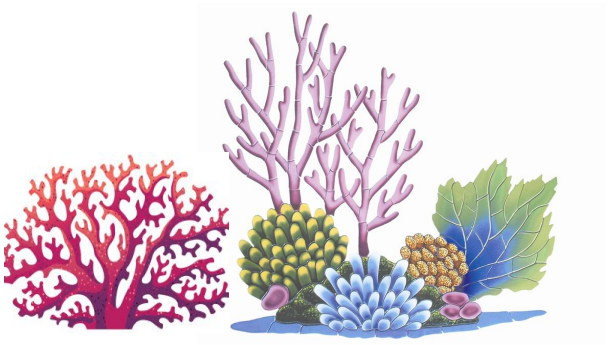
TROPICAL MARINE ECOLOGY

Syllabus Winter 2019 (FISH 427A)

A journey into the fascinating marine tropical world



Instructor: **Jacqueline Padilla-Gamiño**
Email: jpgamino@uw.edu, Phone: (206) 543-7878

Class: Monday, Wednesday and Friday 1:30-2:20 pm
Lab: Wednesday 9:30 am - 12:20 pm.
Course #: FISH 427, Tropical Marine Biology (5 credits), location FSH 213
Class hours: 3 lectures per week (50 minutes each) and a lab/discussion section (3 hrs)
Office hours: SAFS 204A, Tuesday 2:30-3:30 pm, and by appointment.
Prerequisites:

Aquatic Ecophysiology FISH/OCEAN/270 or BIO 220
Scientific writing: FISH290/FHL333/MARBIO305
Statistics: STAT311 or QSCI 381

Course Objectives

This course will provide an integrated overview of the biology of tropical systems, by examining the biogeography, evolution and ecology of coral reefs, mangroves and sea grass beds. We will examine the function, physiology, ecology, and behavior of marine tropical organisms and the ecology and evolution of tropical reef systems and creatures living on them. Emphasis will be placed on the adaptations of organisms to physical and chemical environmental characteristics, the natural and environmental processes that affect physiology, and reef structure and function. We will also examine factors that influence coral reef, mangroves and seagrass beds distributions, biogeography, anatomy and life history traits. Reef fishes and their interaction with coral communities will be highlighted, along with coral reef fisheries. Modern threats to tropical systems, including thermal bleaching, ocean acidification, nitrification, and diseases will be examined with emphasis on processes affecting the future status of reef communities. The course will close by taking a critical look at natural and human disturbances to reefs, seagrass beds and sponge reefs with an emphasis on current models of management and conservation.

Learning Goals:

On successful completion of the course, you will be able to:

1. Apply your knowledge of physical oceanography to predict the distribution and biogeography of tropical ecosystems.
2. Understand and analyze the ecological interactions of marine organisms in different tropical systems including coral reefs, mangroves and seagrass beds.
3. Identify, contrast and synthesize the physiological adaptations of tropical marine species.
4. Integrate ecological and physiological concepts to understand how anthropogenic stressors such as increased temperature, pollution, and ocean acidification can impact the resilience of tropical marine ecosystems.
5. Synthesize new literature from peer-reviewed journals and interpret their relevance to marine conservation (accomplished via a writing assignment, and a final presentation).
6. Gain skills in experimental research, maintenance and husbandry of marine cnidarians.

7. Develop and apply your research skills by designing and performing physiological experiments, analyzing your data and reporting your findings within a physiological and ecological context.
8. Present data associated with tropical marine systems to specialists and lay people.
9. Evaluate current management practices of tropical ecosystems by applying concepts in this class to case studies.

Required Readings

There is no required textbook but students may find it useful to look at a copy of The Biology of Coral Reefs, by Sheppard, Davy and Pilling, 2009. We will read selected articles from journals, books, and other published scientific literature. These will be available as PDFs through the course's website. Please read the papers prior to class, this will strengthen your understanding and assimilation of the class materials and help you to generate good questions for the discussion sessions.

For those especially interested in this subject, some suggested texts include:

- *Life and death of coral reefs* by Charles Birkeland 1997
- *Aquarium Corals* by Eric Borneman, 2004.
- *Coral reefs in the microbial seas* by Forest Rohwer, with M Youle and D. Vosten. 2010.
- *Corals in Space and Time: the biogeography and evolution of Scleractinia* by Veron, 1995.
- *The biology of reefs and reef organisms* by Goldberg, 2013.
- °

