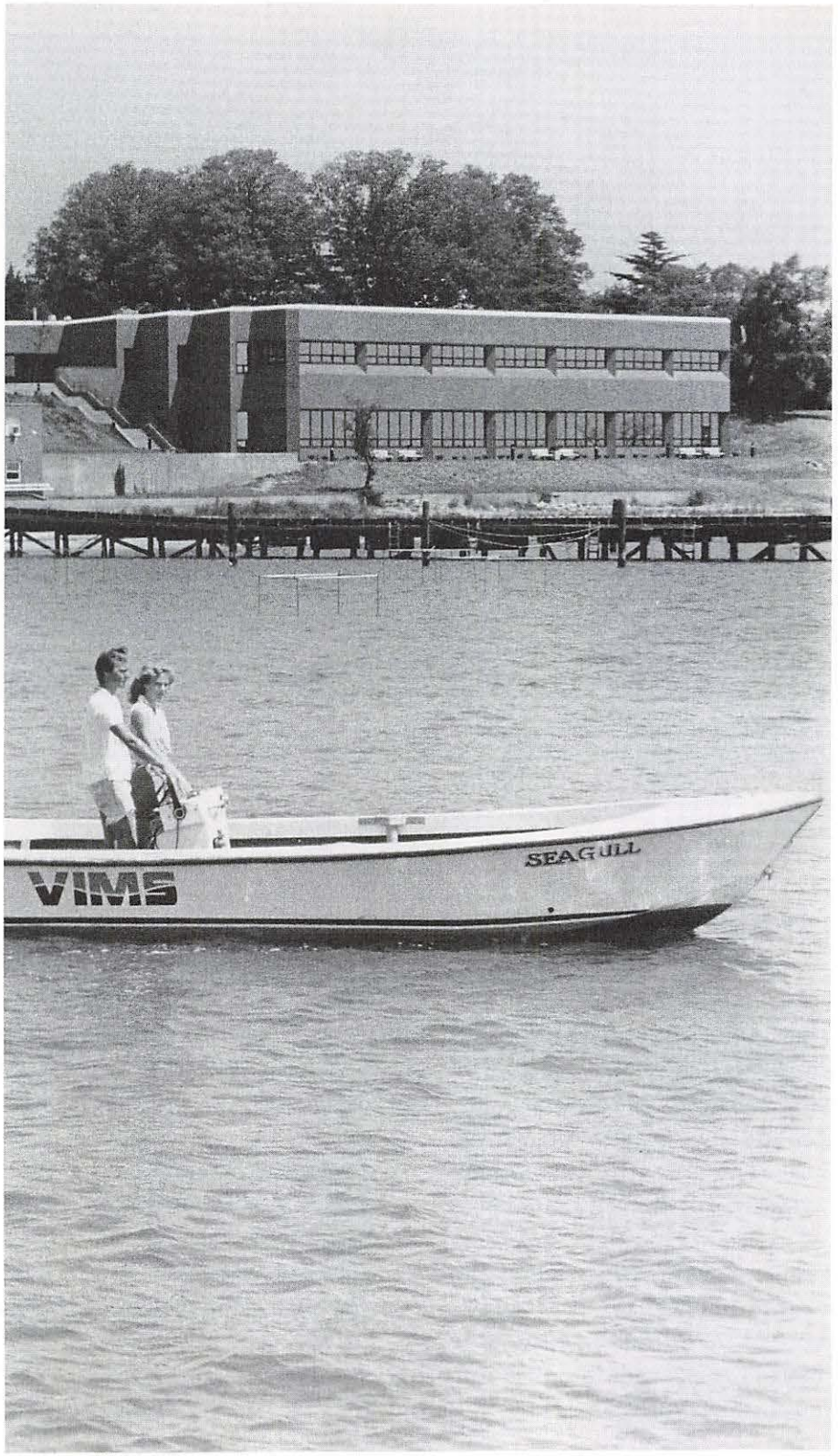
The College of
William & Mary

BIOLOGICAL SCIENCES

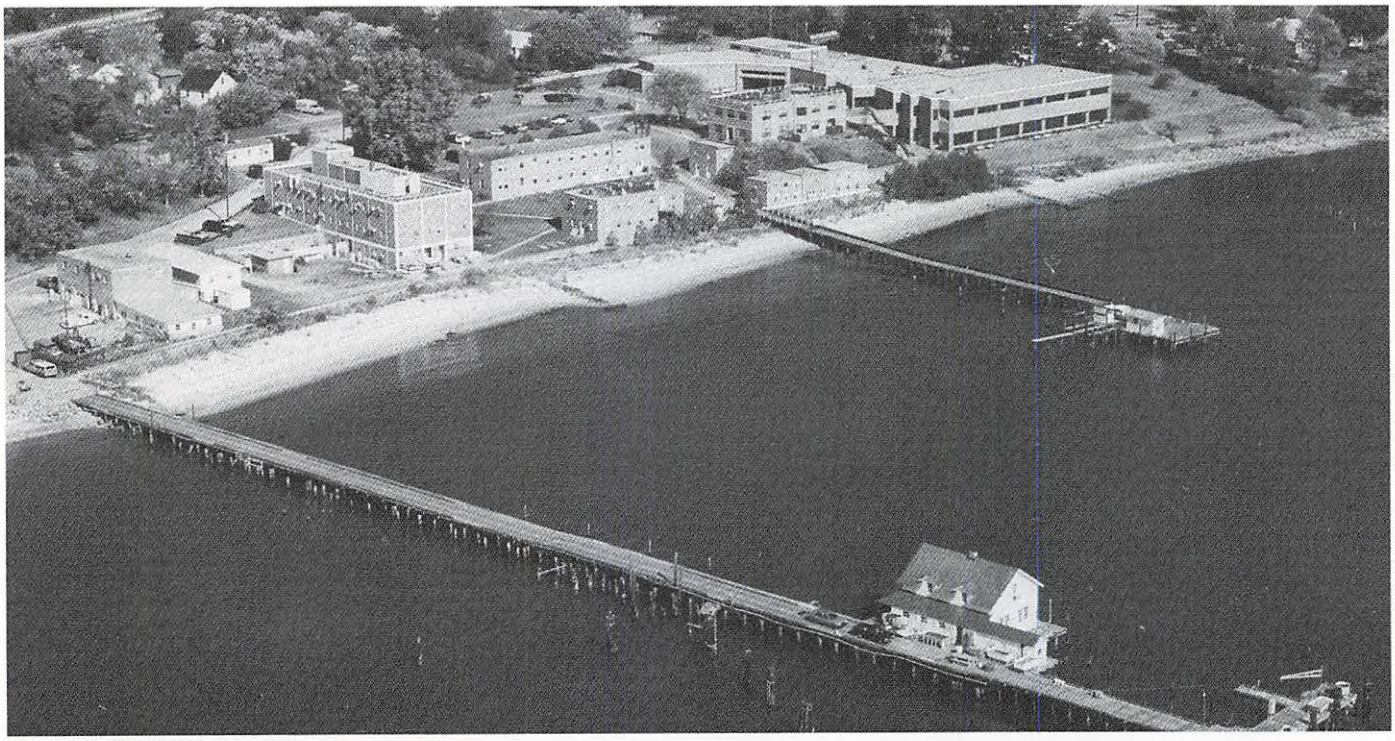
School of
Marine Science

Virginia Institute
of Marine Science



The School of Marine Science is one of four professional graduate schools of the College of William & Mary. The objective of the educational program is to provide a fertile and stimulating learning environment for students preparing for careers in marine science.

The School of Marine Science



The School of Marine Science/Virginia Institute of Marine Science occupies the site of Gloucester Town, a colonial settlement established in 1680. The remains of military fortifications from both the Revolutionary War and the Civil War reflect Gloucester Point's strategic location at the mouth of the York River.

Chartered in 1940, the School of Marine Science/Virginia Institute of Marine Science (SMS/VIMS), has a tripartite mission of research, education, and advisory service in marine science. This mandate established an institution that is uniquely prepared to educate the highly qualified researchers, resource managers, and educators needed for the future. Today, SMS/VIMS is the third largest marine research and education center in the country.

The School awards both Master of Arts and Doctor of Philosophy degrees. Graduate studies are offered in five areas:

Biological Sciences
Environmental Sciences
Fisheries Science
Physical Sciences
Resource Management & Policy

Academic programs are closely allied to the research and advisory programs of the Virginia Institute of Marine Science enabling students to participate in basic and applied science. Faculty scientists are involved in collaborative research with scientists from other institutes both nationally and internationally. In addition, researchers work closely with marine industries, policy makers, and regulatory agencies.

The Institute accommodates the interdisciplinary investigation that is essential to understanding and addressing the complex issues of modern marine science. Faculty, researchers, and students maintain a primary affiliation in one of the five departments. However, programs and research within departments are often carried out in association with scientists from other departments. Students with specific interests in areas outside their department may arrange crossover study and research. This interactive approach enables students to work with various members of the diverse faculty and provides access to all facilities at the Institute.

In a society that is increasing its pressure on the environment and natural resources, the coastal, estuarine, and marine environment has become an area of critical concern.

Research at SMS/VIMS encompasses all elements—land, sea, and air—that affect marine ecosystems.

Major Programs

Resource Management and Policy

- Wetlands
- Comprehensive Coastal Inventory
- Chesapeake Bay National Estuarine Research Reserve in Virginia
- Water Quality Monitoring/ Modeling
- Ocean and Coastal Law
- Coastal Management and Policy

Biological Sciences

- Physical Biology
- Seagrass Biology & Ecology
- Plankton Processes
- Nutrient Processes
- Benthic Ecology
- Benthic Processes
- Ichthyoplankton Research
- Fisheries Systematics
- Ecosystem Modelling
- Microbial Ecology
- Evolutionary Ecology

Physical Sciences

- Biogeochemistry
- Surface Geochemistry
- Organic Geochemistry
- Chemical Fate & Transport
- Sediment Geochemistry/ Geochronology
- Sediment Environments and Stratigraphy
- Shoreline Studies
- Sediment Erosion & Deposition
- Hydrodynamic Modeling
- Small-Scale Physical Processes
- Wave Climate and Air-Sea Interaction
- Benthic Boundary Layer Dynamics
- Shelf Dynamics
- Estuarine Dynamics
- Water Quality
- Input and Dispersal of River Sediment in Coastal Seas

Fisheries Science

- Crustacean Ecology
- Bivalve Ecology
- Fisheries Oceanography
- Fish and Shellfish Pathology
- Finfish Ecology
- Chondrichthyan Biology
- Sea Turtle Ecology
- Marine Mammal Ecology
- Systematics
- Population Genetics

Environmental Sciences

- Environmental Chemistry
- Analytical Chemistry
- Biochemistry
- Toxicology
- Pathobiology and Histology
- Immunology

Located in Gloucester Point at the mouth of the York River, the campus has easy access to Virginia's estuaries, tidal and non-tidal wetlands as well as the Chesapeake Bay and Atlantic Ocean. The Wachapreague campus, on Virginia's Eastern Shore, is surrounded by embayments, salt marshes, barrier beaches, and coastal waters. Both locations provide ideal settings for research and teaching.

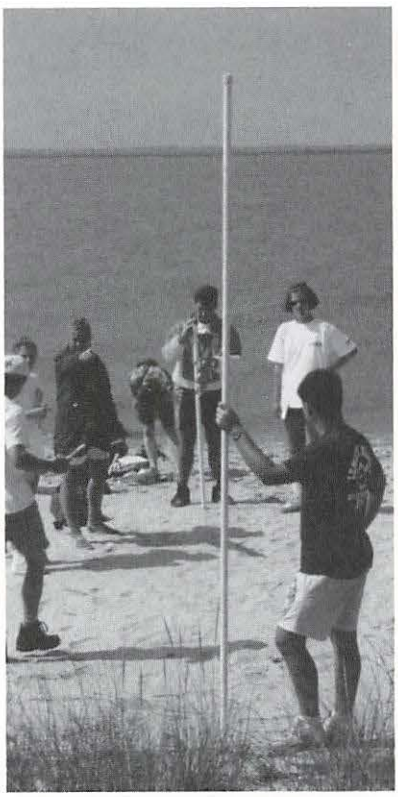
The thirty-five acre Gloucester Point campus houses six buildings with flow-through salt water systems and various laboratories that are well equipped for basic as well as specific project research. Equipment includes: a mass spectrometer, scanning and transmission electron microscopes, hydraulic flumes, an underwater video system, acoustic doppler current profilers, electromagnetic current meters, and a Geographic Information System.

A 60,000 square foot laboratory is scheduled for completion in the fall of 1995. The facility will house highly-specialized labs for advanced research in chemistry, geochemistry, toxicology, pathobiology, microbiology, genetics, physiology, planktonology, nutrient cycling, and parasitology.

