



ENVS/MARI 4005 Coral Reefs and Environmental Change

Faculty of Science Course Syllabus Fall 2025

Department of Earth and Environmental Science

Class Times: Mondays and Wednesday 11:35 – 12:55 pm **Location:** Killam Library 4106

Tutorial times: Tuesdays 235-325 pm **Location:** LSC B2055

Instructor: Dr. Sue Gass | Email: sue.gass@dal.ca

Student Support Hours: Mondays 1:00 - 2:30 pm In person LSC 3082 or on MS Teams

Communication guidelines

Good communication between the Instructor and students is key to the success of students in a course. I will do my best to respond to your emails within 24 hours except over the weekend where it may be 48 hours. If you have a concern with the course, please reach out.

Class Description

Coral reefs are iconic of highly diverse ecosystems and play a significant role in the economies of most countries where they exist. Cold-water corals are lesser known than their tropical relatives but also enhance the structural complexity and thus habitats within their deep ocean environments. Humans have changed coral reef environments and further changes are predicted to occur in the future. This class will introduce you to the biology of corals and the key characteristics that make up their environments. We will examine some of the major human impacts on these environments including warmer temperatures, acidification, pollution, and commercial activities. Finally, we will consider options to minimize further negative changes and ways to help sustain coral ecosystems into the future. This course runs parallel with ENVS 4003 but includes the addition of a 7-day field trip to the Bermuda Institute of Ocean Science.

Dalhousie University operates in the unceded territories of the Mi'kmaw, Wolastoqey, and Peskotomuhkati Peoples. These sovereign nations hold inherent rights as the original peoples of these lands, and we each carry collective obligations under the Peace and Friendship Treaties. Section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights in Canada.

We recognize that African Nova Scotians are a distinct people whose histories, legacies, and contributions have enriched that part of Mi'kma'ki known as Nova Scotia for over 400 years.

Course pre-requisites, exclusions

Chem 1011/Chem 1012 and Biol 2060. Also restricted to students with six credit hours in Environmental Science or Biology or Marine Biology at or above the 3000 level. This course is an exclusion with ENVS/MARI 4005.

Key knowledge or skills expected of students coming into the course:

- Student should know how to balance chemical equations
- Student should be familiar with reading scientific literature
- Students should be able to describe major drivers of and differences among marine biomes; how abiotic factors influence the distribution and abundance of organisms; and the effects of disturbance on species diversity.
- Students should be able to predict the impacts of human activities (e.g. climate change, nutrient loading) using knowledge of the major biogeochemical cycles on the planet (e.g. water, carbon and nitrogen).
- No previous knowledge of corals is required

Course learning outcomes:

1. Describe the anatomy and identifying features of common tropical and cold-water corals
2. Describe taxonomic relationships among corals
3. Describe the abiotic environment of tropical and cold-water corals including nutrient cycling
4. Predict how changing environmental factors will affect corals (temperature, salinity, ocean acidification, sedimentation, excess nutrients, freshwater inputs)
5. Describe the reproductive strategies of corals and how these influence coral resilience
6. Describe how corals feed and grow
7. Describe different research methods used to study coral responses to environmental change.
8. Differentiate the functional roles of fish groups within coral reef ecosystems
9. Carry out literature-based research and communicate the current state of knowledge on a range of topics related to corals and environmental change
10. Describe localized impacts on coral reefs
11. Describe the causes, the biological process, and the ecological consequences of coral bleaching.
12. Describe how ocean acidification may or may not hinder coral growth
13. Explain the options for coral reef conservation and the challenges faced by Low-Income and High-Income countries when trying to implement these measures.
14. Describe the potential resilience of coral reefs to environmental change
15. Present and critique scientific findings from the literature to fellow students
16. Develop familiarity with the terminology used in the study of corals
17. Evaluate anthropogenic interventions that could be used to protect coral reefs from climate change

Textbook and Readings

1. The Biology of Coral Reefs, 2nd Edition. Charles R.C. Sheppard et al., 2018 (required text).

There are several ways for you to access readings in the textbook:

- E-book available for free through the Dalhousie Library
<https://ezproxy.library.dal.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=e000xna&AN=1640102&site=ehost-live&scope=site>
- Hard copies are available to purchase at the Dalhousie bookstore
- E-book is available to purchase from Oxford University Press
- It's the same textbook as in previous years so you may be able to find a second hard copy

Additional Readings List – links and/or pdfs are found on Brightspace. Additional readings may be added.

