THE SCHOOL FOR FIELD STUDIES

Tropical Coastal Ecology
SFS 3790

Syllabus
4 credits

The School for Field Studies (SFS)
Center for Tropical Island Biodiversity and Conservation Studies (CTIBCS)
Isla Colón, Bocas del Toro, Panama

This syllabus may develop or change over time based on local conditions, learning opportunities, and faculty expertise. Course content may vary from semester to semester.

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COURSE CONTENT SUBJECT TO CHANGE

Please note that this is a copy of a recent syllabus. A final syllabus will be provided to students on the first day of academic programming.

SFS programs are different from other travel or study abroad programs. Each iteration of a program is unique and often cannot be implemented exactly as planned for a variety of reasons. There are factors which, although monitored closely, are beyond our control. For example:

- Changes in access to or expiration or change in terms of permits to the highly regulated and sensitive environments in which we work;
- Changes in social/political conditions or tenuous weather situations/natural disasters may require changes to sites or plans, often with little notice;
- Some aspects of programs depend on the current faculty team as well as the goodwill and generosity of individuals, communities, and institutions which lend support.

Please be advised that these or other variables may require changes before or during the program. Part of the SFS experience is adapting to changing conditions and overcoming the obstacles that they may present. In other words, this is a field program, and the field can change.

Course Overview

Tropical Coastal Ecology (TCE) is a course that provides fundamental knowledge necessary to understand the main ecological processes and interactions in a fragile marine island ecosystem. Basic ecological principles are paired with field observation and measurement to understand the interdependencies of species, populations, communities and ecosystems in the coastal and marine environment, and with particular attention to the management of resources and environments.

Our studies will focus on the shallow marine and coastal environments of Bocas del Toro with an emphasis on coral reef, seagrass and mangrove habitats. We will study the biology, ecology and behavior of key species, including those that form habitats and those that are important resources to the people of Bocas del Toro through fisheries and tourism. Finally, we will consider the impact of anthropogenic disturbance and global climate change to the island ecosystem and organisms living there, as well as discuss possible management solutions.

Learning Objectives

At the end of the course, students will:

1. Understanding the main ecological processes and interactions that occur in coastal island environments;
2. Understand the biology and ecology of species important to the economy and coastal ecosystems of Bocas del Toro;
3. Be able to identify key marine species by observation;
4. Understand the importance of scientific information for the conservation of species and the management of marine protected areas;
5. Comprehend and be able to choose the most appropriate techniques to collect and analyze data collected in coastal and marine environments;
6. Identify threats to the coastal ecosystem of Bocas del Toro and develop and discuss solutions to these problems;
7. Improve communication skills to both scientific and broader audiences through written assignments, oral presentations, and the creation of educational materials.

Thematic Components and Research Direction

The overarching question we address in the Tropical Coastal Ecology curriculum is:

What is the state of the coastal ecosystems in Bocas del Toro and how are they affected by climate change, ongoing coastal developments, tourism, fishing, invasive species, contamination, and other anthropogenic factors?

Consequently, we will cover the following topics this semester, directly associated with this theme:

- Species ID and taxonomy of marine animals and plants
- Mangrove and seagrass ecosystems
- Coral reef ecosystems
- Marine ecology and species interactions
- Marine protected areas
- Threats and impacts (fisheries, climate change, invasive species, plastics)
- Effects of tourism on local marine population

Assessment

Assessment Item	Value (%)
Field Guide	15
Class Assignments	20
Technical Reports	15
Scientific Article	20
Participation and Conduct	10
Final Exam	20
TOTAL	**100**

Field Guide (15%)

Students will produce photographic field guides with pictures taken during four field trips. This is a group-assignment (4-5 students per group) but each student must contribute photographing and identifying 5 corals, 5 fishes, 3 seaweeds or seagrasses, and 3 sponges. Each picture must be labeled with: 1) the name of the identified organism and 2) the name of the student who identified it. Two students cannot get credit for the same picture, but they are allowed to contribute different pictures to the same organism; in these cases, both pictures must appear together in the report, associated to the same organism, but each showing the name of their corresponding student. Finally, one student cannot contribute more than one photo to the same organism.

Class assignments (20%)

During 4 lectures, students will be given a series of questions/problems to solve during class.

Technical reports (15%)

Students will submit technical reports presenting observations or results for 3 field trips.

Scientific article (20%)

To gain experience with scientific writing, as well as think critically about the field work conducted as part of class, students will write detailed Results and Discussion portions of a field trip, following the format of the journal Marine Ecology Progress Series.

Participation and conduct (10%)

This grade will be based on: a) participation in class discussions and evidence of completing assigned readings and homework assignment; b) active participation during in-class workshops; c) timely and proper submission of data from field exercises; d) conduct and preparedness in the field; e) working well with group members during field work and in-class exercises; and f) returning equipment and field guides to the lab or proper campus location after each activity.

