

OCES 4204 – Coral Reef Ecosystem Science

Spring 2026

1. Instructors

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2. Teaching Assistants (TAs)

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3. Class Time

Tuesday & Thursday, 12:00 – 13:20 (5560, Lift 27/28)

4. Office hours

By appointment (or Zoom)

5. Course Description

Credit points: 4

Pre-requisite: OCES 3003 and OCES 3160

Exclusion: Nil

Brief description:

This course provides a grounding in the theory required for comprehensive multi-disciplinary study of subtidal coastal ecosystems. Using coral reefs as an example, lectures will explore global values and threats on coral reefs, the physical, biogeochemical and ecological factors controlling their structure and function, and how to study these factors using integrative, multi-disciplinary research based on the concepts of ecosystem science.

6. Intended Learning Outcomes

At the end of this course, students should be able to:

1. explain complex interactions between oceanography and the ecology of coastal ecosystems,
2. explain the structure and function of coral reef ecosystems and their basic drivers,
3. formulate scientific hypotheses and design appropriate tests based on theoretical concepts and contemporary literature in the form of a robust scientific or consulting proposal,
4. work collaboratively in a multi-disciplinary group to plan a (remote) field research project, maximising both safety and scientific return per unit effort and expense, including through the preparation of risk assessments,

5. demonstrate familiarity with a wide range of sampling techniques used to survey subtidal coastal ecosystems,
6. demonstrate familiarity with a range of oceanographic instrumentation used in coastal research,
7. critically evaluate and explain sustainability issues relating to coral reef ecosystems, and
8. demonstrate a global perspective on coral reef ecosystems and links to cultures that depend on them.

7. Expected Preparation

A basic background in biological and physical oceanography is expected to be obtained from required OST courses (e.g., OCES 2001, 2002, and 2003). Students must have completed OCES 3003 (Field Methods in Marine Studies) and OCES 3160 (Ecology). Enrolment by research postgraduate students will be possible subject to approval. Students will be required to conduct independent reading before the commencement of the course and prior to each week's lectures.

8. Assessment Scheme

- Class participation: 10 %
- Journal Club: 15 %
- Case Study (literature review): 30 %
- Research proposal (eminent paper update): 20 %
- Group Project & Presentation: 25 %

Class participation

Participation will be assessed both informally (e.g., questions during class) and formally (e.g., online quizzes to be completed prior to classes on Canvas, student sharing in class, participation in lab or field experience sessions).

Journal Club:

Regularly throughout the semester, each student (once each) will be assigned a paper focusing on coral ecosystem science (from a provided list) to read thoroughly and present to the class, explaining the background and rationale (with reference to other literature as needed), outlining the major technique(s) used, and the major conclusions of the study in the context of ecosystem science. All students will be expected to at least skim-read the assigned papers prior to the respective classes and actively participate in the discussions. The presenting student will lead each discussion, including posing questions to the class based on the paper and course content.

Case Study (literature review):

Pick a scientific question related to coral reef ecosystem science and perform a thorough literature review on it, then draft a coral reef “Case Study” chapter that could be included in the textbook based on your reading (see case study chapters in Section V of **WEA**). Topics should focus on interdisciplinary interactions between at least two of (1) biological, (2) chemical and (3) physical process on coral reefs. Extra marks will be given for original data synthesis or analysis.

Research proposal (eminent paper update):

You will propose a modern update to a classic paper in coral ecosystem science (to be provided). This paper offered considerable insights into the ecosystem function of coral reefs but, being conducted in the mid-20th century, did not have access to the methodology and equipment available today. Your task will be to identify gaps, uncertainties or follow-on questions that could be addressed with more modern approaches. The proposal for an updated follow-up study, at a field location of your choosing, will follow a standard research proposal format of Background, Aims, Methodology, Equipment Needs, Statement of Impact, and References. This will be a blue-skies proposal with no budget limit or consideration to cost. The proposal will be assessed on the basis that it identifies a well-justified approach, based on contemporary methods and equipment, and seems likely to provide exciting new insights based on the methodology/location proposed.

Group Project: Response to Tender:

As part of an assigned group students will form a consultancy and, reporting to the Teaching Assistants (TAs) acting as the Client, prepare a proposal/quotation to address an interdisciplinary problem associated with Hong Kong’s coral reef ecosystems. The specifications will be presented to you as a ‘Request for Proposal’ or ‘Request for Tender’ from the client. Tenders will be assessed based on justification (background information), clear objectives/hypotheses, a feasible approach that addresses the specifications, and realistic budget within defined limits. Each group will present their research proposal to the client and class as an oral presentation and receive feedback from their peers, the client (TAs), and the instructor. This assignment will provide experience in the realities of preparing proposals or tenders that students will encounter working in academia or industry (e.g., consulting), as well as conducting science-based presentations aimed at securing funding or contracts (i.e., “sales pitches”).

