

# School of Marine Science

Graduate Catalog  
2011-2012



Virginia Institute of Marine Science



The College of  
William and Mary



AUGUST 2011

Note: This catalog provides announcements for the 2011-12 academic year. It is current until August 2012. The College reserves the right to make changes in the regulations, charges, and curricula listed herein at any time.

Catalogs are issued for other College programs as follows:

Undergraduate  
School of Business  
School of Education  
Graduate Studies in Arts and Sciences  
School of Law  
Summer Sessions  
Special Programs

## General Statement of Policy

The College of William and Mary does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, disability or age in its programs and activities.

Inquiries regarding the non-discrimination policies should be addressed to:

Ms. Tammy Currie  
Director of Equal Opportunity  
Hornsby House  
P.O. Box 8795  
Williamsburg, VA 23187-8795  
(757) 221-2615

## The College of William and Mary Diversity Statement

The College of William and Mary in Virginia is a community of teachers, students, and staff who share our national ideals of human equality, democracy, pluralism, and advancement based on merit. We give life to these principles - and prepare women and men to be citizens of the wider world - when we value diverse backgrounds, talents, and points of view.

As a community, William and Mary believes that cultural pluralism and intellectual freedom introduce us to new experiences, stimulate original ideas, enrich critical thinking, and give our work a broader reach. We cannot accomplish our mission of teaching, learning, discovery, and service without such diversity. William and Mary belongs to all Virginians, to the nation, and to the world. Yet our College, like our country, failed for many years to open the door of opportunity to all people. In recent decades, William and Mary has made itself a more diverse community, and thus a better one. Structures and habits that create injustices, however, have yet to be fully banished from American society. We are committed to establishing justice.

The College of William and Mary strives to be a place where people of all backgrounds feel at home, where diversity is actively embraced, and where each individual takes responsibility for upholding the dignity of all members of the community.

*-Approved by the William and Mary Board of Visitors on November 17, 2006*

*Cover Photo: Eastern Shore mud flat by Hadley McIntosh.*

# School of Marine Science

Graduate Catalog  
2011 - 2012



*Ichhika Sivaipram*

[www.vims.edu](http://www.vims.edu)

# Contents

The College of William and Mary .....	3	Summary of Degree Requirements -	
The Virginia Institute of Marine Science .....	3	Master of Science .....	60
Departments.....	3	Summary of Degree Requirements -	
Programs & Centers .....	4	Doctor of Philosophy .....	61
School of Marine Science .....	6	Leave of Absence .....	62
Mission of the School of Marine Science...	6	Withdrawal from the Program.....	63
Office of Academic Studies.....	7	Reinstatement after Withdrawal .....	63
Academic Calendar .....	8	Financial Information .....	64
Administration.....	10	Tuition and Fees .....	64
VIMS/SMS Faculty .....	11	Graduate Funding.....	64
Academic Programs .....	17	Fellowships .....	65
Admission .....	18	Research Graduate Student Status .....	65
Procedures .....	18	Eligibility for In-State Tuition for	
International Students.....	19	Research and Teaching Assistants .....	65
Degree-Seeking Students .....	20	Eligibility for In-State Tuition for	
Non Degree-Seeking Students.....	20	Students with Permanent Domicile .....	66
Graduate Program.....	21	Payment of Accounts.....	66
Department of Biological Sciences .....	21	Students Who Withdraw	
Department of Environmental		from the College.....	67
and Aquatic Animal Health .....	23	Withholding of Transcripts and Diplomas	
Department of Fisheries Science .....	25	in Cases of Unpaid Accounts .....	68
Department of Physical Sciences.....	27	Student Insurance Requirement.....	68
Marine & Environmental Policy .....	30	Student Insurance Plan.....	68
Course Descriptions .....	31	General Statements of Policy.....	69
Graduate Courses.....	31	Honor Code.....	69
Undergraduate Courses.....	48	Office of the Dean of Students	
Degree Requirements.....	50	(Williamsburg campus).....	69
Residency .....	50	Counseling Center .....	70
Registration .....	50	Cohen Career Center .....	70
Academic Standing .....	51	Disability Services.....	70
Degree Program Milestones.....	51	Student Health Center .....	71
Academic Probation .....	53	VIMS Campus and Student Activities .....	73
System of Grading and Quality Points.....	54	The Graduate Student Association .....	73
SMS Core Curriculum.....	54	Cultural Life at VIMS and	
Department Core Courses .....	55	William and Mary .....	73
Required Courses .....	56	Housing.....	74
Core Course Exemption.....	56	Recreational Sports .....	74
Retaking a Course .....	56	Parking .....	75
Transfer of Academic Credit.....	56	Research Facilities and Equipment	
Auditing a Course.....	57	by Department .....	76
Master of Science Bypass Option .....	57	Department of Biological Sciences .....	76
Comprehensive Examination .....	58	Department of Environmental and	
Qualifying Examination.....	58	Aquatic Animal Health .....	76
Filing for Graduation.....	59	Department of Fisheries Science .....	77
Submission of Theses and Dissertations.	59	Department of Physical Sciences.....	78
Conferral of Degrees.....	60	VIMS Facilities .....	79



## *The College of William and Mary*

The College of William and Mary in Virginia, founded in 1693, is one of the most distinguished liberal arts universities in the nation. As the nation's second oldest institution of higher education – the oldest is Harvard - the College has built an eminent reputation for excellence in education. The College's nationally acclaimed undergraduate program is integrated with graduate and professional programs in five faculties - Arts and Sciences, Business, Education, Law, and Marine Science. Master's and doctoral programs in the humanities, sciences, social sciences, business, education, and law provide a wide variety of intellectual opportunities for students at both graduate and undergraduate levels.

The College of William and Mary is accredited by the Southern Association of Colleges and Schools.

## *The Virginia Institute of Marine Science*

As one of the largest marine science centers in the United States, the Virginia Institute of Marine Science (VIMS) has a long history of excellence in coastal and estuarine science. Founded in 1940, the Institute's strength lies in its diverse faculty and interdisciplinary approaches to complex scientific questions combined with an ability to provide practical advice on issues that have important implications for society. Faculty members lead global efforts to understand the coastal environment and to provide independent scientific information that informs policy solutions nationally and internationally. VIMS also takes a leading role in identifying and addressing the problems of Chesapeake Bay.

### *Departments*

**Department of Biological Sciences:** The faculty of the Department of Biological Sciences includes a diverse group of estuarine and coastal marine ecologists and biological oceanographers who work in a wide range of research areas, such as biogeochemical cycling; physiological, population, and community ecology; and whole ecosystem modeling using state-of-the-art approaches. Scientists in the department study benthic, planktonic and nektonic organisms and the temporal and spatial patterns and processes that control their distribution, diversity and ecological functioning in estuarine, coastal and open ocean regimes.

**Department of Environmental and Aquatic Animal Health:** Research within the Department of Environmental and Aquatic Animal Health emphasizes understanding the fates of contaminants and pathogens in



Candace Spiter

estuarine and marine environments and their effects on important species as well as humans. A diverse faculty consisting of environmental chemists, toxicologists, ecotoxicologists, biochemists, immunologists, microbiologists, molecular geneticists, and pathobiologists collaborate to achieve these goals. A key mission of the department is to identify and detect toxicological, pathobiological and biochemical agents in the Chesapeake Bay and its watershed that affect the health of important aquatic organisms and surrounding human populations. Research questions are pursued at all levels of biological organization from the molecular and cellular to the organismal and population levels. Activities reflect a strong commitment to provide technical support to environmental managers and stakeholders who regulate and protect the waters and natural resources of the Commonwealth regional and federal management agencies, and marine-related industries.

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

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

## ***Programs & Centers***

**Marine Advisory Service/Virginia Sea Grant Program (VASG):** In partnership with VIMS, Virginia Sea Grant provides expert science-based information and assistance to marine industry sectors to maximize efficiency, economy and safety in the judicious utilization of marine resources. In addition, VASG supports programs to educate the public, K-12 students and private industry as to the importance of sustaining the marine environment and its resources.

**Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR):** In partnership with VIMS, the Estuarine Reserves Division of the National Oceanic and Atmospheric Administration (NOAA) is responsible for the operation and management of CBNERR. The reserve's mission is to preserve a network of protected areas that represent the diversity of coastal ecosystems found within the York River estuary

and manage these areas to support informed decision-making regarding coastal resources through research, K-12 education, public outreach, professional training, stewardship and advisory service. CBNERR has developed focus areas that direct reserve programs and address national, regional and local issues. Primary focus areas include: functions and linkages of land-margin ecosystems; ecosystem vulnerability to climate and human induced stressors; water quality and aquatic stressors; and integrated ocean and coastal observing systems.

**Center for Coastal Resources Management (CCRM):** The VIMS Center for Coastal Resources Management provides support to the state and nation to enable informed management of coastal resources in Virginia and the mid-Atlantic region. To accomplish its mission the CCRM is organized into three programs with broadly integrated activities. The Wetlands Advisory Program provides scientific and technical advice on management of tidal and nontidal wetland resources, tidal shorelines, and subaqueous lands. The Comprehensive Coastal Inventory Program collects data, conducts inventories, and develops analytical tools in support of coastal resource management. The Coastal Watersheds Program conducts basic and applied research on the ecological services provided by coastal resources.

**Aquaculture Genetics and Breeding Technology Center (ABC):** The VIMS ABC operates an experimental genetics and shellfish breeding program for the growing oyster culture industry. The program's primary objective is to develop genetically improved animals to be used as brood stock for hatcheries in Virginia and, one day, throughout the mid-Atlantic. ABC's research involves hatchery technology, quantitative genetics, and applied breeding techniques. The Center provides training to graduate students and offers an Oyster Aquaculture Training program to train interns for industry positions. The Gloucester Point Hatchery provides a home for spawning

seed for experiments and the breeding program. ABC's field operations include experimental farms at Gloucester Point, and four other locations throughout the Virginia portion of the Bay. ABC staff collaborate with industry extensively. The Kauffman Aquaculture Center, which is a part of the ABC, is a state-of-the-art quarantine facility for brood stock isolation and conditioning.



Anu Frank-Lawale

# School of Marine Science

The School of Marine Science (SMS) is an integral part of the Virginia Institute of Marine Science. It is also one of five graduate and professional schools of the College of William and Mary. The campus is in Gloucester Point, approximately 20 miles from the main campus located in Williamsburg, Virginia. VIMS awarded its first master's degree in 1943 and inaugurated a Doctoral program in 1964. Nearly 900 marine scientists have earned graduate degrees over the Institute's history. At present SMS has 100 graduate students, with about half working towards a Master of Science (M.S.) degree and half towards a Doctorate (Ph.D.). Our alumni have gone on to distinguished careers in academia and research-focused institutions, regulatory agencies at the local, state and federal levels and in the corporate and private sectors.

## Mission of the School of Marine Science

**Graduate Program:** The primary mission of the School of Marine Science is to provide graduate students with education and training that will allow them to achieve their full intellectual potential and successfully pursue careers in marine science.

To accomplish this, the SMS Faculty:

- provides instruction in the fundamentals of marine science so that students gain a general understanding of oceanic, coastal and estuarine systems,
- offers advanced courses tailored to each student's area of research specialization, and
- encourages students to develop a specialization that is informed by basic and applied principles of marine science and facilitates the development of independent, as well as collaborative and interdisciplinary research perspectives.



Grace Cartwright



Placed within the Virginia Institute of Marine Science's tripartite mission of research, education and advisory service, the SMS offers exposure to a variety of career options while providing students with the education and research skills necessary to meet present and future societal needs. In addition, SMS graduate students perform or assist with research and teaching activities that directly benefit the Commonwealth of Virginia and the nation.

**Undergraduate Program:** Building on the successes of our graduate education program, the School of Marine Science entered a partnership with Arts and Sciences to offer undergraduates the opportunity to minor in marine science. The undergraduate minor in marine science provides interested students a coherent experience in this interdisciplinary subject. More information on the minor is available at: <http://www.wm.edu/as/marinescience/>

**Public Education and Outreach:** The Virginia Institute of Marine Science offers marine science education for a wide variety of audiences and age levels. VIMS and its federal partners work closely with schools, businesses, government agencies, and individuals to provide information and guidance on a wide range of marine-related programs and activities. The School of Marine Science encourages its faculty and students to engage in outreach activities that serve to strengthen marine science education at all levels.

In addition to the information contained in this catalog, more information on the education activities and academic programs of VIMS/SMS can be found at: <http://www.vims.edu/education/>

## ***Office of Academic Studies***

The Office of Academic Studies is located in Watermen's Hall on the VIMS Gloucester Point Campus (Room 251). Please contact us if you need additional information:

**Dr. Linda Schaffner**, Associate Dean of Academic Studies – office telephone: (804) 684-7105; e-mail: [linda@vims.edu](mailto:linda@vims.edu)

**Ms. Sue Presson**, Registrar – office telephone: (804) 684-7106; e-mail: [snpres@vims.edu](mailto:snpres@vims.edu)

**Ms. Fonda Powell**, Administrative Assistant – office telephone: (804) 684-7105; e-mail: [fonda@vims.edu](mailto:fonda@vims.edu)

For general questions concerning our academic programs, please use this e-mail: [AD-AS@vims.edu](mailto:AD-AS@vims.edu)

This SMS Graduate Catalog lists the key guidelines, milestones, requirements and regulations for the program. The current catalog can be viewed on the web at: <http://www.vims.edu/education/graduate/coursecatalog/>

The W&M Graduate Studies Student Handbook can be viewed at: [http://www.vims.edu/education/graduate/student\\_handbook/](http://www.vims.edu/education/graduate/student_handbook/)

General information on the VIMS/SMS Graduate Program can be found at: <http://www.vims.edu/gateways/prospectivestudents/>  
<http://www.vims.edu/gateways/currentstudents/>

# Academic Calendar

## Fall Semester 2011

### August

22	Mon.	Tuition and Fees due for 2011 Fall Semester
22-23	Mon.-Tues.	Orientation for New Students
22-23	Mon.-Tues.	Final Fall Registration period for all SMS Students
24	Wed.	FIRST DAY OF CLASSES: 8:00 am
24	Wed.	Beginning of Add/Drop Period for 2011 Fall Semester
24	Wed.	Non-degree seeking Student Registration

### September

2	Fri.	Last Day to Add/Drop a Class for Fall 2011 Semester
3	Sat.	Withdrawal Period Begins - See Graduate Registrar for more information
6	Mon.	Labor Day (classes meet)

### October

3	Mon.	DEADLINE TO FILE FOR GRADUATION IN MAY or AUGUST 2012 (Notice of Candidacy for Graduation Forms due to SMS Registrar)
8-11	Sat.-Tues.	Fall Break (classes resume Wednesday)
24-28	Mon.-Fri.	Advanced Registration for Spring 2012 Begins

### November

23	Wed.	Begin Thanksgiving Holiday: 8:00 am
27	Sun.	End Thanksgiving Holiday

### December

2	Fri.	END OF FALL CLASSES: 5:00 pm
2	Fri.	End Make-up of Spring 2011 course work ("I's" change to "F" after this date)
3-4	Sat.-Sun.	Reading Period
5-9	Mon.-Fri.	Examinations
10-11	Sat.-Sun.	Reading Period
12-14	Mon.-Wed.	Examinations

### January 2012

2	Mon.	Fall 2011 Semester Grades Due by 9:00 am
2	Mon.	LAST DAY TO SUBMIT THESES AND DISSERTATIONS FOR JANUARY 2012 CONFERRAL OF DEGREES
13	Fri.	WINTER DEGREE CONFERRAL DATE (no ceremony)

NOTE: Additional dates and deadlines of importance can also be found on the Academic Calendars & Exam Schedules pages of the University Registrar's web site [www.wm.edu/registrar](http://www.wm.edu/registrar). Calendar dates may be subject to change.

## *Spring Semester 2012*

### January

13	Fri.	End of Advanced Registration for continuing SMS students for Spring 2012
18	Wed.	FIRST DAY OF CLASSES: 8 a.m.
18	Wed.	Beginning of Add/Drop Period for Spring 2012 Semester
27	Fri.	Last day of Add/Drop Period for Spring 2012 Semester
28	Sat.	Withdrawal Period Begins - See Graduate Registrar for more information

### March

3-11	Sat.-Sun.	Spring Break
12	Mon.	Classes Resume
12	Mon.	Summer Sessions 2012 Registration begins for continuing students
19	Mon.	Fall 2012 Registration begins for continuing students

### April

27	Fri.	Last Day to Withdraw from Course - See Graduate Registrar for more information
27	Fri.	LAST DAY OF SPRING CLASSES: 5:00 pm
28-29	Sat.-Sun.	Reading Period
30	Mon.	LAST DAY TO SUBMIT THESES AND DISSERTATIONS FOR MAY 2012 CONFERRAL OF DEGREES
30-May 4	Mon.-Fri.	Examinations

### May

5-6	Sat.-Sun.	Reading Period
7-9	Mon.-Wed.	Examinations
9	Wed.	Make-up of Fall 2011 "I's" (change to "F" after this date) end
11	Fri	Spring 2012 Semester grades due for graduating students
13	Sun.	COMMENCEMENT/SPRING CONFERRAL DATE
16	Wed.	Remaining SPRING 2012 Grades Due
25	Fri	End Registration for Continuing Students for Summer Sessions 2012

## *Summer Sessions 2012*

<b>SESSION I:</b>	May 29 - June 29
<b>SESSION II:</b>	July 2 - August 3
<b>SESSION III:</b>	May 29-August 3 (Research Session, for students taking only dissertation or thesis credits)

### August

6	Mon.	LAST DAY TO SUBMIT THESES AND DISSERTATIONS FOR AUGUST 2012 CONFERRAL OF DEGREES
21	Tues.	SUMMER DEGREE CONFERRAL DATE (no ceremony)

# Administration

Sandra Day O'Connor ..... Chancellor of the College

## **William and Mary Board of Visitors**

Jeffrey B. Trammel '73 ..... Rector

Charles A. Banks, III ..... Vice Rector

Dennis H. Liberson '78 ..... Secretary

Janet M. Brashear '82

Colin G. Campbell

Timothy P. Dunn '83

Edward L. Flippen M.B.A '67, J.D '74

Laura L. Flippen '92

Thomas R. Frantz '70, J.D. '73, M.L.T. '81

R. Philip Herget, III

Leigh A. Pence '00

L. Clifford Schroeder, Sr.

Robert E. Scott J.D '68

Peter A. Snyder '94

Todd A. Stottlemeyer '85

Michael Tang '76

John C. Thomas

## **2011-2012 Faculty Representatives**

Alan J. Meese '86 ..... College of William and Mary

Steven E. Martin ..... Richard Bland College

## **2011-2012 Student Representatives**

Kaveh Sadeghian..... College of William and Mary

Emily R. Michalek..... Richard Bland College

## **Administrative Officers - College of William & Mary**

W. Taylor Reveley, III..... President

Michael R. Halleran..... Provost

Anna B. Martin ..... Vice President for Administration

Samuel E. Jones ..... Vice President for Finance

James R. Golden.....Vice President for Strategic Initiatives

Virginia M. Ambler ..... Vice President for Student Affairs

Sean M. Pieri ..... Vice President for University Development

Terry Driscoll ..... Director of Athletics

## **Administrative Faculty and Staff - VIMS**

John T. Wells ..... Dean and Director

Roger L. Mann..... Director for Research and Advisory Services

Linda C. Schaffner.....Associate Dean of Academic Studies

Carl H. Hobbs, III.....Director for Operations, Support Services & Special Programs

