas chromatographs, high performance liquid chromatographs, mass spectrometers and enhanced solvent extractors are maintained for the determination of organic pollutants.

Genetic and molecular analyses of pathogenic organisms are performed using DNA sequencers, PCR thermal cyclers, a real-time PCR system and associated electrophoretic and imaging equipment. State-of-the-art electron microscopes allow identification of microorganisms (e.g. *harmful algae*) and ultrastructural analysis of diseased organisms, supplementing traditional light microscopy.

Instrumentation is available for sophisticated research on enzyme systems that play a role in detoxification of chemicals and lipids that are involved in accumulation of hydrophobic chemicals and in resistance to some disease organisms. The immunology laboratory has the capability to produce monoclonal antibodies for a variety of antigens.

A new 43,000 square foot Seawater Research Laboratory (SRL), the largest in the nation, provides increased space and substantially expanded opportunities for toxicant and pathogen challenge studies and includes a Level 3 biosafety facility. The facility has flowing seawater, several configurations for aquaria, heated and chilled lines for temperature control and separate laboratories for quarantines.

The present facilities and equipment available in the department are described in more detail on the departmental website.

Testing for *Perkinsus*

Fisheries Science

www.fisheries.vims.edu/

Faculty

John E. Graves (Chair), *Chancellor Professor*
Standish K. Allen, Jr., *Professor*
Richard W. Brill, *Affiliate Faculty*
Mary C. Fabrizio, *Associate Professor*
Eric J. Hilton, *Assistant Professor*
John M. Hoenig, *Professor*
James E. Kirkley, *Professor*
Robert J. Latour, *Moses D. Nunnally Distinguished Associate Professor*
Romuald N. Lipcius, *Professor*
Roger L. Mann, *Professor*
Tracey T. Sutton, *Assistant Professor*
Michael Vecchione, *Adjunct Professor*

Research within the Department of Fisheries Science is focused on understanding the population dynamics and biology of fish, crab, and mollusc species of commercial, recreational and ecological importance. Also included within the research framework of the department is the Aquaculture Genetics and Breeding Technology Center. Collaborative research and teaching efforts are common among department faculty. In addition to furthering knowledge through peer-reviewed publications, members of the department advise local, regional and national resource management agencies and involve students directly in fisheries management. The department also maintains an internationally recognized collection of alcohol-preserved and skeletal specimens of fishes that are available for student research.

Major Programs

Anadromous Fishes

Research and monitoring of the abundance, reproductive ecology, life history and exploitation of highly migratory marine species such as striped bass, Atlantic sturgeon, river herrings and American shad that spawn in fresh water. Studies include monitoring commercial and recreational landings, monitoring stock status with fishery-independent surveys, developing novel approaches to stock assessment, conducting surveys of juvenile abundance, mark/recapture and telemetry methods for estimation of fishing rates and description of migratory behavior.

Aquaculture Genetics & Breeding Technology Center

Research includes development of brood stocks in shellfish species of interest to Virginia and the region, including selective breeding (especially for disease resistance), chromosome set manipulation, and evaluation of non-native species.

Commercial Fisheries Development

Research is focused on gear selectivity and bycatch as well as management and regulatory strategies for seafood production, processing and utilization.

Crustacean Ecology

Investigations address the ecology, population dynamics, and conservation of the blue crab in Chesapeake Bay and spiny lobster in the Caribbean.

Deep-Sea Ecology

Research focuses on oceanic ecosystems with emphasis on community structure, trophic dynamics, biophysical coupling and ecosystem functioning with emphasis on deep-sea fishes and their prey. Current projects include studies of the deep Atlantic, Pacific and Southern Oceans.

Fisheries Ecosystem Modeling and Assessment Program

Areas of interest in this program include monitoring of the abundance, predator-prey, and competitive interactions among fish populations within Chesapeake Bay. Primary objectives of the program are the development of multispecies stock assessments for the purpose of understanding the joint impact of harvesting and biological interactions on these populations. Information derived from these assessments is designed to yield advice for ecosystem-based approaches to fisheries management.

Fisheries Genetics

This program 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.

Invasive Species Biology

Research focuses on history and pathways of invasions, the characteristics of invasive species ecosystem impacts, and mechanisms of control, national and international policy relating to introductions, and evaluation and implementation of intentional introductions for ecological and economic purposes.

Marine Conservation Biology

Areas of interest include the ecology and conservation of the blue crab, diamondback terrapin, sea turtles (loggerhead and Kemp's Ridley), Caribbean spiny lobster, queen conch, eastern oyster, and other marine bivalves. Emphasis is placed on metapopulation and source-sink dynamics, marine reserves and dispersal corridors, habitat fragmentation, degradation and loss effects on marine invertebrates, recruitment processes, and predator-prey interactions.

Marine Resource Policy and Fisheries Management

Research is performed to support determination of socially optimal rates of exploitation and optimum allocation of marine resources among competing user groups. Studies emphasize assessment and estimation of net social benefits to society and the economic impacts of proposed management and regulatory options. Additional research focuses on numerous international aspects of marine resource management, including, but not limited to, reducing the capture of sea turtles and other undesirable outputs, enhancing technical and economic efficiency of fishing gear, designing capacity reduction programs, and promoting ecosystem-based management.

Marine Vertebrate Ecology

Research areas of interest include the comparative morphology, reproduction, and population dynamics of sharks; long term changes in the distribution, migration, abundance, ecology and energetics of sea turtles; and investigations of the life history and community structure of finfish taxa.

Stock-Assessment Methodology

Program involves the systematic evaluation of stock-assessment procedures and the development of new mathematical models and statistical methods for studying populations and their responses to exploitation. Tagging, survey, and landings data are used to estimate population size, mortality rates, components of mortality, yield, spawning potential, and effects of changes in fishery regulations. Applications include invertebrates and vertebrates in temperate and tropical sport and commercial fisheries (Hoenig, Fabrizio).

Molluscan Ecology

Studies focus on ecology and stock assessment of estuarine and continental shelf molluscs. Broad program interests include ecology and behavior of molluscan larvae, life history and population dynamics, restoration culture for commercial

purposes, and molluscs as indicators of climate and environmental change.