Final Exam (20%)

The final exam will comprise a written test that will require students to use their knowledge of coastal ecosystems covered in the course, as well as the assigned readings assigned and related discussions. The assignment will require students to think critically about issues in Bocas del Toro and use their skills in marine ecology to propose solutions or analyze ecological data provided during the test.

Grading Scheme

A	95.00 - 100.00%	B+	86.00 - 89.99%	C+	76.00 - 79.99%	D	60.00 - 69.99%
A-	90.00 - 94.99%	B	83.00 - 85.99%	C	73.00 - 75.99%	F	0.00 - 59.99%
		B-	80.00 - 82.99%	C-	70.00 - 72.99%		

General Reminders

Honor Code/Plagiarism – SFS places high expectations on their students and we hold students accountable for their behaviors. SFS students are held to the honor code below. SFS has a zero-tolerance policy towards student cheating, plagiarism, data falsification, and any other form of dishonest academic and/or research practice or behavior. Using the ideas or material of others without giving due credit is cheating and will not be tolerated. Any SFS student found to have engaged in or facilitated academic and/or research dishonesty will receive no credit (0%) for that activity.

> *"SFS does not tolerate cheating or plagiarism in any form. While participating in an SFS program, students are expected to refrain from cheating, plagiarism and any other behavior which would result in a student receiving credit for work which they did not accomplish on their own. Students are expected to report any instance of cheating or plagiarism by others."*

Deadlines – Deadlines for written and oral assignments are instated to promote equity among students and to allow faculty ample time to review and return assignments before others are due. As such, deadlines are firm; extensions will only be considered under extreme circumstances. Late assignments will incur a penalty of 10% of your grade for each day you are late. After two days past the deadline, assignments will no longer be accepted. Assignments will be handed back to students after a one-week grading period. Grade corrections for any assessment item should be requested in writing at least 24 hours after assignments are returned. No corrections will be considered afterwards.

Content Statement – Every student comes to SFS with unique life experiences, which contribute to the way various information is processed. Some of the content in this course may be intellectually or emotionally challenging but has been intentionally selected to achieve certain learning goals and/or showcase the complexity of many modern issues. If you anticipate a challenge engaging with a certain topic or find that you are struggling with certain discussions, we encourage you to talk about it with faculty, friends, family, the HWM, or access available mental health resources.

Participation – Since we offer a program that is likely more intensive than you might be used to at your home institution, missing even one lecture can have a proportionally greater effect on your final grade simply because there is little room to make up for lost time. Participation in all components of the course is mandatory, it is important that you are prompt for all activities, bring the necessary equipment for field exercises and class activities, and simply get involved.

Course Content

Type: D: Discussion, **FL:** Field Lecture, **GL:** Guest Lecture, **L**: Lecture, **O**: Orientation

*Readings in **Bold** are required.

Code	*Lecture Title and Description*	*Type*	*Time*	*Readings*
TCE 01	**Course Introduction** Course overview & introduction to assignments and expectations.	O	1.0	
TCE 02	**Defining our field** What is tropical? What is coastal? What is ecology? What is biodiversity?	L	1.0	**Grorud-Colvert & Ward (2023)**
TCE 03	**Open Water Test** Field Exercise: students photograph five corals and five fishes to identify later.	FL	3.0	
TCE 04	**Marine Zoology** The tree of animal life, identification of Caribbean corals and fishes, indices of biodiversity	L	1.5	Field Guide: Humann and Deloach (2002)
TCE 05	**Phanerogam-Based Ecosystems** Mangrove Forests & Seagrass Meadows	L; D	1.0	**Araújo (2018)** **Steward et al. (2023)**
TCE 06	**Marine Invertebrate ID** Identification of echinoderms, crustaceans, polychaetas, and other marine invertebrates of Bocas del Toro. Students observe and photograph non-sessile marine invertebrates.	FL	2.5	
TCE 07	**Field Trip to Mangrove Forest & Seagrass Meadows** Students photograph three sponges and three seagrass species to identify them later and add them to their Field Guides.	FL	2.5	
TCE 08	**Marine Phycology: Seaweeds** The botanic tree of life and functional groups and identification of Caribbean seaweeds. Field Exercise: collect seaweeds to identify them in the lab.	L; FL	1.5	Field Guides: Littler et al. (1989) Balata et al. (2011)
TCE 09	**Identification of organisms in the lab** Identify species photographed and collected during all the field trips and produce Field Guides.	O	1.5	Field Guides: Humann and Deloach (2002) Littler et al. (1989) Balata et al. (2011)
TCE 10	**Measuring and quantifying marine biodiversity** Students learn multiple indices of biodiversity and how to use them. Students learn to survey marine organisms with quadrats and transects, practicing in classroom and analysing images of photo-quadrats.	D; O	2.0	**Hill and Wilkinson (2004)** Obura (2019) Raymundo et al. (2008)
TCE 11	**Benthic Survey** Benthic organisms are surveyed with transects and quadrats.	FL	3.0	

