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.

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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 may be 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.

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 biodiversity and habitat assessment of seagrass meadows and biodiversity and health assessment of corals.

6. Gain experience in aspects of scientific poster creation

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

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:. In the Marine Ecology course we will use Case Study I to learn about marine organisms and the coastal ecosystems of the TCI

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 observe and document these behaviors in the field.

The course will also teach the students different types of field research techniques, field data analysis and write up. This will be done throughout the course in both Case study I and II.

Assessment

Students will be assessed in a variety of ways during the Marine Ecology course, including written exams, field exams, short reports, documentation of field observation and a poster. The written exams at the of the class account for 30% of the course assessment, with the remaining 70% 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.

Assignments

Assessment Item	Type	Value (%)
Case Study I		
Mangrove and seagrass communities	Field test	5
Seagrass FEX and JMP exercise	Group short report	15
Coral reef invertebrates and fish	Field test	5
Species poster	Group poster and presentation	20
Stony coral tissue loss disease FEX	Group short report	20
Case Study II		
Symbiosis and competition field observations	Group assignment	10
Case Study II final exam	Exam	20
Participation	Participation grade	5
TOTAL		**100**

Species poster: 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 3 students to complete this assessment.

Mangrove and seagrass communities: 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: Students will employ the practical seagrass field techniques that have been covered in class to assess the abundance of seagrass species and macro invertebrates living in the seagrass bed. 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 up the results from their study in a scientific paper style results section. This results section will also count towards the grade. Students will work in groups of 3 to complete this assessment.

Coral reef invertebrates and fishes: 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.

Stony coral tissue loss disease FEX: Students will employ the practical coral reef field techniques that have been covered in class to assess the biodiversity and health of the corals found on the coral reefs surrounding South Caicos. They will calculate biodiversity indexes and statistically analyze their data using a Permanova and submit these for part of their grade. Students will also practice writing a scientific paper style methods section including study site, field methods and data analysis, which will also be graded. Students will work in groups of 3 to complete this assessment.

Symbiosis and competition field observations: Students will employ the knowledge gained on fish behavior, competition and symbiosis on the coral reef to identify and document symbiotic and competitive interactions in the field. As a buddy pair (2-3 people) they will film five of these behaviors. The videos together with a short description of the behaviors will be submitted and graded.

Participation: 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.

Exam: is given at the end of the course and is based on the lectures and readings from that Case Study. The exam is an open book take home exam. **PLEASE BE AWARE THAT YOU NEED TO PREPARE FOR YOUR EXAMS AS YOU PROGRESS THROUGH THE COURSE.** 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 - 65.99%
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 at least a 10% penalty (depending on how late it is). 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 - Content*	*Reading*
ME01 (**L**, 1.0 hr)	**Course Introduction** • Course components • Assessments and dates • Expectations • Ecological concepts	
ME02 (**L**, 1.0 hr)	**Diversity of Marine Life** • The organization of life • Taxonomic nomenclature • Characteristics and ecological roles of common marine taxa	Castro, P., & Huber, M. E. (2008). Marine Biology, 7th edition: Chapters 5 - 9. This reading is optional but strongly recommended, particularly for students who do not have a strong biological background.
ME03 (**FEX**, 2.5 hr)	**Marine Life Field Exercise** • In-water observations of common marine taxa	
ME04 (**L**, 1.0 hr)	**Mangrove and Seagrass Organisms ID Slideshow** • Introduction to the taxonomic characteristics of mangroves and associated organisms	
ME05 (**FEX**, 2.0 hr)	**Mangrove and Seagrass Organisms Field ID** • In-water identification of mangroves and associated organisms	
ME06 (**DEX**, 0.5 hr)	**Mangrove and Seagrass Organisms ID Review** • Revision session for organisms covered during ME04 and ME05	**Reference resources:** 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. Humann, P., Deloach, N., & Wilk, L. (2002). Reef Creature Identification: Florida, Caribbean, Bahamas.

