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# **1. Oceanographic Center Overview**

## **1.1. OCEANOGRAPHIC CENTER MISSION STATEMENT**

The mission of the Oceanographic Center is to carry out innovative, basic, and applied research and to provide high-quality graduate and undergraduate education in a broad range of marine-science and related disciplines.

The center also serves as a community resource for information, research, and education on oceanographic and environmental issues.

## **1.2. GRADUATE RESEARCH ACTIVITIES**

The Oceanographic Center pursues studies and investigations in observational and theoretical oceanography. Research interests include modeling of large-scale ocean circulation, coastal dynamics, ocean-atmosphere coupling, surface gravity waves, biological oceanography, chemical oceanography, coral reef ecology, assessment, restoration, and monitoring, Pleistocene and Holocene sea level changes, benthic ecology, marine plankton, invertebrate systematics and phylogeny, calcification of invertebrates, cell ultrastructure, marine fisheries, molecular ecology and evolution, wetlands ecology, aquaculture, and nutrient dynamics.

Regions of interest include not only Florida's coastal waters and the continental shelf/slope waters of the southeastern United States, but also the waters of the Caribbean Sea, the Gulf of Mexico, and the Antarctic, Atlantic, Indian, and Pacific Oceans.

## **1.3. ACADEMIC PROGRAMS: INSTITUTE OF MARINE AND COASTAL STUDIES**

### **Programs and majors:**

Individual MS degree programs in:

- Marine Biology
- Coastal Zone Management
- Marine Environmental Sciences

Joint MS degree programs in

- Marine Biology and Coastal Zone Management
- Marine Biology and Marine Environmental Sciences
- Coastal Zone Management and Marine Environmental Sciences
  
- PhD in Oceanography/Marine Biology

The Oceanographic Center offers the PhD degree in oceanography and the MS degree in marine biology, coastal zone management, and marine environmental sciences. The joint MS degree can be obtained in marine biology and coastal zone management; marine biology and marine environmental sciences; and coastal zone management and marine environmental sciences.

This catalog provides guidelines and rules to assist the student in fulfilling the academic requirements of the MS and PhD degrees. MS majors and the PhD course of study contain a common core of five courses (Physical Oceanography, Marine Ecosystems, Marine Geology, Marine Chemistry, and Biostatistics) that provides an overview and foundation in the ocean sciences. Specialty and tutorial courses provide depth in each program. The Oceanographic Center operates on a quarter-term system with 12-week courses.

Graduate students are responsible for requirements set forth in the *most recent edition* of this catalog, unless exceptions are specifically (and individually) approved by the program administration. Updates may be issued at the Oceanographic Center between catalog publications. Copies of the catalog and updates are available upon request.

For the MS program each class meets typically one evening per week in a three-hour session. Thesis and capstone review tracks are offered in all MS majors.

For completion of the MS degree, students must either choose a capstone review paper or thesis track. Carrying out either thesis or capstone is possible only after agreement with a major professor and completion by the student of an approved proposal. This proposal must be signed off on by the student's committee, and submitted to the Program office before registering for thesis or capstone credits.

The capstone review paper track requires a minimum of 45 credits, including 5 three-credit core classes, 8 three-credit specialty courses and a six-credit capstone review paper, consisting of an extended literature review of an approved subject. The completed capstone paper is an open defense that includes the student's advisory committee. A typical capstone committee consists of the major professor and one other member who has at least a master's degree, and experience in the field being reviewed.

The thesis track requires a minimum of 39 credits, including 5 three-credit core classes, 5 three-credit specialty courses and at least nine credits of master's thesis research. The number of thesis research credits above the minimum is dependent upon the length of time needed to complete the thesis research, which may be more than a minimum of three terms. The final thesis is formally defended before the committee. A typical thesis committee consists of the major professor and two other committee members. It is preferred if one of the committee members is from outside the Oceanographic Center.

The joint specialization MS degrees require a minimum of 57 course credits (19 courses) or 51 course credits (17 courses) (for thesis or capstone review paper respectively) and nine credits minimum thesis research or the three credits for the capstone review paper. The total minimum requirement is 51 to 57 credits for the thesis or capstone review paper track, respectively. For the joint programs, students take approximately equal numbers of courses within each of the two specialties.

For both the capstone and the thesis degree tracks, once the proposal has been accepted, enrollment in the chosen track must continue until completion of the degree.

The PhD degree requires a minimum of 90 credits beyond the baccalaureate. At least 48 credits must consist of dissertation research. At least 42 credits must be in upper-level course work, which usually consists of tutorial studies with the major professor. The student also must successfully complete the PhD comprehensive examination and defend the completed dissertation before the committee. The Oceanographic Center faculty has the final approval of the dissertation. The student's PhD committee consists of at least four people, three of whom must be center faculty members and one of whom must be from outside the Oceanographic Center. The committee monitors all phases of the candidate's progress. Students are expected to complete the program in nine years or less, a minimum of three years of which must be in residence.

### **1.3.1. MS Marine Biology**

This course of study is designed to equip students with a substantial understanding of the nature and ecology of marine life and grounding in the other overlapping areas of marine science. Program flexibility provides preparation for further graduate study, secondary education career enhancement, or employment in technical research institutions, government agencies, or environmental consulting firms.

Applicants should hold a bachelor's degree in biology, oceanography, or a closely related field, including science education.

### **1.3.2. MS Coastal Zone Management**

This program leads to a multidisciplinary professional MS degree, intended for employees of government and industry seeking career enhancement, as well as for recent college graduates seeking careers in planning and management with governmental agencies, industries, and other activities depending on or affecting the coastal zone or its resources. The program also can be of value for enhancement of careers in education. It focuses on contemporary problems and conflicts arising from increased use of coastal areas and emphasizes the evaluation of alternative policy management solutions. Coastal studies combine elements of ecology, geology, physics, engineering, economics, law, the social sciences, and management. Because of this diversity, applicants with any undergraduate major will be considered for admission.

A science major is most useful. A science background including general biology, chemistry, and organic chemistry is essential.

### **1.3.3. MS Marine Environmental Sciences**

This master's degree program results from the need to educate professionals beyond the bachelor's in a synthesis of diverse disciplines, each of which views the marine environment in disparate ways. We anticipate that students who complete the M.E.S. Program will enter, or re-enter, the work force directly. This professional degree program is designed to serve working professionals in Florida and across the nation with training and education beyond the bachelor's degree. It is also appropriate for marine scientists who are interested in learning how the marine system works. Graduates can find employment in environmentally oriented agencies/organizations and hopefully make a difference' in the ways of the world. The M.E.S. is not designed as an intermediate degree for the PhD, although some M.E.S. graduates will be well prepared for, and may later apply to, a PhD program either at the Oceanographic Center or elsewhere. The program is of value for prospective or actual employees of government and industry seeking careers in areas of marine science.

Because of this diversity, applicants with any undergraduate major will be considered for admission. However, a science major is most useful and a science background is essential.

It is important to differentiate the Marine Environmental Sciences MS Program from the Coastal Zone Management MS Program. We view the M.E.S. as a more broadly based degree without the management emphasis of C.Z.M. The potential M.E.S. curriculum contains some, but does not accentuate management elements.

#### **1.3.4. Joint MS Degrees**

The joint MS degrees are combinations of essential elements of the separate majors: marine biology/coastal zone management, marine biology/marine environmental science, or coastal zone management/marine environmental science. These options give students a broader training in marine science. They do, however, require that students take additional courses to satisfy requirements of the joint MS degree.

#### **1.3.5. PhD in Oceanography/Marine Biology**

The PhD degree consists of a program of upper-level course work and original research on a selected topic of importance in the ocean sciences. Courses consist of required general core courses as well as tutorial studies with the major professor. PhD programs are informally divided into physical oceanography and marine biology.

### **1.4. FACILITIES**

#### **1.4.1. Laboratories and Offices**

The Oceanographic Center is located on a 10-acre site on the ocean side of Port Everglades, adjacent to the port's entrance. The center has a one-acre boat basin. Its location affords immediate access to the Gulf Stream, the Florida Straits, and the Bahama Banks.

The center is composed of three buildings, two modulars, and two houseboats. The main two-story building houses seven laboratories, conference rooms, workroom, and 13 offices. A second building contains a large two-story warehouse and staging area, classroom, biology laboratory, electron microscopy laboratory, darkroom, machine shop, carpentry shop, electronics laboratory, the library, student computer lab, computing center, and 15 offices. A one-story building contains a wetlab/classroom, coral workshop, and an X-ray facility. A modular laboratory is used for aquaculture studies. A two-story houseboat provides a union area, a conference room, and student/staff offices. The other houseboat is used for housing visiting research scientists.

#### **1.4.2. Library Resources**

The William S. Richardson Library at Nova Southeastern University's Oceanographic Center is a research-oriented library for all the disciplines of marine and aquatic science. Located at the entrance of Port Everglades, it is open to the public for browsing, but its primary use is for faculty research, and for Masters students in Marine Biology, Coastal Zone Management and/or Marine Environmental Sciences, and PhD students in Oceanography.

The library has 83 current subscriptions to journals and over 3000 books and monographs which can be found in the On-line Catalog. Databases include ASFA (Aquatic Sciences and Fisheries Abstracts), and Science Direct (full-text Elsevier Journals) which can be accessed through NSU's Electronic Library. The library also has an ARIEL station for sending and receiving documents.

The library is a member of IAMSLIC, an international marine science library organization, SAIL, the regional offshoot of IAMSLIC, and the FBIC, a group dedicated to the identification and distribution of information on Florida's species and ecosystems.

Other campus libraries offer other on-line databases, along with an interlibrary loan service that makes available books and copies of articles from other libraries around the country.

### **1.4.3. Computer Services**

The primary research computing facility at the Oceanographic Center consists of a cluster of HP/Compaq/DEC Alpha workstations. The workstations are used primarily for ocean modeling and analysis and are kept running 24x7. They are capable of running the majority of numerically intensive computing tasks at the Oceanographic Center. Printing needs are served by several laser printers and a networked Phaser 550 color laser printer.

For faculty and student computing, the Oceanographic Center has approximately 80 PC's on a LAN connected to main campus and the Internet. The student computer lab has individual cubicles with networked Pentium computers, laser and inkjet printers, and a high-resolution color flatbed scanner. Various peripherals throughout the Center include an HP 1055C large format poster printer, color flatbed scanners, and assorted imaging software and hardware.

The Center is linked to the Internet and NSU main campus via a T-1 network link. A wireless network allows indoor and outdoor access to the Internet from any location at the Center.

The center's Web site is located at

### **1.4.4 National Coral Reef Institute**

The National Coral Reef Institute (NCRI) was established by Congressional mandate in 1998. NCRI's primary objective is the assessment, monitoring, and restoration of coral reefs through basic and applied research and through training and education. NCRI operates at the Nova Southeastern University Oceanographic Center near Ft. Lauderdale, Florida.

#### Mission

NCRI's mission is to identify gaps and constraints in scientific knowledge of reef structure and function as it relates to issues of assessment, monitoring, and restoration.

Through active research and collaborative funding, NCRI undertakes and facilitates hypothesis-based scientific research in emerging reef issues and technologies. NCRI provides scientific synthesis and evaluation criteria of existing programs for use by the research and management community. These include the study of minimally impacted, stressed, and imminently threatened and endangered reefs. Assessing and monitoring biodiversity is a priority, especially as it affects and interacts with ecological processes, overall reef function, reef recovery, and restoration. NCRI's primary capability is that of offering a strong scientific focus as well as innovative approaches to relevant scientific issues in all aspects of coral reef biology.

More information about NCRI can be found at.

#### **1.4.5 South Florida Ocean Measurement Center**

The Oceanographic Center is involved in the South Florida Ocean Measurement Center (SFOMC), a joint effort involving government and educational agencies that includes the following:

- University of South Florida
- Florida Atlantic University
- Harbor Branch Oceanographic Institution, Inc.
- University of Miami: RSMAS
- NOAA: AOML
- Naval Surface Warfare Center
- University of South Florida: Department of Marine Science

A Congressional grant, along with a combination of other federal and state money, is being used to construct this exciting new facility, which includes an extensive natural in-water laboratory being built with the guidance of the Office of Naval Research (ONR). This comprehensive in-water installation is located off shore in Dania, just south of Ft. Lauderdale, Florida, in an area with a wide variety of environmental conditions. It also includes living reefs, and is located where the continental shelf break is only three miles from shore.

More information about SFOMC can be found at.

#### **1.4.6 Guy Harvey Research Institute**

The Guy Harvey Research Institute (GHRI) is a scientific research organization based in Ft. Lauderdale, Florida, at the Oceanographic Center of Nova Southeastern University, minutes from coral reefs and popular fishing grounds. GHRI was established in 1999 as a collaboration between the renowned marine artist Dr. Guy Harvey and NSU's Oceanographic Center to assume a leadership role in providing the scientific information necessary to understand and save the world's fish resources and biodiversity from drastic, ongoing declines. GHRI is one of only a handful of private organizations dedicated

exclusively to expanding the scientific knowledge base needed for effective conservation of fish populations and maintenance of fish biodiversity.

More information about GHRI can be found at.

#### **1.4.7 Aquaculture Research Center**

The purpose of the ARC is to foster research and education in the field of aquaculture. The center is testing methods for maximizing production in order to facilitate research and education. The culture facility is comprised of eight 70,000-gallon tanks and four 30,000-gallon tanks. All eight tanks are now in production . Start-up production in the tanks is between 7,000 and 10,000 lbs. per tank, with increases to almost times that possible in later years. The smaller tanks are being used as biofilters to remove nitrogen wastes. Wetland plants are being grown to remove nitrogen as well, and these are being sold for wetland mitigation projects. The Aquaculture Research Center is located in Ft. Lauderdale, near Nova Southeastern University's main campus.

