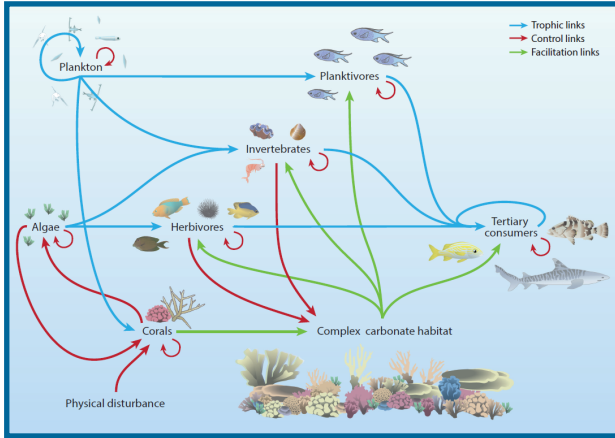


Marine Ecology

Meeting time: M, W, F 2:30 - 3:20 pm
Meeting place: 229 Long Hall
Office hours: Tues 11:00 - 12:30 pm



Harborne et al. 2017. Annu. Rev. Mar. Sci.



Photo by M.J. Childress

Course Description

Marine ecology is the study of the relationships between marine organisms and their ocean environment. Although the ecological processes that govern the transfer of nutrients and energy are similar to those in terrestrial ecosystems, the ocean environment presents many unique challenges for marine communities and the organisms that live there. Students in Marine Ecology will (1) explore the relationships of marine animals to the marine environment, (2) understand the relationships of organismal form, function, ecology, and evolution, and (3) engage in discussions about the impact of humans and climate change on the sustainability of the planet. Marine ecology is also a course in critical thinking where we will examine the complex challenges of marine conservation and human impacts on both local and global scales. In this course you will (4) explore the multi-dimensional challenges of the physical, chemical and biological processes that influence the structure of marine communities, (5) synthesize alternative solutions to the greatest challenges our oceans face today including overharvesting, habitat destruction, and global climate change, and (6) effectively communicate the complex conservation strategies essential for the preservation of our oceans.

Student Learning Objectives

1. Demonstrate the ability to increase critical thinking skills (Application)
2. Identify the limitations of one's own hypotheses, interpretations, or positions. (Analysis)
3. Integrate information/data to solve a problem. (Synthesis)
4. Distinguish and summarize the problem/question at issue (and the source's position). (Analysis)
5. Validate evidence and identify both reasonable and inappropriate conclusions. (Evaluation)
6. Interpret quantitative relationships in graphs, tables, charts, etc. (Application)
7. Criticize the appropriateness of procedures for investigating a question of causation. (Evaluation)
8. Evaluate hypotheses for consistency with established facts. (Evaluation)
9. Assess data for consistency with established facts, hypotheses, or methods. (Evaluation)
10. Prioritize alternative solutions and implement the optimal one(s). (Evaluation)
11. Develop and justify one's own hypotheses, interpretations, or positions. (Synthesis)

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Special points of interest

- Ecology is the study of the interaction between the environment and the organisms that live there.
- Critical thinking is a systematic and analytical approach to the evaluation of data, ideas, and concepts.
- Marine science is the study of the physical, chemical, and biological processes of ocean



Textbook, Readings, and Course Expectations

Each week you will be expected to read two assigned chapters in the Marine Community Ecology and Conservation textbook along with additional outside readings from the primary literature. Monday and Wednesday of each week will be spent covering the material presented on that week's topic and Friday will be a graded in-class participation activities that will evaluate your understanding of the material through dialog, group discussion, debate, problem solving, policy construction, mini-presentations, data analysis, critiques, inquiry activities, and journal writing.

The weekly in-class participation activities are worth 20 points each. There are no make-up class participation activities, but there will be a surplus of in-class participations (12 total). Your participation score will be based on the 10 in-class participations with the highest

scores and thus, the maximum number of points you can earn is 200 points. In-class participations completed and turned in before the end of the week will also be accepted when an absence cannot be avoided.

You will be expected to understand the material presented in lecture and the assigned readings. Each unit exam (I, II, III) will cover only the material presented since the previous exam. Exams are multiple-choice and short answer closed-book tests to be completed during the 50-minute class period. Missed exams are not considered excused exams without consultation with the instructor and may be averaged in as a zero grade. **If you miss a unit exam and have an excused absence, you will take the cumulative final exam as your make-up exam.**

Bertness MD, Bruno JF, Silliman BR, and Stachowicz JJ. 2014. Marine Community Ecology and Conservation. Sinauer. [ISBN 978-1-60535-228-2](https://doi.org/10.1002/9781118782222)

Do I really need to read the assigned readings?