Stock Assessment Methodology

This program involves the systematic evaluation of stock assessment procedures and the development of new mathematical models and statistical methods for studying populations and their responses to exploitation. Tagging, survey, and landings data are used to estimate population size, mortality rates, components of mortality, yield, spawning potential, and effects of changes in fishery regulations. Applications include invertebrates and vertebrates in temperate and tropical sport and commercial fisheries.

Systematics and Taxonomy

Taxonomically diverse studies focus on the taxonomy, morphology, phylogenetic systematics, zoogeography and evolutionary biology of various vertebrate and invertebrate groups. The program promotes a total evidence approach to phylogenetic research, including molecular techniques and morphological studies of larval, juvenile and adult forms.

Facilities and Equipment

Each research program in the Department has a fully equipped laboratory, collection and sampling equipment, and extensive computer capabilities.

- The Fisheries Science Laboratory has available an Optimas® image analysis system, computerized scale projectors, and a Biosonics® digitizing system to provide automated morphometric measurements, rapid analysis of hard structures for age determination, and automated counting procedures. Automated fish measuring boards and a variety of collections are also available.
- The Crustacean Ecology Program maintains the GEM Lab with two large (1800 gallon) benthic mesocosm tanks monitored by IR-sensitive, computer-controlled cameras with time-lapse image recorders.
- The Bivalve Ecology Program's laboratory is well equipped for physiological and ecological studies with a UV-VIS spectrophotometer, centrifuges, a fluorescence microscope, compound and dissecting microscopes, and an image-analysis system.
- The Fisheries Genetics Program maintains a large laboratory with walk-in cold rooms, and is equipped to perform a variety of genetic analyses. Major equipment includes an automated DNA sequencer, five thermal cyclers, refrigerated centrifuges, ultracentrifuges, a vacuum concentrator, an automated X-ray developer, and several ultra-cold freezers.
- Three wet-lab facilities are available to Department faculty and students. First is VIMS' 43,000 sf Seawater Research Lab (see p.24).The fisheries wet lab contains a flow-through system with several wet tables and tanks. In addition, a special greenhouse/wet lab houses large sea turtle holding tanks, which are supplied with recirculated filtered sea- water. Adjacent to the sea turtle greenhouse is a 7,560-gallon tank used for research.

Physical Sciences

www.vims.edu/phys

Faculty

Carl T. Friedrichs, (Chair), *Professor*
Aaron J. Beck, *Assistant Professor*
Deborah A. Bronk, *Professor*
John M. Brubaker, *Associate Professor*
Elizabeth A. Canuel, *Professor*
Courtney K. Harris, *Associate Professor*
Carl H. Hobbs, III, *Associate Professor*
Steven A. Kuehl, *Professor*
Jerome P.-Y. Maa, *Professor*
John D. Milliman, *Chancellor Professor*
William G. Reay, *Research Associate Professor*
Jian Shen, *Research Associate Professor*
Harry V. Wang, *Professor*
John T. Wells, *Professor*

The objectives of the Department of Physical Sciences are to generate, communicate and apply knowledge concerning the physical, chemical and geological processes that operate in the coastal ocean and estuaries. The physical oceanography group studies and models the properties and movement of water and dissolved and suspended material in estuarine, coastal and continental shelf environments. Geological oceanography includes the study of the processes of sediment erosion, transport and accumulation as well as the resulting stratigraphy. Marine chemistry emphasizes the study of marine biogeochemical processes, and environmental fate and transport of natural and anthropogenic substances. Interdisciplinary studies are strongly emphasized in the Department of Physical Sciences.

Major Programs

Chemical Oceanography/Marine Geochemistry

includes a diverse faculty with numerous cross-disciplinary interests. Work is conducted across riverine, estuarine, continental margin and open ocean environments on a variety of projects intended to help better understand the cycling of organic and inorganic species from both natural and anthropogenic sources. Individual faculty and students in this program collaborate actively not only with other programs in Physical Sciences, but also with the departments of Biological and Fisheries Science. Examples of current and on-going projects within the Chemical Oceanography/ Geochemistry group include: cycling and diagenesis of dissolved and particulate organic matter in estuaries and open ocean settings; carbon and nitrogen transport and cycling in rivers, estuaries, and the coastal ocean, environmental exchanges and transport of contaminants and use of natural and anthropogenic substances as tracers of ecological processes.

Geological Oceanography

encompasses local and international research on a variety of disciplinary and interdisciplinary topics. Research sites span the full range of marine/nearshore environments from coastal plain and river floodplains, through estuaries and across the margin to the base of the continental rise. Although much of our effort addresses questions in Chesapeake Bay and surrounding areas, federal funding supports research in many other areas in the U.S. and around the world (including New Zealand, China, and Taiwan) that generates knowledge about geological phenomena in the coastal ocean. Some of the major focal areas include: sediment transport and boundary layer processes; sediment flux and fate; seabed dynamics; shoreline erosion/sand resource issues; and Quaternary stratigraphic development. Interdisciplinary research efforts involve faculty from the departments of Biological Sciences and Environmental and Aquatic Animal Health, as well as colleagues from other institutions worldwide.

Physical Oceanography

focuses on water motion in estuaries and on the continental shelf along with the associated transport of buoyancy, suspended particles, nutrients and pollutants. Physical Oceanography at VIMS is extremely interdisciplinary, with faculty who straddle fluid physics, material transport and water quality, and who have ongoing collaborations with chemists and geologists within our department, biologists and resource managers elsewhere at VIMS, and with scientists from various disciplines throughout the country and around the world. We have recent and/or ongoing field projects in the Chesapeake Bay and its tributaries as well as on the shelves of the east and west coasts of the U.S., and we are applying three-dimensional numerical models to study circulation and associated dissolved and particulate transport in estuarine and shelf environments. Cooperative research projects are underway with scientists from countries including Korea, The Netherlands, Taiwan, and the U.K. Some of the major focal areas of scientists in our group include: wind- and buoyancy driven circulation on the inner shelf; bottom boundary layer processes; the dynamics of estuarine fronts; three-dimensional modeling of estuarine sediment transport and water quality; the association of characteristic density- and tidally-driven estuarine circulation patterns with the fate and transport of pollutants; wind wave evolution in estuaries and on shelves; and the physics governing sediment transport on shelves, in estuaries and in the surf zone.

