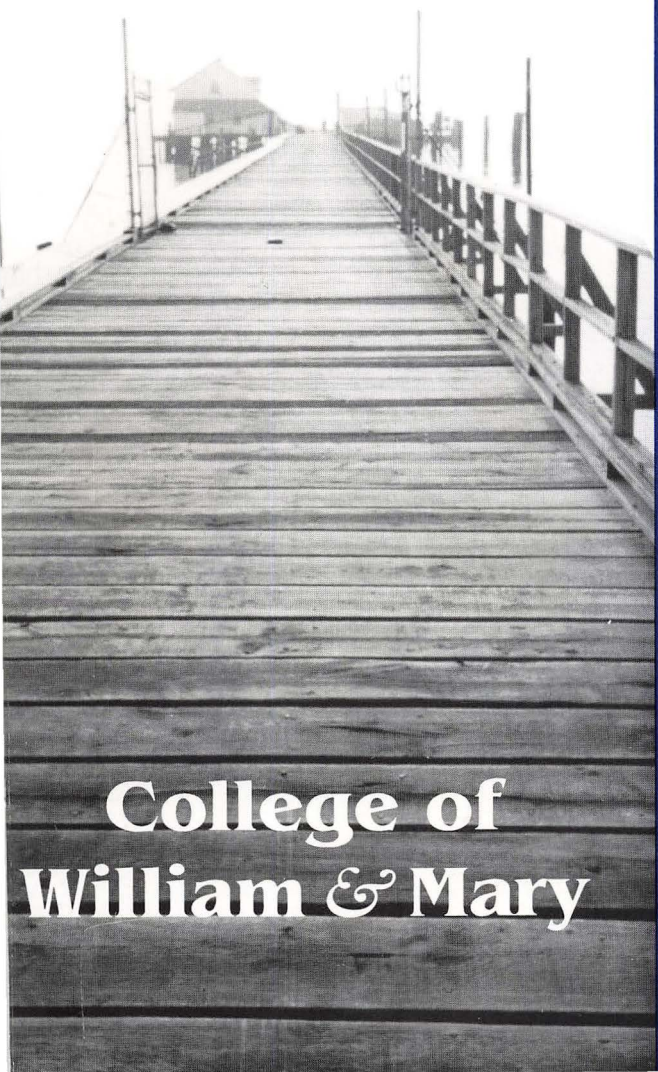
Graduate Catalog

1995-1996



College of William & Mary

School of Marine Science

August 1995

NOTE: This catalog provides announcements for the 1995-96 academic year. It is current until August 1996. The College reserves the right to make changes in the regulations, charges, and curricula listed herein at any time.

Catalogs are issued for College programs as follows:

Undergraduate
School of Business Administration
School of Education
Graduate Studies in Arts and Sciences
School of Marine Science
Marshall-Wythe School of Law
Summer Sessions
Special Programs

Graduate Catalog

1995-1996

School of Marine Science

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L. Donelson Wright . . . . . Acting Dean, School of Marine Science
Acting Director, Virginia Institute of Marine Science
John D. Milliman . . . . . Dean of Graduate Studies, School of Marine Science
Henry Aceto, Jr. . . . . Associate Dean of Graduate Studies, School of Marine Science
Robert J. Byrne . . . . . Director for Research and Advisory Services, Virginia Institute of Marine Science
Paul V. Koehly . . . . . Associate Director for Planning and Budget, School of Marine Science, Virginia Institute of Marine Science

Administrative Staff

A. H. "Hank" Humphreys, Jr. . . . . Executive Assistant to the Dean / Director
Linda F. Caporale . . . . . Assistant to the Director
Charles McFadden . . . . . Library Director
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Sue N. Presson . . . . . Student Records Coordinator
Sarah R. Hamrick . . . . . International Student Advisor
V. Zealon Stilley . . . . . Executive Secretary

Contents

Calendar

Fall Semester 1995

August

21	Mon.	Tuition and Fees for 1995 Fall Semester Due to SMS/VIMS Cashier
21-22	Mon. -Tues.	Orientation Period
21-22	Mon.-Tues.	General Registration & Registration for Incoming SMS Students
23	Wed.	FIRST DAY OF CLASSES: 8:00 am
23	Wed.	Beginning of Add/Drop Period for 1995 Fall Semester
30	Wed.	Last Day to Drop a Class for 1995 Fall Semester
31	Thurs.	Beginning of Period for Withdrawal from a Class with Grade "W"

September

1	Fri.	Last Day to Add a Class
1	Fri.	NOTICE OF CANDIDACY FORMS DUE FOR DECEMBER 1995 GRADUATION

October

6	Fri.	Mid-Semester (for grading purposes only)
7-10	Sat.-Tues.	Fall Break
27	Fri.	NOTICE OF CANDIDACY FORMS DUE FOR MAY 1996 GRADUATION
27	Fri.	Last Day to Withdraw from a Class with a Grade of "W" for 1995 Fall Semester

November

22	Wed.	Beginning of Thanksgiving Holiday: 8:00 am
27	Mon.	End of Thanksgiving Holiday: 8:00 am

December

1	Fri.	END OF CLASSES: 5 pm
2-3	Sat.-Sun.	Reading Period
4	Mon.	LAST DAY TO SUBMIT THESIS AND DISSERTATIONS FOR DECEMBER 1995 CONFERRAL OF DEGREES
4-5	Mon.-Tues.	Examinations
6	Wed.	Reading Period
7-8	Thurs.-Fri.	Examinations
9-10	Sat.-Sun.	Reading Period
11-12	Mon.-Tues.	Examinations
13	Wed.	Reading Period
14-15	Thurs.-Fri.	Examinations
26	Tues.	OFFICIAL DECEMBER GRADUATION DATE

Spring Semester 1996

January

15	Mon.	GENERAL REGISTRATION
15	Mon.	Tuition and Fees for 1996 Spring Semester Due to SMS/VIMS Cashier
17	Wed.	FIRST DAY OF CLASSES: 8 am
17	Wed.	Beginning of Add/Drop Period
24	Wed.	Last Day to Drop a Class for 1996 Spring Semester
26	Fri.	Last Day to Add a Class for 1996 Spring Semester

February

15	Thurs.	FINAL DAY TO FILE NOTICE OF CANDIDACY FORMS FOR MAY 1996 GRADUATION

March

1	Fri.	Mid-Semester (for grading purposes only)
2-10	Sat.-Sun.	Spring Vacation
22	Fri.	Last Day to Withdraw from Course with Grade "W" for 1996 Spring Semester
25-29	Mon.-Fri.	GRADUATE STUDENT REGISTRATION PERIOD

April

15-19	Mon.-Fri.	Open Add/Drop for Fall 1996 Semester
26	Fri.	END OF CLASSES: 5 pm
27-28	Sat.-Sun.	Reading Period
29	Mon.	LAST DAY TO SUBMIT THESIS AND DISSERTATIONS FOR MAY 1996 CONFERRAL OF DEGREES
29-30	Mon-Tues.	Examinations

May

1-3	Wed.-Fri.	Examinations
4-5	Sat.-Sun.	Reading Period
6-8	Mon.-Wed.	Examinations
12	Sun.	COMMENCEMENT

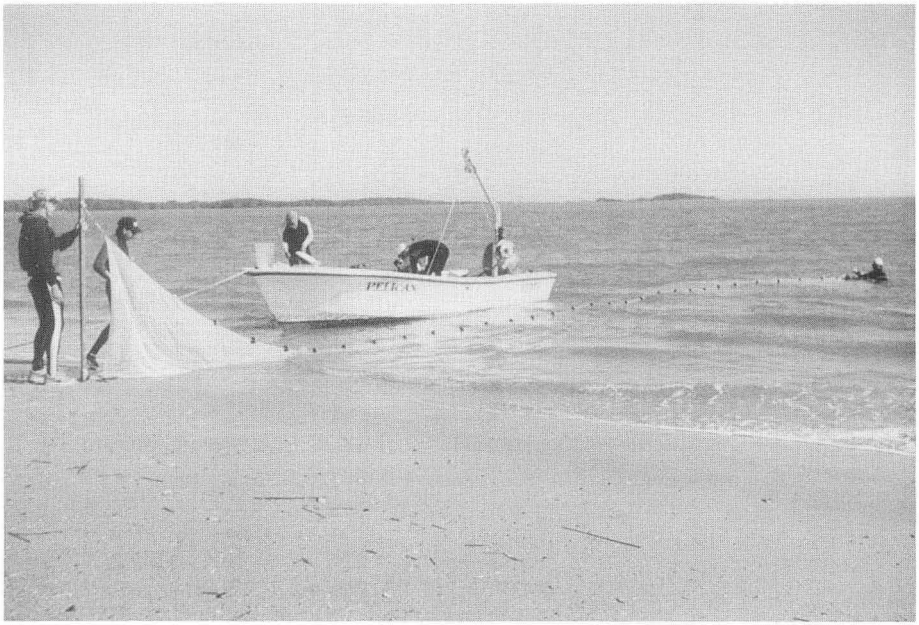
Summer Sessions 1996

SESSION I: MAY 27-JUNE 28 (Mon.-Fri.) (Mon., May 27 is an observed holiday)

SESSION II: JULY 1-AUGUST 2 (Mon.-Fri.) (Thurs., July 4 is an observed holiday)

May 6	Mon.	Summer School Bulletins Available (Mon.)
May 6-17	Mon.-Fri.	REGISTRATION FOR SUMMER SESSIONS
May 31	Fri.	NOTICE OF CANDIDACY FORMS DUE FOR AUGUST 1996 GRADUATION (Forms may be obtained from SMS Registrar's Office)
August 6	Mon.	AUGUST 1996 GRADUATION DATE

The historic "Ferry Pier" on the SMS campus.



Juvenile bluefish seine survey.

The College of William and Mary

The College of William and Mary in Virginia, founded in 1693, is the nation's second oldest institution of higher education. During its 301 year history, the College has built an eminent reputation for excellence in education. The College's commitment to a thorough, well rounded education through exploration, innovation and involvement is the source of institutional coherence. Today the College is national and international in its character and contributions. Students and faculty from diverse backgrounds are attracted to both the undergraduate programs and the various schools offering graduate studies.

The College of William and Mary is a small, residential university currently enrolling approximately 5,400 undergraduate and 2,300 graduate students. The School of Arts and Sciences offers Masters and Doctorate degrees in several departments. Graduate degrees may be pursued in four professional schools: Marshall Wythe School of Law; the School of Business Administration; the School of Education; and the School of Marine Science.

The College is accredited by the Southern Association of Colleges and Schools. In keeping with the College's mission as a state institution, a wide range of courses, seminars and programs both for credit and non-credit are offered on all campuses.

School of Marine Science Virginia Institute of Marine Science

Since their founding more than 50 years ago, the School of Marine Science and the Virginia Institute of Marine Science have functioned under a tripartite mission: to conduct independent research, to provide advisory services, and to provide education in the marine sciences. From 1940 to 1962, the academic program was conducted through the Department of Biology and Marine Science of the College of William and Mary. Since 1961, the School of Marine Science has functioned as a professional graduate school of the College of William and Mary. Faculty of the School of Marine Science are appointed from the larger faculty of the Virginia Institute of Marine Science. The School of Marine Science awarded its first masters degree in 1943 and inaugurated a doctoral program in 1964. Over the past 50 years more than 500 marine scientists have earned graduate degrees from the School of Marine Science.

At present the School of Marine Science has 130 graduate students; about one-half are working on their masters thesis and one-half are working on doctoral dissertations. In recent years the School has received more than 200 applications from prospective students. Approximately 30 enter the program each academic year.

Statement of Purpose for the School of Marine Science

The purpose of the School of Marine Science is to provide quality education and the scholarly research associated with advanced degree programs to students pursuing careers in marine science. The objective of the program is to provide a fertile and stimulating learning environment in which students can pursue their studies. This is accomplished by providing a comprehensive program in the basic principles of marine science and marine resource management, and close interaction with faculty actively involved in research and management issues.

Facilities

School of Marine Science students participate in graduate studies at an active, year-round research facility with approximately 300 scientists, support technicians and staff. The 35-acre main campus of the School of Marine Science of the Virginia Institute of Marine Science (SMS/VIMS) is located in Gloucester Point at the mouth of the York River, an important estuary and natural passageway to the Chesapeake Bay and Atlantic Ocean.

The Eastern Shore Laboratory offers access to embayments, salt marshes, barrier beaches and coastal waters. This facility, located in Wachapregue, about 2 hours from Gloucester Point, is an important center for research in bivalve aquaculture and houses a hatchery and nursery facilities in addition to nearby grow-out sites. A seawater flume laboratory is also located on the campus.

Various service centers and special programs at the SMS/VIMS complement and enhance the student's experience.

Library: Current holdings include more than 500 journal subscriptions, 44,000 volumes and 19,200 titles in addition to topographic maps, nautical charts and scientific archives. On-line networks provide access to marine science literature, Aquatic Fisheries Abstracts, Chesapeake Bay Bibliography and other data bases. Students have access to on-line catalogs at Swem Library on the main campus of William & Mary from the SMS/VIMS library.

Vessels: The SMS/VIMS maintains and operates a fleet of 40 vessels for research, equipped with flow-through sea water and sample collection-analysis labs and electronics labs. In addition to the 65-foot R/V *Bay Eagle*, 44-foot R/V *Langley*, and 29-foot R/V *Fish Hawk*, there is a sizable trailerable fleet. State-of-the-art electronic systems can be transferred among the smaller boats. A new diving facility, completed in 1992, includes a diver training room and classroom to support the 40-member dive team.

Aircraft: A DeHavilland Beaver airplane is equipped for reconnaissance, remote-sensing and aerial photography to support various research.

Information Technology and Networking Services Unit: Provides technical support for all computer platforms used on campus, in addition to maintaining a campus-wide backbone network linked to Internet and several local area networks (LANs).

Marine Advisory Service / Virginia Sea Grant Program: Serves as a liaison between commercial and recreational marine related industries providing them with access to the university system.

Chesapeake Bay National Estuarine Research Reserve System: VIMS is the lead agency in Virginia, with four designated sites preserved for estuarine research, monitoring, education, and conservation of key resources.

Center for Coastal Management and Policy (CMAP): In association with the Public Policy Program at William and Mary, CMAP combines education and research efforts with members of the College's law school, business school, and departments of economics and government. The program also maintains a Comprehensive Coastal Inventory to generate a constantly updated inventory of tidal shorelines in Virginia.