Since this course is essentially a graduate course, I will assume that you are familiar with the lecture topics and have already completed all assigned readings before coming to class. The lectures will then primarily be a critique and synthesis of what you have already learned in the textbook and assigned readings.

Lectures presentations will be available in Canvas before each class, but the presentation will only include the diagrams and illustrations. The critical text will not be included so you can fill it in while you attend lecture. Videos of each lecture will be posted after class to help you keep up with the material if you miss a class or need more time for note taking.

Grades and Grading Policy

Grades will be determined by the total number of points earned and the section of the course you are enrolled in.

Section	4480-001 (regular)	4480-002 (honors)*	6480-001(grad)*
Exam I – Physical and Historical Processes	50	50	50
Exam II – Community Structure	50	50	50
Exam III – Human Impacts and Solutions	50	50	50
Class participation activities (10 @ 20 pts)	200	200	200
Discussion Group		50	50
Literature Review Paper			50
Total points	350	400	450
A grade	315-350	360-400	405-450
B grade	280-315	320-360	360-405
C grade	245-280	280-320	315-360
D grade	210-245	240-280	
F grade	< 210	< 245	< 315

*Honors section will be required to complete either the discussion group or literature review paper while the graduate section will be required to complete both the discussion group and literature review paper. See page 6 for more details about these assignments.

Cumulative Final Exam (optional unless needed as make-up exam)

There is also a cumulative final exam (50 points) that is optional if you have taken all three of the unit exams. If you take all three unit exams and the cumulative final exam, the three highest exam scores will be used to calculate your grade. If you miss one of the three unit exams, the cumulative final exam is required and will be your make-up exam.

Strong 4 -- Consistently does all or almost all of the following

- ✚ Accurately interprets evidence, statements, graphics, questions, etc.
- ✚ Identifies the most important arguments (reasons and claims) pro and con.
- ✚ Thoughtfully analyzes and evaluates major alternative points of view.
- ✚ Draws warranted, judicious, non-fallacious conclusions.
- ✚ Justifies key results and procedures, explains assumptions and reasons.
- ✚ Fair-mindedly follows where evidence and reasons lead.

Acceptable 3 -- Does most or many of the following:

- ✚ Accurately interprets evidence, statements, graphics, questions, etc.
- ✚ Identifies relevant arguments (reasons and claims) pro and con.
- ✚ Offers analyses and evaluations of obvious alternative points of view.
- ✚ Draws warranted, non-fallacious conclusions.
- ✚ Justifies some results or procedures, explains reasons.
- ✚ Fair-mindedly follows where evidence and reasons lead.

Unacceptable 2 -- Does most or many of the following:

- ✚ Misinterprets evidence, statements, graphics, questions, etc.
- ✚ Fails to identify strong, relevant counter-arguments.
- ✚ Ignores or superficially evaluates obvious alternative points of view.
- ✚ Draws unwarranted or fallacious conclusions.
- ✚ Justifies few results or procedures, seldom explains reasons.
- ✚ Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions.

Weak 1-- Consistently does all or almost all of the following:

- ✚ Offers biased interpretations of evidence, statements, graphics, questions, information or the points of view of others.
- ✚ Fails to identify or hastily dismisses strong, relevant counter-arguments.
- ✚ Ignores or superficially evaluates obvious alternative points of view.
- ✚ Argues using fallacious or irrelevant reasons, and unwarranted claims.
- ✚ Does not justify results or procedures, nor explain reasons.
- ✚ Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions.
- ✚ Exhibits close-mindedness or hostility to reason.

[Holistic Critical Thinking Scoring Rubric. \(Facione and Facione 2009\)](#)

Class Activities and Critical Thinking Rubric

Marine Ecology is a critical thinking course developed as part of Clemson's CT2 initiative. These courses share a common theme of developing critical thinking skills essential to addressing today's most pressing issues. Critical thinking courses strive to align course assessments with process-oriented student learning outcomes such as those presented on page 1 of the syllabus.

