



## **Coral Reef Ecology, Health, and Conservation**

### **Spring 2020**

(updated 7 Jan 2020)

**EVPP 490-002/BIOL 417-006**

**EVPP 505-004/BIOL 508-002**

**Lecture (3 credits)**

Music/Theater Building 1002  
Tuesdays/Thursdays, 12:00–1:15 p.m.

Instructor: Dr. Jennifer Salerno  
Phone: 703-993-3457  
Email: [jsalerno@gmu.edu](mailto:jsalerno@gmu.edu)  
Office Location: David King Hall 3024  
Office Hours: Tuesdays 2:00–3:00 p.m.; Thursdays, 4:00–5:00 p.m. or BY  
APPOINTMENT

#### **Prerequisites**

Permission of the instructor (contact Dr. Salerno)

#### **Course Description/Overview**

Current coral reef ecology and conservation knowledge and efforts will be examined in this course, with a focus on environmental and anthropogenic stressors threatening coral reefs and the organisms that inhabit them. Students will examine how environmental impacts affect coral reefs, the direct and indirect effects of these impacts on human society, and current and potential reef restoration solutions that may mitigate the current decline in the health of coral reef organisms, biodiversity, and ecological functions. During the twice-a-week lecture sessions, students will be encouraged to engage in open dialogue regarding many different aspects of coral reef conservation including the biology and health of corals in relation to other animals and people as well as ocean policy at the state, federal, and international levels. An optional 1-credit field experience course is offered concurrently with international travel to Curaçao during spring break to examine reefs, their history, and future; separate registration and an additional fee is required.

#### **Learning Objectives**

On completion, students will:

1. Broadly understand the anatomy, physiology, ecology, and pathology of corals;
2. Understand the geology of coral reef ecosystems and their relationship to other ecosystems such as mangroves and sea grass beds;



3. Be able to identify different types of corals, as well as families of fishes and other reef creatures and understand the symbiotic and ecological relationships they have with one another;
4. Understand the ecological goods and services provided by coral reef ecosystems and conservation measures implemented to help protect and restore them; and
5. Be able to discuss global and local threats to corals and how they impact the greater ecosystem and are linked to human health (as related to the 'One Health' concept)

### **Instructor Expectations**

Students are expected to read books and journal articles, study supporting materials, and prepare assignments outside of class. Students are required to organize material logically and communicate effectively orally and in writing. Class participation, as well as a project and presentation, will be required of each student.

**Attendance in lectures is required and recorded.** Tardiness and absenteeism should be limited to illness or emergencies. Dr. Salerno should be notified PRIOR to the start of class if a student will not be in attendance. Lectures will be posted as pdfs on blackboard after class so please come prepared to take notes. Make-up exams will only be given in extenuating circumstances and must be cleared with Dr. Salerno PRIOR to the exam.

Students should come to class ready to participate in all activities with assignments and readings completed prior to class, behave in a mature and professional manner, and abide by the GMU honor code.

### **Lecture Assignments**

#### (1) Quizzes (ALL STUDENTS):

Five (5) quizzes will be given by Dr. Salerno at the start of lectures throughout the semester. Graduate students will have extended questions to cover the additional required readings. The lowest quiz grade will be dropped at the end of the course and the remaining four (4) will be counted towards your final grade.

#### (2) Exams (ALL STUDENTS):

A mid-term and final exam will be given by Dr. Salerno in the format of multiple choice, short-, and long-answer questions. Students will have until the end of class to turn in their exam. The final will be given during finals week. Graduate students will have extended questions to cover the additional required readings.

#### (3) Research One-Pagers and Presentations (ALL STUDENTS):

More than ever, it's important for students in the sciences to be able to communicate technical scientific information to diverse audiences with clarity and accuracy. Students will prepare a "one-pager," essentially a policy brief, on a topic of their choosing related to coral reef ecology,



or coral reef conservation, and with an intended audience of relevant stakeholders (e.g. elementary school students, college students, resource managers, policymakers, NGOs, the public). We will discuss this over the course of the semester, but check out <https://writingcenter.unc.edu/policy-briefs/> for the general idea and structure of a policy brief. It is intended that you will select a subject relevant to this class that interests you and probe that subject deeply – become “experts” on that subject. Undergraduates may work in pairs, but graduate students will work individually.

As evidence of that expertise each student/group will write/design a one-page policy brief. Ideas of such topics could include educating stakeholders on a point of interest (e.g. marine plastic debris, climate change affecting weather patterns, underwater research methods, biomedical compounds derived from coral reef ecosystems, a specific coral disease, etc.), or identifying a specific problem and proposing a solution (policy, conservation issues, or community programs; consider including different points of view, i.e., why is this problem a problem? And what could be a solution?). **Each student must submit a draft title and outline of their one-pager to Dr. Salerno by the beginning of the 5th week via Blackboard** (see schedule).

You will also be required to present a 2-minute lightning talk on your topic (allowing an additional 3 minutes to field questions). The one pager and presentation are worth 20% of your lecture grade so working on that diligently during the semester is important.