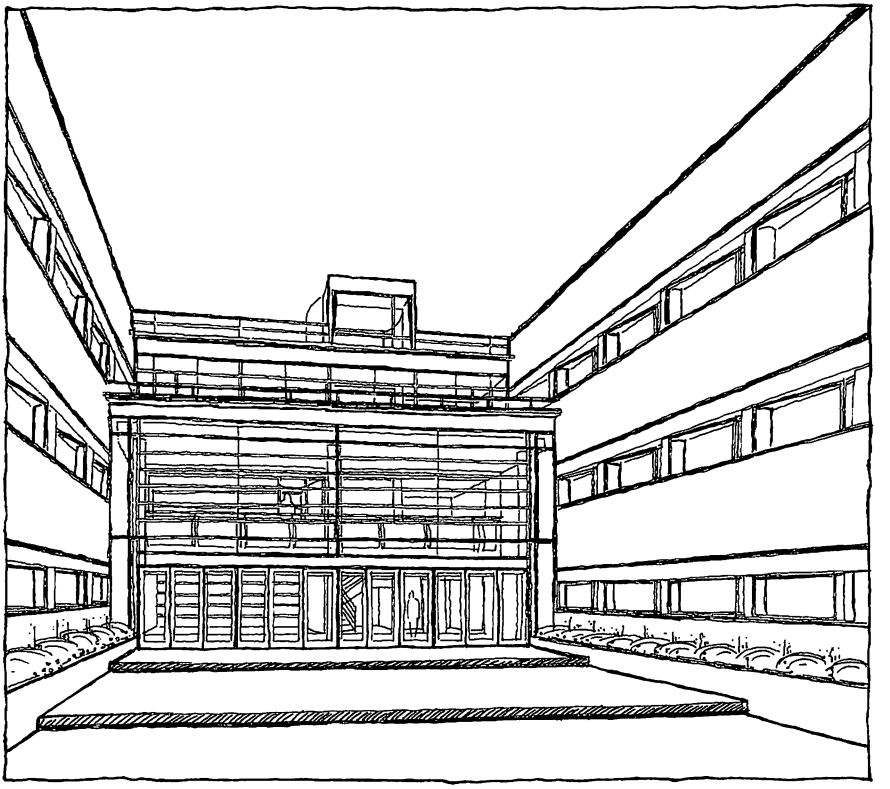
Students examine benthic samples taken at Wachapreague, Virginia.

Oyster Hatchery / Algae Culture Lab: Provides breed stock for class labs, research, conditioning and selective breeding experiments. Specimens of any specified size are provided year-round. This lab also houses the largest algae culture lab on the East Coast. Virtually any kind of algae can be produced for research or as a food source.

Nutrient Lab: Provides analytical services to both students and scientists. Water samples can be analyzed for physical measurements, suspended solid concentrations, and concentrations of chlorophyll and nutrients. Sediment and tissue samples can be analyzed as well.

Nunnally Hall: Completed in 1992, Nunnally houses the extensive fisheries collection that includes approximately 85,000 specimens in 247 families.

Marine Chemistry and Toxicology Building: Scheduled for completion in the fall of 1996, this 60,000 sq. ft. building will house portions of three departments with labs for chemistry, geochemistry, toxicology, pathobiology, microbiology, genetics, physiology, planktology, nutrient cycling and parasitology.



The Marine Chemistry & Toxicology Building will include labs and offices for approximately 20 faculty members and 25 graduate students.

School of Marine Science Faculty

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

Fu-Lin Chu, Professor of Marine Science. B.S., The Chinese University of Hong Kong; M.S., University of Rochester; Ph.D., College of William and Mary. Environmental Sciences.

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.

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.

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

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.

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.

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

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

Peter Van Veld, Associate 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.

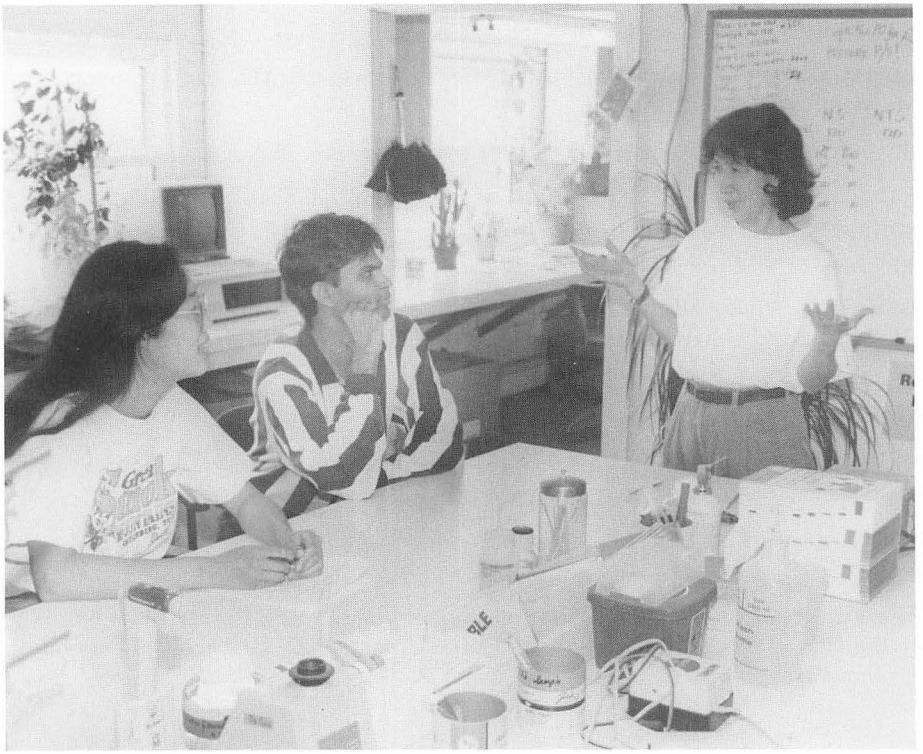
James E. Bauer, Assistant Professor of Marine Science. B.A., Boston University; M.S., State University of New York, Stonybrook; Ph.D., University of Maryland. Physical Sciences.

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.

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

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



Student-faculty interaction at the School of Marine Science ranges from impromptu teaching sessions to the weekly seminar series.

Virginia Institute of Marine Science Faculty

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.

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.

Jane A. Lopez, B.A., James Madison University. Director of Sponsored Programs.

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.

Graduate Study Programs

The primary focus of SMS faculty research and expertise is coastal and marine environments from estuaries to the continental slope. In addition to their teaching and basic research, many of the faculty are actively engaged in applied research of direct concern to industry and regulatory/management agencies. As such, students often find that their assistantship duties and/or research topics bring them into close contact with researchers in other departments at SMS and at William and Mary, marine related industries, and state, regional, and federal management agencies.

Based on the primary academic and research disciplines represented at SMS/VIMS, graduate studies are offered in five areas.

Biological Sciences

The Department of Biological Sciences includes a diverse group of biologists and ecologists working in a variety of disciplines from microbiology and taxonomy to ecosystem modeling. Scientists in the department are engaged in research aimed at elucidating the temporal and spatial patterns and processes controlling benthic, nektonic, and planktonic systems. The research is oriented toward understanding the basic driving forces in these communities on local and global scales.

Major Programs

Benthic Ecology: Studies focus on the major processes governing the structure and function of benthic systems. Component processes are addressed using a variety of approaches, ranging from molecular genetic studies of evolutionary relationships among species to interdisciplinary studies of organisms or communities interacting with their environment. In most cases research is focussed on benthic systems of the land-sea margins, including tidal freshwater, estuarine and coastal regions. On-going research programs include studies of proc-

Graduate Study Programs

esses influencing recruitment, growth and production of benthic organisms; linkages between benthic and pelagic systems through processes such as nutrient cycling and tropic transfer; functional role of estuarine benthic communities in the transport and fate of materials such as sediments, organic matter and contaminants.

Plankton Processes: Studies stress interdisciplinary research in several areas. Long-term research focuses on trends in species composition and/or abundance in relation to eutrophication and nutrient enrichment. Short-term changes in phytoplankton processes, including trophic relationships, are also investigated. Cooperative studies with Fisheries scientists focus on processes related to larval fish dynamics. Growth and grazing dynamics of heterotrophic microflagellates, physiological ecology of coccoid cyanobacteria and heterotrophic bacteria are studied.

Nutrient Cycling: Studies focus on the spatial and temporal control of phytoplankton production by either phosphorus or nitrogen, addressing nitrogen cycling processes with the use of stable isotopes, and investigating the impact of these processes upon the food web. Sediment-related processes and exchange with overlying water also form a core research area within the program.

Macrophyte Ecology: Studies concentrate on submersed 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 response to environmental variability, plant growth and productivity, carbon and nitrogen cycling and ecosystem simulation modeling. The program encourages multi-investigator and multi-institutional collaborative efforts.

Physical Biology: Interdisciplinary studies utilize methods from fluid and solid mechanics, and heat and mass transfer theory, to investigate food capture, bioenergetics, primary and secondary production, and allometry in invertebrates and algae. On-going projects include the effects of internal waves on secondary production at seamounts (Gulf of Maine), flow modulation of coral bleaching (Caribbean), organism-sediment-flow interactions (Chesapeake Bay), and impact of sponges on water column processes (Lake Baikal).

Ecosystem Modeling: The program develops and uses digital computer simulation models as an integrative and synthetic tool in ecosystem's analysis. Current programs include modeling studies of both temperate and tropical seagrasses, the dynamics of littoral zones in estuaries, estuarine plankton-nutrient interactions, sediment nitrogen cycling processes with an emphasis on microbial transformations. Working with hydrodynamic and water quality modelers, a general goal of the program is to develop linked models that address both basic and applied ecological management questions.

Ichthyoplankton Ecology and Systematics: Studies on the distribution and abundance of fish eggs and larvae in temperate and tropical seas investigate factors affecting survival and recruitment. Ichthyoplankton surveys form the basis of population dynamics and stock assessment, but also supply materials for the study of ontogeny and evolutionary relationships of bony (teleostean) fishes.

Evolutionary Ecology: Research focuses on the ecological and evolutionary mechanisms that generate and maintain diversity in natural communities. Integrating methods from experimental ecology, behavior, demography, and molecular genetics, studies concentrate on the evolutionary consequences of resource use patterns. Current projects address the role of grazer diversity in seagrass ecosystem function (Chesapeake Bay), evolutionary consequences on symbiosis in coral-reef shrimp (Caribbean), and phylogenetic analysis of the adaptive radiation of freshwater amphipods (Lake Baikal, Siberia).

Research Facilities

The department is well equipped with modern laboratory and field instrumentation in support of Biological Sciences. Various laboratories are equipped with running salt water. Major equipment includes gas chromatographs fitted with various detectors, ^{15}N-emission spectrometer, an alpkem auto-analyzer for ten water chemistries, computer-assisted image analysis hardware, a remote sensing imaging processor, underwater spectral radiometer, Li Cor light sensors and data loggers, spectrophotometer, sediment profile cameras, box corer and benthic grabs, underwater video, hydrolabs, and a seawater flume. Greenhouses are available for research on macrophytes.

Preparatory Studies

A solid background in modern biology and basic science courses is required. This background should include mathematics through calculus, a year of statistics, physics and chemistry including organic and biochemistry, as well as contemporary biology courses. A foreign language such as German, French, Russian or Spanish is recommended.

Typical Course of Study

Students in the Biological Sciences area must include in their programs the required core courses as well as the advanced biological course. Additionally, courses related to the student's area of specialization should be included as appropriate, e.g. plankton and microbiology for specialization related to small planktonic organisms; marine benthos and secondary production of invertebrates for those interested in benthic specializations. Theoretical ecology, ecological modeling and computer applications should be included in any biological program that relies on modeling or theoretical mathematical formulations.

Environmental Sciences

The Department of Environmental Sciences combines the expertise of chemists and biologists to study the fate and effects of hazardous substances and pathogenic organisms in estuarine and marine systems. Within the Department, faculty backgrounds include environmental chemistry, biochemistry, toxicology, histopathology and immunology. Collaboration within this multidisciplinary group provides both faculty and students the opportunity to obtain a more complete understanding of how toxic chemicals and pathogens move through the environment, what reactions they undergo, and how toxic chemicals and pathogens affect aquatic organisms.

The research focuses on the fate and effects of pollutants in the estuarine and marine environments, the mechanisms by which pathogens invade and kill their hosts and the mechanisms by which hosts resist or defeat their pathogens. Understanding the underlying mechanisms is emphasized, although much of the research performed has direct practical applications. By their nature, many pollution- and disease-related problems require an interdisciplinary approach. As a consequence, students from a variety of fields work in this area.

Major Programs

Environmental Chemistry: Sources, distribution, transport, fate and bioavailability of pollutants are studied in marine and estuarine environments. Interactions of toxic chemicals with marine life are explored through collaboration of chemists and biologists within the department. New techniques are developed to determine the identities and concentrations of anthropogenic compounds and their breakdown products. Computer programs are developed to improve data collection, manipulation and retrieval.

Toxicology: In this program, mechanisms of uptake, distribution, biotransformation and clearance of toxicants are examined as well as effects of toxicants on the health and survival of marine organisms. Among the effects studied are disruption of immunocompetence, carcinogenesis, alterations in cell growth, reproduction and survival. Laboratory and field investigations focus on biological responses and adaptations of marine organisms to pollutants.

Pathobiology: Abnormalities in structure and function at the cellular and organismal level are examined as responses to infectious agents and chemicals. Techniques of study include gross examination, detailed electron and light microscopy, biochemical and immunological analysis. The immune systems in fish and shellfish are studied on the molecular, cellular and whole animal level. Several areas of specialization are supported: immunotoxicology, cellular immunolgy, immunochemistry, vaccination, and immunodiagnosis. These and other techniques are applied in three principle subprograms: carcinogenesis, oyster diseases, and fish diseases.

Research Facilities

The Environmental Sciences Department is equipped with state-of-the-art instrumentation for studies of environmental chemistry, toxicology, immunology and pathology. Instrumentation includes mass spectrometers, high-resolution gas chromatographs, high performance liquid chromatographs, scanning and transmission electron microscopes, power supplies and gel apparati for biochemical and molecular biological studies, and a monoclonal antibody facility. The toxicologists maintain several saltwater laboratories with flowing estuarine water for holding and exposing aquatic fish and invertebrates. Colonies of mysids and amphipods are maintained for toxicity tests (short- and long-term). In addition, cultures of hepatocancerous and other cell lines are maintained under sterile conditions.

Preparatory Studies

Strong written communication skills, one year of organic chemistry, basic training in statistics and familiarity with computer usage recommended.

Typical Course of Study

The educational program of the Department of Environmental Sciences is closely related to its research activities on the fate and effects of chemical contaminants in aquatic ecosystems. The Department takes a multidisciplinary approach incorporating concepts of chemistry, toxicology, immunology and disease processes. The purpose of the educational program is to prepare students for careers as scientists or managers. Because of the interdisciplinary nature of the research and education program, incoming students are expected to have strong backgrounds in biology and chemistry. Following completion of this requirement, most students will focus on one of two tracks (environmental chemistry or biology/toxicology). It is expected that students in the environmental chemistry track will be encouraged to take Environmental Chemistry (MS 563) while those in the biology/toxicology track will take Aquatic Toxicology (MS 564). The remainder of the upper level courses will be selected to meet the student's individual needs. For environmental chemistry track students, many of these courses will be offered by the Department of Physical Sciences.

