

MARINE BIOLOGY AND ECOLOGY

<https://graduate.earth.miami.edu/phd-and-ms-programs/marine-biology-and-ecology/index.html>

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 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 University of Miami 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 a minimum of 24 course credit hours and 2-6 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 16 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.) Program

- M.P.S. in Marine Biology and Ecology (MBE) (<http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/marine-biology-ecology/marine-biology-ecology-mps/>)

Master of Science (M.S.) Program

- M.S. in Marine Biology and Ecology (MBE) (<http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/marine-biology-ecology/marine-biology-ecology-ms/>)

Doctor of Philosophy (Ph.D.) Program

- Ph.D. in Marine Biology and Ecology (MBE) (<http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/marine-biology-ecology/marine-biology-ecology-phd/>)

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 608. Discussions of Marine Mammal Welfare. 1 Credit Hour.

This course will investigate the welfare debate of marine mammals in managed care and in the wild. Using animal welfare concepts developed for farm animals, laboratory animals, other captive animals, and free-ranging animals subject to human ecologic changes and/or human interference, we will investigate the potential positive and negative welfare effects on marine mammals. The goal of the course is to critically assess both sides of the marine mammal welfare discourse to be able to address these issues as raised by animal activists. In addition, we will discuss and evaluate the criteria used to assess welfare status.

Components: DIS.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

MBE 612. Aquaculture I. 3 Credit Hours.

This course examines the various strategies of resource exploitation and utilization related to aquaculture development. It focuses on environmental, technological, management, social and economic aspects of sustainable aquaculture. Advanced, emerging technologies and management strategies are examined, both at the hatchery and growout levels. The course also covers systems and all stages of planning and development, from site and species selection to feasibility studies, evaluation and sustainable use of natural resources, advanced hatchery and growout technologies. Emphasis is given on environmental sustainability as well as technical and economic feasibility of aquaculture projects.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

MBE 613. Aquaculture II Lab. 3 Credit Hours.

This course covers basic science and advanced aquaculture technologies, with emphasis on production. It encompasses reproduction, spawning, larval husbandry, nursery and growout techniques of commercially important species of fish, crustaceans, mollusks, algae, non-traditional species and the production of live feeds such as microalgae, rotifers, *Artemia* spp. and other zooplanktonic organisms. The course also covers ontogeny, nutrition, physiology, bioenergetics and growth, environmental monitoring, disease prevention and control (prophylaxis, probiotics and vaccines), water quality management and growout technologies such as recirculating aquaculture systems (RAS), bioflocs and offshore surface and submerged cages. The course addresses advanced technology and proper management practices for sustainable aquaculture development. Aquaculture II is primarily a lab course, with a great deal of hands-on experience at the experimental hatchery and are required to conduct experimental trials and assist with ongoing projects. Course requires a background in either aquaculture and biological sciences or business.

Components: LAB.

Grading: GRD.

Typically Offered: Spring.

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: FLD.

Grading: GRD.

Typically Offered: Fall, 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 617. Aquaculture IV: Aquaculture Business, Regulatory, and Environmental Considerations. 3 Credit Hours.

This course examines the substantive business, regulatory, and environmental issues concerning Aquaculture from offshore and coastal projects to land-based systems. Legal and regulatory considerations related to Aquaculture project development and operation will be covered. Aspects of business planning for different species and production systems will be examined. The interdisciplinary approach to Aquaculture will combine business and legal considerations with biological and environmental limitations.

Prerequisite: MBE 612 and MBE 613.

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 619. Aquaculture III. 3 Credit Hours.

Aquaculture III will complement Aquaculture I and II-Lab. It is a field course conducted simultaneously with an annual UM-IATTC Tuna Workshop at the world-renowned Achotines Laboratory in Panama, Central America. Students will be able to apply most of the topics taught in Aquaculture I and Aquaculture II. It covers reproduction and larval development of commercially and ecologically important marine fish species, focusing on tuna. Topics include physiology, biology, ecology, genetics, nutrition and environmental issues related to marine fish aquaculture. The course covers and requires participating in capture, handling, transportation, maturation, spawning, larval husbandry, nursery and growout techniques. Participants will learn about the research projects being conducted by the IATTC with yellowfin tuna, *Thunnus albacares*, and will visit and spend time at Open Blue Offshore farm in the Atlantic Ocean side of Panama.

