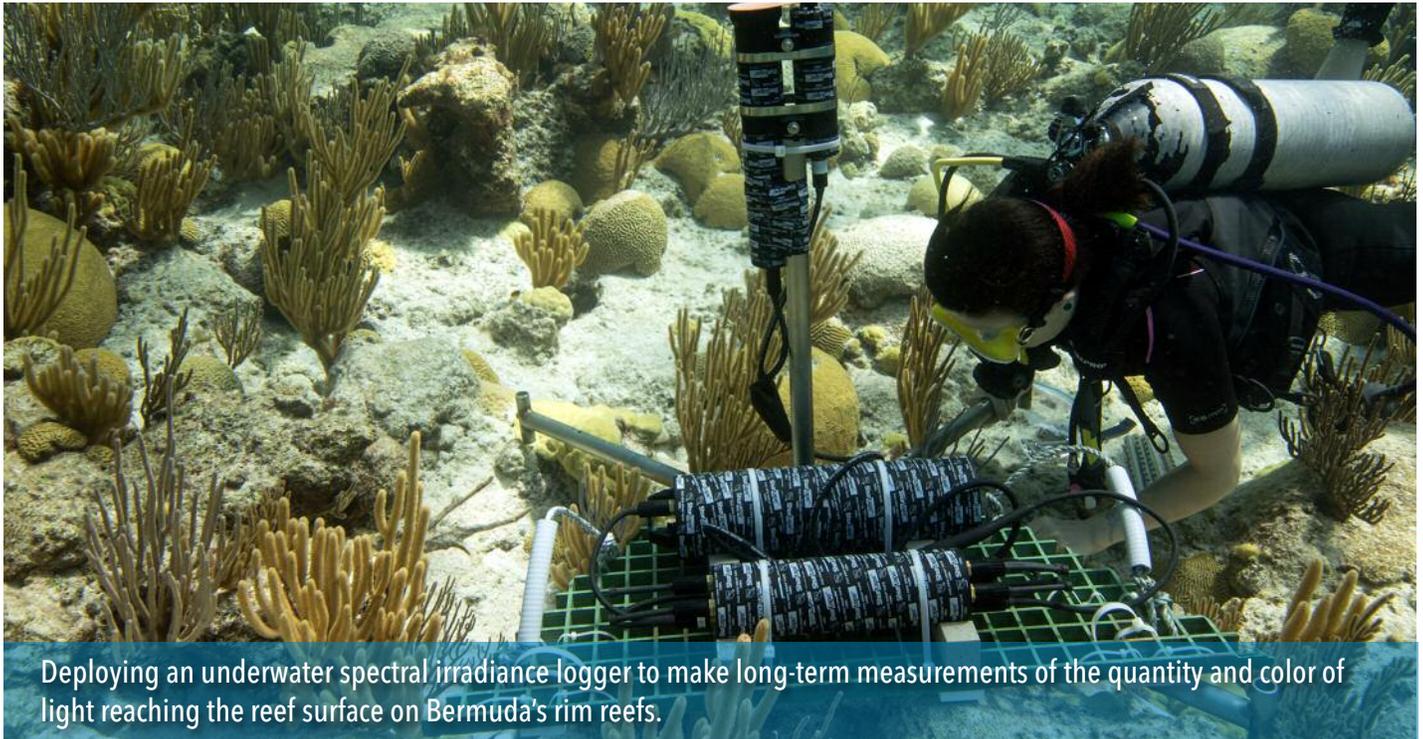


Coral Reef Ecology (CRE) Functional Ecology of Coral Reefs

**June 28 - July 16, 2021
August 9 - 27, 2021**

Instructors:
Dr. Eric Hochberg (BIOS) and Dr. Yvonne Sawall (BIOS)





Coral Reef Ecology: Functional Ecology of Coral Reefs

Reading Material

Instructors will provide readings from the primary scientific literature.

Prerequisites

- University-level Biology and Ecology; marine science desirable.
- The course will require boat work and the ability to work comfortably in the water with a mask and snorkel. Those who are SCUBA certified* will be able to undertake fieldwork underwater and learn scientific diving skills.

**After notification of acceptance in this course, students are required to complete the BIOS Student Diving Information Packet and submit to our Dive Safety Office for approval prior to arrival at BIOS.*

Course Structure

The course has the following components:

- 13 lectures (approx. 1 hour long)
- 6 boat (SCUBA/snorkel) trips (3-4 hours each)
- Two 5-day-long laboratory experiments (flume mesocosm)
- Several precepts (0.5-1 hour each) to discuss background and methods for field and laboratory work
- Several periods for guided laboratory analytical activities (e.g., water quality) and data analysis
- A take-home written exam
- A morning of oral presentations to present the results of the group field and lab experiments



Summer course activities include recording spectral reflectance measurements to study coral condition in the flumes (left) and in the water (center); as well as laboratory work to analyze collected samples (right).