TCE 12	**MPA Design Theory and Workshop** Students reflect on the ecological and socio-economic factors, levels of protection, history and efficacy of Isla Bastimentos National Marine Park. Students perform a thought-experiment where they re-design Bastimentos National Marine Park.	L; O	2.0	**Guerron-Montero (2005)**
TCE 13	**Surveying coral health in an MPA** Students observe the zones of a coral reef, write observations on their flora and fauna, and propose methods to quantify them.	FL	1.5	
TCE 14	**Coral Reefs: function & health**	L; D	1.0	**Lirman & Maté (2018)** Raymundo et al. (2008)
TCE 15	**Reef Fish Survey** Fishes are surveyed with the stationary point count method.	FL	3.0	
TCE 16	**Common Patterns in Biodiversity and Biogeography** Students learn and discuss several ecological patterns of marine organisms worldwide and in the tropics.	L	1.5	**Collin et al. (2024)** Cramer (2012) Cramer (2013)
TCE 17	**Physical Oceanography** Coriolis effect, Eckman spiral, wind patterns, surface currents, thermohaline circulation, El Niño, and how they affect the Bocas Archipelago. Workshop: Students watch videos about various oceanographic topics and analyze oceanographic maps to solve a series of questions given by the instructor.	L; O	1.5	**Collin et al. (2024)** D'Croz et al. (2005) Altieri et al. (2017)
TCE 18	**Formation of the Panama Isthmus** Students learn about and discuss how the emergence of the Panama isthmus affected the ecology of the region	L; O	1.0	**O'Dea et al. (2016)**
TCE 19	**Visit to Caribbean Coral Restoration** Learn methods used in creating artificial reefs and fragmentation and growing of corals; snorkel the artificial reefs and coral nursery to observe firsthand	GL; FL	2.5	
TCE 20	**Primary & secondary production**	L	1.5	**Mumby et al. (2004)** **CARICOMP (2001)**
TCE 21	**Primary Production Seagrass Survey (Part I)** Students mark all the sea grasses in a quadrat so that their production can be measured a week later.	FL	2.5	
TCE 22	**Competitive inhibition of corals** Students discuss two scientific papers and answer a series of questions given by the instructor as a group activity.	L; D	1.5	**McCook et al. (2001)** **Birrell et al. (2008)**
TCE 23	**Turtle conservation efforts in Bocas del Toro**	GL; D	1.0	

TCE 24	**Disturbance, pollution & climate change**	L; D	2.0	**Ripple et al. (2017)** **Seeman et al. (2013)**
TCE 25	**Primary Production Survey of Seagrasses (Part II)** Students collect seagrasses marked during a previous field trip and measure their production.	FL	2.5	
TCE 26	**Review** Students re-visit key material taught in this course to prepare for their final exam.	L; O	2.0	
TCE 27	**Methods in Beach Mapping & Monitoring Coastal Erosion** Map the beach near SFS as part of a long-term monitoring project monitoring coastal erosion.	FL	2.5	
	Total		**50**	
	UMN Instructional Hours*		**60**	

Reading List

*Readings in **Bold** are required

1. Altieri AH, Harrisona SB, Seemann J, Collin R, Diaz RJ & N Knowlton (2017). Tropical dead zones and mass mortalities on coral reefs. PNAS 114(14): 3660-3665
2. **Araújo RJ (2018).** Mangrove forests of Bocas del Toro province and the Ngöbe-Buglé comarca, Panama: structural description and comparison to neotropical forests. In: Suman DO & Spalding AK (eds) Coastal resources of Bocas del Toro, Panama: tourism and development pressures and the quest for sustainability, pp. 182-207
3. **Balata D, Piazzi L & F Rindi (2011).** Testing a new classification of morphological functional groups of marine macroalgae for the detection of responses to stress. Marine Biology 158: 2459-2469.
4. **Birrell CL, McCook LJ, Willis BL & GA Diaz-Pulido (2008).** Effects of benthic algae on the replenishment of corals and the implications for the resilience of coral reefs. Oceanography and Marine Biology: an Annual Review 46: 25-63.
5. **CARICOMP (2001).** CARICOMP methods manual. Levels 1 and 2. Manual of methods for mapping and monitoring of physical and biological parameters in the coastal zone of the Caribbean. CARICOMP Data Management Center, University of the West Indies, Kingston. 91pp.
6. **Collin R, Adelson AE, Giddings SN, Altieri AH, Kastner S, Mach L, Clark KE, Pawlak G, Davis K, Sjögersten S, Torres M, Scott CP (2024)**. Using forty years of research to view Bahía Almirante on the Caribbean Coast of Panama as an integrated social-ecological system. Estuarine, Coastal and Shelf Science 306: 108878. https://doi.org/10.1016/j.ecss.2024.108878
7. Cramer KL, Jackson JBC, Angioletti CV, Leonard-Pingel J & Guilderson TP (2012). Anthropogenic mortality on coral reefs in Caribbean Panama predates coral disease and bleaching. Ecology Letters. doi: 10.1111/j.1461-0248.2012.01768.x
8. Cramer KL (2013). History of human occupation and environmental change in Western and Central Caribbean Panama. Bulletin of Marine Science 89. http://dx.doi.org/10.5343/bms.2012.1028