Jennifer B. Latour.....Chief Financial & Administrative Officer

Anne A. Marshall.....Director of Development

Margaret J. Fonner .....Director of Sponsored Research Administration

Carol B. Coughlin.....Director of Library

Sue N. Presson.....Graduate Registrar

## VIMS/SMS Faculty

**Standish K. Allen, Jr.**, Professor of Marine Science. B.A., Franklin and Marshall College; M.S., University of Maine; Ph.D., University of Washington. Fisheries Science. [ska@vims.edu](mailto:ska@vims.edu)

**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. [iris@vims.edu](mailto:iris@vims.edu)

**Aaron Beck**, Assistant Professor of Marine Science. B.S. Coastal Carolina University; Ph.D., Stony Brook University. Physical Sciences. [abeck@vims.edu](mailto:abeck@vims.edu)

**Donna M. Bilkovic**, Research Assistant Professor of Marine Science. B.S. & M.S., University of Michigan; Ph.D., College of William & Mary. Biological Sciences. [donab@vims.edu](mailto:donab@vims.edu)

**Richard W. Brill**, Affiliate Faculty and Director of CMER. B.A. Lafayette College; M.S. Northeastern University; Ph.D., University of Hawaii. Fisheries Science. [rbrill@vims.edu](mailto:rbrill@vims.edu)

**Deborah A. Bronk**, Professor of Marine Science. B.S., University of Miami; Ph.D., University of Maryland. Physical Sciences. [bronk@vims.edu](mailto:bronk@vims.edu)

**John M. Brubaker**, Associate Professor of Marine Science. A.B., Miami University; Ph.D., Oregon State University. Physical Sciences. [brubaker@vims.edu](mailto:brubaker@vims.edu)

**Mark J. Brush**, Assistant Professor of Marine Science. B.S., Cornell University; Ph.D., University of Rhode Island. Biological Sciences. [brush@vims.edu](mailto:brush@vims.edu)

**Elizabeth A. Canuel**, Professor of Marine Science. B.S., Stonehill College; Ph.D., University of North Carolina. Physical Sciences. [ecanuel@vims.edu](mailto:ecanuel@vims.edu)

**Ryan B. Carnegie**, Research Associate Professor of Marine Science. B.A., Rutgers University; M.A., College of William and Mary; Ph.D., University of Maine. Environmental and Aquatic Animal Health. [carnegie@vims.edu](mailto:carnegie@vims.edu)

**Robert J. Diaz**, Professor of Marine Science. B.A., LaSalle College; M.S., Ph.D., University of Virginia; D.H.C., University of Gothenberg, Sweden. Biological Sciences. [diaz@vims.edu](mailto:diaz@vims.edu)

**Rebecca M. Dickhut**, Professor of Marine Science. B.S., St. Norbert College; M.S., Ph.D., University of Wisconsin, Madison. Physical Sciences. [rdickhut@vims.edu](mailto:rdickhut@vims.edu)

**J. Emmett Duffy**, Loretta & Lewis Glucksman 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. [jeduffy@vims.edu](mailto:jeduffy@vims.edu)



Iris Anderson



**Mary C. Fabrizio**, Moses D. Nunnally Distinguished Associate Professor of Marine Science. B.S., Fordham University; Ph.D., University of Rhode Island. Fisheries Science. [mfabrizio@vims.edu](mailto:mfabrizio@vims.edu)

**Carl T. Friedrichs**, Professor of Marine Science. B.A., Amherst College; Ph.D., Massachusetts Institute of Technology/Woods Hole Oceanographic Institution. Physical Sciences. [cfried@vims.edu](mailto:cfried@vims.edu)

**Marjorie A. M. Friedrichs**, Research Associate Professor of Marine Science. B.A., Middlebury College; M.S., M.I.T./Woods Hole Oceanographic Institution Joint Program; Ph.D., Old Dominion University. Biological Sciences. [marjy@vims.edu](mailto:marjy@vims.edu)

**John E. Graves**, Chancellor Professor of Marine Science. B.A., Revelle College, University of California, San Diego; Ph.D., Scripps Institution of Oceanography, University of California, San Diego. Fisheries Science. [graves@vims.edu](mailto:graves@vims.edu)

**Robert C. Hale**, Professor of Marine Science. B.S., B.A., Wayne State University; Ph.D., College of William and Mary. Environmental and Aquatic Animal Health. [hale@vims.edu](mailto:hale@vims.edu)

**Courtney K. Harris**, Associate Professor of Marine Science. B.S., University of Virginia; M.S., University of California, Berkeley; M.S., Ph.D., University of Virginia. Physical Sciences. [ckharris@vims.edu](mailto:ckharris@vims.edu)

**Troy W. Hartley**, Research Associate Professor of Marine Science and Director, Virginia Sea Grant. B.S., University of Vermont; M.A., George Mason University; Ph.D., University of Michigan. [thartley@vims.edu](mailto:thartley@vims.edu)

**Carl H. Hershner**, Professor of Marine Science. B.S., Bucknell University; Ph.D., University of Virginia. Biological Sciences. [carl@vims.edu](mailto:carl@vims.edu)

**Eric J. Hilton**, Assistant Professor of Marine Science. B.S., M.S., Ph.D., University of Massachusetts, Amherst. Fisheries Science. [ehilton@vims.edu](mailto:ehilton@vims.edu)

**Carl H. Hobbs, III**, Associate Professor of Marine Science. B.S., Union College; M.S., University of Massachusetts; Ph.D., University of Mississippi. Physical Sciences. [hobbs@vims.edu](mailto:hobbs@vims.edu)

**John M. Hoenig**, Professor of Marine Science. B.S., Cornell University; M.S., Ph.D., University of Rhode Island. Fisheries Science. [hoenig@vims.edu](mailto:hoenig@vims.edu)



Susan Stein

**Stephen L. Kaattari**, CSX Professor of Marine Science. B.S., Ph.D., University of California, Davis. Environmental and Aquatic Animal Health. [kaattari@vims.edu](mailto:kaattari@vims.edu)

**Howard I. Kator**, Associate Professor of Marine Science. B.S., Harpur College; Ph.D., Florida State University. Environmental and Aquatic Animal Health. [kator@vims.edu](mailto:kator@vims.edu)

**James E. Kirkley**, Professor of Marine Science. B.S., M.S., Ph.D., University of Maryland. Fisheries Science. [jkirkley@vims.edu](mailto:jkirkley@vims.edu)

**Steven A. Kuehl**, Professor of Marine Science. B.A., Lafayette College; M.S., Ph.D., North Carolina State University. Physical Sciences. [kuehl@vims.edu](mailto:kuehl@vims.edu)

**Robert J. Latour**, Associate Professor of Marine Science. B.A., Western New England College; M.B.A., Ph.D., North Carolina State University. Fisheries Science. [latour@vims.edu](mailto:latour@vims.edu)

**Romuald N. Lipcius**, Professor of Marine Science. B.S., University of Rhode Island; Ph.D., Florida State University. Fisheries Science. [rom@vims.edu](mailto:rom@vims.edu)

**Mark W. Luckenbach**, Professor of Marine Science. B.S., University of North Carolina; Ph.D., University of South Carolina. Biological Science. [luck@vims.edu](mailto:luck@vims.edu)

**Jerome P.-Y. Maa**, Professor of Marine Science. B.S. and M.S., National Cheng-Kung University; Ph.D., University of Florida. Physical Sciences. [maa@vims.edu](mailto:maa@vims.edu)

**Roger L. Mann**, Professor of Marine Science and Director for Research and Advisory Services. B.S., University of East Anglia; Ph.D., University of Wales. Fisheries Science. [rmann@vims.edu](mailto:rmann@vims.edu)

**John D. Milliman**, Chancellor Professor of Marine Science. B.S. University of Rochester; M.S., University of Washington (Seattle); Ph.D., University of Miami. Physical Sciences. [milliman@vims.edu](mailto:milliman@vims.edu)

**Kenneth A. Moore**, Professor of Marine Science. B.S., Pennsylvania State University; M.S., University of Virginia; Ph.D., University of Maryland. Biological Sciences. [moore@vims.edu](mailto:moore@vims.edu)

**Michael C. Newman**, A Marshall Acuff Jr., Professor of Marine Science. B.A., M.S., University of Connecticut; Ph.D., Rutgers University. Environmental and Aquatic Animal Health. [newman@vims.edu](mailto:newman@vims.edu)

**Robert J. Orth**, Professor of Marine Science. B.A., Rutgers University; M.A., University of Virginia; Ph.D., University of Maryland. Biological Sciences. [jjorth@vims.edu](mailto:jjorth@vims.edu)

**Susan Park**, Research Assistant Professor of Marine Science. B.A., University of Pennsylvania; M.A., University of Pennsylvania; Ph.D., University of Delaware. Fisheries Science. [spark@vims.edu](mailto:spark@vims.edu)

**Mark R. Patterson**, Professor of Marine Science. A.B., Harvard College; A.M., Ph.D., Harvard University. Biological Sciences. [mrp@vims.edu](mailto:mrp@vims.edu)

**James E. Perry, III**, Professor of Marine Science. B.S., Murray State University; Ph.D., College of William and Mary. Biological Sciences. [jperry@vims.edu](mailto:jperry@vims.edu)

**William G. Reay**, Research Associate Professor of Marine Science. B.S., George Mason University; M.A., College of William and Mary; Ph.D., Virginia Polytechnic Institute and State University. Physical Sciences. [wreay@vims.edu](mailto:wreay@vims.edu)

**Kimberly S. Reece**, Professor of Marine Science. B.S., University of Rochester; Ph.D., Cornell University. Environmental and Aquatic Animal Health. kreece@vims.edu

**Linda C. Schaffner**, Professor of Marine Science and Associate Dean of Academic Studies. B.A., Drew University; M.A., Ph.D., College of William and Mary. Biological Sciences. linda@vims.edu

**Rochelle D. Seitz**, Research Associate Professor of Marine Science. B.A., Colgate University; M.A., Ph.D., College of William & Mary. Biological Sciences. seitz@vims.edu

**Jian Shen**, Research Associate Professor of Marine Science. B.S., Shanghai Teacher's University, M.A., Ph.D., College of William and Mary. Physical Sciences. shen@vims.edu

**Jeffrey D. Shields**, Professor of Marine Science. B.A., University of California, Santa Barbara; M.S., University of California, Berkeley; Ph.D., University of California, Santa Barbara. Environmental and Aquatic Animal Health. jeff@vims.edu

**Walker O. Smith, Jr.**, Professor of Marine Science. B.S., University of Rochester; Ph.D, Duke University. Biological Sciences. wos@vims.edu

**Deborah K. Steinberg**, Professor of Marine Science. B.A., University of California, Santa Barbara; Ph.D., University of California, Santa Cruz. Biological Sciences. debbies@vims.edu

**Tracey Sutton**, Assistant Professor of Marine Science. B.S., M.S. Ph.D., University of South Florida. Fisheries Science. tsutton@vims.edu

**Kam W. Tang**, Robert & Sara Boyd Term Distinguished Associate Professor of Marine Science. B.S., M.S., The Chinese University of Hong Kong, Hong Kong; Ph.D., University of Connecticut. Biological Sciences. kamtang@vims.edu

**Michael A. Unger**, Associate Professor of Marine Science. B.S., Michigan State University; M.S., Ph.D., College of William and Mary. Environmental and Aquatic Animal Health. munger@vims.edu

**Peter A. 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 and Aquatic Animal Health. vanveld@vims.edu

**Wolfgang Vogelbein**, Professor of Marine Science. B.S., Southampton College; M.S., California State University; Ph.D., Louisiana State University. Environmental and Aquatic Animal Health. wolf@vims.edu

**Harry Wang**, Professor of Marine Science. B.S., National Taiwan University; Ph.D., Johns Hopkins University. Physical Sciences. wang@vims.edu

**John T. Wells**, Professor of Marine Science and Dean and Director. B.S., Virginia Polytechnic Institute; M.S., Old Dominion University; Ph.D., Louisiana State University. Physical Sciences. wells@vims.edu

## ***Emeritus Faculty***

**Henry Aceto, Jr.**, Professor Emeritus of Biology and Marine Science. B.S., State University of New York, Albany; M.S., University of California, Berkeley; Ph.D., University of Texas.

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

**Thomas A. Barnard, Jr.**, Assistant Professor Emeritus of Marine Science. B.A., Milligan College; M.A., College of William and Mary.

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

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

**Eugene M. Bureson**, Chancellor Professor Emeritus of Marine Science. B.S., Eastern Oregon College; M.S., Ph.D., Oregon State University.

**Robert J. Byrne**, Professor Emeritus of Marine Science. M.S., Ph.D., University of Chicago.

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

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

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

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

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

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

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

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

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

**John A. Musick**, A. Marshall Acuff, Jr. Professor Emeritus of Marine Science. A.B., Rutgers University; M.A., Ph.D., Harvard University.

**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.

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

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

**Gene M. Silberhorn**, Professor Emeritus of Marine Science. B.S., Eastern Michigan University; M.S., West Virginia University; Ph.D., Kent State University.

**Dennis L. Taylor**, Professor Emeritus of Marine Science. B.A., University of Pennsylvania; Ph.D., University of Wales.

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

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

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

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

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



Susan Stein



# Academic Programs

Degree programs of the School of Marine Science (SMS) are intended primarily for those who wish to specialize in marine science at the graduate level. Degrees offered are the Master of Science and Doctor of Philosophy in Marine Science. Faculty of four departments offers research opportunities and instruction: Biological Sciences, Environmental and Aquatic Animal Health, Fisheries Science and Physical Sciences. A joint program between the SMS and the Thomas Jefferson Program in Public Policy (TJPPP) at the Williamsburg campus enables SMS students interested in resource management and policy to complete additional course work for a sub-concentration in marine policy or, with successful application to both the SMS and TJPPP degree programs, a Master of Science (M.S.) degree in Marine Science and Master of Public Policy (M.P.P.).

An undergraduate minor in marine science (18 credit hours) is jointly offered and administered by the School of Marine Science and the Department of Arts & Sciences (main campus). The minor provides interested students with an interdisciplinary introduction to the marine sciences. Courses are offered both at the VIMS Gloucester Point campus and the main campus. The undergraduate minor in marine science addresses the growing national demand for undergraduate education in the earth and environmental sciences in general, and in the marine sciences specifically.

Advanced undergraduates (juniors and seniors) who receive permission of the instructor may also participate in some SMS graduate level courses. For instance, biology, chemistry, and physics majors may enroll in suitable 500-level marine science courses for credit towards the bachelor's degree and to fulfill the requirements of the undergraduate minor in marine science provided certain conditions are met (see College of William and Mary Undergraduate Program Catalog for more details). Undergraduates also may enroll for credit to conduct research projects 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 Requirements: Students interested in pursuing marine science as a profession should consult with their academic advisor or the Associate Dean of Academic Studies, School of Marine Science (AD-AS@vims.edu), early in their college careers to identify an academic program that will prepare them for graduate study in marine science. All potential students should have a strong background in basic science, 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 is recommended.

# *Admission*

The Virginia Institute of Marine Science, School of Marine Science is committed to building a diverse and inclusive community of marine scientists. All individuals, including those traditionally under-represented in the marine sciences, are encouraged to apply. The School of Marine Science does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, disability or age in its programs or activities. Admissions criteria are based on past and potential academic and research performance and potential for leadership in the field of marine science.

## *Procedures*

Application instructions and forms are available electronically at: <http://www.vims.edu/sms/admissions>.

E-mail inquiries for general questions about the VIMS/SMS admission process may be sent to: [AD-AS@vims.edu](mailto:AD-AS@vims.edu)

Applicants who do not have access to a computer may request application forms and send completed application materials to:

Associate Dean of Academic Studies  
School of Marine Science  
College of William and Mary  
P.O. Box 1346  
Gloucester Point, Virginia 23062

Students are encouraged to apply for admission during the winter of each calendar year, with a closing date of **January 15**. Applicants will be notified after April 15. Admission will be valid for matriculation for the following summer or fall terms. Most students should anticipate a fall matriculation. The Associate Dean of Academic 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.

Students who apply to SMS, particularly those who seek a Ph.D., are advised to contact faculty members with whom they share similar research interests. Students seeking a M.S. may apply without identifying a potential advisor, however, only students for whom a faculty mentor has been identified are admitted to SMS.

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 \$50. This fee is not credited to the student's account. There is no fee for application for admission as a non-degree seeking (post-baccalaureate) student. In addition, William & Mary is pleased to waive the application fee for anyone who has served honorably in the armed forces of the United States. Please contact the Office of Academic Studies ([AD-AS@vims.edu](mailto:AD-AS@vims.edu)) if you wish to request a fee waiver.
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 are not required. GRE scores more than 5 years old are not acceptable. Applicants are encouraged to take the Graduate Record Examination at scheduled dates that will allow for receipt of scores by the aforementioned closing date. The School will not evaluate applications lacking GRE scores or other critical materials after the closing date.

In general, minimum requirements for acceptance to the School of Marine Science are a GPA of 3.0 or higher and a combined GRE score (Verbal plus Quantitative) of 1100 or higher.

Applicants are encouraged to visit the campus and 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 100 applicants for the entering class of 2011, of which 18 were accepted and 14 matriculated. The SMS Admission Committee, department faculty and the Associate Dean of Academic Studies carefully evaluate criteria of performance, which include GRE scores, overall GPA and GPA in area of concentration, 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, see the figure below for GPA and GRE scores of students offered admission in 2006 – 2011.

SMS Applicant Statistics	2006	2007	2008	2009	2010	2011
# applicants	103	93	114	133	121	102
# admitted	37	32	35	31	36	22
# enrolled	20	22	23	27	27	15
Mean GPA	3.50	3.51	3.40	3.47	3.49	3.45
Mean GRE	1194	1233	1243	1273	1158	1253

## *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 Test of English as a Foreign Language (TOEFL).

In general, the minimum acceptable TOEFL scores are: 550 (paper version), 220 (computer version), or 80 (internet version). 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 attend an appropriate English course offered at the Williamsburg campus. A reduced load of graduate courses is suggested for these students.

Non-English academic transcripts, certificates of degrees and similar documents submitted by international applicants must be accompanied by an English translation.

International students admitted to SMS 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.

The Reves Center on main campus provides valuable information for international applicants as well as current international students. Please visit their website for additional information:

[http://www.wm.edu/offices/revescenter/issp/documents/student\\_welcome\\_book.pdf](http://www.wm.edu/offices/revescenter/issp/documents/student_welcome_book.pdf)

### ***Degree-Seeking Students***

Students are admitted as Regular or Provisional graduate students in either the M.S. or Ph.D. program. 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.

Students may be admitted to either the Master of Science or Doctor of Philosophy program. Students without a master's degree must enter the program as a master's student; however, those wishing to continue directly to the Ph.D. degree may apply to by-pass the M.S. degree, provided the student meets the criteria for the bypass (see Master of Science Bypass Option). Bypass requires approval of the student's advisory committee, department chair, Academic Status and Degrees Committee, and the Associate Dean of Academic Studies.

An applicant judged deficient in preparatory studies or other areas may be admitted as a Provisional student. A Provisional student may petition for Regular student status after successful completion of those requirements stipulated in his/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. If recommended by ASDC, the petition must be approved by the Associate Dean of Academic Studies. Graduate credit earned by a Provisional student will be applied toward the graduate degree upon successful conversion to Regular student status.

