THE SCHOOL FOR FIELD STUDIES

Tropical Marine Ecology
SFS 3730

Syllabus

The School for Field Studies (SFS)
Center for Marine Resource Studies (CMRS)
South Caicos, Turks & Caicos Islands

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.

www.fieldstudies.org

Sp19

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, the elephants are not always where we want them to be, so be flexible!

Course Overview

Marine ecology is the study of how marine organisms interact with their biotic and abiotic environments. In this course we will focus on the ecosystems that dominate the shallow coastal areas of the tropical western Atlantic, i.e. mangrove forests, seagrass meadows and coral reefs. The course will focus on the biological and ecological characteristics of the aforementioned ecosystems. Furthermore, we will explore the ways in which Marine Protected Areas, climate change and hurricanes can alter ecological processes, and we will learn how practical field techniques can be employed to assess marine communities. Lastly, the students will receive training in video making and apply the training they received by creating a short documentary on how coral reef species interact with each other.

Learning Objectives

After completing this course, students should:

1. Understand the various levels of ecological organization.

2. Understand the concepts of energy flow and biogeochemical cycling in marine ecosystems.

3. Be able to identify, and understand the ecological importance of, common marine macro algae, plants, invertebrates and vertebrates in the tropical western Atlantic.

4. Understand the direct and indirect effects of Marine Protected Areas, climate change and hurricanes on marine communities.

5. Be competent in the collection and analysis of field data; in particular, relating to abundance estimates of seagrass and parrotfish.

6. Gain experience in aspects of video content creation.

7. Understand how species on the coral reef interact with each other through competition and symbiosis and learn about behaviors of fish and bioluminescent species.

Case Study Foci

During the semester, the SFS program will use two case studies to frame our analysis and discussions, each of which addresses specific issues:

Case Study I: Background on the marine ecosystems that are currently considered important to the ecological and socioeconomic well-being of the TCI and research methods to study them. In the Marine Ecology course we will use Case Study I to learn about marine organisms and the coastal ecosystems of the TCI and how they can be studied using field research techniques.

Case Study II: Broad look at how these ecosystems are linked to each other and are affected by Marine Protected Areas, climate change and hurricanes as well as a close up look at the coral reef community. In the Marine Ecology course we will use Case Study II to learn about how the three ecosystems are linked, the potential value of Marine Protected Areas, the treats posed by climate change and hurricanes. Furthermore, we will learn about the coral reef community and its behaviors and produce short documentaries about them.

Assessment

Students will be assessed in a variety ways during the Marine Ecology course, including written exams, field exams, short reports, a poster and a short documentary. The written exams at the end of Case Study I and Case Study II account for 35 % of the course assessment, with the remaining 65 % being accounted for by field-based activities (see below). The written exams at the end of Case Study I and Case Study II are academically rigorous and will require students to display an in-depth understanding of the material covered in class and the associated readings. While an understanding of ecological concepts and processes is the main goal of this course, Marine Ecology involves a lot of factual details and students are expected to retain such information.

Assessment Item	Type	Value (%)
Case Study I		
Species poster	Group Poster	10
Mangrove and seagrass communities	Field test	5
Seagrass FEX and JMP exercise	Group short report	10
Coral reef invertebrates and fish	Field test	5
Parrotfish FEX	Short report	10
Case Study I final exam	Exam	20
Case Study II		
Coral Reef Documentary	Group video	20
Case Study II final exam	Exam	15
Participation	Participation grade	5
TOTAL		**100**

Species poster (10%): The goal of this assignment is to provide students with experience in designing a conference-style poster. This poster will be a review of a species (alga, plant or animal) that is found in the TCI and can be readily observed by students in the field. They will perform a literature search for scientific information that is relevant to the species they choose. Students will work in groups of 4-5 students to complete this assessment.

Mangrove and seagrass communities (5%): In class, students will be introduced to the taxonomic classification and trophic characteristics of local mangrove and seagrass species and their associated macroalgae, invertebrates, and fishes. This briefing will be followed by an in-water observation session, a desk-based taxonomic review session, and an in-water identification test.