Facilities and Equipment

The department maintains state-of-the-art equipment for conducting high-quality field and laboratory research. Major field equipment includes: Laser In-Situ Scattering and Transmissiometry (LISST); sea-bed hydraulic flume; and bottom boundary layer instrumental tetrapod systems for measuring bed stress, wave and currents, sediment resuspension, and bed-level changes. A variety of instrumentation including tide gauges, current meters, conductivity- temperature-depth (CTD) profilers, fluorometers, dissolved oxygen (DO) meters, fathometers, dual-frequency side-scan sonars, variable frequency seismic profiling systems, directional wave gauges, turbidity sensors, acoustic Doppler current profilers (ADCP), and Kasten and box corers are available for field studies. Microwave and GPS navigation systems are maintained by the department for accurate positioning of research vessels.

The department houses extensive laboratory instrumentation, including: an isotope ratio mass spectrometer coupled to an elemental analyzer; an elemental analyzer; UV/Vis spectrophotometer; gas chromatographs with flame ionization and electron capture detectors; quadrupole mass spectrometers; EDS system with full SEM imaging capabilities; nitrogen adsorption surface area and porosity analyzer; high performance liquid chromatograph with UV absorbance and liquid scintillation detectors; two laboratory flumes (recirculating and annular);five intrinsic germanium gamma spectrometers; eight channel alpha spectroscopy system; digital X-ray radiography unit; coulter multisizer automatic particle analyzer; rapid sediment analyzer. Computer facilities range from laptop units for field use to work stations supporting LANs (local area networks) to the institute-wide network. For numerical modeling, department personnel also use multi-processor UNIX machines maintained by VIMS, and the College of William & Mary's SCI-CLONE supercomputer cluster.

Andrews Hall

Chesapeake Bay National Estuarine Research Reserve in Virginia
Catlett-Burruss Lab

Eastern Shore Laboratory

www.vims.edu/esl

Mark W. Luckenbach, Director

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.

Major Programs

Restoration Ecology

Current research focuses on ecological aspects of oyster-reef restoration, including the effects of habitat complexity and scale on the development of oyster populations and associated reef communities.

Non-Native Oysters

Studies at the ESL are examining various aspects of the biology and ecology of non-indigenous oyster species to inform management decisions regarding the possibility of an intentional introduction. Ongoing studies are examining the reproductive biology and larval behavior of an Asian oyster species and its competitive interactions with the native oyster.

Shellfish Aquaculture

Research and advisory service activities related to shellfish aquaculture at the ESL include developing carrying-capacity models for major clam-growing areas, investigating interactions between aquaculture and the environment, developing Best Management Practices, maintaining algal stock cultures, and disseminating technical information.

Water Quality

Research and monitoring projects are ongoing to evaluate interactions between changing land-use on the Eastern Shore and water quality in adjacent tributaries and bays. Projects include watershed-based mapping of land-use, groundwater and surface-water sampling, and collaborations with numerical modeling studies in the Physical Sciences Department.

Education

The ESL supports a wide variety of educational activities ranging from single-day fieldtrips to two-week-long classes from a diversity of institutions. In addition to VIMS and William & Mary, numerous other colleges and universities from Virginia, other states, and other countries utilize the field station for classes. A variety of public education activities are hosted at ESL.

Facilities and Equipment

Facilities at the ESL include seawater laboratories, quarantine hatchery facilities, a seawater flume laboratory, and classroom and laboratory teaching facilities. Office and laboratory space for visiting investigators is also located here. There are two dormitory facilities at the Eastern Shore Lab. The Owens House is a 4,000 sq. ft., two-story house, converted from a single family dwelling. Total sleeping capacity is 32 people and The Council House is a 1,135 sq. ft. one-story rancher. Total sleeping capacity is 6 people.

Current research activities include investigations into nitrogen cycling in salt marshes, disease transmission between mollusks, and population dynamics of finfish and shellfish. A large-scale research project on habitat restoration of oyster reefs and seagrass beds is continuing. The ESL also has been expanding its capabilities in the area of relating land, water quality, and living resources in coastal and estuarine environments.

Kauffman Aquaculture Center

www.vims.edu/kac

The Kauffman Aquaculture Center (KAC) lies 30 miles north of VIMS' main campus on a tributary of the Rappahanock River known as Locklies Creek.

The KAC significantly expands the scope of aquaculture research at VIMS by providing a facility that was specifically designed to hold both native species for conditioning and non-native species in quarantine. Initial use of the facility focuses on studies of the native oysters C. ariakensis and C. hongkongensis.

Stocks of native oysters in Chesapeake Bay have declined to the lowest point in history due to many years of overfishing, habitat loss, and disease. The National Academy of Sciences recently recommended that work with non-natives be pursued carefully using triploid, sterile varieties. VIMS has developed the technology to enable this recommendation, and, through the facilities available at KAC, expand the scope of this activity.

The Kauffman Center features four separate laboratories that were each purpose-built to protect Chesapeake Bay and its living resources from disease, parasites, and the unintentional introduction of non-natives:

Facilities and Equipment

Oyster Isolation Laboratory

This room is designed to hold recently imported non-native species in quarantine from the rest of the facility and the external environment, and to spawn these imports when necessary.

Health Certification and Reproductive Containment Laboratory

This room is designed to hold oysters cleared of exotic diseases to prevent spawn from any experimental oysters from entering the Bay. Native oysters are also prepared for spawning here, and are distributed to commercial hatcheries for production of seed.

Natives Laboratory

This "reverse quarantine" room is designed to keep native oysters from being exposed to MSX and Dermo, two diseases that have devastated wild oyster populations in Chesapeake Bay.

Operations and Analysis Laboratory

This lab is the facility's "nerve center." It holds equipment for monitoring water quality in the seawater systems on the main floor and for assessing the condition of animals held in quarantine. This lab is designed for future addition of cryopreservation capabilities, which will allow for long-term storage of frozen sperm for breeding purposes.

The remainder of the building is devoted to equipment for algal culture, mechanical systems, and a small lobby area with educational displays describing the Center's work. Public access to the working parts of the facility is limited due to biosecurity concerns.