Components: FLD.

Grading: GRD.

Typically Offered: Summer.

MBE 621. Field Techniques in Tropical Marine Ecology I. 2 Credit Hours.

This class combines both classroom instruction and field experience to introduce graduate students to the field techniques necessary to collect biological/ecological data in the major tropical and subtropical marine environments. It also delves into some of the most used analytical techniques used in interpreting these data. Along with MBE 631, it provides an opportunity for students to experience the entire scientific method, from hypothesis formation, to write up and presentation of results.

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 623. Marine Parasite Ecology. 3 Credit Hours.

Parasites constitute the most common lifestyle among living organisms. They are found in nearly every Phylum and on or in nearly every living organism and in every ecosystem. Parasites range from microscopic single-cells to small sharks. Thus, an understanding of the ecology of parasites is essential for an understanding of ecology in general. This course focuses on the ecology of host-parasite interactions in the marine environment, with an emphasis on coral reef systems. It includes the role of parasites in diseases, food webs, host behavior, and species invasions. While it will include some single-celled parasites, the focus will be on multicellular macro parasites. The course meetings will be integrated lecture/lab and discussion and will include student presentations, guest presentations, and collection and examination of marine parasites.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

MBE 628. Seafood Market and Marketing. 3 Credit Hours.

This course aims at educating the next generation of professionals in the seafood business and present future managers of an aquaculture business with the necessary knowledge in the packaging, pricing, placement, promotion and distribution of their finished product to give them the best return on their investment. The course covers basic theories but it is primarily a practical approach to the production, marketing and distribution of seafood products in the U.S. and the world market.

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 631. Field Techniques in Tropical Marine Ecology II. 1 Credit Hour.

This class is a continuation of MBE 621 and consists mainly of intensive field work using methodology learned in that class. Students will formulate a hypothesis, use data collected by the class to answer the hypothesis, and present analysis and results in a short presentation. Depending on section, this class may be taught at Rosenstiel, at its nearby Broad Key field station, or at another remote field station possibly in another area or country. Distant field sites may require additional travel cost to the student.

Pre-requisite MBE 621.

Components: FLD.

Grading: GRD.

Typically Offered: Summer.

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 633. Ecology, Conservation, and Ecotourism in the Galapagos I. 2 Credit Hours.

This class gives a broad view of the physical/biological/ecological setting of the Galapagos Islands, and then analyzes sustainability at 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. A hands-on component to this course is offered the following semester in MBE 643, which takes place in the Galapagos.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & 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 636. Scientific Programming and Simulation Modelling. 3 Credit Hours.

Hands-on training in object-oriented programming using Java, including Java statistical packages, and in the development of agent-based and individual-based simulation models for ecological, physiological, social, economic, and physical sciences. Course includes introductions to cellular automata and models based on social and behavioral networks. No prior programming experience required.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

MBE 637. Practical Data Analysis for Marine Scientists. 3 Credit Hours.

This course will provide a background on common analysis performed on different data types, including environmental, spatial, census, and sequence data. Along with getting more insight into the experimental design and data collection of each, this course will provide hands-on experience processing comparable ecological datasets both individually and in small groups. This course is NOT recommended for students who are concurrently enrolled in MBE 621.

Prerequisite: RSM 612.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

MBE 638. Tropical Marine Microbiomes. 3 Credit Hours.

Ecosystem processes and organismal health depend on their interaction with microbial life, whether providing otherwise limiting nutrients or initiating dysbiosis. This course will review recent advancements in marine microbial ecology, the sampling and molecular methodologies employed, and will include hands-on training in common microbial bioinformatic analysis. Recommended prerequisite: MBE 615.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

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 phytoplankton 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. dredging 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 II - Field. 1 Credit Hour.

This field class takes place over two weeks in the Galapagos, Ecuador, and requires that the student has taken the lecture, MBE 633. This trip is meant to bring together in a tangible real-world scenario, the intersection between human development and nature in this fragile environment. It allows the students to experience for themselves the ecology, biology, conservation, and ecotourism that they learned about in MBE 633 and write critically about their experience.

Pre-Requisite: MBE 633.

Components: FLD.

Grading: GRD.

Typically Offered: Spring & Summer.

