ENVS 4003/MARI 4003 Coral Reefs and Environmental Change

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Office Hours: Tuesdays 1-230 pm or by appointment

Class Times: T/Th 2:35-3:55 pm Fall Term – Room LSC 812

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 impacts humans are having 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.

Course pre-requisites

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.

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

- Student should know how to balance chemical equations and understand the principles of stable isotopes.
- 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 goals and learning outcomes:

- Describe the anatomy of common tropical and cold water corals
- Describe taxonomic relationships of the different corals
- Describe the abiotic environment of tropical and cold-water corals
- Predict how changing environmental factors will affect corals (temperature, salinity, ocean acidification, sedimentation, excess nutrients, freshwater inputs)
- Describe the reproductive strategies of corals.
- Describe how corals feed and grow
- Describe different research methods used to measure coral growth and the impacts of changing environments on coral growth.

- Choose an appropriate research technique for measuring coral growth under different circumstances
- Carry out literature-based research and communicate the current state of knowledge on a range of human impacts on tropical and cold-water coral reefs.
- Describe the causes, the biological process, and the ecological consequences of coral bleaching.
- Choose an appropriate research method for measuring the impacts and predict coral bleaching events.
- Explain the options for coral reef conservation and the challenges faced by developed and developing countries when trying to implement these measures.
- Describe the potential resilience of coral reefs to environmental change.
- Critique scientific writing
- Present scientific findings from the literature to fellow students

Brightspace Site

The course syllabus, assignments, and other pertinent information will be located on the course Brightspace site. You are expected to check this site regularly (i.e. every week) and will be asked to submit assignments through this site.

Textbook and Readings

The Biology of Coral Reefs, Charles R.C. Sheppard et al., 2009 (required text)

Other readings (links provided via Brightspace):

1. Hoegh-Guldberg, O. (1999). Climate change, coral bleaching and the future of the world.s coral reefs. Marine and Freshwater Resesearch 50, 839.66.
2. Hoegh-Guldberg, O. P., J. Mumby, A. J. Hooten, et al. (2007) Coral reefs under rapid climate change and ocean acidification. Science 318: 1737-1742.
3. Roberts, J.M., Wheeler, A. and A. Freiwald (2006). Reefs of the Deep: The Biology and Geology of Cold-Water. Science 312: 543-547.
4. Gass, S. and J.H.M. Willison (2005). An assessment of the distribution of deep-sea corals in Atlantic Canada by using both scientific and local forms of knowledge. Pages 223–245 in A. Freiwald and J. M. Roberts, eds. Cold-water corals and ecosystems. Springer-Verlag, Heidelberg
5. Guinotte, J.M., J. Orr, S. Cairns4 et al. (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
6. DFO (Fisheries and Oceans Canada) (2015). Coral and Sponge Conservation Strategy for Eastern Canada. Fisheries and Oceans Canada. 70 pp.

Grading scheme

Assessment component	% of Final Grade	Due Date
Midterm	10	October 11 – in class
Final exam	25	TBA Final Exam Period
Assignments		
1	3.33	September 27th in dropbox
2	3.33	October 20th in dropbox
3	3.33	October 25th in dropbox
Group poster	20	November 24th in dropbox/presentation in class Dec. 1
Research paper		
Outline	5	November 3rd Hard copy in class, e-copy in dropbox
Final draft	N/A	
Peer review	5	November 15th In class 2 x hard copies (1 original and 1 photocopy)
Final paper	20	December 6th in dropbox
Participation	5	All term

Mid-term and final exam

There will be a mid-term and a final exam on the material covered in class. The mid-term is schedule for **October 11, 2016** in class and the final exam will be 2 hours held during the official exam period.

Assignments

There will be 3 assignments each of which will include a written component to be uploaded via the appropriate Brightspace dropbox. Assignment 1 is due by midnight on September 27th. Assignment 2 and Assignment 3 are due on Brightspace before the following class. The majority of the work for the assignments will be completed in class.

In-class participation

Attendance and participation in class discussions, and in-class activities will be worth 4% of your grade. I have posted a rubric for your class participation grade on Brightspace.

#OceanOptimism (Group) Posters

This assignment will allow each group to research and become familiar with a management tool that can be used to protect tropical or cold-water coral reefs. Within a group of 2-3 students you will be responsible for finding a case study where your management tool has been successfully implemented and present this case study via a poster. We will hold an open poster session on the last day of classes where each group will present their posters. Posters must be uploaded onto the dropbox by **November 24th** so I can get them printed in time for the poster session. Below you will find a list of topics. A sign up sheet will be available at the start of term and each person is to sign up to a topic. No more than three students can sign up for any one topic. Details for the assignment are posted on Brightspace.

Poster topics:

1. Conservation economics
2. Marine protected areas
3. Collaborative or co-management
4. Community based management
5. Integrated coastal (zone) management/watershed level management
6. Sustainable eco-tourism
7. Education
8. Coral reef restoration
9. Environmental impact assessment
10. Assisted evolution
11. Cold-water coral conservation in Canada
12. Cold-water coral conservation in a country or region other than Canada
13. Cold-water coral conservation on the high seas

Research Paper

Whereas your group poster will be based an pre-selected topics, your research paper will allow you to dive deeper into an issue of greatest interest to you and share with me your individual scholarship on corals and changing environments. You may choose to write your paper on any topic that relates to coral reefs and environmental change. The marks will be broken down into three parts. You will provide me with an outline of your paper (preferably after some initial discussions with me on your topic) by September 20th for 5% of your grade. A final draft of your paper is due in class on November 3rd and will be reviewed by the instructor and a fellow student over the study break. At this stage you are being graded on your review of someone else's paper and not on your paper. Your review of your peers' paper is worth 5% and is due on November 15th in class. I will also have feedback on your final drafts ready for you on this date. Your final paper is due on December 6th uploaded into the dropbox and will be worth 20%.