Aquaculture Genetics and Breeding Technology Center

www.vims.edu/abc

Standish K. Allen, Director

The Aquaculture Genetics and Breeding Technology Center (ABC) at VIMS enables the growth of oyster culture by adding value to shellfish stocks through domestication and breeding, to improve the economic characters and uniformity of aquatic species for aquaculture. At present, ABC researchers focus on shellfish because of their ecological and commercial importance to the Commonwealth. ABC technology contributes to economic development in oyster aquaculture in a number of ways.

Major Programs

Selective Breeding

A serious impediment to commercial oyster culture in Chesapeake Bay has been disease susceptibility in wild oysters, which perish before reaching market size. For this reason, ABC has developed disease-resistant native oysters. Several varieties have been released to commercial hatcheries for seed production. These lines have spurred the growth of aquaculture in Virginia, with seed sales reaching 30-40 million in 2009. ABC is now concentrating on other production traits besides disease resistance, such as meat production and growth rate. Through a network of three research farms in the Virginia portion of the Bay, ABC scientists are testing as many as 12 lines simultaneously.

Polyploidy

So-called triploids (spawnless) are engineered to have an additional set of chromosomes, rendering the oyster reproductively sterile. Sterility retards gonad production and allows a superior product in months without the letter "R" (summer spawning season). The combination of triploidy and selectively bred lines also imparts a more robust oyster for aquaculture. The principal method of producing triploids is through a patented intermediate, the tetraploid oyster (having four sets of chromosomes). ABC is actively engaged in evaluating the factors that provide the most productive aquaculture product by testing combinations of tetraploids and selected strains. In 2009, 80% of the seed produced for oyster culture in Virginia was triploid (spawnless). The development of yield-specific tetraploid brood stock is cutting-edge breeding technology for shellfish.

Quantitative Genetics

Using two of our three research farms, ABC is also running a program to determine the quantitative genetic characters of superior oyster strains. This is accomplished by producing 50-100 family groups in a mating scheme to allow the detection of correlations among important traits such as disease resistance, growth, and meat weight.

Center for Coastal Resources Management

www.ccrm.vims.edu

Carl Hershner, Director

The Center for Coastal Resources Management (CCRM) develops and supports integrated and adaptive management of coastal zone resources. To fulfill this mission, the Center undertakes research, provides advisory service, and conducts outreach education. These tasks are carried out by a staff of professional scientists and technical experts using a mix of state funding and grant/ contract support.

Within its broader mission, the Center has specific tasks to support Virginia's wetlands and shoreline management programs. These core activities create a natural focus on the littoral zone and riparian lands in coastal and estuarine areas. Management of resources in these areas has evolved from resource-specific considerations to system-level perspectives. The Center has been an active agent in this change, and has developed the required internal capabilities and external collaborations to support multidisciplinary approaches to management and policy issues.

Major Programs

The Center currently manages its multiple activities within three broad and interacting programs.

The Wetlands Program

The Wetlands Program deals with both tidal and nontidal wetlands. The program conducts basic research on the structure and functions of these systems, collaborating with researchers throughout the mid-Atlantic region. A wide variety of applied research is also undertaken. This includes policy-option analysis, functional assessment methods, inventory and monitoring techniques, and creation/restoration protocols. The Wetlands Program provides extensive support to the Commonwealth's two management programs through review of individual tidal wetland permit applications, training for local and state managers, and development/ management of data bases supporting and tracking regulatory program activities.

The Coastal Inventory Program

The Coastal Inventory Program has a basic mission to monitor tidal shoreline conditions and to develop policy/management recommendations based on analysis of that information. The Program has developed extensive capabilities in geographic information systems (GIS) and in analysis of remotely sensed information. It has expanded its inventorying activities to include almost all terrestrial and aquatic resources within the coastal zone in support of the Center's focus on integrated and adaptive management. Development of GIS-based analytical protocols has become a major activity in the Coastal Inventory. Development of these tools has proven to be a most effective mechanism for integrating technical understanding and extensive data sets in a format that is comprehensible and informative for managers. The Coastal Inventory generates detailed shoreline condition inventories for every tidal county and city as part of its basic mission, and shares its extensive GIS data bases with state and federal agencies throughout the region.

The Coastal Watersheds Program

The Coastal Watersheds Program evolved to deal with the water quality/quantity, land use, and habitat issues that were part of integrated management of coastal resources. The program focuses on basic and applied research in support of policy and regulation development. There are both regional and international elements in the Coastal Watersheds Program. The program is working to develop indicators for health of aquatic ecosystems, use conflict management plans for shallow waters, anadromous fish spawning and nursery habitat studies, and climate change impact assessments. Because much of the work on use-conflict analysis, shallow-water management, and fishery-habitat assessment is of interest in coastal systems around the world, the Center manages growing international collaborations through the Coastal Watersheds Program.

VIMS Teaching Marsh

Marine Advisory Program

www.vims.edu/adv

Thomas J. Murray, Associate Director

The role of the Marine Advisory Service (MAS) is to respond to the needs of marine industries, resource managers and the general public, and to provide information that will increase the public's awareness of the marine environment. MAS also implements marine extension services on behalf of Virginia Sea Grant which is part of a state/federal program administered through the National Oceanic and Atmospheric Administration.

Major Programs

Marine Recreational Fisheries

This program focuses primarily on the issues and concerns associated with recreational fisheries management. Current staff efforts reflect the needs of a growing number of recreational users and an expanding coastal population, and focus upon communicating such needs to fisheries researchers and managers. From a fisheries management perspective, staff time is devoted to encouraging anglers to develop stronger fishing ethics while leading collaborative fisheries research on behalf of the Commonwealth

Marine Business and Coastal Development

The marine business and coastal development program provides support for all commercial and recreational water dependent industries—a broad constituent base whose members support the economies of Virginia's coastal cities, rural areas, and towns. Staff devotes their energies to economic development initiatives, providing technical assistance, access to capital and facilitating communication between the marine industries, coastal resource management and regulatory agencies and partners interested in sustainable economic development.

Commercial Fisheries and Aquaculture

Research and advisory services are directed toward helping individuals and organizations engaged in the commercial harvesting, culturing, processing, and distribution of fisheries products. Staff also conduct applied research and outreach on shellfish and marine finfish aquaculture in cooperation with private industry. Through their close working relationships, MAS staff promote cooperation and information transfer between fishery scientists and managers, and harvesters, culturists, processors, and distributors.

