THE SCHOOL FOR FIELD STUDIES

Tropical Marine Ecosystems - Monitoring and Management

SFS 3530

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.

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

The Turks and Caicos Islands (TCI) advertises itself to tourists as "Beautiful by Nature." Indeed, the tourism that the country's economy is heavily dependent on is driven by its stunning marine environment, which is characterized by extensive coral reefs, seagrass meadows and mangrove forests. However, the health of these ecosystems, and therefore the "Beautiful by Nature" motto, is under threat. At the local level, unsustainable and damaging fishing practices, increased water-based recreational activities, and coastal development are potentially major sources of disturbance. Furthermore, the ocean impacts of global climate change will continue to negatively affect marine organisms and ecosystem processes, adding an additional layer of complexity to the problem.

Tropical Marine Ecosystems - Monitoring and Management is an interdisciplinary four-week summer course that highlights the ecological characteristics and current threats to coastal ecosystems, in addition to exploring existing and potential environmental management approaches that would encourage the sustainable development of small island nations such as the TCI. Course participants will gain knowledge of tropical marine ecosystem function and connectivity and will be introduced to the most pressing threats at the intersection of marine conservation and economic development.

The course will take place on the island of South Caicos which is at a pivotal time in its development. Until recently, the island's economy centered around small-scale local fisheries, but tourism is now a growing industry and South Caicos is experiencing major changes to its social and structural fabric. As the economy and the population grow and diversify, so too do the demands on the marine environment, making this the perfect location to study a small, tropical island in transition.

The course has two main themes:

Marine Ecosystem Ecology and Monitoring

Students will be introduced to the ecological characteristics of coral reefs, seagrass meadows and mangrove forests, including the biology of key organisms in each. The numerous ways in which these ecosystems are inter-connected and inter-dependent will also be discussed. This will be followed by an exploration of the multiple anthropogenic threats that the ecosystems face, including overfishing, coastal development and pollution, and climate change. Students will learn different techniques to monitor the health and worth of these marine ecosystems.

Marine Ecosystem Management

After introducing students to the ecology and threats to the Turks and Caicos Islands marine ecosystems, a broader context of managing these ecosystems will be introduced. The class will examine management and advisory bodies of these ecosystems; how marine protected areas can be a tool for conservation and the impacts of these tools; engage stakeholders with design and implementation of management plans.

Both themes will be analyzed and discussed during lectures, discussions, workshops and exercises. Students will spend time snorkeling and/or diving (not mandatory to participate in the course) in mangrove, seagrass, and coral reef environments. Material taught in class and learned in the field will be assessed through a variety of assignments and a final exam.

Learning Objectives

The learning objectives of this summer program are:

1) To gain a baseline understanding of coastal tropical marine ecosystems, their ecology, their connectivity, the ecosystem goods and services they provide, and the threats to their future good health.

2) To recognize and identify a broad range of organisms the characterize these ecosystems in the Tropical Northwestern Atlantic.

3) To develop skills, both in and out of water, to monitor the health and conservation status of tropical marine ecosystems.

4) To gain an understanding of international and local management approaches that affect the conservation status of tropical marine ecosystems.

5) To identify and engage stakeholders' views for the purpose of designing a general management plan.

Field Exercises, Workshops, and Data Analysis

Students will participate in several field exercises to view and identify the organisms that characterize coral reef, seagrass and mangrove ecosystems. Students will practice different monitoring techniques used in these ecosystems. Students will also take part in field exercises and workshops that allow them to live the stakeholder experience and cast as the TCI Marine Police in a mock enforcement exercise. In addition, students will be responsible for reports and data management.

Assessment

Course Component	Value (%)
ID Test	20
Total Economic Valuation Report	20
Conch FEX Report	2
Coral Bleaching & Diseases Report	10
Participation	10
Final Examination	20
Total	**100**

ID test: In class, students will be introduced to the taxonomic classification and trophic characteristics of local fish, coral and species living in mangroves and seagrass beds. The briefings will be followed by an in-water observation sessions, a desk-based taxonomic review session, and an identification test.