1. Moberg, F. and C. Folke. (1999). Ecological goods and services of coral reef ecosystems. *Ecological Economics* 29: 215-233.
2. Obura DO (2020) Getting to 2030 - Scaling effort to ambition through a narrative model of the SDGs. *Marine Policy* 117:103973
3. Wiedenmann, J., D'Angelo, C., Mardones, M.L. *et al.* Reef-building corals farm and feed on their photosynthetic symbionts. *Nature* **620**, 1018–1024 (2023). <https://doi.org/10.1038/s41586-023-06442-5>
4. Gilmour, J., Smith, L., Cook, K., and S. Pincock. (2013) Discovering the Scott Reef: 20 years of exploration and research. Australian Institute of Marine Science. Chapter: Coral Ecology.
5. Hoegh-Guldberg, O. (1999). Climate change, coral bleaching and the future of the worlds coral reefs. *Marine and Freshwater Research* 50, 839.66.
6. NOAA Coral Reef Watch. (nd). Introduction Tutorial to NOAA's Coral Reef Watch program. Accessed from: <https://coralreefwatch.noaa.gov/satellite/education/tutorial/welcome.php>
7. Hughes, T.P., J.T. Kerry, A.H. Baird, S.R. Connolly, A. Dietzel, C.M. Eakin, S.F. Heron, et al. (2018). Global warming transforms coral reef assemblages. *Nature* 556: 492-496
8. Aswani, S., Mumby, P. J., Baker, A. C., Christie, P., McCook, L. J., Steneck, R. S., & Richmond, R. H. (2015). Scientific frontiers in the management of coral reefs. *Frontiers in Marine Science*, 2. <https://doi.org/10.3389/fmars.2015.00050>
9. Bellwood, D.R., T.P. Hughes, C. Folke and M. Nystrom. (2004). Confronting the coral reef crisis. *Nature* 429: 827-833
10. McLeod, E., Anthony, K. R. N., Mumby, P. J., Maynard, J., Beeden, R., Graham, N. A. J., Heron, S. F., Hoegh-Guldberg, O., Jupiter, S., MacGowan, P., Mangubhai, S., Marshall, N., Marshall, P. A., McClanahan, T. R., Mcleod, K., Nyström, M., Obura, D., Parker, B., Possingham, H. P., ... Tamelander, J. (2019). The future of resilience-based management in coral reef ecosystems. *Journal of Environmental Management*, 233, 291–301. <https://doi.org/10.1016/j.jenvman.2018.11.034>
11. Roberts, J.M., A. Wheeler and A. Freiwald. (2006). Reefs of the Deep: The Biology and Geology of Cold-Water. *Science* 312: 543-547.
12. Hoegh-Guldberg, O. P., J. Mumby, A. J. Hooten, R.S. Steneck, P. Greenfield, E. Gomez, C.D. Harvell et al. (2007). Coral reefs under rapid climate change and ocean acidification. *Science* 318: 1737-1742

13. Guinotte, J.M., J. Orr, S. Cairns, A. Freiwald, L. Morgan and R. Goerge. (2006). Will human-induced changes in seawater chemistry alter the distribution of deep-sea scleractinian corals? *Frontiers in Ecology and Environment* 4(3): 141–146
14. DFO (Fisheries and Oceans Canada). (2015). Coral and Sponge Conservation Strategy for Eastern Canada. Fisheries and Oceans Canada. 70 pp.

Grading Scheme – ENVS/MARI 4005

Assessment component	%	Due Date
Assignment 1 Coral morphology	10	October 2 nd
Assignment 2 Coral bleaching	10	November 18 th
Midterm Exam (in class)	30	Oct 26 th in class
BIOS project presentations	20	December 1 st
Course engagement	20	10% during regular term classes 10% during field trip to Bermuda
Course reflection	10	December 11 th

All assignments, unless otherwise specified above, are submitted on Brightspace before midnight on the due date

Course engagement and in-class participation

Attendance and engagement with the course material will be worth 10% of your grade. Attendance alone does not earn grades; your grade will increase the more you take advantage of opportunities to engage with the course content. The grading rubric focuses on each student setting personal goals and assessing your own success through reflection with oversight by the course instructor.

Opportunities to engage with the course material come in many forms. It could include coming to class having done the readings and ready to answer or ask questions on the readings, contributing to small group discussions, offering feedback from your small group to the whole class, raising your hand to answer or ask questions in class, participating in whole class discussions, allowing other students to participate by not dominating discussions when you would normally be inclined to speak often. If you are less comfortable speaking out in class, you can post comments and/or questions on lecture material to the Class Discussion Board. I encourage you to push yourselves outside of your comfort zone and set ambitious goals. I also encourage you to practice your critical thinking skills, i.e.,

asking questions that arise from the readings and making connections between course topics and with previous courses and the material in this course. Everyone is allowed two free missed classes without deductions, e.g. due to illness, and should submit an SDA for missed classes. After that, your course engagement grade will be pro-rated based on your attendance in class.