### ***Non Degree-Seeking Students***

The School of Marine Science accepts non-degree seeking applications from individuals who have earned a bachelor's degree from an accredited college or university. Permission to enroll in a graduate marine science course as a non-degree seeking student must be applied for every semester and does not imply admission to any graduate program at the College of William and Mary. Graduate credit earned in a marine science course as a non-degree seeking student may be applied toward a marine science degree upon a the student's admission and matriculation as a regular graduate student.

# *Graduate Program*

Students in the advanced degree programs of the School of Marine Science are assigned to a department based on their research interests and the affiliation of their faculty advisor. Interdisciplinary studies are encouraged and students may be co-advised by faculty across or within departments. Graduate studies are offered in many sub-disciplines of marine science within the four departments of VIMS, as described below. Although students enrolled in the graduate program “reside” in departments, most of the required courses and degree requirements are determined by the Faculty of the School of Marine Science. Individual departments and a student’s advisory committee may specify additional coursework requirements over those stipulated as general degree requirements.

## *Department of Biological Sciences*

[www.vims.edu/research/departments/bio](http://www.vims.edu/research/departments/bio)

### *Preparatory Studies*

A strong background in modern biology and basic science is required. This should include mathematics (ideally through calculus), chemistry (through organic chemistry), physics and basic statistics. Students should have strong writing and verbal communication skills. Past research experience and training are highly desirable. Students are strongly encouraged to contact and discuss plans with prospective advisor(s) before applying to the graduate program.

### *Typical Course of Study*

In addition to the core courses required of all SMS graduate students, Biological Sciences students are required to take MSCI 526 unless exemption is granted by instructor and approved by the Associate Dean of Academic Studies. Students are strongly encouraged to take MSCI 501D unless they can demonstrate to their advisory committee that they have successfully taken a similar course as part of earlier graduate studies. Students are required to enroll in the departmental noon seminar (MSCI 515) each spring semester. Additionally, appropriate courses related to the student’s area of specialization will be included, in consultation with the student’s advisory committee. These might include Plankton and Microbial Ecology for students specializing in plankton biology and Marine Benthos, Seagrass Ecology, or Secondary Production for those specializing in benthic systems. Theoretical Ecology, Ecological Modeling and computer applications are recommended for students whose research will rely on modeling or theoretical mathematical formulations.

### *Areas of Research*

**Marine and Benthic Ecology:** Studies focus on the processes governing structure and functioning of communities and ecosystems. Current research includes: experimental and observational studies of recruitment, growth, and production; role of benthic organisms and communities in the fate and transfer of nutrients, organic matter, energy and sediments; effects of natural and anthropogenic disturbances on benthic community structure and functioning; consumer-prey relationships and benthic support of higher trophic levels; systematics and biodiversity of benthic animals and



evolutionary ecology. Faculty members employ diverse research approaches including field and mesocosm experimentation, biogeochemical analyses, remote sensing, molecular genetics and a range of modeling techniques. Most research focuses on benthic systems of the land-sea margins, including tidal freshwater, estuarine and coastal regions and coral reefs.

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

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

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

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

**Antarctic Oceanography:** The Antarctic continent and the Southern Ocean together regulate the Earth's weather, and the Southern Ocean, a major component of the planetary carbon cycle, is a key engine of global climate change, a source of rich

fisheries, and haven for marine birds and mammals. VIMS/SMS programs provide an opportunity for graduate and undergraduate students to live and work in the Antarctic and on icebreakers; and to carry out research on production, nutrient cycling, organic matter diagenesis and ecosystem change. VIMS researchers work primarily in the Ross Sea (McMurdo Station) and the West Antarctic Peninsula (Palmer, Antarctica Long Term Ecological Research site). These programs also emphasize public education and outreach as important components of our work.

## ***Department of Environmental and Aquatic Animal Health***

[www.vims.edu/research/departments/eaah](http://www.vims.edu/research/departments/eaah)

### ***Preparatory Studies***

Successful Environmental and Aquatic Animal Health students typically possess a degree in a natural science and should have strong written and oral communication skills. Depending on research interests, advanced course work in biology (e. g., biochemistry, molecular biology, and genetics), chemistry (organic or inorganic), physics, calculus and statistics is expected. Students lacking these courses are strongly advised to complete them before matriculation rather than while in graduate school. Students are strongly encouraged to discuss academic background, research experience and career objectives with prospective mentors before applying.

### ***Typical Course of Study***

The program prepares students for careers as environmental scientists, educators and managers. Since departmental research and educational programs are interdisciplinary, incoming students are expected to have strong backgrounds in biology and chemistry. Following satisfactory completion of the SMS core curriculum, students may pursue courses and research in any of the major program areas (environmental chemistry, toxicology, environmental risk assessment, environmental microbiology or pathobiology). The department offers a number of relevant courses including Protein Biochemistry in Marine Organisms (MSCI 558), Parasitology (MSCI 559), Fundamentals of Ecotoxicology (MSCI 560), Water Pollution (MSCI 562), Environmental Chemistry (MSCI 563), Aquatic Toxicology (MSCI 564), Principles of Pathobiology (MSCI 565), Diseases of Marine Organisms (MSCI 566), Comparative Immunology (MSCI 567), Environmental Microbiology (MSCI 573), Molecular Genetic Data Analysis, Bioinformatics (MSCI 583), Fish Histology and Histopathology (MSCI 638), Quantitative Ecotoxicology (MSCI 640) and Environmental Risk Assessment (MSCI 641). Students are expected to select at least two departmental offerings and typically complement their curriculum with additional courses offered by this and other departments. Students in the department are also required to enroll in the departmental noon seminar (MSCI 515) each fall and spring semester.

### ***Areas of Research***

**Environmental Chemistry:** Research addresses the sources, transport, fate, bioavailability and impacts of contaminants in marine and estuarine systems. Some recent

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

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

**Toxicology:** Effects of toxic chemicals in water and sediment are measured at the molecular to population levels. Endpoints include 1) uptake and elimination of pollutants by individual organisms, 2) vital processes (mortality, growth, reproduction), and 3) mechanisms of internal distribution, biotransformation, and clearance of hazardous chemicals. Molecular, cellular, and whole organism responses are being evaluated as a basis for predicting population effects at sublethal concentrations.

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

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

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

# Department of Fisheries Science

[www.vims.edu/research/departments/fisheries](http://www.vims.edu/research/departments/fisheries)

## Preparatory Studies

Students interested in graduate study in Fisheries Science should have substantial undergraduate coursework in biology including: physiology, biochemistry, comparative morphology or developmental biology, 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 Marine Fisheries Science (MSCI 528) as the advanced (3 credit) course in their core course curriculum. Fisheries students are required to take an additional quantitative course, chosen from the following menu: Multivariate Analysis and Time Series (MSCI 625), Experimental and Quantitative Ecology (MSCI 667), Stock Assessment Methods (MSCI 670), or Linear and Generalized Models in Ecology (MSCI 669). Fisheries students are required to enroll in the departmental noon seminar (MSCI 515) each spring semester. Other courses offered by the Fisheries faculty include Modeling Biological and Ecological Systems (MSCI 649), Larval Ecology (MSCI 658), Deep Sea Biology (MSCI 663), Marine Conservation Biology (MSCI 664), Ichthyology (MSCI 666), Malacology (MSCI 668), Fisheries Population Dynamics (MSCI 671), Marine Molecular Genetics (MSCI 673), Marine Molecular Genetics Laboratory (MSCI 674) and Fish Physiology (MSCI 698).



ChesMAP Trawl Survey

## Areas of Research

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

**Aquaculture Genetics and Breeding Technology Center:** Research includes development of brood stocks in shellfish species of interest to Virginia and the region,

including selective breeding (especially for disease resistance), chromosome set manipulation, and evaluation of non-native species.

**Molluscan Ecology:** Studies focus on ecology and stock assessment of estuarine and continental shelf molluscs. Broad program interests include ecology and behavior of molluscan larvae, life history and population dynamics, restoration culture for commercial purposes, and molluscs as indicators of climate and environmental change.

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

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

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

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

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

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

**Marine Finfish Dynamics:** Investigations focus on the recruitment dynamics of finfish in coastal ecosystems based on data from long-term bottom-trawl and beach seine surveys in Chesapeake Bay. A primary goal of these studies is to calculate recruitment indices to gauge the strength of the current year class and permit informed management of coastal fisheries. Another goal is to integrate observations from the surveys with field and laboratory research to understand large-scale patterns in the distribution and habitat use of coastal fishes. Such research may include individual-based behaviors as evidenced by acoustic tagging studies or physiological responses to habitat change.

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

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

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

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

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

## *Department of Physical Sciences*

[www.vims.edu/research/departments/physical](http://www.vims.edu/research/departments/physical)

### *Preparatory Studies*

In all aspects of the Department of Physical Sciences' education and research programs, there is a heavy reliance on quantitative skills. Our incoming students are expected to have a strong background in one or more areas of physical sciences and mathematics. Undergraduate majors providing preparation for graduate study in Physical Sciences include physics, applied mathematics, engineering, chemistry and geology. Biological Sciences 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***

Students in the Department of Physical Sciences specialize in Chemical, Geological or Physical Oceanography by following one of the tracks described below. In addition to the core courses required of all SMS students and a required departmental course in the area of specialization, each student is required to enroll in the departmental noon seminar (MSCI 515) each fall and spring semester.

Graduate students in chemical oceanography/marine geochemistry may specialize in any of the various aspects of marine and environmental chemistry. Students are required to take Principles of Chemical Oceanography (MSCI 524); Advanced Aquatic Chemistry (MSCI 630) is recommended. Specialized course work in other aspects of marine and environmental chemistry can be selected through recommendation of the student's advisory committee.

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, sediment transport, multivariate and time-series analysis, and isotope geochronology. Geological Oceanography students are required to take Geological Oceanography (MSCI 522). In addition, depending on a student's particular emphasis, geological students may be required to take advanced courses in physical, chemical or biological oceanography.

Students majoring in physical oceanography are required to take Principles of Coastal and Ocean Dynamics (MSCI 520). Additional advanced courses address estuarine hydrodynamics and water quality, provide an in-depth focus on estuarine physics and its influence on biogeochemical processes, boundary layer processes, various topics in coastal ocean dynamics, and the application of three-dimensional numerical modeling to estuarine and coastal issues.

## ***Areas of Research***

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

**Geological Oceanography:** Encompasses local and international research on a variety of disciplinary and interdisciplinary topics. Research sites span the full range of marine/nearshore environments from coastal plain and river floodplains, through estuaries and across the margin to the base of the continental rise. Although much

of our effort addresses questions in Chesapeake Bay and surrounding areas, federal funding supports research in many other areas in the U.S. and around the world (including New Zealand, China, and Taiwan) that generates knowledge about geological phenomena in the coastal ocean. Some of the major focal areas include: sediment transport and boundary layer processes; sediment flux and fate; seabed dynamics; shoreline erosion/sand resource issues; and Quaternary stratigraphic development. Interdisciplinary research efforts involve faculty from the departments of Biological Sciences and Environmental and Aquatic Animal Health, as well as colleagues from other institutions worldwide.

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



Grace Cartwright

# *Marine & Environmental Policy*

The School of Marine Science recognizes the critical need to improve communication between marine scientists and resource managers, policy makers, and the public. This requires literacy in the language of policy. Students enrolled in the M.S. and Ph.D. programs in Marine Science who wish exposure to Marine and Environmental Policy can elect one of the following options:

- A combined marine science and public policy program is available in which students may obtain both the Master of Science (M.S.) degree in Marine Science and Master of Public Policy (M.P.P.) in three years, instead of the four years that would be required if each degree were pursued separately. Candidates interested in this concurrent degree program must apply to and gain acceptance by both the School of Marine Science and the Thomas Jefferson Program in Public Policy (TJPPP) at the main campus.
- A joint program between the SMS and the TJPPP enables students to complete additional course work for a sub-concentration in marine policy. Students exercising this option will receive a notation of “Sub-concentration in Marine Policy” on their transcript. In addition to the course work required for the M.S. or Ph.D. degrees in Marine Science, students pursuing this option must meet the following criteria:
  1. Completion of 10 credits of course work to include the following courses:
    - a. MSCI 689, Public Policy for Science and Professions. 3 credits. (main campus)
    - b. MSCI 687, Environmental Policy. 3 credits. (main campus)
    - c. MSCI 698, Sea Grant Policy Seminar Series. 1 credit.
    - d. Elective course (3 credits) from the following menu:
      - MSCI 684, Coastal and Marine Policy Implementation: The Art & Science of Governance
      - MSCI 693 (Law 424), Environmental Law (main campus)
      - MSCI 694 (Law 425), Land Use Control (main campus)
  2. All grades for coursework in the Marine Policy sub-concentration must be B- or above.
  3. A student must receive the approval of his/her advisor prior to pursuing the sub-concentration.
  4. Once the student has advisor approval for the sub-concentration, the SMS Graduate Registrar must be notified.
- Within the SMS, students may access a wide range of cross-departmental policy and resource management-oriented courses that are designed to provide a more complete understanding of marine and environmental policy and its application to marine problems. In addition, courses related to environmental law are available through the Marshall-Wythe School of Law at the Williamsburg campus.

# *Course Descriptions*

## *Graduate Courses*

These descriptions provide basic information about the courses. Actual course content and format are updated regularly and may also be modified to meet students' specific needs. MSCI 691 to MSCI 696 are cross-listed courses taught by staff of the College of William and Mary's School of Law on the Williamsburg campus. Students wishing to take any of these courses must contact the School of Law instructor to gain permission.

### **MSCI 501A - Fundamentals of Marine Science, Physical Oceanography. Fall (2) Brubaker**

This course provides an introduction to the various types and scales of motion in the ocean, the global heat budget, major water masses, and processes controlling distributions of temperature and salinity. Discussions on phenomena associated with water motion will include global circulation, wind-driven circulation in ocean basins, tides, coastal upwelling, storm surge, waves, turbulence, and circulation in estuaries. Underlying dynamics governing water motion will be presented, elucidating the role of the rotation of the earth. The El Nino/La Nina oscillation will be examined as a key example of large-scale ocean-atmosphere interactions.

### **MSCI 501B - Fundamentals of Marine Science, Chemical Oceanography. Fall (2) Dickhut**

This course presents an overview of the chemistry of estuaries and the ocean including chemical processes that occur in marine sediments and at the air/sea interface. Discussion topics will include the chemical properties of seawater, chemical equilibrium and kinetics, the seawater carbonate system and ocean acidification, the global and oceanic carbon and nitrogen cycles, ion speciation, trace metals, and nutrients, sediment diagenesis, and fundamentals of radioisotope and stable isotope biogeochemistry. Interdisciplinary applications are emphasized.

### **MSCI 501C - Fundamentals of Marine Geology. Fall (2) Kuehl**

This course provides an introduction to the major topics of marine geology without expecting the student to have a background in geology. The course addresses the age and internal structure of the earth, the processes of plate tectonics including the formation of oceanic crust, seamounts, hydrothermal vents, the characteristics and classification of sediments and the distribution of sediments in the deep sea. Also addressed are the interrelationships among and importance of paleoceanography, climate change, and sea-level change, and the processes and characteristics of various marine, estuarine, and coastal sedimentary environments. The course includes discussion of various types of field equipment and logistics and of some economic and societal implications.

### **MSCI 501D - Fundamentals of Marine Science, Biological Oceanography. Fall (2) Steinberg**

This course examines the biology and ecology of marine organisms and how they interact with their environment. Topics include the organisms and their behavior, distribution, and underlying physiology; effects of biology on elemental and nutrient

cycles and visa versa; and ecosystem structure and ecological interactions. An interdisciplinary approach will be taken, as biology both depends on and influences ocean chemistry, physics, geology, and climate. The course will emphasize open ocean, pelagic systems, but will include many examples from coastal and estuarine systems, as well as shallow and deep-sea benthic ecosystems.

**MSCI 501E - Fundamentals of Environmental Chemistry, Toxicology and Pathobiology. Fall (2) Van Veld, Vogelbein**

This course emphasizes ongoing and emerging environmental concerns in the Chesapeake Bay and world ocean. Lectures will address basic concepts and mechanisms of contaminant chemistry and toxicology, infectious and noninfectious diseases in aquatic organisms. Case histories will be used to illustrate sources, fate and effects of anthropogenic chemical contaminants, and the important role of environmental change on disease in marine and estuarine ecosystems.

**MSCI 501F - Fundamentals of Marine Fisheries Science. Spring (2) Fabrizio, Graves**

This lecture course is intended for SMS students outside of the Department of Fisheries Science and will introduce the principles and techniques of fishery science. Lecture topics will include the theory and impacts of fishing, description and status of international, North American and regional fisheries, fisheries oceanography, recruitment processes, single-species and ecosystem-based approaches to stock assessment, and fisheries management, and the goals and problems of sustaining an open-access common pool resource.



Aimee Halvorson

**MSCI 503 - Interdisciplinary Research in Estuarine and Coastal Systems. Spring (2) Brush**

This is an interdisciplinary, field-based laboratory course applying concepts from MSCI 501 to a semester-long study of the estuarine and coastal environments of the lower Chesapeake Bay and Virginia's Eastern Shore. The course is designed to expose students to today's typical interdisciplinary research process from project conception through presentation of results. Students will organize into cross-disciplinary groups around a particular study site and research topic, and develop and implement a scientifically sound, hypothesis-driven research plan through a series of group cruises and instrument deployments. Particular emphasis will be placed on spatial and temporal patterns of biotic and abiotic processes and their interactions, along with sample design, collection, analysis, and interpretation of data. Students will also be exposed to utilizing historical and ongoing databases as well as synthesizing data from each group member to create an interdisciplinary story. The course culminates with oral presentations and a group poster.

**MSCI 504 - Fundamentals of Statistical Methods and Data Analysis. Spring (4) Latour**

In this course, students are introduced to the fundamental statistical methods commonly used for analysis of biological and ecological data. Topics include describing data, probability distributions, statistical inference, hypothesis testing, elementary experimental design, analysis of variance, and regression and correlation. The introductory aspects of categorical data analysis and multivariate techniques will also be covered. Course content will be integrated with a weekly laboratory session using the statistical computing language R.

**MSCI 506 - Scientific Communication Skills. Spring (2) Hilton, Milliman**

The important elements of oral and written presentation skills for communicating scientific research will be reviewed in this course. The course addresses topics such as the critical evaluation of literature, development of scientific questions and rationale for research, and formulation of conceptual models for developing high-quality scientific research projects. Oral and written presentation skills are emphasized through written exercises and class presentations, with peer review.

**MSCI 515A-D - Marine Science Seminar. Fall and Spring (1) Staff**

The departmental seminar course offers a multidisciplinary review of significant areas of marine science. Guest speakers will present a variety of views, and course participants will organize and present talks related to the seminar theme. Students may repeat seminar registration as required by their respective departments; however, only two (2) credits will be applicable to an SMS degree.

**MSCI 520 - Principles of Coastal and Ocean Dynamics. Spring (3) Brubaker, Friedrichs, Maa, Wang**

Following a review of the governing equations, the lectures and discussions of this course will survey key dynamics of circulation and waves in ocean, shelf and in estuarine environments. Topics to be covered include fundamentals of wind and density-driven flow, and aspects of fronts, mixing and secondary circulation. Time-dependent motion such as surface gravity waves, internal waves, and coastally trapped waves and tides also will be discussed.