Grades Are Based On

- Participation (30%)
- Take-home Exam (40%)
- Oral presentation (30%)

Lecture Topics

- Paleogeography & Geology of Coral Reefs
- Physical Environment–Waves & Currents
- Physical Environment–Light and Temperature
- Chemical Environment
- Reef Corals–Biology
- Reef Corals–Evolution and Taxonomy
- Reef Algae
- Reef Sediments
- Community and Ecosystem Metabolism
- Community and Ecosystem Calcification
- Carbon and Nutrient cycling
- Zonation of Processes
- Trophics

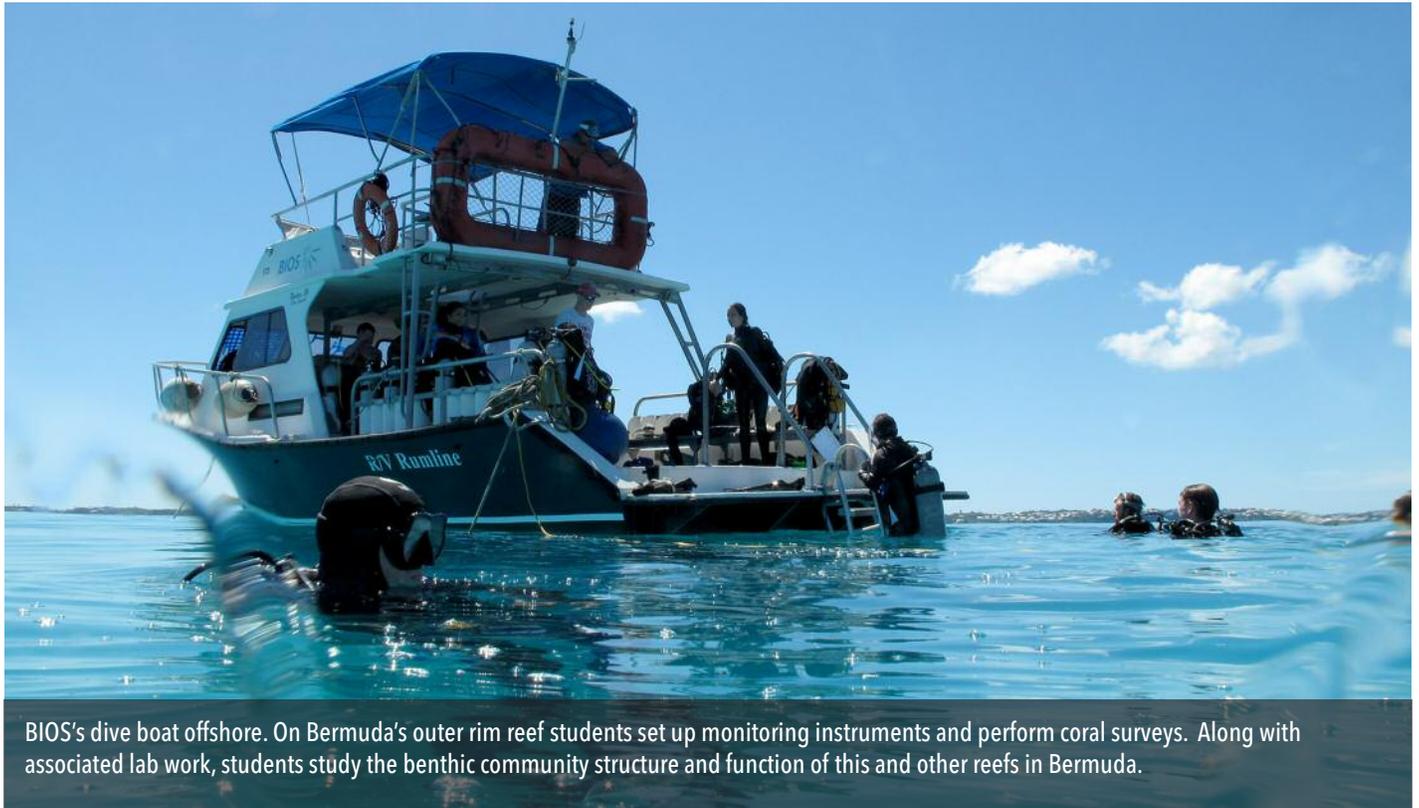
Field and Lab Activities

- Field: Reef surveys–transects, quadrats, photomosaics
- Field: Reef community metabolism & calcification via gradient flux
- Field: Collecting corals for laboratory experiments
- Field: Measuring the underwater light field and seafloor optical properties
- Laboratory: Coral community metabolism & calcification at different temperatures via flow respirometry
- Laboratory: Coral optical properties
- Laboratory: Demo of total alkalinity measurements required for calculating calcification rates