Fisheries Science

This program encompasses a broad range of studies in ecology, population biology, pathology and genetics. While traditional organismal biology continues to be the mainstay of activities, molecular biology plays an increasing role in departmental research. The fisheries genetics programs address a variety of problems from regional to global in scope. The integration of the ever expanding databases produced by these studies provides the opportunity to improve understanding of individual stocks for management purposes and synthetic multispecies models to define more clearly the roles of these organisms in marine ecology.

Major Programs

Crustacean Ecology: Behavioral ecology, population dynamics and recruitment mechanisms of blue crabs in Chesapeake Bay, and of spiny lobsters in the Caribbean. Emphasis on predator-prey interactions, with additional concentration on population and fisheries modeling, the ecology of natural and artificial reef systems, and the ecology of tropical fish and queen conch.

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

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

Fish and Shellfish Pathology: Systematics, life cycles, ecology, pathology and control of important disease agents in the Chesapeake Bay region. Emphasis is on protozoan parasites of oysters, blue crabs and fishes.

Finfish Ecology: Research on the population dynamics, recruitment, stock structure and life history of marine, estuarine and anadromous fishes; based on sampling fisheries landings, extensive research surveys and tagging studies. Information collected in this program area is directly applied to fisheries management by state and regional agencies.

Chondrichthyan Biology: Studies of comparative morphology (drag-reducing mechanisms, electroreception, etc.) of sharks and their relatives; population dynamics, reproduction, feeding strategies and energetics of coastal and deep-sea sharks; shark fishery management problems.

Sea Turtle Ecology: Research on distribution, abundance, ecology and energetics of sea turtles; behavior and migration studies using sonic, radio and satellite tracking; studies on nesting and sex ratios; population studies using aerial surveys. The SMS is the Sea Turtle Stranding Center for Virginia.

Systematics: Research on the morphology, evolution, taxonomy and zoogeography of various finfish groups. Studies involve both larval and adult characters.

Fisheries Genetics: Research involving the application of molecular genetic techniques to address problems in fisheries science. The scope of studies includes: analyses of stock structure; the use of molecular characters to identify the early life history stages of marine organisms; and the evaluation of taxonomic and biogeographic hypotheses with molecular genetic information. Current projects range from investigations of estuarine to pelagic organisms, including oysters, bluefish, sharks, tunas and billfishes.

Research Facilities

The fish population laboratory has available automated fish measuring boards that electronically record and store length and bionomic data as they are being collected. The age and growth laboratory has computerized scale projectors and a Biosonics digitizing system used in ageing and morphometric studies. The larval fish laboratories house a reference collection containing over 120 families of marine, estuarine and freshwater fishes. Faculty and students in the Larval/Fish Program utilize an *in situ* silhouette plankton camera as well as more traditional plankton gear in their field studies. The Crustacean Ecology and Bivalve Ecology programs also have dedicated laboratories.

Other major facilities include a modern fisheries genetics laboratory with full capability for protein and DNA analyses, and a catalogued fish collection containing approximately 85,000 species in 247 families. This research and teaching collection incorporates extensive holdings from Chesapeake Bay, the Middle Atlantic Bight, and from Appalachian freshwater habitats as well as an internationally recognized deep-sea fish collection.

Two wet lab facilities are available to Marine Fisheries faculty and students. The general wet lab contains a flow-through system with several wet tables and tanks. In addition, a special greenhouse/wet lab houses the 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.

Preparatory Studies

Students interested in graduate study in Fisheries Science should have a solid undergraduate background in biology including: physiology, biochemistry, comparative morphology or developmental biology, histology or cytology, genetics, ecology and related topics, and evolutionary biology. College physics, chemistry (through organic) and math through calculus are required. Courses in statistics, marine biology and fishery biology may be helpful but are not prerequisites.

Typical Course of Study

In addition to the core courses required of all SMS graduate students, Fisheries students are required to take a second quantitative course such as Experimental and Quantitative Ecology (MS 667), Design and Analysis of Experiments (MS 669), Multivariate Analysis and Time Series (MS 625), or Applied Regression and Forecasting (MS 672); a third upper level quantitative course is also recommended. Among the courses offered by the Fisheries faculty are Fisheries Climatology (MS 665), Ichthyology (MS 666), Diseases of Marine Organisms (MS 566), Malacology (MS 668), Marine Fisheries Science (MS 528), Culture and Physiology of Marine Organisms (MS 571), Early Life History of Marine Fishes (MS 657), Fisheries Population Dynamics (MS 671) and Marine Population Genetics (MS 673).

Fisheries Science student compares male (L) and female (R) tautogs.

Physical Sciences

The overall objective of the Department of Physical Sciences is to generate, communicate and apply knowledge concerning the physical, chemical and geological processes that operate in the coastal ocean and estuaries. The emphasis of the physical oceanography group is to study water properties and water movement in estuarine, coastal and continental shelf environments. Geological oceanography includes the study of morphodynamics as well as the processes of sediment erosion, transport and accumulation. 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 this department.

Major Programs

Physical Oceanography: Research directions include observational, theoretical and numerical modeling studies of small, intermediate and large scale dynamical processes, and their influence on biogeochemical processes and water quality. Focuses on the fluid dynamics of oceanographic processes range from small-scale turbulence and internal waves through continental shelf processes to basin and global scale circulation dynamics.

Geological Oceanography: Specific research interests include marine sedimentation, coastal morphodynamics, benthic boundary layers, multivariate and time-series analysis, and coastal and marine stratigraphy. The program also includes applied studies in shoreline stabilization and non-energy mineral resources. While most research deals with terrigenous sediments, there also is considerable interest in the biogeochemistry of sediments, particularly carbonates.

Marine Chemistry: Various aspects of marine and environmental chemistry include aqueous geochemistry, biogeochemistry, organic geochemistry, pollutant fate and transport processes, as well as surface chemistry. Chemical transport and transformation processes are examined on both large and small scales, and include determination of global fluxes, air/water exchange of chemicals, estuarine and ocean cycling, sediment diagenesis, particle/chemical interactions, and biologically mediated chemical reactions.

Research Facilities

The laboratory equipment includes a recirculating hydraulic flume and several calibration tanks. Field equipment includes current meters, an acoustic Doppler current profiler, tide gauges, CTD (conductivity, temperature, depth) profilers, fluorometers, dissolved oxygen meters and various small instruments. For bottom boundary layer studies we have two complete instrumented tetrapods each supporting arrays of five Marsh McBirney electromagnetic current meters (EMCMS) and five optical backscatterance turbidity sensors, pressure sensors, thermistors, and high frequency sonar altimeters. The recently developed VIMS seabed flume permits *in situ* measurement of critical bed stress for sediment entrainment. Addi-

tional field equipment includes a digital side scan sonar system, a digital survey fathometer, various subbottom profiling systems, box corers and a Kasten corer. Major instrumentation available for chemistry research consists of gas chromatographs (GCs) with a variety of detectors including mass selective, flame ionization, and electron capture detectors, high performance liquid chromatograph (HPLC) with UV absorbance and liquid scintillation detectors, total dissolved carbon and nitrogen analyzer, cross-flow filtration units, inductively-coupled plasma (ICP) spectrophotometer, sedigraph automatic particle size analyzer, and facilities for low-level alpha and beta particle analyses and gamma-ray spectrometry. Other chemistry instrumentation available for use on campus includes transmission and scanning electron microscopes, liquid scintillation counters, UV/Vis spectrophotometers, nutrient and elemental analyzers, GC/MS with chemical ionization and negative chemical ionization capabilities, and additional HPLC instrumentation. Instrumentation available through other College of William and Mary departments include: Infrared spectrometry, atomic absorption, and nuclear magnetic resonance (NMR) spectroscopy, and an x-ray diffractometer.

Computation facilities include an HP 735 UNIX workstation dedicated for circulation and water quality modeling, and 3 SUN Sparcstations for general purpose use. A number of dynamic modeling packages, including a general purpose three-dimensional estuarine and coastal ocean circulation model, are supported on the network. The Physical Sciences network also serves many PC's throughout the department and provides links to other computational resources of the Institute and access to Internet.

Preparatory Studies

In all aspects of the Department of Physical Sciences' education and research programs, there is a heavy reliance on quantitative skills, and our incoming students therefore are expected to have a strong background in mathematics. Undergraduate majors providing appropriate preparation for graduate study in physical sciences include physics, applied mathematics, engineering, chemistry, and geology. Biological science majors interested in pursuing graduate work in physical sciences are encouraged to include introductory physics and calculus through ordinary differential equations in their backgrounds.

Typical Course of Study

For students majoring in physical oceanography, a two course sequence in estuarine hydrodynamics provides an in-depth focus on estuarine physics and its influence on biogeochemical processes. A companion course explores the coupling of physical and biogeochemical processes in estuaries. A course in oceanic and atmospheric circulation modeling covering a broad range of spatial and temporal dynamic and coupled processes is available for students with interests in modeling.

Students interested in geological oceanography may pursue tracks emphasizing sedimentary environments and stratigraphy, sediment geochemistry, or physical transport/morphodynamic processes. Courses include marine sedimentation,

coastal morphodynamics, benthic boundary layers, multivariate and time-series analysis, and coastal and marine stratigraphy. In addition, depending on a student's particular emphasis, geological students may be required to take advanced courses in physical, chemical, or biological oceanography.

Graduate students in marine chemistry may specialize in any of the various aspects of marine and environmental chemistry. Required courses include Advanced Aquatic Chemistry (MS 555), Principles of Chemical Oceanography (MS 524) and a quantitative course. Specialized course work in other aspects of marine and environmental chemistry may be selected through recommendation of the student's thesis committee.

Up-close and personal.

Resource Management and Policy

The faculty and staff of the Department of Resource Management and Policy pursue both basic and applied research. Studies of the structure and function of wetlands, identification and classification of land forms and land cover, and the relationship of landscape pattern and coastal system performance are among the ongoing basic research programs. Applied projects address everything from developing educational programs for resource managers, to tracing wetland ownership records, to analysis of use conflicts in coastal waters, to preparation of resource management plans for coastal parks and sanctuaries. The highlight of these efforts is their interdisciplinary character. Students working in the department will be involved in the ongoing process of synthesizing knowledge from many different fields including not only the core science disciplines but also law, economics, government and sociology.

Major Programs

The Wetlands Program: undertakes basic and applied research; advisory support of tidal and nontidal wetlands management programs; graduate education; and outreach education projects.

The Comprehensive Coastal Inventory Program (CCI): undertakes inventory and monitoring projects for wetlands, shoreline and associated natural and cultural resources in the coastal plain; applied research in GIS and image processing; and applied research in resource management based on inventory information.

The Chesapeake Bay National Estuarine Research Reserve (CBNERRS): develops and manages the reserve system; supports and conducts research at reserve sites; and conducts outreach educational programs associated with the reserve sites.

The Ocean and Coastal Law Program (OCL): provides graduate education; advisory support to state agencies and the General Assembly; and conducts research on resource management topics pertinent to Virginia.

The Center for Coastal Management and Policy (CMAP): is an administrative device for managing interdisciplinary projects involving personnel from RMAP, SMS/VIMS, the College of William and Mary, and/or other institutions.

Research Facilities

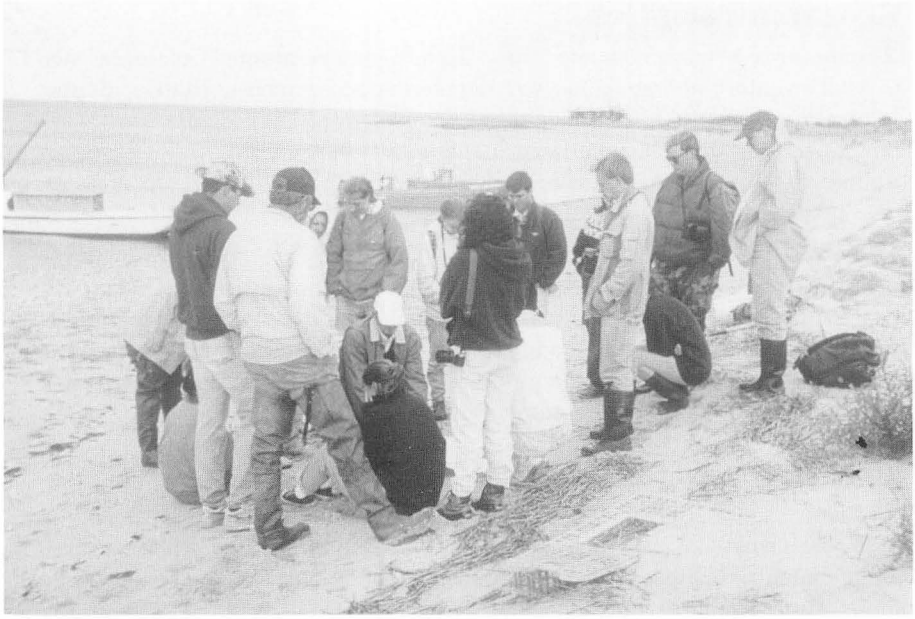
The Resource Management and Policy Department operates the Comprehensive Coastal Inventory laboratory that is a computer-based facility using the Geographic Information System (GIS) and image processing software. The program also utilizes remote sensing data, satellite images and aerial photography. In addition, an up-to-date resource management/legal library is available within the department.

Preparatory Studies

Students interested in pursuing a career in resource management and policy will benefit by having a solid background in mathematics and the basic sciences including: physics, chemistry, biology, and geology. Preparation in ecology and statistics, as well as competence with computers is desirable. Strong writing and verbal communication skills also are recommended.

Typical Course of Study

The typical course of study for students in RMAP will involve completion of the SMS core curriculum, as well as advanced courses in three areas: science, policy, and quantitative methods. The science requirement can be fulfilled by any of the initial advanced courses offered in other departments (MS 520, MS 522, MS 524, MS 526, MS 528). The policy requirement will typically be met by the RMAP "Principles" course (MS 542). The quantitative methods requirement will be satisfied by courses in other departments in subjects such as Ecological Modeling and Simulation Analysis (MS 651), Estuarine Water Quality Models (MS 617), or Multivariate Analysis and Time Series (MS 625). Additional related graduate coursework in public policy, law, economics, government and business is available on the Williamsburg campus and may be used as part of the RMAP curriculum.



"Sand" lecture at the Eastern Shore Lab. Faculty from Resource Management and Policy and Fisheries Science with MS 503 students.

Students aboard R/V *Bay Eagle* on a 24-hour sampling cruise.

Graduate Courses

The courses presented below may be offered in a different format than listed under the course description if the number of students registering for the course is such that the listed format is inappropriate. For example, if only one student registers for a course listed as being taught in a lecture format, the instructor may decide that the content is better presented through directed readings and one-on-one discussion.