Marine Education

The marine education program is multi-faceted and serves a variety of audiences. Built on the content and expertise of research and academic programs, the program focuses on bridging the gap between researchers and educators and employs Internet technology to maximize impact. Projects address three major areas: K-12 teaching and learning; seafood education; and online ocean sciences education resources.

Federal Partnerships

Chesapeake Bay National Estuarine Research Reserve in Virginia

www.vims.edu/cbnerr

William Reay, Director

Designated in 1991 and managed by the Virginia Institute of Marine Science (VIMS), the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA) maintains a network of protected areas along the York River estuary for long-term research, environmental monitoring, education, and natural resource stewardship. CBNERRVA strives to be a national leader in demonstrating how science, education, and coastal resource stewardship can solve coastal management problems and improve the awareness and understanding of estuaries.

Research and Environmental Monitoring

CBNERRVA promotes, supports, coordinates, and engages in basic and applied research and monitoring efforts within Virginia's coastal region. There are typically more than 30 research/monitoring projects conducted on an annual basis by researchers from a variety of state and federal agencies, academic institutions, and private consulting firms within the Reserve's boundaries. Research areas at CBNERRVA include investigating the relationships between watershed nutrient dynamics, and environmental factors that limit the growth and survival of submerged aquatic vegetation. With respect to environmental monitoring, CBNERRVA participates in national and regional water quality, atmospheric, and biological monitoring programs. These include the NOAA/NERRS System-Wide Monitoring Program, U.S. EPA Chesapeake Bay Shallow Water Monitoring Program, and the National Atmospheric Deposition Program.

Education and Public Outreach

The CBNERRVA general education program works to provide meaningful Bay experiences for student (K-12 and college), educator, and public audiences. Programs are designed to enhance awareness and understanding of the estuary and emphasize the interrelationships of coastal habitats and human activities. Selected programs include *Investigating Current Chesapeake Bay Fisheries Issues: A Field-Based Education Program* (High School), *Exploring Chesapeake Bay Habitats* (Middle School), *Habitat Restoration Teacher Training Workshops*, and the VIMS After Hours Lecture Series (General Public).

Coastal Training Program

The Coastal Training Program at CBNERRVA aims to provide timely scientific information, training, and resources to individuals that play a direct role in making decisions that affect coastal and estuarine resources. The target audience for these programs includes land-use planners, regulatory and management personnel, elected officials, developers, and other coastal businesses. Training courses focus on wetland plant identification and delineation, riparian buffers, shoreline management, water quality, and water-management issues.

Resource Management

CBNERRVA maintains research reserves at Goodwin Islands, Catlett Island, Taskinas Creek, and Sweet Hall Marsh within the York River Basin. In addition, CBNERRVA administers the Virginia Estuarine and Coastal Research Reserve System. Resource stewardship activities are designed to ensure that the integrity of the natural system is protected to preserve the representative ecosystem and support long-term research, monitoring, and education programs.

Cooperative Marine Education and Research Program

www.nefsc.noaa.gov/cmer/

Richard Brill, CMER Program Director

CMER, the Cooperative Marine Education and Research Program, is a partnership between the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and academic institutions. CMER was established to help the small in-house staff at NMFS make complex decisions in fisheries management by collaborating with university researchers.

CMER addresses mission-related research problems identified by NMFS and facilitates the training of marine scientists. The program strives to help the nation meet the challenges posed by issues of resource management in the marine environment.

The Virginia CMER program was established in 2000. It includes both Hampton University and VIMS. In addition to supporting the overall goals of CMER, this partnership facilitates interactions between a historically minority-serving university and VIMS, with its established program in marine science.

National Oceanic and Atmospheric Administration Chesapeake Bay Office in Virginia

chesapeakebay.noaa.gov

VIMS has served as the site for NOAA's Chesapeake Bay Office (NCBO) in Virginia since 2004. NCBO was established in Annapolis, Maryland in 1992 to manage NOAA's activities in Chesapeake Bay and to coordinate with the Chesapeake Bay Program (CBP). The Virginia office gives NCBO greater collaboration and oversight on lower Bay projects, which often generate time-sensitive data and deliverables that federal and state resource managers need for decision-making. The VIMS office allows NCBO to be more responsive to both grant recipients and to managers that need the data and tools. NCBO funds support a wide variety of research, monitoring, and restoration projects at VIMS and in Chesapeake Bay. These include efforts to breed and plant disease-resistant strains of the native oyster *Crassostrea virginica*, monitor industry trials of the non-native oyster *C. ariakensis*, and study the issue of marine debris in Virginia waters. NCBO funding also supports ChesMMAP (the Chesapeake Bay Multispecies Monitoring and Assessment Program) and FEMAP (the Fishery Ecosystem Monitoring and Assessment Program), two VIMS programs aimed at providing resource managers with data and tools to assess and manage Chesapeake Bay's fisheries in a sustainable, ecosystem-based manner. VIMS researchers also rely on NCBO funding to help study and restore Bay grasses, advise shoreline management agencies, develop the next generation of coastal observing systems, and study invasive species.

Virginia Sea Grant

www.vims.edu/seagrant

Troy W. Hartley, Director

Susan Park, Assistant Director Margaret Pizer, Communications Director

Virginia Sea Grant provides science-based solutions to address coastal and marine resource issues. Using an infrastructure of regional, state, federal, and university partners and with top-notch research capabilities, Virginia Sea Grant studies and supports marine industries and communities.

Marine and coastal communities are experiencing changes and challenges. By the year 2020, more than 16 million people will live in the Chesapeake Bay region—twice as many people as lived here in 1950. At the same time, coastal zones will continue to act as a significant economic engine to Virginia. The combined economic impact of Virginia's commercial and recreational fisheries exceeds $1 billion annually. Compounding these factors and Virginia's economic activities is the growing threat of climate change, which brings sea level rise and increased storm surges, coastal flooding, and inundation.

To meet these challenges, Virginia Sea Grant supports research, extension, education, and communication in a variety of areas, including aquaculture, commercial fisheries, seafood technology, coastal ecology and habitat quality, coastal community adaptation, coastal and marine resource management, and education of teachers, students, and culinarians. Virginia Sea Grant partners closely with VIMS Marine Advisory Program in extension and education activities and supports a Communication Center that specializes in disseminating science and advisory information through publications and online media. These capabilities are not duplicated elsewhere in the public or private sectors, making Virginia Sea Grant an ideal vehicle for transforming scientific advances into technological realities for industry, tools and options for resource managers, and ocean literacy for Virginia's students and the general public.