A required list of literature cited will also be provided by each student and included in the one-pager. Use Zotero (<http://www.zotero.org/>). Instruction is available in the library. The literature cited may include references like newspaper articles and books, but at least 3 sources need to be from the primary literature (i.e. scientific journals). I want to see that you can use the tool to help with your research and writing. You can get individual help in the library if you need it.

Dr. Salerno will post the one-pager guidelines, rubric, and citation formatting instructions on Blackboard. The one-pager will be due by the beginning of the 12th week via email (see schedule).

#### (4) Critical Review of Scientific Articles (GRADUATE STUDENTS ONLY):

Students completing the course for graduate credit will be required to submit two (2) critical reviews of scientific articles related to coral reefs or marine conservation. At least one article should come from a recent (2017-2018) peer-reviewed scientific journal; The 2nd can come from a scientific journal, news article, or the popular press. Each critique should be no more than 300 words (not including references), should be backed with at least 3 references including the original source, and should be written in the style of Science Letters.

Example from Rogers (2013) Science Letters

<http://science.sciencemag.org.mutex.gmu.edu/content/sci/340/6140/1522.1.full.pdf>



Identify specific issues/critiques you have with an article of your choice from a refereed journal or popular magazine (not a literature review or book chapter). This can be something that you found problematic, interesting, ridiculous, missing, etc. and then compare and support your arguments with other sources in the literature. Make your critiques explicit and clear, e.g.: “I have three main issues with the way this argument was presented”, then elaborate in 3 subsequent paragraphs. Give a very brief overview of the important points with the majority of the paper focused on your own opinion. Consider ending with possible solutions based on your critique. Be concise and clear with your points and mind the word limit. References should be primary literature (e.g., peer-reviewed journal articles) and reports from reputable sources. Use Science Letters for citation style but include all authors in the Literature Cited portion of the paper. Sources should be designated by numbers within the body of the text to correspond with a numbered and alphabetized Literature Cited section.

Each grad student must send their critical reviews to Dr. Salerno via email (see schedule below). When the instructor receives your critical review, you will receive an email confirmation. If you do not receive a confirmation, it is YOUR responsibility to either resubmit or check-in with the instructor to confirm receipt of the review PRIOR to class.

**\*Late policy** – late assignments will be deducted by 10% of the total points per day late unless an alternate agreement has been arranged with the professor.

## Readings

### (1) Required Books (ALL STUDENTS):

1. Goldberg, Walter M. 2013. *The Biology of Reefs and Reef Organisms*. Chicago: University of Chicago Press.
2. Dubinsky, Zvy and Stambler, Noga (editors). 2011. *Coral Reefs: An Ecosystem in Transition*. New York: Springer. \*This book is available for online access through GMU libraries.
3. Precht, William F. (editor). 2006. *Coral Reef Restoration Handbook*. Boca Raton: Taylor and Francis Group. \*This book is available for online access through GMU libraries.

### (2) Weekly Assigned Readings (ALL STUDENTS):

- All assigned readings are listed in the course schedule, posted on Blackboard, and should be completed PRIOR to class.
- Undergraduate students are required to read the first reading listed in bold but are encouraged to read all readings listed.
- Graduate students are required to read all three (3) readings listed and lead a discussion of the scientific articles in class.



## Grading

### Undergraduate Level:

Class Participation	20%
Mid-Term Examination	20%
Final Examination	20%
Quizzes (4 total)	20%
<u>One-pager/Presentation</u>	<u>20%</u>
Total	100%

### Graduate Level:

Class Participation	10%
Mid-Term Examination	20%
Final Examination	20%
Quizzes (4 total)	20%
One-pager/Presentation	20%
<u>Critical Reviews (2)</u>	<u>10%</u>
Total	100%

For undergraduates: the final grade will be based on this scale: A = 100–93%, A- = 92-90%, B+ = 89-86%, B=85-83, B- = 82-80%, C = 79–70%, D = 69–60%, F < 59%. A CURVE WILL NOT BE APPLIED.

For graduate students: the final grade will be based on this scale: A = 100–90%, B = 89–80%, C = 79–70%, F < 69%. A CURVE WILL NOT BE APPLIED.

## Course Materials

See required textbooks under Readings, above.

### **Additional Areas of Mention (University Policies, Resources, Etc.)**

WRITING CENTER: A114 Robinson Hall; (703) 993-1200; <http://writingcenter.gmu.edu>

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS): (703) 993-2380; <http://caps.gmu.edu>

COMPLIANCE, DIVERSITY, AND ETHICS; <https://diversity.gmu.edu/>

TITLE IX COORDINATOR; <https://diversity.gmu.edu/title-ix/who-can-i-call>

The University Catalog, <http://catalog.gmu.edu>, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at <http://universitypolicy.gmu.edu/>. All members of the university community are responsible for knowing and following established policies.