Field trip participation

The field trip is focused on learning by doing, while also hearing from a range of experts conducting research on coral reefs and environmental change. You will be expected to actively participate in all the field and lab activities. This will allow you to learn new knowledge and take away as many new skills as possible from your experience in Bermuda. In addition, scientists do not work in isolation; therefore, working effectively with others is a valuable skill to develop. The following parameters will be assessed for the participation during the field trip:

- Participating willingly in activities and allowing others to participate
- Asking questions when things aren't clear
- Being familiar with the readings
- Providing ideas, working with others to solve problems
- Being prepared, punctual and courteous in the field
- Lending a hand in the field or lab when help is needed
- Being safe and looking out for fellow students

Mid-term exam

There will be a mid-term exam on the material covered up to and including the lecture held on October 8th. The mid-term will be held in class and is scheduled for **October 26th**.

Assignments

There will be 2 assignments. Assignment 1 is due before midnight on **Oct 2nd** via Brightspace. Assignment 2 is due **November 18th** before midnight and should be submitted online via Brightspace. Assignment instructions are posted on Brightspace.

BIOS Project Presentations

You will participate in three field trips and one lab to collect data and further your understanding of coral reefs and environmental change while at BIOS. You will work in groups to prepare an oral presentation focused on the Bermuda reef environment, the field methodology, and results for one of these four experiences. A detailed description of what is required for the presentations will be posted on Brightspace.

Policy on late assignments

Missed or Late Academic Requirements due to Student Absence

Dalhousie students are asked to take responsibility for their own missed deadlines (3 days or less) by contacting their instructor by email **prior to** the academic requirement deadline or scheduled time **and** by submitting a completed Student Declaration of Absence (SDA) to their instructor in case of missed or late academic requirements. The SDA form can be found on our Brightspace page under “Assignments”. Only **TWO** separate SDA forms may be submitted per term for missed classes and **TWO additional** SDAs may be submitted for late assignments. Once the SDA has been submitted, you will have three days to submit your assignment. If you miss the mid-term due to illness, you must follow the protocol as above and a make-up mid-term will be scheduled one week later.

Assignments submitted late without prior notification **and** the submission of an SDA, or without an approved extension will be deducted 10% per day. Extensions are granted with good reason and **must be requested prior** to the assignment’s original due date. If you have any questions or concerns, please do not hesitate to reach out to the instructor.

Course Policies related to Academic Integrity and Student Accommodations

Accessibility: Refer to the [Student Accommodation Policy](#) for information on how Dalhousie instructors and staff work collaboratively with students to create and sustain an accessible educational environment.

- If there are aspects of this course, including but not limited to its design, teaching approaches, learning activities, and assessments, that result in barriers to your learning or do not align with your formal academic accommodations, reach out to me to collaboratively find a solution that meets your needs.
- You are eligible for accommodations based on [protected characteristics](#) such as religion. If you have [religious, cultural, or community-significant observances](#) that conflict with course requirements, reach out to me to collaboratively find alternatives for completing the course requirements.
- To begin the process of requesting a formal academic accommodation, contact the [Student Accessibility Centre](#) (or the [Student Success Centre](#) for Faculty of Agriculture courses).
- Your classroom may contain accessible furniture and equipment. It is important that these items remain in the classroom, undisturbed and unused, so that classmates who require their use will be able to fully participate in the course.

Academic Integrity: Dalhousie expects all students to be responsible learners, [demonstrating the values](#) of intellectual honesty, trust, fairness, and respect in your work. Key aspects of academic integrity include, but are not limited to: avoiding plagiarism, not engaging in cheating, submitting

original work, and acknowledging sources of information and ideas when they are not your own. Refer to the [Statement on Intellectual Honesty](#) for definitions of various academic offences. Failure to meet Dalhousie's academic integrity standards will result in appropriate [disciplinary and/or corrective measures](#).

Although you are allowed and in some cases encouraged to work together on course assignments, unless specifically stated in the assignment instructions, the final work that is submitted must be completed individually.

You will find that the use of AI generative tools will not be helpful to the first two assignments in this course because of the specific nature of each assignment and you are not permitted to use AI in these cases.

You should note that the material generated by generative AI programs may be inaccurate (creates hallucinations), lacks human judgement and comes with a series of ethical considerations such as training with copyrighted content, the use of unpaid labour, a large carbon and water footprint, and it perpetuates biases, stereotypes, and prejudices found in the training data. Further, you should be aware that use of generative AI may also stifle your own development as an independent critical thinker and stifle your creativity and comes with a significant energy and water footprint.