Virginia Sea Grant is part of a national network of more than 30 programs based at top universities in every coastal and Great Lakes state, Puerto Rico, and Guam. The programs of the Sea Grant network work to help citizens understand, conserve, and sustainably utilize America's coastal, ocean and Great Lakes resources. Sea Grant's partnership between universities and the federal government directs federal and state resources to pressing problems in local communities. Drawing on the expertise of more than 3,000 scientists, engineers, public outreach specialists, educators and graduate students from more than 300 institutions, Sea Grant is able to make an impact at local and state levels, and serves as a powerful national force for change.

Left, marine education specialist Lisa Lawrence assists teachers with online teaching resources; center left, fisheries specialist Bob Fisher examines rays in by-catch; center right, Mike Oesterling injects spadefish with spawning hormone; right, marine education specialist Chris Petrone prepares a group of teachers to use ocean observing tools.

Education

School of Marine Science

www.vims.edu/sms

The problems affecting estuaries and the coastal ocean are formidable and continue to intensify as coastal populations grow. Society's ability to cope with these problems depends in large part on the activity and involvement of appropriately trained scientists, managers, and policy makers. The goal of the College of William and Mary's School of Marine Science at VIMS is to produce students optimally trained to study, understand, and manage the coastal environment.

Currently about 125 students are enrolled in the graduate program. They are equally divided between Master of Science and Ph.D. candidates. Students are drawn from colleges and universities nationwide. International students constitute about 12% of the student body.

Because coastal and estuarine research requires an interdisciplinary understanding of the environment, first-year students take a series of five 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.

More than 700 SMS students have received advanced degrees in marine science during the Institute's 67-year history. Graduates find work at academic and research institutes; in management and regulatory agencies at the local, state and federal level; and in the corporate and private sectors.

Internships can serve as an excellent way for students to gain real-world experience as part of their interdisciplinary training at SMS/VIMS. In recent years a large number of VIMS students have received Knauss Fellowships to intern in agency and legislative offices in Washington, D.C., and other students have had both research and teaching internships at various labs and schools around the country.

The School of Marine Science also has an active and highly competitive summer internship program for undergraduate students, funded in part by the National Science Foundation. Students spend ten weeks at VIMS working with their mentors on a variety of research projects. A number of these summer projects have resulted in published papers in peer-reviewed journals. Minorities and women are particularly encouraged to apply to this program (see www.vims.edu/sms/intern).

Research projects.

Public Outreach

www.vims.edu/events

VIMS provides a rich program of public outreach that includes a monthly public lecture series, periodic mini-schools on topical issues in marine science, public tours, an annual Marine Science Day, Bay Exploration Canoe trips, and the Summer Saturdays program. Public outreach facilities include a 1-acre Teaching Marsh, a coastal maritime forest, a Visitor's Center and Aquarium, the McHugh Auditorium, and the Seawater Research Lab's public observation bay.

VIMS offers mini-schools on various aspects of marine science and policy for the general public and educators. These offerings provide in-depth exploration of topical issues in marine science for non-scientists. They are funded through grants, partnerships with other institutions and private donations. In addition, K-12 tours, lectures and canoe trips are offered by VIMS staff, reaching thousands of students each calendar year. Workshops and conferences for educators are available throughout the year and some provide opportunities for graduate credit.

Our faculty enthusiastically participate in special Federal and State programs for high school students (Governor's School at Wm & Mary; Ocean Sciences (Blue Crab) Bowl which alternates between VIMS and ODU as host institutions-*http://www.vims.edu/adv/bcb)*; for undergraduate students to increase ethnic diversity (DREAMS Program in conjunction with Hampton Univ.-*www.vims.edu/dreams)*; for graduate students to increase under-represented PhDs (Hall Bonner Program with ODU and Hampton University (*www.hamptonu.edu/academics/schools/science/marine/hallbonner.htm*); and, for educators who seek accurate ocean science data and teaching resources (the on-line Bridge Program-*http://www.vims.edu/bridge/main.html*). The Chesapeake Bay National Estuarine Research Reserve (CBNERRVA) works with the public providing a series of Discovery Labs and outreach programs in the public schools.

The Center for Coastal Resources Management (CCRM) and CBNERRVA through the Coastal Training Program provide education and training classes for the regulatory community. Since Virginia's natural resource management structure largely is composed of citizen boards, education regarding regulated resources is critical for the regulatory programs to function effectively and fairly.

Professional Development Programs for Educators

www.vims.edu/adv/ed

VIMS provides a suite of programs designed to support the continuing education of professional educators from classrooms, museums, science centers and aquaria, natural resource agencies, and environmental organizations. These programs include graduate courses in marine science, including applications for the science classroom; workshops highlighting current research topics and methods; lectures and seminars, field and laboratory activities, and conferences.

Emeritus Faculty

Henry Aceto, Jr.
Herbert M. Austin
Thomas A. Barnard, Jr.
Rudolf H. Bieri
John D. Boon, III
Eugene Burreson
Robert J. Byrne
Mark E. Chittenden, Jr.
Fu-Lin Chu
William DuPaul
David A. Evans
Leonard W. Haas
Dexter S. Haven
Robert J. Huggett
Albert Y. Kuo
Maurice P. Lynch
William G. MacIntyre
John A. Musick
Maynard M. Nichols
Frank O. Perkins
Evon P. Ruzecki
Gene M. Silberhorn
Dennis L. Taylor
N. Bartlett Theberge, Jr.
J. Ernest Warriner
Kenneth L. Webb
Richard L. Wetzel
Frank J. Wojcik
L. Donelson Wright

Andrews Hall

From the VIMS campus....

Institute Support Resources

Seawater Research Laboratory

www.vims.edu/srl

James E. Brister, Director

The 43,000 square foot Seawater Research Laboratory (SRL) allows scientists from VIMS and other institutions to conduct research on living marine and estuarine organisms under controlled conditions. The SRL allows for great diversity with respect to the types of organisms that may be studied. There is likewise a great deal of flexibility in terms of water source, water-temperature control, lighting control, and treatment of discharge from the various user areas within the laboratory. All basic life-support equipment is attached to a monitoring control and alarm system, which allows for continuous 24-hour monitoring of critical parameters.