No.	Title - Content	Readings
ME07 (**T**, 2.0 hr)	**Mangrove and Seagrass Organisms ID Test** • In-water species identification test	
ME08 (**L**, 1.0 hr)	**Conch, Lobster, Grouper Biology** • Taxonomy • Distribution and habitat requirements • Anatomy • Feeding • Reproduction • Growth	
ME09 (**L**, 1.0 hr)	**Seagrass Biology** • Global distribution • Anatomy • Growth • Physical environment • Photosynthetic adaptations • Reproduction	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.
ME10 (**L**, 1.0 hr)	**Seagrass Research Methods and FEX dry run** • Overview of seagrass research methods • On land practice time of methods use later in the field	
ME11 (**FEX**, 3.0 hr)	**Seagrass FEX** • In-water assessment of seagrass abundance • Time dedicated to individually work on JMP tutorial	
ME12 (**L**, 1.0 hr)	**Seagrass Communities** • Epibiota • Mobile fauna • Species interactions	
ME13 (**DEX**, 2 hr)	**Seagrass DEX** • Time allocated to work on Seagrass FEX short report	
Assignment	**Seagrass FEX write up due 8 AM**	
ME14 (**L**, 1.0 hr)	**Mangrove Biology** • Global distribution • Environmental challenges • Reproduction and dispersal	Valiela, I., Bowen, J. L., & York, J. K. (2001). Mangrove Forests: One of the World's Threatened Major Tropical Environments: *AIBS Bulletin*, *51*(10), 807-815.

No.	*Date*	*Title - Content*	*Reading*
ME15 (**L**, 1.0 hr)	26 Sept	**Mangrove Forest Structure & Nutrients** • Classification schemes • Forest zonation • Inorganic nutrients • Nutrient recycling • Nutrient limitation	
ME16 (**L**, 1.0 hr)	26 Sept	**Mangrove Communities** • Community zonation • Epibiota • Below-water mobile fauna • Above-water mobile fauna • Species interactions	
ME17 (**L**, 1.0 hr)	30 Sept	**Coral Reef Invertebrates ID Slideshow** • Introduction to the taxonomic characteristics of corals and other reef-associated invertebrates	
ME18 (**FEX**, 2.0hrs)	1 Oct	**Coral Reef Invertebrates Field ID** • In-water identification of corals and other reef-associated invertebrates	
ME19 (**L**, 1.0 hr)	3 Oct	**Coral Reef Fish ID Slideshow** • Introduction to the taxonomic characteristics of reef-associated fish	
ME20 (FEX, 2.0 hr)	3 Oct	**Coral Reef Fish Field ID** • In-water identification of coral reef fishes	
ME21 (**L**, 1.0 hr)	4 Oct	**Coral Biology** • Global distribution • Taxonomy and anatomy • Growth • Reproduction • Feeding and nutrients • Aggression and defense	
ME22 (EX, 2.0 hr)	7 Oct	**Coral Reef Invertebrates and Fish ID Review** • Revision session for organisms covered during ME21, ME22, ME25 and ME27	**Reference Resources:** Humann, P., & Deloach, N. (1994). Reef Coral Identification. *Paramount Miller Graphics*. Humann, P., Deloach, N., & Wilk, L. (2002). Reef Creature Identification: Florida, Caribbean, Bahamas. Humann, P., Deloach, N., & Wilk, L. (2002). Reef Fish Identification: Florida, Caribbean, Bahamas.
ME23 (**T**, 2.0 hr)	8 Oct	**Coral Reef Invertebrates and Fishes ID Test** • In-water species identification test	