Seagrass FEX and JMP exercise (10%): Students will employ the practical seagrass field techniques that have been covered in class to assess the abundance of seagrass species and compare different techniques to do so with each other. To practice using the statistical program JMP, they will complete a tutorial and fill out a worksheet that is graded. Lastly, they will use JMP to statistically compare the data they collect and write a short paragraph with the results and discussion of the result of the statistical test which will also count towards the grade. Students will work in groups of 2 to complete this assessment.

Coral reef invertebrates and fishes (5%): In class, students will be introduced to the taxonomic classification and trophic characteristics of local corals, other invertebrates and fishes that are common on local coral reefs. This briefing will be followed by two in-water observation session, a desk-based taxonomic review session, and an in-water identification test.

Parrotfish FEX (10%): Students will employ the practical coral reef field techniques that have been covered in class to assess the abundance of parrotfish and compare different techniques to do so with each other. They will conduct a statistical analysis comparing the results of both technique and calculate the impact of the parrotfish on the benthos of the reef. They will write a short report that includes the aim, methods used, results and discussion of results.

Coral Reef Documentary (20%): Students will employ the knowledge gained on fish behavior, competition and symbiosis on the coral reef to produce a short coral reef documentary highlighting one or multiple of these processes. Students will attend workshops to gain skills video production and go in the field to collect footage. They will perform a literature search for scientific information that is relevant to their footage and produce a short documentary style video. Students will work in groups of 4-5 students to complete this assessment.

Participation (5%): Active participation in the entire course is crucial to a successful learning experience. A participation grade will be given assessing the active participation in the readings discussion, lectures and field work.

Exams: are given after each Case Study and are based on the lectures and readings from that Case Study. Sometimes the days before exams can be busy with other course activities/assignments. This is logistically unavoidable, so please ensure that you make full use of the time available earlier in the semester.

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

Lectures & field briefings are held at the Center. It is mandatory to attend all lectures and briefings. PDFs of the lecture presentations will be provided to students via the Marine Ecology course folder on the Student Drive; however, it is important to note that these slides only contain key points and illustrations; it is essential that students also take notes during lectures. Students are permitted to make audio recordings of lectures on the understanding that any such recordings are for personal use only (i.e. they cannot be shared or distributed).

Readings: Assigned readings will be available on the student server. You are expected to be familiar with these readings during the associated lecture; the readings are designed to supplement the lecture content. A small student lead discussion of the reading will take place during the lecture, please come to the lecture with 3 ecology related questions about the reading. You are expected to be familiar with the content of all assigned readings for the written exams at the end of Case-Study I and Case-Study II.

Plagiarism and Cheating: Using ideas and materials of others without giving due credit is cheating and will not be tolerated. A grade of zero will be assigned to anyone caught cheating or aiding another person to cheat, either actively or passively (e.g., allowing someone to look at your exam or report). Unless specifically stated otherwise, all assignments should be individual pieces of work.

Appropriate use of technology: SFS has worked hard to provide internet access to all its staff and students. Inappropriate uses include gaming or video/music downloading. **Laptops/tablets are permitted in lectures for the sole purpose of note taking**. Any inappropriate use (e.g. accessing the internet, working on assignments. gaming etc.) will result in this privilege being withdrawn. **Cellphones are not permitted in lectures**.

Deadlines: Deadlines for written and oral assignments are instated for several reasons:

1. Deadlines are a part of working and academic life to which students need to become accustomed.
2. Deadlines promote equity among students.
3. Deadlines allow faculty ample time to review and return assignments before others are due.

As such, deadlines are *firm* and extensions will only be considered under the most extreme circumstances. Late assignments will incur a 10% penalty for every day that they are late. This means an assignment that is five minutes late will have 10% removed, an assignment that is one day and five minutes late will have 20% removed, and so on. Assignments will be handed back to students after a one-week grading period.