The Institute is the largest marine center in the U.S. that is focused on coastal and estuarine science.

Institute scientists have monitored natural, commercial, and industrial effects on the Chesapeake Bay and its estuaries for more than fifty years.

EASTERN SHORE LABORATORY



Students from Virginia Polytechnic Institute & State University utilize facilities at the Eastern Shore Lab.

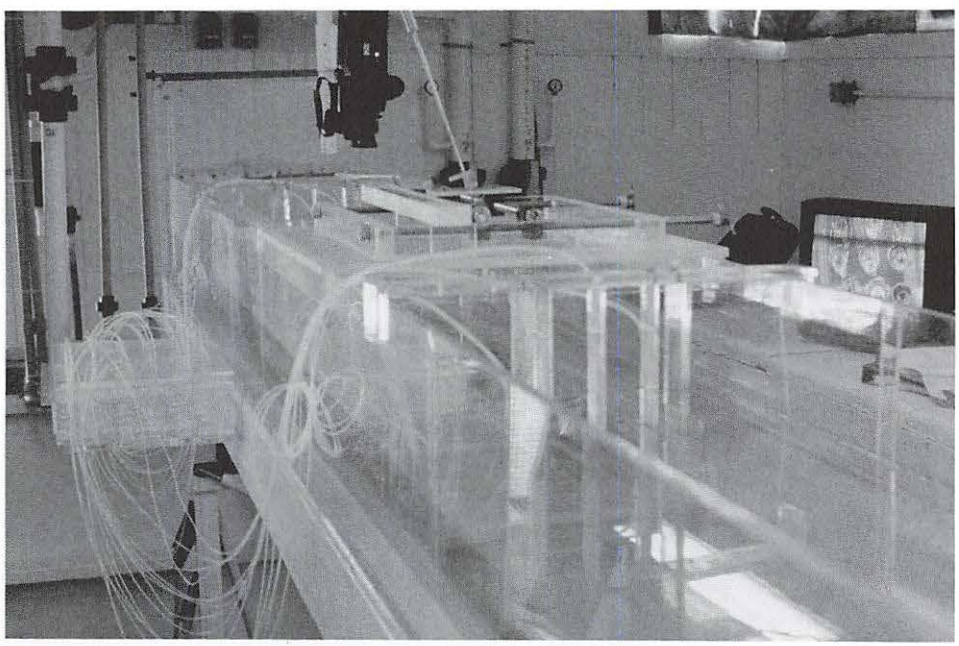
The VIMS Eastern Shore Laboratory, located in the seaside village of Wachapreague, serves as a field station for research, teaching, and advisory activities of SMS/VIMS.

Along the approximately 100 km of its Atlantic shoreline, the Virginia Eastern Shore remains one of the least developed coastal regions in the United States, with essentially no development on its barrier islands. This pristine area is uniquely suited for field research into coastal processes. The location provides convenient access to the eastern portion of the Chesapeake Bay and the barrier island, salt marsh-lagoonal systems along Virginia's Atlantic shore.

Widely recognized for its contributions to research in bivalve aquaculture, the Lab also supports activities of scientists and students from the Gloucester Point campus and other institutions. Recent research activities at the facility include: investigations into nitrogen cycling in salt mashes, disease transmission between mollusks, population dynamics of finfish and shellfish, chemical induction of settlement in invertebrates, and hydrodynamic characteristics of seagrass seeds.

Extensive wet laboratory facilities include running seawater tables and large holding tanks. A small hatchery for the culture of marine and estuarine organisms is especially well suited for mollusk culture. An on-site flume laboratory permits investigation of processes (hydrodynamic, sedimentological, and biological) in the benthic boundary layer.

Office and dry laboratory space are available to students and visiting investigators. An on-site dormitory can accommodate up to 28 visitors.



The seawater flume laboratory was designed and built by the Eastern Shore Lab faculty and staff.

More than 600 dives are logged annually by the 40-member dive team.

VESSELS CENTER

The vessels center maintains and operates a fleet of 40 vessels. The 65-foot *R/V Bay Eagle* is outfitted with a wet lab containing a flow-through seawater system, a dry lab housing electronics, and project-oriented equipment. Similarly outfitted is the 44-foot *R/V Langley*. Both vessels have Loran interface for downloading information to on board computers. In 1990, the 29-foot *R/V Fish Hawk* was especially designed and equipped to perform trawl surveys. A sizeable trailerable fleet supports estuarine and tributary research. Electronic systems can be transferred to these smaller boats, enabling precise scientific surveys to be conducted on board. A new diving facility includes a diver training room and classrooms to support the 40-member VIMS dive team. The VIMS diving program is an organizational member of the American Academy of Underwater Sciences.

LIBRARY

The library supports the Institute's mission by collecting and providing access to marine science literature, with emphasis on estuaries and the coastal zone. Currently the collection includes 521 journal subscriptions, 44,000 volumes and 19,200 titles in addition to topographic maps, nautical charts, and scientific archives. Access is provided through the card catalog as well as through the circulation terminal and personal computers. On-line networks provide access to marine science literature through *Aquatic Sciences and Fisheries Abstracts* and the *Chesapeake Bay Bibliography*, and Swem Library on the Main Campus in Williamsburg. The library workstation is networked to computers in the student User's Room.

MARINE ADVISORY SERVICES/SEA GRANT

Marine Advisory Services' (MAS) role is to be directly responsive to the needs of industry and the general public, and to provide information that will increase the public's awareness of the marine environment. MAS is associated with the Sea Grant Program, a state/federal program administered through the National Oceanic and Atmospheric Administration.

Specialists from MAS work closely with businesses, governmental agencies, educational organizations, and individuals to provide information and advice on a wide range of marine-related programs and activities.

The direction of MAS research is dictated by industry and government needs. Research has ranged from gear selectivity experiments and sea scallop biology, to technology for soft crab shedding and clam relaying. MAS works extensively with the recreational fishery, marine trades, and the offshore pelagic fishery.

In the past few years, changing needs and opportunities—driven in part by enacted or pending regulatory measures–have presented new challenges to MAS in the areas of seafood processing, water quality, and mariculture development.

Students at MAS are generally associated with Fisheries Science or Resource Management departments. Their research has been diverse. Projects have included sea scallop biology, the socioeconomics of Virginia's recreational fishery, the food/feeding habits and trophic interaction of tuna species in Virginia's offshore waters, and the biology of recreational reefs.

Advisory scientists work closely with industry, in this case the operator of a blue crab shedding facility.

MAS maintains the aquarium that attracts more than 5,000 visitors each year.

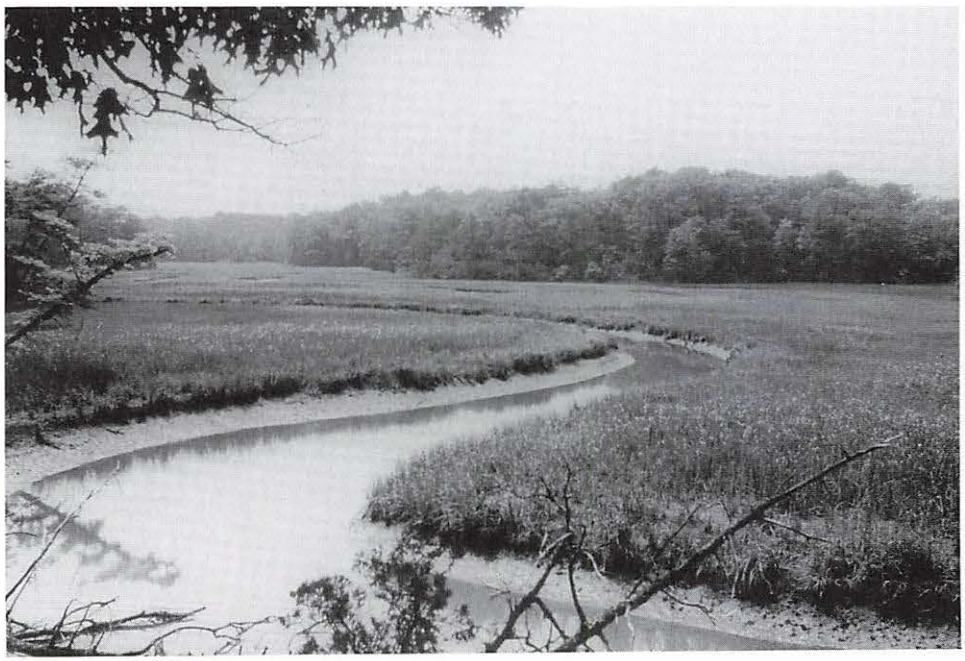
CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE

Since 1987, Virginia Institute of Marine Science has been the lead agency for the Reserve System in Virginia. Reserve sites are preserved for estuarine research, monitoring, education, and conservation of key resources in relatively pristine settings. Establishment of four sites began a system that will include sites on the York, Pamunkey, Potomac, Rappahannock, and James rivers, the mainstem of the Bay and the Eastern Shore. Sites of activity today are the Goodwin Islands, the Catlett Islands, Taskinas Creek, and Sweet Hall Marsh. More than 20 research projects involving investigators from several colleges and universities are currently underway. The program provides study areas for numerous graduate research projects, "outdoor classrooms" and ecology presentations.

FISH COLLECTIONS

Nunnally Hall, completed in 1992, houses the extensive ichthyology collection that includes approximately 85,000 specimens in 247 families from Chesapeake Bay and contiguous waters, the continental slope and abyssal plain of the western Atlantic, and freshwater species of the southern Appalachians. More than 13,000 catalogued lots are stored on specially constructed shelving that provides access to the entire collection. The Institute also maintains a growing collection of marine and estuarine ichthyoplank-ton from Chesapeake Bay, Mid-Atlantic Bight, and Caribbean waters as well as a number of exotic species including a 5-foot female coelacanth from the Comoros Island in the Indian Ocean. There are facilities for processing acquisitions, x-ray studies, and performing necropsies on large fishes, sea turtles and cetaceans.

The Institute houses one of the most extensive fisheries collections on the East Coast.

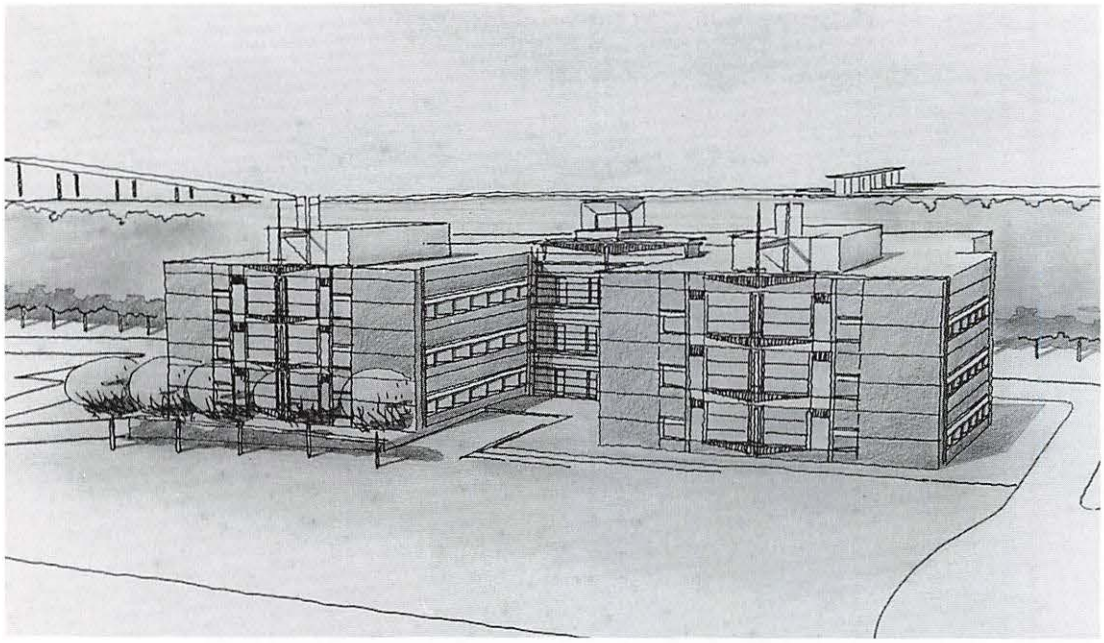


Taskinas Creek is one of the four Reserve Sites for estuarine research.