Total Economic Valuation Report: This field exercise will give you the chance to apply an economic valuation method used in policy making to an important South Caicos natural area. After learning

about this method in class, we will visit a nearby area to assess the status of the ecosystems present. You will be working as a team to write up a formal report on the value of ecosystem goods and services in this area.

Marine Resource Management Exercise (Conch Assessment Exercise): During this field exercise, the students will work in groups to employ visual survey methods outlined during the lectures to collect data on the size & age structure of the queen conch (*Lobatus gigas*) population according to habitat type both inside and outside a Marine Protected Area (MPA).

The second objective of the field exercise is to enhance student ability to analyze data and produce an accurate and coherent scientific paper. Each group will produce a written report, and each member of the group will be required to participated in the data collection, analysis and writing of the report. You will receive a group grade on the paper and an individual grade for performance and participation as a portion of the final grade for the exercise. Students will be assessed based on their ability to write a scientific report in a coherent and logical way, as well as data entry and management.

Coral Bleaching Assessment Exercise: Students will work in buddy-pairs to assess the extent of bleaching and stony coral tissue loss disease on local coral reefs, using the CoralWatch Coral Health Chart. The data collected will then be analyzed and a small group report will be written.

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

Readings: Assigned readings will be available on the student server. It is important that you read all materials before class since the volume of the material in the class requires a brisk pace. You are expected to have read all the assigned articles and demonstrate that by answering quiz questions based on them. Anything contained in the readings is fair game for the exams.

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). 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 but is limited in capacity, so there can be no inappropriate uses (gaming or video/music

downloading). Screens (laptops and tablets) are permitted during lessons for taking notes, however inappropriate use will result in the loss of this privilege. Phones are not permitted in class.

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

2. Group assignments should be named…

   Group#_Assignment

   Example… Group1_DataAnalysis

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

L (Lecture), **FEX** (Field Exercise), **DEX** (Desk Exercise), **P** (Presentation), **T** (Test)

NO.	*TITLE - CONTENT*	*READINGS*
SME01 (**L**, 1.0 hrs.)	**Course Introduction – SFS teaching and research** Outline of the summer program at CMRS including an introduction to course structure and expectations	
SME02 (**L**, 1.0 hrs.)	**History of the Turks and Caicos Islands** Students will be exposed to the Turks and Caicos Islands history, including the past industries that have fallen, the current status of the economy and the evolution of TCI government. We will begin with time prior to Columbus "landfall", eras of slavery and finish with the current situation in South Caicos.	Sadler, H. E. 1997. Turks Islands Landfall: A History of the Turks and Caicos Islands. United Cooperative Printers Ltd: Kingston. p. 132-151; 259-264. *Optional*: Mills, C (Ed.). 2008. *A History of the Turks and Caicos Islands*. Macmillan: Oxford. Chapter 10-13, 16.
SME03 (**L**, 1.0 hrs.)	**Tropical Marine Ecosystems a Global Perspective** The world has a variety of different marine ecosystems. However, the tropical marine ecosystems are limited in range based on environmental factors. Students will be introduced to the availability and conservation interest of these ecosystems.	Polidoro, B. et al. (2010) The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern. *PLoS ONE* 5(4). (Focus on Intro and Results & Discussion) Spalding, M., Taylor, M., & Ravilious, C. (2003) Global Overview–The Distribution and Status of Seagrass In: Green E.P., Short F.T., Spalding M.D. (eds) The World Atlas of Seagrasses: present status and future conservation. P 24-30. *Optional:* Costanza, R., R. de Groot, P. Sutton, S. van der Ploeg, S.J. Anderson, I. Kubiszewski, S. Farber, and R.K. Turner (2014). Changes in the global value of ecosystem services. *Global Environmental Change* 26: 152-158.
SME04 (**L**, 1.0 hrs.)	**Mangrove Biology** An introduction to the biology of mangrove trees and their adaptations for life in the marine environment.	
SME05	**Mangrove Forest Ecology**	Donato, D. C., Kauffman, J. B., Murdiyarso, D., Kurnianto, S., Stidham,

