The Marine Biology and Ecology (MBE) academic program focuses on a wide range of field, laboratory, and theoretical coursework in a range of research areas, such as physiology, genetics, evolution, diseases, molecular biology, coral reef ecology, tropical marine ecosystem conservation, fish biology, ecology, conservation and management, and biological oceanography.

MBE faculty, students, and their many international collaborators participate in multi-institutional, multi-disciplinary research programs. The UM Rosenstiel School hosts many research centers and groups, such as the experimental hatchery, the Rescue-a-Reef citizen science initiative, and the world-renowned NIH/University of Miami National Resource for Aplysia.

Graduate students can choose from a diversity of research areas and coursework taught by internationally recognized scientists studying animal behavior and physiology, coastal ecosystem ecology, coral reef biology and ecology, fisheries biology and management for sustainability, genomics, mangrove and marshland ecology, marine life population dynamics, microbiology, marine toxins, and marine organism diseases, zoogeography and invertebrate systematics, zooplankton and phytoplankton ecology, and microbial ecology.

### Degree Programs

- **Master of Professional Science (M.P.S.)** (p. 1)
  - Requires 30 credit hours, including 24 course credit hours and 6 internship credit hours.
- **Master of Science (M.S.)** (p. 1)
  - Requires 30 credit hours, including 24 course credit hours and 6 research credit hours.
- **Doctor of Philosophy (Ph.D.)** (p. 1)
  - Requires 60 credit hours, including a minimum of 18 course credit hours and a minimum of 12 research credit hours.

### Research Areas

The Department of Marine Biology and Ecology (MBE) is dedicated to enhancing our understanding of marine organisms and their interrelationships with their biotic and physical environments. The pursuit of this understanding involves studies of physiology, genetics, ecology, behavior, population dynamics, connectivity, toxicology and conservation science. Study organisms are from coastal and oceanic ecosystems, from seagrass to corals, plankton to seabirds, and minnows to marlins.

Enhancing our understanding of marine systems requires research, the education of undergraduates and training of graduate students and post-doctoral fellows. We strive to provide our students with the tools, training and opportunities to pursue cross-disciplinary research and develop integrative thinking that will impact our understanding of fundamental biological processes and the conservation of marine life. MBE faculty pursue these goals to address important societal problems including the degradation and depletion of habitats and species, the effects of climate change, and the unsustainable exploitation of marine resources.

### Master of Professional Science (M.P.S.) Programs

There are two MBE tracks for the M.P.S degree:

- M.P.S. in Tropical Marine Ecosystem Management (TME) (http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/marine-biology-ecology/tropical-marine-science-mps/)

### Master of Science (M.S.) Program


### Doctor of Philosophy (Ph.D.) Program

MBE 604. Biology of Marine Mammals. 3 Credit Hours.
The purpose of this class is to introduce students to the biology, evolution, taxonomy, physiology, natural history, behavior, conservation, and management of marine mammals.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MBE 605. Marine Mammal Disease and Medicine. 3 Credit Hours.
This course will cover the basics (theory and application) of marine mammal disease and medicine. Applications will focus on the medical management of managed care and wild populations.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 606. Procedures in Marine Mammal Health and Disease. 1 Credit Hour.
The aim of this course is to provide the student with more in-depth exposure and study of various practical health related techniques/skills that are integral to marine mammal health and disease assessment. While the procedures are most applicable to marine mammals in managed care, several of the procedures can be adapted and/or are used in study of wild marine mammals. Health and disease assessment procedures will be divided into the following five categories/areas: physical examination and behavioral assessment; multimodal and advanced diagnostics (eg., electrocardiogram, ultrasound, etc.); sample collection (types, procedures); clinical pathologic (eg., hematology, biochemistry, serology) interpretation; gross and histopathologic necropsy techniques and interpretation.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 607. Marine Mammal Applied Behavior Analysis and Managed Care. 3 Credit Hours.
This course involves a thorough examination of specific aspects of marine mammal managed care and conservation programs, with an emphasis on behavior management, analysis, and modification as a basis for adaptive response to changing environments both in-situ and ex-situ. Coursework will also focus on health management and assessment, emergency handling and transportation, government regulations, and wildlife conservation.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MBE 614. Tropical Marine Biology. 3 Credit Hours.
In this intensive one-week field course, students are introduced to the ecology, biology, and interconnections of all of South Florida's major marine habitats through a combination of lectures and field excursions from UM's remote private island research station in the Florida Keys.
Components: LEC.
Grading: GRD.
Typically Offered: Spring & Summer.