MBE 644. Tropical Coastal Restoration. 3 Credit Hours.

This course provides an overview of the history of tropical coastal restoration, current restoration approaches, innovative techniques to enhance restoration in a changing environment, and the various metrics and monitoring methods to evaluate restoration success. Restoration fields covered include coral reef, artificial & hybrid reef, seagrass, sponge, mangrove, dune, historical, and biocultural restoration, along with marine debris removal. Students will have the opportunity to gain hands-on experience within these restoration fields through regular field trips. The ability to participate in strenuous fieldwork is required for enrollment.

Prerequisite: MBE 615.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

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 648. Preparing Successful National Science Foundation GRFP Applications for Marine Scientists. 1 Credit Hour.

The purpose of the course is to provide current graduate students and eligible undergraduate students in marine science seeking a research-based M.S. or Ph.D. with an opportunity to develop a fellowship grant application for the National Science Foundation Graduate Research Fellowship Program (NSF-GRFP).

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

MBE 649. Molecular Methods and Bioinformatics for Marine Biologists. 3 Credit Hours.

This course will provide the theoretical background for basic techniques in molecular biology as well as hands-on practical experience implementing these techniques within a marine biology context. Theoretical and laboratory practices be followed by an introduction to processing these data types using both command-line and online tools for studying biological and ecological trends. This course is directed to MPS, MS, and PhD students who could benefit from an introduction to wet lab work and processing 'omics data.

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 651. Engaging the Arts in Science Communication. 1 Credit Hour.

Modern education in science, technology, engineering, and mathematics (STEM) has left little place for the arts and humanities. Coincidentally, there is a large gap in scientific literacy between specialists and non-specialists. This interferes with the transmission of scientifically-generated knowledge to the broader society. Some members of the scientific community have recognized this problem, particularly in the context of failed attempts to motivate behavioral and policy changes that are deemed beneficial to society, and have recognized the power of the arts to motivate change. This has resulted in the re-emergence of art and science collaborations such as that between evolutionary biologist E.O. Wilson and actor Alan Alda, and the reintegration of arts in STEM education to create STEAM education. This seminar course explores the synergy between the arts and sciences. It particularly examines the role of arts and artists in improving communication of scientific research. Each semester the course is offered will focus on a specific topic within this broader theme.

Components: SEM.

Grading: GRD.

Typically Offered: Spring.

MBE 652. Advanced Invertebrate Zoology. 4 Credit Hours.

Advanced focus on the primary principles of invertebrate zoology. This graduate course will include critical thinking skills, group learning, hands-on laboratory activities, group projects, and field work.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

MBE 653. Evolutionary Marine Phylogenetics, Systematics, and Genomics. 3 Credit Hours.

This course will provide the foundations of evolutionary phylogenetics, systematics, and the application of phylogenetics and systematics in genomics. Students will focus on how to construct, read, and validate different types of phylogenetic trees. Systematics and the power of genomics will also be investigated. The primary focus will be on marine invertebrates; however, students will learn concepts that can be applied to any organism.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

MBE 654. Museum Collections and Data Management. 3 Credit Hours.

This course will act as an introduction to the management and maintenance of museum collections with a focus on marine invertebrate collections. However, the principles learned can be applied to any specimen based museum collection.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

MBE 670. Physiology of the O₂ Transport. 3 Credit Hours.

This course provides an introduction to the study of the effects of hypoxia (low O₂) in relation to both high-altitude biology and medicine, and intermittent hypoxia associated with diving physiology. It focuses on mechanisms of hypoxia resistance influencing the requirement to match O₂ supply and demand throughout the O₂ cascade: a) gas exchange (hypoxic ventilatory responses (HVR) & morphology of lungs and air sacs), b) circulatory O₂ delivery (Hb-O₂ affinity, blood hemoglobin content [Hb]), hematocrit (Hct), & cardiac output), c) tissue O₂ diffusion (muscle capillarity & myoglobin (Mb) function), and d) tissue energy metabolism (mitochondrial respiration & enzyme function). Lectures and discussions will draw from disciplines as diverse as genomics, integrated physiology, population genetics, biochemistry, gene expression, evolution, and alpine medicine. The taxonomic examples from the literature will include humans, other mammals, birds, herps, and fish.

Components: LEC.

Grading: GRD.