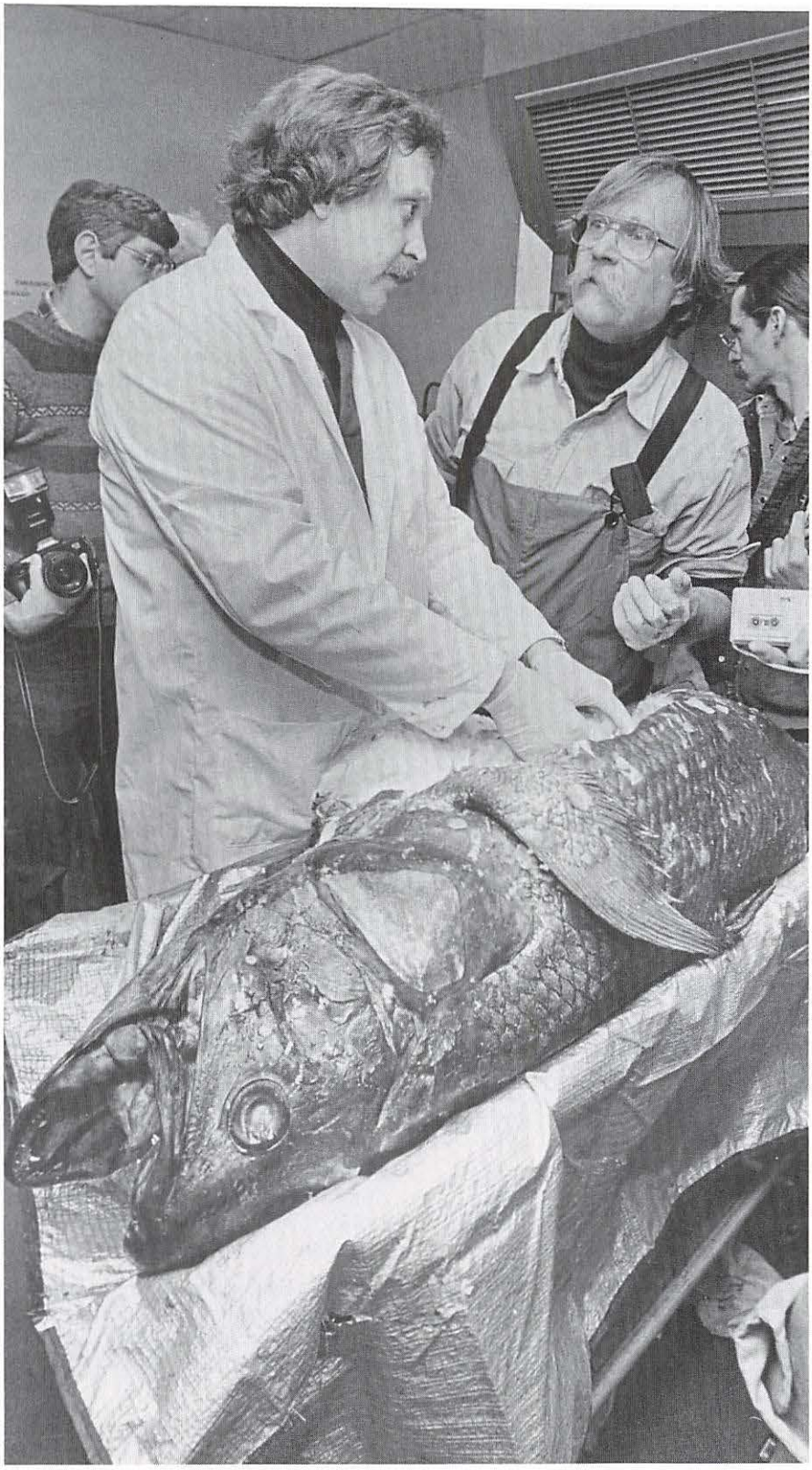
OYSTER HATCHERY

Established in 1985, the Oyster Hatchery provides breed stock (up to 2,000 at any given time) for research, conditioning, and selective breeding experiments. Specimens of any specified size are provided for class labs on a year-round basis. The hatchery is equipped with setting tanks for fertilization and a temperature controlled environment for development from larval to spat stage. Grow-out spats for oyster aquaculture are produced by the hatchery as well. In addition, the laboratory houses the largest algae culture lab on the East Coast. Four 1,000-gallon tanks, four 400-gallon tanks, state-of-the-art water temperature control and filtering systems enable the lab to produce vast quantities of virtually any kind of algae required for research or as a food source.

Oyster research ranges from cell cultures of the Perkinsus *virus, to developing disease-resistant hybrids and oyster aquaculture.*



The Marine Chemistry and Toxicology building will house specialized laboratories designed for biological and chemical research to examine the fate and effects of organic pollutants.



The diverse faculty is the cornerstone of the Institute's nationally and internationally recognized education and research programs.

School of Marine Science

Dennis L. Taylor, Dean and Acuff Professor of Marine Science. B.A., University of Pennsylvania; Ph.D., DSc., University of Wales. Biological Sciences.

John D. Milliman, Dean of Graduate Studies and Professor of Marine Science. B.S. University of Rochester; M.S., University of Washington (Seattle); Ph.D., University of Miami. Physical Sciences.

Henry Aceto, Jr., Associate Dean of Graduate Studies, Professor of Marine Science, and Professor of Biology. B.S., State University of New York, Albany; M.S., University of California, Berkeley; Ph.D., University of Texas. Environmental Sciences.

Herbert M. Austin, Professor of Marine Science. B.S., Grove City College; M.S., University of Puerto Rico; Ph.D., Florida State University. Fisheries Science.

John D. Boon, III, Professor of Marine Science. B.A., Rice University; M.A., Ph.D., College of William and Mary. Physical Sciences.

Eugene M. Burreson, Professor of Marine Science. B.S., Eastern Oregon College; M.S., Ph.D., Oregon State University. Fisheries Science.

Robert J. Byrne, Director for Research and Advisory Services and Professor of Marine Science. M.S., Ph.D., University of Chicago. Physical Sciences.

Mark E. Chittenden, Jr., Professor of Marine Science. B.A., Hobart College; M.S., Ph.D., Rutgers University. Fisheries Science.

Hugh W. Ducklow, Loretta & Lewis Glucksman Professor of Marine Science. A.B. Harvard College; A.M., Ph.D., Harvard University. Biological Sciences.

William D. DuPaul, Professor of Marine Science. B.S., Bridgewater State College; M.A., Ph.D., College of William and Mary. Fisheries Science.

Robert J. Huggett, Professor of Marine Science. M.S., Scripps Institution of Oceanography; Ph.D., College of William and Mary. Environmental Sciences.

Stephen L. Kaattari, Professor of Marine Science. B.S., Ph.D., University of California, Davis. Environmental Sciences.

Albert Y. Kuo, Professor of Marine Science. B.S., National Taiwan University; M.S., University of Iowa; Ph.D., The Johns Hopkins University. Physical Sciences.

Joseph G. Loesch, Professor of Marine Science. B.S., University of Rhode Island; M.S., Ph.D., University of Connecticut. Fisheries Science.

Maurice P. Lynch, Professor of Marine Science. A.B., Harvard University; M.A., Ph.D., College of William and Mary. Resource Management and Policy.

William G. MacIntyre, Professor of Marine Science. B.S., M.S., Ph.D., Dalhousie University. Physical Sciences.

Roger L. Mann, Professor of Marine Science. B.S., University of East Anglia; Ph.D., University of Wales. Fisheries Science.

John A. Musick, Professor of Marine Science. A.B., Rutgers University; M.A., Ph.D., Harvard University. Fisheries Science.

Bruce J. Neilson, Professor of Marine Science. B.A., M.S.E., M.A., Princeton University; Ph.D., The Johns Hopkins University. Resource Management and Policy.

Frank O. Perkins, Professor of Marine Science. B.A., University of Virginia; M.S., Ph.D., Florida State University. Fisheries Science.

Morris H. Roberts, Jr., Professor of Marine Science. B.A., Kenyon College; M.A., Ph.D., College of William and Mary. Environmental Sciences.

Gene M. Silberhorn, Professor of Marine Science. B.S., Eastern Michigan University; M.S., West Virginia University; Ph.D., Kent State University. Resource Management and Policy.

N. Bartlett Theberge, Jr., Professor of Marine Science. B.S., J.D., College of William and Mary; LL.M., University of Miami. Resource Management and Policy.

Kenneth L. Webb, Chancellor Professor of Marine Science. A.B., Antioch College; M.S., Ph.D., Ohio State University. Biological Sciences.

Richard L. Wetzel, Professor of Marine Science. B.S., M.S., University of West Florida; Ph.D., University of Georgia. Biological Sciences.

L. Donelson Wright, Chancellor Professor of Marine Science. B.A., University of Miami; M.A., University of Sydney; Ph.D., Louisiana State University. Physical Sciences.

Mohamed Faisal Abdel-Kariem, Associate Professor of Marine Science. B.V. Sci., M.V. Sci., Cairo University; D.V.M., University of Ludwig-Maximillian. Environmental Sciences.

John M. Brubaker, Associate Professor of Marine Science. A.B., Miami University; Ph.D., Oregon State University. Physical Sciences.

Fu-Lin Chu, Associate Professor of Marine Science. B.S., Chung Chi College; M.S., University of Rochester; Ph.D., College of William and Mary. Environmental Sciences.

Robert J. Diaz, Associate Professor of Marine Science. B.A., LaSalle College; M.S., Ph.D., University of Virginia. Biological Sciences.

David A. Evans, Associate Professor of Marine Science. B.A., M.A., Cambridge University; D.Phil., Oxford University. Physical Sciences.

John E. Graves, Associate Professor of Marine Science. B.S., Revelle College, University of California, San Diego; Ph.D., Scripps Institution of Oceanography, University of California, San Diego. Fisheries Science.

Robert C. Hale, Associate Professor of Marine Science. B.S., B.A., Wayne State University; Ph.D., College of William and Mary. Environmental Sciences.

John M. Hamrick, Associate Professor of Marine Science. B.C.E., Georgia Institute of Technology; M.S., Massachusetts Institute of Technology; Ph.D., University of California, Berkeley. Physical Sciences.

Carl H. Hershner, Associate Professor of Marine Science. B.S., Bucknell University; Ph.D., University of Virginia. Resource Management and Policy.

Howard I. Kator, Associate Professor of Marine Science. B.S., Harpur College; Ph.D., Florida State University. Biological Sciences.

James E. Kirkley, Associate Professor of Marine Science. B.S., M.S., Ph.D., University of Maryland. Fisheries Science.

Steven A. Kuehl, Associate Professor of Marine Science. B.A., Lafayette College; M.S., Ph.D., North Carolina State University. Physical Sciences.

Romuald N. Lipcius, Associate Professor of Marine Science. B.S., University of Rhode Island; Ph.D., Florida State University. Fisheries Science.

Jerome P.-Y. Maa, Associate Professor of Marine Science. B.S., M.S., National Cheng-Kung University; Ph.D., University of Florida. Physical Sciences.

Robert J. Orth, Associate Professor of Marine Science. B.A., Rutgers University; M.A., University of Virginia; Ph.D., University of Maryland. Biological Sciences.

Mark R. Patterson, Associate Professor of Marine Science. A.B., Harvard College; A.M., Ph.D., Harvard University. Biological Sciences.

Evon P. Ruzecki, Associate Professor of Marine Science. A.B., Knox College; M.S., University of Wisconsin; Ph.D., University of Virginia. Physical Sciences.

Beverly A. Weeks-Perkins, Associate Professor of Marine Science. B.A., Winthrop College; M.S., Tulane University; Ph.D., North Carolina State University. Environmental Sciences.

James E. Bauer, Assistant Professor of Marine Science. B.A., Boston University; M.S., State University of New York, Stonybrook; Ph.D., University of Maryland. Physical Sciences.

Elizabeth A. Canuel, Assistant Professor of Marine Science. B.S., Stonehill College; Ph.D., University of North Carolina. Physical Sciences.

Catherine J. Chisholm-Brause, Assistant Professor of Marine Science. B.A., Harvard University; M.S., Ph.D. Stanford University. Physical Sciences.

Rebecca M. Dickhut, Assistant Professor of Marine Science. B.S., St. Norbert College; M.S., Ph.D., University of Wisconsin, Madison. Physical Sciences.

Linda C. Schaffner, Assistant Professor of Marine Science. B.A., Drew University; M.A., Ph.D., College of William and Mary. Biological Sciences.

Peter Van Veld, Assistant Professor of Marine Science. B.S., University of North Carolina, Chapel Hill; M.A., College of William and Mary; Ph.D., University of Georgia. Environmental Sciences.

Wolfgang Vogelbein, Assistant Professor of Marine Science. B.S., Southampton College; M.S., California State University; Ph.D., Louisiana State University. Environmental Sciences.

Virginia Institute of Marine Science

All School of Marine Science faculty are also Virginia Institute of Marine Science faculty.

Iris C. Anderson, Professor of Marine Science. B.S., Colby College; S.M., Massachusetts Institute of Technology; Ph.D., Medical College of Virginia, Virginia Commonwealth University. Biological Sciences.

Leonard W. Haas, Associate Professor of Marine Science. A.B., Dartmouth College; M.S., University of Rhode Island; Ph.D., College of William and Mary. Biological Sciences.