## 2. Faculty and Staff

### 2.1. Nova Southeastern University Administration

Ray Ferrero, Jr., LL.B., President

George Hanbury II, PhD, Executive Vice President for Administration

Ronald Chenail, PhD, Assistant to the President for Academic Affairs

Morton Terry, DO, Chancellor

Frederick Lippman, R.Ph., Executive Vice Chancellor and Provost

### 2.2. Oceanographic Center Faculty

Patricia Blackwelder, Associate Professor  
PhD, University of South Carolina

Curtis Burney, Associate Professor  
PhD, University of Rhode Island

Richard E. Dodge, Dean  
Professor  
PhD, Yale University

Veljko Dragojlovic, Associate Professor  
PhD, University of British Columbia

Joshua Feingold, Assistant Professor  
PhD, University of Miami

Sean Keenan, Assistant Professor  
PhD,

Edward O. Keith, Associate Professor  
PhD, University of California, Santa Cruz

Charles Messing, Professor  
PhD, RSMAS, University of Miami

Andrew Rogerson, Professor  
Director, Institute of Marine and Coastal Studies  
PhD, University of Stirling

Mahmood Shivji, Associate Professor  
PhD, University of Washington

Alexander Soloviev, Associate Professor

PhD, P.P. Shirshov Institute of Oceanology

Richard Spieler, Professor  
PhD, Louisiana State University

James D. Thomas, Professor  
PhD, Florida Institute of Technology

Alexander Yankovsky, Assistant Professor  
PhD, Marine Hydrophysical Institute

### **2.3. Oceanographic Center Staff**

Bart Baca, Director of Aquaculture  
PhD, Texas A&M University

Damien Chapman, Research Assistant  
National Science Foundation Graduate Student Fellowship

Melissa L. Dore, Administrative Coordinator  
Institute of Marine and Coastal Studies

Jane Dougan, Distance Education Coordinator

Brian Ettinger, Research Assistant, Assistant Harbormaster  
MS, Nova Southeastern University

Daniel Fahy, Research Assistant

Carol Fretwell, NCRI Operations Coordinator

David Gilliam, Research Scientist  
PhD, Nova Southeastern University

Elizabeth Glynn, Research Assistant

Heather Halter, Research Assistant  
MS, Nova Southeastern University

Kevin Helmle, Research Assistant  
MS, Nova Southeastern University

Marcy Henning, Clerical

Erin Hodel, Research Assistant

Kevin E. Kohler, Senior Programmer/Coordinator  
MS, University of Miami

Ruth Lazarus, Administrative Officer

Kathleen Maxson, Manager of Library Services

Ryan Moyer, Research Assistant  
MS, Nova Southeastern University

Peggy Oellrich, Administrative Assistant

Laszlo Nemeth, Research Associate

T. Patrick Quinn, P.C. Computing Specialist  
MS, Nova Southeastern University

Vince Richards, Research Assistant

Bernhard Riegl, Research Scientist, National Coral Reef Institute  
PhD,

Lance Robinson, Harbormaster/Divemaster

Bernardo Vargas-Angel, Research Scientist, National Coral Reef Institute  
PhD, University of Miami

Jamie Vernacchio, Research Assistant

Brian Walker, Research Assistant  
MS, Nova Southeastern University

## **2.4. Oceanographic Center Adjunct & Affiliate Teaching Faculty**

Brion Blackwelder, JD  
Nova Southeastern University, Shepard Broad Law Center

Jane Dougan, MS  
Nova Southeastern University, Oceanographic Center

Nancy J. Gassman, PhD  
Broward County Department of Natural Resource Protection

Richard Grosso, JD  
Nova Southeastern University, Shepard Broad Law Center

Phil Light, PhD, Palm Beach Community College

Mark Farber, PhD, University of Miami

Donald McCorquodale, PhD  
Spectrum Laboratories, Inc., Fort Lauderdale, Florida

Julian P. McCreary, PhD  
University of Hawaii

Stacy Myers, MS  
South Florida Water Management District, Lake Worth, Florida

Bernhard Riegl, PhD  
Nova Southeastern University, Oceanographic Center

Keith Ronald, PhD

Steffen Schmidt, PhD,  
Iowa State University

Scott Shatz, OD, PhD  
Nova Southeastern University, Health Professions Division

William Venezia, PhD  
US Naval Surface Warfare Center, Fort Lauderdale, Florida

Marianne Walch, PhD  
US Naval Surface Warfare Center, Fort Lauderdale, Florida

Alan Watson, PhD  
University of Guelph, Canada

## **2.5. Oceanographic Center Honorary Adjunct & Affiliate Faculty**

James Bohnsack, PhD  
NOAA/National Marine Fisheries Service  
Miami, Florida

Guy Harvey, PhD  
University of the West Indies

Stephen Hess, PhD  
E.R.M. South, Inc.  
Miami, Florida

Anthony Knap, PhD, Bermuda Biological Station

Robert B. Long, PhD,  
Retired from NOAA/AOML  
Miami, Florida

Dennis W. Moore, PhD, NOAA/PMEL  
Seattle, Washington

Jeffrey Proehl, PhD, Dartmouth College

Thomas Sleeter, PhD, Bermuda Government

Steven Somerville, M.P.A.  
Broward County Office of Natural Resource Protection

Carmello Tomas, PhD, University of Rhode Island

### **3. CURRENT RESEARCH ACTIVITIES**

#### **3.1. Physical Oceanography**

##### **Dynamics of Three-Dimensional Thermohaline Circulations**

The dynamics and parameter sensitivity of the steady-state thermohaline circulation and meridional heat transport in rotating basins of water, such as the Atlantic Ocean, are being investigated. Understanding steady-state circulation is a prerequisite for predicting future ocean-atmosphere equilibrium states that result from changes in parameters such as atmospheric carbon dioxide concentration, as well as insight into oscillating departures from equilibrium.

##### **Ecosystem Modeling**

The annual cycle of biological activity in the Arabian Sea is under study. Modelers are attempting to illustrate some of the fundamental interactions between biology and the physical environment in the region. In particular, the effect of mixed-layer diurnal variability on biological activity is being assessed.

##### **El Niño Southern Oscillation (ENSO) and other circulation studies**

Relatively new and emerging ideas about the stability of dynamical systems are being used to examine the onset and development of ENSO episodes in the tropical Pacific Ocean, using coupled ocean-atmosphere models. These same ideas are being used to understand the predictability of ENSO phenomena. Work along these same lines is underway to investigate the factors that limit the predictability of ocean currents, such as the Gulf Stream. Other areas of interest include modeling of stochastically driven recirculating flows in the coastal zone.

##### **Effects of Salinity in the Indian Ocean**

Researchers are using a numerical model to study the effects of salinity variations on circulations throughout the Indian Ocean. Influences caused by precipitation, river outflow (like the Ganges River), the Indonesian Throughflow, and the generation of salty Persian Gulf and Red Sea waters are studied.

##### **Pacific Circulation and Interannual Variability**

Previous work on links between the Equatorial Undercurrent (EUC) and subtropical circulation is being exploited to investigate interdecadal modulation of El Niño.

##### **Sea State Response to Wind Forcing**

Wave research focuses on developing techniques for studying the evolution of sea state (temperature, flow rate, direction) in response to forcing by wind. The techniques include a computer model of these evolving states, and telemetering instrumentation to monitor the wave and wind fields over a semi-enclosed region of the Bahama Banks.

### **The Tsuchiya Jets (TJs)**

A numerical model is being developed to study the TJs, two subsurface currents located about 500 km on either side of the equator at depths ranging from 200 to 500 km. The source waters of the TJs appear to be the South Pacific Ocean, but it is not known where they eventually go. The goal of this project is to simulate the TJs in a numerical solution, to diagnose their causes in the solution, and to understand their role in the Pacific general circulation.

### **3.2. Faculty & Associates in Physical Oceanography**

Faculty members at the Oceanographic Center who are involved in active research on the above topics include:

*Sean Keenan, Assistant Professor:* studies tropical ocean currents, mesoscale and submesoscale eddies and instabilities, the response of the upper ocean to wind events, and investigates their relationships to the atmosphere and climate.

*Alexander Soloviev, Associate Professor:* Primary interests are in research of turbulence in the wave-enhanced surface layer of the ocean, spatial anisotropy of wind stress effects in the warm pool area, and parameterization of the air-sea gas exchange.

*Alexander Yankovsky, Assistant Professor:* Studies wind- and buoyancy-driven currents on the continental shelf and slope, their meso-scale variability and adjustment to realistic shelf topography. He addresses these problems both in terms of numerical modeling and observational data analysis.

### **3.3. Marine Biology/Geology/Chemistry**

#### **Aquaculture**

This program focuses primarily on research and training in the culture of marine shrimp and tilapia. A series of seminars and short courses, as well as literature reviews, identify research needs in the field, which are then addressed by organized expansion of the facilities

#### **Chemistry**

Studies address the design and development of chemical instrumentation and methodologies employed in the measurement of industrial and environmental samples. The major emphasis is on methods employing spectroscopic techniques. This includes the development of software and determination of physical constants associated with the chemical analyses. Currently the emphasis is on the spectroscopic measurement of oceanic pH. Other constituents are also being investigated that can be tied into the same instrumentation package.

#### **Coral Growth Rate**

The growth rate of corals is preserved in the form of annual growth bands (visible by X-radiography) in the coral skeleton. Corals can grow to large size and reach ages greater

than 100 years. Applications of a long chronology of coral growth rings include reconstruction of past climate changes or of environmental factors that have influenced reef health over long periods.

### **Coral Reef Assessment and Restoration**

Method development and applications are currently being studied to better describe, assess, and restore coral reefs. Many of these important geological structures are currently under severe stress from natural and man-induced perturbations. Pollution investigations include evaluation of the effects of ship groundings, oil spills, and beach renourishment dredging. These studies have implications for the protection and restoration of coral reefs.

### **Fishes**

Diverse research studies on fishes are currently under way, including natural history, functional morphology, larval fish recruitment, artificial reef functions, stress response in elasmobranchs, and aquaculture. This research is both applied and basic in nature.

### **Macrobenthic Community Ecology**

Current studies examine the effects of dredging and beach renourishment on estuarine and coastal soft-bottom communities of marine invertebrates, and provide a baseline for understanding spatial and long-term temporal variations in community composition and diversity.

### **Marine Chemistry/Biochemical Oceanography**

Method development and applications are currently being studied on the dynamics of dissolved carbohydrates in the sea and their relationship with the microbial plankton in local waters and the open ocean. Marine bacteria are an extremely important, but little understood group. Valuable baseline data are being collected to improve understanding of the oceanic ecosystem. Techniques for determining primary production by the oxygen method also are being investigated.

### **Marine Mammals**

Annotated referenced marine mammal projects will be accepted for capstone paper credit. This includes a full survey of all relevant literature on the management, physiology, functional anatomy, and intra- and interspecific interactions of cetaceans, pinnipeds, sirenids, and polar bears.

### **Marine Microbial Ecology**

Studies focus on the ecology of the eukaryotic microbes (the protists) that play a major role in the cycling of carbon and nutrients in coastal waters. One group in particular, the amoeboid protozoa, are being investigated because these inconspicuous protists are often overlooked in ecological studies. Current research areas include the design of effective enumeration methods for amoebae, elucidation of their ecological role, and the identification of novel isolates.

### **Molecular Marine Biology**

Molecular techniques are being applied to study the ecology, conservation, population biology, evolution, and management of aquatic organisms. The structure and function of specific genes in marine organisms, and their molecular-level adaptations to environmental conditions are being investigated.

### **Paleoceanography**

Studies are related to biomineralization, fossil microfauna, and paleoclimate reconstruction. Biomineralization studies utilizing electron microscopy are related to calcification in marine invertebrates. Examination of marine microfauna in the Gulf of Mexico and Florida Bay are current focuses. Paleoclimate studies utilizing floral and faunal assemblages have included reconstruction on time scales from the Pleistocene to the last century.

### **The Role of Man in the Environment**

Studies are under way to deal with the potential impacts of human population growth in the coastal southeastern United States. Research includes restoration ecology, fisheries, impact abatement in estuaries, aquaculture, and the linking of science, policy, and management.

### **Sea Turtle Conservation**

The Broward County sea turtle project provides for the conservation and improved understanding of endangered and threatened loggerhead, green, and leatherback sea turtles. During the nesting season, beaches are surveyed, and most nests are carefully excavated and moved to designated relocation sites, primarily in order to prevent hatchling loss due to their disorientation by coastal lights on highly urbanized beaches.

### **Systematics and Ecology of Crinoidea**

Crinoids have a long fossil record and remain important components of many deep and shallow marine environments. Current studies use stalked crinoids, or sea lilies, as models for better understanding the ecology and taphonomy of their ancient counterparts. Systematic investigations of both sea lilies and unstalked crinoids, or feather stars, attempt to better understand both their phylogeny and the relationship between form and environmental conditions.

### **Tropical Marine Biodiversity**

Amphipod crustaceans are the dominant mesobenthic component in reef systems worldwide. Their poorly known taxonomic status constrains their use in more sophisticated ecological investigations. Amphipods are important micrograzers and converters of organic material and are a primary prey source for fish. The interaction of the mesobenthic community regulates a number of trophodynamic processes in reefs, the exact mechanisms of which are poorly understood. This research module is intended to

advance the level of knowledge in amphipod taxonomy and systematics and to explore the processes and dynamics of the mesobenthic coral reef community.

## **Wetlands**

Wetlands research centers around mitigation, a process of creating or restoring wetlands to compensate for losses due to rock mining or various types of development. Researchers study freshwater and estuarine wetlands to evaluate the productivity and ecology of natural versus created or restored habitats. Results of this research continue to be important to understanding the proper use and management of our wetlands.

