DALHOUSIE UNIVERSITY

ENVS/MARI 4003 Coral Reefs and Environmental Change

Faculty of Science Course Syllabus Fall 2025

Department of Earth and Environmental Sciences

Class Times: Class Times are Mondays and Wednesdays 2:35-3:55 pm

Location: LSC C334

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

Student Support Hours: Mondays 1-230 pm in person LSC 3082 or on MS Teams or by appointment

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 or any questions related to 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 fishing. Finally, we will consider options to minimize further negative changes and ways to help sustain coral ecosystems into the future.

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.

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

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. Compare 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 and coral reef management techniques 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:

- Two-hour reserve at the Killam Library
- 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. Hoegh-Guldberg, O. (1999). Climate change, coral bleaching and the future of the worlds coral reefs. Marine and Freshwater Research 50, 839.66.
4. 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
5. 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
6. 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
7. Bellwood, D.R., T.P. Hughes, C. Folke and M. Nystrom. (2004). Confronting the coral reef crisis. Nature 429: 827-833
8. Roberts, J.M., A. Wheeler and A. Freiwald. (2006). Reefs of the Deep: The Biology and Geology of Cold-Water. Science 312: 543-547.
9. 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
10. 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
11. DFO (Fisheries and Oceans Canada). (2015). Coral and Sponge Conservation Strategy for Eastern Canada. Fisheries and Oceans Canada. 70 pp.
12. 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

Grading Scheme – ENVS/MARI 4003

Assessment component	%	Due Date
Assignment 1 Coral morphology **Assignment 2** Coral bleaching	10 10	October 15th November 24th
Midterm Exam (in class)	30	October 27th
Reading the Primary Literature 3 article discussions (peer evaluations) 1 written summary	(10) 5 5	See class schedule for primary literature discussion dates – Summaries are due one week after the discussion.
Term project **Outline with references** **Final Project**	(30) 5 25	 December 3rd December 15th
Course engagement	10	Goal setting (2%) – due Sept 29th, Goal reflection 1 (2%) due Oct 31st, and Goal reflection 2 (4%) due December 12th

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.

Mid-term exam

There will be a mid-term exam on the material covered up to and including the Lecture 8. The mid-term will be held in class and is scheduled for **October 27th**.

Assignments

There will be 2 assignments. Assignment 1 is due before midnight on **October 15th** via Brightspace. Assignment 2 is due **November 24th** before midnight and should be submitted online via Brightspace. Assignment instructions are posted on Brightspace.

Primary Literature Article Discussions and Summaries

There will be three in-class small-group discussions based on primary literature articles. You will be responsible for writing a summary for **one** of the articles and for leading one of the discussions in class. The summary is due one week after the particular in-class discussion you wish to write about.

Your primary literature discussions and summary are worth 10% of your grade. You will receive a peer evaluation grade based on your performance leading the group discussion and contributing to the other two student led discussions (5%). And the written summary is worth 5%.

Term project

Your term project will allow you to work with a peer to apply your understanding of coral reefs and environmental change to a case study. Your project will focus on a coral reef system under threat and proposed management actions that could help overcome these threats. You will provide a project outline (it's recommended to have some initial discussions with the Instructor on your proposal before submitting the outline). A detailed description of what is required for the project is 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.

If you think you are going to miss acting as a discussion leader due to illness, then you should first ask if anyone in the group is willing to switch days with you. If you are unable to switch, then please contact the instructor and we will do our best to accommodate you. 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

Although you are allowed and in same 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 novel and specific nature of each assignment and you are not permitted to use AI in these cases.

You should note that the material generated by large language model 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 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. For these reasons, 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, without prior written instructor approval, 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 Sept 24	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) Obura (2020)
Week 2 Sept 29&Oct 1	What is a coral?	Lecture 2 • Discussion questions from previous lecture • What is a coral? What is a coral reef?	Lecture 3 • Coral ID Lab Assignment 1 (due October 15th) Attend a 30 mins slot in the McCullough museum	Chapter 2
Week 3 Oct 6 & 8	Abiotic environment Growth & feeding	Lecture 4 • Salinity • Temperature • Light • Nutrients	Lecture 5 • Coral calcification • Growth	Chapters 3 & 4
Week 4 Oct 13 & 15	Reproduction and recruitment **Assignment 1 due October 15th**	**No Class - Thanksgiving**	Lecture 6 • Feeding and symbiosis	Chapter 4
Week 5 Oct 20 & 22	Coral bleaching	Lecture 7 Reproduction & Recruitment	Lecture 8 • Introduction to coral bleaching • Predicting bleaching events using remotely sensed data • Hotspots and DHWs	Hoegh-Guldberg et al. 1999 NOAA Coral Reef Watch Introduction

Week 6 Oct 27 & 29	Midterm and coral bleaching	**Midterm in class**	Lecture 9 • Recording past bleaching events • What is El Nino? • Graphing coral bleaching data	
Week 7 Nov 3 & 5	Midterm & coral reef fisheries	Lecture 10 • Background information for Assignment 2 (Due November 24th) • Changes in bleaching frequency according to Hughes et al. 2018 ***1st primary literature discussion***	Lecture 11 • Coral reef fish	Hughes et al. 2018 Chapter 6
Week 8	**Study Break – No classes**			
Week 9 Nov 17 & 19	Marine management	Lecture 12 • Coral reef fisheries	Lecture 13 • Local stressors • Coral reef management ***2nd primary literature discussion***	Chapter 7 & 8 Aswani et al.
Week 10 Nov 24 & 26	Cold water corals **<u>Assignment 2 due Nov 24</u>**	Lecture 14 • Coral reef management for resilience and restoration	Lecture 15 • Introduction to the term project • Form teams and choose topics Brainstorm session in teams	Bellwood et al. 2004 McLeod et al. 2020
Week 11 Dec 1 & 3	Cold-water corals	Lecture 16 • Work on term projects	Lecture 17 • Introduction to cold-water corals • Corals of Atlantic Canada ***3rd primary literature discussion***	Roberts et al. 2006
Week 12 Dec 8-10		Lecture 18 • Tropical corals and ocean acidification	Lecture 19 • Cold-water corals and ocean acidification	Hoegh-Guldbert et al. 2007 Guinotte et al. 2006

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: https://www.dal.ca/about-dal/internationalization.html

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with

the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: http://www.dal.ca/cultureofrespect.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.