Mark W. Luckenbach, Associate Professor of Marine Science. B.S., University of North Carolina; Ph.D., University of South Carolina. Biological Sciences.

Craig L. Smith, Associate Professor of Marine Science. A.B., The Johns Hopkins University; Ph.D., University of Florida. Environmental Sciences.

Thomas A. Barnard, Jr., Assistant Professor of Marine Science. B.A., Milligan College; M.A., College of William and Mary. Resource Management and Policy.

J. Emmett Duffy, Assistant Professor of Marine Science. B.S. Spring Hill College; M.S. University of Maine; Ph.D. University of North Carolina at Chapel Hill. Biological Sciences.

Carl H. Hobbs, III, Assistant Professor of Marine Science. B.S., Union College; M.S., University of Massachusetts. Physical Sciences.

John E. Olney, Assistant Professor of Marine Science. B.S., M.A., College of William and Mary. Biological Sciences.

James E. Perry, III, Assistant Professor of Marine Science. B.S., Murray State University; Ph.D., College of William and Mary. Resource Management and Policy.

Michael A. Unger, Assistant Professor of Marine Science.B.S., Michigan State University; M.S., Ph.D., College of William and Mary. Environmental Sciences.

Kevin P. Kiley, Instructor in Marine Science. B.S., Tufts University; M.A., College of William and Mary. Resource Management and Policy.

Jon A. Lucy, Instructor in Marine Science. B.S., University of Richmond; M.A., College of William and Mary. Fisheries Science.

Robert J. Lukens, Instructor in Marine Science. B.S., Massachusetts Institute of Technology. Physical Sciences.

Kenneth A. Moore, Instructor in Marine Science. B.S., Pennsylvania State University; M.S., University of Virginia. Biological Sciences.

Walter I. Priest, III, Instructor in Marine Science. B.S., Virginia Military Institute; M.S., Old Dominion University. Resource Management and Policy.

Martha W. Rhodes, Instructor in Marine Science. B.S., Virginia Polytechnic Institute and State University; M.A., Medical College of Virginia, Virginia Commonwealth University. Biological Sciences.

Jacques van Montfrans, Instructor in Marine Science. B.S., Florida State University; M.S., Florida Atlantic University. Fisheries Science.

Gary F. Anderson, B.S., Southampton College of Long Island University; M.A., College of William and Mary. Physical Sciences.

C. Scott Hardaway, B.A., M.S., East Carolina University. Physical Sciences.

John N. Posenau, B.A., Christopher Newport College. Physical Sciences.

Emeritus

Jay D. Andrews, Professor Emeritus of Marine Science. B.S., Kansas State College; M.A., Ph.D., University of Wisconsin. Fisheries Science.

Rudolf H. Bieri, Professor Emeritus of Marine Science. Dr.rer.nat. Johann Gutenberg University. Environmental Sciences.

Michael Castagna, Professor Emeritus of Marine Science. B.S., M.S., Florida State University. Biological Sciences.

George C. Grant, Professor Emeritus of Marine Science. B.S., University of Massachusetts; M.A., College of William and Mary; Ph.D., University of Rhode Island. Biological Sciences.

William J. Hargis, Jr., Professor Emeritus of Marine Science. A.B., M.A., University of Richmond; Ph.D., Florida State University. Biological Sciences.

Dexter S. Haven, Professor Emeritus of Marine Science. B.S., M.S., Rhode Island State College. Fisheries Science.

Maynard M. Nichols, Professor Emeritus of Marine Science. B.S., Columbia University; M.S., Scripps Institution of Oceanography; Ph.D., University of California at Los Angeles. Physical Sciences.

Willard A. Van Engel, Professor Emeritus of Marine Science. Ph.B., Ph.M., University of Wisconsin. Fisheries Science.

J. Ernest Warinner, III, Assistant Professor Emeritus of Marine Science. B.S., M.A., College of William and Mary. Environmental Sciences.

Frank J. Wojcik, Assistant Professor Emeritus of Marine Science. B.S., University of Massachusetts; M.S., University of Alaska. Fisheries Science.

The specially equipped DeHavilland-Beaver aircraft logged 300 hours in 1993 to support various research.

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

The Department of Biological Sciences

Iris C. Anderson

Professor of Marine Science

B.S., Colby College;
S.M., Massachusetts Institute of Technology;
Ph.D., Medical College of Virginia, Virginia Commonwealth University

RESEARCH INTERESTS

My primary research interest is in the area of microbial ecology with an emphasis on the study of microbial nitrogen and carbon cycling processes. The long term objective of my present research is to better understand the biological and physical processes that govern exchanges of dissolved inorganic and organic forms of nitrogen and carbon between uplands, wetlands, the atmosphere and coastal waters. The importance of such research is that it will provide an improved understanding of the role that wetlands and estuarine systems play in modifying anthropogenic inputs of nitrogen and carbon to coastal waters.

CURRENT STUDENT

Betty Berry, M.A. - Exchanges of DIN and DON between saltmarsh sediment and the overlying water.

CURRENT PROJECTS

- Development and application of ^{15}N-isotope dilution and tracer techniques for measuring rates of nitrogen cycling processes in intertidal and shallow marine ecosystems. Funded by NSF.
- Determination of the effects of anthropogenic disturbances on emissions of nitrogen trace gases to the atmosphere. Funded by USDA Forest Service.

SELECTED PUBLICATIONS

Anderson, I. C., M. A. Poth, J. Homstead, and D. J. Burdige. A comparison of NO and N_2O production by the autrophic nitrifier, *Nitrosomonas europaea,* and the heterotrophic nitrifier, *Alcaligenes faecalis fecalis.* Appl. Environ. Microbiol. 59:3525-3533.

Anderson, I. C. and M.A. Poth. 1989. Semiannual losses of nitrogen as NO and N_2O from unburned and burned chaparral. Global Biogeochem. Cycles. 3: 121-135.

Anderson, I. C., J. S. Levine, M. A. Poth, and P. J. Riggan. 1988. Enhanced emissions of biogenic nitric oxide and nitrous oxide from semi-arid soils following surface biomass burning. J. Geophys. Res. 93: 3893-3898.

Anderson, I. C. and J. S. Levine. 1987. Simultaneous field measurements of biogenic emissions of nitric oxide and nitrous oxide. J. Geophys. Res. 92:965-976.

Anderson, I. C. and J. S. Levine. 1986. Relative rates of nitric oxide and nitrous oxide production by nitrifiers, dentrifiers, and nitrate respirers. Appl. Environ. Microbiol. 51:938-944.

RESEARCH INTERESTS

My research interests center around understanding trophic dynamics and the functional importance of production in ecosystems, benthic boundary layer processes, and organism-sediment interactions, and how perturbations of these processes influence energy flow. Recently I have investigated the effects of low dissolved oxygen on trophic transfer of benthic secondary production and developed several methods for assessing environmental impacts which incorporate the functional aspects of benthic communities and remote sensing technology (sediment profile and underwater photography). I am striving to estimate the relative resource value of all the various estuarine and marine benthic habitat types for the dual purpose of quantifying energy flow between habitats and for developing environmentally sound management strategies. This research has led me to consider a landscape ecological approach to looking within and between systems for how the physical and biological processes interact. In addition, I am also interested in the application of the statistical and numerical methods to biological data. I am broadly interested in the ecology and taxonomy of estuarine and marine invertebrates with specialization in oligochaetes.

CURRENT PROJECTS

- Benthic processes on the Continental Slope off Cape Hatteras, NC. Funded by MMS.
- Development of rapid bioassessment methods for estuarine and marine habitats. Funded by EPA.
- Evaluation of the effects of eutrophication and oil pollution on marine ecosystems. Private funds from Swedish oil industry. Co-PI, R. Rosenberg, University of Göteborg.
- Energy flow through shallow estuarine habitats. General funds.
- Long-term benthic monitoring. General funds.
- Invertebrate museum curation and collecting. General funds.

CURRENT STUDENTS

Giancarlo Cicchetti, Ph.D. - Predator-prey energetics in shallow water habitats.
Elizabeth Hinchey, M.A. - Autecology of *Parapridnospio pinnata.*
Amanda Maxemchuk-Daly, M.A. - The influence of hypoxia on predator prey interactions.
Janet Nestlerode, M.A. - Estuarine environmental assessment using macrofauna.
Eric Wooden, M.A. - Benthic-Pelagic coupling.

SELECTED PUBLICATIONS

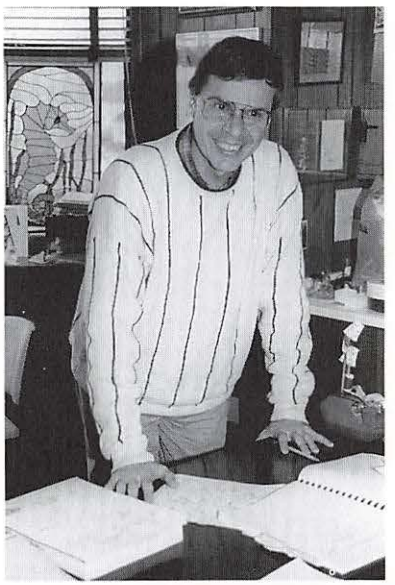
Diaz, R. J., L. J. Hannsson, R. Rosenberg, P. Gapcynski and M. Unger. 1993. Rapid assessment of sedimentological and biological characteristics of hydrocarbon pollution gradient. Water, Air and Soil Pollution. 66:251-266.

Rosenberg, R. and R. J. Diaz. 1993. Sulphur bacteria (*Beggiatoa* spp.) mats indicate hypoxic conditions in the Inner Stockholm Archipelago. Ambio 22:32-36.

Diaz, R. J. 1992. Ecosystem assessment using estuarine and marine benthic community structure. In: A. Burton (ed.), Contaminated Sediment Toxicity Assessment. Lewis Publ., Boca Raton. pp. 67-85.

Phil, L., S. P. Baden, R. J. Diaz, and L. C. Schaffner. 1992. Hypoxia-induced structural changes in the diet of bottom feeding fish and crustacea. Mar. Biol. 112:349-361.

Phil, L., S. P. Baden and R. J. Diaz. 1991. Effects of periodic hypoxia on distribution of demersal fish and crustaceans. Mar. Biol. 108:349-360.



Robert J. Diaz

Associate Professor of Marine Science

B.A., La Salle College;
M.S., University of Virginia;
Ph.D., University of Virginia

Hugh W. Ducklow

Glucksman Professor of Marine Science

A.B., Harvard College
A.M., Harvard University
Ph.D., Harvard University

RESEARCH INTERESTS

My specific research interest is in the roles of bacterioplankton in the ecology and biogeochemistry of estuarine, coastal, and open ocean plankton systems. This research area fits within a more general interest in the marine carbon cycle and the trophodynamic linkages which regulate the biological pump of carbon dioxide. Operationally, I measure bacterioplankton biomass, production, and substrate utilization in different habitats over a range of time and space scales to clarify how bacterioplankton participate in plankton biogeochemistry by converting dissolved and particulate carbon and nitrogen into biomass and transferring these elements to higher trophic levels or remineralizing them. Popularly, this is known as the "link-sink" problem of aquatic microbial ecology. I am also interested in a variety of modeling approaches ranging from network analysis to simulation, including coupling ecological and circulation models. The model results help us to assess and possibly verify the adequacy of our measurements.

CURRENT PROJECTS

- Bacterioplankton in the carbon system of the Equatorial Pacific Ocean. Funded by NSF, JGOFS project.
- Bacterioplankton dynamics in the Sargasso Sea. (Doctoral dissertation for Craig Carlson.) Funded by NSF (JGOFS).
- Physical-biological interactions in the Global equatorial surface layer. Subcontract from NASA. Goddard Space Flight Center.
- JGOFS: Bacterioplankton cycling of dissolved and particulate organic matter in theutrophic and ologotrophic production regimes of the Arabian Sea. Co-PI, Farooq Azam. Funding NSF(pending).

CURRENT STUDENTS

Fuh-Kwo Shiah, Ph.D. - Multiscale variability in bacterioplankton abundance and growth rate in temperate estuarine habitats.
Craig Carlson, Ph.D. - Bacterioplankton dynamics and DOC in the Sargasso Sea.
Alison Bryant, MSc. - Bacterioplankton dynamics: dependence on ecosystem dimensions. A mesocosm investigation.

SELECTED PUBLICATIONS

Ducklow, H. W. and F. K. Shiah. 1993. Estuarine Bacterial Production. Chap. 11, pp. 261-284 In: T. Ford, Ed., "Aquatic Microbiology: An ecological approach," London: Blackwell.

Ducklow, H. W. 1993. Bacterioplankton distributions and production in the Northwestern Indian Ocean and Gulf of Oman. September 1986. Deep-Sea Res. II. 40:753-771.