In Marine Ecology, we will accomplish this through the weekly class participation (CP) activities such as debates, film critiques, case study analysis, guided inquiry data analysis, essays, and development of management strategies. Each weekly class participation activity is worth 20 points and will be evaluated using the critical thinking grading rubric presented above. Strong = 19-20 pts, acceptable = 16-18 pts, unacceptable = 12-15 pts, weak = 0-11 pts. For some of the class participation activities, you will evaluate yourself, for other activities your classmates will evaluate you, and the remainder will be evaluated by Dr. Childress.

Since Marine Ecology also requires a significant amount of content knowledge, traditional content exams will also be used to evaluate your critical thinking and quantitative problem solving. Multiple choice questions will explore your understanding the processes of marine ecology but also how well existing data confirms or refutes alternative hypotheses. The problem sets will explore your ability to evaluate how well data fit the predictions of specific ecological models.

Finally, you will take the Ocean Knowledge Survey twice, once at the beginning and once at the end of the course, to measure how much your critical thinking about the ocean has improved.

What is critical thinking?

Critical thinking is a systematic and analytical approach to the evaluation of data, ideas, and concepts. It has been broadly defined by experts as "the process of purposeful, self-regulatory judgement" (1990, The Delphi Report). Mostly critical thinking is about having good judgement. Critical thinking is something we all possess, but like other skills it can be improved with practice and constructive feedback.

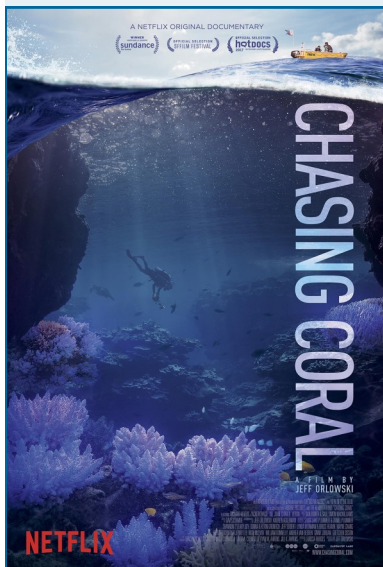
Critical thinking plays an important role in the sciences. Scientists employ critical thinking in the development and interpretation of their hypotheses. They utilize their critical thinking skills in the design of their experiments and the analysis of their data. But even more importantly, scientists must also develop their critical thinking skills when it comes to sharing their findings with the public and communicating with policy makers.

Critical thinking is more important today than ever. The overload of conflicting information that is flooding society often leads one to ask "who should I believe"? Much of the debate over issues, such as climate change, are so charged with emotion that critical thinking is all but lost. So it is essential that you hone your critical thinking skills and apply it to your pursuit of scientific knowledge. That is why our traditional methods of teaching science as content, rather than as process, must also evolve. In this course, the methods of gathering, analyzing, interpreting, and sharing of the principles of marine ecology are as important as the details about individual marine communities.

Course Schedule and Reading Assignments

How should I prepare for the exam?

The exams will cover the lecture material presented only for that unit. Material presented in the textbook, lecture, and outside readings are fair game, but the emphasis will be on what we discussed in lecture. The week of the exam will begin with an in-class review on Monday, where we will spend the entire period answering your lecture review questions and working sample problems. The exam will be on Wednesday and there may be a take-home portion as well. On Friday following the exam, we will have a debriefing where we discuss the exam and go over any questions or problems you had on the exam. If you know you will miss an exam, you may request to take it early. If you miss an exam, you will take the cumulative final exam as your make-up exam.