### **3.4. Faculty in Marine Biology/Geology/Chemistry**

Faculty members at the Oceanographic Center currently involved in active research on the above topics include:

*Patricia Blackwelder, Associate Professor:* A marine biogeologist studying calcification and distribution of marine microfauna that are important in marine food chains and also provide a historical record of past climate changes through their shell incorporation into marine sediments.

*Curtis Burney, Associate Professor:* A marine ecologist studying the relationship of dissolved nutrients and marine microbes, especially bacteria, on which marine food chains ultimately depend.

*Veljko Dragojlovic, Associate Professor:* A chemist studying natural products (isolation, characterization and synthesis of natural products); synthetic organic chemistry, in particular in the development of new synthetic methodology and application of photochemistry to organic synthesis; organic geochemistry (structure elucidation of insoluble organic materials).

*Richard E. Dodge, Professor:* A marine biogeologist concentrating on coral reefs and constituent reef-building corals to understand and assess the effects of pollution and climatic change.

*Joshua Feingold, Assistant Professor:* A marine ecologist concentrating on effects of disease on coral populations, impact and recovery of coral populations in the Galapagos Islands following disturbances associated with the El Niño-Southern Oscillation, and comparisons of coral populations on natural and artificial substrata in coastal waters.

*Edward Keith, Associate Professor:* A marine mammalogist whose research is in the structure, function, and evolution of milk and tear proteins; physiological ecology of terrestrial and marine mammals; molecular phylogenetics and evolution of marine mammals; and the mathematical and computer modeling of complex biological systems.

*Charles Messing, Professor:* A zoologist specializing in invertebrates, he is studying the ecology and systematics of crinoids as well as macroinvertebrate communities.

*Andrew Rogerson, Professor:* **NEED Blurb HERE...**

*Mahmood Shivji, Associate Professor:* A marine biologist using molecular genetic techniques to investigate various aspects of fish and marine mammal biology. Areas of research interest include conservation biology, biodiversity, evolution, molecular ecology, and population biology.

*Richard Spieler, Professor:* An ichthyologist studying fish chronobiology, artificial reefs, and habitat assessment.

*James Thomas, Professor:* A marine invertebrate taxonomist studying the systematics, distributional ecology, and ecology of coral reef amphipods. Especially interested in evolutionary scenarios of marine invertebrates as they relate to identifying centers of evolutionary diversification in coral reef systems worldwide.

## **4. Graduate Educational Programs**

### **4.1. ADMISSION**

#### **4.1.1. Application**

Application forms for admission may be requested from the Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, Florida 33004-3078 (phone: 954-262-3600). Applications must be completed and returned to the following address:

Enrollment Processing Services  
Attn: Oceanographic Center  
3301 College Avenue  
PO Box 299000  
Ft. Lauderdale, FL 33329-9905

along with a \$50 nonrefundable application fee. Prospective students may apply at any time during the year. All correspondence pertaining to admission should be addressed to the Oceanographic Center. It is the responsibility of the applicant to obtain the supporting documents required for application.

For international students, the student I-20 visa may be issued only upon completion of all admission requirements. Therefore, international students are urged to be sensitive to requirements prior to applying to the program. For more information regarding procedures for obtaining a student visa, please contact the Office of International Students:

Nova Southeastern University  
Attn: Office of International Students  
3301 College Avenue  
Fort Lauderdale, Florida 33314  
Phone: (954)262-7241 or 1-800-541-6682 x7241 (long distance)  
Email: [intl@nova.edu](mailto:intl@nova.edu)

#### **4.1.2. Acceptance Status**

Students are accepted under one of three classifications: full, full with academic requirements, and special status.

- Full acceptance is given upon satisfying all acceptance criteria (stated below).

- Full acceptance with academic requirements is given to students who have not satisfied all of the criteria, but who have given evidence that they may succeed in the degree program.
- Special student status is reserved for non-degree-seeking students. While this status may be preliminary to full acceptance, enrollment in, and satisfactory completion of, courses do not guarantee admission to any program. Special students are limited to 2 in house classes.

When application is complete, students will be notified of the status under which they may register. For acceptance with academic requirements, conditions for the student to convert to full status will be given. Once these requirements are met, the student should petition to change to full status in a written statement. This should be accomplished within one year of entry into the program.

#### **4.1.3. PhD and MS Acceptance Criteria**

For PhD applicants, previous degree(s) should be in the area of mathematics (for physical oceanography) or an appropriate area of the natural sciences (for marine biology). A master's degree in oceanography, biology or marine biology, or a related science is preferred, especially for the biological sciences PhD

PhD applicants should have obtained agreement from a faculty member to serve as major professor. For the biological sciences, PhD applicants should have a completed draft dissertation proposal that is submitted with the application. The proposal content will be a major factor in acceptance.

Applicants for admission to degree programs leading to the MS degree must meet certain requirements. As a general rule, they must hold baccalaureate degrees from regionally accredited institutions.

The table on the previous page lists full and provisional admissions/acceptance criteria for the PhD degree in oceanography and the MS programs in marine biology, coastal zone management, marine environmental sciences, and the joint MS programs.

Applicants may be fully or provisionally accepted only if they meet at least the minimum guidelines. For full acceptance, at least two of the three criteria (GPA, GRE, and letters) must be met satisfactorily. If applicants do not make minimum provisional guidelines, the applications may be rejected out of hand and not circulated through the Admissions Committee.

#### **4.1.4. Registration**

It is the student's responsibility to register *prior to* the beginning of class. This is done at the either online at or at Oceanographic Center Program Office. First time students must register on paper with the Oceanographic Center. From then on students may register online. Payment is due upon registration. NSU accepts major credit cards, checks, money orders, and financial aid. MS students pay tuition each term for their courses, according to the number of credit hours taken. PhD students pay a flat rate per term.

##### **4.1.4.1 Online Registration (Webstar)**

The Oceanographic Center offers the opportunity to register online. The web address for the online system is. This feature will allow students to register, update addresses, look at financial aid standings, and view transcripts anytime day or night. Once accepted into the program, students are mailed PIN numbers. If you need to receive a PIN, or if you have misplaced your PIN, you can contact the PIN Specialist by calling (954) 262-4850 (local) or 1-800-541-6682 x4850 (long distance) between 8:30 a.m. and 5:00 p.m. weekdays or via email at pinhelp@nova.edu. They will then mail the PIN. Once you have your PIN, feel free to checkout the online information site at. Incoming students will still be required to register at the program office.

**PLEASE NOTE: NSU Full-time Employees must register by paper at the program office at all times.**

#### **4.1.4.1. MS**

**Capstone Review:** Once the capstone review paper proposal has been approved, MS capstone review students register for the first of two three-credit capstone courses (OCMB-7000, CZMT-0701 or MEVS-5026). It is desirable that students should complete their capstone review paper during the two terms of registration. If the capstone review paper is not finished after completion of the minimum number of required capstone review credits (6), the MS student continues registration for three additional credits in each subsequent term until the capstone review paper is finished. The capstone review paper is expected to be completed no later than the second term of registration. Permission for registration into the third term must be granted in writing from program administration.

**Thesis:** Once the thesis proposals have been approved, MS thesis students sequentially register for and complete a minimum of three thesis research credits (OCMB-6900, CZMT-0681, or MEVS-5028) in each succeeding term until the thesis is complete. It should be noted that while a minimum of nine-thesis research credits are required, more than this number are usually necessary for the completion of MS research.

Sequential registration continues until the thesis is finished. If a MS thesis student fails to register for any given term without approval, missed credits must be made up before graduation, usually during the next term of registration.

#### **4.1.5.2. PhD**

PhD students pay full tuition while in active status, that is, taking courses, finalizing the proposal, performing research, and writing the dissertation. The minimum activity requirement is three years, but the typical activity requirement for a student with an in-field master's degree is more than three years. Once PhD activity has begun, registration is sequential each term. PhD candidates must register for at least nine credits per term to qualify for active status. Full tuition for each term must be paid. Failure to register for a particular term without prior written approval is not permitted and may signal the student's resignation from the degree program.

While refining and compiling the dissertation in final form after successful defense, the PhD student pays tuition at only one half of the normal rate. Successful defense is

defined as the passing of the thesis, with no revisions or only very minor revisions, by the dissertation committee and the Oceanographic Center faculty.

#### **4.1.6. Transfer Credit Policy**

MS students may transfer up to six credits of previous graduate course work. Course work must replicate Oceanographic Center offerings in the major field of interest or must clearly be closely related. Students should submit requests for transfer credits in writing; with documentation indicating the subject matter and that the transfer credits were of graduate level from accredited institutions. This can consist of the course syllabus, transcripts, and/or the course description from the professor.

PhD students may transfer up to 30-graduate course credits from prior graduate programs in the same discipline as the PhD degrees aspired to. Transfer courses must be either reasonable duplicates of courses offered at NSU or clearly in the applicable PhD field of interest.

Transfer acceptability for both the MS and PhD programs will be decided by the director of the Institute of Marine and Coastal Studies.

#### **4.1.7. Transferability of Credits**

Credits earned at Nova Southeastern University are transferable only at the discretion of the receiving school.

### **4.2. TIME LIMITS**

The time limit for completion of the MS program is five years. Students must petition the program office in writing for an extension of the time limit, which may be granted only under extenuating circumstances.

PhD students are expected to complete the program in nine years, a minimum of three years of which must be in residence. Students must petition the program office in writing for an extension of the time limit, which may be granted only under extenuating circumstances.

The NSU residency is defined as full-time enrollment for a period of at least one year. The university recognizes that individual programs require differing time limits for the completion of academic studies leading to a degree. Therefore, the time frame is a discretionary matter within each academic program.

### **4.3. TUITION AND FEES**

#### **4.3.1. Tuition and Fees: SUMMER 2003**

Application Fee	\$50
Registration Fee (per term)	\$25
Degree Application Fee	\$75
Incomplete Fee	\$15
Late Registration Fee	\$50
MS Tuition Credit	\$525/cr.hr.

MS Tuition Audit	\$262.50/cr.hr.
PhD Tuition	\$14,328/yr. or \$3,582/term

The late registration fee is charged when payment is received by the school beyond the closing date for registration. This closing date is the Friday of the first week of classes in a particular term. The incomplete fee is charged when a student receives an "incomplete" grade for a particular course (regular or thesis/capstone review credits). To avoid receiving an automatic "incomplete" (I) for thesis/capstone review credits, all students must submit progress reports prior to the last date of the term.

#### **4.3.2. Withdrawal and Refunds**

MS students may withdraw from a course at any time before the fourth class meeting and receive a partial refund. A request for tuition refund must be made in writing at the time of withdrawal. Refunds will be made solely at the option of the university and will be based on the legitimacy of the reason for withdrawal. If granted, refunds are adjusted as follows:

Before the second class meeting	75%
Before the third class meeting	60%
Before the fourth class meeting	50%
Thereafter	0%

Refunds are not granted to PhD students upon withdrawal.

Students have three working days from the date of signing an enrollment contract or financial agreement with the university to cancel the contract and receive a full refund of any tuition and registration fees paid. Further, a student shall receive a full refund of tuition and registration fees paid by the student prior to the commencement of instruction if the student submits a written request to the institution within three working days of the payment. Refund schedules for tuition and fees after the commencement of instruction may be found above.

#### **4.3.3. Leaves of Absence**

##### **4.3.3.1. MS Program**

Students do not have to register for course work sequentially in each subsequent term. If a student anticipates a hiatus of one term or longer between registrations for course work, the program office should be notified. Note, however, that once capstone review paper or thesis registration has begun, but has not been finished, continuous registration each term for a minimum of three credits is required. Failure to register for capstone or thesis credits during a given term without an approved leave of absence is not permitted and may signal a student's withdrawal from the degree program.

A leave of absence for one or more terms may be granted if a student must interrupt thesis research or capstone review paper studies. In order to obtain a leave of absence, the

student must request and justify the leave of absence in writing to the program administrator(s) and major professor well prior to the desired absence. Reentry into the MS program after a leave of absence should be requested in writing and is not guaranteed.

#### **4.3.3.2. PhD Program**

Students are expected to register for course or thesis work sequentially in each subsequent term. A leave of absence for one or more terms may be granted if a student must interrupt his/her studies. In order to obtain a leave of absence, the student must request and justify the leave of absence in writing to the program administrator(s) and major professor. Reentry into the PhD program after a leave of absence is not automatic or guaranteed and must be requested and justified in writing.

### **4.4. MS PROGRAM**

#### **4.4.1. Capstone Review/Thesis**

There are two tracks for MS students to follow: the capstone review paper track and the thesis track. All dual track students initially fall within the capstone review track. The capstone review paper track requires formal course work and a paper (an extended literature review of an approved subject). The thesis track requires formal course work and a research thesis. The completed capstone paper or thesis is defended before the student's advisory committee. Entrance into the thesis track is not automatic and can be made only after consultation with and approval by the student's major professor, advisory committee, and program administration. Approval requires preparation of an acceptable thesis proposal.

#### **4.4.2. Credit-Hour Requirements**

Individual MS degrees (marine biology, coastal zone management, marine environmental sciences): The capstone review requires a minimum of 45 total credits, including 13 three-credit courses, a six-credit capstone review paper, and extra capstone review continuation credits as necessary. The thesis track requires a minimum of 39 total credits, including at least 10 three-credit courses, a minimum of nine credits of master's thesis research, and extra thesis research credits as necessary.

The joint marine biology and coastal zone management; marine biology and marine environmental sciences; and coastal zone management and marine environmental sciences major: The capstone review track requires a minimum of 57 total credits, consisting of five core (OCOR) courses, and six courses from each of two specialties chosen from the three available, and a six-credit capstone review paper. Additional capstone review paper credits are taken as necessary. The thesis track requires a minimum total of 51 credits consisting of five core (OCOR) courses, nine specialty courses chosen from two of the three specialties: marine biology (OCMB), coastal zone management (CZMT), or marine environmental sciences (MEVS), and a minimum of nine thesis credits. Additional thesis credits are taken as necessary.