Naming assignments:

1. Word documents, Excel documents, and PDFs for all individual assignments, exams, reports should be saved as… **FirstName_LastName_Assignment**
   Example… John_Smith_Literature Review

3. Group assignments should be named…
   Group#_Assignment
   Example… Group1_DataAnalysis

Participation: Participation in all components of the program is mandatory, as there will be no spare time to catch up on any missed classes. Missing even one lecture or discussion can significantly affect the experience you and your classmates have while at CMRS. Within our teaching environment, there is no reason to miss classes. You will get as much out of this course as you put into it, so please dive in. In all circumstances, we expect you to respect yourself and your fellow students. Dissent and discord are expected, but disrespect will not be tolerated.

Course Content

Type- L: Lecture, **FEX:** Field Exercise, **T:** Test, **EX**: Desk Exercise, **P:** Presentation

No.	*Title*	*Type*	*Time (hrs)*	*Readings*
ME1	**Couse Introduction** Course components • Assessments and dates • Expectations • Ecological concepts	L	1	
ME2	**Diversity of Marine Life** • The organization of life • Taxonomic nomenclature • Characteristics and ecological roles of common marine taxa	L	1	Castro, P., & Huber, M. E. (2008). Chapters 5 - 9. This reading is optional but strongly recommended, particularly for students who do not have a strong biological background.
ME3	**Marine Life Field Exercise** • In-water observations of common marine taxa	FEX	1.5	
ME4	**Species Poster briefing** • Background on scientific posters Assignment explanation	L	1	
ME5	**Species poster work time** • Group work on poster	DEX	1.5	
ME6	**Conch, Lobster, Grouper Biology** • Taxonomy • Distribution and habitat requirements • Anatomy • Feeding • Reproduction • Growth	L	1	
ME7	**Mangrove Biology** • Global distribution • Environmental challenges • Reproduction and dispersal	L	1	**Valiela**, I., Bowen, J. L., & York, J. K. (2001). 807-815.
ME8	**Mangrove Forest Structure & Nutrients** • Classification schemes • Forest zonation • Inorganic nutrients • Nutrient recycling • Nutrient limitation	L	1	
Assignment	**Species poster due at 8 AM**			
ME9	**Seagrass Biology** • Global distribution • Anatomy • Growth • Physical environment	L	1	**Orth**, R. J., et al (2006). 987-996.

	• Photosynthetic adaptations • Reproduction			
ME10	**Mangrove and Seagrass Organisms ID Slideshow** • Introduction to the taxonomic characteristics of mangroves and associated organisms	L	1	
ME11	**Mangrove and Seagrass Organisms Field ID** • In-water identification of mangroves and associated organisms	FEX	2	
ME12	**Poster presentation** • Students give a short (3 minute) presentation about their poster to the SFS staff and answer questions regarding their posters	DEX	1	
ME13	**Mangrove Communities** • Community zonation • Epibiota • Below-water mobile fauna • Above-water mobile fauna • Species interactions	L	1	
ME14	**Seagrass Communities** • Epibiota • Mobile fauna • Species interactions	L	1	
ME15	**Mangrove and Seagrass Organisms ID Review** • Revision session for organisms covered during ME10 and ME11	DEX	1.5	**Kaplan**, E. H. (1999). **Littler**, D. S., Littler, M. M., Bucher, K. E., & Norris, J. N. (1989). **Humann**, P., Deloach, N., & Wilk, L. (2002).
ME16	**Mangrove and Seagrass Organisms ID Test** • In-water species identification test	T		
ME17	**Seagrass Research Methods and FEX dry run** • Overview of seagrass research methods • On land practice time of methods use later in the field	L	1	
ME18	**Seagrass FEX/JMP exercise** • In-water assessment of seagrass abundance • Time dedicated to individually work on JMP tutorial	FEX/DEX	2	
ME19	**Seagrass FEX/JMP exercise Q&A** • Briefing on short report writing and answering of questions	L	1	