Evaluation and Grading

Midterm 1	15%	Testing knowledge concepts, terminology, processes
Midterm 2	15%	Testing knowledge and ability to integrate concepts
Paper discussions	10%	Testing ability to synthesize and interpret peer-reviewed literature, participate and lead a discussion
Project – writing assignment	15%	Testing ability to write clear and concisely, synthesize scientific literature, interpret results and think critically
Project - presentation	15%	Testing ability to synthesize and present scientific information
Video assignment	5%	Testing ability to transmit a message to broader audiences and think creatively
Final exam	25%	Testing knowledge and ability to integrate concepts

Lectures: This course will consist of three 50-minute lectures per week. Lectures will be primarily PowerPoint based and made available on the course website before class for downloading and reviewing. Computers/surftabs are allowed in class for educational purposes (i.e. follow slides, take notes) but the use of any other electronic devices for other purposes during class is prohibited. Keep in mind that research shows that taking notes by hand is better than taking notes on a laptop for remembering conceptual information over the long term (Mueller and Oppenheimer 2014, Psychological Science, The Pen is Mightier Than the Keyboard http://journals.sagepub.com/doi/abs/10.1177/0956797614524581).

Exams: There will be two written midterms (15% of final grade each) and one final exam (25% of final grade). Both 50-minute midterm exams will consist of short essays. The final exam will be comprehensive, 60% of the final exam questions will be based on the last portion of the class (weeks 8-10) and the other 40% will be based on the entire course (weeks 1-10). The exams will cover the assigned reading and material covered in lecture and laboratory. The purpose of these exams will be to test your knowledge and ability to integrate ecological, evolutionary and physiological concepts, terms, and processes. Material that is covered in class and laboratory but not contained in PowerPoint presentations will be considered part of testable class content. Potential types of questions that may appear on the exam will be raised during discussion sections, so that students gain practice in addressing scope and content.

Attendance: Attendance is EXPECTED for every lecture. Regular attendance and participation during paper discussions and laboratories are essential for a good performance in this course. Students are individually responsible for all information presented in lectures, guest lectures, readings and discussion and laboratory sections. No make-up exams/labs will be scheduled and no late short assignments will be accepted unless of medical or personal emergency. If you know you have a conflict with a class session, please speak with J. Padilla-Gamiño well ahead of time. Only excused absences will be accepted. Excused absences are religious holidays, pre-approved professional activities, injury or illness of student or family member. Verification of these events will be needed and notification of anticipated absences should occur as early as possible prior to absence.

Online tools: I have set up a Canvas website that will be used to disseminate resources for the class. To access materials on the website, you will need your UW NetID and password. A Canvas email list will be used for notifications. *Please check your UW email regularly*, because assignment links will be sent to this email address. (There will be no excuses for emails not read!)

Academic Integrity: Trust between student and instructor is of paramount importance in academic settings. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-120) and your personal contract as a student. I expect that you will know and follow the university's policies on cheating and plagiarism. Please review the College of the Environment website on academic integrity so that you are clear on what constitutes academic misconduct. Any suspected cases of academic misconduct will be handled per University of Washington regulations. For more information, see the College of the Environment Academic Misconduct Policy and the University of Washington Community Standards and Student Conduct website. Be advised that as an instructor at the UW, I have the *responsibility* to notify University Conduct committees about *any* suspected student misconduct.

Disability Accommodations: It is crucial that all students in this class have access to the full range of learning experiences. At the University of Washington, it is the policy and practice to create inclusive and accessible learning environments consistent with federal and state law. Full participation in this course requires: 1) the ability to attend three 50 minute lectures per week with 20 other students; 2) participate in small group discussions on topics relevant to the course, 3) participate in 3h laboratory/discussion sections and 3) make short presentations that synthesize small group discussions and/or results of specific analyses to the class orally. If you anticipate or

experience barriers to your learning or full participation in this course based on a physical, learning, or mental health disability, please immediately contact the instructor to discuss possible accommodation(s). A more complete description of the disability policy of the College of the Environment can be found here. If you have, or think you have, a temporary or permanent disability that impacts your participation in any course, please also contact Disability Resources for Students (DRS) at: 206-543-8924 (V), 206-543-8925 (TDD), uwdss@uw.edu.

LABORATORY

Laboratory activities are designed to foster exchange of ideas and team work. Laboratory activities include a field trip, discussions, aquarium maintenance, and experimental design. We will perform laboratory experiments with sea anemones for the purpose of understanding how anthropogenic stressors can affect the health, growth and physiological characteristics in cnidarians and their symbionts (see laboratory schedule below). Starting the first lab, we will develop hypotheses, organize the research teams (4-5 students per team), assign team tasks and setup the experiments. Be sure to exchange contact information with your teammates at the start of class. Each team will expose cnidarians (sea anemones) to different conditions associated with characteristics in the natural environment and/or anthropogenic stressors. Each team will be in charge of maintaining the aquaria and feeding the anemones during the duration of the experiment. The final report, presentation and video will be related to the hypotheses and results of your experiments.