#### **4.4.3. Program of Studies**

Course lists and descriptions are given elsewhere in this section. An updated schedule of available courses for the marine biology, coastal zone management, and marine environmental sciences majors is included in the catalog as an insert or may be obtained from the program office.

**Five core courses are required in either major and for the joint major:**

OCOR-5601	Concepts in Physical Oceanography <i>or</i> *
OCOR-5607	Physical Oceanography*
OCOR-5602	Marine Ecosystems
OCOR-5604	Marine Geology
OCOR-5605	Marine Chemistry
OCOR-5606	Biostatistics

\*Either Physical Oceanography course may count as a CORE class.

**For the marine biology major, the normal courses include:**

OCMB-5606	Plankton Ecology
OCMB-6085	Taxonomy of Marine Invertebrates
OCMB-6086	Invertebrate Zoology
OCMB-6100	GIS & Environmental Remote Sensing (*) (+)
OCMB-6220	Biology of Sharks
OCMB-6230	Marine Ichthyology
OCMB-6315	Marine Biodiversity (*) (+)
OCMB-6321	Wetlands Ecology (*) (+)
OCMB-6325	Deep-Water Ecology of the Straits of Florida (+)
OCMB-6340	Marine Mammals (+)
OCMB-7012	Coral Reef Ecology (*)
OCMB-7013	Molecular Marine Biology (+)
OCMB-7015	Coral Reef Geology and Evolution
OCMB-8100	Ecology of Belize Barrier Reef
OCMB-8150	Ecology of the Great Barrier Reef
OCMB-8500	Scientific Writing (*) (+)
OCMB-9700	Scientific Diving and Coral Reef Assessment

(\*) Also available for the coastal zone management major.

(+) Also available for marine environmental sciences major.

**For the coastal zone management major, the normal courses include:**

CZMT-0603	Law and the Coastal Zone
CZMT-0609	Principles of Coastal Zone Management
CZMT-0610	Dry Coastal Ecosystems
CZMT-0613	Environmental Policy
CZMT-0621	Environmental Regulation
CZMT-0622	Water Resource Impacts
CZMT-0634	Oil Pollution Effects (*) (+)

CZMT-0639	GIS & Environmental Remote Sensing (*)(+)
CZMT-0645	Environmental GIS
CZMT-0665	Coral Reef Ecology (*)
CZMT-0675	Environmental Conflict (+)
CZMT-0680	Conservation Biology (+)
CZMT-0685	Marine Biodiversity
CZMT-0687	Coastal Ecology
CZMT-0690	Tropical Marine Fish Ecology (*)
CZMT-0790	Aspects of Marine Pollution
CZMT-0791	Wetlands Ecology (*)(+)
CZMT-0800	Scientific Writing
CZMT-0807	Aquaculture (*)(+)
CZMT-0808	Marine Botany(*)
CZMT-0810	Aquaculture Systems (*)(+)

(\*) Also available for the marine biology major.

(+) Also available for the marine environmental sciences major.

**For the marine environmental sciences major, the normal courses include:**

MEVS-5000	Tropical Marine Fish Ecology (*)
MEVS-5005	Aquaculture (*)(+)
MEVS-5007	Coral Reef Ecology
MEVS-5009	Conservation Biology (+)
MEVS-5010	Deep Water Ecology of the Straits of Florida (*)
MEVS-5011	Wetlands Ecology (*)(+)
MEVS-5012	Dry Coastal Ecosystems (*)(+)
MEVS-5016	Oil Pollution Effects (*)(+)
MEVS-5017	Marine Mammals (*)
MEVS-5018	Marine Environmental Policy
MEVS-5020	Coastal Water Resources
MEVS-5023	GIS & Remote Sensing (*)(+)
MEVS-5035	Environmental Conflict
MEVS-5100	Aspects of Marine Pollution (+)
MEVS-5105	Marine Biodiversity (*)(+)
MEVS-5110	Introduction to Marine Environmental Sciences
MEVS-5115	Marine Botany (*)(+)
MEVS-5140	Molecular Marine Biology (*)
MEVS-5300	Scientific Writing (*)(+)

(\*) Also available for the marine biology major.

(+) Also available for the coastal zone management major.

For the joint marine biology and coastal zone management; marine biology and marine environmental sciences; and coastal zone management and marine environmental sciences majors, the choice of courses includes those listed above for the individual specialties.

Since the “normal” curriculum may not exactly suit an individual student’s career goals, interests, or research needs, some program flexibility may be provided in the form of elective courses and courses from a specialty other than the one in which the student is enrolled. Permission for program flexibility must be given in writing by program administrators. Such course flexibility is limited to one or (in extreme cases) two courses. It is stressed that any deviation from the normal program must be done carefully and with approval of a program administrator and the major professor (if selected). The applicability of the elective course must be justified and approved prior to registration. Failure to do this risks non-approval of the course for program credit after the fact. This can delay a student’s progress.

#### **4.4.4. Distance Education**

##### **4.4.4.1 Graduate Certificate in Coastal Studies**

The Institute of Marine and Coastal Studies at the Oceanographic Center, Nova Southeastern University, offers a distance learning Graduate Certificate in Coastal Studies. This is awarded upon successful completion of any four Oceanographic Center distance-learning courses at the graduate level. Successful completion of the Graduate Certificate will award the equivalent of 12 graduate credits.

##### **4.4.4.2 Program of Study – Distance Education**

Course lists and descriptions are given elsewhere in this section. An updated schedule may be found at.

CZMT-0687	Coastal Ecology: Implications for Management
CZMT-0612	Coastal Policy
CZMT-0667	Coastal Zone Interpretation
CZMT-0677	Coastline Environmental Security: new perspectives on threats to the natural environment.
CZMT-0645	Environmental GIS
CZMT-0655	Environmental Remote Sensing
CZMT-0665	Environmental Sustainability: Choices for the Future
CZMT-0614	International Integrated Coastal Zone Management
CZMT-0664	Internship in Coastal Policy (available year round upon approval of Supervising Professor)
CZMT-0630	Life on a Water Planet: Challenges for the new millennium
CZMT-0675	Resolving Environmental and Public Disputes
CZMT-0710	WATER: Cross-cultural, Scientific and Spiritual Perspectives
OCMB-6330	Marine Mammal Management
OCOR-5604	Marine Geology
OCOR-5606	Biostatistics

##### **4.4.4.3. Distance Education Withdrawal and Refunds**

MS students may withdraw from a course at any time before the fourth class meeting and receive a partial refund. A request for tuition refund must be made in writing at the time of withdrawal. Refunds will be made solely at the option of the university and will be based on the legitimacy of the reason for withdrawal. If granted, refunds are adjusted as follows:

Before the second class week	75%
Before the third class week	60%
Before the fourth class week	50%
Thereafter	0%

Students have three working days from the date of signing an enrollment contract or financial agreement with the university to cancel the contract and receive a full refund of any tuition and registration fees paid. Further, a student shall receive a full refund of tuition and registration fees paid by the student prior to the commencement of instruction if the student submits a written request to the institution within three working days of the payment. Refund schedules for tuition and fees after the commencement of instruction may be found above.

#### **4.4.5. Academic Activities and Approvals**

##### **4.4.5.1. Advising**

Incoming MS students may be assigned temporary academic advisors, depending upon the stated goals in their application packages. Students should consult their advisors or program administration for questions about their MS programs.

##### **4.4.5.2. Orientation**

A mandatory orientation session is held every fall for incoming students and may be held at other times for groups of incoming students to inform them about center facilities and about the MS program requirements.

##### **4.4.5.3. Suggested Activities Timelines**

The following approvals and activities are essential for proper progress toward the degree:

- Follow normal curricula. If changes are desired, formalize a program of studies in consultation with program administration. Accomplish before completion of 12th program credit.
- Select major professor. Discuss, examine, and evaluate capstone review paper/thesis topics. Accomplish before 39th/30th course credit (depending on capstone or thesis track).
- Select capstone review paper /thesis topic, get topic approval, and form advisory committee. Accomplish before 39th/30th course credit (depending on capstone or thesis track).
- For topic/proposal development under guidance of the thesis or capstone review paper, students are required to enroll for directed independent study if the

development effort is expected to be greater than three weeks. The number of credits would typically be a minimum of three for each term of activity.

- Submit capstone review paper proposal and outline to major professor and (provisional) committee. Accomplish before first term of capstone review registration.
- Upon approval of capstone review paper proposal, commence capstone review registration (minimum three credits); if not complete at the end of initial term, register for three capstone review continuation credits/term thereafter). Accomplish before expiration of time limit (five years).
- Submit thesis proposal and outline to major professor and (provisional) committee. Upon approval, commence Thesis registration (three thesis credits per term until minimum is achieved; three thesis credits/term thereafter). Accomplish before first term of capstone review paper/thesis registration.
- Continue thesis registration on each following term and complete degree requirements. Accomplish by or before expiration of time limit (five years).

#### **4.4.6. Capstone Review/Thesis Requirements**

##### **4.4.6.1. Proposal**

Commencement of the MS capstone review paper or the thesis may begin only after the MS student has an approved proposal. Students not yet having approved thesis/capstone review topics or proposals, but desiring to prepare them under guidance, should register for directed independent study credits (OCMB-0796, CZMT-0775, MEVS-5025; 3 cr.).

*Develop the topic.* The student should develop the idea, discuss with faculty and major professor, or investigate a new aspect of an existing research program. The major professor is a source of ideas, help, and direction, but the project must be taken beyond the conceptual stage by the student.

*Obtain approval of the tentative topic.* The explicit procedure is that the student approaches a potential major professor and obtains agreement for consideration of the student's proposal. The potential major professor may form a provisional committee that includes at least one other center faculty member. Proposal drafts will be reviewed by the major professor and committee. If this process is anticipated to take more than several weeks, the student must be registered for three directed independent study credits during the process.

*Write the proposal.* Start in the library. The student should review the current literature to determine how the problem relates to previous work and to assess its feasibility and significance. For a literature review, the student should obtain an idea of the quantity of information available (breadth of topic) and any previous reviews of the subject. For the proposal, the review should be thorough but need not be fully and completely developed. Any proposal submitted without evidence of a literature search will be rejected out of hand. Any proposal with poor English, spelling, and format will be rejected out of hand. The proposal should be as well written and as complete as possible. It should not be submitted as a draft needing extensive editorial changes, but rather as the student's best effort toward a finished product.

A proposal draft will be reviewed by the major professor and provisional committee. The student may meet and discuss issues with the professor and committee. The major

professor makes a final decision as to whether the proposal is acceptable and files a report with the program office. If acceptable, thesis/capstone review work may begin, directed by the major professor and committee.

The proposal should consist of the following elements:

- Title of the proposed thesis/capstone review paper
- Statement of the problem, hypothesis to be tested, or topic to be reviewed
- Statement of the significance of the work
- Capstone review paper: A detailed outline of the topic to be intensively reviewed, along with the preliminary literature review
- Thesis: A description of the methodology to be used Literature should be cited where applicable with enough detail that the methodology can be understood without going to the literature. Experimental design is very important. The expected results should be provided, and any required facilities and funding should be listed, with their availability.
- References/Bibliography

#### **4.4.6.2. Committee Composition**

**Capstone review:** The capstone review committee will consist of at least two members, one of which must be a faculty member of the Oceanographic Center. Members of the committee must ordinarily have the terminal degree.

**Thesis:** The thesis advisory committee will consist of a major professor from the Oceanographic Center faculty and at least two additional members, one of whom may be from another center of Nova Southeastern University or from outside the university. The committee participates in topic selection and preparation of the proposal/outline and thesis. Close coordination between student and committee during this process is strongly advised.

#### **4.4.6.3. Report of Progress (per term)**

This report is absolutely required from each student registered for thesis credits, the capstone review paper, or capstone review continuation credits by the end of each term of registration. The report will include the following information:

- A brief narrative statement of progress since the last report
- Estimated percentage completion
- Estimate of time spent on this term
- For research thesis: details of all experiments conducted and literature reviewed; include all data collected in graphic or tabular form. This may be discussed orally with the major professor, but should also be reported in writing
- A current bibliography of all pertinent literature references consulted
- A list of problems experienced (if any)

#### **4.4.6.4. Contents**

**Capstone review:** The capstone review paper is to be considered an extended term paper in a format generally similar to that of the more formal thesis. The paper is soft-cover bound using the Oceanographic Center Library approved cover (see center librarian) and should be presented in good wordprocessed, laser-printed quality. Three copies are required: one for the library, one for the MS program office, one for the major professor. The paper should contain at minimum:

- Title page
- Table of Contents (detailed outline, using outline headings in text, same format)
  1. Introduction
  2. Statement of Purpose or Objectives
  3. Methods
  4. Results or Review
  5. Summary and Conclusions
  6. References

The text (excluding tables and figures) of the capstone review paper normally should be longer than 45 pages.

**Thesis:** The thesis should contain the following sections:

- Title page (see end of handbook for standard form)
- Approval page (see end of handbook)
- Abstract
- Acknowledgments
- Preface (optional)
- Table of Contents - (detailed; this serves as the outline and section headers as well)
- Body of Thesis (see Style Options)
  1. Introduction
  2. Statement of Purpose or Objectives
  3. Methods and Materials (if applicable)
  4. Results
  5. Discussion
  6. Summary and Conclusions
  7. References
  8. Appendices (optional)

#### **4.4.5.5. Time Guidelines**

The capstone review paper topic and proposal must be submitted to and approved by program administrators prior to capstone review course registration. Committee members should be identified prior to registration.

After course registration the following schedule and deadlines are in effect for the capstone review paper.