	regarding the assignment			
ME20	**Seagrass FEX/JMP exercise work time** • Time allocated to work on Seagrass FEX/JMP exercise short report	DEX	1.5	
ME21	**Coral Reef Invertebrates ID Slideshow** • Introduction to the taxonomic characteristics of corals and other reef-associated invertebrates	L	1	
ME22	**Coral Reef Invertebrates Field ID** • In-water identification of corals and other reef-associated invertebrates	FEX	2	
ME23	**Coral Biology** • Global distribution • Taxonomy and anatomy • Growth • Reproduction • Feeding and nutrients • Aggression and defense	L	1	
ME24	**Coral Reef Formation and Structure** • Limiting factors • Reef classification • Reef zonation • Reef constituents • Reef growth • Types of calcium carbonate	L	1	**Perry**, C. T., Steneck, R. S., Murphy, G. N., Kench, P. S., Edinger, E. N., Smithers, S. G., & Mumby, P. J. (2015). 1153-1164.
ME25	**Coral Reef Fish ID Slideshow** • Introduction to the taxonomic characteristics of reef-associated fish	L	1	
ME26	**Coral Reef Invertebrates and Fish ID Review** • Revision session for organisms covered during ME21, ME22, ME25 and ME27	EX	2.5	**Reference Resources:** **Humann**, P., & Deloach, N. (1994). **Humann**, P., Deloach, N., & Wilk, L. (2002).
ME27	**Coral Reef Fish Field ID** • In-water identification of coral reef fishes	FEX	2	
ME28	**Coral reef communities** • Reef algae • Reef sponges and other invertebrates • Reef fishes • Species interactions	L	1	**Mumby**, P. J., Hastings, A., & Edwards, H. J. (2007).
ME29	**Coral Reef Invertebrates and Fishes ID Test** • In-water species identification test	T		

ME30	**Coral Reef Research Techniques** • Benthic community assessment • Reef fish census	L	1	
ME31	**Parrotfish FEX briefing and dry run** • Briefing on survey techniques used • On land practice of survey techniques	L	1	
ME32	**Parrotfish FEX** • In water assessment of Parrotfish abundance	FEX	2	
ME34	**Case-Study I Review** • A review of the topics covered during Case-Study I • Description of the Case-Study I final exam	L	1	
ME37	**Case-Study I Final Exam** • Written exam	T		**Mumby**, P. J., Edwards, A. J., Arias-González, J. E., Lindeman, K. C., Blackwell, P. G., Gall, A., & Wabnitz, C. C. (2004).
ME35	**Parrotfish FEX data analysis and write up Q&A** • Briefing on short report writing and answering of questions regarding the assignment	L	1	**Lester**, S. E., et al (2009). 33-46.
ME36	**Parrotfish FEX data analysis and write up** • Time allocated to work on Parrotfish FEX short report	DEX	1.5	
ME37	**Mangrove-Seagrass-Coral Connectivity** • Biogeochemical linkages • Ecological linkages	L	1	Bshary, R., Hohner, A., Ait-el-Djoudi, K., & Fricke, H. (2006).
ME38	**Ecological Impacts of MPAs** • Direct effects • Indirect effects • Ecosystem functioning	L	1	
ME39	**Case-Study I Exam Debrief** • Explanation of exam answers • Common mistakes and misconceptions	L	1	
ME40	**Symbiosis and competition on coral reefs** • Symbiosis • Parasitism • Competition • Co-evolution	L	1	
ME41	**Reef Fish behavior** • Reproduction • Cleaning stations • Feeding	L	1	

	• Competition			
ME42	**Effects of Climate Change on Marine Ecosystems** • Causes • Temperature effects • Ocean acidification	L	1	Hoegh-Guldberg O., et al (2018) Read: • 3.4.4.10 Framework organisms (tropical corals, mangroves and seagrass) (p.225-226) • Figure 3.18 (p. 228) • Box 3.4 (p. 229-230)
ME43	**Coral Reef Documentary Briefing** Briefing on FEX and DEX to create a coral reef documentary	L	1	
ME44	**Hurricanes and Marine Ecosystems** • Effects on Mangroves • Effects on Seagrass • Effects on Coral Reefs • Effects on abiotic properties	L	1	**Gardner**, T. A., Cote, I. M., Gill, J. A., Grant, A., & Watkinson, A. R. (2005). 174-184.
ME45	**Case-Study II Review** • A review of the topics covered during Case-Study II • Description of the Case-Study II final exam	L	1	
ME46	**Coral Reef Documentary workshops** Students can choose a workshop to attend to learn skills associated with creating exciting videos	DEX	2	
ME47	**Coral Reef Documentary FEX** In water recording of video and photographs for Coral Reef Documentary	FEX	4	
ME48	**Coral Reef Documentary Literature Research and editing time** Time allocated for literature research and video editing	DEX	4	
ME49	**Coral Reef Documentary screening** Students show their coral reef documentary to other students, faculty and staff	L	1	
ME50	**Case-Study II Exam** • Written exam (two hours)	T		
ME54	**Case-Study II Exam Debrief** • Explanation of exam answers • Common mistakes and misconceptions	L	1	
TOTAL			**65**	