***501. Fundamentals of Marine Science. Fall (6) Mr. Patterson, Staff.**

An interdisciplinary introduction to the marine sciences. History and modern paradigms of oceanography; origin and evolution of the lithosphere, atmosphere and oceans; ocean and climate; biological oceanography; global biogeochemical cycles and large-scale processes. *Required of all students unless justification for exemption is approved by the Dean of Graduate Studies upon recommendation of the appropriate faculty committee.*

***502. Coastal and Estuarine Processes and Issues. Spring (4) Ms. Schaffner, Staff.**

An introduction to the science and management of estuaries and the coastal ocean. Physical nature of coastal environments; physical processes in coastal environments; chemical cycling in estuarine and coastal zones; biological processes in estuaries and the coastal ocean; interactive processes in coastal environments. *Required of all students unless justification for exemption is approved by the Dean of Graduate Studies upon recommendation of the appropriate faculty committee.*

***503. Field and Laboratory Methods in Marine Science. Fall (2) Mr. Austin, Staff.**

Provides students with an understanding of the basic observational, sampling and analytical techniques in marine science. Topics include data collection, quality assurance, statistical and conceptual evaluation of data, preparation of scientific reports. *Required of all students unless justification for exemption is approved by the Dean of Graduate Studies upon recommendation of the appropriate faculty committee.*

* These courses may be taken by undergraduate students with the permission of instructor.

***505. Scientific and Statistical Methods. Fall (3) Mr. Diaz, Mr. Evans.**
Provides students with the fundamental statistics methods and critical thinking skills for executing high quality scientific research. Includes lectures on the scientific method, formation and testing of a hypothesis, and statistical methods, including time and space scales, random and haphazard sampling, principles of experimental design, ANOVA and regression. *Required of all students unless justification for exemption is approved by the Dean of Graduate Studies upon recommendation of the appropriate faculty committee.*

***506. Scientific Communication Skills. Spring (2) Mr. Milliman, Ms. Dickhut.**
Review of the important elements of oral and written presentation skills for communicating scientific research. Critical evaluation of literature, development of scientific question and rationale for research, formulation of conceptual models for developing high quality, scientific research projects. Oral and written presentation skills will be emphasized through class presentations and development of a written proposal, with peer review.

***508. Scientific Writing and Information Sources. Spring (1-2) Mr. Lynch.**
Instruction on content and use of selected bibliographic, abstracting, indexing, data and other information data bases useful to marine scientists (emphasis is on on-line bases). Structure and content of journal articles, theses, dissertations and technical reports. Emphasis is on writing; students prepare and are evaluated on several written assignments.

***511. History of Marine Science. Fall, even years (3) Mr. Lynch.**
Comprehensive review and evaluation of the major events, personages, and organizations involved in the development of marine science and marine resource management, the acquisition of knowledge of the oceans, their coastal waters and tributaries, and the ability to work on and in the sea and make use of its resources and amenities, with consideration of the impacts of the resources and amenities of the ocean on the affairs of men. Lecture, discussions and reading. All students will be required to prepare and submit a suitable course-related term paper.

520. Introduction to Fluid Mechanics. Fall (3) Mr. Friedrichs, Mr. Maa.
Aspects of incompressible fluid mechanics most relevant to oceanography. Applications will be taken from diverse branches of marine science. Specific topics include properties of fluids, dimensional analysis and scaling, hydrostatics, conservation of mass and momentum, formulation of transport processes, motion with and without rotation, laminar and turbulent flow, drag and lift forces, and boundary layers.

522. Principles of Geological Oceanography. Spring, odd years (3) Mr. Boon, Staff.
A brief review of the tectonic history of the oceans followed by detailed study of the ocean margins including sea-level history and nearshore geological processes

in the coastal zone and continental shelf regions. The geological effects of bottom currents on oceanic sediments will be examined along with ocean basin sediment history and approaches to paleooceanography.

524. Principles of Chemical Oceanography. Spring (3) Mr. Bauer, Ms. Canuel.

This course covers in a comprehensive and integrated manner the important factors controlling the chemical composition of seawater. Basic principles of chemical thermodynamics will be applied to the seawater medium and will serve to introduce contemporary, global-scale chemical processes such as the role of the oceans in global climate change. Selected topics include distributions of the biolimiting elements; chemistry of marine sediments; trace metal chemistry; marine organic chemistry; and ocean-atmosphere interactions.

526. Principles of Biological Oceanography. Spring (3) Mr. Ducklow, Mr. Duffy.

Lecture and discussion of the fundamental processes underlying primary and secondary production in marine ecosystems. Examples are drawn primarily from offshore systems. Emphasis on physical processes supporting primary production, plankton dynamics, biotic interactions structuring communities, vertical and horizontal distributions, foodweb structure, ecological role of higher and lower trophic levels, and benthic-pelagic coupling. The course concludes with a survey of the major oceanic ecosystems.

***527. Coastal Botany. Fall (3) Mr. Silberhorn.**

A general survey of maritime vascular plant communities. Marshes, swamps, beaches, dunes, maritime forests and submerged aquatic communities of the coastal region. Field trips, laboratory and lectures.

528. Marine Fisheries Science. Fall, even years (3) Mr. Austin.

Principles and techniques, including the theory of fishing, age and growth, definition of stocks, catch statistics, description of world fisheries, goals and problems in managing a common property resource. Six lecture, laboratory and field hours.

529. Economic Principles of Fisheries Management. Fall (3) Mr. Kirkley.

An introduction to economic theories and principles which determine the exploitation, utilization, and management of marine fisheries. Theories and principles are presented in a graphical format, but the interpretation and understanding of policies and solutions are emphasized. The course provides a balanced understanding of the underlying economics of conflicting user groups. Methods of fisheries management and regulation are emphasized with respect to economic and social concerns.

* These courses may be taken by undergraduate students with the permission of instructor.

542. Principles and Theory of Resource Management. Spring (1-3) Mr. Hershner, Staff.

An introduction to the history of the management of natural resources and a survey of principles and theories associated with resource management. Although the course addresses general concepts, marine oriented materials and examples will be emphasized. Required of all students in Resource Management and Policy.

543. Law and Resource Management. Spring (1-3) Mr. Theberge.

A course designed to examine the relationships between science, resource management, and legal concepts. The evolution of institutions, legislation, and issues related to managing resources will be explored from international, national, state, and local perspectives. Particular attention will be paid to major federal programs and statutes, significant case law, and case studies involving the interaction of special interest groups and governmental instituions at local, state, national, and international levels. A small portion of the course will be devoted to the interaction of law, science and ethics. The course is intended to function in an intimate seminar setting with discussion and exchange of ideas being important aspects of student performance.

***545. Marine Sedimentation. Spring, odd years (3) Mr. Kuehl.**

Introduction to continental margin sedimentary environments with emphasis on physical, biological and chemical controls on the development of sedimentary strata over a range of spatial and temporal scales. Case studies from modern settings will be used to illustrate concepts of strata formation.

551. Oceanographic Instrumentation. Summer, even years (2 or 3) Mr. Ruzecki, Staff.

General description, physical characteristics, capabilities and limitations of oceanographic instruments are discussed and demonstrated. Emphasis is on instruments used to obtain physical data with inclusion of selected chemical and geological instruments. Operation, deployment and data retrieval are emphasized. This course will be taught in a long summer session. Two credits for lecture, with an optional one hour for laboratory and field work.

553. Introduction to Benthic Boundary Layers and Sediment Transport. Fall, even years (3) Mr. Wright, Mr. Maa.

Physical and geological aspects of coastal and estuarine benthic boundary layers, their dynamic forcings and the associated suspension and transport of sediments. Principles of waves, tides and currents are introduced with emphasis on shallow-water processes. Boundary layer structure and shear stress on the seabed, wave boundary layers and turbulence are considered in relation to the coastal environment. Forces on sediment particles, initiation of sediment movement and principles of sediment transport are treated at an intermediate level.

555. Advanced Aquatic Chemistry. Fall (3) Ms. Chisholm-Brause, Mr. MacIntyre. Prerequisites: Instructor's consent.

Discussion of the principles of chemistry focusing on the chemistry of natural water systems. Quantitative problem solving and application of computer codes will be emphasized. Topics will include: principles of chemical kinetics and thermodynamics, structure and properties of liquid water, electrolyte and polyelectrolyte solution chemistry, acid-base chemistry, carbonate equilibria, precipitation-dissolution reactions, basic coordination chemistry, and redox reactions with reference to the physical chemistry of biochemical and aquatic systems. Quantum chemistry as necessary for understanding marine phenomena, e.g. photosynthesis, hydrogen bonding, also will be presented.

561. Analytical Approaches in Environmental and Biogeochemical Studies. Spring (3) Mr. Hale.

Modern techniques to identify and quantify trace organic and inorganic compounds in the marine environment. Principles of extraction, purification, identification and quantification. Techniques include SFE, TLC, open column chromatography, HPLC, GC, trace metal spectroscopy and mass spectrometry. Sampling, quality assurance/control, detection limits and other concerns will be covered.

563. Environmental Chemistry. Fall (3) Mr. Unger, Staff.

Overview of the major classes of environmental toxicants. Fundamentals of aquatic, atmospheric, and geo/soil chemistry. Emphasis on the environmental significance of chemical processes. Fate and transport of contaminants and how this affects bioavailability will be stressed.

564. Aquatic Toxicology. Fall (3) Mr. Van Veld.

Factors influencing the fate and behavior of major environmental toxicants in aquatic organisms. Mechanisms involved in their uptake, distribution, biotransformation and clearance. Effects of toxicants on aquatic organisms ranging from effects at the biochemical and cellular level to effects on individuals, populations and communities. Current methods of laboratory and field toxicity testing.

566. Diseases of Marine Organisms. Fall, odd years (4) Mr. Burreson and Mr. Vogelbein.

Identification, life histories, host defense mechanisms, pathology and control of non-infectious and infectious disease agents including viruses, bacteria, protozoa, helminth and arthropods in marine fishes and shellfishes. Three lecture and three laboratory hours.

* These courses may be taken by undergraduate students with the permission of instructor.

567. Basic and Theoretical Immunology. Spring, odd years (4) Mr. Kaattari. Prerequisites: Genetics and biochemistry, and permission of instructor. Recommended: An introductory immunology course.
Current theories and applications of molecular and cellular immunology. A comparative approach to the understanding of immune function throughout the animal kingdom. Topics include antibody and antigen structure and function, immune cell networks, major histocompatability complex and disease resistance, mechanisms of pathogen recognition and elimination, general principles of vaccine design and modification. Three hours of lecture, plus one hour of discussion.

568. Cell and Tissue Culture of Aquatic Organisms. Spring, odd years (3) Mr. Faisal.
Overview on the general aspects of culturing cells of aquatic animals including their biology, derivation and characterization. Discussion of the practical application for the use of tissue culture in marine science research. The course will provide students with an opportunity to practice culturing, maintaining and characterizing cells from marine organisms including invertebrates. Two hours of lecture and two hours of laboratory.

569. Molluscan Immunology and Pathology. Fall, odd years (3) Ms. Chu. Prerequisite: Instructor's consent.
Concept of invertebrate internal defense; structure and function of molluscan blood cells (hemocytes and phagocytes); role of humoral factors in molluscan defense; models of non-self recognition; specificity and memory. Evasion mechanisms of the parasites. Case studies in host-parasite interactions including seasonal, environmental and toxic effects. Lecture and laboratory.

570. Nutrition and Energy Reserve in Marine Organisms. Fall, even years (3-4) Ms. Chu. Prerequisite: Instructor's consent.
Biochemistry of food source; feeding strategies; energy requirements and factors affecting energy requirements; energy reserve and metabolism, including digestion, absorption, transport, deposition, and mobilization; nutritional effects on reproduction and larval ecology. Lecture and laboratory.

571. Culture and Physiology of Aquatic Organisms. Fall 1995 and Spring, odd years (3) Mr. Mann.
History and principles of culture of aquatic organisms. Physical and biological system requirements, water quality, feeding and nutrition, manipulation of reproductive biology, selection of cultured species, quarantine and disease control, current practices in finfish and shellfish culture, physiological and biochemical methods to assess condition of cultured organisms.

575. Aquatic Microbial Ecology. Spring, odd years (3) Ms. Anderson, Mr. Kator. Recommended: Organic chemistry or biochemistry.
An introduction to the distribution and activities of procaryotic microorganisms in aquatic environments. Topics include types and distribution of microorgan-

isms, methods for their detection and determination of biomass and activity, metabolism and energetics, microbial interactions, characteristics of microbial communities and ecosystems, microbial habitats, biogeochemical cycles, biodegradation and microbial involvement in water distribution, waste and groundwater, and ecosystem models.

577. Physical Biology of Marine Organisms. Spring, even years (3) Mr. Patterson.

Principles from the physical sciences (fluid and solid mechanics, mass and heat transfer theory) applied to the analysis of form, function, and evolution of marine organisms. Engineering methods and measurement techniques appropriate for investigations in physical biology will be presented.

579. Wetlands Ecology. Fall (2-4) Mr. Hershner, Mr. Perry. Prerequisite: Instructor's consent.

Structural and functional attributes of tidal and nontidal wetlands. Emphasis on analysis of wetland systems at the landscape and community level. Introduction and practical experience in common research techniques including wetland classification, vegetation mapping, functional assessment models, and field sampling techniques. Individual research projects and/or paper expected. Lectures and field trips.

582. Applied Methods of Fisheries. Fall (3-4) Mr. Chittenden.

Practice, principles, and theory of applied methods in fisheries. Sampling and data collection tools, practice, and theory. Principles and theory of age determination, estimation of abundance, reproductive biology, marking and tagging, and mark-recapture. Special topics as necessary.

590-591. Departmental Seminar in Resource Management. Fall (2) Mr. Hershner, Staff.

Guided readings of the literature with the objective of synthesizing scientific, legal, economic, and management aspects of resource management. Course format includes faculty presentations and invited speakers.

592. Seminar on Current Resource Management Issues. Spring (3) Mr. Perry.

This seminar series addresses current resource management issues specific to the Chesapeake Bay. Invited speakers will discuss various option, approaches, and techniques used to find solutions to similar issues in various terrestrial-transitional-aquatic ecosystem throughout the United States. A different topic will be addressed each year. Students will be required to participate in all seminars and discussion groups and to prepare a final paper.

597. Problems in Marine Science. Fall, Spring, and Summer (1-4) Staff.

Supervised projects selected to suit the need of the graduate student. Projects are chosen in consultation with the student's supervising professor and the instructor. Credit hours depend upon the difficulty of the project and must be arranged with the instructor in advance of registration. (See MS 697).

598. Special Topics in Marine Science. Fall, Spring, and Summer (1-3) Staff.

This is the avenue through which subjects not covered in other formal courses are offered. These courses are offered on an occasional basis as demand warrants. Subjects will be announced prior to registration. Hours to be arranged.