Hoppe, H. G., H. W. Ducklow, and B. Karrasch. 1993. Bacterial growth in the mesopelagic ocean depends on enzymatic hydrolysis of POM. Mar. Ecol. Progr. Ser. 93: 277-283.

Fasham, M J. R., J. L. Sarmiento, R. D. Slater, H. W. Ducklow and R. Williams. 1993. A seasonal three-dimensional ecosystem model of nitrogen cycling in the North Atlantic euphotic zone: A comparison of the model results with observations from Bermuda Station "S" and OWS "India." Glo. Biogeochem. Cycles. 7:379-416.

Sarmiento, J. S., R. D. Slater, M. J. R. Fasham, H. W. Ducklow, J. R. Toggweiler, and G. T. Evans. A seasonal three-dimensional ecosystem model of nitrogen cycling in the North Atlantic euphotic zone. Glo. Biogeochem. Cycles 7:417-450.

RESEARCH INTERESTS

My interests range broadly over the ecological and evolutionary mechanisms that generate and maintain diversity in natural communities.

At present, my research concentrates on the factors promoting speciation in a diverse clade of symbiotic coral reef shrimps, via complimentary studies of host use patterns, behavior, demography, and population genetics. I am currently working out protocols for sequencing mitochondrial DNA from sponge-dwelling shrimps, which will then be used to reconstruct the phylogeny of this group as a basis for tracing the history of changes in host use and life history characteristics in their radiation. A second focus of my research involves interactions among marine plants, herbivores (particularly amphipods and other small phytal invertebrates), and predators, with emphasis on the role of species diversity mediating ecological stability and interactions among trophic levels.

CURRENT PROJECT

- Host race speciation in sponge-dwelling shrimps (*Synalpheus*): mechanisms and phylogenetic consequences. Funded by NSF.

CURRENT STUDENTS

Dr. Duffy is new to the SMS faculty for the 1993-1994 academic year.

SELECTED PUBLICATIONS

Duffy, J. E. 1993. Genetic population structure in two tropical sponge-dwelling shrimps that differ in dispersal potential. Mar. Biol. 116:459-470.

Duffy, J. E. 1992. Host use patterns and demography in a guild of tropical sponge-dwelling shrimps. Mar. Ecol. Prog. Ser. 90:127-138.

Duffy, J. E. and V. J. Paul. 1992. Prey nutritional quality and the effectiveness of chemical defenses against tropical reef fishes. Oecologia 90:333-339.

Duffy, J. E. and M. E. Hay. 1991. Host plants as food and shelter: determinants of food choice in an herbivorous marine amphipod. Ecology 72:1286-1298.

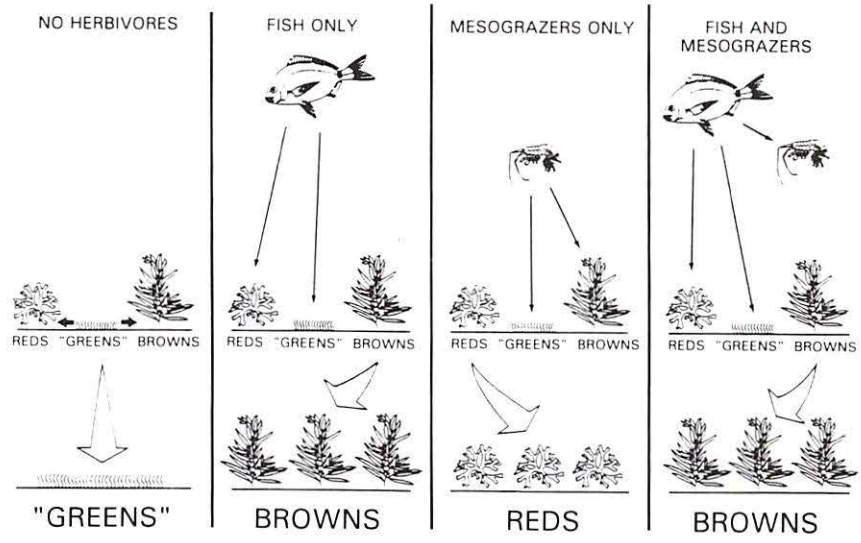
Duffy, J. E. 1990. Amphipods on seaweeds: partners or pests? Oecologia 83:267-276.

Duffy, J. E. and M. E. Hay. 1990. Seaweed adaptions to herbivory. BioScience 40:368-376.

J. Emmett Duffy

Assistant Professor of Marine Science

B.S,. Spring Hill College
M.S., University of Maine
Ph.D., University of North Carolina at Chapel Hill



Schematic diagram of the impacts of different functional groups of consumers on the organization of a benthic plant community.

Leonard W. Haas

Associate Professor of Marine Science

A.B., Dartmouth College;
M.S., University of Rhode Island;
Ph.D., College of William and Mary

RESEARCH INTERESTS

My broad research interests are marine microbial food web dynamics in estuarine and coastal plankton systems, and interaction of physical-hydrodynamic processes with planktonic physiological and ecological processes. These interests are expressed in the following specific research areas: growth and grazing dynamics of heterotrophic microflagellates; physiological ecology of coccoid cyanobacteria; use and development of epifluorescent microscopy for the study of planktonic microbes; nutrient and plankton dynamics in the Chesapeake Bay and tributaries.

CURRENT PROJECTS

- Seasonal and geographical patterns of nutrient limitation based on nutrient bioassay studies with water from stations throughout the lower Bay and tributaries. Funded by NOAA Coastal Oceans Program through the State Water Control Board.
- Studies on the growth and grazing dynamics of heterotrophic flagellates grazing coccoid cyanobacteria using size fractioned, bottle incubations. VIMS General funds.

CURRENT STUDENTS

Albert Curry, Ph.D. - Heterotrophic flagellate dynamics.
Angela Smith, M.S. - Dinoflagellate predator-prey dynamics in red tides.

SELECTED PUBLICATIONS

Hoepffner, N. and L. W. Haas. 1990. Electron microscopy of nanoplankton from the North Pacific central gyre. J. Phycol. 26:421-439.

Ray, R. T., L. W. Haas, and M. E. Sieracki. 1989. Autotrophic picoplankton dynamics in a Chesapeake Bay sub-estuary. Mar. Ecol. Prog. Ser. 51:273-285.

Haas, L. W. and B. W. Hill. 1987. Hypoxia in Virginia's Estuaries: an assessment of historical data. Pages 5-11 In G. B. Mackiernan (ed.) Dissolved oxygen in the Chesapeake Bay, processes and effects. Maryland Sea Grant Publication, College Park, Maryland.

Laws, E. A., D. G. Redalje, L. W. Haas, P. K. Bienfang, R. W. Eppley, W. G. Harrison, D. M. Karl, and J. Marra. 1984. High phytoplankton growth and production rates in oligotrophic Hawaiian coastal waters. Limnol. Oceanogr. 29:1161-1169.

Landry, M. R., L. W. Haas, and V. L. Fagerness. 1984. Dynamics of microbial plankton communities: experiments in Kaneohe Bay, Hawaii. Mar. Ecol. Prog. Ser. 13:458-466.

Haas, L. W. 1982. Improved epifluorescence microscopy for observing planktonic microorganisms. Ann. Inst. Oceanogr., Paris 58(S):261-266.

RESEARCH INTERESTS

My research interests are varied, but all involve aspects of environmental microbiology. One interest is ecology of bacterial and viral indicators of fecal contamination in estuarine waters and shellfish waters. The purpose of this research is to examine the validity of selected microorganisms or chemicals as indicators of sewage or fecal contamination, to evaluate their methods of detection, and to establish their applicability for regulatory use in the context of classifying waters for the harvesting of molluscan shellfish. This research focuses on the effects of various biological, physical, and chemical factors on the detection, survival, and persistence of these indicators. Recently, my colleagues and I have explored some of these same interests in the context of fecal contamination of groundwater and receiving waters originating from septic tanks, focusing on proposed viral indicators.

My other interests include nitrification and the rates and transformations of nitrogen in groundwater, the microbial degradation of organic compounds, especially petroleum hydrocarbons and their derivatives, and the microbiology of surface waters impacted by nonpoint source runoff.

CURRENT PROJECTS

- Manual of procedures for analysis of molluscan shellfish and growing waters. Funded by NOAA/NMFS.
- Evaluation of male-specific coliphages, a candidate human-specific indicator of fecal pollution of fecal contamination for shellfish-growing waters. Funded by NOAA/NMFS. Co-PI, M. Rhodes.
- The effects of watershed use on bacterial and nutrient water quality parameters in Lake Matoaka. Funded by College of William and Mary. Co-PI, M. Rhodes.
- Evaluation of selected bacteriophages as indicators of septic contamination of groundwater and estuarine waters. Funded by Virginia Water Resources Research Commission. Co-PI's: M. Rhodes, G. Johnson, G. Simmons.
- Use of a three-dimensional transport model to predict the distribution of a candidate viral indicator (male-specific coliphage) of fecal pollution from a large point source of sewage effluent: calibration and verification of the model based on field data. Funded by NOAA Sea Grant, Co-PIs: M. Rhodes and J. Hamrick.

CURRENT STUDENT

Terry Muller, M.A. - Topic to be determined.

SELECTED PUBLICATIONS

Hackney, C. R., M. B. Kilgen, and H. Kator. 1992. Public health aspects of transferring mollusks. J. Shellfish Res. 11:521-533.

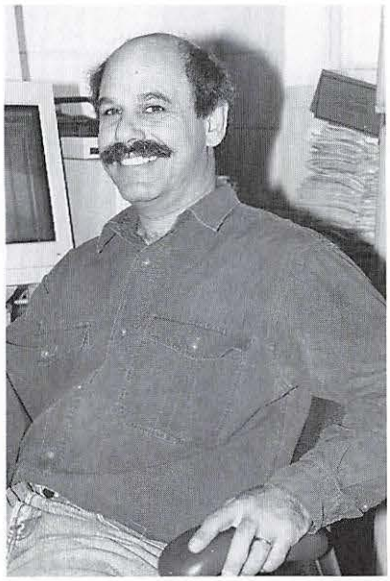
Kator, H. and M. W. Rhodes. Microbial and chemical indicators. In: M. Pierson and C. Hackney (eds.) *Environmental Indicators and Shellfish Safety*, Van Nostrand Reinhold, 64 pp (In press).

Kator, H. and M. Rhodes. 1990. Indicators and alternate indicators of growing water quality. In: D. Ward and C. Hackney (eds.) *Microbiology of Marine Food Products.* Van Nostrand Reinhold, New York, pp. 135-196.

Keopfler, E. T., H. I. Kator, R. L. Wetzel, L. W. Haas, and K. L. Webb. Spatial and temporal bacterioplankton dynamics during destratification in the James River Estuary, Virginia. Mar. Ecol. Prog. Series (in press).

Kator, H., L. J. Morris, E. T. Koepfler, and R. L. Wetzel. 1992. A rapid chromatographic method for recovery of ^{15}N-nitrite and nitrite produced by nitrification in aqueous samples. Limnol. Oceanogr. 37:900-907.

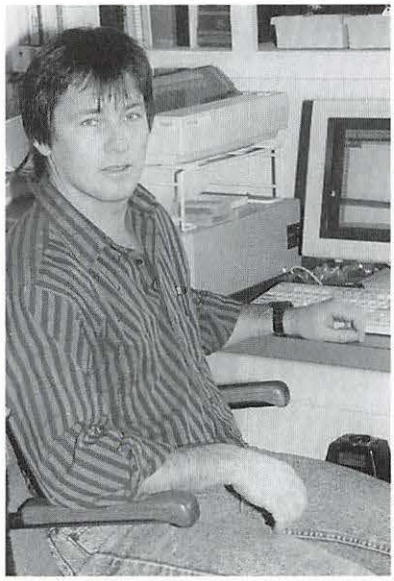
Rhodes, M. W. and H. Kator. 1992. Use of *Salmonella typhimurium* WG49 to enumerate male-specific coliphages in an estuary and watershed subject to nonpoint pollution. Water. Res. 25:1315-1323.



Howard Kator

Associate Professor of Marine Science

B.S., Harpur College; Ph.D., Florida State University



Mark Luckenbach

Director, Oyster Aquaculture Program
Scientist-in-Charge, Eastern Shore Lab

B.S., University of North Carolina;
Ph.D., University of South Carolina

RESEARCH INTERESTS

My primary research interests are in marine benthic ecology with particular emphasis on recruitment dynamics. Hydrodynamic effects on the recruitment, feeding and growth of marine benthos have occupied much of my research. Bivalve ecology, especially in relation to aquaculture, is an area of recent research interest for me. Additionally, I have research interests and ongoing projects in the areas of chemical defenses against predation in crustaceans, interactions between dinoflagellate blooms and shellfish, and environmental effects monitoring.