MBE 615. Tropical Marine Ecology. 3 Credit Hours.
Marine ecology with emphasis on tropical ecosystems and local habitats. Physical environmental and biotic adaptations, population, and community ecology are discussed. Field exercises in mangrove, sea grass, and coral reef ecosystems are also included.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MBE 618. Reef Coral Biology, Ecology, and Conservation. 3 Credit Hours.
Scleractinian (stony) corals are the principal builders of contemporary coral reefs and their unique biology underpins the ecological success of reef ecosystems in the world's shallow tropical seas. This class covers the physiology and ecology of these critical organisms, the environmental factors governing their health, and their biotic interactions with other species. Examples of topics covered include algal symbiosis, calcification, reproduction, taxonomy, microbial ecology, competition with macroalgae, and herbivory, with insights at all levels from molecules to ecosystems. A special focus is on the decline of coral reefs due to anthropogenic stressors including climate change and coral bleaching, diseases, nutrient pollution, overfishing, and ocean acidification.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 621. Field Techniques and Instrumentation in Tropical Marine Ecology. 3 Credit Hours.
This course covers the instrumentation and field techniques commonly used to characterize the structure and function of the three dominant ecosystems in the tropics and subtropics, i.e. coral reefs, seagrass beds and mangroves.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
MBE 622. Marine Microbial Dynamics. 3 Credit Hours.
An overview of the function of microbes in the ocean from a chemical perspective, building a quantitative understanding of cellular needs and metabolic functions, and the role these microbial processes play in controlling chemical fluxes and biogeochemical cycles in the ocean.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 629. Population Genetics and Genomics. 3 Credit Hours.
This course provides an introduction to population genetics, which examine the evolutionary processes that affect genomes of natural populations: mutation, genetic drift, natural selection, and gene flow.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 630. Marine Microbiology. 4 Credit Hours.
This course introduces the diversity, habitats and ecology of the marine microbial biosphere. Microbes drive many elemental cycles in the oceans. As primary producers and final degraders of organic matter they provide the foundations of marine trophic webs and biogeochemical processes. This course will place microbes into the context of marine ecosystem function and biogeochemistry.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MBE 632. Marine Mammal Research Techniques. 3 Credit Hours.
The goal of this course is to provide an overview of the field of marine mammal research (historic, current, and future), hands-on training in applied research skills relevant to the field of marine mammalogy, as well as an understanding of the biological and ecological significance of captive and wild research and contributions to management and conservation.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 635. Practical Computing for Biologists. 3 Credit Hours.
Biology is becoming far more computationally intensive, yet the undergraduate and graduate biology curricula have not kept pace with this new reality. Practical Computing for Biologists, based on Haddock's and Dunn's book of the same name, is a problem-centric course that provides resources for biologists to analyze the increasingly complex data sets generated by new technologies. We will cover flexible, scalable tools to accomplish a diversity of tasks using open source software. Topics will include: regular expressions, command line operations, Python programming, and bioinformatics pipelines. Exercises relevant to the students' needs will be used to illustrate and develop new skills. After doing several assigned homework problems, students will have an opportunity to develop a bioinformatic analysis on their own data set.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MBE 639. Oceanic Productivity. 3 Credit Hours.
History, methods, and current topics relevant to studies of marine primary production. Magnitude and fate of primary production in the sea is essential to understand secondary production, the success of fisheries recruitment, and global climate.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 640. Marine Phytoplankton and Primary Productivity. 3 Credit Hours.
Ecology of marine photoplankton and overview of major taxa including cyanobacteria. Distribution and magnitude of primary production in the sea and relationship to marine food webs and biogeochemical cycling is included.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MBE 641. Reef Restoration Techniques. 2 Credit Hours.
This course will provide a comprehensive background on the theory and practice of active coral reef restoration. This 5-day lab and field-intensive course will be structured with lectures and demos in the morning followed by lab or field activities in the afternoon. Readings for this class will include 2 restoration manuals and papers from the primary literature. Grades will be based on 1 exam, 2 quizzes, and 1 field monitoring report. Field activities will be carried out at sites around Key Biscayne. During these field trips, students will conduct hands-on restoration activities (e.g., nursery maintenance, equipment deployment, coral collections, coral planting, coral monitoring). The data collected during these activities will be used by the students to write a monitoring report.
Components: LEC.
Grading: GRD.
Typically Offered: Summer.
**MBE 642. Oceans and Human Health. 3 Credit Hours.**