599. Thesis. Fall, Spring, and Summer (hours to be arranged).

Original research in biological, physical, chemical or geological oceanography, environmental science, marine fisheries science and marine resource management. Project to be chosen in consultation with the student's major professor and the Dean of the School.

601. Marine Science Seminar. Fall and Spring (1-3) Staff.

Multidisciplinary review of significant areas of marine science. The topic will vary each semester. Guest speakers will present a variety of views. Course participants will organize and present talks related to the seminar theme. Credit will be determined by the level of participation. One credit hour (pass/fail only) for attendance and participation at seminars; two credits (pass/fail or grade option) for additional participation by contribution to discussions and presentation of seminar; three credits (pass/fail or grade option) for additional submission of written critical literature review/synthesis.

611. Estuarine Hydrodynamics I. Spring, odd years (3) Mr. Kuo. Prerequisite: MS 520.

Classification of estuaries, time scales of motions, tidal dynamics in estuaries, non-tidal circulation, mechanism of arrested salt wedge, gravitational circulation, diffusion induced circulation, turbulence in stably stratified flows.

612. Estuarine Hydrodynamics II. Fall, odd years (3) Mr. Kuo, Mr. Hamrick. Prerequisite: MS 611.

Zero-, one- and two-dimensional descriptions of estuaries, salt intrusion, pollutant flushing, sediment transport through estuaries, field experience in estuaries, model laws for estuarine models.

613. Ocean Dynamics I. Spring (3) Mr. Brubaker, Mr. Hamrick. Prerequisite: Instructor's Consent

Following a brief review of the governing equations, aspects of small to intermediate scale dynamics of stratified, rotating flow in oceanography will be considered. Topics include internal waves; turbulence, mixing and stability; free and forced waves in channels and along coastlines.

614. Ocean Dynamics II. Fall (3) Mr. Hamrick, Mr. Brubaker. Prerequisite: Instructor's Consent.

Intermediate to large scale dynamics in coastal and open ocean environments. Topics include low frequency waves and upwelling, downwelling in the coastal ocean; quasi-geostrophic flow and Rossby waves; equatorial waves and El Nino; wind-driven and thermohaline circulation in ocean basins; boundary currents.

615. Oceanic and Atmospheric Circulation Modeling. Spring (3) Mr. Hamrick. Prerequisite: MS 613 and 614 or Instructor's Consent.
A survey of numerical methods for the solution of partial differential equations describing oceanic and atmospheric motion and transport. Finite difference, finite element, spectral and semi-Lagrangian methods. Stability, accuracy, consistency and convergence analysis of numerical schemes. Formulation of quasi-geostrophic, primitive equation and nonhydrostatic circulation models and active and passive scalar transport models. Data assimilation and parameter identification methodologies. Implementation of numerical models on serial, vector and parallel computing systems. Application of models for operational environmental prediction and climate studies.

617. Estuarine Water Quality Models. Fall, even years (3) Mr. Kuo. Prerequisite: MS 611.
Principles of mass balance, physical transport processes, diffusion and dispersion in estuarine environments. Water quality processes, representation of biochemical transformations, dissolved oxygen modeling, survey of available models.

621. Coastal Morphodynamic Processes. Fall, odd years (3) Mr. Wright.
Emphasis is on the mutual adjustments between coastal depositional and erosional morphologies and the hydrodynamic processes that cause sediment transport and transport gradients. Continental shelf, surf-zone, beach, and estuarine processes will be examined. The course involves a mix of classroom lectures, seminar discussion of readings, application of computer models and analysis of field data.

622. Quaternary Evolution of Coastal Environments. Spring, even years (3-4) Mr. Wright and Mr. Kuehl. Prerequisite: MS 502.
Introduction to: (1.) the causes of climate and climate change; (2.) atmospheric-ocean-seabed coupling on long time scales; (3.) the development and interpretation of coastal, shelf and estuarine statigraphy; and (4.) coastal morphodynamic evolution on time scales of millennia. The course extends the concepts learned in MS 502 into a longer time domain and considers the geological consequences of the slowly changing process regimes.

623. Isotope Geochronology. Spring, even years (3) Mr. Kuehl.
Principles of radioisotope dating techniques with emphasis on those applicable to marine settings. Equations of radioisotope decay and ingrowth will be detailed along with the geochemical systematics of each technique.

624. Ocean Waves: Theory, Measurement and Analysis. Fall, odd years (3) Mr. Maa, Mr. Boon. Prerequisite: MS 520.
Introduction to linear wave theory and shoaling wave transformations, wave dispersion, radiation stress, refraction and reflection. Mechanisms of wave generation in the ocean, including wind waves, seiches and tides. Discussion of ocean wave spectra and methods of wave analysis.

625. Multivariate Analysis and Time Series. Fall (3) Mr. Boon, Mr. Evans.
Eigenvector methods, principal component analysis and factor analysis; regression methods; Fourier and stochastic models applied to geophysical and other time series data sets. Two lecture hours and one hour of computer laboratory with assigned problems.

626. Advanced Quantitative Methods for Marine Scientists. Spring (3) Mr. Evans.
Introduction to matrices. Advanced topics in regression, including multiple regression, sensitivity analysis. Non-linear function fitting techniques. Empirical eigenfunction methods with applications. complex notation as applied to the description of sinusoidal variations. Fourier transforms, spectra and filtering.

627. Marine Organic Geochemistry. Spring, even years (3) Ms. Canuel, Mr. Bauer.
Characterization of organic carbon, nitrogen, phosphorus and sulfur in marine water column and sediments. Modern methods of organic analysis that enhance our understanding of how organic materials cycles through the oceans will be discussed. Topics include the role of organic matter in the C, N, S, and P cycles; chemical composition of marine organic matter; diagenetic transformations of organic materials; organic matter degradation and preservation; and petroleum geochemistry.

628. Chemistry of Surfaces and Interfaces. Spring, odd years (3) Ms. Chisholm-Brause.
Chemical properties and reactions at surfaces and interfaces, focusing on aquatic surface chemistry relevant to natural systems. Topics include structure and reactivity of surfaces; properties of bulk and interfacial water; chemical reactions at surfaces and interfaces; bonding mechanisms at the water/solid interface; and relevant experimental and spectroscopic methods.

629. Fate and Transport Processes for Organic Contaminants. Fall, odd years, optional lab (3-4) Ms. Dickhut.
Overview of partitioning, transport, and transformational processes controlling the environmental fate of organic contaminants. Fundamentals of thermodynamics and chemical kinetics relevant to organic chemical fate and transport mechanisms. Elementary mass transfer equations and application to chemical transport in the environment. Laboratory will emphasize methods for measuring physical-chemical coefficients.

635. Immunotoxicology. Spring, even years (3) Mr. Faisal.
Mechanisms through which several classes of toxic chemicals compromise the function and phenotype of immunocompetent cells. Methods of data interpretation and extrapolation of conclusions at the organismal and population levels. Topics include principles of immunotoxicology, chemical immunomodulators or environmental concern, effects of toxic chemicals on the ontogeny of immune functions and hemopoietic organs, tiered approach to evaluate toxic insult on the

immune system, and molecular mechanisms of immunotoxicology, correlation between immunotoxicity, carcinogenicity, and susceptibility to disease. Two hours of lecture and two hours of laboratory.

638. Fish Histology and Histopathology. Spring, even years (4) Mr. Vogelbein.

Detailed examination of the normal microscopic structure and function of tissues and organs in fishes and the morphological and functional changes that occur in tissues during disease. Infectious and non-infectious diseases, including pathological changes elicited by chemical toxicants and environmental factors will be evaluated. Lab will consist of in-depth training in routine methods of paraffin histology and histochemistry. Three lecture and 3 laboratory hours. Restricted to 6 students.

650. Analysis of Discrete Data. Spring (3) Mr. Diaz. Prerequisite: Instructor's Consent.

Design, analysis and interpretation of field and laboratory studies that rely on discrete or count data, including rates and proportions. Models based on Chi-squared and other nonparametric distributions for uni-, bi-, and multi-variate data will be covered. Topics include sample size experimental design, single and cross classification, covariate inference, and numerical classification techniques. Lecture and computer laboratory.

651. Ecological Modeling and Simulation Analysis. Fall (3) Mr. Wetzel. Prerequisite: Instructor's Consent.

Theoretical and practical aspects of conceptualizing, simulating and analyzing digital computer models of estuarine and marine ecosystems. Systems theory, control and optimization is presented in terms of ecological processes. Computer modeling project required.

652. Marine Plankton Ecology. Fall, even years (3) Mr. Ducklow. Prerequisite: MS 526.

Contemporary topics in cellular, population, community and ecosystem level dynamics of plankton systems, including nutrients and organic matter, viruses, bacteria, phytoplankton, protists and zooplankton.

653. Marine Benthos. Spring (3) Ms. Schaffner, Mr. Diaz. Prerequisite: MS 526.

Ecology of marine and estuarine benthos. Emphasis is placed on determining how ecological processes effect function and structure of benthic communities. Consideration is given to interactions among autotrophs, microheterotrophs and larger metazoans and interactions between these organisms and their physical-chemical environments.

654. Secondary Production of Invertebrates. Fall (3) Mr. Diaz.
Principles and theories of secondary production. Physical and biological factors influencing production, role of habitat complexity, implications for community structure, estimation of trophic resources and techniques of measuring secondary production.

655. Methods in Aquatic Microbial Ecology. Spring, even years (3) Ms. Anderson, Mr. Kator. Prerequisite: MS 575 or equivalent.
An advanced laboratory-oriented course covering methods used to measure microbial numbers and biomass, activity, primary production, secondary production, community metabolism, specific biogeochemical cycling, and degradation of pollutants. Methods include gas chromatography, emission spectrometry, epifluorescence microscopy, and application of stable and radioactive isotopes. Each student will design, prepare and perform a field-project utilizing methods described in the course.

656. Seagrass Ecosystems. Spring, odd years (1-2) Mr. Orth, Mr. Moore.
A lecture-seminar course covering topics related to seagrass ecosystems. Emphasis on the structure and function of seagrass communities, submerged angiosperm physiology, primary and secondary production, and integration of seagrass communities to the marine environment. Students will be assigned projects to complete. Credit, which must be arranged in advance of registration, will depend upon difficulty of the assignments.

657. The Early Life History of Marine Fishes. Fall, odd years (3) Mr. Olney. Prerequisite: MS 666 or consent of instructor.
Ontogeny, systematics, physiology, behavior and ecology of egg, larval and juvenile stages of fishes with special reference to adaptations for survival. Population dynamics and the importance of early life history in the recruitment process are emphasized. Ichthyoplankton sampling methods are outlined. In the laboratory, eggs and/or larvae of 100+ families of teleostean fishes are examined, and characters useful in identification are presented. Two lecture and two laboratory hours.

665. Fisheries Climatology. Fall, odd years (3) Mr. Austin. Prerequisite: MS 528.
Effects of natural environmental variability on the recruitment, availability (yield), abundance and behavior of living marine resources. Application to real-time fishing operations and climate scale analysis of fishery fluctuations. Instruction in basic meteorology and climatology with application to the ocean. Two lecture hours and one laboratory hour.

666. Ichthyology. Spring (3 or 5) Mr. Musick.
Functional morphology, behavior, ecology, zoogeography and evolution of fishes. Seven lecture, laboratory and field hours. Three credits without laboratory; five credits with laboratory.

667. Experimental and Quantitative Ecology. Spring (4) Mr. Lipcius.
The design, conduct, analysis and interpretation of field and laboratory experiments in ecology. Includes lectures, discussion and supervised field and laboratory projects designed to illustrate the diversity of experimental and quantitative approaches in use by ecologists. Topics include the scientific method, experimental design, the use and abuse of statistical techniques, modeling and manuscript preparation, with emphasis on topical ecological issues such as those dealing with predator-prey interactions, recruitment phenomena, environmental science (e.g., dose-response assays) and metapopulation dynamics. Lecture and laboratory.

668. Malacology. Spring, even years (3) Mr. Mann.
The fossil record and the ancestral mollusc. Structure and function of the molluscan shell. Review of molluscan taxonomy. Reproductive biology, physiology, ecology, and feeding mechanisms of the molluscs.

669. Design and Analysis of Experiments. Spring (4) Mr. Loesch.
Concepts and methods of experimental statistics. Topics in analysis of variance (single- and multifactor) and associated analyses and statistics (tests of assumptions, power, relative efficiency, and multiple comparisons). Analysis of covariance, regression (models I and II), and an introduction to multiple regression will be presented; other models as time permits.

671. Fisheries Population Dynamics. Spring (3-4) Mr. Chittenden.
Theory and practice of stock identification, growth, abundance, mortality, recruitment, and biomass production in fisheries stocks. Objectives of fishery management. Responses of stocks and fisheries to exploitation. Fluctuations in abundance, population growth forms, and population regulation. Theory, interpretation, and application of fisheries yield models including yield and eggs-per-recruit, production, and spawner-recruit models. Examples drawn from finfish and shellfish stocks.

672. Applied Regression and Forecasting. Spring (3) Mr. Kirkley. Prerequisite: MS 505 or equivalent.
Course introduces theory and practice of quantitative methods in marine science. Methods of regression and time-series analysis will be emphasized. Topics include linear and nonlinear regression, model validation and testing, univariate and multivariate models, transfer functions, intervention analysis, and forecasting.

673. Marine Population Genetics. Spring, odd years (3) Mr. Graves. Prerequisite: Undergraduate Genetics or permission of instructor.
A study of the evolutionary processes responsible for the intra- and interspecific genetic relationships of marine organisms with an emphasis on the application of current molecular methodologies. 3 hrs. lecture.

674. Marine Population Genetics Laboratory. Spring (2) Mr. Graves. Prerequisite: Undergraduate Genetics or permission of instructor.
Students will elucidate intra- and interspecific genetic relationships by employing a variety of molecular techniques for the analysis of proteins and nucleic acids. 5 hrs. laboratory.

685. Practical Application of Marine Resource Management Techniques. As required (1-3) Mr. Hershner, Staff.
Students participate in real world management activities under the guidance of involved faculty members and in association and consultation with members of various levels of government. May include issue identification and resolution, committee involvement at local, regional, state, interstate, and federal levels of government, development of management plans, drafting position papers, developing draft legislation and exposure to policy making mechanisms. Requirements will vary depending on the issue(s) addressed. Students will be evaluated on participation, written work (memoranda, position papers, etc.) and knowledge gained as evidenced by interaction with staff and by other means. Students may repeat the course provided the instructor determines there is no duplication of material. Credit, which must be arranged in advance of registration, will depend upon difficulty of the assignment.

697. Problems in Marine Science. Fall, Spring and Summer (1-4) Staff.
Supervised projects selected to suit the needs of the graduate student. Projects to be chosen in consultation with the student's major professor and the instructor. Acceptable research outlines and project reports are required. Amount of credit depends upon difficulty of course. Hours to be arranged with instructor prior to registration. The degree of difficulty and requirements of this course surpass those of MS 597.