Example Schedule (subject to change)

Day	Time	Activity	Description
Sun	1700-1800	Welcome reception	
Mon	09:00-10:00 10:00-10:30 11:00-12:00 13:00-14:00 14:30-17:00	Orientation Introductions Lecture 1: Paleogeography & Geology Lecture 2: Physical Environment–Waves & Currents <i>Precept: Transects, quadrats, and photomosaics</i>	
Tue	08:30-12:00 13:00-14:00 14:30-15:30 16:00-17:00	Boat: Check-out snorkel/dive; In-water methods practice Lecture 3: Physical Environment–Light & Temperature <i>Precept: Agisoft, point-counting, and statistics</i> <i>Precept: Field and flume sensors overview</i>	
Wed	09:00-12:00 13:00-17:00	Lab: Field-work prep–sensor calibration, hardware prep Lab: Flume experiment prep–sensor calibration, flume setup	
Thu	08:30-12:00 13:00-17:00	Boat: Instrument deployment (GF1), Benthic surveys; Attenuation profiles Lab: Flume experiment start; Mosaic processing	
Fri	09:00-10:15 10:45-12:00 13:00-14:30 15:00-17:00	Lecture 4: Chemical Environment Lecture 5: Reef Corals 1–Biology Data analysis (e.g., benthic surveys, attenuation profiles) Discussion: Readings and open questions/comments	
Sat	15:00-17:00	Lab: Field work prep- Prep for instrument retrieval	
Sun	09:00-12:00 13:00-16:00	Boat: Instrument retrieval (GF1), benthic surveys Lab: GF1 data download and initial data processing	
Mon	09:00-10:15 10:45-12:00 13:00-15:30	Lecture 6: Reef Corals 2–Evolution & Taxonomy Lecture 7: Reef Algae Data analysis	

Tue	09:00-10:15 10:45-12:00 13:00-14:30 15:00-17:00 21:00-22:00	Lecture 8: Reef Sediments Lecture 9: Community & Ecosystem Metabolism Data analysis Data analysis Lab: Retrieve flume sensors; offload data; re-deploy sensors
Wed	09:00-12:00 13:00-16:00	Lab: Field work prep: sensor calibration, hardware prep Boat: Instrument deployment (GF2), Benthic surveys
Thu	09:00-10:15 10:45-12:00 13:00-15:00 15:30-17:00	Lecture 10: Community & Ecosystem Calcification Lecture 11: Carbon & Nutrient Cycling Data analysis Discussion: Readings and open questions/comments
Fri	09:00-10:15 10:45-12:00 13:00-15:00 15:00-17:00	Lecture 12: Zonation of Processes Lecture 13: Trophics Data analysis Data analysis; field work prep
Sat	09:00-12:00 13:00-16:00	Boat: instrument retrieval (GF2), Benthic surveys Lab: GF2 data download and initial data processing
Sun	Free day	
Mon	09:00-12:00 13:00-14:00 15:00-17:00	Lab: Flume experiment end: offload data; cleaning Data analysis (field survey and flume experiment) Data analysis
Tue	09:00-12:00 13:00-17:00 17:00	Boat: Benthic surveys; Attenuation profiles Data analysis; Lab demo: total alkalinity measurements Take-home exam (covers lectures)
Wed	09:00-12:00 13:00-15:00 15:30-17:00	Data analysis and presentation prep Data analysis and presentation prep Discussion: Readings and open questions/comments
Thu	09:00 09:00-12:00 13:00-15:00	Take-home exam due Data analysis and presentation prep Data analysis and presentation prep
Fri	09:00-12:00 17:30-19:00	Group Presentations Farewell BBQ



BIOS's dive boat offshore. On Bermuda's outer rim reef students set up monitoring instruments and perform coral surveys. Along with associated lab work, students study the benthic community structure and function of this and other reefs in Bermuda.