**MSCI 522 - Principles of Geological Oceanography. Fall, even years (3) Milliman**

A brief review of the tectonic history of the oceans will be presented in this course, followed by detailed study of the ocean margins, including sea-level history and near shore geological processes in the coastal zone and continental shelf regions. The geological effects of bottom currents on ocean sediments will be examined along with ocean basin sediment history and approaches to pale oceanography.

**MSCI 524 - Principles of Chemical Oceanography. Spring (3) Beck, Canuel.  
Prerequisite: Instructor's consent**

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 bio limiting elements; chemistry of marine sediments; trace metal chemistry; marine organic chemistry; and ocean-atmosphere interactions.



**MSCI 526 - Principles of Marine Ecology. Spring, odd years (3) Duffy, Smith**

The course covers the fundamental processes underlying structure and functioning of marine ecosystems, both pelagic and benthic, and application of those principles to understanding responses of marine ecosystems to anthropogenic and natural global change. Lectures, readings and discussion will emphasize physical processes supporting primary production, planktonic and benthic dynamics, distribution and functional importance of marine biodiversity, biotic interactions structuring communities, and food web structure. The course concludes with a survey of the major marine ecosystem types. A central part of the course involves design, writing, reviewing, and panel discussion of student research proposals.

**MSCI 527 - Coastal Botany. Fall (3) Perry**

A botanical and ecological survey of vascular plant communities of the mid-Atlantic coastal plain is presented in this course. Discussion topics include the common and important terrestrial, emergent and aquatic vascular plant species of the coastal plain tidal marshes, swamps, beaches, dunes, maritime forests and submerged aquatic communities of the mid-Atlantic coastal regions as well as their strategies for survival in these coastal habitats. The course consists of field trips as well as both laboratory and lectures sessions.

**MSCI 528 - Marine Fisheries Science. Spring (3) Fabrizio, Graves**

This course focuses on the principles and techniques of marine fisheries science, including the theory of fishing, age and growth, definition of stocks, catch statistics, description of world fisheries, and goals and problems in managing a common property resource. Students will participate in lectures, laboratory exercises, and field trips.

**MSCI 529 - Fish Physiology. Spring, odd years (3) Brill**

This course is intended for students interested in incorporating physiological principles and techniques into projects addressing questions in ecology, fishery biology and environmental assessment. It will emphasize basic concepts to make physiological jargon and the published literature understandable.

**MSCI 545 - Marine Sedimentation. Spring, even years (3) Milliman, Staff**

This course provides an 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. Laboratory exercises include petrographic, textural and mineralogical analysis.

**MSCI 548 - Technical and Continuing Education in Marine Science. Fall, Spring and Summer (1-3) Staff. Prerequisite: Instructor's consent**

This course provides graduate-level instruction to public school teachers and other professionals who require postgraduate certification or special training. Courses are offered on an occasional basis as demand warrants. Instructors or faculty team members identify a client group and formulate a course description that serves individual professional needs. Courses may include lecture and laboratory components, field trips and demonstrations. An example of a course offered recently is experimental design in the marine science laboratory, a lecture and laboratory course for science teachers that addressed standards of learning in Virginia.

**MSCI 550 - Rivers: Processes and Problems. Spring, odd years (3) Milliman**  
Rivers form the main link between land and the ocean, discharging more than 35 thousand km<sup>3</sup> of water and more than 20 billion tons of suspended and dissolved solids annually to the global ocean. Three central themes are stressed: 1) How do rivers work: the hydrologic cycle and water budget, basin character, physical and chemical erosion; 2) Temporal and spatial variations, ranging from seasonal to millennial, with particular emphasis on catastrophic events; 3) Human interactions: land degradation, river management, future impact of climatic change and anthropogenic activities. Includes a one-week field trip.

**MSCI 553 - Introduction to Benthic Boundary Layers and Sediment Transport. Fall, even years (3) Friedrichs, Harris**  
This course addresses the physical and geological aspects of coastal and estuarine benthic boundary layers, their dynamic forcing and the associated suspension and transport of sediments. Principles of waves, tides and currents are introduced with emphasis on shall-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.

**MSCI 554 - Principles of Numerical Computing. Spring (3) Harris, Wang**  
This course provides students in the marine sciences with the tools needed to pursue study and research using numerical methods. It will enable them to write programs to solve fairly complex problems, to explore and understand the current literature in which numerical methods are used. Topics include principles of floating-point computation, interpolation, linear and non-linear systems of equations, numerical integration, ordinary and partial differential equations, and optimization. Emphasis is placed on finite difference solutions to conservation of mass and momentum equations. The course consists of three lecture hours per week, assigned problems using MATLAB, and a term project in a topic chosen by the student.

**MSCI 556 - Biogeochemical Modeling. Spring (3) Dickhut**  
This course will focus on developing mathematical descriptions for biogeochemical processes, as well as on using mathematical models to design experiments to verify specific biogeochemical mechanisms in a system. Equations describing biogeochemical processes will be derived. Discussion will include descriptions of the conditions and assumptions of the models, as well as situations where specific models apply. The course will emphasize mathematical derivations, graphical visualization and use of model fitting software.

**MSCI 559 - Parasitology. Spring, odd years (3) Shields. Recommended: Invertebrate Zoology or comparable course**  
This course covers the biology and ecology of protozoan, helminth and crustacean parasites. Focus is on parasites of medical and veterinary importance. Emphasis is placed on life cycles, pathology, control methods and ecological impacts of parasitic infections. Three lecture and three laboratory hours. (Cross-listed with Bio 404 and Bio 504)

**MSCI 560 - Fundamentals of Ecotoxicology. Spring (3) Newman. Prerequisite: Basic Ecology**

This course is an introduction to ecotoxicology, the science of contaminants in the biosphere and their effects on constituents of the biosphere, including humans. The course provides a general survey of environmental toxicology and risk assessment from an ecological vantage. (Cross-listed with BIOL 404)

**MSCI 562 - Water Pollution. Fall (2) Hale**

This course will introduce students to processes impacting aquatic environments. Emphasis will be on pollution by man-made chemicals and metals. Additional topics include consequences of excessive nutrients, habitat modification and introduction of exotic or elimination of native species.

**MSCI 563 - Environmental Chemistry. Spring (3) Unger**

The fundamental physical, chemical and biological processes controlling the fate of major classes of aquatic contaminants are covered in this course. Topics such as photolysis, biodegradation, sorption and redox chemistry are examined to elucidate the mechanisms controlling chemical degradation and transport. Case studies are used to show how these basic research principals can be integrated and applied to solve real word environmental problems.

**MSCI 564 - Aquatic Toxicology. Spring (3) Van Veld**

This course will present factors influencing the fate and behavior of major environmental toxicants in aquatic organisms and mechanisms involved in their uptake, distribution, biotransformation and clearance. Topics of discussion will include the 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 will be addressed

**MSCI 565 - Principles of Pathobiology. Spring (3) Kaattari, Shields**

This course focuses on the molecular and cellular mechanisms of pathogenesis in important emerging diseases in the medical, veterinary, and aquacultural fields. Students will learn how current molecular and cellular techniques are being applied to the resolution of a variety of infectious and non-infectious diseases. Mammalian models provide a foundation for application to the diseases of fish and shellfish.

**MSCI 566 - Diseases of Marine Organisms. Fall, odd years (4) Staff**

This course includes identification, life histories, pathology, and control of important infectious disease agents of fish and shellfish including viruses, bacteria, protists, helminths and arthropods. Also covered will be general principles of disease in the marine and estuarine environment. Three lecture and three laboratory hours.

**MSCI 567 - Comparative Immunology. Fall, odd years (3) Kaattari. Recommended: Some familiarity with biochemistry and genetics.**

This lecture course focuses on the immunology of teleost and elasmobranch fish. Topics include the biochemistry of antibody function, the molecular and cellular basis of the immune response, the role of innate and adaptive immunity in disease resistance, aquacultural vaccine design, development, and application, immunopathology, immunodeficiencies, and immunotoxicology.

**MSCI 572 - Estuarine Benthic Processes. Fall, odd years (3) Moore, Schaffner**

This course examines current concepts in estuarine benthic processes, especially the major factors governing productivity and biodiversity. It is organized around the theme of major habitats from the upper to lower estuary and open bay, and the coastal bay mouth region. Lectures and readings will draw on examples from the Chesapeake Bay and other estuarine systems. The format consists of lectures and discussions of the primary literature.

**MSCI 573 - Environmental Microbiology. Fall, even years (3) Anderson, Kator**

This course examines the role of autotrophic and heterotrophic microorganisms in response to anthropogenic and natural perturbations of importance in aquatic environments. Specific topics may include responses to nutrient enrichment and changes in sea level, temperature, and light quality/quantity. The effect of global climate change on microbial biodiversity, factors leading to the development of harmful algal blooms, and the occurrence and transmission of water-borne pathogens will also be considered. Attention will be also be focused on the role of microorganisms in biodegradation and bioremediation in both surface and subsurface habitats. Methodologies for detecting microorganisms and measuring processes in a variety of environments will be addressed as well as regulatory approaches designed to address environmental microbiological concerns.

**MSCI 575 - Aquatic Microbial Ecology. Fall, odd years (3) Anderson, Kator.**

**Recommended: Organic chemistry or biochemistry**

This course provides an introduction to the role that microorganisms play in the biogeochemical cycling and production of dissolved and particulate inorganic and organic matter in freshwater and marine ecosystems. The approach will be ecological, relating environmental physiochemical properties to regulation of microbial processes, distributions, and biodiversity. Topics will include state of the art methods for detecting distributions, biomass, and activities of microorganisms in the natural environment, the energetics regulating microbial processes, microbial biochemical pathways, biodegradation, microbial interactions, and the role that microorganisms play in the food webs of various ecosystems. Although emphasis will be placed on marine systems, processes in lacustrine, riverine, and groundwater ecosystems will also be discussed. Readings will draw heavily on the primary literature.



Lindsey Kraatz

**MSCI 576 - Evolutionary Ecology. Fall, even years (3) Duffy**

This course presents a conceptual and empirical exploration of interactions between environment and evolution of organismal structure, function, and behavior in deep time through contemporary ecological time scales. Topics include natural selection and adaptation, sexual selection and mate choice, evolution of life histories, speciation, coevolution, human evolutionary ecology, and evolutionary responses to human-induced environmental change. Reading, discussions and writing projects draw from the primary literature, concentrating on examples involving marine organisms.

**MSCI 577 - Biomechanics of Marine Organisms. Spring, odd years (3) Patterson**

This course introduces principles from the physical sciences (fluid and solid mechanics, mass and heat transfer theory) applied to the analysis of form, function, ecology, and evolution of marine organisms. Topics covered include suspension and deposit feeding in invertebrates, allometry of metabolic processes, locomotion of fishes and plankton, thermal transactions in intertidal organisms, the biology of the benthic boundary layer, and the properties of biomaterials and biological structures. Engineering methods and measurement techniques applicable to biomechanical investigations will be presented.

**MSCI 578 - Ocean Observing Systems: Technology and Applications. Fall, odd years (3) Patterson**

Ocean Observing Systems (OOSs) are oceanography's newest tools, and this course aims to make graduate students expert in ocean observing system technology and applications. The course includes weekly "hands-on" experience with Autonomous Underwater Vehicles (Fetch 1 AUV), sensor platforms like the VIMS buoys in the York River, and other online resources at other OOSs planet-wide. Topics include but are not limited to hardware components of OOS platforms (buoys, AUVs, gliders, shore-based radars), sensors, navigation techniques and georeferencing, integration of OOSs with models, OOS data management issues, and science and dual use (homeland defense, search and rescue, shipping commerce) aspects. Students from all disciplines are qualified to take this course. Student presentation of original work with an OOS is required.

**MSCI 579 - Wetlands Ecology. Fall (4) Chambers, Perry. Prerequisite: Instructor's consent**

Structural and functional attributes of tidal and non-tidal wetlands are examined in this course, with emphasis on analysis of wetland systems at the landscape and community level. The course provides an 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 a paper will be expected. The course includes lectures and field trips. (Cross-listed with BIOL 427, BIOL 627)

**MSCI 580 - Asian Environmental Issues of the 21st Century, Spring, (3) Perry, Smith**

This purpose of this course is to provide students with a working knowledge of past, current, and future environmental issues in East Asia in relation to societal, economic, and regulatory structures. Emphasis will be placed on large-scale environmental issues that impact ecological, social, and economic processes. Students will be expected

to assimilate the course material into hypothetical development of future East Asian and global environmental policies. Grading will be based on a presentation, written mid-term prospectus, and final term paper on an individual environmental topic. (Cross-listed with ENST 440-02).

**MSCI 583 - Molecular Genetic Data Analysis, Bioinformatics. Spring, odd years (3) Reece**

This is a lecture and largely computer-based laboratory course covering the principles and practice of analyzing and interpreting population genetic, phylogenetic and genetic mapping datasets. Molecular data sets including sequences and genotypic profiles will be generated on agarose gels or the automated sequencers/gel scanners. Data will be exported and processed for analysis by the appropriate suite of computer software programs. Software to be utilized include DNA sequence analysis, genotyping, population genetic, sequence alignment, phylogenetic, and mapping programs. Phylogenetic programs will include those based on genetic distance, maximum parsimony, maximum likelihood and Bayesian analyses. Population genetics programs include those such as GenePop to perform standard population genetic statistical analyses, Arlequin for doing AMOVAs, and STRUCTURE for doing assignment testing.

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

This is the avenue for original research in biological, chemical, geological and physical oceanography, environmental science, marine fisheries science and marine resource management. The master's project is chosen in consultation with the student's major professor and the Associate Dean of Academic Studies.

**MSCI 610 - Effects of Global Change on Modern Marine Systems. Fall (2-3) Canuel, Smith**

The course will explore the recent literature highlighting effects of climate and global change on various aspects of marine systems including (but not limited to) biogeochemical cycling, ecosystem structure and function, alterations in ocean chemistry, and physical processes such as polar and glacial ice melting, ocean circulation and sea level rise. The course is designed as a 2-credit course. Students will be evaluated primarily on the basis of the quality and organization of the class discussion they lead (including a short introductory background presentation), as well as participation in all other class discussions. In addition, a short (5 pages) critical writing assignment assessing the effectiveness of one or more recently published papers on impacts of global change in marine systems will be required. A 3-credit option may be made available to students who wish to undertake more detailed independent study of a particular topic in the form of additional readings and a research term paper.

**MSCI 611 - Estuarine Hydrodynamics I. Spring, even years (3) Wang. Prerequisite: MSCI 520**

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



**MSCI 612 - Estuarine Hydrodynamics II. Fall, even years (3) Wang. Prerequisite: MSCI 611**

The content of the course includes zero-, one- and two-dimensional descriptions of estuaries, salt intrusion, and pollutant flushing sediment transport through estuaries, field experience in estuaries and model laws for estuarine models.

**MSCI 615 - Hydrodynamic Modeling of Estuarine and Coastal Waters. Spring (3) Wang. Prerequisite: MSCI 613 or Instructor's consent**

This course will survey numerical methods for the solution of partial differential equations describing the estuarine and coastal water motion and transport. Topics include stability, accuracy, consistency and convergence analysis of numerical scheme, formulation of primitive and scalar transport equations, and the pre- and post-processing for numerical computational models. The course will involve classroom lectures, seminar readings, and application of models for operational environmental prediction.

**MSCI 617 - Estuarine Water Quality Models. Fall, odd years (3) Staff. Prerequisite: MSCI 611**

This course examines the principles of mass balance, physical transport processes, diffusion and dispersion in estuarine environments. Water quality processes, representation of biochemical transformations, dissolved oxygen modeling and survey of available models are other topics of discussion.

**MSCI 621 - Coastal Morphodynamic Processes. Fall, odd years (3) Friedrichs**

The emphasis of this course is on the mutual adjustments between coastal depositional and erosional morphologies and the hydrodynamic processes that cause sediment transport and transport gradients. Continental shelf, beach/shoreline, reef, deltaic, and estuarine processes will be examined. The course involves a mix of classroom lectures, seminar discussion and student presentation of readings, application of computer models, and analysis of field observations.

**MSCI 623 - Isotope Geochronology. Fall, odd years (3) Kuehl**

The focus of the course is on the principles of radioisotope dating techniques with emphasis on those applicable to marine settings. Equations of radioisotope decay and in growth will be detailed along with the geochemical systematics of each technique.

**MSCI 624 - Ocean Waves: Theory, Measurement and Analysis. Fall, even years (3) Maa. Prerequisite: Instructor's consent**

In this course, students are introduced to linear water wave theory and its applications. Course topics include mechanisms of wave generation (wind waves and tides), the governing equations, wave properties, wave transformation, special cases for tidal wave propagation (e.g., Kelvin waves), wave bottom boundary layer, nonlinear properties (i.e., radiation stress). Practical applications of numerical models for wind wave generation, wave transformation, the spectrum analysis for wave measurements, and harmonic analysis for tides will be introduced and demonstrated.

**MSCI 625 - Multivariate Analysis and Time Series. Spring, odd years (3) Forrest**

This course will address the topics of regression and modeling, analysis of residuals; multivariate regression, eigenvector methods, principal component analysis and factor analysis. Fourier and stochastic models applied to geophysical and other time series data sets will be included.

**MSCI 626 - Advanced Quantitative Methods for Marine Scientists. Spring (3) Staff**

Topics in this course include an introduction to matrices, multiple regression, sensitivity analysis, non-linear function-fitting techniques. Additional areas of focus include empirical eigen function methods with applications, complex notation as applied to the description of sinusoidal variations, and fourier transforms spectra and filtering.

**MSCI 627 - Marine Organic Geochemistry. Spring, even years (3) Canuel. Prerequisite: Organic Chemistry**

This course focuses on the characterization of organic carbon, nitrogen, phosphorus and sulfur in the marine environment. Modern methods of organic analysis that enhance our understanding of how organic materials cycle 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; biogeochemistry; diagenetic transformations of organic materials; organic matter decomposition and preservation; and petroleum geochemistry.

**MSCI 627L - Marine Organic Geochemistry Lab. Spring, even years (1) Canuel. Prerequisite: Organic Chemistry**

In this 1-credit lab module students will conduct an independent lab project that complements the lecture portion of MSCI 627.

**MSCI 629 - Environmental Organic Chemistry. Fall, odd years (3) Dickhut**

This course presents an overview of the partitioning, transport, and transformation processes controlling the environmental fate of organic contaminants. The fundamentals of thermodynamics and chemical kinetics relevant to organic chemical fate and transport, elementary mass transfer equations and their application to chemical transport in the environment is discussed.

**MSCI 630 - Advanced Aquatic Chemistry. Spring, even years (3) Beck**

This course explores the basic principles of natural water chemistry, with particular focus on marine systems. Topics include chemical kinetics and thermodynamics, ions in aqueous solution, acids and bases, carbonate chemistry, oxidation and reduction reactions, sorption and mineral precipitation/dissolution, and photochemical processes, with reference to biogeochemical cycling in marine waters.

**MSCI 638 - Fish Histology and Histo-pathology. Spring, even years (4) Vogelbein**

The course is a 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.)