698. Special Topics in Marine Science. Fall, Spring and Summer (1-3) Staff.
This is the avenue through which subjects not covered in other formal courses are offered. These courses are offered on an occasional basis as demand warrants. Subjects will be announced prior to registration. Hours to be arranged.

699. Dissertation. Fall, Spring and Summer (hours to be arranged).
Original research in biological, physical, chemical or geological oceanography, environmental science, marine fisheries science, or marine resource management. Project to be chosen in consultation with the student's major professor with the approval of the Dean of Graduate Studies.

Undergraduate Courses

Undergraduates can take 500-550 level courses with the permission of instructor.

409. Program Design and Data Structures Using Pascal. Spring (2) Staff.
Structured programming techniques are presented using the Pascal programming language. Elementary data structures are presented with attention to forms which are useful in scientific programming. Practical applications are stressed with emphasis on graphics in the latter portion of the course. The linkage of system and user-written libraries to Pascal programs is covered.

410. Applied Computing for Marine Scientists. Fall (1) Mr. Anderson.
An introduction to the use of computers in scientific research. Topics covered include software systems for data analysis, spatial analysis, word processing, and graphics. Class assignments will be carried out in the microcomputer laboratory and on various computing platforms across VIMS campus-wide network. The role of computing and information resources on the Internet will also be discussed. One lecture hour and two laboratory hours weekly.

497. Problems in Marine Science. Fall, Spring and Summer (1-4) Staff.
Supervised projects selected to suit the need of the graduate student. Projects are chosen in consultation with the student's supervising professor and the instructor. Credit hours depend upon the difficulty of the project and must be arranged with the instructor in advance of registration.

498. Special Topics in Marine Science. Fall, Spring and Summer (1-3) Staff.
This is the avenue through which subjects not covered in other formal courses are offered. These courses are offered on an occasional basis as demand warrants. Subjects will be announced prior to registration. Hours to be arranged.

From sequencing the small subunit ribosomal DNA of oysters and some of their parasites, VIMS/SMS scientists were able to develop a powerful DNA probe which will help understand the life cycle of one of the diseases causing high mortality in Chesapeake Bay oyster populations.

Academic Program

General Program Description

The academic program of the School of Marine Science is intended primarily for the student who wishes to specialize in marine science at the graduate level. Degrees offered are the Master of Arts and Doctor of Philosophy in Marine Science. The school offers research opportunities and instruction at the graduate level in five general areas: Fisheries Science, Biological Sciences, Environmental Sciences, Physical Sciences, and Resource Management and Policy.

Though the courses offered by the School are primarily for graduate students, advanced undergraduates (juniors and seniors) may participate. For instance, biology, chemistry, and physics majors can enroll in suitable 400 level marine science courses for credit toward the bachelor's degree provided certain conditions (see College of William and Mary Undergraduate Program Catalog) are met. Undergraduates also may enroll for research credit to work on problems in marine science. The student is responsible for making the necessary arrangements with an individual School of Marine Science faculty member, and the consent of the chairperson of the student's major department is also required.

General Preparatory Requirements

Students who are interested in pursuing marine science as a profession should consult with their academic advisor or the Dean of Graduate Studies, School of Marine Science, early in their college careers to identify an academic program that will prepare them for graduate study in marine science.

Students interested in biological sciences, environmental sciences, or fisheries science should have a strong background in basic sciences, including a suite of contemporary biology courses, physics and chemistry (through organic), and mathematics through calculus and differential equations. The prospective chemical, geological or physical oceanography student should have an undergraduate degree with appropriate course work in chemistry, geology or related geophysical science, physics, meteorology, mathematics or engineering, and a solid quantitative background. Course work in statistics and competence with computers are particularly important for prospective resource management and policy students, but also are considered beneficial to students in all other fields of concentration as well.

Degree Requirements

General

Students generally are bound by the requirements stated in the catalog in effect when they enter the School. The department in which the student specializes and individual advisory committees may prescribe additional requirements for their students.

Residency

To fulfill the full-time academic residency requirement of the School of Marine Science, students must

1. Successfully complete the core course requirements;
2. Be a full-time student in good standing for two consecutive semesters.

Satisfactory Progress

To continue in a degree program, a student must make satisfactory progress towards the degree. If the faculty of a program in which a student is enrolled determines that satisfactory progress is not being made, a student may be required to withdraw because of academic deficiency. A student may appeal to the Academic Status and Degrees Committee.

Qualifying Exam

Each student must satisfactorily complete a qualifying examination that indicates a proficiency in the student's particular field of study. This examination is typically coupled with a presentation of the student's thesis/dissertation prospectus. Qualifying exams usually are completed by the end of the third semester (M.A.) or fourth semester (Ph.D.).

Registration Requirements

All active students (i.e. those working toward completion of a degree program who have not been granted leave), must register for a minimum of nine paid hours each semester, and one paid hour for each term of the summer session. Students must be registered in the semester during which they graduate. For a single semester, the student may be given research student status. This generally would be the semester in which the student completes the thesis and graduates.

System of Grading and Quality Points

The grades A (excellent), B (good), C (satisfactory), P (pass), in certain courses, D (unsatisfactory), and F (failure) are used to indicate the quality of work in a course. "W" indicates that a student withdrew from the College before mid-semester or

dropped a course between mid-semester and the last day of class and was passing at the time that the course was dropped.

For each semester credit in a course in which a student is graded A, 4 quality points are awarded; A-, 3.7; B+, 3.3; B, 3; B-, 2.7; C+, 2.3; C, 2; C-, 1.7. P carries credit but is not included in a student's quality point average; D and F carry no credit but the hours attempted are included in the student's average.

In addition to the grades A, B, C, P, D, F, and W, the symbols "G" and "I" are used on grade reports and in the College records. "G" is given to work in progress towards Masters (MS 599) or PhD (MS 699) research, since there is insufficient evidence upon which to base a grade. "I" indicates that because of illness or other major extenuating circumstances, the student has postponed, with the explicit consent of the instructor, the completion of certain required work. "I" automatically becomes "F" at the end of the next semester if the postponed work has not been completed.

Transfer of Graduate Credit

On the recommendation of the Academic Status and Degrees Committee and the approval of the Dean of Graduate Studies, a regular student may apply up to six hours of graduate credit earned at another accredited institution of higher learning toward an advanced degree at the College of William and Mary, School of Marine Science. The credits must have been earned in courses appropriate to the student's program in the School and must fall within the time specified by the general college requirements for degrees. Credit may be transferred only for courses in which the student received a grade of "B" or better and may not be counted in compiling his or her quality point average at William and Mary.

Retaking a Course

Degree credit is granted only for coursework in which a student earns a grade of "C" or above. A graduate student may repeat one course in which a grade of "C" or lower is received; however, the initial grade earned remains a part of the student's record and is included in computations of quality point requirements. Any student receiving more than one "D" or "F" in a program of study will not be permitted to continue in the School of Marine Science.

Changes in Registration

All changes in students' schedules after the close of registration require approval of the instructors involved and the Dean of Graduate Studies. Students may not add courses after the last day for changes in registration as indicated in the calendar. If the student drops a course or courses before mid-semester but remains registered for other academic work, the course or courses dropped will be removed from the student's record. If the student drops a course or courses after mid-semester through the last day of classes but remains registered for other academic work, the grade of "W" or "F" will be awarded by the instructor in the course depending upon whether or not the student was passing at the time the course was dropped.

A student wishing to withdraw from a course (or courses) due to medical reasons after mid-semester may apply to the Academic Status and Degrees Committee for approval. If the Academic Status and Degrees Committee approves the request, a grade (or grades) of "W" will appear on the transcript.

Students may not drop a course after the last day of classes. If for medical reasons a student does not complete a course, "W" with appropriate notation will be entered on the record upon approval of the Dean of Graduate Studies and the appropriate authorities at the College.

Leave of Absence

A student may request a leave of absence from the program for a specific period of time. Leaves of absence will relieve the student of the obligation of paying tuition while still remaining as a student in good standing. A student must terminate the leave of absence and be a registered student in the semester in which his or her degree requirements are completed or in which he or she graduates.

Probation

A student will be placed on probation for: receipt of a grade below a C (< 2.0) or a cumulative average less than a B (< 3.0).

Probation will last until a student's cumulative average is raised to at least a B (3.0), and will in no circumstances last longer than one calendar year.

If, during probation, the student receives a grade less than C (<2.0), receives a semester average less than a B (<3.0), or fails to raise cumulative average to at least a B (3.0), the penalty is automatic dismissal from the School of Marine Science, with the possibility of appeal to the Academic Status and Degrees Committee for reinstatement.

Withdrawal from the Program

Withdrawal from the program constitutes termination of the student's program of study in the School of Marine Science. Withdrawal may be voluntary on the part of the student or be imposed by the School of Marine Science for reasons of academic deficiency. A student who fails to register for a regular semester (fall or spring) once the student has begun his or her graduate study, who has not requested a leave of absence or permission to withdraw, will be placed on a leave of absence for one semester by the Dean of Graduate Studies. If the student has not applied for a leave of absence prior to the end of registration for the next regular semester, or if the Dean of Graduate Studies is not able to justify continuing the leave of absence, the student's record will be marked withdrawn unofficially.

If the student withdraws from the College before mid-semester, a grade of "W" will appear on the record for each course in progress at the time of withdrawal. After mid-semester through the last day of classes, students who withdraw from the

College will be awarded a "W" or "F" by the faculty member teaching each course in progress at the time of withdrawal.

Reinstatement After Withdrawal

A student wishing reinstatement after withdrawal must reapply to the School of Marine Science under the procedures in effect at the time of reapplication.

Extension of Time Limit

Classified (regular) students who have exceeded the time limit for degree completion and who have not been granted a time extension will not be permitted to register in the School of Marine Science.

Required Courses

All students

By the end of a student's second year in the School, the student must have passed the following core courses, MS 501, MS 502, MS 503, MS 505. Exemptions may be granted only under exceptional circumstances.

Students in Biological Sciences

MS 526.

Students in Environmental Sciences

MS 563 and MS 564.

Students in Fisheries Science

Must take one of the following: MS 625, MS 667, MS 669 or MS 672.

Students in Physical Sciences

Students must take one course from each of the following sequences:

1. MS 524 or MS 520 or MS 522
2. MS 555 or MS 613
3. MS 626 or other quantitative course
4. MS 601 (seminar)

In addition, Ph.D. students in Marine Chemistry must take MS 630.

Students in Resource Management and Policy

MS 542.

Language Requirement

Reading knowledge of one foreign language is required for either the M.A. or Ph.D. degree. Candidates for the doctorate who have passed a language examination for the master's degree in the School of Marine Science need not take another language examination. Individual committees may adopt additional language requirements at their discretion.

This requirement may be satisfied by achieving a grade of C or better in two semesters of any major modern foreign language at the undergraduate level or may be satisfied for bilingual students by an oral examination. A student not meeting this qualification may be granted provisional admission but will not be allowed to be admitted to candidacy until a proficiency has been demonstrated.

Students whose native language is not English may, with the permission of the Dean of Graduate Studies, use English to fulfill the foreign language requirement. Proficiency in the use of the English language may be demonstrated by the completion of twelve credit hours of formal class work with grades of B or higher in the School of Marine Science. Upon recommendation of the Academic Status and Degrees Committee of the faculty, the Dean of Graduate Studies may approve alternate methods.

Degree of Master of Arts

The steps to be accomplished and requirements for the degree are:

1. The student must select a suitable major professor, who must be a faculty member of the School of Marine Science, as soon as possible following admission. The student and the major professor will choose an Advisory Committee, which must be approved by the Dean of Graduate Studies. The major professor and Advisory Committee direct the student's program.

2. The Advisory Committee, chosen by the student and approved by the Dean of Graduate Studies, must consist of at least five members. A majority of the committee's members must be members of the faculty of the School of Marine Science, although persons with appropriate qualifications from outside the School of Marine Science may serve on the committee. For students with a specialty in biology or fisheries science, at least one member must be from the discipline of physical or environmental science. For students with a specialty in physical or environmental science, at least one member must be from the discipline of biological or fisheries science. For students with a specialty in resource management and policy, at least one member must be from another discipline within the School of Marine Science.

3. At least one year of each student's program must be spent as a full-time resident student as defined in the general degree requirements.

4. At least 36 credit hours of advanced work, of which at least 9 credit hours must have been earned in courses numbered 550 or above with a grade point average of 3.0 or better, are required for the M.A. degree. In addition, a student must have registered for thesis (MS 599) for at least one semester. No more than six thesis credits may be counted toward the minimum 36 credits required for the M.A.

   Credits more than seven (7) years old and earned in the program in which the student is currently enrolled will be deleted from the accumulation of credits required for a degree. Credits acquired while enrolled in previous programs here or elsewhere will not be subject to this limitation.

5. Upon a favorable recommendation of the student's Advisory Committee and the Academic Status and Degrees Committee, followed by a majority vote of the Academic Council and the approval of the Dean of Graduate Studies, a student may be admitted to candidacy after completion of the following requirements:

   a. The student must have achieved a grade point average of B (3.0) or better, averaged over all courses taken for credit at the time of application for admission to candidacy.

   b. All core courses required by the School of Marine Science (MS 501, MS 502, MS 503, MS 505) must be passed with a grade of B or better or officially exempted, and all other courses specifically required by the student's department and Advisory Committee must be completed.

   c. The language requirement and the qualifying examination must be satisfactorily completed.

6. The student must present a seminar to the marine science faculty, staff and students on a thesis topic approved by the major professor, the Advisory Committee and the Dean of Graduate Studies, and must defend this thesis before his or her major professor and committee. The defense of the thesis shall be separate from any other examination. Full details of this requirement can be obtained from the Office of the Dean of Graduate Studies.

7. All requirements for the degree must be completed within three calendar years after commencing graduate study. In exceptional cases, if recommended by the Academic Status and Degrees Committee, time extensions may be approved by the Dean of Graduate Studies.

Degree of Doctor of Philosophy

The steps to be accomplished and the requirements are:

1. The student must select a suitable major professor, who must be a faculty member of the School of Marine Science, as soon as possible following admission. The student and the major professor will choose an Advisory Committee, which must be approved by the Dean of Graduate Studies. The major professor and Advisory Committee direct the student's program.

2. The Advisory Committee, chosen by the student and approved by the Dean of Graduate Studies, must consist of at least five members, at least one of whom must be from outside the College of William and Mary. A majority of the committee's members must be members of the faculty of the School of Marine Science, although persons with appropriate qualifications from outside the School of Marine Science may serve on the committee. For students with a specialty in biology or fisheries science, at least one member must be from the discipline of physical or environmental science. For students with a specialty in physical or environmental science, at least one member must be from the discipline of biological or fisheries science. For students with a specialty in resource management and policy, at least one member must be from another discipline within the School of Marine Science.