Generative AI programs are not allowed under any circumstances to be used for generative editorial work and autonomous content creation. You may use it for study aids such as helping to explain concepts while you review lecture material or to help you with time management/planning. Any additional uses of AI will be deemed an academic offence under the Academic Integrity policy at Dalhousie. Any plagiarism or other form of cheating will be dealt with severely under relevant Dalhousie University policies.

The Meaning of Grades

Evaluation will be completed and expressed in raw marks throughout the course. Letter grades will be assigned only to the final distribution of marks for the course.

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (<50)
A- (80-84)	B- (70-72)	C- (55-59)	

Class schedule

Week	Topic	Monday	Wednesday	Readings
Week 1	Introduction and ecosystem services		Lecture 1 - Introduction to the course - Value of coral reefs - Ecosystem goods and services & sustainable development goals	Chapters 1 Moberg and Folke (1999) Ologies Podcast: Cnidariology
Week 2	What is a coral?	Lecture 2 - Discussion questions from previous lecture - What is a coral – Hard corals	Lecture 3 - Coral ID Lab Assignment 1 (due Oct. 2nd) - Sign up for a 30 mins slot in the McCullough museum	Chapter 2 Obura (2020)
Week 3	Abiotic environment	Lecture 4 - What is a coral: Soft corals, Black corals, Sea pens - Abiotic Environment: Salinity, Temperature	Lecture 5 Abiotic environment: Light, Nutrients, Sedimentation	Chapters 3
Week 4	Coral growth	Lecture 6 - Coral calcification - Growth	Truth and Reconciliation Day Assignment 1 due Friday Oct 2 nd	Chapter 4
Week 5	Symbiosis	Lecture 7 Feeding and symbiosis	Lecture 8 Coral nutrition update Part 1	Chapter 4 Wiedenmann et al. 2023
Week 6	Symbiosis	No Class - Thanksgiving	Lecture 9 Coral nutrition update Part 2	Wiedenmann et al. 2023
Week 7	Reproduction Coral Bleaching	Lecture 10 - Reproduction - Recruitment	Lecture 11 Introduction to coral bleaching	Gilmour et al. 2013 Hoegh-Guldberg et al. 1999

Week 8	Midterm Coral Bleaching cont'd	Midterm in class Covers Lectures 1-10		Lecture 12 - Predicting bleaching events using remotely sensed data - Hotspots and DHWs	NOAA Coral Reef Watch Introduction
Week 9	Coral Bleaching cont'd Coral reef fish	Lecture 13 - Background information for Assignment 2 – Coral Bleaching - Changes in bleaching frequency according to Hughes et al. 2018		Lecture 14 Coral reef fish <i><u>Class ends 30 mins early</u></i>	Hughes et al. 2018 Chapter 6
Week 10	Field Trip to Bermuda Friday Nov 6 – Friday Nov 13th				
Week 11	Human impacts and management	Lecture 15 - Coral reef fisheries - Local stressors		Lecture 16 Coral reef resilience and management Assignment 2 due Nov 18th	Chapter 7 & 8 Bellwood et al. 2004 Aswani et al. 2015
Week 12	Management	Lecture 17 Coral reef management		Lecture 18 No class – work on group projects	McLeod et al. 2020
Week 13	Cold-water corals	Lecture 19 No class – work on group projects		Lecture 20 No class – work on group projects	
Week 14	Ocean acidification	Lecture 21 Tropical corals and ocean acidification	Lecture 22 Cold-water corals and ocean acidification <i><u>Class ends 30 mins early</u></i>	Lecture 23 Cold water coral conservation and management Course reflections	Hoegh-Guldbert et al. 2007 Guinotte et al. 2006 Coral & sponge conservation strategy for Eastern Canada 2015

Week	Tutorial
Week 1 - Sept 8	Introduction to field trip Review logistics
Week 2 - Sept 15	Community building
Week 3 - Sept 22	Intro to Predeparture modules
Week 4 - Sept 29	Complete predeparture modules
Week 5 - Oct 6	Complete predeparture modules
Week 6 - Oct 13	Bermuda Coral IDs Intro to Lab
Week 7 - Oct 20	Bermuda Fish IDs Intro to Lab
Week 8 - Oct 27	Introduction to final projects Oral presentation guidelines
Week 9 - Nov 3	Review activities and background information for field trip
Week 10	Field trip – no tutorials
Week 11 - Nov 17	Work on BIOS project presentations
Week 12 - Nov 24	Work on BIOS project presentations
Week 13 - Dec 1	BIOS project presentations (extended class time)

Student Supports and University Statements, Policies, and Guidelines

You can find all relevant information: [Here](#)