The objective of this interdisciplinary course is to provide students with introductory knowledge of the broad and relatively young field of Oceans and Human Health. The focus is the present, future, and potential effects of oceanic processes and aquatic organisms on human health, and vice versa. These diverse factors reflect the physical, chemical, biotic and social processes which require an integration of information and knowledge from the medical, marine and social sciences. The course covers harmful algal blooms, marine microbes, and global climate change as well as an overview of coastal impacts and remedies (e.g., drugs from the sea and marine models) through a series of coordinated lectures and case studies on human health, physical environment, and oceanographic processes. Prerequisite: Permission of instructor.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 643. Ecology, Conservation, and Ecotourism in the Galapagos. 3 Credit Hours.**

This class takes place over three weeks in the Galapagos, Ecuador. It first gives a broad view of the physical/biological/ecological setting of the Galapagos Islands, and then analyzes the intersection between human development and nature in this fragile environment. It also provides an exploration of how tourism offers an alternative income source to unsustainable fisheries that once drove the local economy, and now has created a new set of pressures on the people and the environment.

**Components:** FLD.

**Grading:** GRD.

**Typically Offered:** Fall & Summer.

**MBE 645. Microbial Ecology and Evolution. 4 Credit Hours.**

This course integrates lecture and laboratory studies to focus on the ecology and evolution of microbial organisms belonging to the three domains of life, Archaea, Bacteria and Eukarya. The laboratory component will have a focus on the analysis of the structure, function, evolution, mapping and editing of microbial genomes.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 650. Analytical Techniques in Marine Biology. 2 Credit Hours.**

Theory and applications of selected analytical techniques necessary to conduct quantitative research in marine biology (e.g., electrophoresis, metabolite assays, enzyme assays, radioisotope methodology). One hour lecture followed by three hour laboratory per week.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 670. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 671. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 672. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 674. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 676. Diseases of Marine Organisms. 3 Credit Hours.**

Infectious, genetic, and environmentally induced diseases of marine fishes and invertebrates as well as diagnostic methods, cellular, and molecular pathology. Lecture, 3 hours.

**Components:** LEC.

**Grading:** GRD.
**MBE 678. Evolutionary Genetics. 3 Credit Hours.**
A Graduate course that presents an overview from "New Evolutionary Synthesis" (1900) to Evolutionary Genomics. The critical points to emphasize is the importance of standing genetic variation, the role of neutral evolutionary process versus evolution by natural selection and how a evolution perspective provides meaning insights into the biology.

Components: LEC.
Grading: GRD.
Typically Offered: Fall.

**MBE 686. Fish Physiology. 3 Credit Hours.**
Ecology, dispersal, and modes of life of fishes. Adaptations by larvae and adults to various habitats are covered as well as the effects of man on fish faunas and the importance of fishes to various ecological systems. Lecture, 3 hours.

Components: LEC.
Grading: GRD.
Typically Offered: Spring.

**MBE 702. Marine Biology and Ecology Graduate Student Seminar. 1 Credit Hour.**
Participation is required of all students in the Department of Marine Biology and Ecology every semester they are in residence, whether or not they are registered for the course, beginning in year 1 for PhD students with a MS, year 2 for PhD students without an MS, and approximately in their second semester in residence for MS students. Talks consist of one, 15-minute presentation per year on the research or research plan. The moderator assigns talk dates in May before the academic year. The course may be taken for credit once, but registration is not required.

Components: SEM.
Grading: SUS.
Typically Offered: Fall & Spring.

**MBE 704. Biological Oceanography. 3 Credit Hours.**
A comprehensive course in biological oceanography, including energy flow, biogeochemical cycles, planktonic and benthic ecosystem structure, the evolutionary ecology and adaptations of marine organisms, and paleoceanography.

Components: LEC.
Grading: GRD.
Typically Offered: Fall.

**MBE 707. Biochemical Toxicology. 3 Credit Hours.**
Biochemical mechanisms of absorption, distribution, metabolism, and excretion of natural and synthetic environmental toxicants. Methods for evaluation of acute and chronic toxicity, carcinogenesis, mutagenesis, and teratogenesis including in vivo, isolated organ, tissue culture, and subcellular approaches to toxicity testing are included.

Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

**MBE 710. Advanced Marine Mammal Biology. 3 Credit Hours.**
The purpose of this class is to build upon foundational knowledge relevant to the biology, taxonomy, physiology, natural history, behavior, ecology, and conservation of marine mammals. Advanced concepts will include hydrodynamics, osteology and myology, respiratory system and diving physiology, circulatory/lymphatic systems, the nervous system, urinary/genital/reproductive systems, and neurobiology. Students must have 1 year of general biology/labs and general chemistry, 1 semester of calculus, and at least 9 credits in the natural sciences.

Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

**MBE 715. Advanced Topics in the Ecology of Coastal Tropical Marine Ecosystems. 3 Credit Hours.**
This advanced class in tropical marine ecology is targeted at students in the MS and PhD programs as well as students in the MPS program with a strong background in marine ecology. The class describes the status, trends, and disturbance ecology of tropical coastal ecosystems and organisms, with a focus on coastal ecosystems of South Florida. In addition to reinforcing and expanding knowledge of basic ecological principles through lecture materials, students will be required to complete extensive readings on current topics relating to these ecosystems from the primary scientific literature. Students will participate in several paper discussions based on these readings. Additionally, students will complete two data analysis activities and write brief reports based on these analyses. Some prior knowledge of statistics is expected to complete these assignments.

Components: LEC.
Grading: GRD.
Typically Offered: Fall.
MBE 716. Bayesian Statistics for Marine Scientists. 3 Credit Hours.
Bayesian methods are increasingly used in ecology, fisheries science and marine biology, as a statistically rigorous means to incorporate information from diverse sources into a single analysis, deal with missing or incomplete data, and directly estimate the probabilities of hypotheses or outcomes. This course will cover Bayesian methods from the theory to the practical use of the statistics packages OpenBUGS and JAGS for Bayesian analysis. Topics will include development of prior probability density functions, numerical methods for integrating posterior probability density functions, diagnostics of convergence, and methods for model selection and model averaging. Examples will be taken from ecology and marine science and will include Bayesian meta-analysis of life history parameters, fisheries stock assessment models, tag-recapture models, molecular biology, decision analysis and estimation of animal abundance from surveys. Students will be encouraged to read the peer reviewed literature critically, and evaluate whether the Bayesian methods that are commonly applied are being used and interpreted appropriately. After doing several assigned homework problems, students will have an opportunity to develop a Bayesian analysis on their own data set. Knowledge of the R language is useful but not required.
Prerequisite: RSM 612 Or MES 608.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MBE 770. Mentoring and Supervising Skills. 1-3 Credit Hours.
This course is intended for PhD students who are interested in developing their skills as mentors and research supervisors in preparation for a career in academia or research institutions. It combines reading the literature on best practices in mentoring while implementing the skills they learn, along with the faculty instructor, to co-mentor 1-3 undergraduate researchers in MSC 411/412 or equivalent research classes. This class may be taken for 1-3 credits with 1 credit per undergraduate mentored. The class may be taken more than once, for a total of up to the 3 credits maximum.
Components: IND.
Grading: SUS.
Typically Offered: Fall & Spring.

MBE 771. Advanced Studies. 1-4 Credit Hours.
Supervised study in areas of special interest to graduate students.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MBE 772. Advanced Studies. 1-4 Credit Hours.
Supervised study in areas of special interest to graduate students.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MBE 773. Advanced Studies. 1-4 Credit Hours.
Supervised study in areas of special interest to graduate students.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MBE 775. Advanced Studies. 1-4 Credit Hours.
Supervised study in areas of special interest to graduate students.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MBE 787. Biology and Systematics of Fishes. 3 Credit Hours.
Lectures and laboratories on comparative evolution, morphology, physiology, and ecology of fishes. Laboratory emphasis is placed on family level taxonomy and systematics of marine and estuarine fishes.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MBE 805. MPS Internship. 1-6 Credit Hours.
The MPS internship is an approved, supervised internship project with an organization engaged in activities associated with the student’s degree track. The internship results in a collaborative project, written report, and oral presentation on a topic approved by the student’s advisory committee. Up to 6 credits are necessary for graduation.
Components: PRA.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.
MBE 810. Master’s Thesis. 1-6 Credit Hours.
The student working on his/her master’s thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

MBE 830. Doctoral Dissertation. 1-12 Credit Hours.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 12. Not more than 12 hours of MBE 830 may be taken in a regular semester, nor more than six in a summer session. Where a student has passed his/her (a) qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.