Within four weeks after the start of the term, submit to program administrators and advisor a draft of the paper abstract (summary), a draft introduction, a detailed outline, and a representative bibliography. This should be word processed, laser-printed, and as

clearly written as possible. Great care should be taken by the student to use appropriate style, syntax, grammar, spelling, etc. A draft in poor form will be returned unread to the student for revisions. Committee members should be listed along with the topic.

Within eight weeks from the start of the term, submit a first draft of the full paper. This should be word processed and laser-printed, comprehensive, and as well-written as possible. This draft will be reviewed by the committee, discussed with the student, and returned for revisions, as appropriate.

Before the end of the term, submit a defensible draft of the paper and schedule the defense. The defense date should be cleared initially with the committee and confirmed by program administrators. A copy of the defensible draft also should be submitted to program administrators at this time.

If the above deadlines are ignored during the term of registration, the student will be administratively withdrawn from the capstone review paper course (OCMB-7000/CZMT-0701/MEVS-5026). Registration must again be undertaken in a subsequent term.

If a good-faith effort has been made but the paper has not been submitted or needs revisions, the student will register for three capstone review continuation credits in the following term (OCMB-7010/CZMT-0702/MEVS-5027). Completion means that the paper has been submitted and fully approved by the committee. The student should allow at least two weeks for committee review of submitted drafts. If the paper has already been defended, the committee may or may not elect to have a second oral “defense”; however, the final paper must be completely acceptable and judged so by the committee prior to the end of the term of registration. If the student is not administratively withdrawn, he/she will receive an "I" grade for the capstone review paper until it is complete.

#### **4.4.6.6. Style**

**Capstone review:** The student uses a manuscript format applicable to library research and term papers. A table of contents must be provided, which is then expanded into major topics and divided with subtopics. No further guidelines are given, in order to allow some flexibility. A scientific journal format will be acceptable.

**Thesis:** The required editorial style for a thesis reporting lab or field research can be obtained from an appropriate scientific journal in the field (selected with approval of the major professor). Each journal publishes a list of guidelines to authors. The thesis is written as a journal article but with more methodological detail and raw data than would normally be published. The intent is to prepare the thesis in a form that can be pared down and submitted for publication.

A left-hand margin of one-and-a-half inches is essential. Final copies of theses with a left-hand margin less than one-and-a-half inches will be rejected. This is necessary to prevent loss of text during binding. All other margins should be one inch. Word processing should be neat and clean and laser-printed. Dot matrix or inkjet printing is unacceptable. For the final copies, paper must be of good quality, acid-free, 20 percent cotton (rag) bond. Erasable bond and heat-sensitive paper for thermal printers are absolutely forbidden. Right margins should be even, not ragged.

#### **4.4.6.7. Rough Drafts/Committee Inspection**

Rough draft copies of the thesis submitted to committee members prior to the defense must be complete, containing figures and tables with legends and a bibliography. The draft must be double-spaced and should be in good form. It must not be missing parts essential to a proper evaluation, especially the data. A complete and detailed outline should be included with all drafts.

Figures need not be in final drafted form but they must be legible. For the standard form, individual chapters may be submitted for reading if they are complete in themselves with a bibliography.

Students should expect major revisions by the committee (editorial or otherwise), especially in the first drafts. Several drafts are usually necessary before the final form is achieved. The use of a word processor will save much time and effort at this stage.

#### **4.4.6.8. Defense**

On completion of the capstone review paper or thesis to the major professor's satisfaction, it is formally submitted to the other committee members. Upon agreement of the committee members, defense is scheduled at least two weeks later for the thesis and one week later for the capstone review paper. For very long works, this time period must be extended to provide the committee adequate time for reading.

The capstone defense will optionally consist of a private defense with the committee or a public defense. For the private defense, requirements include a 10- to 15-minute presentation to the committee, followed by questions and discussion. Center faculty may also attend. For the public defense, requirements include a 30- to 50-minute oral presentation (with appropriate visual aids) to the faculty, student body, and other interested persons. The public defense is mandatory for the thesis option. The committee then will question the candidate in private on the thesis work and related aspects. This private session is closed and limited to the candidate, members of the committee, and interested faculty members. The committee then takes a vote in closed session. The capstone review paper or thesis may be accepted, accepted with revision, or rejected.

The Oceanographic Center faculty ultimately must pass on acceptability. The student should consult frequently with the committee during all phases of Thesis work for continuity and in order to avoid problems during the formal defense. If the paper is not acceptable, the student receives the grade of "F" for the course. If the paper and defense are acceptable, the student receives a grade of "P". If the paper is acceptable, but requires only minor corrections, the student may receive a grade of "P" when the corrected paper is received. In this case, the paper must be received within one week of the defense. The student will be informed of the committee's decision following the closed defense.

All MS thesis defenses must be scheduled at least two weeks in advance and all MS capstone review paper defenses must be scheduled at least one week in advance through the Institute of Marine and Coastal Studies. Notice will be provided to the faculty. At least two weeks prior to scheduled thesis defenses and one week prior to scheduled capstone review paper defenses, a copy of the work must be submitted to and reside in the program office. This defensible copy must be complete, including, for example, all relevant materials, appendices, figures, and data tables. The copy (or reproductions thereof) will be available for review to any interested faculty member. Incomplete works will not be acceptable for defense. If the defensible copy is not submitted in time, the

defense will be rescheduled. Once the defensible copy is submitted, additional revisions should not be made or circulated prior to the defense.

#### **4.4.6.9. Final Submission**

At least three signed copies of the successfully defended capstone review paper/thesis, including any revisions specified during the defense, must be submitted in correct form to the Oceanographic Center librarian for binding. The cost of binding is the student's responsibility.

One bound copy will be placed in the library, one is for the student's major professor, and one is for the program office. The student may submit any number of additional personal copies for binding.

#### **4.4.6.10. Sample Cover and Approval Sheets**

Students should seek sample cover and approval sheets from the library or the program office.

#### **4.4.7. Course Descriptions**

The permission of the instructor or program administrator is a prerequisite for all courses.

### **CORE CURRICULUM:**

**OCOR 5601 Concepts in Physical Oceanography**/3 credits. Introduction to how wind, radiation, gravity, friction, and the Earth's rotation determine the ocean's temperature, salinity patterns, and currents. Conceptual models (geostrophy, Ekman transport, Rossby waves, etc.) explain physical features of the ocean ranging from microscopic to global circulation. Prerequisite: algebra. Students are required to take either this course or OCOR-5607 as a core course.

**OCOR 5602 Marine Ecosystems**/3 credits. A study of the major plankton, nektonic, and benthic groups and associations, including their diversity, distribution, metabolism, production, trophic relationships, and ecological roles, with emphasis on coastal communities.

**OCOR 5604 Marine Geology**/3 credits. The origin, form, and resources of the ocean basins and continental margins, including discussion of seafloor spreading; trenches and island arcs; mountain building; coral reefs and atolls; sedimentation; ocean mining; coastal morphology; and the impact of wave action and human activities on beaches, coasts, continental shelves, and submarine canyons.

**OCOR 5605 Marine Chemistry**/3 credits. A study of the properties, composition, and origin of seawater; the importance, distribution, relationships, and cycling of the major inorganic nutrients, dissolved gases, trace metals, and organic compounds; and the use of radiotracers for water mass dating.

**OCOR 5606 Biostatistics**/3 credits. This is a basic course on the practical applications of descriptive and inferential statistics with emphasis on principles and methods of summarizing and analyzing biological data. Measures of central tendency, dispersion, and variability testing will be discussed along with basic concepts of probability distributions, hypothesis testing, and decision making. Topics will also include simple

statistical tests, analysis of variance (ANOVA – single classification, nested and two-way), linear regression, and correlation.

**OCOR-5607 Physical Oceanography/3 credits.** This course covers basic ocean physics with a focus on the large scale circulation of the oceans and their relation to weather and climate. Topics include: the physical properties of seawater, temperature and salinity structure of the oceans, major current patterns, waves and tides, influences of the wind, El Nino and tropical oceanography, and some relations to climate. This course should be appropriate for students interested in a global view of physical oceanography. Students are required to take either this course or OCOR-5601 as a core course.

## **ADDITIONAL COURSES:**

**OCMB 0796 Directed Independent Study/3 credits.** Directed study in aspects of marine biology. May be used, under special circumstances, for completion of capstone review paper.

**OCMB 5606 Plankton Ecology/3 credits.** Traditionally, plankton have been dealt with under two broad headings: phytoplankton and zooplankton. While this categorization is useful, it does not reflect current research emphasis of the smaller members of the plankton community; bacteria (picoplankton) and the grazing protozoa (nanoplankton). This course will deal with these smaller members of the plankton community. Plankton Ecology will begin with a summarization of the plankton environment in lakes, oceans, and estuaries. It will continue with the essential aspects of the biology and physiology of bacteria and protozoa. It will finish with the exploration the functional role of these organisms within aquatic ecosystems.

**OCMB 6070 Marine Botany/3 credits.** Morphology, life histories, taxonomy, physiology, and ecology of multicellular marine phototrophs, including algae, seagrasses, and mangroves.

**OCMB 6085 Taxonomy of Marine Invertebrates/3 credits.** Systematics and ecology of marine invertebrates with an emphasis on shallow-water species of the tropical Western Atlantic. Field work and a self-paced laboratory are integral to the course.

**OCMB 6086 Invertebrate Zoology/3 credits.** This is a basic invertebrate zoology course including introductory anatomy, physiology, phylogeny, and ecology of major animal phyla from protozoa through echinoderms, with emphasis on marine organisms. Includes laboratory sessions.

**OCMB 6120 Tropical Marine Fish Ecology/3 credits.** Study of the ecology of tropical fish, including coastal, estuary, mangrove, and pelagic fish. Current theories on distribution and abundance are discussed in addition to ecological theory.

**OCMB 6200 Aquaculture/3 credits.** Designed to survey the field of aquaculture, this course will provide direct, practical, hands-on training in the latest methods of commercial shrimp, fish, and other animal culture. Course work includes activities with live animals in each life- history stage, and instruction in hatchery design and management; culture of larval foods; larval culture techniques; stocking and growout; disease and problems; sourcing of breeders; and maturation; as well as marketing and finances. Modern and classical methodologies will be discussed. Emphasis is on species from the United States and abroad, including catfish, tilapia, shrimp, and clams.

**OCMB 6205 Aquaculture Systems/3 credits.** This course covers the engineering and mechanics of both freshwater and marine aquaculture systems. Students will study the major aquaculture methods for food species and aquarium hobby culture, including system design and construction. Students will learn to use aquaculture materials such as fiberglass, PVC, and concrete. Systems studied will include indoor, recirculating, outdoor, high intensity, tank culture, and pond culture, and the aeration, water treatment, and filtration components of these systems. Course lectures will be supplemented by field trips to representative facilities and one-week internships at operating facilities.

**OCMB 6220 Biology of Sharks/3 credits.** Sharks have long held the fascination of humans, with resulting exploitation by the media to capitalize on this interest. Regrettably, a severe lack of understanding of the biology and natural history of sharks has resulted in numerous misconceptions about these fishes, and traditionally little attention to management and preservation of sharks as integral components of marine ecosystems. With increasing commercial and recreational fishing of sharks and the realization that these fishes may need to be managed using different strategies than used for teleost fishes, there is now tremendous interest worldwide in researching and understanding the biology of sharks. This course will cover fundamental aspects of the biology of sharks, including systematics, evolution, reproduction, behavior, genetics, migration, conservation, fisheries management, and field research techniques. When possible, the course will be offered in a field setting to allow students the opportunity to observe the practice of field research with these charismatic animals.

**OCMB 6230 Marine Ichthyology/3 credits.** Topics include the systematics, ecology, behavior, and resource management of marine fishes, with emphasis on the inshore fishes of the tropical Atlantic. A self-paced laboratory and some field work are integral to the course.

**OCMB 6315 Marine Biodiversity/3 credits.** Diversity of life on earth is now being dramatically & irreversibly altered and reduced by human activities. Because so many species are still undescribed, and the ecological roles of those that have been named are so poorly understood, the magnitude of these changes is difficult to evaluate. The course will discuss multiple aspects of marine biodiversity including: definition and importance of marine biodiversity to marine conservation issues; threats to marine biodiversity including non-indigenous species introductions; impediments to marine conservation; scientific constraints; developing tools and forums for conserving marine biodiversity, and evaluating existing marine biodiversity initiatives currently in place and planned. Management approaches such as marine protected areas, no-take or completely protected reserves, and special management areas will be discussed and evaluated. The course will consist of assigned readings, extensive discussions and panel participation, review of latest developments in marine biodiversity research and conservation, and preparation of several review and planning documents. In the course, students will also incorporate emerging scientific information from taxonomy, systematics, [both morphological and molecular methods] and evolutionary theory at both macro and micro scale processes as it impacts and effects marine biodiversity. While all marine systems will be considered, the course will focus specifically on tropical marine ecosystems, especially coral reefs.

**OCMB 6321 Wetlands Ecology/3 credits.** Basic ecology of coastal (marine and fresh water) wetlands, followed by intensive field work in the identification, delineation, and evaluation of these wetlands. Students learn to identify wetland indicator species and visit

area wetlands to learn agency delineation techniques based on vegetation, soils, and hydrology. Evaluation of the functions of the wetlands is taught using the Adamus and other methods. Some field work is required.

**OCMB 6325 Deep-Water Ecology of the Straits of Florida**/3 credits. This course consists of three successive intensive weekend sessions. The first consists of a lecture series that introduces physicochemical, geological and biological aspects of the Florida Current and Straits of Florida, a history of investigation of the area and the instrumentation employed. The second consists of two days of shipboard work that includes physicochemical analyses of the water column (e.g., temperature, salinity, dissolved oxygen), and sampling plankton, mid-water and benthic faunas in ~50-400 m. In the third session students sort and identify collections and analyze organism distributions relative to abiotic environmental factors. The laboratory will be available during the week as well. Students take written and practical examinations on the fourth weekend.