(**L**, 1.0 hrs.)	The ecological characteristics of mangrove forests, including physiographic classification, forest zonation, and trophodynamics.	M., & Kanninen, M. (2011). Mangroves among the most carbon-rich forests in the tropics. *Nature geoscience*, *4*(5), 293.
SME06 (**L**, 1.0 hrs.)	**Seagrass Biology** An introduction to the biology of seagrasses and their adaptations for life in the marine environment.	
SME07 (**L**, 1.0 hrs.)	**Seagrass Meadow Ecology** The ecological characteristics of seagrass meadows, including the importance of epibionts, and trophodynamics.	Short, F. *et al*. (2007). Global seagrass distribution and diversity: A bioregional model. *Journal of Experimental Marine Biology and Ecology* 350: 3 – 20.
SME08 (**L**, 1.0 hrs.)	**Coral Reef Ecology** An introduction to the biology of corals and the ecological characteristics of coral reefs	
SME09 (**L**, 1.0 hrs.)	**Mangrove and Seagrass Communities – ID slide Show** Taxonomic and trophic characteristics of the plants, macroalgae and invertebrates that characterize mangrove and seagrass ecosystems.	Reference Books: Littler et al. (1999). Marine plants of the Caribbean. Kaplan (1988). A field guide to south eastern and Caribbean seashores.
SME10 (**FEX**, 2.0 hrs.)	**Mangrove and Seagrass Communities – Field ID** In-water identification of organisms covered during SME09. Snorkeling required.	
SME11 (**L**, 1.0 hrs)	**Valuing Ecosystems** Ecosystems like coral reefs, mangroves and seagrass beds are more than just habitats for marine organisms; they provide a number of ecosystem services. Scientists and policy makers are now starting to attach monetary values to these ecosystems.	Conniff, R. (2012). What's wrong with putting a price on nature. *Yale Environment*, *360*, 18. https://e360.yale.edu/features/ecosystem_services_whats_wrong_with_putting_a_price_on_nature Plummer, M.L. (2009). Assessing benefit transfer for the valuation of ecosystem services. *Frontiers in Ecology and the Environment* 7(1): 38-45.
SME12 (**L**, 1.0 hrs.)	**Coral Reef Invertebrates - ID slideshow** Taxonomic and trophic characteristics of reef-forming corals and other associated invertebrates.	Reference books: Humann and DeLoach (2013). Reef coral identification. Humann et al. (2013). Reef creature identification.

SME13 (**FEX**, 1.0 hrs.)	**Scavenger Hunt** A historical hunt across South Caicos.	
SME14 (**FEX**, 2.0 hrs.)	**Coral Reef Invertebrates - Field ID** In-water identification of organisms covered during SME12. Snorkeling required.	
SME15 (**L**, 1.0 hrs.)	**Fisheries Impacts** Marine ecosystems are directly affected by impacts caused by fishery activities. An introduction to the impacts caused by fishing practices and high exploitation will demonstrate the need for research and management of these systems.	Coll et al. (2016). Ecological indicators to capture the effects of fishing on biodiversity and conservation status of marine ecosystems. *Ecological Indicators* 60, 947-962.
SME16 (**L**, 1.0 hrs.)	**Impacts of Climate Change** The causes of climate change; impacts of temperature change; the process and effects of ocean acidification.	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.* 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) • Table 3.6 (p. 261) • Table 3.7 (p. 264) • Cross-Chapter Box 8 (p.274) Stafford, Richard, and Peter JS Jones. "Viewpoint–Ocean plastic pollution: A convenient but distracting truth?." *Marine Policy* 103 (2019): 187-191. http://nymag.com/intelligencer/2018/10/un-says-climate-genocide-coming-but-its-worse-than-that.html?fbclid=IwAR3ZlDTrjTb5pLEht3