Facilities and Equipment

The SRL facility consists of six discrete wet-lab areas. Most of these areas are highly specialized to allow for safe containment and treatment of aquatic pathogens and toxins. Special care is taken to protect the laboratory personnel who work within these areas. State-of-the-art filtration and effluent-treatment technologies are used to protect the receiving waters of the York River estuary from exposure to these compounds as well.

In addition to the wet-lab areas there is a teaching laboratory, a necropsy lab, and a general-purpose lab available for research and instructional use. A multi-media conference room, vending area, and a break room are also available for laboratory users. A viewing gallery in the main foyer is available for outreach programs to the general public.

General Purpose Aquaculture Lab

This 12,600 square-foot area is designed to accommodate the basic culture requirements of a wide variety of benthic, planktonic, and large nektonic aquatic organisms. Ample space and infrastructure support is available for most physiological, ecological, nutritional, and genetic research needs.

High Bay Area

The 5,400 sf High Bay area is an extension of the General Purpose Aquaculture lab with a ceiling clearance of 30 ft. It will be equipped with a rail-mounted, 10-ton overhead bridge crane for moving large pieces of equipment at a later date. In addition to research on living marine organisms, the area can accommodate large-scale systems designed for calibration of large oceanographic research instruments. Flume systems can be erected in the area for observation of fluid and sediment transport as well as the effects of these variables on benthic and interstitial organisms.

Coral Reef Laboratory

This area provides for public viewing of small-scale coral-reef communities. The area can also serve as a holding space for live tropical research specimens collected from abroad.

BSL-2 Pathogen and Quarantine Lab

The Biosafety Level 2 lab is a restricted-access area for quarantine of aquatic organisms potentially infected with pathogens that may pose a moderate threat to human health, and for challenge-studies that expose aquatic organisms to specific pathogens of this type.

BSL-3 Pathogen Lab

The BSL-3 is a restricted-access area for isolation and challenge-testing of aquatic pathogens that may be of a more significant health risk to humans and that may be transmitted to humans via aerosol. The lab is physically sealed and isolated via a double key-card access system, has its own dedicated HVAC system with HEPA filtration of both intake and exhaust air, and is continuously under negative pressure.

Toxicology Lab

This area is a large restricted-access area for exposure of marine organisms to minute quantities of a wide array of aquatic toxicants.

Carcinogen Exposure Lab

This area is a restricted-access lab for exposure of aquatic organisms to carcinogens and toxins that due to their toxicity or high concentrations may pose a significant risk to human health. The area is equipped with an array of biosafety cabinets and glove boxes for safe exposure.

Analytical Service Center

www.vims.edu/admin/asc

For more than two decades, the Analytical Service Center (ASC) has researched, developed, and refined methodologies for analysis in a wide spectrum of environmental matrices. The quality of data is a direct result of thorough statistical controls, documentation, and training. ASC instrumentation is state-of-the-art with computer control/acquisition, background correction, and optimization for a saline matrix. Quality Control criteria are monitored at the instruments and overseen by the Quality Assurance Officer.

The Center's research efforts focus on characterizing the ecosystem of Chesapeake Bay and associated tributaries. The team has extensive experience in monitoring research programs coordinated by state and federal agencies as well as participation in coastal and open ocean projects. Support personnel provide field services using traditional and modified sampling techniques and equipment. To meet the immediate demands of researchers, costing and processing of samples for nutrient analysis is available. The ASC provides a full-cost analysis to facilitate proposal preparation, and prices remain firm for two years following submission.

Dive Program

www.vims.edu/admin/vessels/diveteam

The VIMS full-service dive center provides both training and equipment for diving scientists. A diving safety officer administers the program through the guidance and counsel of the Diving Control Board. VIMS has been an organizational member of the American Academy of Underwater Sciences (AAUS) since 1986, and is governed by their standards.

The facility includes classroom space, equipment sign-out and maintenance capabilities, an air-fill station, and photo/video equipment. Classes for diver training are held on a regular basis, and are taught in accordance with AAUS standards.

Fish Collection

www.vims.edu/ich_coll

The Institute maintains the Commonwealth's ichthyology collection, which includes approximately 100,000 specimens in 247 families from Chesapeake Bay and contiguous waters, the continental slope, and the abyssal plain of the western Atlantic; as well as a number of exotic species including a 5-foot female coelacanth from the Comoros Islands in the Indian Ocean. The collection has comprehensive and historical coverage of freshwater species from Virginia and the southern Appalachians. More than 20,000 lots, of which 13,000 are computer cataloged, are stored on specially constructed shelving that provides access to the entire collection. The Institute also maintains a growing collection of marine and estuarine ichthyoplankton from the Chesapeake Bay, the Mid-Atlantic bight, and Caribbean waters. The facility provides equipment for processing acquisitions, x-ray studies, and performing necropsies on large fishes, sea turtles, and cetaceans.

Information Technology and Network Services

www.vims.edu/itns

Information Technology and Newworking Services provides the information technology infrastructure and resources to support VIMS' tripartite mission of research, education, and advisory services. All buildings on the 40-acre VIMS campus are connected to a high-speed switched Ethernet network. The VIMS campus network is connected to the Internet via a high speed link to Network Virginia, which connects VIMS to the Wachapreague campus on the Eastern Shore, the William and Mary main campus, and the world.

Services such as electronic mail, web sites, Internet news, databases, file transfer, search engines, administrative systems access, user home space, etc. are provided by a collection of Unix and Windows-based servers. This environment provides students, faculty, and staff with a robust variety of software tools and scientific data resources, facilitating activities such as analysis, visualization, GIS mapping, genetic modeling, and hydrodynamic modeling.

Publications Center

www.vims.edu/pubs

The Publications Center provides publishing, photographic, and video support to the Institute. The Center provides graphic design and layout services, scientific illustrations; color copies and posters up to 40" inches wide. Center graphic designers produce interactive, multimedia presentations, videography, and computer-based presentations. They also provide custom photography; and photographic and video support.

Sponsored Research

www.vims.edu/admin/sponpgms/

The VIMS Office of Sponsored Programs(OSP) assists faculty and staff in soliciting, negotiating, and managing support from a variety of funding sources. The office serves as the central point of contact for sponsored-program activities, and is charged with ensuring that all awards are managed in compliance with appropriate financial and administrative regulations.