**OCMB 6340 Marine Mammals**/3 credits. This course provides an overview of the anatomy, biomedicine, evolution, husbandry, natural history, pathology, and physiology of the cetaceans, pinnipeds, sirenians, and allies. The course consists of lectures, laboratory exercises, field trips, and a research paper.

**OCMB 6900 Master's Thesis Research (Marine Biology)**/3 credits each. Research and thesis preparation. No more than nine credits toward the MS degree may be applied. Requires prior consultation with major professor and submission of an approved thesis proposal.

**OCMB 7000 Capstone Review Paper**/3 credits. An extended literature review of a subject approved by the student's advisory committee. The paper should demonstrate proficiency in library research, organization, and writing.

**OCMB 7012 Coral Reef Ecology**/3 credits. General ecology of corals and coral reefs. Includes discussion and description of distribution, abundance, and physiology of corals and coral reef animals. The effects of important natural and anthropogenic events and causes are described. Emphasis is given to coral reefs of the Caribbean and the Florida Keys.

**OCMB 7013 Molecular Marine Biology**/3 credits. This course covers theoretical and laboratory aspects of recombinant DNA techniques as applied to ecological, evolutionary, and physiological investigations of marine organisms.

**OCMB 7015 Coral Reef Geology and Evolution**/3 credits. Throughout earth history, bioconstructions, reefs being the most noticeable, have been focal points of organismal evolution which is recorded in the fossil record as well as the growth fabrics and lithologies of the reef rocks. Organism-environment, and environment-sedimentology feedbacks create distinct signatures that allow us to gain detailed insight into the ecological functioning of reef communities long gone since and the environment they lived in – if only we can make the rocks talk.

**OCMB 8100 Ecology of the Belize Barrier Reef**/3 credits. A field course to be held at South Water Caye, Belize. This course will be an intensive hands-on learning experience at the magnificent barrier reef system of Belize. We will spend a majority of our time actually diving on the reef and waters of the lagoon and back reef. Students will experience firsthand the great natural biodiversity of the pristine reef system of Belize. Registration is open to undergraduate science majors, graduate students, and to others by

permission of instructor. Prerequisites: Invertebrate zoology, marine ecology, or equivalent.

**OCMB 8150 Ecology of the Great Barrier Reef/3 credits.** This is an intensive, academically focused course designed for advanced undergraduate and graduate students. Students will travel to Australia and stay at a pristine Great Barrier Reef location, Orpheus Island Research Station. In addition to the two weeks spent at the reef, students will travel to other Natural World Heritage sites on land to further investigate land-based connections to the Great Barrier Reef ecosystem. These areas include the Daintree River area, Atherton Tablelands, Kuranda, a small community nestled deep in the rainforest north of Cairns, and Ingham, located in the sugar district north of Townsville.

**OCMB 8500 Scientific Writing/3 credits.** This course is designed to provide tools, resources, and approaches to improve a student's ability to write in a scientifically precise and accurate manner and to interrelate complex conceptual issues in a coherent manner. The skills acquired while learning to write a grant proposal are very similar to the skills needed to write a project plan or scientific paper. Thus, by building grant-writing skills, general scientific writing skills are improved in equal measure. This course is an intensive introduction of how to prepare, write, edit, and review a standard grant proposal. Participants in this course will be expected to write a grant proposal in their field of interest as a class project. Proposal writing is essential in the competitive scientific job market, but it can be intimidating for the novice. There is nothing worse than staring at a blank piece of paper or computer screen with the sinking feeling that so much is riding on the prose you must create. This course will provide the tools and procedures to write and submit a competitive grant proposal. Participants in this course will be expected to be motivated and willing to improve their written and verbal communication skills. There will be an abundant writing load and outside class assignments.

**OCMB 9700 Scientific Diving and Coral Reef Assessment/3 credits.** This course is designed to provide continuing SCUBA diving education and teach basic scientific diving techniques especially as applied to coral reef assessment. Upon successful completion of the course, the student will be a certified Scientific Diver in the NSU OC Scientific Diving Program. In addition, the student will have the opportunity to acquire higher recreational PADI certifications including: Advanced Open Water Diver, Rescue Diver, and several other specialty certifications.

**CZMT 0603 Law and the Coastal Zone/3 credits.** General instruction in legal fields and in selected environmental sciences, combined with in-depth study of administration of maritime industries and coastal activities. Focuses on the regulation of marine and maritime pursuits that pertain to the coastal zone and adjacent territorial waters.

**CZMT 0609 Principles of Coastal Zone Management/3 credits.** Management of coastal resources, based on the principles and techniques of a diverse array of disciplines, discussed in terms of a balanced coastal strategy. Practical solutions to conflicts of use, especially those of coastal zone protection versus land, mineral, and water development practices, are studied in relation to their impact on the coastal resource base.

**CZMT 0610 Dry Coastal Ecosystems/3 credits.** A comprehensive review of coastal drylands comprising dune strands, barrier beaches, old dunes, hammocks, and the sub-maritime fringe. The complexities and subtleties of ecological relationships and the importance of organic resources in this zone are emphasized.

**CZMT 0613 Environmental Policy/3 credits.** This course deals with the current governmental policies that affect the environment. Discussions will center specifically on those policies that affect the needs of the earth's biota and society. The course also addresses the recent changes in environmental policies that relate to human health risk, ecological risk, and economics. Specific concepts reviewed include ecological integrity, economic growth, carrying capacity, biodiversity, ecosystem health, resilience, and sustainability.

**CZMT 0621 Florida Environmental Regulation/3 credits.** A study of the organizational structure and operation of Florida state, county, and local environmental regulatory agencies.

**CZMT 0622 Coastal Water Resource Impacts/3 credits.** This course is oriented toward a systems analysis of the multiple uses that shape the coastal zone. Emphasis is on the multiple uses of the coastal zone and their associated impacts. In addition, the current "balancing" of development, and environmental protection policies of state and federal government and how these policies have affected the coastal environment, are discussed. The course not only deals with specific environmental problems but also analyzes the problems and prospects of effective planning, technical management, regulation, and legislation used for managing the coastal environment.

**CZMT 0634 Oil Pollution Effects/3 credits.** This course focuses on the impact of petroleum hydrocarbons on natural and human environments. The course is designed to provide a background in petroleum chemistry, natural resources, and human resources at risk; the effects and fate of spilled hydrocarbons; relevant regulations; and spill contingency planning. Data are drawn from recent publications in petroleum and environmental research, from case studies of actual spills, and from various contingency plans. Students have the opportunity to participate in a spill drill, study recent spill sites, review area contingency plans, and use computer-generated (geographic information systems) maps for oil spill response.

**CZMT 0639 GIS and Environmental Remote Sensing/ 3 credits.** This course provides hands-on training with the latest techniques in geographic information systems and remote sensing. Course work includes lecture and hands-on computer training. Areas covered (utilizing both ERDAS Imagine 8.3 and ESRI Arcview 3.0) include: GIS/remote sensing theory, image georeferencing and mosaicking, image enhancement and classification procedures, accuracy assessment procedures, importing GPS polygons, establishing database and multimedia hotlinks, importing tables, joining, building queries, charting and map creation. Instruction will be centered on application of these techniques to actual environmental case studies.

**CZMT 0655 Coral Reef Ecology/3 credits.** General ecology of corals and coral reefs. Includes discussion and description of distribution, abundance, and physiology of corals and coral reef animals. The effects of important natural and anthropogenic events and causes are described. Emphasis is given to coral reefs of the Caribbean and the Florida Keys.

**CZMT 0690 Conservation Biology/3 credits.** Conservation Biology will provide an introduction to the role of science in the conservation of animals and plants. There will be three major goals for the course. First, the course lectures and text readings will provide a rigorous introduction to the motivation for, methods of, and major challenges

facing contemporary conservation biology. Second, the lectures and laboratories will seek to enhance each student's understanding of the scientific process and thus the potential and limitations of science as a tool in addressing contemporary social problems. Finally, and most fundamentally, readings from primary and secondary literature sources will be selected to further develop skills in critical analysis. The content of course lectures will focus on an introduction to the scientific study and analysis of biodiversity; a survey of the major threats to biodiversity; an overview of contemporary conservation strategies and an analysis of recent and historic success and failures in conservation efforts.

**CZMT 0681 Master's Thesis Research (Coastal Zone Management)/2 credits.** Research and thesis preparation. Normally no more than six credits toward the MS degree may be applied. Requires prior consultation with the major professor and submission of an approved thesis proposal.

**CZMT 0690 Tropical Marine Fish Ecology/3 credits.** Study of the ecology of tropical fish, including coastal, estuary, mangrove, and pelagic fish. Current theories on distribution and abundance are discussed in addition to ecological theory.

**CZMT 0701 Capstone Review Paper/3 credits.** An extended literature review of a subject approved by the student's advisory committee. The paper should demonstrate proficiency in library research, organization, and writing.

**CZMT 0702 Capstone Review Continuation Credits/ 1-3 credits each.** These credits are necessary to complete the capstone review paper (coastal zone management).

**CZMT 0775 Directed Independent Study (DIS)/ 3 credits.** Directed Independent Study courses are offered each term on an elective basis. This triad in the course sequence is reserved for student internships in the work-study program. Students working off campus will be directed by on-site adjunct professors, counselors, or thesis mentors, but must report to the program professor. A term paper or progress report is required by the end of each term.

**CZMT 0790 Aspects of Marine Pollution/3 credits.** Deals with various forms of environmental pollution as they affect both the land and maritime environment. Sources, measurement, and control of pollution in marine and coastal environments are discussed.

**CZMT 0791 Wetlands Ecology/3 credits.** Basic ecology of coastal (marine and fresh water) wetlands, followed by intensive field work in the identification, delineation, and evaluation of these wetlands. Students learn to identify wetland indicator species and visit area wetlands to learn agency delineation techniques based on vegetation, soils, and hydrology. Evaluation of the functions of the wetlands is taught using the Adamus and other methods. Some field work is required.

**CZMT 0807 Aquaculture/3 credits.** Designed to survey the field of aquaculture, this course will provide direct, practical, hands-on training in the latest methods of commercial shrimp, fish, and other animal culture. Course work includes activities with live animals in each life-history stage, and instruction in hatchery design and management; culture of larval foods; larval culture techniques; stocking and growout; disease and problems; sourcing of breeders; and maturation, as well as marketing and finances. Modern and classical methodologies will be discussed. Emphasis is on species from the United States and abroad, including catfish, tilapia, shrimp, and clams.

**CZMT 0808 Marine Botany/3** credits. Morphology, life histories, taxonomy, physiology, and ecology of multicellular marine phototrophs, including algae, seagrasses, and mangroves.

**CZMT 0810 Aquaculture Systems/3** credits. This course covers the engineering and mechanics of both freshwater and marine aquaculture systems. Students will study major aquaculture methods for food species and aquarium hobby culture, including system design and construction. Students will learn to use aquaculture materials such as fiberglass, PVC, and concrete. Systems studied will include indoor, recirculating, outdoor, high-intensity, tank culture, and pond culture, and the aeration, water treatment, and filtration components of these systems. Course lectures will be supplemented by field trips to representative facilities and one-week internships at operating facilities.

**MEVS 5000 Tropical Marine Fish Ecology/3** credits. Study of the ecology of tropical fish, including coastal, estuary, mangrove, and pelagic fish. Current theories on distribution and abundance are discussed in addition to ecological theory.

**MEVS 5005 Aquaculture/3** credits. Designed to survey the field of aquaculture, this course will provide direct, practical, hands-on training in the latest methods of commercial shrimp, fish, and other animal culture. Course work includes activities with live animals in each life-history stage, and instruction in hatchery design and management; culture of larval foods; larval culture techniques; stocking and growout; disease and problems; sourcing of breeders; and maturation, as well as marketing and finances. Modern and classical methodologies will be discussed. Emphasis is on species from the United States and abroad, including catfish, tilapia, shrimp, and clams.

**MEVS 5007 Coral Reef Ecology/3** credits. General ecology of corals and coral reefs. Includes discussion and description of distribution, abundance, and physiology of corals and coral reef animals. The effects of important natural and anthropogenic events and causes are described. Emphasis is given to coral reefs of the Caribbean and the Florida Keys.

**MEVS 5009 Conservation Biology/3** credits. Conservation Biology will provide an introduction to the role of science in the conservation of animals and plants. There will be three major goals for the course. First, the course lectures and text readings will provide a rigorous introduction to the motivation for, methods of, and major challenges facing contemporary conservation biology. Second, the lectures and laboratories will seek to enhance each student's understanding of the scientific process and thus the potential and limitations of science as a tool in addressing contemporary social problems. Finally, and most fundamentally, readings from primary and secondary literature sources will be selected to further develop skills in critical analysis. The content of course lectures will focus on an introduction to the scientific study and analysis of biodiversity; a survey of the major threats to biodiversity; an overview of contemporary conservation strategies and an analysis of recent and historic success and failures in conservation efforts.

**MEVS 5010 Aquaculture Systems/3** credits. This course covers the engineering and mechanics of both freshwater and marine aquaculture systems. Students will study major aquaculture methods for food species and aquarium hobby culture, including system design and construction. Students will learn to use aquaculture materials such as fiberglass, PVC, and concrete. Systems studied will include indoor, recirculating,

outdoor, high-intensity, tank culture, and pond culture, and the aeration, water treatment, and filtration components of these systems. Course lectures will be supplemented by field trips to representative facilities and one-week internships at operating facilities.