Reading List

*Readings in **Bold** are required.

Bshary, R., Hohner, A., Ait-el-Djoudi, K., & Fricke, H. (2006). Interspecific communicative and coordinated hunting between groupers and giant moray eels in the Red Sea. *PLoS biology*, *4*(12), e431

Castro, P., & Huber, M. E. (2008). Marine Biology, 7th edition: Chapters 5 - 9.
Gardner, T. A., Cote, I. M., Gill, J. A., Grant, A., & Watkinson, A. R. (2005). Hurricanes and Caribbean coral reefs: impacts, recovery patterns, and role in long-term decline. *Ecology*, *86*(1)
Humann, P., Deloach, N., & Wilk, L. (2002). Reef Creature Identification: Florida, Caribbean, Bahamas.
Humann, P., & Deloach, N. (1994). Reef Coral Identification. *Paramount Miller Graphics*.

Hoegh-Guldberg O., Jacob D., Taylor M., Bindi M., Brown S., Camilloni I., Diedhiou A., Djalante R., Ebi K. L., Engelbrecht F. Guangsheng Z., Guiot J. Hijioka Y., Mehrotra S., Payne A., Seneviratne S. I., Thomas A., Warren R. (2018) Impacts of 1.5 C of Global Warming on Natural and Human Systems. *Chapter 3 of IPCC Special report Global Warming of 1.5 C.*
Kaplan, E. H. (1999). *A field guide to southeastern and Caribbean seashores: Cape Hatteras to the Gulf coast, Florida, and the Caribbean* (Vol. 36). Houghton Mifflin Harcourt.

Littler, D. S., Littler, M. M., Bucher, K. E., & Norris, J. N. (1989). *Marine plants of the Caribbean; a field guide from Florida to Brazil*. Smithsonian Institution Press.

Lester, S. E., Halpern, B. S., Grorud-Colvert, K., Lubchenco, J., Ruttenberg, B. I., Gaines, S. D., ... & Warner, R. R. (2009). Biological effects within no-take marine reserves: a global synthesis. *Marine Ecology Progress Series*, *384*, 33-46.

Mumby, P. J., Hastings, A., & Edwards, H. J. (2007). Thresholds and the resilience of Caribbean coral reefs. *Nature*, *450*(7166), 98

Mumby, P. J., Edwards, A. J., Arias-González, J. E., Lindeman, K. C., Blackwell, P. G., Gall, A., & Wabnitz, C. C. (2004). Mangroves enhance the biomass of coral reef fish communities in the Caribbean. *Nature*, *427*(6974), 533.

Orth, R. J., Carruthers, T. J., Dennison, W. C., Duarte, C. M., Fourqurean, J. W., Heck, K. L., & Short, F. T. (2006). A global crisis for seagrass ecosystems. *Bioscience*, *56*(12), 987-996.
Perry, C. T., Steneck, R. S., Murphy, G. N., Kench, P. S., Edinger, E. N., Smithers, S. G., & Mumby, P. J. (2015). Regional-scale dominance of non-framework building corals on Caribbean reefs affects carbonate production and future reef growth. *Global Change Biology*, *21*(3), 1153-1164.

Valiela, I., Bowen, J. L., & York, J. K. (2001). Mangrove Forests: One of the World's Threatened Major Tropical Environments: *AIBS Bulletin*, *51*(10), 80