No.	Date	Title - Content	Readings
ME24 (**L**, 1.0 hr)	10 Oct	**Coral Reef Formation and Structure** • Limiting factors • Reef classification • Reef zonation • Reef constituents • Reef growth • Types of calcium carbonate	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.
ME25 (**L**, 1.0 hr)	11 Oct	**Coral reef communities** • Reef algae • Reef sponges and other invertebrates • Reef fishes • Species interactions	Mumby, P. J., Hastings, A., & Edwards, H. J. (2007). Thresholds and the resilience of Caribbean coral reefs. *Nature*, *450*(7166), 98.
ME26 (**L**, 1.0 hr)	28 Oct	**Ecological Impacts of MPAs** • Direct effects • Indirect effects • Ecosystem functioning	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.
ME27 (**L**, 1.0 hr)	29 Oct	**Mangrove-Seagrass-Coral Connectivity** • Biogeochemical linkages • Ecological linkages	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.
ME28 (**L**, 1.0 hr)	29 Oct	**Species Poster briefing** • Background on scientific posters Assignment explanation	
ME29 (**L**, 1.0 hr)	29 Oct	**Species poster work time** • Group work on poster	
ME30 (**L**, 1.5 hr)	6 Nov	**Species poster presentation**	
ME31 (**L**, 2.0 hr)	5 Nov	**Stony coral tissue loss disease FEX briefing and dry run** • Briefing on field exercise and short report writing and answering of questions regarding the assignment • Briefing on survey techniques used • On land practice of survey techniques	

ME32 (**FEX**, 3.0 hr)	5 Nov	**Stony coral tissue loss disease FEX** In water assessment of SCTLD abundance	

No.	Title - Content	Readings
ME33 (L, 2.0 hr	**Biodiversity indexes and Permanova** Introduction to Biodiversity Biodiversity indexes as measure of biodiversity Using Permanova's to statistically test biodiversity differences	
ME34 (**DEX**, 2.0 hr)	**Stony coral tissue loss disease FEX data analysis and write up** • Time allocated to work on Parrotfish FEX short report	
Assignment	**Stony coral tissue loss disease write up due at 8 AM**	
ME35 (**L**, 1.0 hr)	**Reef Fish behavior** • Reproduction • Cleaning stations • Feeding • Competition	
ME36 (**L**, 1.0 hr)	**Symbiosis and competition on coral reefs** • Symbiosis • Parasitism • Competition • Co-evolution	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
ME37 (**FEX**, 2.0 hr)	**Symbiosis and competition FEX** • In water observation and filming of examples of symbiosis and competition	
Assignment	**Symbiosis and competition assignment due at 8 AM**	

No.	Title - Content	Readings
ME38 (L, 1.0 hr)	**Effects of Climate Change and Hurricanes and Marine Ecosystems** • Effects on Mangroves • Effects on Seagrass • Effects on Coral Reefs • Effects on abiotic properties	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), 174-184. Halpern, B.S, Walbridge S., Selkoe, K. A., Kappel C.V., Micheli, F, D'Agrosa C.,. Bruno, J. F., Casey K.S., Ebert C., Fox H.E., Fujita R., Heinemann D., Lenihan, H. S., Madin, E.M.P., Perry, M.T., Selig, E. R., Spalding, M. Steneck, R, Watson R. (2008)A global map of human impact on Marine Ecosystems. Science (319):948-952.
ME39 (**L**, 1.0 hr)	**Exam** Open book take home exam covering the entire course's content	
ME40 (**L**, 1.0 hr)	**Symbiosis and competition videos screening**	
ME41 (**L**, 1.0 hr)	**Exam Debrief** • Explanation of exam answers • Common mistakes and misconceptions	
60	**HOURS**	

Reading List

*Readings in **Bold** are required. Readings are listed in the order they appear in the syllabus.

Castro, P., & Huber, M. E. (2008). Marine Biology, 7th edition: Chapters 5 - 9.
Valiela, I., Bowen, J. L., & York, J. K. (2001). Mangrove Forests: One of the World's Threatened Major Tropical Environments: *AIBS Bulletin*, *51*(10), 807-815.
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.
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.

Humann, P., Deloach, N., & Wilk, L. (2002). Reef Creature Identification: Florida, Caribbean, Bahamas.
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.
Humann, P., & Deloach, N. (1994). Reef Coral Identification. *Paramount Miller Graphics*.

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.

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.

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

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.*

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)