**MEVS 5011 Wetlands Ecology/3 credits.** Basic ecology of coastal (marine and fresh water) wetlands, followed by intensive field work in the identification, delineation, and evaluation of these wetlands. Students learn to identify wetland indicator species and visit area wetlands to learn agency delineation techniques based on vegetation, soils, and hydrology. Evaluation of the functions of the wetlands is taught using the Adamus and other methods. Some field work is required.

**MEVS 5012 Dry Coastal Ecosystems/3 credits.** A comprehensive review of coastal drylands comprising dune strands, barrier beaches, old dunes, hammocks, and the sub-maritime fringe. The complexities and subtleties of ecological relationships and the importance of organic resources in this zone are emphasized.

**MEVS 5016 Oil Pollution Effects/3 credits.** The focus of this course is the impact of petroleum hydrocarbons on natural and human environments. The course is designed to provide a background in petroleum chemistry, natural resources, and human resources at risk; the effects and fate of spilled hydrocarbons; relevant regulations; and spill contingency planning. Data are drawn from recent publications in petroleum and environmental research, from case studies of actual spills, and from various contingency plans. Students have the opportunity to participate in a spill drill, study recent spill sites, review area contingency plans, and use computer-generated (geographic information systems) maps for oil spill response.

**MEVS 5017 Marine Mammals/3 credits.** This course provides an overview of the anatomy, biomedicine, evolution, husbandry, natural history, pathology, and physiology of the cetaceans, pinnipeds, sirenians, and allies. The course consists of lectures, laboratory exercises, field trips, and a research paper.

**MEVS 5018 Environmental Policy/3 credits.** This course deals with the current governmental policies that affect the environment. Discussions will center specifically on those policies that effect the needs of the earth's biota and society. The course also addresses the recent changes in environmental policies that relate to human health risk, ecological risk, and economics. Specific concepts reviewed include ecological integrity, economic growth, carrying capacity, biodiversity, ecosystem health, resilience and sustainability.

**MEVS 5020 Coastal Water Resource Impacts/3 credits.** This course is oriented toward a systems analysis of the multiple uses that shape the coastal zone. Emphasis is on the multiple uses of the coastal zone and their associated impacts. In addition, the current "balancing" of development and environmental protection policies of state and federal government and how these policies have affected the coastal environment are discussed. The course not only deals with specific environmental problems but also analyzes the problems and prospects of effective planning, technical management, regulation, and legislation used for managing the coastal environment.

**MEVS 5023 GIS and Environmental Remote Sensing/3 credits.** This course provides hands-on training with the latest techniques in geographic information systems and remote sensing. Course work includes lecture and hands-on computer training. Areas covered (utilizing both ERDAS Imagine 8.3 and ESRI Arcview 3.0) include: GIS/remote sensing theory, image georeferencing and mosaicking, image enhancement and

classification procedures, accuracy assessment procedures, importing GPS polygons, establishing database and multimedia hotlinks, importing tables, joining, building queries, charting and map creation. Instruction will be centered on application of these techniques to actual environmental case studies.

**MEVS 5100 Aspects of Marine Pollution/ 3 credits.** Deals with various forms of environmental pollution as they affect both the land and maritime environment. Sources, measurement, and control of pollution in marine and coastal environments are discussed.

**MEVS 5110 Introduction to Environmental Sciences/ 3 credits.** Interested in learning about the ways of the world? This course is introductory in nature and will appeal to students wanting to learn more about ecological and environmental issues. Its introductory nature makes it inappropriate for students who already have degrees in ecology or environmental science. Part A of the course will focus on ecosystems, how they work and how they maintain a delicate balance in terms of energy transfer and material cycling. Part B will address man's activities and examine how these are threatening the stability of ecosystems in general. Topics examined will include eutrophication, pollution and global warming. Part C will focus on the resources afforded by our ecosystems and will look at ways to responsibly manage these resources. Topics will include biodiversity, waste disposal, and the promise of biotechnology.

#### **4.4.8. Distance Education course descriptions**

**CZMT 0687 Coastal Ecology: Implications for Management/3 credits.** The course provides a thorough synthesis of the physical processes in relation to biological functioning in near-shore environments. Course elements include consideration of: introductory level coastal oceanography and adaptations of marine organisms, principles for understanding the ecological structure and dynamics of coastal marine communities, ecological descriptions of major coastal marine ecosystems, and scientific principles relating to management and decision-making processes.

**CZMT 0612 Coastal Policy/3 credits.** This web-based distance education course explores the issues, problems, and potential political and public policy solutions to the challenges of achieving smart, sustainable stewardship of the seashores. Primary emphasis is on the United States experience. Students read two outstanding books and participate in on- line activities including original case studies, on-line tests, and selected interactive discussion with each other, the professor, and guests.

**CZMT 0667 Coastal Zone Interpretation/3 credits.** This course can best be described as an applied course that helps you explore communication and experiential learning theories and their application to natural heritage (nature) interpretation and environmental education program design. You will also develop and present interpretive materials and a program within the context of the nature interpretation in the coastal zone environment. Throughout our lives we often find ourselves in situations where we interpret nature to others. Think of the number of times a parent interprets aspects of nature to a child, or you interpret the area in which you live to a visitor. Indeed, commenting on a beautiful sunset is an interpretation of nature. Just what is the definition of nature interpretation? What theories support nature interpretation? Is interpretation a science or an art? How can we develop our skills as interpreters? How can we apply interpretive techniques in

our daily lives and careers? This course aims at providing opportunities for you to find answers to these and other questions.

**CZMT 0677 Coastline Environmental Security: new perspectives on threats to the natural environment/3 credits.** In the post-September 11, 2001 global theatre there is a widely-held perception of new threats facing democratic societies. Traditional terrorist targets include human assets such as political leaders and foreign diplomatic staff; physical assets such as aircraft, buildings, factories, and power stations; and institutional assets such as legislatures and courts of law. We seek here to expand the notion of threat beyond these traditional determinants to include the coastal environment, domestically and internationally.

**CZMT 0645 Environmental GIS/3 credits.** Increasingly, work in coastal zone management requires at least a passable knowledge of Geographic Information Systems (GIS) and Remote Sensing. This course provides hands on training with the latest GIS and Remote Sensing techniques. This web-based course includes interactive hands on computer training and lesson based web instruction. Areas covered by the Environmental GIS course includes: GIS Theory, Importing GPS Polygons, Establishing Database and Multimedia Hot links, Importing Tables, Joining, Building Queries, Creating ArcIMS sites, Charting and Map Creation. Class instruction will focus on application of these tools and techniques to actual environmental case studies/projects.

**CZMT 0655 Environmental Remote Sensing/3 credits.** Increasingly, work in coastal zone management requires at least a passable knowledge of Geographic Information Systems (GIS) and Remote Sensing. This course provides hands on training with the latest GIS and Remote Sensing techniques. This web-based course includes interactive hands on computer training and lesson based web instruction. Environmental Remote Sensing deals with the application of image processing tools to environmental problems. Areas covered by these courses include: Remote Sensing Theory, Type of Imagery, Mosaicing, Photo Interpretation, Image Enhancement and Classification Procedures, Accuracy Assessment Procedures, and Importing GPS Polygons. The course will also provide you with: Basic and Advanced Skills to utilize the latest in Remote Sensing Software by ERDAS, Inc., The necessary advanced training to apply these skills to environmental studies, The ability to apply these skills to "real world" regional and global environmental problems, Training in techniques that cannot be found in other online remote sensing courses. Class instruction will focus on application of these techniques to actual environmental case studies.

**CZMT 0665 Environmental Sustainability: Choices for the Future/3 credits.** This web-based distance education course highlights more than 25 years of international discussion, debate and ideas with regard to the state of the environment and our actions towards it. Key considerations and voices are included, from both North and South. This course examines in a cross-cutting approach the environmental and social issues that effect our lives. Students become part of an "international learning community", by participating in on-line closed discussion. The emphasis is on presenting an international range of perspectives and case studies, linking the issues and ideas to up-to-the-moment occurrences as they effect students, when they happen and wherever they are.

**CZMT 0614 International Integrated Coastal Zone Management/3 credits.** This web-based distance education course focuses on the international dimensions of integrated coastal zone management. Students will first examine the major "big picture" issues

affecting the world's coastal areas and oceans, and will examine seven case studies that will help to bring alive the grave problems of mismanaging coastal and economic resources: the Black Sea, Newfoundland, the Louisiana Region of the Gulf of Mexico, Belize, the Marshall Islands, and Antarctica. The second part of the course will provide students with the opportunity to study major international conferences, treaties, and policy principles (including the Law of the Sea). In the final third of the course, students will examine regional as well as selected country coastal-zone policies. Students completing this course will be familiar with the most important aspects of Integrated Coastal Zone Management globally and will have a basis for comparison of these policies. Students will also be in a position to assess the costs and benefits of different coastal zone management strategies around the world.

**CZMT 0664 Internship in Coastal Policy**/3 credits. Students enrolled in this course are expected to invest the equivalent of 3 hours per week for 12 weeks (i.e. at least 42 hours) in their internship. This can be done at a research organization, private company or consulting firm; local, county, state or federal agency; or other approved venue that is related to coastal zone activities. In addition to hands-on work, each intern will also keep an academic journal of internship activities. The journal will be submitted for review for the final grade. The student's supervisor at the internship venue will also evaluate the student. Permission and approval of supervising Professor is required before you enroll in this class.

**CZMT 0630 Life on a Water Planet: Challenges for the new millennium**/3 credits. Life on a Water Planet has four broad aims: (1) to provide a holistic and current perspective on key water issues that includes ecological, socio-economic, historical and cultural perspectives, together with consideration of the water needs of other species; (2) to provide a forum for sharing understandings and perspectives; (3) to help you shift your perception of our planet from "the earth" to "water"; (4) to encourage you to take information and knowledge about water issues from a broad base and apply it to your own community or individual situation. The course is organized into ten units which involve readings available as direct links with the course homepage, online activities and discussion, and optional web resources for further exploration and study.

**CZMT 0675 Resolving Environmental and Public Disputes**/3 credits. This course focuses on the theoretical bases, practical applications, process orientations, and actual intervention into complex multiparty, multi-issue public disputes regarding management of the coastal zone. The emphasis is on social/environmental interactions and sources of political and economic conflict over human health environmental protection and natural resource scarcity.

**CZMT 0710 WATER: Cross-cultural, Scientific and Spiritual Perspectives** /3 credits. This course will introduce students to the expanding international dialogue regarding water and the coastal zone that is now occurring amongst the scientific, interfaith and policy communities. We will consider and evaluate whether this may result in new understanding and a greater commitment towards our stewardship of water, and particularly the coastal environment.

**OCMB-6330 Marine Mammal Management**/3 credits. An interdisciplinary approach to examining the present state of the relationship between marine mammals, people and the environment: as this has evolved over time, as it stands today, and as it is likely to be for the future, whether by default or design. The marine mammal and environment

relationship is extremely complex and fluid. It changes depending upon place and time, and the rate of this change is accelerating along with related developments such as population and economic growth, technological capacity, and our expanding use of the world's oceans and waterways. We will look at the position and influence of marine mammals within the environment, as well as the development of physical conditions, values and economic activities that have led to their present situation.

**OCOR 5604 Marine Geology/3 credits.** The objectives of the course are (1) to enable students to examine the structure, evolution and stratigraphy of the ocean basins and continental margins, and (2) to provide an understanding of the dynamic processes that shape the surface of the earth under the ocean surface.

**OCOR 5606 Biostatistics/3 credits.** This is a basic course on the practical applications of descriptive and inferential statistics with emphasis on principles and methods of summarizing and analyzing biological data. Measures of central tendency, dispersion, and variability testing will be discussed along with basic concepts of probability distributions, hypothesis testing, and decision making. Topics will also include simple statistical tests, analysis of variance (ANOVA – single classification, nested and two-way), linear regression, and correlation.

## **4.5. PHD PROGRAM**

### **4.5.1. General and Credit-Hour Requirements**

There are two informal divisions within the PhD in Oceanography Program: marine biology and physical oceanography. The PhD degree requires a minimum of 90 credits beyond the baccalaureate. At least 48 credits must consist of dissertation research. At least 42 credits consist of upper-level course work. Required courses include the five MS core courses (Physical Oceanography, Marine Ecosystems, Marine Geology, Marine Chemistry, Biostatistics). Other upper-level course work usually consists of tutorial studies with the major professor. PhD courses are included at the end of this section. The student must successfully complete the PhD comprehensive examination and successfully defend the completed dissertation before the committee. The Oceanographic Center faculty has final approval of the dissertation.

### **4.5.2. Academic Activities and Approvals**

PhD students may transfer up to 30 graduate course credits from prior graduate programs in the same disciplines that the PhD degrees aspired to. Transfer courses must be either reasonable duplicates of courses offered at NSU or clearly in the applicable PhD field of interest. Transfer acceptability will be decided by the director of the Institute of Marine and Coastal Studies, the students' advisors, and the students' dissertation committees (if formed at entrance).

#### **4.5.2.1. Committee**

The student's PhD Committee consists of four people, at least three of who must be center faculty and one of who must be from outside the Oceanographic Center. The

committee monitors all phases of the candidate's progress. The committee is formed prior to acceptance or within two terms of admission.

#### **4.5.2.2. Comprehensive Examination**

The examination consists of written and oral phases. The written exams, taken on completion of formal course work, are administered by the major professor and consist of questions submitted by each committee member potential. The candidate is allowed an appropriate time to answer each member's questions. The entire exam takes at least three days. The student is informed of the results of the written examination within one week of completion. The student normally takes the oral examination within two weeks of this notification. The oral phase consists of questions concerning any aspect of marine science posed by each committee member during a joint meeting. The exam is chaired by the outside committee member and must be at least two hours in length. After the examination, the student will be excused and the committee will determine the outcome. The decision of the committee must be unanimous. A student failing either part may retake the exam once, typically two to six months after the first attempt.