Mike Neuman

### **MSCI 640 - Quantitative Ecotoxicology. Spring (4) Newman**

This course covers essential ecotoxicology principles and quantitative methods for the analysis of ecotoxicological data. Laboratory exercises will include method applications with PC-based software. Emphasis will be placed on the scientific and statistical soundness of techniques.

### **MSCI 641- Identifying, Quantifying and Communicating Environmental Risk. Fall (3) Newman**

Methods for identifying harmful agents, quantifying any associated risk, and communicating that risk will be covered in this course, with an emphasis on practical, quantitative techniques. The basic NRC framework and methods for environmental risk assessment are presented for comparative, retrospective, and predictive assessments. The course explores logical and quantitative methods for identifying hazards in the presence of high uncertainty, working in teams to effectively assess risk, and communicating risk to stakeholders. Bayesian inference and estimation will be emphasized with additional theory and quantitative methods drawn from cognitive psychology, epidemiology, innovation diffusion theory and group decision theory.

### **MSCI 642 - Practical Environmental Statistics. Spring, even years (3) Newman. Prerequisite: Instructor's consent**

This course explores practical statistics for sampling, measuring, and making sound inferences from environmental data. The course is intentionally a broad survey of methods applicable to physical, chemical and biological studies, drawing examples from each of these areas. It will blend lectures, student-directed exploration of concepts, and computer-based examples. Exercises will be done with the SAS statistical software package and other more specialized shareware. Eight general themes will be addressed: quantitative measurement, basic measurement quality control/outlier detection, variance structure, applications of regression analysis, sample size estimation, establishing field sampling or laboratory experiment designs, quantifying belief, and Monte Carlo/Bootstrap methods.

### **MSCI 648 - An Introduction to Mathematical Biology. Fall (3) Staff**

In this course, students are given an introduction to developing, simulating, and analyzing models to answer biological questions. Mathematical topics may include matrix models, non-linear difference and differential equations, and stochastic models. Biological topics may include ecology, epidemiology, evolution, molecular biology, and physiology. (Cross-listed with MATH 345).

### **MSCI 649 - Modeling Biological and Ecological Systems. Spring, even years (3) Brush, Latour**

This course provides an introduction to quantitative modeling in marine science, with an emphasis on the process of constructing mechanistic models of biological, ecological, and biogeochemical processes. General topics include determination of modeling objectives and assumptions, model formulation and parameter estimation, determination of model accuracy through calibration, validation, and sensitivity analysis, and use of models to address scientific questions through simulation analysis. Types of models covered include compartmental ecosystem models, age/size-structured population models, and food web network analysis, with consideration of deterministic, stochastic, and spatially explicit approaches. Lectures are supplemented with readings

from the primary literature and students receive hands-on experience building and using models through in-class lab exercises.

**MSCI 652 - Marine Plankton Ecology. Fall, odd years (3) Smith, Steinberg, Tang. Prerequisite: MSCI 524 or 526 or consent of the instructors**

This course will cover contemporary topics in cellular, population, community and ecosystem level dynamics of plankton systems, including nutrients and organic matter, viruses, bacteria, phytoplankton, protists and zooplankton. Course format will be primarily discussions, student presentations, literature evaluation, and writing exercises.

**MSCI 653 - Marine Benthos. As required (3) Diaz, Schaffner. Prerequisite: Permission of instructor**

Ecology of marine and estuarine benthos is the focus of this course. Emphasis is placed on determining how ecological processes affect 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.

**MSCI 655 - Stable Isotope Biogeochemistry. Fall, even years (2) Anderson, Bronk**

This course is a survey of applications that use stable isotopes of carbon, nitrogen, oxygen, and sulfur to define elemental flow through experimental and natural systems. Topics include stable isotope theory; tracer versus natural abundance techniques; quantifying processes of elemental uptake, regeneration, and respiration; and defining trophic relationships using multiple tracers.

**MSCI 656 - Seagrass Ecosystems. Spring, odd years (1-2) Moore, Orth**

This lecture-seminar course covers topics related to seagrass ecosystems. Emphasis will be 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. Course credit will depend upon difficulty of the assignments and must be arranged prior to registration.

**MSCI 658 - Larval Ecology. Spring, odd years (3) Mann**

The course is based on a broad discussion of the following topics within the marine invertebrates: the concept of the larval form, spawning and developmental patterns, limitations on the fertilization process and embryology, the Reynolds number environment at typical larval size, feeding and nutrition in the larval size range, larval size and parental investment, larval dispersal and supply in maintaining community structure, roles of physical versus biological processes in inducing metamorphosis, early post-metamorphic survival, and larval ecology in extreme environments.

**MSCI 659 - Phytoplankton Ecology. Fall, odd years (3) Smith. Prerequisites: MSCI 501 (may be taken concurrently with Instructor's consent.)**

This course will examine the factors, which influence the growth, losses and distributions of phytoplankton in marine systems. Topics include photosynthesis, pigmentation, productivity, biochemical fractionation, grazing, and nutrient uptake and interactions. A laboratory will introduce students to modern methods used in the study of phytoplankton such as isotopic measurements, HPLC analysis of pigments, fluorometry, and image analysis. Samples from the local estuaries will be used in the laboratories to illustrate the principles discussed in class.

**MSCI 660 - Zooplankton Ecology. Spring (4) Steinberg, Tang**

This course will examine the ecology, natural history, basic cell or body design features, physiology, and life histories of all the major groups of zooplankton. Food webs, specialized habitats, physical-biological coupling, and behavior are also discussed. Laboratories will concentrate on the groups or topics that are being discussed that week in lecture. The laboratories will be devoted to studying freshly collected (live local net tows), laboratory cultured, and occasionally museum specimens of the various taxa, and to introducing students to methods of study of zooplankton ecology (microscopy, biomass measurement, grazing experiments). There will also be field trips.

**MSCI 663 - Deep-Sea Biology. Spring (2) Vecchione. Prerequisite: Instructor's consent**

Students will receive an introduction to the animals of the deep sea and characteristics of deep-sea and polar ecosystems. Lectures will survey the major metazoan groups found in deep-sea habitats, as well as physical characteristics of the environments and adaptations to life in these cold, dark, hyperbaric regions. An opportunity to participate in a deep-sea trawling cruise may be coordinated with the course.

**MSCI 664 - Marine Conservation Biology. Fall, even years (3) Lipcius**

This course focuses on the application of multidisciplinary scientific principles to the protection, enhancement and restoration of marine biodiversity (genetic, species, community and ecosystem). Ecological emphasis will be on the conservation of biodiversity threatened by habitat degradation and loss, overexploitation, invasive species, and global change. Social, legal, economic and political influences will be discussed. Also included will be practical application through case studies and training in population viability analysis. (Lecture and laboratory)

**MSCI 666 - Ichthyology. Spring (4) Hilton**

Fishes form a large, diverse group of vertebrates that are culturally, economically, and scientifically important, and they offer much for the study of evolutionary biology. This course provides an intensive overview of all aspects of the evolution of fishes, with an emphasis on their morphology and systematic relationships; other topics include the biogeography, functional anatomy, and physiology of fishes. The lectures cover the diversity and evolutionary history of fossil and living fishes, and discuss the evidence for different hypotheses of their phylogenetic relationships. The mandatory lab section emphasizes dissection-based anatomical study and the global diversity of fishes, and includes some field sampling.

**MSCI 667 - Experimental and Quantitative Ecology. Fall, odd years (3) Lipcius**

The course addresses the design, conduct, analysis and interpretation of field and laboratory experiments in ecology. The lectures, discussion and supervised field and laboratory projects are 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 predatory-prey interactions, recruitment phenomena, environmental science (e.g., dose-response assays) and metapopulation dynamics. (Lecture and laboratory)

**MSCI 668 - Malacology, Spring, even years (3) Mann**

The course begins with a discussion of the ancestral mollusc form and the fossil record, proceeds through examination of the structure and function of the molluscan shell. It concludes with reviews of molluscan taxonomy, reproductive biology, physiology, ecology, and feeding mechanisms.

**MSCI 669 - Linear and Generalized Linear Models in Ecology. Fall (3) Fabrizio.**  
**Prerequisite: MSCI 528 or consent of instructor, and ability to program in SAS or R.**

This course emphasizes the design and analysis of field data (e.g. retrospective studies, experimental manipulations in the field), rather than design and analysis of controlled laboratory experiments. Students will gain a working knowledge of linear and generalized linear models useful in the analysis of ecological data. Both theoretical development and application of statistical methods will be presented.

**MSCI 670 - Stock Assessment Methods. Spring (3) Hoenig**

This course will survey methods for assessing the status of exploited populations given various combinations of data types. Emphasis will be placed on deriving statistical methods using maximum likelihood and other analytical techniques, and on computing estimates for a variety of datasets. Population models will be used to integrate information on stock status in order to determine appropriate management measures. Additional topics include analysis of uncertainty in the assessment of results and implications of uncertainty for management, analysis of research surveys, commercial catch, fishing effort, and tagging data.

**MSCI 671 - Fisheries Population Dynamics. Fall (3) Latour**

This course provides an introduction to the fundamental processes governing fish population dynamics, with an emphasis on the theory and practical application of models used to characterize the factors influencing population abundance. Topics include the theory of mortality, growth, stock-recruitment (compensation, depensation), surplus production, VPA, statistical catch-at-age, tagging, and the introductory aspects of multispecies and fisheries ecosystem models. Lectures are supplemented with readings from the primary literature and students receive hands-on experience with nonlinear parameter estimation through computer laboratory sessions using the statistical software package R.

**MSCI 672 - Ecology of Fishes. Fall (3) Sutton**

This course will provide students with an understanding of fish ecology as related to vertebrate evolution and diversity, systematics, feeding and reproductive biology, early life history ecology, and fish community structure and biotic interactions.

**MSCI 673 - Marine Molecular Genetics. Spring, even years (3) Graves, McDowell, Reece. Prerequisite: Undergraduate Genetics or permission of instructor**

Students will study 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.



**MSCI 674 - Marine Molecular Genetics Laboratory. Spring, even years (2) Graves, McDowell, Reece. 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. of laboratory).

**MSCI 684 – Coastal and Marine Policy Implementation: The Art & Science of Governance. Spring (3) Hartley**

This course will examine real world examples of implementation of local, state, federal, and regional coastal and marine policies through case studies, guest speakers, and literature from public administration, policy, and political science.

**MSCI 685 - Practical Application of Marine Resource Management Techniques. Hershner, Staff. As required (1-3)**

In this course, 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. Topics 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. The course may be repeated 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.

**MSCI 687 - Environmental Policy, Fall, (3) Hicks**

This course will explore policy making for environmental problems and will focus on issues that are local, national, and international. The course will primarily focus on national environmental policy, and the procedures by which policy is implemented at both local and regional levels. Issues explored will include water pollution policy and land-use in the Chesapeake Bay, U.S. Marine Mammal Policy, and U.S. water and air quality regulations. For each of these issues, U.S. laws and regulations as well as federal agencies' approaches for quantitatively assessing the benefits and costs of environmental policy will be examined. (Cross-listed with PUBP 622)

**MSCI 689 - Public Policy for Science & Professions. Fall (3) Gilmour, Rossiter**

This course examines a component of the larger process of law and rule making, for students to understand the identification and definition of a policy problem, the generation of options or choices for addressing the problem, the selection of a particular policy option through political institutions (e.g., the executive or legislative), the development of a plan for implementation, and the implementation and evaluation of the outputs and outcomes of policy. The course is specifically designed for an interdisciplinary class of graduate students from the Schools of Business, Education, Law, and Marine Science, and non-master's in Public Policy from the School of Arts and Sciences. Students will come to understand public policy as an academic discipline and as a systematic method of thinking about the design, development and assessment of public sector policies and programs. By the end of the course students

will develop the skills required to define and analyze policy issues and problems, articulate relevant decision-making criteria for policy analysis, evaluate alternative policy solutions, assess their political and economic implications. The course is taught in an engaging seminar format using provocative materials with practical application.

**MSCI 693 - (LAW 424). Environmental Law. As required (3) Law School Staff. Prerequisite: Consent of instructor**

Students will study the nature and causes of environmental pollution and of the main legal techniques for its control. The course will consider the common law, the environmental impact assessment process (e.g., the National Environmental Policy Act), and the basic regulatory framework for air, water and solid and hazardous waste control (the Federal Clean Air Act, Clean Water Act and Resource Conservation and Recovery Act), with attention given under each statute to the basic regulatory framework and the main policy issues presented by it. Other topics will include the role of the federal courts in reviewing agency action, new developments in federal administrative law (including current efforts at administrative law reform), natural resource management and allocation issues involved in the division of scarce resources (e.g., air and water) among competing users, toxic and hazardous substance regulation, and enforcement of environmental laws.

**MSCI 694 - (LAW 425). Land Use Control. As required (3) Law School Staff, Butler. Prerequisite: Consent of instructor**

This course presents an analysis of the legal principles governing the use and management of land and the fundamental values underlying those principles. While focusing primarily on government regulation of land use, the course also will examine common law rules, which affect the way that land is used. Topics that might be considered include judicial control of land use, zoning and the rights of landowners, zoning and the rights of neighbors, land use planning, public regulation of land development, aesthetic regulation, and the preservation of natural and historic resources.

**MSCI 695 - (LAW 453). Administrative Law. As required (3) Law School Staff. Prerequisite: Consent of instructor**

This course is a study of practice in the administrative process, examining the procedures for administrative adjudication and rule making; legislative and judicial control of administrative action; and public access to governmental processes and information.

**MSCI 697 - Problems in Marine Science. Fall, Spring and Summer (1-4) Staff**

This is the avenue through which supervised projects may be selected to suit the needs of the graduate student, including those wishing to perform an internship as part of the Curricular Practical Training Program. Projects are chosen in consultation with the student's major pro-



Sarah Sumoski

fessor and the instructor. Acceptable research outlines and project reports are required, and the amount of credit depends upon difficulty of course. Examples of projects offered in recent years include management issues in shellfish sanitation; groundwater nutrient processes; bacterioplankton methods and techniques; pesticide analysis in environmental samples; marine molecular population genetics; and law and policy relating to the introduction of non-indigenous plants. Subjects will be announced prior to registration and after approval by the Educational Policy Committee (EPC).

**MSCI 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. Examples of courses offered in recent years include: continental margin sedimentation; biomineralization in marine organisms; molecular markers and evolution; oligochaete biology; quantitative methods of image analysis; and organism-sediment interactions in coastal systems. Subjects will be announced prior to registration and after approval by the EPC.

**MSCI 699 - Dissertation. Fall, Spring and Summer (hours to be arranged).**

This is the avenue for original research in biological, chemical, geological and physical oceanography, environmental science, marine fisheries science and marine resource management. The doctoral project is chosen in consultation with the student's major professor and the Associate Dean of Academic Studies.

## ***Undergraduate Courses***

In addition to the courses listed in this section, advanced undergraduates may take 500- level courses with the permission of the instructor. Undergraduate students taking any of the SMS "Fundamentals" courses (MSCI 501A-D, listed under Graduate Courses) including those pursuing the undergraduate minor in marine science, should register for the 02 sections.

**MSCI 330 - Introduction to Marine Science. Spring (3) Bronk, Patterson, Tang. Prerequisites: GEOL 101, 110 or 150, OR BIOL 220 and 225 (formerly BIOL 203 and 204)**

In this course the physical, chemical, biological and geological processes operating in the world's oceans will be described. The interdisciplinary nature of oceanography is emphasized, providing an integrated view of factors, which control ocean history, circulation, chemistry and biological productivity. (Cross-listed with BIOL 330 and GEOL 330)

**MSCI 331 - Coastal Marine Environments. Summer (3) Brubaker, Luckenbach, Perry and Smith Prerequisites: MSCI 330**

This field course is designed to introduce undergraduate students to field research in the marine environment. Class sessions will take place over an intensive 14-day period at the VIMS marine field station located on the Eastern Shore in Wachapreague, Virginia. This interdisciplinary course will involve study of concepts and linkages between climate change, hydrodynamics, coastal morphodynamics, biological diversity and function. Field instruction will focus on three coastal ecosystems: barrier islands, coastal bays, and salt marshes. The course also will examine the influence of natural and anthropogenic forcings, including climate, tides, waves, currents, nutrient

enrichment, and land-use change on ecological responses and their feedbacks. A series of lectures will be presented to provide students with a basic understanding of each ecosystem, the communities present, the linkages between ecosystems, and the physical/biological drivers that regulate community composition and process rates. Students will be provided opportunities for hands-on experience with observational tools (e.g. datasondes, geophysical seismic profilers, seafloor mapping systems, wave and current measuring devices) and analytical techniques (microscopic, chlorophyll, nutrient, plankton analyses) typically used for field investigations. Each student will take part in a team effort to perform a hypothesis-driven research project, collect, analyze and present data. (Cross-listed with Biol 404, Geology 407 and ENSP 440)

**MSCI 332 - Coastal Marine Habitats in North Wales. Summer (3) Luckenbach, Perry**

This is an intensive 16-day, field-based course conducted in north Wales, U.K. in association with the School of Ocean Sciences, Bangor University. The course emphasizes field-based instruction and student-led data collection in coastal marine environments in northern Wales, the Isle of Anglesey and the eastern Irish Sea. Topics include the ecology of rocky shores, biological and physical processes affecting species distribution and ecology in high energy macrotidal coastal environments, paleo-oceanography and geological history of the region. Permission of the instructor is required. (Second Summer Session)

**MSCI 398 - Marine Science Seminar. Fall, Spring (1) Staff**

One or more sections of one-credit seminar courses will be offered to undergraduates interested in marine science each semester. The courses will explore a range of interdisciplinary topics in marine science and the slate of offerings will change each semester. Examples of courses offered in recent years include: Climate Change in the Frozen South, Chesapeake Bay Fisheries and Environmental Issues and Marine Conservation Biology. Subjects will be announced prior to registration and following approval by the Undergraduate Minor in Marine Sciences Curriculum Committee and the Associate Dean of Academic Studies. Depending on the topic, a specific section may be cross-listed with GEOL 407 (Special Topics in Geology) and/or ENSP 249 (Environmental Challenges: Topics).

**MSCI 460 Ocean and Climate. Spring (2) Tang. Prerequisite: MSCI 330**

This course will examine how physical, geological, chemical and biological processes in the oceans together affect the planet's climate in different time and spatial scales. Abrupt climate change caused by recent human activities will also be discussed.

**MSCI 497 - Problems in Marine Science. Fall, Spring and Summer (1-4) Staff**

This is the avenue through which supervised projects are selected to suit the need of the upper level undergraduate 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.

**MSCI 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.

# *Degree Requirements*

Students generally are bound by the requirements stated in the catalog for the academic year stated in their Notification of Admission letter. The department in which a 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 academic standing for two consecutive semesters.

## *Registration*

All continuing students who have not been granted leave must register for a minimum of nine hours each semester, and one-hour for each 5-week term of the summer sessions. Students must be registered in the semester during which they graduate. Once they have achieved Candidacy, students may be eligible for one semester of Research Graduate Status (M.S students) or two semesters (Ph.D. students), depending on availability of funds.

Summer enrollment: All newly-admitted students for the fall who elect to begin their degree programs in the summer will need to register as full-time students if any of the following applies:

1. The student is funded by an assistantship during the summer;
2. The student wishes to purchase the college-endorsed health insurance plan;
3. The student is an international student (note: the college-endorsed health insurance plan is mandatory for international students).