Student discussions will be an important part of the laboratory. Discussions will be based on class material and assigned readings. The discussion period will be led by student(s) who will be responsible for leading the discussion and promoting conversation. You will be evaluated on your leadership and participation during discussions. We will assign the discussion leaders for each lab at the beginning of the semester.

Laboratory Schedule

Week	Date	Lab
1	9-Jan	Lab Introduction, design and set up student experiments, organize feeding schedule and aquarium maintenance timesheet, assign discussion leaders.
2	16-Jan	Coral taxonomy (skeletons and photos), look at polyp behavior with sea anemones, extract, observe and quantify nematocysts and zooxanthellae.
3	23-Jan	Discussion Tropical Ecology: What is Natural? Game to prepare for mid-term.
4	30-Jan	Seattle Aquarium Trip
5	6-Feb	Respiration and photosynthesis measurements for student projects.
6	13-Feb	Estimate anemone growth and zooxanthellae densities for student projects End of experiment. How to make a video.
7	20-Feb	Data Analyses writing reports, provide feedback, Game to prepare for mid-term.
8	27-Feb	Movie Chasing Coral and discussion. Project feedback.
9	6-Mar	Discussion Conservation and management, Report DUE.
10	13-Mar	Review for final and outreach videos.

Presentation and video assignments: Students will work with their lab teammates to prepare a 20-min presentation of their findings. Each team will prepare a 1-minute outreach video based on the results of their research and implications for marine conservation. Video equipment can be

checked out at the UW Media Center (http://www.lib.washington.edu/media/equipment). Information on video production, and editing can be found in the UW Information Technology website (IT Connect, https://itconnect.uw.edu/learn/workshops/online-tutorials/digital-video-workshops/digital-video-overview/).

Writing assignment Students will work individually to write a research paper about their results from the laboratory experiment. Research papers need to include abstract, introduction, research questions/hypotheses, experimental design methods, results, discussion and references. Sources to improve your writing can be found at the UW writing center (depts.washington.edu/writeuw/)

LECTURE SCHEDULE

Week	Lecture #	Date	Class Topic
1	1	7-Jan	Introduction to course and research project
	2	9-Jan	Biophysical characteristics of the tropical region, experimental design
	3	11-Jan	Coral taxonomy, biogeography and evolution
2	4	14-Jan	Coral Ecology and Function/ Evolutionary Ecology: Symbiotic interactions
	5	16-Jan	Coral Physiology: Metabolism, Bleaching and Calcification
	6	18-Jan	*Coral Physiology: Calcification *by Dr. Gagnon*
3	-	21-Jan	HOLIDAY - Marin Luther King
	7	23-Jan	Coral Physiology: Reproduction
	8	25-Jan	Microbial ecology in reef systems and coral disease
4	9	28-Jan	**MIDTERM 1**
	10	30-Jan	Mesophotic Reefs
	11	1-Feb	*Reef Fish: Evolution, Diversity & Function *by Dr.Tornabene*
5	12	4-Feb	Other Reef occupiers
	13	6-Feb	Sponge biogeography and evolution
	14	8-Feb	Sponge Ecology and Function
6	15	11-Feb	Seagrass beds Biogeography, Diversity and Function
	16	13-Feb	Seagrass ecology
	17	15-Feb	Mangrove biogeography and evolution
7	-	18-Feb	HOLIDAY - Presidents Day
	18	20-Feb	Mangrove Ecology and Function
	19	22-Feb	**MIDTERM 2**
8	20	25-Feb	Population Ecology: Phase shifts, resilience and recovery
	21	27-Feb	Environmental stress and anthropogenic impacts in marine tropical systems
	22	1-Mar	Environmental stress and anthropogenic impacts in marine tropical systems
9	23	4-Mar	Effective communication techniques

	24	6-Mar	Conservation and management, Final Report Due
	25	8-Mar	Fisheries and reef aquaculture
10	26	11-Mar	Guest speaker
	27	13-Mar	Final presentations
	28	15-Mar	Final presentations
11	29	18-Mar	**FINAL EXAMINATION**