A detailed description of what is required for the paper is posted on Brightspace.

Policy on late assignments

Assignments submitted late without an approved extension or unaccompanied by a doctor's note will be deducted 10% a day. Extensions may be granted under certain circumstances but **must be requested *at least* one week** prior to assignment's original due date.

Academic Integrity

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.

The Academic Integrity website (http://academicintegrity.dal.ca) provides students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed

honestly. The full text of Dalhousie's ***Policy on Intellectual Honesty*** and ***Faculty Discipline Procedures*** is available here:

http://www.dal.ca/dept/university_secretariat/academic-integrity/academic-policies.html

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)	

Accommodation policy for students

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie's Student Accommodation Policy can be accessed here: http://www.dal.ca/dept/university_secretariat/policies/academic/student-accommodation-policy-wef-sep--1--2014.html

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the ***Request for Accommodation*** form are available at www.dal.ca/access.

Student Code of Conduct

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. In general:

"The University treats students as adults free to organize their own personal lives, behaviour and associations subject only to the law, and to University regulations that are necessary to protect

- the integrity and proper functioning of the academic and non – academic programs and activities of the University or its faculties, schools or departments;
- the peaceful and safe enjoyment of University facilities by other members of the University and the public;
- the freedom of members of the University to participate reasonably in the programs of the University and in activities on the University's premises;
- the property of the University or its members."

The full text of the code can be found here: http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

Service	Support Provided	Location	Contact
General Academic Advising	Help with - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals - dealing with academic or other difficulties	**Killam Library Ground floor** Rm G28 ***Bissett Centre for Academic Success***	In person: Killam Library Rm G28 By appointment: - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal
Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	**Killam Library** **Ground floor** Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328
Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	**Killam Library 3rd floor** Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours **All information can be found on our website: www.dal.ca/sfs**

Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field	**Killam Library Ground floor** Learning Commons & Rm G25	To make an appointment: - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week **See our website: writingcentre.dal.ca**

Course Schedule

Week	Date	Topic	Readings
1	Sept 6	An Introduction to the class Values of coral reefs	Syllabus Chapter 1
	Sept 8	BBC Blue Planet - Coral Seas What is a reef? Diversity patterns Mangroves-Seagrasses-Coral reefs	Chapter 1
2	Sept 13	What is a coral? Coral taxonomy and morphology Stony corals, soft corals, sea fans, black corals Other reef organisms - macroalgae	Chapter 2
	Sept 15	The main tropical reef builders – Assignment 1 - Meet in McCulloch Museum	Assignment 1 - Handout
3	Sept 20	Abiotic environment - Controls on reef distribution Divide up into topics to research How do we study corals and environmental change? **Research Paper Outlines due by midnight**	Chapter 3
	Sept 22	Sedimentation How do we study corals and environmental change?	Chapter 3
4	Sept 27	Coral calcification and growth **Upload Assignment 1 by midnight**	Chapter 4
	Sept 29	Feeding and symbiosis	Chapter 4
5	Oct 4	Coral reproduction and recruitment	Chapter 2 – pg 40-43
	Oct 6	Coral reef fishes and fisheries	Chapters 6&7
6	Oct 11	**Midterm**	
	Oct 13	Coral bleaching	Hoegh-Guldberg et al. 1999
7	Oct 18	Coral bleaching Assignment 2 – meet in LSC B2087	Assignment 2 Handout Upload assignment before next class
	Oct 20	Coral bleaching Assignment 3 – meet in	Assignment 3 Handout

		LSC B2087	Upload assignment before next class
8	Oct 25	Tropical corals and ocean acidification	Hoegh-Guldbert et al. 2007
	Oct 27	Coral reefs in the modern world	Chapter 8
9	Nov 1	Coral reef management and conservation, reef resilience – Part 1	Chapter 7, 9 and 10 Christie and White 2007
	Nov 3	Coral reef management and conservation, reef resilience – Part 2 **Final Drafts for Peer Review are due**	Chapter 7, 9 and 10 Christie and White 2007
10	Nov 8	Study break	
	Nov 10	Study break	
11	Nov 15	Introduction to cold water corals *Oasis of the Deep: Cold Water Corals of Canada* **Peer Review comments are due back**	Roberts et al. 2006
	Nov 17	Cold-water corals in Atlantic Canada Specimens in class	Gass and Willison 2005
12	Nov 22	Mapping corals – Guest Lecture Dr. Craig Brown – Applied Research, NSCC	
	Nov 24	Cold-water corals and ocean acidification **Final posters uploaded for printing**	Guinotte et al. 2006
13	Nov 29	Cold-water coral conservation in Atlantic Canada	Coral & Sponge Conservation Strategy for Eastern Canada 2015
	Dec 1	**Poster presentation session**	
14	Dec 6	**No class - Final paper due on Brightspace**	