Full-time enrollment during the summer is defined as 3 credit hours in any combination of summer terms, and enrollment at the level of two credits is considered half-time.

**Off-site students:** Off-site students are defined as those who do not receive any funding (assistantship, fellowship, workshop) or make use of on-site resources of VIMS/SMS. Once a student has achieved candidacy and completed course and research requirements they are allowed to finish their degree programs in a special part-time registration status. Off-site students pay for one credit at the out-of-state rate or three credits at the in-state rate during fall and spring semesters, based on his/her domicile status. Students enrolled for the summer are required to register for one credit hour for each 5-week term.

**Changes in Registration:** All changes in student schedules must be done in accordance with relevant deadlines as indicated in the Academic Calendar for the School of Marine Science. Any changes requested after the close of registration require approval of the instructor(s) involved and the Associate Dean of Academic Studies. Students may not add courses after the last day for changes in registration. If a 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 after mid-semester may apply to the Associate Dean of Academic Studies for approval. With the approval of 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 a student does not complete a course, "W" with appropriate notation will be entered on the record upon approval of the Associate Dean of Academic Studies and the appropriate authorities at the College.



Iris Anderson

## ***Academic Standing***

Admission to the SMS graduate program implies a significant commitment on the part of the student, the student's advisor and their department, as well as VIMS/SMS. To remain in good academic standing a student must:

1. maintain a cumulative GPA of B ( $< 3.0$ ) or better with no core course grade lower than B-;
2. make satisfactory progress as defined by College degree requirements and regulations of the School of Marine Science.

The Academic Status and Degrees Committee, SMS Registrar and the Associate Dean of Academic Studies regularly review student transcripts and progress to ensure the timely completion of degree requirements at the individual and School of Marine Science levels. A student who fails to remain in good academic standing may lose funding or be terminated from the degree program.

## ***Degree Program Milestones***

Student progress within the degree programs of the School of Marine Science is guided by milestones, which specify how long a student has to complete each degree requirement. In addition to fulfilling course and credit-hour requirements, the student must complete and document their program milestones. Forms for documenting completed milestones are available from the Office of Associate Dean of Academic Studies or may be printed from the following URL: <http://www.vims.edu/sms/documents/forms.html>



The milestones of the School of Marine Science are as follows:

- Selection of Major Professor
- Selection of Committee & Research Topic
- Pre-Qualifying Interview
- Comprehensive Examination (Ph.D. only, for those entering Fall 2008 or later)
- Qualifying Examination
- Prospectus Acceptance
- Admission to Candidacy
- Seminar Presentation
- Defense of Thesis
- Acceptance of Approved Thesis/Dissertation by Swem/SMS Libraries

**Failure to meet major milestones (Qualifying Examination, Comprehensive Examination, Graduation) is evidence that a student is not making satisfactory progress in the program and may result in loss of funding, academic probation or dismissal from the program.**

**Qualifying Examination Milestone:** The qualifying examination and prospectus defense gauge a student's progress early in their research program. The qualifying examination milestone is 18 months for a M.S. student and 30 months for a Ph.D. student. The exam must be completed within 6 or 12 months of the milestone date for M.S. and Ph.D. students, respectively. A student who fails to meet the milestone in the timeframe specified will be placed on academic probation. A student on academic probation will have one calendar year to satisfy any outstanding deficiencies. Failure to do so will result in automatic termination of the student's degree program.

**Comprehensive Examination Milestone:** A written comprehensive exam at the Ph.D. level allows a student to demonstrate quantitatively, comprehension and integration of material from the disciplines of marine science that are relevant to the student's area of specialization. Successful completion of a rigorous comprehensive exam signals that a student is ready to pursue advanced training and original scientific research. The comprehensive examination milestone is 21 months. The exam must be passed within 6 months. A Ph.D. student may take the exam twice and will be given an option to enroll in the M.S. degree program if they do not pass. Master's bypass candidates who do not pass the first examination are not permitted to advance directly to the Ph.D. program.

**Graduation Milestone:** Students are expected to complete all degree work within the following time lines established by the faculty:

- 36 months - students pursuing a master's degree
- 48 months - students pursuing a Ph.D. who enter the program with an SMS master's degree
- 60 months - students pursuing a Ph.D. who enter the program with an outside master's degree
- 72 months - students pursuing a Ph.D. who bypass completion of a master's degree

A student who fails to meet their graduation milestone must apply for an extension to the Academic Status and Degrees Committee. Adequate justification for the extension is required, as is the permission of the student's advisor and committee members. If an extension is recommended by the Academic Status and Degrees Committee and approved by the Associate Dean of Academic Studies, the student must complete all requirements for the degree program within a maximum of one year for the M.S. or two years for the Ph.D. . Students who exceed the first extension may continue in the degree program with the recommendation of the Academic Status and Degrees Committee and the approval of the Associate Dean of Academic Studies, but will be required to cover their own tuition costs out of pocket (i.e., grant or contract funds, or other institutional support, regardless of source, may not be used). Students exceeding the graduation milestone by 2 years for M.S. or 3 years for Ph.D. will be terminated from the degree program.

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.

**Non-Resident Students:** Students who leave VIMS to take outside employment will be required to meet milestones and complete all requirements for graduation within the same time limits as listed above for M.S and Ph.D. students. The same degree program milestones and SMS rules and regulations apply unless permission to change degree program milestones has been approved by the Academic Status and Degrees Committee and the Associate Dean of Academic Studies.

**VIMS Employees:** Employees who are concurrently enrolled in a degree program are expected to meet the same milestones and complete all requirements for graduation within the same time limits as listed above for M.S and Ph.D. students. The same degree program milestones and SMS rules and regulations apply unless permission to change degree program milestones has been approved by the Academic Status and Degrees Committee and the Associate Dean of Academic Studies.

Students may reference the SMS Student Handbook for a complete listing of degree program milestones and their due dates.

## ***Academic Probation***

1. Students will be placed on academic probation if their cumulative average is less than B. In the case of a grade deficiency in a SMS core course, the student must make up the deficiency by retaking the course and passing with a grade of B- or better, by taking another course from the core group of Fundamentals courses (outside of specialty) or by taking an Advanced Principles core course (outside of specialty) which must also be passed with a grade of B- or better. Probation will last until a student's cumulative average is raised to at least a B (3.0) and/or the core course requirement is satisfied, but will not exceed one calendar year. Failure to raise the cumulative grade average to B or address a core course grade deficiency within one calendar year will result in dismissal from the School of Marine Science. Reinstatement is possible only with the approval of the Academic Status and Degrees Committee and the Associate Dean of Academic Studies.

2. Students will be placed on academic probation if they fail to complete the qualifying exam milestone within 6 months of the program due date for M.S. students, or 12 months of the program due date for Ph.D. students. Students on academic probation will have one year to satisfy any outstanding milestone deficiencies in order to prevent automatic termination of the degree program.

## ***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 master's (MSCI 599) or Ph.D. (MSCI 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.

## ***SMS Core Curriculum***

Successful completion of the SMS core curriculum ensures that students achieve a broad understanding of the essential processes that define oceanic, coastal, and estuarine environments. Students are expected to build upon this foundation by pursuing specialized and advanced courses tailored to the needs of their individual research projects.

Relative to this goal, specific objectives of the SMS core course curriculum are to:

- Educate students in the fundamentals of marine science in a way that fosters interdisciplinary and synthetic understanding of oceanic, coastal and estuarine systems;
- Provide students with an appreciation for the integration of marine science and its application to complex environmental problems;
- Ensure that students have the methodological, quantitative and communication skills needed to pursue successful careers in marine science.

Students are required to choose courses in each of the following four groups, I-IV, as follows:

- I. **Fundamentals Core Courses:** MSCI 501A, 501B, 501C, 501D, 501E, or 501F
  - A Ph.D. student must choose four (4) of the fundamentals courses outside of the student's specialty.

- A M.S. student must choose three (3) of the fundamentals courses outside of the student's specialty. (For example, a student in the Department of Biological Sciences is encouraged to take Fundamentals of Biological Oceanography; however it will not satisfy their core course requirement.)
- Successful completion of an advanced principles core course outside of one's specialty in lieu of one of the above Fundamentals Courses will also satisfy the above core course requirement. In order for a core course to satisfy the core course requirements, a grade of B- or above must be earned in the course.

## II. Advanced Principles Core Courses:

- Students in either degree program must choose one of the advanced principles courses their department of specialty (For example, a student in the Department of Biological Sciences must take MSCI 526):
- Biological Sciences: MSCI 526
- Environmental & Aquatic Animal Health: Any course in the department over the 550 level
- Fisheries Science: MSCI 528
- Physical Sciences, discipline specific: MSCI 520 (physical oceanography); MSCI 522 (geological oceanography); MSCI 524 (marine chemistry)

## III. Quantitative Core Courses:

Students in either degree program must choose at least one of the following quantitative courses; the required course may be specified by each department: MSCI 504, MSCI 554, MSCI 583, MSCI 625, or MSCI 642

## IV. Interdisciplinary Core Requirement:

Students in either degree program are required to take the following interdisciplinary course: MSCI 503

## *Department Core Courses*

In addition to the SMS core courses specified above, students are expected to take core courses required by their department as follows:

**Biological Science:** MSCI 515A (Spring Semester).

**Environmental and Aquatic Animal Health:** MSCI 515B (Fall and Spring Semesters) and at least one additional departmental offering.

**Fisheries Science:** MSCI 515C (Spring Semester) and one of the following: MSCI 625, MSCI 667, MSCI 669, MSCI 670, or MSCI 671.

**Physical Sciences:** MSCI 515D (Fall and Spring semesters) and at least one advanced course (550-level or higher) appropriate to the student's specialty.

## ***Required Courses***

Students must pass all required SMS core courses with a grade of B- or better by the end of their second year in the School of Marine Science . Alternatively, with the exception of MSCI 503, students may petition for exemption from core courses upon application to the Academic Status and Degrees Committee (see below). There are no exemptions from MSCI 503.

## ***Core Course Exemption***

With the exception of MSCI 503, students who have had comparable course work elsewhere may petition for exemption from any of the SMS core courses. The application for core course exemption must be approved by the core instructor(s) of the SMS course for which exemption is sought. Prior to consulting the core instructor, the student must attach the following to the application for exemption: (1) a syllabus of the student's applicable prior course work and (2) a transcript showing the grade/credits of the student's prior course work. The SMS instructor must indicate on the application that he/she has reviewed the student's previous studies and is satisfied that those studies are sufficient to permit exemption from the applicable core course. The application and attachments must be submitted in entirety to the Academic Status and Degrees Committee, in care of the SMS Graduate Registrar. Credits for exempted courses will not be transferred to a student's record until the student petitions the Academic Status and Degrees Committee for credit transfer and the Associate Dean of Academic Studies approves the request.

## ***Retaking a Course***

In order for a core course to satisfy the core course requirements, a grade of B- or above must be earned in the course. A deficiency in a core course may be made up by:

1. retaking the course and passing with a grade of B- or better;
2. taking another course from the core group (outside of specialty) with a grade of B- or better;
3. taking an Advanced Principles core course (outside of specialty) with a grade of B- or better.

In the case of non-core coursework, degree credit is granted only for the course in which a student earns a grade of "C" or above. A graduate student may also repeat one non-core course in which a grade of "C" or lower is received. When a course is repeated, both the initial and new grades earned are included in computations of quality point requirements. Any student receiving more than one "D" or "F" in a program of study will be dismissed from the degree program.

## ***Transfer of Academic Credit***

On the recommendation of the Academic Status and Degrees Committee and the approval of the Associate Dean of Academic Studies, a regular student may apply up to 15 hours of graduate credit for graduate courses equivalent to the SMS core courses earned at another accredited institution. Credit may be transferred only for courses in which the student received a grade of "B" or better and will not be counted in compiling his/her quality point average at William and Mary.

To petition for acceptance of transfer credits, the approved application must be submitted to the Academic Status and Degrees Committee c/o the Graduate Registrar, Watermen's Hall 233. The application must include documentation for the course(s) proposed to supplant the core course(s), and a statement from each School of Marine Science faculty teaching the course for which transfer credits are sought. The faculty member's statement must indicate that he/she has reviewed the student's previous studies and is satisfied that those studies are sufficient to permit acceptance of the applicable transfer credits.

Students may petition for up to six additional credit hours of graduate work not already applied toward another degree, but the total transfer credits cannot exceed 15 hours. The credits must have been earned in courses appropriate to the student's program in the SMS and must fall within the time specified by the general college requirements for degrees.

### ***Auditing a Course***

Any graduate student may audit a graduate or undergraduate course with permission of the instructor, the student's advisor and the Associate Dean of Academic Studies. The form may be obtained from the SMS Graduate Registrar.

Before beginning the audit, the student and the instructor must agree on what is required for the audit to be successful. The audited course is listed on the student's official transcript as either a grade of 'O' for a successful audit, or 'U' for an unsuccessful audit.

### ***Master of Science Bypass Option***

A superior student originally accepted to the SMS master's program who demonstrates early potential to successfully conduct Ph.D. level research may petition to bypass the M.S. degree and proceed directly toward the doctorate. Students interested in the bypass option should file a Notification of Intent to Bypass M.S Degree form as early as possible and in all cases prior to taking a comprehensive examination (end of second year in degree program). Once approved and by the start of their third year the student may submit an Application to Bypass the M.S Degree to the Academic Status and Degrees Committee, with the following elements:

1. Approval of the Notification of Intent to Bypass M.S. Degree form.
2. Completion of the SMS core course requirements for the M.S. degree.
3. A student must be in good academic standing.
4. Submission of a CV and 1-2 page statement by the student describing the student's achievements and demonstrated potential to conduct independent research.
5. Submission of a 1-2 page statement by the student's advisor describing the student's achievements and demonstrated potential to conduct independent research.
6. Recommendation by the student's advisory committee to bypass the master's degree.
7. Successful completion of a written comprehensive examination.
8. Formal acceptance of a Ph.D. prospectus by the student's committee.
9. Successful completion of a qualifying examination at the Ph.D. level.



Evidence of scholarly potential in the form of independent research, professional presentations, submitted or accepted manuscripts and research proposals will strengthen a student's petition for the bypass. The Academic Status and Degrees Committee will recommend to the Associate Dean of Academic Studies whether or not permission to bypass should be granted. A bypass also represents a change in funding obligations for most students and, for that reason, must be approved by the student's Department Chair. Appeals of an adverse decision of the Academic Status and Degrees Committee or department chair may be made to the Associate Dean of Academic Studies. It is important that a student submit the bypass form as early as possible and no later than the start of the third year. VIMS/SMS will not guarantee institutional funding to students who fail to submit the petition in a timely fashion. In order to apply the doctoral program milestones equitably, the Academic Status and Degrees Committee will determine an "effective completion date" of the doctoral program, which normally will be designated as 72 months from date of matriculating at VIMS/SMS.

### ***Comprehensive Examination***

All students in the Ph.D. program will be required to pass a written comprehensive examination, designed to demonstrate the student's comprehension and integration of material from the various disciplines of marine science that are relevant to the student's area of specialization. Successful completion of a rigorous comprehensive examination signals that a student is ready to pursue advanced training and original scientific research. The major advisor is responsible for scheduling the exam before the end of the student's second spring term (or 21 months following matriculation), and should notify the Associate Dean of Academic Studies of the exam date.

The objective of the written comprehensive examination is to ensure that the student has an appropriate general understanding of the field as well as the specific knowledge needed to undertake their research project. The exam will be created, administered, and graded by the student's advisory committee. The student's advisor will notify the Associate Dean of Academic Studies of the outcome of the pass/fail exam and if any remedial action is needed. Following the exam, a copy of the questions, as well as the graded exam with the questions and student responses will be submitted to the Associate Dean of Academic Studies. The questions will be maintained electronically in the Office of Academic Studies. The graded exam will be maintained in the student's file.

If more than one section is not passed, the student receives a "no pass" for the entire exam. The student is allowed one exam retake for any sections that were not passed. The exam retake must be completed within 3-6 months of the original exam date. If a Ph.D. student does not pass the second exam, he/she will be given an option to enroll in the M.S. degree program. Master's bypass candidates who do not pass the first exam are not permitted to advance directly to the Ph.D. program.

### ***Qualifying Examination***

The qualifying examination is an oral exam designed to test a student's scientific competence and ability to pursue his/her graduate research project. The exam consists of two components: (1) questions that address knowledge specific to the proposed research project and (2) questions concerning the general knowledge in the student's field of study. The qualifying examination will be administered by the student's advi-

sory committee and chaired by a moderator who is not a member of the student's advisory committee. The moderator must be identified at least two weeks prior to the examination. Students must file appropriate paperwork for the scheduling and announcement of the qualifying examination with the VIMS/SMS Office of Academic Studies. Consistent with SMS procedures, the examination will be advertised and open to all faculty members. The examination allows a student's advisory committee to identify any deficiencies in a student's preparation to successfully conduct and complete their degree program. The minimum elapsed time between successful completion of the qualifying examination and the final defense must be no less than six months for M.S. students and no less than one year for Ph.D. students.

If the student does not pass the qualifying examination he/she must retake the examination within six months. A no-pass on the second examination results in automatic termination of the degree program.

### ***Filing for Graduation***

Students filing for graduation must complete an Online Graduation Application in Banner. Instructions are found at: <http://www.wm.edu/offices/registrar/graduation/onlinegraduation>. There is a one-time graduation fee, currently \$75.00, payable for the initial filing date. Only first-time filers can use the on-line filing process. If a student is unable to complete the requirements for graduation by the date specified, he/she must notify the SMS Graduate Registrar and complete a paper form to re-file for a new graduation date. There is no graduation fee charge for re-filing.

### ***Submission of Theses and Dissertations***

All graduating students are required to submit copies of their theses or dissertations, ready for binding, to both the Swem and Hargis Libraries no later than 5:00 p.m. on the deadline date listed in the calendar in this catalog. A receipt of payment of binding fees from the SMS Cashier also must be presented to the respective libraries. One copy of the thesis or dissertation is required for archiving in Swem Library and two copies for Hargis Library. Additional copies will be required for advisors and personal use.

In addition, each graduating student is encouraged to deposit an electronic (PDF) copy of his/her thesis or dissertation with the School of Marine Science library. Authors will retain all copyrights for their work.

Ph.D. students must submit to Swem Library one additional copy of their dissertation abstract for UMI Dissertation Publishing. This may be the abstract prepared by the student for his/her dissertation, however, the abstract for UMI should not be numbered. At the bottom of the last page of the abstract for UMI, the author's full name, name of school or department, name of college, the advisor's name, and the advisor's title should be centered on separate lines. The additional abstract and the student's Agreement Form will be submitted to ProQuest's UMI Dissertation Publishing for production of an archival microform copy and inclusion in the ProQuest dissertation database.

### ***Conferral of Degrees***

The College confers degrees in August, January and May of each year. The commencement ceremony is in May. Degree recipients of the previous August and January are recognized and invited to attend the May ceremony. Students who will complete

requirements in August rather than May may participate in the spring commencement with permission of the Associate Dean of Academic Studies and the Vice President for Student Affairs.