CURRENT PROJECTS

- Oyster Aquaculture Program. VIMS Initiative.
- Production of triploid oysters. Funded by NOAA. VA Center for Innovative Tech. Co-PI's, R. Mann, M. Castagna.
- Predictive growth model for oysters. Funded by NOAA, NCRI. Co-PI, R. Mann.
- Dinoflagellate bloom effects on oysters. Funded by NOAA, NMFS. Co-PI's, K. Sellner (Benedict Estuarine Lab.) and S. Shumway (Bigelow Lab).
- Oyster feeding, water flow & SAV survival. Funded by NOAA, NERRS. Co-PI's, R. Orth, R. Mann, K. Moore.
- Chemical defense against predation in the pea crab. General Fund. Co-PI, R. Orth.

CURRENT STUDENT

Deborah Harsh, M.A. - Co-major professor with R. Mann, SAV oyster interactions.

SELECTED PUBLICATIONS

Dauer, D. M., M. W. Luckenbach, and A. J. Rodi, Jr. 1993. Abundance biomass comparison (ABC method): effects of an estuarine gradient, anoxic/hypoxic events and contaminated sediments. Mar. Biol. (in press).

Luckenbach, M. W., R. J. Orth. 1992. Swimming velocities and behavior of blue crab (*Callinectes sapidus* Rathbun) megalopae in still and flowing water. Estuaries 15:186-192.

Luckenbach, M. W. and R. J. Orth. 1990. Chemical defense in Crustacea? J. Exp. Mar. Biol. Ecol. 137:79-87.

Luckenbach, M. W., R. J. Diaz, E. C. Zobrist, and C. H. Hutton. 1990. Evaluation of the benthic resource value of impounded and non-impounded tidal creeks in Virginia, USA. Ocean and Shoreline Management 14:35-50.

Cahalan, J. A., S. E. Siddall, and M. W. Luckenbach. 1989. Effects of flow velocity, food concentration, and particle flux on growth rates of juvenile scallops, *Argopecten irradians*. J. Exp. Mar. Biol. Ecol. 192:45-60.

Luckenbach, M. W. 1987. Effect of adult infauna on new recruits: implications for the role of biogenic structures. J. Exp. Mar. Biol. Ecol. 105:197-206.

RESEARCH INTERESTS

Studies of the ecology of estuarine aquatic angiosperms have been the focus of my research interests for the past number of years. Specifically, I have studied the relationships between these aquatic macrophyte systems and environmental factors that limit their growth and survival. These studies have been hierarchal in nature, ranging from the physiological response of individual organisms to ecosystem-level response of seagrass beds in the Chesapeake Bay. Similarly, tools for investigating these different levels have varied, from measurements of plant photosynthesis in chambers to bay-wide abundance changes using remotely sensed data and satellite imagery.

CURRENT PROJECTS

- Monitoring the distribution and abundance of Submerged Aquatic Vegetation (SAV) in Chesapeake Bay and Tributaries and Chincoteague Bay. Funded by EPA, USFWS, MD DNR, NOAA-CZM. Annual Program. Co-PI, R. Orth
- The Role of Light Attenuation Processes and Plant-Sediment Interactions in Determining Seagrass Survival. Funded by NOAA Coastal Ocean Program. Co-PI's, R. Orth, R. Wetzel. Cooperative program with Univ. of Maryland.
- Impacts of Oyster Aquaculture on SAV. Funded by NOAA-NERRS (National Estuarine Research Reserve System). Co-PI's, M. Luckenbach, R. Orth, R. Mann.
- Relations between variable water quality and SAV. Funded by EPA. Co-PI's, R. Orth, R. Wetzel.
- Water Quality-SAV Interactions, Restoration of SAV and Processes Affecting SAV. Reestablishment in Chesapeake Bay. Funded by VIMS Chesapeake Bay Initiative. Continuing Program. Co-PI's, R. Orth, R. Wetzel.

SELECTED PUBLICATIONS

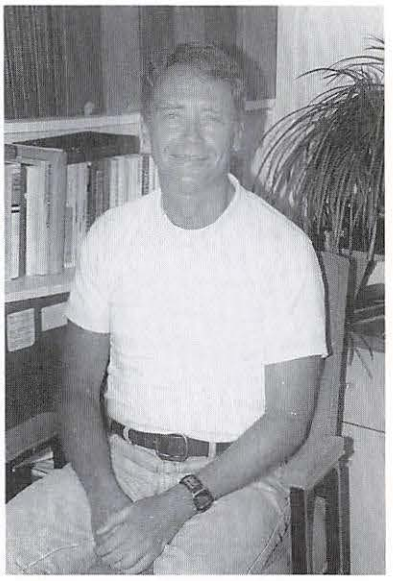
Moore, K. A., R. J. Orth, and J. F. Nowak. 1993. Environmental regulation of seed germination in *Zostera marina* L. (eelgrass) in Chesapeake Bay: Effects of light, oxygen and sediment burial depth. Aquat. Bot. 45:79-91.

Dennison, W. C., R. J. Orth, K .A. Moore, J. C. Stevenson, V. Carter, S. Kollar, P. K. Bergstrom, and R. Batiuk. 1993. Monitoring Chesapeake Bay water quality with seagrass distribution. Bioscience 43:86-94.

Orth, R. J. and K. A. Moore. 1988. Distribution of *Zostera marina* and *Ruppia maritima* sensu lato along depth gradients in the Lower Chesapeake Bay, U.S.A. Aquat. Bot. 32:291-305.

Orth, R. J. and K. A. Moore. 1988. Submerged aquatic vegetation in the Chesapeake Bay: A barometer of bay health. Pages 619-62. In Understanding the Estuary: Advances in Chesapeake Bay Research. CRC Publication No. 129.

Orth, R. J., and K. A. Moore. 1986. Seasonal and year-to-year fluctuations in the growth of eelgrass (*Zostera marina* L.) in the lower Chesapeake Bay, Virginia, USA. Aquat. Bot. 24:335-341.



Kenneth A. Moore

Instructor of Marine Science

B.S., Pennsylvania State University;
M.S., University of Virginia

Experiments relating underwater light to seagrass growth.

John E. Olney

Assistant Professor of Marine Science

B.S., M.A. College of William & Mary

RESEARCH INTERESTS

My broad research goals are to conduct taxonomic and systematic investigations of marine, estuarine and freshwater fishes with emphasis on early ontogeny; to promote an understanding of the biotic and abiotic factors that regulate egg, larval and juvenile fish survival; to conduct basic research on the reproductive ecology of marine, estuarine and freshwater fishes; and to develop ichthyoplankton techniques useful in assessment and monitoring of important fish stocks. These goals are expressed in the following specific research areas: ichthyology; taxonomy and systematics of marine fishes; identification of early life history stages of marine fishes; taxonomy and ecology of marine zooplankton; ecology of estuarine zooplankton communities; the role of physical processes in ichthyoplankton distribution and survival; survival and recruitment of fishes; population dynamics; fisheries-independent stock assessment; and fisheries management.

CURRENT PROJECTS

- Biology and Ecology of Striped Bass with Emphasis on the Physical and Biological Factors Affecting Survival of Early Life History Stages and Spawning Success. Funded by VIMS Chesapeake Bay Initiative. Continuing Program.
- Atlas of Pelagic Fish Eggs of Belize. Funded by Smithsonian Institution Caribbean Coral Reef Ecosystems Program (CCRE). Trophic Dynamics of Copepod Populations. Funded by NOAA Sea Grant (Maryland). Co-PI, Dr. J. Purcell (Horn Point Environmental Laboratory).
- Curation and Relocation of the VIMS Fish Collection. Funded by NSF. Co-PI, J. Musick.

CURRENT STUDENTS

Martin Cavalluzzi, Ph.D., Phylogeny of ephippid fishes.
Louis Daniel, Ph.D., Reproductive ecology of black drum.
Monica Lara, Ph.D., Ontogeny of sensory systems.

SELECTED PUBLICATIONS

Olney, J. E., G. D. Johnson, and C. C. Baldwin. 1993. Phylogeny of Lampridiform fishes. Bull. Mar. Sci. 52:137-169.

Olney, J. E. and E. D. Houde. 1993. Evaluation of *in-situ* silhouette photography in studies of estuarine zooplankton and ichthyoplankton. Bull. Mar. Sci. 52:845-872.

Olney, J. E., J. D. Field, and J. C. McGovern. 1991. Striped bass egg mortality, production, and female biomass in four Virginia rivers, 1980-1989. Trans. Amer. Fish. Soc. 120:354-367.

Govoni, J. J. and J. E. Olney. 1991. Potential predation on fish eggs by the ctenophore, *Mnemiopsis leidyi*, in and about the Chesapeake Bay plume. Fish. Bull. 89:181-186.

Markle, D. F. and J. E. Olney. 1990. Systematics of the pearlfishes (Pisces, Ophidiiformes). Bull. Mar. Sci. 47:269-410.

Olney, J. E. and G. Boehlert. 1988. Nearshore ichthyoplankton assemblages associated with seagrass beds in the lower Chesapeake Bay. Mar. Ecol.-Prog. Ser. 45:33-43.

RESEARCH INTERESTS

My current research focuses on the biology and ecology of seagrasses in the Chesapeake Bay. Specifically, I am interested in the dense and diverse faunal communities associated with seagrasses and the mechanisms for this high diversity, with particular relevance to one species, the blue crab, *Callinectes sapidus.* An aspect of this research has been to understand the recruitment dynamics of the early life history stages in these seagrass beds. I have also focused much of my work on the long term trends in the distribution and abundance of submersed aquatic vegetation communities in the Chesapeake Bay and the role of anthropogenic and meteorological factors in determining local and regional changes over different temporal scales. Another aspect of my work has concentrated on restoration efforts of one species, *Zostera marina,* and the role of seed dispersal in the colonization of new areas. Additionally, I am intensely interested in understanding the role of different water quality parameters on the growth and distribution of these plant communities in the Chesapeake Bay.

CURRENT PROJECTS

- Monitoring the distribution and abundance of Submerged Aquatic Vegetation (SAV) in Chesapeake Bay and Tributaries and Chincoteague Bay. Funded by EPA, USFWS, MD DNR, NOAA-CZM. Co-PI, K. Moore.
- Blue Crab Recruitment Dynamics: Determinants of Post-Settlement Population Size. Funded by NOAA-Sea Grant. Co-PI's, R. Lipcius, J. van Montfrans.
- Blue Crab Inter-regional Recruitment Program. Partial support from NOAA-Sea Grant. Co-PI's, R. Lipcius, J. van Montfrans.
- Impacts of Oyster Aquaculture on SAV. Funded by NOAA-NERRS. Co-PI's, M. Lukenbach, K. Moore, R. Mann.
- Water Quality-SAV Interactions, Restoration of SAV and Processes Affecting SAV Reestablishment in Chesapeake Bay. Funded by Chesapeake Bay Initiative and EPA. Co-PI's, K. Moore, R. Wetzel.
- Chemical Defense Mechanism in the Pea Crab. General funds. Co-PI, M. Luckenbach.
- Seagrass Habitat Restoration. Implications for Finfish Enhancement in Chesapeake Bay and its Tributaries. Funded by VA Recreational Saltwater Fishing Board. Co-PI's, K. Moore, J. van Montfrans.

CURRENT STUDENTS

Jamie Fishman, M.A. - Seed predation in *Zostera marina* (eelgrass).
Renee Pardiek, M.A. - Habitat selections by post-larval blue crabs.

SELECTED PUBLICATIONS

Orth, R. J., M. W. Luckenbach, and K. A. Moore. In press. Seed dispersal in a marine macrophyte: Implications for colonization and restoration. Ecology.

Neckles, H. A., R. L. Wetzel, and R. J. Orth. 1993. Relative effects of nutrient enrichment and grazing on epiphyton-macrophyte (*Zostera marina* L.) dynamics. Oecol. 93:285-295.

Dennison, W. C., R. J. Orth, K. A. Moore, J. C. Stevenson, V. Carter, S. Kollar, P. Bergstrom, and R. Batiuk. 1993. Monitoring Chesapeake Bay water quality with seagrass distribution. Bioscience 43:86-94.

Orth, R. J. and J. van Montfrans. 1990. Utilization of marsh and seagrass habitats by early stages of *Callinectes sapidus*: A latitudinal perspective. Bull. Mar. Sci. 46:126-144.

Orth, R. J. and J. van Montfrans. 1987. Utilization of a seagrass meadow and tidal marsh creek by blue crab, *Callinectes sapidus* Rathbun. I. Seasonal and annual variations in abundance with an emphasis on juvenile stages. Mar. Ecol. Prog. Ser. 4:283-294.