		doXf70Plv5F7lHf4A21MxpMpTnGCw0MnUbxBtjm-c
SME17 (**L**, 1.0 hrs.)	**Coastal Development Impacts (Recreation and Pollution)** Small developing island nations have found it difficult to protect marine ecosystems, while finding economic security in coastal development. Developments on the coast line can both directly and indirectly affect the marine waters through pollution, erosion, siltation and even recreational activities.	Upadhyay, V., Ranjan, R., Singh, J., 2002. Human-mangrove conflicts: The way out. *Current Science* 83, 1328-1336. **To read The conflicts - p1331-1333.** Jackson, J. B. C., Donovan, M. K., Cramer, K. L., & Lam, V. V. (2014) Status and trends of Caribbean coral reefs. *Global Coral Reef Monitoring Network, IUCN, Gland, Switzerland*. **To read P11-24.** *Review:* Polidoro et al. (2010) The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern. *PLoS ONE* 5(4).
SME18 (**L**, 1.0 hrs.)	**Reef fishes- ID slideshow** Taxonomic and trophic characteristics of reef-fish.	Reference books: Humann and DeLoach (2013). Reef fish identification.
SME19 (**FEX**, 2.0 hrs.)	**Reef Fishes - Field ID** In-water identification of fishes covered during SME18. Snorkeling required.	
SME20 (**FEX**, 2.0 hrs.)	**Total Economic Valuation FEX** In this field exercise you will work in teams to survey a designated ecosystem, which you will then have to attach a value to. In this first part of the practical you will collect all the data you need.	
SME21 (**DEX**, 2.0 hrs.)	**Coral, Reef Fishes, Mangrove and seagrass species – ID Review Session** Desk-based review of the organisms from field ID session	
SME22 (**T**, 1.0 hrs.)	**ID Test** A powerpoint based test that will require students to scientifically identify the species learned during mangrove and seagrass, coral	

	invertebrate and reef fish ID slide shows and FEX.	
SME23 (**L**, 1.0 hrs.)	**Restoration and Rehabilitation** The degradation of coastal and marine habitat due to human activity and, to a lesser extent, natural events is pervasive and has direct and measurable effects on marine ecosystem communities and processes. Restoration ecology seeks to mitigate anthropogenic biological and physical degradation by restoring impacted habitats. We review restoration and rehabilitation practices.	Cruz et al. (2015) Assessing an abridged nursery phase for slow growing corals used in coral restoration. *Ecological Engineering* 84:408-415. *Optional:* Thayer, G. (1992) Restoring the Nation's Marine Environment. Maryland Sea Grant College. UM-SF-TS-92-06. Chapter 3). Pg.80-104. Seaman, W. (2000) Artificial Reef Evaluation: with application to Natural Marine Habitats. CRC marine Science Series, ISBN: 0-8493-9061-3. (Chapter 1). Page 1-20.
SME24 (**L**, 1.0 hrs.)	**Introduction to MPAs and Fisheries Impacts** Management of entire ecosystems is difficult with a variety of needs and uses by multi-users. Often Marine Protected Areas are tools that can assist with the management of differing ecosystems. This lecture will introduce what MPAs are and how they can be designed and used as a management tool.	Edgar et al. (2014) Global conservation outcomes depend on marine protected areas with five key features. *Nature* 506: 216-220. Roberts et al. (2003) Applications of Ecological Criteria in Selecting Marine Reserves and Developing Reserve Networks. *Ecological Application* 13(1): 215-228. *Optional:* Salm, R and Clark, J. (2000) Marine and Coastal Protected Areas. *International Union for Conservation of Nature and Natural Resources (IUCN).* ISBN: 2-8317-0540-1. (Chap 1) 13-34. (Chap 4) 81-93
SME25 (**L**, 1.0 hrs.)	**Ecological Impacts of MPAs** What ecological changes take place within a Marine Protected Area, and can these changes lead to benefits for fishers beyond the boundaries of the MPA?	Lester, S. E. *et al*. (2009). Biological effects within no-take marine reserves: a global synthesis. *Marine Ecology Progress Series* 384: 33 – 46.