9. D'Croz L, Del Rosario JB & P Góndola (2005). The effect of fresh water runoff on the distribution of dissolved inorganic nutrients and plankton in the Bocas del Toro Archipelago, Caribbean Panama. Caribbean Journal of Science 41(3): 414-429

10. **Edgar GJ, Stuart-Smith RD, Willis TJ, et al (2014).** Global conservation outcomes depend on marine protected areas with five key features. Nature 506: 216-220

11. **Guerron-Montero C (2005).** Marine Protected Areas in Panama: Grassroots activism and advocacy. Human Organization 64(4): 360-373.

12. **Grorud-Colvert K & M Ward (2023).** Chapter 3 - The Ocean: An Introduction to the Marine Environment. In: Spalding AK & DO Suman (eds.) Oceans and Society - An Introduction to Marine Studies, pp. 24-37

13. **Hill J & C Wilkinson (2004).** Methods for ecological monitoring of coral reefs. Version 1. Australian Institute of Marine Science, Townsville QLD. 123 pp.

14. **Humann P & N DeLoach (2002a).** Reef coral identification – Florida, Caribbean, Bahamas. 2nd Edition. New World Publications Inc., Jacksonville FL. 278 pp.

15. **Humann P & N DeLoach (2002b).** Reef fish identification – Florida, Caribbean, Bahamas. 2nd Edition. New World Publications Inc., Jacksonville FL. 537 pp.

16. **Humann P & N DeLoach (2002c).** Reef creature identification – Florida, Caribbean, Bahamas. 2nd Edition. New World Publications Inc., Jacksonville FL. 420 pp.

17. **Lirman D & JL Maté (2018).** Status of coastal habitats of Bocas del Toro, Panama: coral reefs and seagrass meadows. In: Suman DO & Spalding AK (eds) Coastal resources of Bocas del Toro, Panama: tourism and development pressures and the quest for sustainability, pp. 159-181

18. **Littler DS, Littler MM, Bucher KE & JN Norris (1989).** Marine Plants of the Caribbean: A Field Guide from Florida to Brazil. Smithsonian Institution Press. Washington DC. 264 pp.

19. **McCook LJ, Jompa J & G Diaz-Pulido (2001).** Competition between corals and algae on coral reefs: a review of evidence and mechanisms. Coral Reefs 19: 400-417.

20. **Mumby PJ, Edwards AJ, et al. (2004).** Mangroves enhance biomass of coral reef fish communities in the Caribbean. Nature 427(6974): 533–536.

21. Obura DO, Aeby G, et al. (2019). Coral Reef Monitoring, Reef Assessment Technologies, and Ecosystem-Based Management. Frontiers in Marine Science 6:580. doi: 10.3389/fmars.2019.00580

22. **O'Dea A, Lessios HA, et al. (2016).** Formation of the Isthmus of Panama. Science Advances 2:e1600883. https://doi.org/10.1126/sciadv.1600883

23. Raymundo LJ, Couch CS & CD Harvell (eds.) (2008). Coral Disease Handbook: Guidelines for Assessment, Monitoring & Management. Coral Reef Targeted Research and Capacity Building for Management Program.

24. **Ripple et al. (2017).** World Scientists' Warning to Humanity: A Second Notice. BioScience 67(12): 1026–1028. https://doi.org/10.1093/biosci/bix125

25. **Seeman J, González CT, Carballo-Bolaños R, Berry K, Heiss GA, Struck U, & RR Leinfelder (2013).** Assessing the ecological effects of human impacts on coral reefs in Bocas del Toro, Panama. Environ Monit Assess. DOI 10.1007/s10661-013-3490-y

26. **Stewart EA, Kline DI, Chapman LJ, & AH Altieri (2021).** Caribbean mangrove forests act as coral refugia by reducing light stress and increasing coral richness Ecosphere 12: e03413. DOI: 10.1002/ecs2.3413