MARINE BIOLOGY AND ECOLOGY

http://www.rsmas.miami.edu/academics/graduate-programs/degrees/marine-biology-ecology/

Dept. Code: MBE

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 coral reef studies, biological oceanography and marine biology, fisheries biology, and the biology and behavior of marine animals.

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 National Center for Coral Reef Research, 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 corals and climate change, fisheries biology, and conducting biomedical research.

Degree Programs

• Master of Professional Science (M.P.S.) (p. 1)
  • Requires 60 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. 2)
  • Requires 60 credit hours, including a minimum of 24 course credit hours and a minimum of 12 research credit hours.

The MBE program offers primarily the Ph.D. degree, since more funding opportunities in faculty laboratories are specifically for Ph.D. students. MBE does not require a prior M.S. degree for the Ph.D. program. It is highly recommended that prospective Ph.D. students make contact with specific faculty to inquire about opportunities in their laboratories as well as undergraduate preparations necessary before they apply. Funding opportunities for the M.S. program are very limited, and very few M.S. students are accepted. Prospective M.S. students must contact faculty before they apply to inquire about opportunities.

Both the M.S. and Ph.D. degrees require independent research, but the scope of the research is greater for the Ph.D. degree. Your success in matching your scientific interest with the research area of one of our faculty is one of the most important criteria used in evaluating prospective students for graduate studies in MBE at RSMAS. Most applicants are interested in coral reef ecology, thus competition for admission is highest in that subject.

Most successful applicants have a bachelor’s degree in biological sciences including a strong foundation in physical sciences (chemistry, physics, calculus) and basic biological sciences. However, applicants with a diversity of other degrees also are successful. The advanced biology test is not required. Courses in marine biology and oceanography are not necessary for entrance into the program and are not recommended if taken in place of basic biology courses. Applicants should contact specific faculty to discuss mutual research interests. Applicants must take the GRE, and those whose first language is not English must pass the Test of English as a Foreign Language (TOEFL) with a score of at least 550 (Paper-based) or 80 (IBT).

Research Areas

Coral Reef and Coastal Ecology

Employs ecological, physiological and molecular approaches to understand, conserve, manage, and restore coral reefs, seagrasses, mangroves and their associated biota.

Marine Organismal and Biomedical Science

Focuses on how marine organisms respond to their environment on physiological and evolutionary time scales. This research integrates whole animal and cellular studies of physiology, biochemistry, neurobiology, genomics, molecular biology, aging, pathology and toxicology to understand factors controlling these responses and to develop these systems as models for human health.

Biological Oceanography

Focuses on adaptations, ecological interactions, food webs, and biogeochemical cycles of the ocean.

Fisheries Science

Studies the direct and indirect impacts of living marine resource exploitation on marine populations, communities and habitats and investigates solutions to the problems of unsustainable, habitat-damaging and/or inefficient fishing, including the minimization of bycatch and food web disruption.

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

The M.P.S. degree prepares students for science careers in industry, government, and non-profit organizations, where employment demands are growing. M.P.S. degrees were developed and implemented nationally in response to employer demands for well-rounded, highly trained employees with a breadth of knowledge and practical skills to address emerging environmental issues and improve the management of natural and cultural resources. The curriculum is structured to allow students to complete their degree in as little as 12 months, with the training and real-world experience necessary to prepare them for careers in today’s professional science job market.

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.) Programs**


**Doctor of Philosophy (Ph.D.) Programs**


**MBE 604. Biology of Marine Mammals. 3 Credit Hours.**
The purpose of this course 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 (e.g., electrocardiogram, ultrasound, etc.); sample collection (types, procedures); clinical pathologic (e.g., hematology, biochemistry, serology) interpretation; gross and histopathologic necropsy techniques and interpretation.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**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 608. 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 609. 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 610. 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 611. 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 612. 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 613. 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: A Field Course. 3 Credit Hours.**
General survey of marine flora and fauna of tropical marine ecosystems. Inhabitants and communities of the sandy shore, rocky shore, seagrass meadows, mangrove shoreline, coral and artificial reefs are collected, identified, maintained. Life histories of representatives are presented. Concepts of island biology and geology such as shore zonation local reef formation and the geological history of the lagoon are also discussed. The 10 day course involves 90 contact hours and approximately 40 hours of formal lectures. Grades are based on a laboratory practice and written final exam. The course is given in its entirety at the University’s field station at Bimini, Bahamas.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**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, seagrass, and coral reef ecosystems are also included.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**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:** Offered by Announcement Only.

**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 629. Population Genetics and Genomics. 3 Credit Hours.**
This course provides an introduction to population genetics, which examines 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 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 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 and 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. Environmental Biology of Fishes. 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: Offered by Announcement Only.

MBE 702. Biological Oceanography Seminar. 1 Credit Hour.
Participation is required of all students in Marine Biology and Fisheries department every semester they are in residence whether or not they are registered for the course. Students past their second semester must give one 20-minute presentation per year, on their research or other acceptable topic. Dates are be assigned by lottery. Course may be taken for credit only once.
Components: SEM.
Grading: GRD.
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, evolutionary ecology, adaptations of marine organisms, and paleoceanography. Course is required of all MBF students and should be taken in sequence with Oceanography I (MPO 501), Oceanography II (MAC 502), and Oceanography IV (MGG 504).
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 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 package OpenBUGS 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.
Components: LEC.
Grading: GRD.
Typically Offered: 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 Master of Professional Science 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: THI.
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 MBF 730 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.