3. A minimum of three years of graduate study beyond the baccalaureate is required. At least one academic year must be or have been spent in residence as a full-time M.A. or Ph.D. student of the College of William and Mary at either the Williamsburg or the Gloucester Point campus, or both, as defined in the general requirements above.

4. At least 42 credit hours of advanced work, of which at least 9 credit hours must have been earned in courses numbered 600 or above with a grade point average of 3.0 or better, are required for the Ph.D. degree. In addition, a student must have registered for at least 9 credit hours of dissertation (MS 699).

   Credits more than seven (7) years old and earned in the program in which the student is currently enrolled will be deleted from the accumulation of credits required for a degree. Credits acquired while enrolled in previous programs here or elsewhere will not be subject to this limitation.

5. Upon a favorable recommendation of the student's Advisory Committee and the Academic Status and Degrees Committee, followed by a majority vote of the Academic Council and the approval of the Dean of Graduate Studies, a student may be admitted to candidacy after completion of the following requirements:

   a. The student must have achieved a grade point average of B (3.0) or better, averaged over all courses taken for credit at the time of application for admission to candidacy.

b. All core courses required by the School of Marine Science (MS 501, MS 502, MS 503, MS 505) must be passed or officially exempted, and all other courses specifically required by the student's department and Advisory Committee must be completed.

c. The language requirement and the qualifying examination must be satisfactorily completed.

6. The student must present a seminar to the marine science faculty, staff and students on a dissertation topic approved by the major professor, the Advisory Committee and the Dean of Graduate Studies, and must defend this dissertation before his or her major professor and committee. The defense of the dissertation shall be separate from any other examination. Full details of this requirement can be obtained from the Office of the Dean of Graduate Studies.

7. All requirements for the degree must be completed within the following time frame:

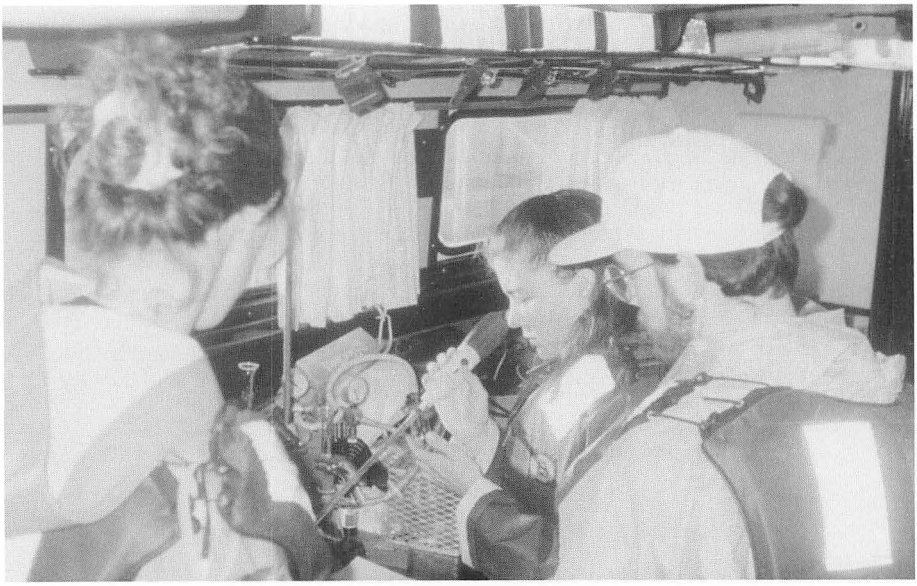
   4 years with a Master's Degree from the School of Marine Science

   5 years with a Master's Degree from another Institution

   6 years with direct admittance (bypass Master's Degree)

   In exceptional cases, if recommended by the Academic Status and Degrees Committee, time extensions may be approved by the Dean of Graduate Studies.

8. Dissertations will be published by having a master microfilm negative made from each original dissertation. These negatives will be stored and serviced by "University Microfilms" of Ann Arbor, Michigan, and positive microfilms or enlarged prints will be produced to order at the standard rate for other scholars who desire access to any dissertation. Each dissertation, when submitted, must be accompanied by two copies of an abstract of not more than 350 words. This abstract or summary will be published in Microfilm Abstracts for national distribution. No dissertation will be accepted without this abstract. A fee for the above services must be paid by the candidate for the Doctor of Philosophy degree before it is conferred. All dissertation research, however, should be planned, conducted and reported with a view toward publication of the results in a legitimate scientific journal.



Students in laboratory aboard R/V *Bay Eagle*.

Core course MS 503 students lowering a bongo net into the water.

General Statement of Policy

The School of Marine Science and the College of William and Mary have an Affirmative Action Policy and are committed to attracting minorities into marine science. The School's Admissions Committee considers applicants without regard to sex, race, color, religion, national origin, sexual orientation, or handicap. Admissions criteria are based on past and future academic and research performance.

The facilities and services of the College are open to all enrolled students on the same basis, and all standards and policies of the institution, including those governing employment, are applied accordingly.

Senior citizens of Virginia who wish to take advantage of fee waiver privileges in order to attend courses at William and Mary are invited to contact the Office of Admissions for full details.

The College reserves the right to make changes in the regulations, charges and curricula listed herein at any time.

Honor System

The Honor System, first established at William and Mary in 1779, remains one of the College's most cherished traditions. It assumes that principles of honorable conduct are familiar and dear to all students and hence dishonorable acts will not be tolerated. Students found guilty of cheating, stealing or lying are subject to dismissal. The principles of the Honor System and the method of administration are described in the Student Handbook.

Graduate Regulations

Application for Admission

Requests for application forms and completed application materials should be sent to:

Dean of Graduate Studies
School of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

Students are encouraged to apply for admission during the winter of each calendar year with a closing date of February 1. Applicants will

be notified after March 15 and no later than April 1. Admission will be valid for matriculation for the following summer, fall and winter semesters. Most students should anticipate a fall matriculation. The Dean of Graduate Studies should be contacted prior to submitting applications at any other time or regarding any special circumstances the student's application or matriculation might present.

The following are required of applicants to the School of Marine Science:

1. One (1) copy of the completed application form.
2. A *non-refundable* processing fee of $30. This fee is not credited to the student's account. There is no fee for application for admission as an unclassified (post-baccalaureate) student.
3. Three (3) 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).

Scores in an Advanced section of the Graduate Record Examination in the applicant's undergraduate major field or an area appropriate to the applicant's proposed concentration in marine science are informative but not essential. *GRE scores more than 5 years old are not acceptable, and the examination must be retaken. Applicants are encouraged to take the Graduate Record Examination at scheduled dates that will allow for receipt of scores by the aforementioned closing date. Applications lacking GRE scores or other critical materials after the closing date can not be evaluated by the Faculty.*

International Students

In addition to the verbal and quantitative sections of the Graduate Record Examination (GRE), international applicants whose primary language is not English must submit the results of the GRE English Language Proficiency Test, Test of English as a Foreign Language (TOEFL).

In general, the minimum acceptable TOEFL score is 550. The TOEFL requirement may be waived if the applicant has completed an undergraduate or graduate degree at an accredited U.S. institution or other appropriate institution in which the language of instruction is English. Students with marginal proficiency in English will be required to register for an appropriate English course offered at the Williamsburg campus. A reduced load of graduate courses is suggested for these students.

Transcripts, certificates of degrees and similar documents submitted by international applicants must be accompanied by an English translation and must include titles of all courses taken and the grade received in each course.

GPA and GRE statistics of applicants offered admission for the Fall semester, 1995

	GRE scores						
GPA	<900	900-999	1000-1099	1100-1199	1200-1299	1300-1399	>1400	Totals
<2.0								
2.0-2.4						1		1
2.5-2.9				6	3	2		11
3.0-3.4			2	4		3	4	13
3.5-4.0			1	5	13	7	4	30
Totals			3	15	16	13	8	55

International students admitted to the School must present proof that they have available funds sufficient to meet all costs they will incur while studying at the School of Marine Science. The form I-20 *will not be mailed* until this proof of financial support is received. For those students offered financial aid by the School of Marine Science, such aid may be included as a source of funds. For additional information, please contact the International Student Coordinator.

Admission Information

Applicants are encouraged to visit the campus to contact faculty members about specific research interests, funding opportunities, and program information.

Admission to the School of Marine Science is highly competitive; there were 325 applicants for the entering class of 1994. Accordingly the Faculty carefully evaluates criteria of performance which include GRE scores, overall GPA and GPA in area of concentration, the difficulty of the applicant's educational program, the applicant's statement of purpose, letters of recommendation, and prior experience. Although it is neither possible nor desirable to provide absolute values of criteria that will ensure admission, the table above shows GRE and GPA scores of applicants offered admission in Fall 1994.

Classified Students

Students are admitted as regular or provisional graduate students. For matriculation as a regular graduate student, an applicant must have completed the requirements for a bachelor's degree at an accredited college, with a record of high performance, and must have the recommendations of the Faculty and officials of the School of Marine Science.

Applicants judged deficient in preparatory studies or other areas may be admitted as provisional students. A provisional student may petition for regular student status after successful completion of those requirements stipulated in his or her

notification of admission. Petition for change in status shall be reviewed by the Academic Status and Degrees Committee, using as criteria overall academic performance and performance standards previously specified on the student's notification of admission. Graduate credit earned by a provisional student will be applied toward the graduate degree upon conversion to regular student status.

Students may be admitted to either the Master of Arts or Doctor of Philosophy programs. Direct admission into the Doctor of Philosophy program is available to qualified applicants without a Master's degree. Applicants requesting this option should indicate this choice in the appropriate section of the application form. Direct admission must be granted and therefore requires an evaluation by the Admissions Committee. The following guidelines are employed by Admissions for this purpose: (1) direct admission is considered for applicants of exceptional promise and superior academic performance, and (2) the applicant must have the support of an appropriate faculty member who agrees to mentor the applicant over the course of study. Identification of a faculty mentor usually requires that the applicant visit campus to interview appropriate SMS faculty. Admissions' actions on requests for direct admission are transmitted to the Dean of Graduate Studies for final action.

Following completion of the course requirements for the M.A. degree in Marine Science, a student initially admitted to the master's program may petition for permission to bypass the master's degree and proceed directly toward the doctorate in a timely manner, assuming the student has met all requirements. The petition, which must be submitted to the Academic Status and Degrees Committee must have support of the student's advisory committee. The advisory committee must support this petition with a written statement confirming that the student has begun work on a research project acceptable as the basis for a doctoral dissertation, and that it is the consensus of the committee that the student has demonstrated a level of excellence to proceed directly to the doctorate. Following review of the petition and supporting documents and consideration of all faculty approved requirements for bypass, the Academic Status and Degrees Committee will recommend to the Dean of Graduate Studies whether or not permission to bypass should be granted. Authority for the final decision rests with the Dean of Graduate Studies.

Students completing an M.A. degree in the School of Marine Science and who desire to enter the Ph.D. program are required to submit a formal application for admission.

Unclassified Students

Students who have received a bachelor's degree from an accredited college or university and who wish to take courses in the School of Marine Science but who are not entering an advanced degree program, may apply for unclassified student status (post-baccalaureate). Graduate credit earned as an unclassified student may be applied toward the graduate degree upon matriculation as a regular graduate student.

Financial Information

Tuition and Fees

The College reserves the right to make changes in its charges for any and all programs at any time, after approval by the Board of Visitors.

The tuition and general fee for full-time students in the School of Marine Science is $2,278 per semester for residents of Virginia and $6,734 per semester for others.

Special Note: All incoming students registered for nine hours or more in 500-level courses or above, or for twelve hours or more at any level, are considered full-time students and charged the full-time rates unless qualified to be a Research Graduate Student.

Tuition for part-time students, at both the undergraduate and graduate levels, is as follows:

$149 per semester hour for Virginia residents.

$419 per semester hour for out-of-state students.

Regularly enrolled degree-seeking students of the College will be charged these rates during the regular session for part-time work, based on their established domiciliary status.

Rates for students who enroll in the Summer Session will be charged on the same basis.

Part-time students who are not regularly enrolled at the College of William and Mary, and for whom, therefore, no domiciliary status previously has been determined, will be charged on the basis of their satisfactorily established domiciliary status. (See statement regarding Eligibility for In-state Tuition Rate).

Auditing fees are the same as those specified for part-time students, unless the auditor is a full-time student. Permission to audit must be obtained from the instructor.

Graduate Assistantships

Graduate research and graduate teaching assistants work an equivalent of twenty hours a week. *For graduate research assistants, every effort will be made to ensure that assistantship duties are relevant to the student's course of study and research program.* Graduate assistants must satisfactorily carry out the duties assigned by the School

of Marine Science, must make satisfactory progress on their programs as defined by the College degree requirements and the regulations of the School of Marine Science, and may not hold any other employment or appointment of a remunerative nature during the term of their assistantships without approval of the Dean of Graduate Studies. Failure to comply with these conditions will lead to revocation of appointments.

Graduate Fellowships

A limited number of outstanding applicants are awarded fellowships that consist of "tuition remission" in addition to a graduate assistantship. These fellowships are awarded via a priority ranking system and are renewable annually for up to 3 years, contingent upon satisfactory performance.

Research Graduate Student Status

Upon the recommendation of a student's major professor, advisory committee, and the Academic Status and Degrees Committee, the Dean of Graduate Studies may approve a student obtaining Research Graduate status ***for a single semester.*** This generally would be the semester in which the student completes the thesis and graduates.

The following conditions must be met:

1. The student has completed all required coursework.
2. The student is not employed significantly in any activity other than research and writing in fulfillment of degree requirements.
3. The student is present on the campus or is engaged in approved field work related to his or her thesis or dissertation.

While classified as a Research Graduate, a student may register for a maximum of 12 credit hours of Thesis or Dissertation per regular semester upon payment of the part-time rate for only three credit hours of Thesis/Dissertation. The student may elect to utilize up to two (2) of the three paid credit hours for formal coursework.

A Research Graduate student may register for additional course credit only upon payment of the generally applicable additional part-time tuition.

A Research Graduate student is eligible for services (e.g. student health and athletic events) only if required fees are paid.

Eligibility for In-state Tuition Rate

To be eligible for the lower tuition rate available to in-state students, a student must meet the statutory test for domicile set forth in Section 23-7.4 of the Code of Virginia.

Domicile is a technical legal concept, and a student's status is determined objectively through the impartial application of established rules. In general, to establish domicile students must be able to show (1) that for at least one year immediately preceding the first official day of classes their permanent home was in Virginia and (2) that they intend to stay in Virginia indefinitely after graduation. Residence in Virginia primarily to attend college does not establish eligibility for the in-state tuition rate.