SME26 (**L**, 1.0 hrs.)	**Ecosystem Connectivity** The biogeochemical and ecological linkages between coral reefs, seagrass meadows and mangrove forests.	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.
SME27 (**DEX**, 3.0 hrs.)	**TCI Economy, Culture and Environmental Regulations** This class will be a test of your practical research skills, as well as of your ability to work in a team to prepare a presentation for your peers. Your task, to be outlined further in class, will involve you bringing new material about the TCI to class.	Mills, C (Ed.). 2008. *A History of the Turks and Caicos Islands*. Macmillan: Oxford. Chapter 25.
SME28 (**L**, 1.0 hrs.)	**Introduction to Marine Resource Assessment Exercise** This briefing will introduce the students to the underwater survey method often used for assessment of different species, habitat and substrate. This exercise will introduce students to data collection to assess abundance, size-class, habitat use, and overall habitat availability for the Queen conch (*Lobatus gigas*).	
SME29 (**FEX**, 2.0 hrs.)	**Dry Run – Marine Resource Assessment** This is a run of survey skills necessary to collect and record accurate data during the conch field exercise. This exercise will be done on land and in shallow water near the center, so as to have students physically deploy and use research equipment effectively in the marine waters.	
SME30 (**DEX**, 2.0 hrs.)	**TEV FEX Write Up** A chance to write up your total economic valuation paper based on the fieldwork in SME20.	
SME31 (**FEX**, 8.0 hrs.)	**Marine Resource Assessment** A field activity involving the underwater visual assessment of the Queen conch both inside and outside an MPA. Included will be specific measurement of size and age structure, habitat coverage and overall abundance.	

SME32 (**DEX**,6. 0 hrs.)	**Marine Resource Assessment Analysis and Write Up** Data collected during the Conch Assessment will be analyzed and a scientific paper prepared. During this time students will be advised on what types of statistics and analysis can be conducted on the data with the JMP Pro 10 program and how to write a scientific paper cohesively.	
SME33 (**L**, 1.0 hrs.)	**General Management Bodies and Plans** Ecosystem management often falls on the shoulders of the Country of domain. Students will be introduced to the advisory and management bodies that drive research and conservation of the tropical marine ecosystems. Furthermore, why GMPs are necessary, who is the target audience, what is included, how are issues, managed, regulated or prohibited activities, management structure and monitoring effectiveness.	Bustamante, G., et al. (2014) Marine protected areas management in the Caribbean and Mediterranean seas: making them more than paper parks. *Aquatic conservation: Marine and Freshwater Ecosystems* 24:153-165. *Review:* Edgar et al (2014) Roberts et al (2003) *Optional:* Keller, G. and Kenchington, R. (1991) Guidelines for Establishing Marine Protected Areas. IUCN.
SME34 (**L**, 1.0 hrs.)	**Identification of coral bleaching and coral diseases** Characteristics of coral bleaching and coral diseases for identification in the field	
SME35 (**L**, 1.0 hrs.)	**Ecotourism** This lecture considers the successes and failures of low-impact nature-based tourism.	West, P. and Carrier, J. Ecotourism and Authenticity: Getting Away from it All? *Current Anthropology* 45: 483-498 (2004).
SME36 (**L**, 1.0 hrs.)	**Social and Economic Impact of MPAs** This lecture will consider the impacts of MPAs on humans.	West, P., Igoe, J., & Brockington, D**.** (2006). Parks and peoples: the social impact of protected areas. *Annu. Rev. Anthropol.*, *35*, 251-277.
SME37 (**FEX**, 2.0 hrs)	**Enforcement at Sea** In this mock sea-based exercise you will be cast as a conservation officer of the Department of Environment and Coastal Resources (DECR), charged with enforcing local marine legislation	

SME38 (**L**, 1.0 hrs)	**Enforcement Lecture (Guest)** A DECR conservation officer will provide a detailed array of his daily, weekly, and monthly activities as a DECR officer. They will speak of the difficulty of the job both socially and economically.	
SME39 (**L/FEX**, 2.0 hrs.)	**Coral Bleaching Briefing and FEX** Introduction to the CoralWatch Coral Health Chart; field collection of coral health data. Diving or snorkeling required.	
SME40 (**DEX**, 3.0 hrs.)	**Coral Bleaching Analysis and Write-Up** Analysis of data collected during SME38, and preparation of a short, written report.	
SME41 (**DEX**, 2.0 hrs.)	**Politics of Marine Management: Mock Negotiations DEX** This stakeholder negotiation simulation will demonstrate the politics, values, power differentials, and knowledges involved in developing marine protected areas in developing countries.	
SME42 (**L**, 1.0 hrs.)	**Course Review** A recap of topics covered during the course, and an explanation of exam structure and expectations.	
SME43 (**T**, 1.0 hrs.)	**Exam** A two-hour written exam that will assess students' understanding of the course material.	
SME44 (**L,** 1.0 hrs.)	**Exam Debrief**	