Lecture Topic	Assigned Readings / Activities
Physical Processes <ul style="list-style-type: none"> Community ecology history Physical oceanography Ecomechanics 	Week of January 8-10 Chap 1 Chap 2 CP 1: Ocean Knowledge Survey
Species Interactions <ul style="list-style-type: none"> Foundation species & facilitation Keystone species & predation Pathogens & disease 	Week of January 13-17 Chap 3 Chap 5 CP 2: Foundation versus Keystone species debate
Biodiversity and History <ul style="list-style-type: none"> Ecosystem function Paleoecology Historical ecology 	Week of January 22-24 (MLK holiday Jan 20) Chap 6 Chap 8 CP 3: Inferring process from pattern data analysis
Dispersal and Biogeography <ul style="list-style-type: none"> Dispersal Connectivity Species ranges 	Week of January 27-31 Chap 4 Chap 7 CP 4: Why are there so many marine species?
Unit I Exam	Wednesday, February 5
Tropical Communities <ul style="list-style-type: none"> Seagrass Coral reefs Disturbance cascades 	Week of February 10-14 Chap 12 Chap 13 CP 5: Can we save coral reefs debate
Temperate Communities <ul style="list-style-type: none"> Soft-sediment Salt marsh Salt marsh die-back 	Week of February 17-21 Chap 10 Chap 11 CP 6: Guided inquiry data analysis
Cold Current Communities <ul style="list-style-type: none"> Intertidal rocky shores Kelp forests Keystone species 	Week of February 24-28 Chap 9 Chap 14 CP 7: Alternative stable states debate
Open Water Communities <ul style="list-style-type: none"> Phytoplankton and pelagic Deep-sea hydrothermal vent Collapse of ocean conveyor belt 	Week of March 2-6 Chap 15 & 16 Chap 17 CP 8: Film critique I
Unit II Exam	Wednesday, March 11
Spring Break	Week of March 16-20
Climate Change <ul style="list-style-type: none"> Ecosystem services Climate change impacts Functional group conservation 	Week of March 23-27 Chap 19 CP 9: Climate change is a hoax debate
Overfishing and Habitat Degradation <ul style="list-style-type: none"> Threats to marine ecosystems Ecosystem-based management Habitat loss – species invasions 	Week of March 30-April 3 Chap 20 CP 10: Persuasive essay
Restoration and Management <ul style="list-style-type: none"> Marine restoration ecology Future of marine conservation Marine protected areas (MPAs) 	Week of April 6-10 Chap 18 Chap 21 CP 11: Film critique II
Global Marine Sanctuary Network <ul style="list-style-type: none"> Mission statement Management goals Monitoring and assessment 	Week of April 13-17 Chap 22 Chap 23 CP 12: Ocean Knowledge Survey
Unit III Exam	Friday, April 24
Final Exam (optional)	Thursday, April 30, 3:00—5:30 pm

About the Instructor

I fell in love with marine biology at the age of 11 after taking a school field trip to the Shedd Aquarium in Chicago. Although I had never laid eyes on the ocean, I knew that I wanted to spend the rest of my life exploring the mysteries of animals that lived in the ocean. I read books by Jacques Cousteau about amazing sea creatures. I started raising tropical fish where I learned the importance of water chemistry. I learned to SCUBA dive so I could discover the behaviors of marine life by direct observation. I attended school at the Univ. of Tampa, UC Berkeley, and Florida State University where I studied physiology, ecology, genetics, animal behavior, evolutionary biology, and physical oceanography to better understand the complex behaviors of marine life.

My research career has taken me from the rocky shores of Oregon to the coral reefs of Hawaii, from the kelp beds of California to the seagrass beds of the Florida Keys. I have studied rotifers, mantis shrimp, sea stars, blue crabs, octopus, spiny lobsters, and parrotfish. I have had the great fortune to share these adventures with many undergraduate and graduate students that serve as a constant source of inspiration. There is so much that we don't yet know about the ecology of marine life and yet, the rate of change we are witnessing in marine communities is much more dramatic than the changes we see on land. So much is at stake that it is essential that we put our critical thinking skills together to solve the pressing issues that are facing the ocean today. For more information visit the Childress lab web site at www.childresslab.weebly.com.



Photo by M.J. Childress

“For most of history, man has had to fight nature to survive; in this century he is beginning to realize that, in order to survive, he must protect it.” Jacques Cousteau

University Expectations and Policies

[Academic Integrity](#)

“As members of the Clemson University community, we have inherited Thomas Green Clemson’s vision of this institution as a ‘high seminary of learning.’ Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.”

[Attendance Policy](#)

There is no mandatory attendance policy except that failure to participate in a class participation activity will receive a zero grade. If you know that you will be unable to attend a regularly scheduled exam you may contact us in advance to make arrangements to take the exam early. In the case of an unplanned absence due to illness or death in the family, please contact us upon your return to campus. If you miss a lecture, you are strongly encouraged to watch the lecture video replay and take careful notes.

[Disability Access](#)

“It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students are encouraged to contact Student Disability Services to discuss their individual needs for accommodation.”

[Sexual Harassment](#)

“Clemson University is committed to an educational and work environment in which all individuals are treated with respect and dignity, free from harassment and/or discrimination. Accordingly, it is the policy of Clemson University that harassment/discrimination as defined in this policy, by employees, students or non-employees will not be tolerated.”