On admission to the College an entering student who claims domiciliary status is sent an application form and instructions on how to fill it out. The Office of the Registrar evaluates the application and notifies the student of its decision. A student re-enrolling in the College after an absence of one or more semesters must re-apply for domiciliary status and is subject to the same requirements as an entering student. A matriculating student whose domicile has changed may request reclassification from out-of-state to in-state; since reclassification is effective only prospectively, however, it must be applied for before the beginning of the academic semester. Any student may ask for written review of an adverse decision, but a change in classification will be made only when justified by clear and convincing evidence. All questions about eligibility for domiciliary status should be addressed to the Office of the Registrar.

Payment of Accounts

Charges for the tuition and general fee are payable in advance by the semester. Registration is not complete until all fees due the Treasurer's Office are paid. Any unpaid balance on an individual's account could result in cancellation of registration. Remittance being made by check should be drawn to the College of William and Mary. Checks returned by the bank for any reason will constitute nonpayment of fees and will result in subsequent cancellation of registration.

Refunds to Students Who Withdraw from the College

Subject to the following regulations and exceptions, all charges made by the College are considered to be fully earned upon completion of registration by the student. Due to administrative procedures, refunds will not be processed until six (6) weeks after classes begin.

1. A student who withdraws within the first five-day period immediately following the first day of classes is entitled to a refund of all charges, with the exception of $50 which shall be retained by the College to cover the costs of registration, subject to Item No. 5, below. (Such refunds shall not include any deposits or advance payments that may have been required by the College as evidence of the student's intention to enroll.)

2. A student who withdraws at any time within the next following 25 days after the first day of classes shall be charged 25% of the tuition and general fee, subject to Item No. 5 below.

3. A student who withdraws at any time within the second 30-day period after the first day of classes shall be charged 50% of the tuition and general fee, subject to Item No. 5 below.

4. A student who withdraws at any time after 60 calendar days following the first day of classes shall be charged the full tuition and general fee, subject to Item No. 5 below.

5. No refunds will be made to a student who has been required by the College to withdraw, regardless of the date of withdrawal.

6. No refunds will be made to a student who withdraws unofficially.

7. A registration fee of at least $50 will be deducted from the amount due and paid by a part-time student who withdraws within 60 calendar days immediately following the first day of classes, except in the case of an in-state student who is registered for only one credit hour. In such a case, the student will receive no refund.

If the total amount due and paid is more than $100, a maximum of 50% of the total will be refunded. The graduated refund policy noted for full-time students will not apply to part-time students.

No refund will be granted to a part-time student who withdraws after 60 calendar days immediately following the first day of classes; or who has been required by the College to withdraw, regardless of the date of withdrawal; or who withdraws unofficially.

At the graduate and/or law school level, a part-time student is one who is enrolled for eight (8) credit hours or less. An exception to this rule is noted under Tuition and Fees.

Withholding of Transcripts and Diplomas in Cases of Unpaid Accounts

Transcripts or any other information concerning scholastic records will not be released until College accounts are paid in full. Diplomas will not be awarded to persons whose College accounts are not paid in full.

Student Facilities and Services

Housing

There is no student housing on the SMS/VIMS campus, and most students live in Gloucester Point or in surrounding communities. Rental housing is plentiful, and area rents generally range from $250 to $450 or more per month, depending on the accommodations. Students often elect to share housing in order to keep costs to a minimum.

A limited number of apartments for graduate students are available on the Williamsburg campus. Located next to the Marshall-Wythe School of Law, the Graduate Housing Complex is within walking distance of the College's main campus and historic Colonial Williamsburg. Information and application forms can be obtained from the Office of Residence Hall Life, P.O. Box 8795, 206 James Blair Hall, Williamsburg, VA 23187-8795, (804) 221-4134.

Cultural Life at William and Mary

As part of the William and Mary community, School of Marine Science students may participate in a broad range of cultural activities on the Williamsburg campus. Under the auspices of the Committees on Concerts and Lectures and the Speakers Forum, the College provides its students opportunities to enjoy a full spectrum of public lectures and concerts. In recent years College audiences have enjoyed performances by nationally and internationally recognized theatre arts performers. In addition, the William and Mary Theatre annually presents four full-length plays in public performance. The Speakers Forum offers subscription series featuring prominent national personalities from the worlds of politics, entertainment and the arts.

Under the sponsorship of the Fine Arts Department, the Campus Center, and the Muscarelle Museum of Art, exhibits in painting, sculpture, and architectural design, theatre and industrial arts are shown throughout the year.

Numerous small and large cities—including the major metropolitan areas of Norfolk, Virginia Beach, and Richmond—are within easy driving distance of Gloucester Point. Each provides a broad array of cultural and entertainment events throughout the year.

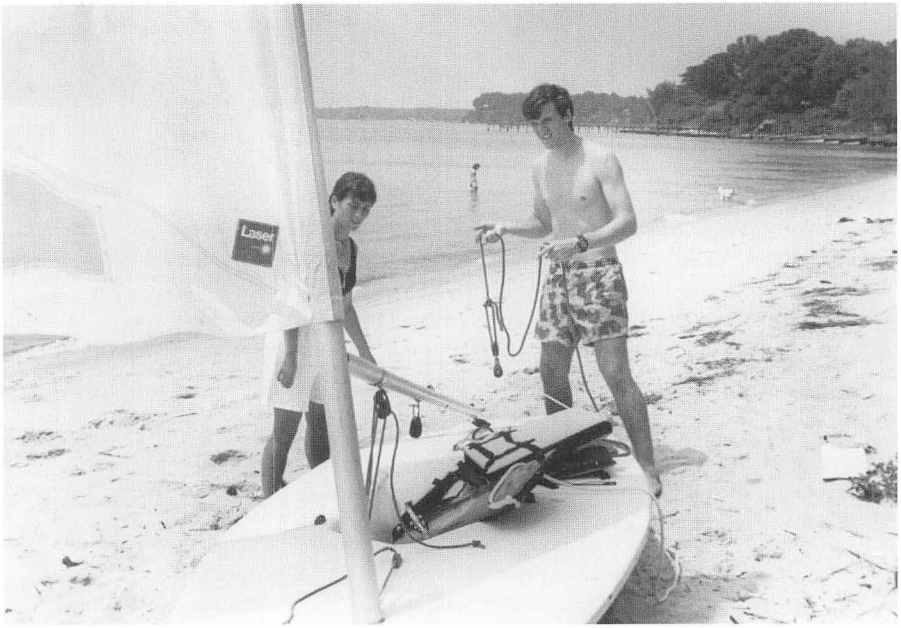
Campus Parking

Many students drive a motor vehicle to the SMS/VIMS campus, and parking can sometimes be at a premium. However, space is usually available in one of the many campus parking areas, including three lots near the Franklin Marine Center. All motor vehicles, including motorcycles and motorbikes, parked on SMS/VIMS property must be registered with Parking Services. Registration includes the purchase of a College of William and Mary parking decal, which must be displayed on or in the vehicle. Decals are also honored on the main campus in Williamsburg. Illegally parked or unregistered vehicles are subject to citation, and students with unresolved citations are not allowed to register for classes or to receive degrees.

A full description of campus motor vehicle regulations is contained in a booklet available from Parking Services.

Outdoor Life and Athletics

With SMS/VIMS' semi-rural setting in close proximity to the Chesapeake Bay and its many tributaries, and with the Blue Ridge Mountains only a few hours drive to the west, students enjoy diverse opportunities for outdoor activities ranging from sailing, canoeing, and kayaking to biking, hiking, and both fresh- and saltwater fishing.



The SMS Sailing Club is one of many recreational and sporting activities in which students may participate.

Graduate students regularly participate in informal and organized soccer, basketball and other team sports, and are eligible for reduced-rate health club memberships at community fitness centers in Gloucester and nearby Newport News.

The Williamsburg campus includes the 15,000-seat capacity Cary Field stadium used for competitive football, track, soccer and lacrosse events, as well as providing space for intramural sports. William and Mary Hall has an indoor seating capacity of 10,000 for basketball, gymnastics and track. Graduate students who pay full tuition and general fees are admitted to all athletic contests by presenting their ID cards.

The Office of Recreational Sports provides a variety of leisure pursuits to all students through intramural, sport club, informal recreation, fitness/wellness and outdoor programs. Facilities include the Student Recreation Center, Adair Gymnasium, William and Mary Hall, Lake Matoaka and various other outdoor facilities. The Recreation Center and Adair Gymnasium each have a 25-yard indoor pool. Facilities are open seven days per week during the academic year and often during the break periods. Facility schedules and procedures for checking out equipment are available at any recreational facility or the Campus Center.

Intramurals are separated into co-rec, men's and women's divisions for most activities. Play is held for each of over 30 sports/activities during the year. Informal or open recreation, generally considered "free-play," is offered in aerobics, swimming, racquetball and squash, basketball, weightlifting, canoeing and kayaking and other sports.

The Sport Club program consists of 23 clubs, each self-governing and self-supporting and dictated simply by participants' interest in the activity. Clubs include badminton, crew, cricket, cycling, ice hockey, judo, men's lacrosse, martial arts, outdoor, racquetball, rifle, men's rugby, women's rugby, running, sailing, scuba, men's soccer, women's soccer, squash, surfing, tennis and ultimate frisbee.

For information on any activity, program or service offered by Recreational Sports, the office may be contacted at 221-3310.

Student Health Service

Graduate students who have filed a history and physical examination form and carry at least nine credits per semester are eligible to use the College's student health service, which is operated on the main campus in Williamsburg. Graduate students who carry fewer than nine credits per semester are eligible to use the health service if they are certified by the Dean of Graduate Studies as "full-time equivalent" students and pay the student health fee.

Any student who has not submitted his/her health history and physical examination form by the end of his/her first semester at the College will not be permitted to register for the next semester.

The health service is housed in the King Student Health Center, which includes an out-patient clinic, a dispensary, and a limited number of beds for overnight care. A variety of services, most of which are covered by the student health fee (a portion of the tuition and general fee), are provided by the King Student Health Center.

Center for Personal Learning and Development

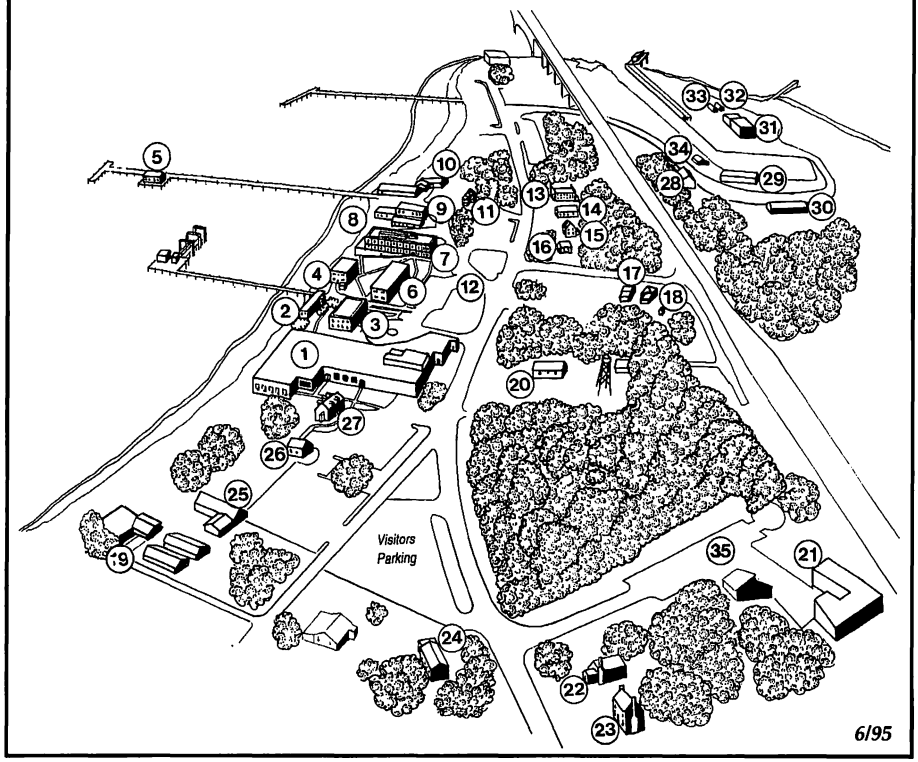
Located on the Williamsburg campus offers professional assistance with psychological problems and problems involving social relationships and the understanding of oneself or others. Services are offered to students through individual psychotherapy, group psychotherapy, and personality testing and assessment. With the exception of national test services, all Center services are free to students. As a matter of policy, the Center does not deal with problems that require the prescribing of drugs, except in instances that warrant cooperative work with the Student Health Service. *No information concerning an individual's contact with the Center will be released without the written permission of the client.* The Center also does not handle problems associated with course selection, job placement, career counseling or remedial academic programs.

Career Services Center

Located in Blow Hall on the William and Mary campus, Career Services provides quality career planning and job search services. Numerous services including a comprehensive computerized career guidance system, and career library. Speakers series and seminars are provided to assist students as well.

The Graduate Student Association

The Graduate Student Association is a voluntary organization open to all graduate students in the School of Marine Science. The purpose of the Association is to advance the academic and social interests of its members. Officers are elected each spring for the following academic year.



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

1. WATERMEN'S HALL
2. MARINE CULTURE LAB
3. MAURY HALL
4. DAVIS HALL
5. FERRY PIER HOUSE
6. BROOKE HALL
7. BYRD HALL
8. SEDIMENT LAB
9. SERVICE CENTER & WET LAB
10. MAINTENANCE SHOP
11. REED HOUSE
12. MARINE CHEMISTRY & TOXICOLOGY BUILDING (Under construction)
13. HOXTON HALL
14. HOLBEN HOUSE
15. WHITE HOUSE
16. STEVENSON HOUSE
17. MELVILLE HOUSE
18. CONRAD HOUSE
19. CMAP COMPLEX
20. RALEIGH HOUSE
21. JEFFERSON HALL
22. HALL HOUSE
23. BROWN HOUSE
24. WILLIAMS HOUSE
25. PAGE HOUSE
26. SAFETY OFFICE
27. CLAYTON HOUSE
28. FRANKLIN HALL
29. NEWPORT HALL
30. BOAT SHED
31. OYSTER HATCHERY
32. SAV GREENHOUSE
33. TURTLE GREENHOUSE
34. DIVING SAFETY OFFICE
35. NUNNALLY HALL (Fisheries Science addition under construction)

School of Marine Science
Virginia Institute of Marine Science
College of William and Mary
P.O. Box 1346
Gloucester Point, Virginia 23062

School of Marine Science
Graduate Catalog
1995 - 1996

Mr. Theberge

1995-96 *GRADUATE CATALOG*
of the School of Marine Science

CORRECTION!

TUITION AND FEES for the 1995-96 Academic Year are incorrectly listed on Page 61 of the *GRADUATE CATALOG*.

The tuition and fees approved by the Board of Visitors for 1995-96 are as follows:

Part-time (8 hours or less):
$153 per semester hour for Virginia students
$450 per semester hour for out-of-state students

Full-time (9 hours or more):
$2,369 per semester for Virginia students
$7,214 per semester for out-of-state students