#### **4.5.2.3. Academic Timetable and Milestones**

- Select major professor and submit tentative program of studies. Complete by or before admission (students are not admitted without prior agreement on a research topic with a faculty member).
- Prepare program of studies (with major professor). Complete by or before one term after admission.
- Take qualifying examinations (at option of major professor). Complete by or before one term after admission.
- Select formal dissertation committee. Complete before two terms after admission.
- Take comprehensive exams. Complete before one term of completion of formal course work, but not prior to one and one-half years after admission.
- Submit formal dissertation proposal and begin research. Complete proposal within one term after exams. The major professor and provisional committee will review the dissertation proposal draft. The student may meet and discuss issues with the professor and committee. The major professor makes a final decision as to whether the proposal is acceptable for presentation to the faculty. The faculty receives and reviews the proposal and vote upon acceptability. If acceptable, dissertation may begin, directed by the major professor and committee.

The dissertation proposal should consist of the following elements:

- Title of the proposed dissertation
- Statement of the problem, hypothesis to be tested, or topic to be reviewed
- Statement of the significance of the work
- A description of the methodology to be used. Literature should be cited where applicable with enough detail that the methodology can be understood without going to the literature. Experimental design is very important. The expected results should

be provided, and any required facilities and funding should be listed, with their availability.

- References/Bibliography

#### **4.5.2.4. Defense of Dissertation**

On completion of the dissertation to the major professor's satisfaction, it is formally submitted to the other committee members, and the defense is scheduled at least two weeks later. For very long works, this time period must be extended to provide the committee adequate time for reading.

The defense will consist of a 50-minute oral presentation (with slides/visual aids) to the faculty, student body, and other interested persons. The committee will then question the candidate on the thesis work and related aspects. This session is closed and limited to the candidate, members of the committee, and interested faculty members. The committee then takes a vote in closed session. The thesis may be accepted, accepted with revision, or rejected. The Oceanographic Center faculty ultimately must pass on acceptability. The student should consult frequently with the committee during all phases of thesis work for continuity and in order to avoid problems during the formal defense.

All PhD dissertation defenses must be scheduled at least two weeks in advance through the Institute of Marine and Coastal Studies. Notice will be provided to the faculty. At least two weeks prior to a student's scheduled defense, a copy of the work must be submitted to, and reside in, the program office. This defensible copy must be essentially complete, including, for example, all relevant materials, appendices, figures, and data tables. The copy (or reproductions thereof) will be available for review to any interested faculty member. Incomplete works will not be acceptable for defense. If the defensible copy is not submitted in time, the defense will be rescheduled.

#### **4.5.2.5. Final Submission of Dissertation**

At least three signed copies of the successfully defended dissertation, including any revisions specified during the defense, must be submitted in bound form to the Oceanographic Center librarian. The complete dissertation may be submitted to the librarian for binding or the student may elect to have this done elsewhere. The cost of binding is the student's responsibility.

The major professor is responsible for insuring that changes specified by the committee are incorporated in the final version. One bound copy will be placed in the library, one is for the student's major professor, one is for the program office. The student may submit any number of additional personal copies for binding.

#### **4.5.2.6. Progress (per term)**

This report is absolutely required from each student registered for thesis credits by the end of each term of registration. The report will include the following information:

- A narrative statement of progress since the last report, as well as the direction of the thesis work.
- Estimated percentage of completion.

- Estimate of time spent on dissertation work this term.
- A report of all experiments conducted and literature reviewed, including all data collected in graphic or tabular form. This may be discussed orally with the major professor, but it also should be reported in writing.
- A current or updated bibliography of all pertinent literature consulted.
- A list or discussion of any problems encountered.

#### **4.5.2.7. Sample Cover and Approval Sheets**

Students should seek sample cover and approval sheets from the library or the program office.

#### **4.5.3. PhD Course Descriptions**

In addition to specialized courses, PhD candidates register for OCGY-8000 (PhD Dissertation Research).

### **CORE CURRICULUM:**

**OCOR 5601 Concepts in Physical Oceanography**/3 credits. Introduction to how wind, radiation, gravity, friction, and the Earth's rotation determine the ocean's temperature, salinity patterns, and currents. Conceptual models (geostrophy, Ekman transport, Rossby waves, etc.) explain physical features of the ocean ranging from microscopic to global circulation. Prerequisite: algebra. Students are required to take either this course or OCOR-5607 as a core course.

**OCOR 5602 Marine Ecosystems**/3 credits. A study of the major plankton, nektonic, and benthic groups and associations, including their diversity, distribution, metabolism, production, trophic relationships, and ecological roles, with emphasis on coastal communities.

**OCOR 5604 Marine Geology**/3 credits. The origin, form, and resources of the ocean basins and continental margins, including discussion of seafloor spreading; trenches and island arcs; mountain building; coral reefs and atolls; sedimentation; ocean mining; coastal morphology; and the impact of wave action and human activities on beaches, coasts, continental shelves, and submarine canyons.

**OCOR 5605 Marine Chemistry**/3 credits. A study of the properties, composition, and origin of seawater; the importance, distribution, relationships, and cycling of the major inorganic nutrients, dissolved gases, trace metals, and organic compounds; and the use of radiotracers for water mass dating.

**OCOR 5606 Biostatistics**/3 credits. This is a basic course on the practical applications of descriptive and inferential statistics with emphasis on principles and methods of summarizing and analyzing biological data. Measures of central tendency, dispersion, and variability testing will be discussed along with basic concepts of probability distributions, hypothesis testing, and decision making. Topics will also include simple

statistical tests, analysis of variance (ANOVA – single classification, nested and two-way), linear regression, and correlation.

**OCOR-5607 Physical Oceanography/3 credits.** This course covers basic ocean physics with a focus on the large scale circulation of the oceans and their relation to weather and climate. Topics include: the physical properties of seawater, temperature and salinity structure of the oceans, major current patterns, waves and tides, influences of the wind, El Nino and tropical oceanography, and some relations to climate. This course should be appropriate for students interested in a global view of physical oceanography. Students are required to take either this course or OCOR-5601 as a core course.

#### **OTHER COURSES:**

**OCGY 8000 PhD Dissertation Research/6 credits.** Research and progress toward completion of the PhD dissertation.

**WHAT ELSE DO YOU WANT HERE? EVERY SPECIAL COURSE WE'VE EVER SET UP FOR THE PHD PROGRAM???**

### **5. STUDENT CONDUCT**

All students are expected to comply with the legal and ethical standards of the institution. Academic dishonesty and/or nonacademic misconduct will result in disciplinary action. Specific instances of misconduct include, but are not limited to, cheating, plagiarism, knowingly furnishing false information to the institution, and forging or altering institution documents and/or academic credentials.

The institution reserves the right to require a student to withdraw at any time for misconduct as described above. It also reserves the right to impose probation or suspension on a student whose conduct is determined to be unsatisfactory.

Students who feel their rights have been denied are entitled to due process.

### **6. Grading**

#### **6.1. GRADING SYSTEM**

The following system is used to grade academic performance:

- A** Excellent
- B** Satisfactory
- C** Marginal Pass
- D** Poor
- F** Failure
- W** Withdrawal: Given after the third class week or termination by the instructor for non-completion of the course by the student.
- I** Incomplete: Given when most (80 percent), but not all, work has been completed.

A grade of incomplete must be requested from the instructor, have the Director's approval, and be accompanied by a **completed contract specifying outstanding course requirements and completion dates**. Completion of the Incomplete grade must occur within two terms (or 6 months) of the end of the course.

Securing the completed and signed incomplete contract forms is the responsibility of the **student**. Blank forms are available from the program secretary. There is a charge of \$10 for processing a grade change. If course requirements are not completed prior to the contracted date, the grade of I becomes IW (Incomplete Withdrawal). Students must then retake the course (full tuition) in order to receive credit. There will be no exceptions to this rule.

**IW** Incomplete Withdrawal

**Au** Audit

**P** Pass

**NG** No Grade (not yet assigned by instructor)

Students are permitted to retake, at their expense, courses for which a grade of C or lower has been earned. Retaking of courses does not remove from the student's official transcript the entry of the earlier registration nor the grades earned; however, the highest grade earned in a course will be computed as part of the grade point average, thus enabling the student to improve his/her academic standing. Courses with a grade of C- or lower will not be counted towards the degree. Core classes with a C- or lower must be retaken to count towards conferment.

Infrequently, students who are not in good standing may be continued on probation for one additional term when exceptional circumstances warrant.

### **6.1.1. Quality Points**

<b>GRADE</b>	<b>QUALITY POINTS</b>
A	4.00
A -	3.67
B+	3.33
B	3.00
B -	2.67
C+	2.33
C	2.00
C -	1.67
D+	1.33
D	1.00
D -	0.67
F	0

Not all courses are graded with the letter + or system. In some courses, only whole letter grades are given.

## **6.1.2. Grading Policies**

### **6.1.2.1. Audit**

Master's degree candidates and special students may audit courses (non-credit) for one-half the normal tuition rate (plus fees). These students may withdraw from audited courses and receive full or partial tuition reimbursement according to the Withdrawal and Refund Policy listed in the handbook and bulletin.

PhD candidates may register to audit courses at no additional charge beyond their regular tuition. They are expected to attend classes and participate in the courses as regular students. If this is not the case, the students will be administratively dropped from the class roster. Audit students may take course exams and complete term papers at their option.

### **6.1.2.2. Attendance**

As a requirement for accreditation, regular and punctual class attendance is necessary.

Each professor has the responsibility to enforce class attendance. To fulfill this requirement students must be present for 80 percent of the regularly scheduled sessions and field trips or they will automatically be withdrawn from the course by the instructor through the Registrar's Office.

There are no excused absences for purposes of this rule.

### **6.1.3. Examinations**

Final written examinations are required in graduate courses, except in seminars and other tutorial courses where research papers or other requirements may be invoked. Usually the final examination or total accumulated points determine the grade for a course. However, the instructor may indicate otherwise.

A student failing to take the final examination in any course must notify the Director's office as soon as circumstances permit, preferably prior to the final. If the Director is satisfied that the absence was justified, permission may be given to take a makeup examination within six months or the next time the course is regularly offered.

### **6.1.4. Student Grade Transmittal**

No grades will be released to students without full payment of tuition and fees (or firm arrangements for their payment). Grade reports are mailed to the student's permanent address and are not given over the telephone or verbally by the program office. Grades are not divulged by telephone.

### **6.1.5. Grade Appeal/Grievance Procedure**

The grade appeal or other grievance procedure for students is itemized below and should be followed in all instances, making sure that each step is completed before going on to the next step. If resolution is reached at the end of any given step, it is not necessary to continue.

Step 1: The professor should be contacted to discuss the grade disparity. The problem should be resolved at this level if at all possible.

- Step 2: The student must make an appeal in writing to the professor noting specific objection to the grade received or the problem encountered. The professor must respond in writing giving justification for the grade or action given. **Copies of both communications should be forwarded to the program administrator.** The program administrator may decide the matter, if that is agreeable to all parties.
- Step 3: An appeal committee will review both written and oral arguments in the case. The committee will consist of at least one administrative officer of the program, at least one faculty member who teaches in the program, and others as deemed necessary by the program administrator(s).
- Step 4: The student and professor will be informed of the committee's decision and, barring any written objections to the committee by either party within fourteen calendar days, the recommendations of the committee will be accepted.
- Step 5: If written objections are received within fourteen days, the matter will be referred to the Director of the Institute of Marine and Coastal Studies for review and resolution. This step does not apply if the Director served on the appeal committee. In the latter case, the matter will be referred to the Dean of the Oceanographic Center.

## 6.2. ACADEMIC STANDING

The academic progress of all students will be evaluated after each term, including the summer term. **Students shall be deemed in good academic standing unless they have a cumulative GPA of less than 3.0.** Any student who fails to maintain a 3.0 will be placed on academic probation for two terms. If probation is not removed at the end of the two terms, the student may be suspended from the program. A student may petition for reinstatement after six months, explaining the reasons why academic potential has changed and re-admission should be considered. Students who have reason to believe that there has been an error in assigning a grade may formally protest and invoke the Grade Appeal Procedure.

## 6.3. STUDENT PROGRESS REPORTS

A yearly progress report is intended to remind the student and administration of the preceding academic activities and approval deadlines and to insure proper progress. It is the student's responsibility to complete and submit a report of his/her yearly progress to the program administrator by **15 April** of each year. **Failure to submit a report signals a student's resignation from the degree program.** The report will include the following information.

1. Student status (Capstone Review Paper/Thesis)
2. Student's major (MS: Marine Biology, CZM, Marine Environmental Sciences; PhD: Oceanography/Marine Biology)
3. Date of program entry/matriculation (month, year)
4. Date of time limit expiration (5 years for MS, 7 years for PhD)

5. Program of studies (indicate if the “normal” curriculum is followed for Marine Biology or CZM, or if there are deviations)
6. List of all courses completed with grades and dates (or working transcript)
7. Name of actual or desired advisor/major professor; list of committee members if appropriate
8. Capstone Review Paper or Thesis title/topic; PhD Dissertation title
9. Date of Capstone Review Paper / Thesis or dissertation proposal approval
10. Date of last conference with major professor / program administrator
11. Date of expected completion of degree requirements
12. Comments, questions, problems, successes

### **7.3. GRADE/PROGRESS REPORTS**

Each VA student will be provided a grade/progress report at the end of every evaluation period (e.g., term, semester, quarter). A copy of each report will be placed in the student's permanent file maintained by the school. The Institute of Marine and Coastal Studies maintains up-to-date progress records on each student. The university periodically furnishes each student with a working transcript that shows current status of grades and earned semester hours for all courses completed and/or attempted, plus grades for courses in which the student is currently enrolled.