[Inclement Weather](#)

If there is inclement weather in the area, we will hold class until the University is officially closed. Since lecture is always recorded, students should use their best judgement whether to attend class or not. If class is canceled, the lecture will be given via Adobe Connect and recorded for those that cannot view the live broadcast.

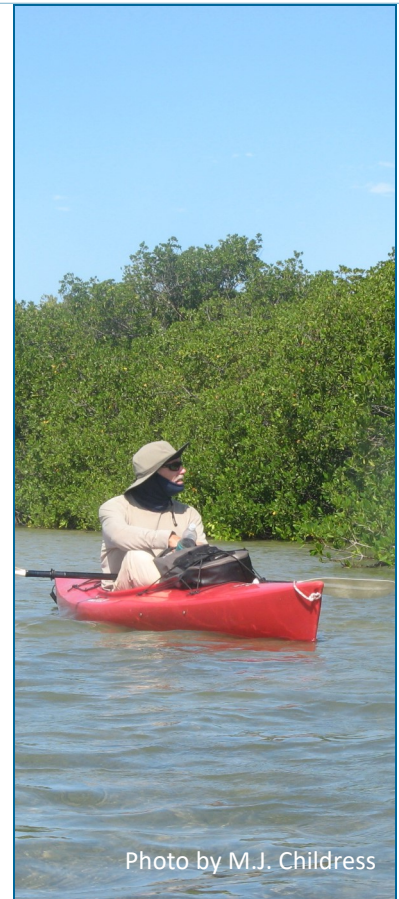


Photo by M.J. Childress

How do I lead a group discussion?

Groups discussion is a common format for many graduate courses. The assigned group discussion leader assumes responsibility for assigning the readings, writing and distributing a set of discussion questions, and facilitating the discussion. This does not mean the discussion leader is expected to talk all the time, but it does require that the leader be able to get the discussion started, and answer questions about the topic that may be inhibiting or derailing productive discussion by the group. A good discussion leader encourages all group members to contribute to the discussion, evaluates the topic critically but fairly, points out logical inconsistencies, and suggests alternative interpretations. Evaluation of the discussion leader is based on the critical thinking rubric with 10 pts for the assigned reading, 10 pts for the discussion questions, 20 pts for effective discussion leadership, and 10 pts for your participation when others are leading the discussion.

Special Assignments for Honors / Grad Students

Honors students will complete one of these two extra assignment for the course worth 50 additional points, while graduate students will complete both extra assignments worth 100 additional points.

Weekly Book Discussion Group

Honors undergraduate and graduate students selecting this option will be required to meet one additional class meeting (60 min) with the instructor. Each week you will be expected to read and discuss 1-2 scientific papers on a pre-approved topic of your choice. At the first meeting, you will sign-up for which week you wish to lead the discussion. You will prepare 5-10 discussion questions covering the topic of your papers and will submit your questions to Dr. Childress a week before your discussion. When it is your week, you will lead the discussion group by encouraging your classmates to discuss the questions you posted. Your grade for this assignment will be based equally on your weekly participation (10 pts), paper choice (10 pts) discussion questions (10 pts), and discussion leadership (20 pts).

A Literature Review Paper on Climate Change Impacts on the Ocean

Honors undergraduate and graduate students selecting this option will be required to write a literature review paper (worth 50 pts) on a topic related to climate changes impacts on the ocean. The purpose of this literature review paper is to synthesis what we currently know, and do not yet know, about how our changing climate is impacting some aspect of ocean ecology. (1) Select a topic for your literature review paper. See the list of suggested topics below. (2) Read journal articles on your topic (minimum of 20 journal articles). (3) Organize your notes on the topic into an organized outline. (4) Write a review of your topic that summarizes your ideas using examples from your 20 primary sources as supporting literature. The review should be 5-10 double spaced pages with standard scientific citations (references should not be counted in your page total). Be sure to distinguish what we know from what needs additional research on each particular topic. (5) Submit your paper by e-mail to Dr. Childress (mchildr@clemson.edu) before the due date on Friday, April 17.

Suggested Topics for your Literature Review Paper

- What are the impacts of ocean acidification and potential adaptations of marine life?
- How will sea grass communities change in response to climate change?
- Are hard corals destined to become extinct and will it matter to reef communities?
- How will loss of shallow marine communities impact deep ocean communities?
- Can commercial fishing actually help address the climate crisis?
- Can marine life behaviorally adapt to changes in ocean temperature?



Chasing Coral—A Netflix Documentary
<https://www.chasingcoral.com/>