Robert J. Orth
Chair of Department

Associate Professor of Marine Science

B.A., Rutgers University;
M.A., University of Virginia;
Ph.D., University of Maryland

Mark R. Patterson

Associate Professor of Marine Science

A.B., Harvard College;
A.M., Ph.D. Harvard University

RESEARCH INTERESTS

I am broadly interested in biofluid mechanics, especially processes involving lower invertebrates and algae. Projects supported by NSF and NOAA have investigated how chemical engineering theory can be used to understand the importance of boundary layer formation in limiting photosynthesis and aerobic respiration in scleractinian corals, soft corals, sea anemones, sea urchins, kelp, and sponges. Recently, I have begun applying these techniques to analyses of coral bleaching patterns. I am also participating in an NSF-funded effort to model mathematically and measure the effects of internal waves on secondary productivity and population interactions at offshore pinnacles. My other research interests include suspension feeding biology, allometry, image processing, and the development of underwater electronic instrumentation for the measurement of environmental variables such as light, oxygen, and shear stress at microscales.

CURRENT PROJECTS

- Physical forcing of spatially distributed, meroplanktonic populations. Funded by NSF, GLOBEC Initiative.
- Internal waves in the rocky subtidal zone: effects of pulsed food and larval supply. Funded by NSF Biological Oceanography.
- Impact of sponge heterotrophy and autotrophy on water column processes of Lake Baikal's littoral zone. Funded by NOAA NURC.
- Simultaneous pumping for larval supply at replicate sites: an experiment in benthipelagic coupling by internal waves. Funded by NOAA NURC.

CURRENT STUDENTS

Adele J. Pile, Ph.D. - Physical biology of marine organisms.
Geoffrey C. Trussell, Ph.D. - Biomechanics and phenotypic plasticity.

SELECTED PUBLICATIONS

Wing, S. R. and M. R. Patterson. 1993. Effects of wave-induced lightflecks in the intertidal zone on photosynthetic efficiency in the macroalgae *Postelsia palmaeformis* and *Hedophyllum sessile* (Phaeophyceae). Mar Biol. 116:519-525.

Patterson, M. R. 1992. A mass transfer explanation of metabolic scaling relations in some aquatic invertebrates and algae. Science 255:1421-1423.

Patterson, M. R. 1992. A chemical engineering view of cnidarian symbioses. Am. Zool. 32:566-582.

Patterson, M. R. 1992. Role of the mechanical microenvironment in growth of sunflower (*Helianthus annuus*) seedlings. J. Exp. Bot. 43:933-939.

Sanderson, S. L., J. J. Cech, Jr., and M. R. Patterson. 1991. Fluid dynamics in suspension-feeding blackfish. Science 251:1346-1348.

Patterson, M. R. 1991. The effects of flow on polyp-level prey capture in an octocoral, *Alcyonium siderium*. Biol. Bull. 180:93-102.

RESEARCH INTERESTS

My research interests are focused on public health issues pertaining to estuarine microbiology. Specifically, I have investigated the fate of bacterial and viral indicators of fecal pollution and enteric pathogens in the estuarine environment. These studies also involve determining the significance of sunlight, salinity, temperature, indigenous microbiota, etc., on survival of enteric microorganisms. Recently I have been involved in evaluating alternate indicators of fecal pollution, e.g., male-specific RNA coliphages, *Bacteriodes fragilis* bacteriophages, and sorbitol fermenting *Bifidobacterium* spp., which are potentially more valid indicators of fecal contamination than traditional bacterial indicators, and are either specific to human sources or allow for distinguishing between human versus animal contributions. Currently I am studying the occurrence of these indicators in septic systems and their potential for detecting septage transport via groundwater into the estuary.

Additional research pursuits include ecological studies of mesophilic *Aeromonas* spp. with respect to eutrophication and public health implications.

CURRENT PROJECTS

- Evaluation of male-specific coliphages, a candidate human-specific indicator of fecal pollution of shellfish-growing waters. Funded by NOAA. Co-PI, H. Kator.
- The effects of watershed use on bacterial and nutrient water quality parameters in Lake Matoaka. Funded by College of William & Mary. Co-PI, H. Kator.
- Evaluation of selected bacteriophages as indicators of septic contamination of groundwater and estuarine waters. Funded by NOAA. Co-PI, H. Kator.
- Evaluation of methods for the enzymatic digestion of shellfish for the quantitative recovery of indicator microorganisms of public health significance. Funded by Louisiana Universities Marine Consortium. Co-PI, H. Kator.
- Identification of pollutant sources contributing to degraded water quality in Taskinas Creek Reserve. Funded by National Estuarine Research Reserve System. Co-PI, H. Kator.

SELECTED PUBLICATIONS

Rhodes, M. W. and H. Kator. 1994. Seasonal Occurrence of Mesophilic Aeromonas spp. as a function of biotype and water quality in temperate freshwater lakes. Wat. Res. (In press).

Kator, H. and M. W. Rhodes. 1994. Microbial and chemical indicators. In: C. Hackney and M. Pierson (eds.) *Environmental Indicators and Shellfish Safety*, Chapman and Hall Publishers, New York and London, pp. 30-91.

Rhodes, M. W. and H. Kator. 1992. Author's Reply to Comment on "Use of *Salmonella typhimurium* WG49 to enumerate male-specific coliphages in an estuary and a watershed subject to nonpoint pollution" by A. H. Havelaar. Wat. Res. 26:706.

Rhodes, M. W. and H. Kator. 1991. Use of *Salmonella typhimurium* WG49 to enumerate male-specific coliphages in an estuary and watershed subject to nonpoint pollution. Wat. Res. 25:1315-1323.

Kator, H. and M. W. Rhodes. 1990. Indicators and alternate indicators of growing water quality. In D. Ward and C. Hackney (eds.) Microbiology of Marine Food Products. Van Nostrand Reinhold, New York, pp. 135-196.

Rhodes, M. W. and H. I. Kator. 1990. Effects of sunlight and autochthonous microbiota on *Escherichia coli* survival in an estuarine environment. Curr. Microbiol. 21:65-73.

Rhodes, M. W. and H. Kator. 1988. Survival of *Escherichia coli* and *Salmonella* spp. in estuarine environments. Appl. Environ. Microbiol. 54:2902-2907.

Martha Rhodes

Instructor in Marine Science

B.S., Virginia Polytechnic Institute and State University;
M.S., Medical College of Virginia, Virginia Commonwealth University

Linda C. Schaffner

Assistant Professor of Marine Science

B.A. Drew University; M.A., Ph.D. College of William & Mary

RESEARCH INTERESTS

My primary interests are in the ecology of estuaries and coastal habitats. Estuaries are especially interesting and challenging environments in which to work because they are highly productive *and* highly variable in space and time. My studies have taken me to estuaries throughout the U.S. and Europe.

Research in my laboratory focuses on such areas as: the structure and function of soft-bottom communities; organism-sediment-flow interactions; couplings of benthic and pelagic systems; interactions between macro-organisms and microbes; role of disturbance in the dynamics of communities; and autecology and population dynamics of estuarine species, especially annelids and crustaceans. Many of the projects in which I am engaged are multidisciplinary.

CURRENT PROJECTS

- Biological mediation of the material fluxes across the sediment-water interface in estuaries and coastal systems. Funded by Office of Naval Research. Co-PI's, D. Wright, M. Patterson, J. Maa, S. Kuehl, R. Dickhut.
- Role of benthic communities in sedment-associated toxic chemical fate and transport in lower Chesapeake Bay the BENTOX project. Funded by NOAA EPA. Co-PI: R. Dickhut.
- Organic contaminant metabolism, production, elimination and bioavailability in benthic macrofauna of lower Chesapeake Bay. Funded by NOAA/EPA Co-PI, R. Dickhut.
- Effects of benthic macrofauna on nutrient transformations and cycling; VIMS Initiatives. Co-PI, M. Mayer (Rutgers University)
- Effects of hypoxia (low dissolved oxygen) and organic enrichment on behavior and growth of estuarine benthos; VIMS Initiative.

CURRENT STUDENTS

Patrick Lay, Ph.D., Trophic transfer of toxic organic contaminants from macrobenthos to demersal predators in lower Chesapeake Bay.

Michelle Thompson, Ph.D. Benthic-pelagic coupling in lower Chesapeake Bay: Ecology of a benthic suspension feeding polychaete, *Chaetopterus variopedatus.*

Caryn Huszai, M.A., Organic contaminant metabolite production processes in estuarine macrobenthos.

Michelle Horvath, M.A., Effects of demersal predators on sediment bioturbation.

SELECTED PUBLICATIONS

Seitz, R. D. and L. C. Schaffner. Population dynamics and secondary production of the polychaete *Loimia medusa.* Mar. Biol. (in press).

Olsen, C. R., I. L. Larsen, P. J. Mulholland, K. L. Von Damm, J. M. Grebmeier, L. C. Schaffner, R. J. Diaz, and M. N. Nichols. 1993. Equilibrium surface applied to particle sources and contaminant distributions in estuarine sediment. Estuaries 16:683-696.

.Schaffner, L. C., P. Jonsson, R. J. Diaz, R. Rosenberg, and P. Gapcynski. 1992. Benthic communities and bioturbation; history of estuarine and coastal systems: effects of hypoxia and anoxia. Total Environment Suppl. pp. 1001-1016.

Pihl, L., S. P. Baden, R. J. Diaz, and L. C. Schaffner. 1992. Hypoxia-induced change in the diet of bottom feeding fish and Crustacea. Mar. Biol. 112:349-361.

Schaffner, L. C. 1990. Small-scale organism distributions and patterns of species diversity: evidence for positive interactions in an estuarine benthic community. Mar. Ecol. Pro. Ser. 61:107-117.

Schaffner, L. C., R. J. Diaz, C. R. Olsen, and I. L. Larsen. 1987. Faunal characteristics and sediment accumulation processes in the James River Estuary, Virginia. Est., Coas. Shelf Sci. 25:211-226.

RESEARCH INTERESTS

My broad research interests are in interdisciplinary investigations related to energy flow and nutrient cycling in marine environments including: estuaries, salt marshes, seagrass systems and coral reefs. Additionally, I have interests in the physiology and nutrition of marine organisms, image analysis and remote sensing and in applying innovative technologies to marine science investigations.

CURRENT PROJECTS

- Minority Undergraduate Participation in Estuarine Food Chain Research. Funded by NSF.
- Nutritional Requirements and microencapsulated diets for hybrid striped bass larvae. funded by NOAA Sea Grant. Co-PI: F.L. Chu
- Demonstration of capability to detect and quantify surface chlorophyll from aircraftborne ocean color instruments in the York River, VA and Patuxent River, MD tributaries of the Chesapeake Bay. Funded by NOAA - Chesapeake Research Consortium, Co-PI: K. Kiley
- Tomales Bay Metabolism: C-N-P stoichi-ometry and ecosystem heterotrophy at the land-sea interface. Logistics support by NSF grants to Univ. Hawaii and San Francisco State University.

CURRENT STUDENT

Christopher Collumb, M.A. - 1993, Bacterivory compared in Tomales Bay, California and the York River, Virginia.

SELECTED PUBLICATIONS

Sieracki, M. E., and K. L. Webb. 1991. The applications of image analyzed fluorescence microscopy for characterizing planktonic bacteria and protists. Pages 77-100 In P. C. Reid et al. (eds.) Protozoa and their role in marine processes. NATO ASI Series, Vol. G25. Springer-Verlag Berlin.

Chu, F.-L. E., K. L. Webb, and J. Chen. 1990. Seasonal changes of lipids and fatty acids in oyster tissues (*Crassostrea virginica*) and estuarine particulate matter. Comp. Biochem. Physiol. 95A:385-391.

Sieracki, M. E., S. Reichenbach, and K. L. Webb. 1989. An evaluation of automated threshold selection methods for accurate sizing of microscopic fluorescent objects by image analysis. Appl. Environ. Microbiol. 55:2762-2772.

Webb, K. L. 1988. Comment on "nutrient limitation of phytoplankton growth in brackish coastal ponds" by Caraco, Tamse, Boutros, and Valiela (1987). Can. J. Fish. Aquat. Sci. 45:380-381.

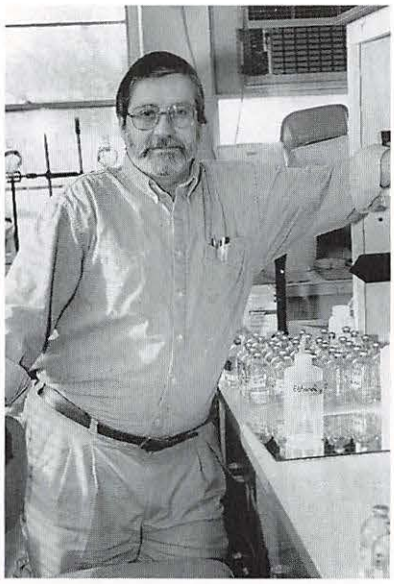
Evans, A. S., K. L. Webb, and P. A. Penhale. 1986. Photosynthetic temperature acclimation in two coexisting seagrasses, *Zostera marina* L. and *Ruppia maritima* L. Aquat. Bot. 24:185-197.