Student Testimonials (*CRE course did not run in 2020 due to COVID19*)

"I hoped to determine whether or not I would like to go into a research-based graduate program surrounding coral and their ecosystems. I was also hoping to gain more dive experience as a scientific diver and meet new connections. I most definitely made some wonderful connections and was able to hone in my diving skills. I was also able to further decide what type of graduate program I would like to attend." - Samantha Morrison

"My plans for the future are to attend law school for environmental law and upon returning I have actually began studying for the LSAT. My time at BIOS has influenced my future plans even greater as now that I have had field experience I will have a greater understanding of what is actually happening in our oceans. I will take what I learned from this course to hopefully develop policies and legislation to further protect the coral reefs, marine life, and other factors within our oceans. By being in this course I believe it can separate me from other environmental lawyers as I have had a first hand experience in working in the field and with corals." - Sean Kelley

"The station is in a beautiful spot right on the harbor. The shore facility and research vessels make BIOS an excellent spot to prepare for and to launch field trips. The scientists at the laboratory were very passionate about their work and were easily approachable. Also, all three of the courses on station this summer attracted driven, enthusiastic, and kind students from all over the world in all stages of their careers as marine scientists. Any organization that can bring such a wonderful and diverse group of scientists together in one spot is certainly impressive to me."
- Sydney Greenlee

"I am a coral reef paleoecologist, meaning I work in deep-time, and although I study similar things as modern coral reef ecologists we tend use a different vocabulary. One of my goals was to become familiar with how coral reef ecologists talk about science. In addition, I believe it is important for paleoecologists to have thorough understanding of modern systems. I am extremely satisfied as I was able to achieved both of these goals."
- Amanda Godbold

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"I wanted to gain experience with scientific diving techniques as well as figure out if research was a route I would be interested in pursuing. I learned a lot from this course and discovered that research definitely is a field that interests me." - Chantelle Clermont

"I loved the time I spent here. Everyone was very friendly and genuinely cared about helping all of the students along on their respective paths. Very educational and useful for setting me up for success for a career in the marine sciences." - Bradley Sommer

"I fell in love with every single lesson of the course and I really liked all the diving and lab activities. But the thing that most impressed me it was the kindness and willingness of all the instructors, which with their passion have really inspired me...Tropical environments are my first passion and I'm currently studying some organisms characterizing the benthos communities of Maldives. So after having read the description of the course, I thought it could be very useful for my career and future works." - Camilla Roveta

"I've really enjoyed my time at BIOS. The course was extremely intense, dense with classes, labs and fieldwork. All the activities done during the course resulted to be very interesting. I learned a lot, not just in class but also by doing, both in the lab and in the field. Professors were very well prepared and knew the topic extremely well. Everyone was very passionate about the subject, which made the classes even more entertaining." - Francesca Molinari

"I hoped to learn as much as possible on the state-of-the-art research in the coral reef ecology field, in hope that it would help my future project proposals on bio-optical measurements and modelling of coral reefs. I was slightly afraid I would have trouble with the biological aspects with my physical/engineering background, however, the contents were very well explained and the additional readings, complemented with lab and field work, enabled me to gain a good insight on the subject. I learned a lot about lab work, understood the procedures and why certain methodologies go well with certain questions to address. Moreover, I got confident working underwater, due to also the invaluable guidance of Alex Hunter. I can't underline enough how these few weeks truly broadened my horizons and made me appreciate even more all the different methodological aspects within a research field. There is no dividing line between biologists, physicists, chemists." - Elena Terzić

"What impressed me the most was the attitude of the academics and teaching team, not only those on the coral reef course but indeed it was a common atmosphere throughout BIOS, that everyone was willing to take the time to talk to you and help you. I was especially impressed by the CRE course team and found that I wanted to be able to work with them in the future as they are all very knowledgeable and are great people to work with." - Helen Ford

"BIOS definitely helped me develop skills that will follow me during all my scientific career, in coral reef research and marine resources management...I chose BIOS for its unique location and formation in the Atlantic, and to look at coral reef ecosystems in this particular setting." - Myriam Dumais

"I never imagined I could learn so much in such short period of time. We learned from the morphology of a coral polyp to extracting DNA samples of crustose coralline algae. I loved how wide and yet with a very fair deepness every topic was imparted...I have always worked with coral restoration, and was very focused on increasing their presence and chances of survival in the wild. After taking this course I am more focused on the science behind restoration, that is often forgotten and essential to measure the efficiency of all efforts. I decided to keep working on restoring these ecosystems, but with controlled and measurable variants to keep innovating on keener strategies." - Nepsis García

"I was impressed by how different types of research are being done there. I think BIOS is a very complete research station and many things impressed me. I really enjoyed the respirometry lab and the experiments they had in there." - Ricardo Pohlenz

"Unforgettable, amazing time learning some new techniques and aspects on coral reef ecosystems that before I was not even taking into account as possible skills/techniques/properties/synergies." - Torcuato Mantas

"I had heard many great things about this course, such as the professional and challenging environment, the great people that you get to work with and develop professional relationships with, and the quality of the course in terms of its content. This course also presented many things of interest to me. Advanced diving opportunities such as collecting data in a challenging environment, and learning about coral reef systems were all new to me. I came to BIOS to learn more about coral systems and to advance my scientific diving skills. I learned more than expected in this course and would definitely recommend it." - Victoria Golding