9. Student Learning Resources:

Primary reference textbook(s):

- Weathers, K.C., Strayer, D.L. and Likens, G.E. (2021) *Fundamentals of ecosystem science*. Second Edition. Academic Press, Waltham, Massachusetts, USA. 358 p. [**WEA**]
 - Library access: <https://lbdiscovers.ust.hk/bib/991013024045303412>
- Sheppard, C., Davy, S.K., Pilling, G.M. and Graham, N.A.J. (2018) *The Biology of Coral Reefs*. Second Edition. Oxford University Press, Oxford, United Kingdom, 370 p. [**SHE**]

- Library access: <https://lbdiscover.hkust.edu.hk/bib/991012401099703412> (first edition)

Supplementary materials

- A range of reading and web resources will be made available on Canvas (canvas.ust.hk) prior to each lecture as handouts [HO].

Additional textbook(s):

Besides the primary reference textbook, required reading takes the form of peer-reviewed journal articles, which are made available through Canvas. We specifically avoid heavy reliance on these coral reef textbooks since the applied information is often quickly outdated. However, several books that may serve as useful resources to supplement core foundational knowledge for the subject include:

- Bertness, M.D., Bruno, J.F., Silliman, B.R. and Stachowicz, J.J. (2014) *Marine community ecology and conservation*. Sinauer Associates, 560 p. [BER]
 - Library access: <https://lbdiscover.ust.hk/bib/991013015207003412>
- Kayanne, H. (2016) *Coral reef science: strategy for ecosystem symbiosis and coexistence with humans under multiple stresses*. Springer Japan, Tokyo, 101 p. [KAY]
 - Library access: <https://lbdiscover.ust.hk/bib/991012683050103412>
- Nybakken, J.W. and Bertness, M.D. (2004) *Marine biology: an ecological approach*. Sixth Edition. Benjamin Cummings, San Francisco, 579 p. [NYB]
 - Library access: <https://lbdiscover.ust.hk/bib/991013015402803412>

10. Learning Activities

This is not a typical lecture course where students sit and listen to a series of lectures and then repeat concepts in a final exam – a high degree of interaction and participation in the learning experience will be required to get the most from the course. Part of the course content will necessitate independent study to be completed prior to class sessions; students will be called upon to share their thoughts with the class, including but not limited to during Journal Club, so prior preparation will be essential (time is provided in the schedule to ensure this is possible). In addition to the defined assessment tasks (which are focused on providing relevant experience beyond pure written assessments), opportunities will be offered to participate in a field trip(s) focused on Hong Kong's coral reef ecosystems as logistical constraints allow. Further details will be provided in class.

11. Course Schedule (*subject to change)

Wk	Date	Topic	Key Text
1	3 Feb	Course preparation, independent reading, video discussion [No class]	-
	5 Feb	Course introduction – what is a coral reef?	HO
2	10 Feb	Introduction to ecosystem science	WEA Ch.1 + HO
	12 Feb	Coral reefs: biodiverse and productive tropical ecosystems	SHE Ch 1
3	17 Feb	HOLIDAY [No class]	-
	19 Feb	HOLIDAY [No class]	-
4	24 Feb	Ecosystem science approaches – not just biology! <i>[Journal Club selection] + [Instrument familiarisation]</i>	WEA Ch.1 + HO
	26 Feb	Introduction to ecological energetics	WEA Sec.II
5	3 Mar	Coral ecosystem primary producers and production rates	WEA Ch.2 + SHE Ch.2
	5 Mar	Group Project meeting [No class]	-
6	10 Mar	Introduction to coral reef environments and hydrodynamics	SHE Ch.3 + HO
	12 Mar	Journal Club 1: Connecting coastal oceanography and coral ecosystems across scales	HO
7	17 Mar	Coral feeding, symbioses and dysbiosis, and calcification	Ch.4 + HO
	19 Mar	Journal Club 2: Drivers of niches and production, and their measurement	SHE Ch.3.8 + HO
8	31 Mar	Coral ecosystem biogeochemistry: nutrient cycling & organic matter dynamics	WEA Ch. 6
	2 Apr	Journal Club 3: Coral ecosystem biogeochemistry	HO
9	7 Apr	MID-TERM BREAK [No class]	-
	9 Apr	Guest Lecture	HO
10	14 Apr	Coral ecosystem secondary producers and consumer energetics	WEA Ch.3 + SHE Ch.6
	16 Apr	Journal Club 4: Drivers of coral fishes and secondary production	HO
11	21 Apr	Climate change and coral bleaching, Human interactions with reefs: resources and impacts	HO
	23 Apr	Journal Club 5: Human impacts, management and conservation	HO
12	28 Apr	Ethical considerations in coral ecosystem research: parachute science and decolonization	HO
	30 Apr	New frontiers in ecosystem science: mesophotic coral ecosystems	WEA Ch. 19 + HO
13	5 May	Group Project Presentations	-
	7 May	Course review Group Project Presentations	-