Webb, K. L. and F.-L. Chu. 1983. Phytoplankton as a food source for bivalve larvae. Pages 272-291 In G. D. Pruder, C. J. Langdon, and D. E. Conklin (eds.) Biochemical and Physiological Approaches to Shellfish Nutrition. Sp. Pbl. No. 2, World Mariculture Society, LSU, Baton Rouge.

Kenneth L. Webb

Chancellor Professor of Marine Science

A.B., Antioch College; M.S., Ph.D., Ohio State University



Richard L. Wetzel

Professor of Marine Science

B.S., M.S. University of West Florida;
Ph.D., University of Georgia

RESEARCH INTERESTS

My current research interests focus on aquatic primary production, nutrient cycling, and ecosystem simulation modelling and systems analysis. Particular attention has been given to understanding the physical and chemical controls on aquatic primary production, especially seagrasses, and the interactive effects of nutrients and grazing. Ecosystem simulation modelling has been applied as an integrative tool for synthesis of data over various time and space scales. Future plans call for directing these efforts at other systems to test their geographic application.

CURRENT PROJECTS

- Cycling of nitrogen in Chesapeake Bay and it's subestuaries with particular emphasis on sediment processes. General funds.
- Microbial nitrogen transformations in sediments and the water column of coastal salt marshes and estuaries. Funded by NSF.Co-PI, I. Anderson.
- Sediment oxygen and nutrient exchange in sediments of differing trophic status. Funded by NOAA National Estuarine Research Reserve System. Co-PI, R. Christian, East Carolina University.
- Light attenuation processes and sediment interactions relative to seagrass survival. Funded by NOAA Coastal Ocean Program. Co-PI's: K. Moore, R. Orth.
- The York River Regional Ecosystem. An institutional program implemented in 1991 to integrate chemical, geophysical and biological/ ecological information about large-scale ecosy-stems using the techniques of computer simulation modeling.
- Ecosystem process modelling of living marine resources in a management framework. Funded by EPA-Chesapeake Bay Program.
- Modelling studies on the effects of projected climate change in seagrass dominated ecosystems of the Gulf of Mexico. Funded by USFWS.

CURRENT STUDENTS

Betty Berry, M.A. - Nitrogen transformations in coastal salt marshes; application of N-15 tracer techniques.
Chris Buzzelli, Ph.D. - Spatial analysis of production in a temperate seagrass-salt marsh complex.
David Fugate, M.A. - Ecological modeling and systems analysis.
Bill Seufzer, M.A. - Measurement and simulation of eelgrass community metabolism; methods and models.

SELECTED PUBLICATIONS

Neckles, H. A., R. L. Wetzel, and R.J. Orth. 1993. Relative effects of nutrient enrichment and grazing on epiphyte- macrophyte (*Zostera marina* L.) dynamics. Oecol. 93: 285-295.

Kator, H. I., R. L. Wetzel, L. J. Morris, and E. T. Koepfler. 1992. A rapid chromatographic method for recovery of ^{15}N nitrite and nitrate produced by nitrification in aqueous samples. Limnol. Oceanogr. 4:900-907.

Christian, R. R. and R. L. Wetzel. 1991. Synergism between research and simulation models of estuarine microbial food webs. Microb. Ecol. 22:111-125.

Wetzel, R. L. and C. S. Hopkinson. 1990. Coastal ecosystem models and the Chesapeake Bay Program: philosophy, background and status. Pages 7-23 In M. Haire and E. C. Krome (eds.) Perspectives on the Chesapeake Bay 1990: Advances in Estuarine Sciences. CBP/TRS41/90, CRC, Inc., Gloucester Point, VA 23062.

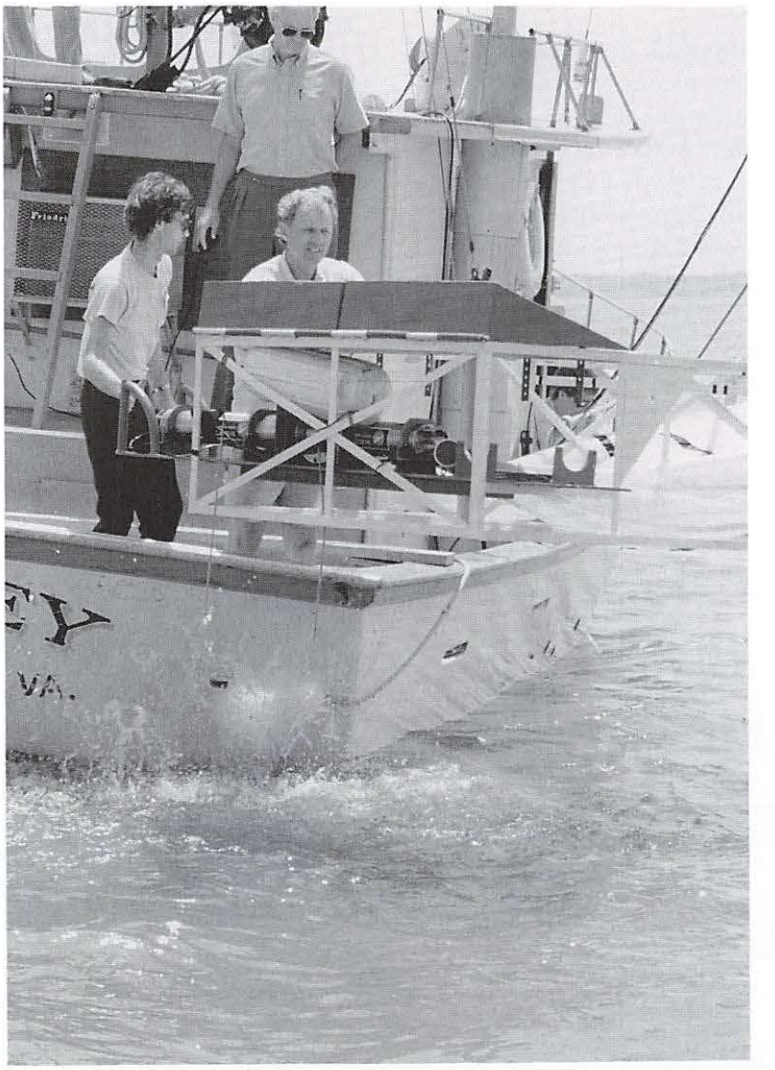
Hopkinson, C. S., R. L. Wetzel and J. W. Day. 1988. Simulation models of coastal wetland and estuarine systems: realization of goals. Pages 67-97 In W. J. Mitsch, M. Straskraba and S. E. Jorgensen (eds.) Wetland Modelling, Elsevier, New York.

Wetzel, R . L. and H. A. Neckles. 1986. A model of *Zostera marina* L. photosynthesis and growth: Simulated effects of selected physical-chemical variables and biological interactions. Aq. Bot. 26:307-323.

DEPARTMENT EQUIPMENT

The department maintains state-of-the-art equipment for conducting high quality field and laboratory research. Major facilities include numerous dry laboratories, a greenhouse with running seawater, a smaller wet laboratory facility, a seawater flume laboratory (located at the Wachapreague facility), an image analysis laboratory, and an above or below ambient temperature-controlled room. A variety of instrumentation, including light meters, radiometers, transmissometers, oxygen meters, anemometers, and other types of flowmeters, CTDs and dataloggers, is available for environmental monitoring. An excellent assortment of field sample collection gear is maintained by the department. Bottom samplers include an assortment of box cores, grabs, and piston-type cores. Sediment profile and surface cameras, as well as a bottom sled with video and still photography capabilities, allow rapid bottom mapping. Plankton nets and an in situ plankton camera allow characterization of water column communities, including larval fish.

Laboratory instrumentation includes: fluorometer, gas chromatography, an emission spectrometer for N-15 analysis, a UV-VIS spectrophotometer, and an elemental analyzer. Dissecting, compound and epifluorescence microscopes are maintained within the department. There is ready access to scanning and electron microscopes and complete preparation facilities. The department also has access to state-of-the-art water chemistry, geochemistry, and environmental chemistry laboratory facilities. Instrumentation and facilities are available for studies involving radioisotopes. The department also maintains close contacts with the physical sciences group and has access to their instrumentation and facilities for use in studies of both water column and benthic processes. Computer facilities range from in-lab laptop units to work stations supporting LANs to an institute-wide network. Computer users have ready access to external networks. Both DOS and MacIntosh systems are supported by the Institute's computer center.



The plankton camera, developed and engineered by scientists in the Department of Biological Sciences, enables researchers to photograph marine organisms at the same time specimens are collected. A CTD device records salinity, temperature, and depth simultaneously with each photograph.

ADMISSION POLICY

Applicants are encouraged to visit the campus and contact faculty members about specific research interests, funding opportunities, and program information. Admission to the School of Marine Science is highly competitive, and admissions procedures are designed to provide adequate information for objective evaluation by the faculty.

Applicants are required to submit:

1) One copy of the completed application form;
2) A non-refundable processing fee of $20. This fee is not credited to the student's account;
3) Three letters of recommendation;
4) Official transcripts of all college work. Final degree transcripts are required of admitted students before they matriculate;
5) Official scores of the Verbal and Quantitative sections of the Graduate Record Examination (GRE); and
6) International students whose primary language is not English are required to submit GRE-TOFEL scores.

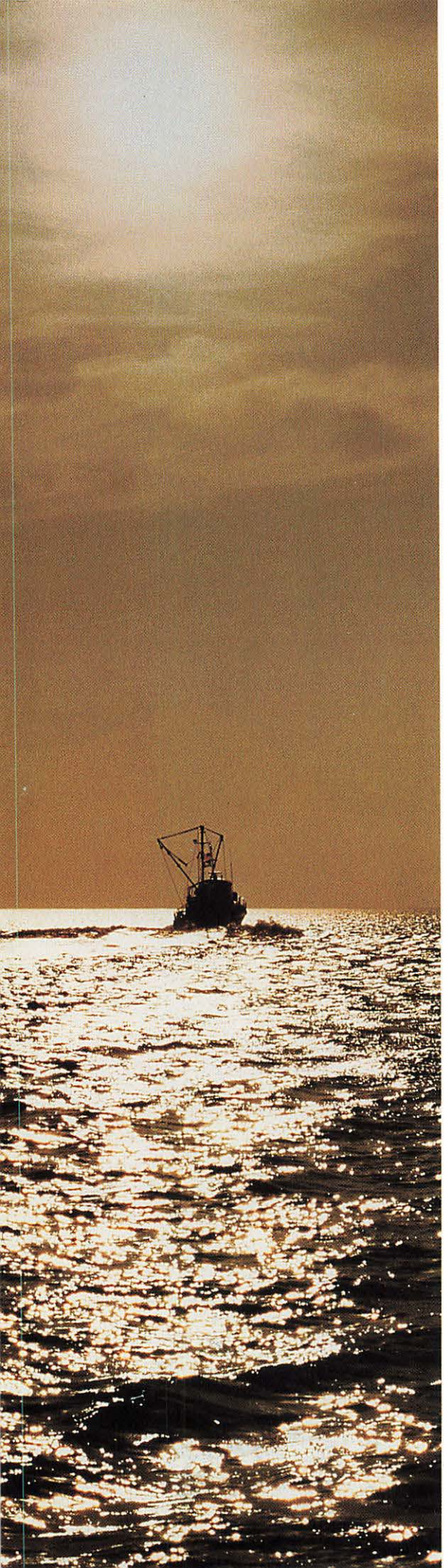
Requests for application forms as well as additional information should be directed to:

Dean of Graduate Studies
School of Marine Science
Virginia Institute of Marine Science
College of William & Mary
P.O. Box 1346
Gloucester Point, VA 23062
(804) 642-7000
Fax (804) 642-7097

GENERAL INFORMATION

Located in historic Tidewater Virginia, Gloucester Point is within 20 minutes of Williamsburg and Hampton/Newport News, Virginia. Major metropolitan areas of Norfolk, Virginia Beach, and Richmond are within easy driving distance. The semi-rural location offers diverse opportunities for outdoor activities from sailing, windsurfing, canoeing, and kayaking to biking, hiking, fresh and salt water fishing. SMS students may participate in a broad range of cultural and athletic activities on the nearby William & Mary campus.

A limited number of apartments for SMS graduate students are available on the William & Mary campus in Williamsburg. There are no housing facilities on the VIMS campus; however, most students live in Gloucester Point and surrounding communities. Rental housing is plentiful and rates are reasonable. It is advisable for students to have access to transportation as most living quarters are not within convenient walking distance of the campus.



The College of William & Mary
School of Marine Science
Virginia Institute of Marine Science