## ***Summary of Degree Requirements - Master of Science***

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



Rosemary Hicks

1. The student must select a suitable major professor, who must be a faculty member of VIMS/SMS, as soon as possible following admission. The student and the major professor will choose an advisory committee, which must be approved by the Associate Dean of Academic Studies. The major professor and advisory committee direct the student's program. Should a student's major advisor retire or leave the VIMS/SMS before the student completes his/her degree, the student is required to select an appropriate on-campus co-advisor.
2. The advisory committee, chosen by the student and approved by the Associate Dean of Academic Studies, must consist of at least four members. A majority of the committee's members must be from the faculty of VIMS/SMS, although persons with appropriate qualifications from outside VIMS/SMS may serve on the committee with the approval of the Associate Dean of Academic Studies. The committee must include at least one VIMS/SMS member who is both outside of the student's research discipline and outside of the student's home department.
3. At least one academic year (Fall and Spring terms) 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 nine (9) credit hours have been earned in courses numbered 550 or above with a cumulative grade point average of 3.0 or better, are required for the M.S. degree. In addition, a student must have registered for thesis credit (MSCI 599) for at least one semester. No more than six (6) thesis credits may be counted toward the minimum 36 credits required for the M.S. Students also will be expected to register for seminar as required by their respective departments; however, only two (2) credits will be applicable to the degree.
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 Associate Dean of Academic 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. The SMS and departmental core course requirements must be completed.
  - c. The qualifying examination must be passed and prospectus must be 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 Associate Dean of Academic Studies, and must defend this thesis before his/her major professor and committee. The defense of the thesis will be separate from any other examination. The qualifying examination must be successfully completed at least six-months prior to the defense of the M.S thesis.
  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, the Associate Dean of Academic Studies may approve time extensions. (See section entitled, Degree Program Milestone Progress under Degree Requirements above).

### ***Summary of Degree Requirements - Doctor of Philosophy***

The milestones to be accomplished and the requirements are:

1. The student must select a suitable major professor, who must be a faculty member of VIMS/SMS, as soon as possible following admission. The student and the major professor will choose an advisory committee, which must be approved by the Associate Dean of Academic Studies. The major professor and advisory committee direct the student's program. Should a student's major advisor retire or leave the VIMS/SMS before the student completes his/her degree, the student is required to select an appropriate on-campus co-advisor.
2. The advisory committee, chosen by the student and approved by the Associate Dean of Academic Studies, must consist of at least five members, at least one of who must be from outside the College of William and Mary. A majority of the committee's members must be from the faculty of VIMS/SMS, although persons with appropriate qualifications from outside VIMS/SMS may serve on the committee. The committee must include at least one VIMS/SMS member who is both outside of the student's research discipline and outside of the student's home department.
3. A minimum of three years of graduate study beyond the baccalaureate is required. At least one academic year (Fall and Spring terms) must be spent in residence at VIMS/SMS, as defined in the general degree requirements.
4. At least 42 credit hours of advanced work, of which at least 15 credit hours have been earned in courses numbered 550 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 dissertation credit (MSCI 699) for a least one semester. At least nine (9) but no more than 12 dissertation credits may be counted toward the minimum 42 credits required for the Ph.D. degree. Students also will be expected

to register for seminar as required by their respective departments; however, only two (2) credits will be applicable to the degree.

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 Associate Dean of Academic 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. The SMS core course requirements must be completed.
  - c. A written comprehensive examination must be passed.
  - d. The qualifying examination must be passed and prospectus must be 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 Associate Dean of Academic Studies and must successfully defend this dissertation before his/her major professor and committee. The defense of the dissertation will be separate from any other examination. A one-year period must elapse between successful completion of the qualifying examination and defense of the Ph.D. dissertation.
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, the Associate Dean of Academic Studies may approve time extensions. (See section entitled, Degree Program Milestones under Degree Requirements above).

### ***Leave of Absence***

The Associate Dean of Academic Studies may grant a leave of absence upon the recommendation of the student's advisor. An approved leave of absence is limited to a maximum of one year during the student's degree program, and relieves the student of the obligation of paying tuition. It is understood that a student on leave of absence is not present on campus, not receiving financial support and not drawing upon campus resources. A student must terminate the leave of absence and be a registered student in the semester in which his/her degree requirements are completed or in which he/she graduates.

Students approved for a leave of absence will have their time limit for degree completion requirement stopped for the duration of the approved period. Upon return from approved leave, the student's time limit to degree completion will resume.

## ***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 or other reasons pursuant to the W&M Student Handbook and the W&M Honor Code (see section General Statements of Policy, below). The Associate Dean of Academic Studies will place a student on a leave of absence for one semester if they fail to register for a regular semester (Fall or Spring) and have not requested a leave of absence or permission to withdraw. 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 Associate Dean of Academic 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.



Daue Malmquist



# *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.

Starting Fall 2011, the tuition and mandatory general fee for full-time students in the School of Marine Science is \$5,481 per semester for residents of Virginia and \$12,416 per semester for non-residents.

**Special Note:** All incoming students registered for nine hours or more are considered full-time students and charged the full-time rates unless qualified for Research Graduate Student status. Students who have been awarded a graduate support package by SMS are generally charged tuition at in-state rates (pending approval of the Provost).

Tuition for part-time graduate students is \$365 per semester hour for Virginia residents and \$985 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 coursework, based on their established domiciliary status.

In addition to tuition, there is a \$25 registration fee and a \$50 comprehensive fee during the summer sessions.

Part-time students who are not regularly enrolled at the College of William and Mary, and for whom 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.

Senior citizens of Virginia who wish to attend School of Marine Sciences courses are invited to contact the Associate Dean of Academic Studies for full details.

## *Graduate Funding*

It is the general policy of the Virginia Institute of Marine Science, School of Marine Science to ensure that all full-time graduate students receive a Graduate Support Package (GSP; tuition, stipend and health insurance benefit), which at a minimum is equivalent to the rate published annually by the SMS Office of Academic Studies. Continuity of student funding is accomplished through a combination of grants and contracts to individual faculty, teaching assistantships, external fellowships, institutional general and endowment funds, as available.

To receive available GSP funding a student must remain in good academic standing, demonstrate satisfactory progress as defined by College degree requirements and regulations of the School of Marine Science, which includes meeting the milestones for normative progress in the degree program, and may not hold any other employment or appointment of a remunerative nature without approval of the Associate Dean of Academic Studies.

VIMS/SMS places strong emphasis on student involvement in research activities and all students who receive financial aid through SMS are expected to participate (equivalent to twenty-hours a week) in their advisor's group activities and in a research project or program as determined jointly with their faculty advisor. 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.

## ***Fellowships***

The VIMS Foundation awards a limited number of fellowships to students with outstanding qualifications. These highly competitive fellowships are awarded to approximately 15-20% of the students in each incoming class via a merit ranking system. Fellowship awards are typically in the range of \$1,000 to \$3,000, with durations of 1-2 years. A VIMS Foundation Fellowship may be used to supplement the stipend or to establish an account to support research, professional travel and computing expenses.

## ***Research Graduate Student Status***

Upon the recommendation of a student's major professor, a student who has achieved Candidacy may apply to the Associate Dean of Academic Studies for either a single semester (M.S. students) or two semesters (Ph.D.) of Research Graduate status. During this period the student will be charged reduced tuition (3 credits). Awarding of Research Graduate status is contingent on the availability of funds. The following conditions must be met:

1. The student has completed all SMS and departmental required coursework.
2. The student has passed the Qualifying Examination and the prospectus has been approved.
3. A Ph.D. student has passed the Comprehensive Examination.
4. The student is not employed significantly in any activity other than research and writing in fulfillment of degree requirements.
5. The student is present on campus or is engaged in approved fieldwork related to his/her thesis or dissertation.

Research Graduate status enables a student to register for a maximum of 12 credit hours of thesis or dissertation credit for fall or spring semester upon payment of the part-time rate (3 credit hours). The student may elect to utilize up to two (2) of the three paid credit hours for formal coursework.

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

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

## ***Eligibility for In-State Tuition for Research and Teaching Assistants***

Regardless of domicile, students with stipends administered by VIMS that pay at least \$4000 per annum may qualify for in-state tuition. Eligibility will be determined by the Associate Dean of Academic Studies and submitted to the Provost for final approval.

## ***Eligibility for In-State Tuition for Students with Permanent Domicile***

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. Detailed information may be obtained from the State Council of Higher Education for Virginia at <http://www.schev.edu/students/vadomicile.asp?from=students> and also from the Office of the University Registrar's web site at: <http://www.wm.edu/offices/registrar/domicile/index.php>.

Domicile is a technical legal concept, and a student's status is determined objectively through the impartial application of established rules. A student who claims Virginia residency must support that claim by clear and convincing evidence. 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. The Office of the University Registrar evaluates the application and notifies the student of adverse decisions only. 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; however, the application must be submitted 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 University Registrar, (757) 221-2808.

## ***Payment of Accounts***

Charges for tuition and general fees are payable by each semester's due date as established by the Office of the Bursar on the W&M main campus in Williamsburg. Any unpaid balance remaining on an individual's account after the end of the add/drop period may result in cancellation of registration. Tuition and fees for SMS students who are supported by a graduate support package may be paid by the Office of Academic Studies or by the student's advisor through the business managers of each department. **It remains each student's responsibility to ensure that tuition and fees have been paid by the date they are due.** Failure to pay by the due date will result in a penalty.

Payment may be made in U.S. dollars by cash, check, money order or cashiers check made payable to the College of William and Mary. Checks returned by the bank for any reason will constitute nonpayment of fees and may result in cancellation of registration. The option of paying in full by credit card or electronic check is offered through the College's payment plan provider, TMS (Tuition Management Systems); however, TMS does charge a convenience fee for paying by credit card. Additional information may be obtained from the Bursar's Office website at [www.wm.edu/offices/financialoperations/sa/index.php](http://www.wm.edu/offices/financialoperations/sa/index.php)

Any past due debt owed the College (telecommunications, emergency loans, parking, health services, library fines, etc.) may result in cancellation of registration and/or transcripts being withheld. In the event a past-due account is referred for collection, the student is required to pay all costs associated with the collection and/or litigation, as well as the College's late payment fee.

## ***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.

**Full-time Graduate Students Who Withdraw From College:** Full-time students who withdraw from the College are charged a percentage of the tuition and fees based on the school week within which the withdrawal occurs. A school week is defined as the period beginning on Monday and ending on the succeeding Sunday. The first school week of a semester is defined as that week within which classes begin. Full-time students who withdraw from the College within the first school week of the semester are eligible for a refund of all payments for tuition and fees less the required enrollment deposit for entering students or a \$50.00 administrative fee for continuing students. After week 1 of the semester, the amount of the tuition and fees charged /refunded will be determined based on the following schedule:

<u>Week</u>	<u>Percentage Charged</u>	<u>Percentage Refunded</u>
1	0%	100%
2	20%	80%
3	30%	70%
4	40%	60%
5	50%	50%
6	60%	40%
After week 6	100%	0%

Students will not be eligible for any refund of tuition and general fees if required to withdraw by the College.

It is College policy to hold the enrolled student liable for charges incurred; therefore, in the case of refunding any overpayment, refund checks will be issued in the name of the student.

**Part-time Graduate Students Who Withdraw From College:** Part-time students who withdraw from the College within the first school week of the semester are eligible for a full refund of tuition and fees less a \$50.00 administrative fee. After the first week, the amount of the tuition and fees to be charged will follow the full-time withdrawal schedule.

Students will not be eligible for any refund of tuition if required to withdraw from the College.

**Graduate Students Who Withdraw From a Course:** A part-time student who withdraws from a course(s) after the add/drop period and remains registered for other academic work will not be eligible for a refund.

**Withdrawal Schedule-Summer Sessions:** Please contact Student Accounts at [bursar@wm.edu](mailto:bursar@wm.edu) or 757-221-1220 for withdrawal refund information for your summer session(s).

## ***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 Insurance Requirement***

The College requires all full-time undergraduate and graduate students admitted Fall 2006 or after and all F-1 and J-1 international students to have health insurance coverage throughout the school year as a condition of enrollment. These students **will be enrolled** in the college-endorsed Student Health Insurance Plan (see below), and the cost **will be billed** to their student account in two installments (fall and spring semester) (UNLESS proof of other adequate health insurance coverage is furnished. Students who already have health insurance for the entire academic year must submit a waiver request by the posted deadline each academic year and the waiver request must be approved to avoid being enrolled in the Student Health Insurance Plan. Students wishing to be enrolled by the College in the Student Health Insurance should verify the charge on your student account. More information about the insurance requirement, the plan, and the waiver or enrollment process, please visit the Student Insurance page of the Student Health Center web site – [www.wm.edu/health/insurance](http://www.wm.edu/health/insurance). If you have any questions please contact Trista Sikes, the Student Insurance Coordinator, by phone at (757) 221-2978 or email at [student.insurance@wm.edu](mailto:student.insurance@wm.edu).

## ***Student Insurance Plan***

United Healthcare Insurance Company underwrites a student sickness and injury insurance plan, designed especially for the students of the College. This plan is intended to provide health care coverage at a reasonable price for professional services obtained both from the Student Health Center and off-campus medical providers. For specific information about the benefits, exclusions or other plan information, view the entire plan brochure at [www.uhcsr.com/wm](http://www.uhcsr.com/wm). If you have questions, contact Trista Sikes, the Student Insurance Coordinator by phone at (757) 221-2978 or by email at [student.insurance@wm.edu](mailto:student.insurance@wm.edu).

The Student Health Center does not have the resources to accept or process claims for any insurance except the College-endorsed plan. The Health Center will provide you with a receipt to submit to your own insurance company for reimbursement. The medical providers at the Student Health Center do not participate in any other insurance provider networks (e.g. HMO's, PPO's, Major Medical or Military Insurance Plans).

# ***General Statements of Policy***

All students enrolled at William and Mary, including students of SMS, are bound by the regulations noted within the W&M Student Handbook. The College reserves the right to make changes in the procedures and regulations contained within the handbook at any time. The handbook contains important information about the College's expectations regarding student conduct, student rights and responsibilities, and relevant processes and procedures to address alleged misconduct. The Honor Code and its procedures are also included in the handbook.

The W&M Student Handbook is available at:

<http://www.wm.edu/offices/deanofstudents/services/studentconduct/studenthandbook/>

Any SMS student seeking to raise a specific concern or discuss a problem regarding graduate studies in the School of Marine Science may contact the SMS Associate Dean of Academic Studies, Dr. Linda Schaffner at (804) 684-7105 ([linda@vims.edu](mailto:linda@vims.edu)). General queries and questions about the SMS academic programs should be sent to [AD-AS@vims.edu](mailto:AD-AS@vims.edu).

## ***Honor Code***

The Honor Code, 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 Code and the method of administration are available on the W&M website:

<http://www.wm.edu/offices/deanofstudents/services/studentconduct/honorcode/>

## ***Office of the Dean of Students (Williamsburg campus)***

In addition to the SMS Office of the Associate Dean of Academic Studies, the Office of the Dean of Students on the Williamsburg campus offers services to all W&M students. Staff members provide learning assistance counseling and workshops for students who are interested in boosting their time management and study skills. Disability Services for permanent or temporary disabilities are coordinated within this office (see Disability Services section). In addition, members of the staff work with students who are experiencing unexpected or difficult circumstances that may result in a need for a medical leave or mid-semester withdrawal.

The Office of the Dean of Student is responsible for managing all violations of the Code of Student Conduct and for training and advising the graduate and undergraduate Honor Councils. Staff members are available to discuss the community's standards, the systems by which they are enforced, or concerns related to the conduct of students or student groups.

Any member of the community may submit reports about student conduct to this office. The Office of the Dean of Students publishes the W&M Student Handbook, which includes statements of rights and responsibilities for all students. Information about other services available to students also is included.

Web site: <http://www.wm.edu/deanofstudents/>



## ***Counseling Center***

The Counseling Center offers a range of brief psychological and counseling services for William and Mary students in order to address psychological issues, personal concerns, interpersonal issues, and crisis intervention. Staff members are available to discuss any important personal concerns a student may be facing and work with that student to provide resources to address those concerns.

The staff of the Counseling Center consists of both male and female mental health professionals, including psychologists, counselors, and social workers. A sport psychologist is available for students interested in learning how to enhance their athletic or academic performance. Psychiatric consultation is available through referral to the Student Health Center. All staff are trained and experienced in dealing with the problems of university students. Students are initially seen for an initial assessment. Follow up services are determined according to the needs of each individual student. Individual, couples, family, or group sessions offered at the counseling center are provided at no additional cost to the student. If appropriate, a student may be referred to other sources of help after an initial evaluation.

Counseling is confidential. Therapy is most effective when a student can be direct and honest with a counselor without fear that personal information will be divulged. Information about a student is not released without that student's written permission, except in accordance with the laws and ethics governing our profession. Notations of counseling are not a part of a student's College educational record.

Appointments may be made by calling the Counseling Center at 221-3620, or by coming to the office in person. Office hours are 8 a.m.-noon and 1:00 p.m.- 5:00 p.m., Monday through Friday. Emergency services during the fall and spring semesters are also available after hours and on weekends by calling the Campus Police at 221-4596 and asking to speak with the Counseling Center 'on-call' counselor. Beginning in Fall 2011 a Counseling Center staff member will be available on the VIMS/SMS campus on a regular basis.

Web site: <http://www.wm.edu/counselingcenter/>

## ***Cohen Career Center***

The Cohen Career Center, centrally located on the William & Mary campus between Sadler Center and Zable Stadium, offers individual career advising and assessment for VIMS/SMS students as well as support in the job search. The Assistant Director serves as the liaison to the sciences across the College, as well as to VIMS/SMS students. The Assistant Director is available to present workshops and seminars at VIMS/SMS and to provide individual career advising both on the Williamsburg and Gloucester Point campuses.

Web site: <http://www.wm.edu/offices/career/>

## ***Disability Services***

Disability Services strives to create a comprehensively accessible living and learning environment to ensure that students with disabilities are viewed on the basis of ability by considering reasonable accommodation on an individual and flexible basis. The decision to request accommodation is voluntary and a matter of individual choice.

Students seeking accommodation are strongly encouraged to notify the College and submit all supporting documentation early to allow adequate time for planning.

**Documentation of Disability:** In general, documentation should not be older than three years from the date of the first accommodation request and is expected to demonstrate the impact of disability upon major life activities and to support all recommended accommodations. As appropriate to the disability, the College expects documentation to meet specified guidelines.

Documentation of disability need not precede arrival on the VIMS campus, but must be filed with Disability Services before reasonable accommodation will be considered. Please refer to the Disability Services web site for more information concerning these specific documentation guidelines. Documentation of disability is confidential will not be released without the student's written consent. In order to provide an accessible educational environment and to meet the individual learning needs of students, we invite self-declaration of disabilities to the Assistant Dean of Students for Disability Services, Campus Center 109, College of William and Mary, P.O. Box 8795, Williamsburg, VA 23187-8795, (757) 221-2510, (757) 221-2538 (Fax).

Web site: <http://www.wm.edu/deanofstudents/disable/>

## ***Student Health Center***

The Student Health Center provides high-quality, primary medical care for full time students that become ill or experience minor emergencies while away from home. There is a co-pay for office visits, as well as a fee for certain services, labs, pharmacy and medical supplies. A list of fees can be found on the website: [www.wm.edu/health](http://www.wm.edu/health). All matters between a student and the Health Center staff are confidential except in the case of life threatening situations, medical emergencies, severe emotional or psychological distress, or when required and/or permitted by law.