COURSE READINGS

Date	Class Topic / Reading
7-Jan	Introduction to course and research project
9-Jan	Physical characteristics of the tropical region Chpt 3. The abiotic environment, The Biology of Coral Reefs
11-Jan	Coral taxonomy, biogeography and evolution Evans 2016 Patterns of species range evolution in Indo-Pacific reef assemblages reveal the Coral Triangle as a net source of transoceanic diversity Enriquez 2017 Key functional role of the optical properties of coral skeletons in coral ecology and evolution
14-Jan	Coral Ecology and Function Barott 2012 coral-algae competition Clements 2015 Competitors as accomplices: seaweed competitors hide corals from predatory sea stars Jackson 1997 Reefs since Columbus
16-Jan	Evolutionary Ecology: Symbiotic interactions Baird 2007 Fidelity and flexibility of coral symbioses Kemp 2014 Symbiodinium before, during and after a bleaching event
18-Jan	Coral Physiology: Metabolism, Bleaching and Calcification Houlbreque 2009 Heterotrophy in scleractinian corals Suggett 2017 Symbiotic dinoflagellate functional diversity mediates coral survival under ecological crisis
23-Jan	Coral Physiology: Reproduction Richmond 1997 Reproduction and recruitment in corals Baird 2009 Patterns in Reproductive Biology of corals Tebben 2015 Chemical mediation of coral larval settlement by crustose coralline algae
25-Jan	Microbial ecology in reef systems and coral disease Rosenberg 2007 The role of microorganisms in coral health, disease & evolution Ainsworth 2009 Future of corals: a microbial perspective
30-Jan	Mesophotic Reefs Padilla-Gamino 2018 Ecophysiology of Leptoseris in Hawaii Kahng 2014 Recent advances in the ecology of mesophotic coral ecosystems
1-Feb	Reef Fish: Evolution, Diversity and Function Munday 2008 Climate change and the future of coral reef fishes Munday 2009 Ocean acidification impairs olfactory discrimination in fish Roff etal 2016 Ecological role of sharks on coral reefs
4-Feb	Other Reef occupiers Gomez-Lemos 2017 Crustose coralline algae and associated microbial biofilms deter seaweed

	settlement on coral reefs Sigl 2016 The role of vision for navigation in the crown-of-thorns seastar, *Acanthaster planci*
6-Feb	Sponge biogeography and evolution Diaz 2001 Sponges: an essential component of Caribbean coral reefs Van Soest 2012 Global Diversity of Sponges (Porifera)
8-Feb	Sponge Ecology and Function De Goeig 2013 Surviving in a marine desert: the sponge loop retains resources within coral reefs Bell 2013 Could some coral reefs become sponge reefs as our climate changes?
11-Feb	Seagrass beds Biogeography, Diversity and Function Short 2007 Global seagrass distribution and diversity: A bioregional model Duffy 2006 Biodiversity and the functioning of seagrass ecosystems
13-Feb	Seagrass ecology Lamb 2017 Seagrass ecosystems reduce exposure to bacterial pathogens of humans, fishes, and invertebrates Sullivan 2017 Review: Host-pathogen dynamics of seagrass diseases under future global change
15-Feb	Mangrove biogeography and evolution Osland 2017 Climatic controls on the global distribution, abundance, and species richness of mangrove forests
20-Feb	Mangrove Ecology and Function Lee 2014 Ecological role and services of tropical mangrove ecosystems: a reassessment Krauss 2013 How mangrove forests adjust to rising sea level
25-Feb	Population Ecology: Phase shifts, resilience and recovery Bellwood 2004 Confronting the coral reef crisis Nystrom 2010 Coral reef disturbance and resilience Bradely 2017 Resetting predator baselines in coral reef ecosystems Eddy 2018 Historical baselines of coral cover on tropical reefs as estimated by expert opinion
27-Feb	Environmental stress and anthropogenic impacts in marine tropical systems Hughes 2003 Climate change, human impacts, resilience of coral reefs Hoegh-Guldberg etal 2007 Coral reefs under rapid climate change Hoegh-Guldberg 2017 Coral reef ecosystems under climate change and ocean acidification
1-Mar	Environmental stress and anthropogenic impacts in marine tropical systems Jokiel 2016 Coral calcification and ocean acidification Van Oppen 2017 Shifting paradigms in restoration of the world's coral reefs
4-Mar	Effective communication strategies Sommerville 2011Communicating the science of climate change
6-Mar	Conservation and management Mellin 2016 Marine protected areas increase resilience among coral reef communities Graham 2013 Managing resilience to reverse phase shifts in coral reefs Hughes 2010 Rising to the challenge of sustaining coral reef resilience Mouillot 2016 Global marine protected areas do not secure the evolutionary history of tropical corals and fishes Weijerman 2017 Evaluating management strategies to optimize coral reef ecosystem services
8-Mar	Fisheries and reef aquaculture Bell 2013 Mixed responses of tropical Pacific fisheries/aquaculture to climate change Pratchett 2014 Reef degradation and loss of goods and services by reef fishes Golden 2016 Fall in fish catch threatens human health Birkeland 2017 Working with, not against, coral-reef fisheries

11-Mar	Guest speaker TBD