**COURSE SCHEDULE AND ASSIGNED READING (to be completed PRIOR to class):**

Week	Date	Topics	Readings for Following Week
1	January 21, 23	Intro/discuss syllabus Coral overview (part I) - coral anatomy, physiology, diversity, identification	<b>Goldberg Ch 6 (Coral reefs and their allies)</b> <i>No additional graduate student readings for week one only</i>
2	January 28, 30	Coral overview (part II) - reproduction/spawning, calcification, symbiotic relationship with zooxanthellae, sensitivity to environmental conditions	<b>Goldberg Ch 1 (Structure and formation of modern reefs)</b> Goldberg Ch 14 (Ecology, diversity and biogeography of coral reefs) Waycott - Accelerating loss of seagrasses across the globe threatens coastal ecosystems (2009)
3	February 4, 6	<b>QUIZ #1</b> Geology of coral reefs, zonation, origins of reefs, bioerosion, biodiversity, connectivity, biogeography Other associated ecosystems - mangroves, seagrass beds, deep water corals ( <a href="#">discuss paper</a> )	<b>Peters (2015) - Diseases of coral reef organisms</b> Mullen - Resistance to disease (2004) Dubinsky p355-367 (Competition among sessile organisms on coral reefs)
4	February 11, 13	Defense mechanisms, competition, immune function, and predation of corals Coral diseases (overview)  <b>Critical Review 1 due February 13 (GRAD STUDENTS ONLY)</b>	<b>Goldberg Ch 4 (Algae and foraminiferans)</b> Goldberg Ch 3 (Reef cyanobacteria) Goldberg Ch 5 (Sponges)
5	February 18, 20	<b>QUIZ #2</b> Microorganisms – Bacteria/Viruses, Cyanobacteria, Fungi, Protists, Apicomplexans  <b>Turn in title and outline for research one-pager on February 20 via Blackboard (ALL STUDENTS)</b>	<b>Dubinsky pp. 292–310 (Invertebrates and their roles in coral reef ecosystems)</b> Goldberg 10 (Crustacea) Goldberg 11 (Echinoderms)
6	February 25, 27	Macroorganisms - Algae, sponges, other marine invertebrates	<b>Goldberg Ch 12 (The effect of feeding by reef fishes on corals and coral reefs)</b> Dubinsky p332-343 (Coral Reef Fishes: Opportunities, challenges and concerns)
7	March 3, 5	<b>QUIZ #3</b> Macroorganisms -Vertebrate species (fishes, elasmobranchs, marine mammals, reptiles)	Study for Mid-Term Exam
8	March 10, 12	<b>Spring Break</b>	Relax and Recharge



Week	Date	Topics	Readings for Following Week
9	March 17, 19	Macroorganisms - continued March 19 - Review for Mid-Term Exam	<b>Moberg - Ecological goods and services of coral reef ecosystems (1999)</b> Other readings to be assigned
10	March 24, 26	<b>Mid-Term Exam (March 26)</b>  Return graded Mid-Term Exams Benefits of corals – Ecological goods and services	<b>Goldberg Ch 15 (Reefs now and the next 100 years)</b> Hughes et al. Spatial and temporal patterns of mass bleaching of corals (2018) Dulvy - You can swim but you can't hide: The global status and conservation of oceanic pelagic sharks and rays (2008) Feary - Latitudinal shifts in coral reef fishes: why some species do, and others do not, shift (2013) Hawkes - Climate change and marine turtles (2009)
11	March 31, April 2	Threats to coral reefs: Micro (local) impacts - overfishing, invasive species, land development/run off, pollution  Threats to coral reefs: Macro (global) impacts - climate change, bleaching, ocean acidification, sea level rise, storm damage	<b>Goldberg Ch 16 (Reef resilience, loss of biodiversity, and the role of conservation)</b> Dubinsky p 509 (The resilience of coral reefs and its implications for reef management) Precht p143 (Legal protections for coral reefs)
12	April 7, 9	<b>QUIZ #4</b> <b>Critical Review 2 due Thursday (GRAD STUDENTS ONLY)</b> Reef resilience and conservation Policy and legal protection involving coral reefs (MPAs etc.)	<b>Precht p39 (Coral reef restoration - an overview)</b> Precht p1 (Coral reef restoration - the rehabilitation of an ecosystem under siege) Precht p315 (Ethical dilemmas in coral reef restoration)
13	April 14, 16	<b>Research one-pager submitted to Dr. Salerno via Blackboard on April 16</b> Coral reef restoration Ethical considerations of coral reef restoration	<b>Zinsstag - From one medicine to one health and systemic approaches to health and well-being (2011)</b> Myers - Emerging Threats to Human Health from Global Environmental Change (2009) Rapport - Ecocultural health, global health, and sustainability (2011)
14	April 21, 23	<b>QUIZ #5</b> One Health - integrating human, animal, and ecosystem health The effects of environmental change on reefs and human health	Work on 2-minute lightning talks
15	April 28, 30	Student lightning talks presented Review for Final Exam	
16	May 7	<b>Final Exam</b> 10:30–1:15 p.m. Music Theater Building 1002	