Typically Offered: Spring Even Years.

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 681. South African Intertidal Ecology. 3 Credit Hours.

Rocky intertidal communities are unique among marine communities. Positioned at the interface between land and sea, they provide trophic linkages between the two. Because these environments are physically dynamic, organisms occupying these habitats must be adapted to extreme environmental fluctuations. Because of the ease with which they can be accessed by humans, rocky intertidal communities have been model systems for all levels of ecological inquiry. The southern tip of South Africa is unique among coastal marine environments in that lies it at the interface between cold temperate and tropical water masses. The feature of the course is a one-week field excursion to Tsitsikamma National Park in South Africa. During this week, students can expect be working on class-related activities 12-14 hours/day. Prior to the field trip, the instructor will hold weekly meetings to discuss course material and logistics. There will be no meetings following the field trip. This course is a continuation of a team-taught, international, field course that includes faculty and students from two South African universities: North West University and University of Johannesburg, along with Hong Kong University. It has been taught with the same core instructors since 2015.

Components: FLD.

Grading: GRD.

Typically Offered: Spring.

MBE 682. South African Marine Parasitology. 2 Credit Hours.

Parasites constitute the most common "lifestyle" among living organisms. They are found in nearly every Phylum and on or in nearly every living organism and in every ecosystem. Thus, an understanding of the ecology of parasites is essential for an understanding of ecology in general. This course is an intensive field-course focused on biodiversity of and methodological advances used to study parasites of marine fishes. It is intended to complement the Marine Parasite Ecology course by providing more in-depth training in field and laboratory techniques. Moreover, it is based at Tsitsikamma National Park, in the southern tip of the African continent at the confluence of the Indian and Atlantic oceans and thus includes a unique blend of subtropical and temperate fauna, including parasites. This course occurs concurrently with a field course in rocky intertidal ecology, which was founded by parasite ecologists and is taught by an international team of instructors. Because of its origin, the Tsitsikamma field excursion provides the opportunity to learn from top marine parasitologists from South Africa, Australia, Germany, and the US.

Pre/Co-Requisite: MBE 523 or MBE 623.

Components: FLD.

Grading: GRD.

Typically Offered: Spring.

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 713. Marine Population Dynamics. 3 Credit Hours.

This course introduces students to the mathematical and statistical models that underpin the study of the fluctuations of marine populations. It focuses on the understanding and theory of the dynamics of marine harvested and protected species (marine mammals, sea turtles, and other endangered taxa). Particular attention is given to understanding these dynamics with the support of data related to marine fisheries. The first half of this course is devoted to the estimation of abundance from surveys, fishery data and mark-recapture experiments. The second part of the course covers the study of population models that explain abundance fluctuations. The last part of the course covers forecasting models that can be used to provide advice to resource managers.

Components: LEC.

Grading: GRD.

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 desirable.

Prerequisite: RSM 612 Or EVR 624.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

MBE 746. Marine Population Biology: Processes and Modeling. 3 Credit Hours.

The course examines some of the fundamental life history processes that control wild aquatic populations and uses mathematics to help describe and understand such processes. Mathematical models, developed for each process following a series of simplifying assumptions, should be an adequate description of the biological traits of interest. In this course, students will learn basic population biology concepts, models to describe them and estimation methods for population parameters included in such models. The course focuses on ageing determination, individual growth, survival, migration, reproduction and feeding. The course also covers the data requirements and statistical validation of statistical model fits such that students will develop an ability to integrate and summarize complex biological knowledge through a set of well-defined mathematical and statistical methods. It uses examples of a broad range of marine taxa including harvested species and protected species (marine mammals, sea turtles and corals).

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 their master's thesis enrolls for credit, in most departments not to exceed six, as determined by their advisor. Credit is not awarded until the thesis has been accepted.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

MBE 820. Research in Residence. 1 Credit Hour.

Used to establish research in residence for the master's degree, after the student has enrolled for the permissible cumulative total in appropriate thesis research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

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 their advisor, but for not less than a total of 12 hours. Up to 12 hours may be taken in a regular semester, but not more than six in a summer session. Where a student has passed their (a) qualifying examinations, and (b) is engaged in an assistantship, they may still take the maximum allowable credit stated above.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

MBE 850. Research in Residence. 1 Credit Hour.

Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.