Field Operations

www.vims.edu/admin/vessels

Much of the Institute's fieldwork involves locations within the Chesapeake Bay. This research is generally performed aboard one of VIMS' four larger vessels: the 65' R/V *Bay Eagle*, the 44' R/V *Langley* (both equipped to deploy large scientific equipment); the 30' R/V *Fish Hawk*, specially equipped for trawl survey work; and the 74" R/V *Pelican*, a former Navy landing craft retrofitted for shoreline studies and deployment of large payloads. This group of vessels is operated by Coast Guard licensed crews. VIMS also maintains a fleet of trailerable vessels for estuarine work.

William J. Hargis, Jr. Library

www.vims.edu/library

The collections of the Hargis Library focus on literature that supports the major programs of study of the School of Marine Science, as well as the research and advisory service programs of the Institute. These specialized collections are a blend of books, technical reports, online and print-based journals, topographic maps, and nautical charts. Many of the scientific reports produced at VIMS have been digitized and are available for viewing by connecting to the library's website.

Current research literature can be accessed via major scientific research databases such as the Web of Science, Science Direct, ASFA, Chemical Abstracts, CSA Biological Sciences, Environmental Sciences and Pollution Management, GeoRef, and Oceanic Abstracts. These and other electronic resources are accessible both on and off campus. Students, faculty, and staff are also able connect to the broad array of more than 200 databases available via main campus connections and VIVA—the Virtual Library of Virginia—as well using the materials in the collections of the other William and Mary Libraries. In addition to the College collections, patrons can acquire research materials from other institutions via InterLibrary Loan.

Librarians are able to provide help in locating information, identifying the best tools for research projects, and clarifying how to access resources.

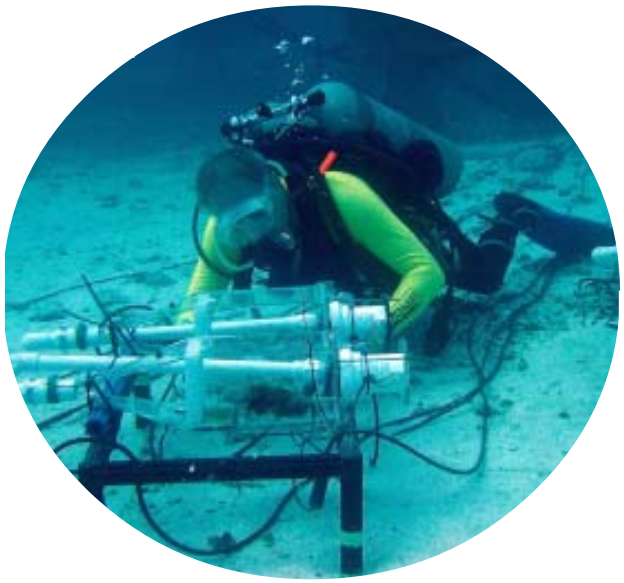
VIMS Industry Partnership

The VIMS-Industry Partnership is a committee that meets approximately eight times a year to facilitate cooperation, promote joint proposals and to advise the Director of VIMS on long-term collaborations with industry.

Through the Partnership, VIMS and the College of William and Mary work to develop and enhance relationships between industry and faculty researchers that may ultimately lead to rapid transfer and commercialization of technology. The collaboration provides support and flexibility for development and dissemination of new intellectual properties to companies in Virginia. It also serves and rewards faculty and staff in a way that is consistent with W&M's Intellectual Property Policy and the Institute's normal research and advisory service framework.

The Partnership includes representatives from VIMS, particularly faculty engaged in research that is focused on ocean observing system technology; the Office of Economic Development at W&W; the Office of the Secretary of Commerce and Trade; and, representatives from approximately 20 industries that have expressed interest in working with VIMS on collaborative research and technology-transfer agreements.

Giving to VIMS and The VIMS Foundation



Giving To VIMS

As a leader in marine research and education, VIMS is currently supported by state appropriations, federal and state grants and contracts, and private donations including unrestricted gifts and gifts for support of programs and various endowments. Like all state-supported institutions of higher education in Virginia and elsewhere, VIMS is increasingly dependent on private support to remain competitive and attract the best and the brightest faculty and students. The VIMS School of Marine Science is part of the College of William and Mary.

Contributions to VIMS may take many forms and may be made directly to VIMS or to the VIMS Foundation, a separate 501 (c) (3) organization with an independent Board of Directors. Ways to give to VIMS include outright cash gifts; gifts of securities and property; and deferred gifts such as a will provision, gift of property, or a charitable remainder trust. Whether a person is interested in establishing an endowment, making a contribution to the Annual Fund, giving in memory of a loved one, or supporting a project, donors can be sure that their gift will advance the quality of research and education in marine science, and thus ultimately improve the health of our planet.

The VIMS Foundation

Incorporated in 2000, the Virginia Institute of Marine Science Foundation is growing for the benefit of VIMS and its students and faculty. While still a young foundation, it's assets as of December 31, 2007, stand at more than $7 million. The VIMS Foundation was created specifically to encourage private gifts to endow student fellowships, professorships, and specific areas of research. In addition, the Foundation is building a permanent unrestricted endowment that allows the Foundation Board and the VIMS Dean and Director to support urgent needs as they arise. The VIMS Foundation is comparable to the many other higher education foundations affiliated with colleges and universities or their constituent schools.

For further information about giving to VIMS, please contact John T. Wells, Dean and Director, at 804-684-7103, Anne Alexander Marshall, Director of Development and Executive Director of the VIMS Foundation, at 804-684-7107, or Lisa C. Phipps, Assistant to the Director of Development at 804-684-7099.

Chesapeake Bay Hall

Publications

VIMS publications can be accessed from the William J. Hargis, Jr. Library home page.·

http://www.vims.edu/library/VIMSReports.htm

VIMS contributions (journal articles, books and book chapters by VIMS faculty, staff and students):

https://lion.wm.edu/uhtbin/servim/virginia+institute+marine+science+contribution

Lists of :

- Masters theses: *http://lion.wm.edu/uhtbin/KWVT/*
- PhD dissertations: *http://lion.wm.edu/uhtbin/KWVD/*