Virginia state law requires all full-time students who are enrolling for the first time in a four-year public institution to provide a health history and an official immunization record. The College of William and Mary further requires ALL full-time students (including previously matriculated students) as well as any other student eligible for services as determined by their department (i.e. Language House tutors, PTUG/Flex Track students with full time hours, students with an approved under-load, transfer students, or Psy. D. students) to provide documentation of meeting the same immunization requirements AND a physician documented medical history performed within the twelve months preceding his/her initial enrollment. This form will not be accepted if the physician completing and signing the form is a family member. Previously enrolled students who are reentering as full-time students after an absence of less than 3 years must update their immunizations to meet current requirements. Additionally, enrolled students who are reentering as full-time students after an absence from campus of greater than 3 years must submit a new history, physical, tuberculosis screening and must update immunizations to meet the current requirements. If the absence is greater than 10 years, then the entire form needs to be resubmitted. This information MUST be submitted on William and Mary's Health Evaluation Form, which is available on the website:

<http://www.wm.edu/health/forms>

Failure to comply with this requirement will result in the following actions: prevention from registering for classes; ineligibility for non-urgent medical care at the Student Health Center; may result in eviction from residence halls and/or removal from campus (depending on medical issue); and also will include referral for judicial action of the Student Code of Conduct.

Medical services are provided for all full time students and those graduate students certified by the Dean of their school to be doing the “equivalent of full time work.” In order to be eligible for medical care, graduate and undergraduate students must have paid a Health Fee for the current semester and met the Health Evaluation Form requirements including a physician documented medical history and submission of an official immunization record. Students choosing to seek care at an off-campus site are responsible for charges incurred. Likewise, if a Health Center physician deems it necessary to refer a student to an off-campus specialist, this also becomes the student’s financial responsibility.

Students experiencing severe emotional or psychological distress, making a threat or a gesture of suicide, or attempting suicide, will be evaluated by the College’s medical/emotional emergency response team and appropriate measures instituted. Anyone having knowledge of such circumstances should immediately contact the Dean of Students at (757) 221-2510, or the Student Health Center at (757) 221-4386.

The Student Health Center is located on Gooch Drive, South of Zable Stadium (Cary Field). Hours of operation during the summer are Monday, Tuesday, Thursday and Friday from 7:45 A.M. to 4:00 P.M. and Wednesday from 10:00 A.M. to 4:00 P.M. Hours of operation when classes are in session are Monday, Tuesday, Thursday and Friday from 8:00 A.M. to 5:00 P.M.; Wednesday from 10:00 A.M. to 5:00 P.M. and Saturday hours are 9-1 with limited services available.

Web site: <http://www.wm.edu/health>



*Itchika Sivaipram*

# ***VIMS Campus and Student Activities***

School of Marine Science students participate in graduate studies at an active, year round research facility with approximately 450 scientists, support technicians and staff. The 35-acre main campus of the Virginia Institute of Marine Science is located in Gloucester Point at the mouth of the York River, a major tributary and natural passageway to the Chesapeake Bay and Atlantic Ocean.

## ***The Graduate Student Association (GSA)***

The Graduate Student Association (<http://wmpeople.wm.edu/site/page/marsci>) is a voluntary organization open to all graduate students in the School of Marine Science. The purpose of the GSA is to advance the academic and social interests of its members. Students will find information on the GSA website about funding opportunities and housing availability. Officers are elected each spring for the following academic year.

## ***Cultural Life at VIMS and William and Mary***

Many activities on the College's campuses and in the local communities enrich the lives and career development of students enrolled in SMS. Students have the opportunity to interact with top national and international marine scientists during an annual seminar series. Luncheons with the speaker and social gatherings also allow students to interact with these scientists in less formal settings. After Hours Lectures feature experts from VIMS and main campus who shed light on the natural history of Chesapeake Bay and the current issues it faces. Marine Science Day, which takes place in May is biggest public event at VIMS. Many members of the VIMS community, including faculty, staff, and students get involved -- it's a great way for scientists to engage with the public and discuss current the implications of current research for the local community and the globe. The GSA also offers many social opportunities to students and the VIMS campus. Parties during the fall and spring are open to all members of the VIMS community and their families. The annual GSA Community Yard Sale is a great way to buy and sell household items and to mingle with locals.

Gloucester Point and Yorktown's Riverwalk Landing are the areas closest to the VIMS campus. They boast popular beaches that attract local citizens. Gloucester Point and other areas along the York River are great locations for water sports including kayaking, sailing, and windsurfing. VIMS staff and students are in charge of a William & Mary's Sail and Paddle Club. The club has kayaks, windsurfers, and sailboats that are available to its members. Lessons and weekend trips are offered many times a year.

Farmer's markets and local produce and seafood stands on both sides of the York River offer local foods and are a great way to network with local community members. The Bena Country Store on Guinea Road displays local art and holds concerts featuring local and national artists. Live music is also accessible at the Crab Deck in Gloucester Point and at Yorktown's Riverwalk Landing.

Gloucester and Yorktown hold many celebrations of local and national pride. In Gloucester, the Daffodil Festival in spring is a large celebration of Gloucester's history of flower cultivation. Seafood festivals in Gloucester, Poquoson, and Urbanna celebrate traditional lifestyles centered around the Chesapeake Bay. Yorktown holds

wonderful fireworks displays and the VIMS campus at Gloucester Point is a prime location for viewing.

Many cities in Virginia are easily accessible from Gloucester, including Richmond, Williamsburg, Norfolk, and Virginia Beach. These cities each provide an array of businesses and cultural and entertainment events throughout the year.

As part of the William & Mary community, School of Marine Science students have access to all of the amenities and events offered at William & Mary. Students have access to Swem Library, the Rec Center, theatric performances, art exhibits, concerts, sporting events and lectures. All VIMS students also have a William & Mary email address, through which important information about student requirements and upcoming events are disseminated. Look for student happenings emails to find out about upcoming events. With a William & Mary ID, School of Marine Science students also have free access to the buildings at Colonial Williamsburg.

## ***Housing***

There is no student housing on the VIMS/SMS campus, and most students live in Gloucester Point or in surrounding communities. Rental housing is somewhat limited in the Gloucester Point area, but apartments in nearby Gloucester, Mathews, Yorktown, and Newport News are more plentiful if one is willing to commute a short distance. One bedroom apartments generally range from \$500 to \$1000, while multiple bedroom apartments will generally cost about \$300 to \$500 per occupant. These figures do not include utilities or amenities. 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 located on the main campus (757) 221-4134, or email [living@wm.edu](mailto:living@wm.edu).

## ***Recreational Sports***

The Recreational Sports Department at the College of William and Mary provides a variety of recreational opportunities to all students, faculty and staff through intramural, sports clubs, informal recreation, fitness/wellness and outdoor programs. Facilities include the Student Recreation Center, Adair Gymnasium, William and Mary Hall and various outdoor facilities. Facilities are open seven days per week during most of the year with a modified schedule during the break periods. Facility schedules and procedures for checking out equipment are available at the Student Recreation Center. See the Recreational Sports website at <http://www.wm.edu/rec> for building hours, intramural schedule, sports club listings, and fitness/wellness services.

The Recreation Center offers 40 fitness classes throughout the year for students, faculty, and staff at the College. Sold at very low rates are Semester and Year Passes. Classes include Body Pump, Cardio Dance, Pilates, Yoga, Spinning, Step and more! Also held at the Rec Center, Personal Training and Massage Services Center. Check for prices on the website.

Intramural play held for each of over 25 sports/activities during the year. Informal or open recreation, generally considered "free play," is offered in swimming, racquetball,



Sarah Sumoski

squash, basketball, volleyball, weightlifting and cardio machines. The Sport Club program consists of 46 clubs, each self-governing and self-supporting and dictated simply by participants' interest in the activity. Clubs includes: Badminton, Ballroom Dance, Baseball, Men's Basketball, Women's Basketball, Brazilian Jiu-Jitsu, Croquet, Cycling, Equestrian, Fencing, Field Hockey, Golf, Gymnastics, Ice Hockey, Judo, Kendo, Men's Lacrosse, Women's Lacrosse, Martial Arts, Outdoor Club, Racquetball, Rock Climbing, Rowing, Men's Rugby, Women's Rugby, Running, Sail and Paddle (VIMS), Sailing (Racing), Scuba, Shotokan Karate, Men's Soccer, Women's Soccer, Softball, Swimming, Synchronized Swimming, Table Tennis, Tae Kwon Do, Tennis, Triathlon, Men's Ultimate Frisbee, Women's Ultimate Frisbee, Men's Volleyball, Women's Volleyball, Water Polo, Wrestling and Yoga.

The use of W&M's Recreational Sports facilities is included in the payment of full-time tuition. Graduate students who pay for fewer than 9 credit hours per semester may use the facilities by paying an annual activities fee. For information on the annual fee, any activity program or service offered by Recreational Sports, please call (757) 221-3310.

## ***Parking***

All motor vehicles, including motorcycles and motorbikes, parked on VIMS/SMS property must be registered with Parking Services. Registration includes the purchase of a College of William and Mary or VIMS-only parking decal or temporary pass, which must be displayed on or in the vehicle. Illegally parked or unregistered vehicles are subject to citation. The VIMS-only decal is valid only at the William & Mary Hall lot when visiting the main campus in Williamsburg. Students with unresolved citations will not be allowed to register a vehicle on campus until the debt is resolved. Outstanding debt to Parking Services may result in an administrative hold in Banner, which will limit registration for classes or to receive degrees. At the end of the semester outstanding debt will be forwarded to the Bursar's office and will be posted to student accounts. A full description of campus motor vehicle regulations is contained in a brochure available from Parking Services or online at [www.wm.edu/parking](http://www.wm.edu/parking). You may also contact Parking Services at telephone (757) 221-4764 or email [parked@wm.edu](mailto:parked@wm.edu).



# ***Research Facilities and Equipment by Department***

## ***Department of Biological Sciences***

<http://www.vims.edu/research/departments/bio/>

The Department of Biological Sciences, housed primarily in Chesapeake Bay and Andrews Halls, is well equipped with state-of-the-art equipment for conducting field and laboratory research. Major facilities include several light-, temperature- and humidity-controlled environmental chambers, a greenhouse with running seawater and temperature controlled tanks for aquatic macrophyte photosynthesis-related studies and plant restoration work, an expansive wet laboratory facility, and a large array of flow-through seawater mesocosm tanks. Laboratory instrumentation includes: gas chromatograph fitted with various detectors, high performance liquid chromatograph, infrared gas analyzer, elemental analyzer, scintillation counter, auto-analyzer for nutrient analyses, computer-assisted image analysis hardware and software, biosafety hoods, fluorometers, spectrophotometers, various microscopes including access to electron microscope facilities, a Coulter Altra flow cytometer, a FLOWCAM imaging cytometer, Total Organic Carbon and Total Nitrogen analyzer, Elzone particle counter/sizer, and microelectrode microprofiler.

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

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

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

## ***Department of Environmental and Aquatic Animal Health***

<http://www.vims.edu/research/departments/eaah/>

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

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

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

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

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

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

## ***Department of Fisheries Science***

<http://www.vims.edu/research/departments/fisheries/>

The Department of Fisheries Science, housed in Nunnally Hall, Chesapeake Bay Hall and Andrews Hall, comprises several programs, each with a fully equipped laboratory, a variety of collection and sampling equipment, and extensive computer facilities.

The Fisheries Science Laboratory has a dedicated age and growth laboratory equipped with multiple high quality optical microscopes linked to an image analysis system. The facility supports rapid analysis of hard structures for age determination and automated morphometric measurements. Also available are otolith sectioning and grinding equipment, hydraulic scale presses, and digital scale projectors. The fish-processing laboratory is a large, multi-user facility designed for the work-up of field samples and storage of field equipment. The lab is equipped with automated fish measuring boards and electronic balances that are linked to the departmental computer network.

The Marine Conservation Biology and Crustacean Ecology Programs maintain several mesocosm tanks suitable for a range of small (crabs) to large (sea turtles) marine species, as well as a Remotely Operated Underwater vehicle equipped with color video, B&W high-resolution camera, integrated navigation and GPS, laser scaling, side-scan sonar and 150-m depth capability. The Programs also maintain various types of benthic and epibenthic sample gears suitable for small and large research vessels.

The Molluscan Ecology Program's laboratory is well equipped for physiological and ecological studies with a UV-VIS spectrophotometer, centrifuges, a fluorescence microscope, compound and dissecting microscopes, and an image analysis system.

The Fisheries Genetics Program maintains a large laboratory that is fully equipped to undertake a variety of genetic analyses. Major equipment includes automated DNA sequencers, a bank of thermal cyclers, refrigerated centrifuges, ultracentrifuges, a vacuum concentrator, a digital imaging system, several ultra cold freezers and a walk-in cold room.

The Fisheries Ecosystem Modeling and Assessment Program maintains a laboratory with a full complement of the equipment needed for finfish diet and analysis and age determination, including several compound and dissecting microscopes, balances, low-speed isomet saws, and hot plates

Nunnally Hall contains a collection of fishes with approximately 128,000 specimens representing 245 families. This research and teaching collection incorporates extensive holdings from Chesapeake Bay, the Middle Atlantic Bight, Appalachian freshwater habitats, and an internationally recognized collection of deep-sea fishes. Associated with the collection are laboratories equipped with high-resolution microscopic imaging and digital x-ray systems.

Two wet lab facilities are available to department 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 re-circulated filtered seawater. Adjacent to the sea turtle greenhouse is a 7,560-gallon tank used for research.

Physiology laboratories are available on the VIMS main campus and at the Eastern Shore Laboratory containing equipment for measuring metabolic rates, as well as conducting a broad range of advanced procedures relevant to environmental physiology, including cardio-respiratory physiology and sensory biology.

Monthly surveys of juvenile fishes and crabs are conducted throughout the Bay and on three major rivers. Plankton studies, larval fish research, and reproductive studies of recreational fishes are conducted in the Bay as well as offshore.

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

## ***Department of Physical Sciences***

<http://www.vims.edu/research/departments/physical/>

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

department maintains microwave and GPS navigation systems for accurate positioning of research vessels.

The department houses extensive laboratory instrumentation, including: an isotope ratio mass spectrometer coupled to an elemental analyzer; an elemental analyzer; UV/Vis spectrophotometer; gas chromatographs with flame ionization and electron capture detectors; quadrupole mass spectrometers; EDS system with full SEM imaging capabilities; nitrogen adsorption surface area and porosity analyzer; high performance liquid chromatograph with UV absorbance and liquid scintillation detectors; an annular flume; five intrinsic germanium gamma spectrometers; eight channel alpha spectroscopy system; digital X-ray radiography unit; Coulter multisizer automatic particle analyzer; rapid sediment analyzer. Computer facilities include laptop units for field use, work stations, a ~40 node cluster located on VIMS' campus, and access to the College of William & Mary's SCI-CLONE supercomputer cluster.

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

## ***VIMS Facilities***

**William J. Hargis, Jr. Library:** The diverse collections of the Hargis Library, located in Watermens Hall, support the major programs of studies of the School of Marine Science as well as the research and advisory service programs of VIMS. These specialized collections are a blend of books, technical reports, online and print based journals as well as topographic maps and nautical charts. Many of the VIMS scientific reports have been digitized and are available for viewing by connecting to the library's website.

Current research literature can be identified by using the major scientific research databases such as the Web of Science, Science Direct, ASFA, CSA Biological Sciences, Environmental Sciences and Pollution Management, GeoRef, and Oceanic Abstracts. These and other electronic resources are accessible both on and off campus. Students, faculty and staff can also connect to the broad array of over 200 databases available via main campus connections and VIVA – the Virtual Library of Virginia, as well as the materials in the collections of the other William and Mary libraries. In addition to the College collections, research materials from other institutions can be acquired for your use via Hargis Library's InterLibrary Loan Service.

Librarians are able to provide help in locating information, identifying the best tools for your research project and clarifying how to access resources. More information on Hargis Library can be viewed at [web.vims.edu/library](http://web.vims.edu/library).

**Analytical Service Center (ASC):** The ASC provides water and sediment analyses to students, scientists and governmental agencies. The ASC has researched, refined and developed methodologies for analyses in a wide spectrum of environmental matrices. The quality of data is the result of thorough statistical controls, documentation, and training. ASC instrumentation is state-of-the-art, with computer control interfacing, background correction and optimization for saline samples.

**Andrews Hall (AH):** This 71,000 square foot facility, which was completed in 2007, houses programs in marine ecology and biological oceanography, geological and

physical oceanography, fisheries and aquaculture. The facility includes class and meeting rooms for the academic program, which can also be used for distance learning and videoconferencing

**Chesapeake Bay Hall (CBH):** Completed in 1997, this facility provides 60,000 square feet of research facilities, including labs for advanced research in chemistry, biogeochemistry, toxicology, pathobiology, microbiology, genetics, physiology, plankton ecology, nutrient cycling and parasitology.

**Eastern Shore Field Laboratory (ESL):** The VIMS ESL facility, on Virginia's Eastern Shore, offers access to coastal lagoons, salt marshes, barrier islands and coastal waters. Located in Wachapreague, about 2 hours from Gloucester Point, this facility supports research on a wide variety of coastal issues with special emphasis on bivalve aquaculture. The ESL houses a hatchery, nursery, seawater flume, nearby bivalve grow-out sites and has a well-equipped laboratory, small boat facility, and dormitory.

**Field Operations:** Field Operations provides a broad range of skilled, technical services in addition to maintaining and operating the vessel fleet. They assist in designing field programs, operating vessels, and conducting field work either locally or away. Staff members also design, fabricate, and repair complex electronic and mechanical instruments. Field Operations supports the diving program, which complies with AAUS standards. In addition to the 65-ft R/V Bay Eagle, the 29-ft R/V Fish Hawk, and the 29-ft R/V Ellis Olsson, a sizeable fleet of smaller boats can be hauled by trailers. On request, Field Operations personnel provide training to qualify students to operate boats.

**Information Technology and Network Services (ITNS):** ITNS provides technical support for Information Technology resources used on campus. Supported desktop and laptop systems are primarily Windows and Macintosh. ITNS maintains a campus-wide backbone network, which has high-speed links to the Internet and NLR, the National Research Network, via Network Virginia. ITNS provides a wide variety of IT services such as file, print, E-mail, web, database, data storage, high performance computing, and video conferencing. Students have access to up-to-date hardware and software in computing labs, the library and via mobile laptop systems that can be used in any classroom. ITNS staff assist students in configuring and using personally owned computer systems that meet or exceed minimum requirements.

**Nunnally Hall:** Completed in 1992, Nunnally Hall houses modern laboratories, dissection facilities for large vertebrates, and an extensive collection of fishes that includes approximately 128,000 specimens representing approximately 245 families of marine and freshwater fishes.

**Seawater Research Laboratory (SRL):** This 47,000 square foot facility allows scientists from VIMS and other institutions to conduct research on living marine and estuarine organisms under controlled conditions, allowing for great diversity with respect to the type(s) of organisms which may be studied and the conditions of exposure. The SRL consists of six primary contained wet lab areas, including some that are highly specialized to allow the safe containment and treatment of aquatic pathogens and toxins. Special care is taken to protect the laboratory personnel who work within these areas. State-of-the-art filtration and effluent treatment technologies are utilized to protect the receiving waters of the York River estuary from exposure to these compounds as well.







School of Marine Science  
Virginia Institute of Marine Science  
College of William and Mary  
P.O. Box 1346  
Gloucester Point, Virginia 23062 USA  
[www.vims.edu](http://www.vims.edu)