THE SCHOOL FOR FIELD STUDIES

# Tropical Marine Ecosystems: Monitoring and Management
# SFS 3530

**Syllabus**
**4 credits**

The School for Field Studies (SFS)
Center for Marine Resource Studies (CMRS)
South Caicos, Turks and 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 they may present. In other words, this is a field program, and the field can change.

## 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 or pollution 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 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 hurricanes, pollution, and climate change. Students will learn different techniques to monitor the health 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 (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

1. Gain a baseline understanding of coastal tropical marine ecosystems, their ecology, connectivity, ecosystem goods and services, and threats to their future good health.
2. Recognize and identify a broad range of organisms that characterize these ecosystems in the tropical northwestern Atlantic.
3. Develop skills, both in and out of water, to monitor the health and conservation status of tropical marine ecosystems.
4. Gain an understanding of international and local management approaches that affect the conservation status of tropical marine ecosystems.

## Assessment

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 monitor the effectiveness of our marine protected areas. In addition, students will be responsible for reports and data management.

| Assessment Item | Value (%) |
|---|---|
| Participation/Peer Evaluations | 10 |
| ID Quiz | 15 |
| Marine Resource Management Exercise (Conch Assessment Exercise) | 20 |
| Biodiversity FEX Report | 20 |
| Reading Quizzes | 10 |
| Final Exam | 25 |
| **TOTAL** | **100** |

### Participation/Peer Evaluations (10%)

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 reading discussion, lectures, and field work. In addition, a major part of research, be it the humanities or science, requires collaborative work. In this course, you will be working on many group projects, presentations, and writing. You will be required to evaluate your classmates on all collaborative work. This peer evaluation will form part of your final grade. Acquiring the ability and skillset to evaluate each other honestly and constructively is essential to your future career paths.

### ID Quiz (15%)

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 session, a desk-based taxonomic review session, and an identification quiz.

### Marine Resource Management Exercise (Conch Assessment Exercise) (20%)

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 (*Aliger 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 poster. You will be working as partners (groups of two).
Students will be assessed based on their ability to create a scientific poster in a coherent and logical way, as well as data entry and management.

### Biodiversity FEX Report (20%)

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. Students will also practice writing scientific paper style results and discussion sections. Students will work in groups of two to complete this assessment.

### Reading Quizzes (15%)

Assigned readings will be available on SharePoint. You are expected to be familiar with these readings during the associated lecture; the readings are designed to supplement the lecture content and reading quizzes will be given for all of the readings.

### Final Exam (25%)

Exams are based on all aspects of the course, including lectures, readings, documentaries, and field exercises. You will need to prepare for these exams throughout the course, as the days preceding the exams can be busy with other activities and assignments, for this course as well as your other courses. You are fully responsible for staying on top of the material.

## Grading Scheme

Grade corrections in any of the above items should be requested in writing at least 24 hours after assignments are returned. No corrections will be considered afterwards.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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

**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** – 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 plagiarizing, cheating or aiding another person to cheat, either actively or passively (e.g., allowing someone to look at your exam, using text or information without proper attribution). Unless specifically stated otherwise, all assignments should be individual pieces of work.

**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.

**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.

**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, **DEX:** Desk Exercise, **D:** Discussion, **T:** Test

***Required readings are in bold**

| *No* | *Title and outline* | *Type* | *Time (hrs)* | *Readings* |
|---|---|---|---|---|
| 1 | **Course Introduction – SFS teaching and research**<br>Outline of the summer program at CMRS including an introduction to course structure and expectations | L | 1.0 | Sadler, H. E. 1997.<br>Mills, C (Ed.). 2008. |
| 2 | **History of the Turks and Caicos Islands**<br>Learn 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 end with the current situation in South Caicos. | L | 1.0 | **Plumeridge, A. A., & Roberts, C. M. (2017).** |
| 3 | **Marine Resource Overview and History**<br>A brief history of fishing & humanity's association with the sea with regards to fishing and fish surveys. We will also explore the concept of the "Shifting Baseline Syndrome." | L | 1.0 | |
| 4 | **Marine Conservation and Socio-Ecological Issues**<br>In this session we will explore the different topics covered in the documentary *Seaspiracy*, as well as critically examine the information presented in the film. | D | 1.0 | ***Reference Book:*** **Littler et al. (1999).** |
| 5 | **Mangrove and Seagrass Communities – ID slide Show**<br>Taxonomic and trophic characteristics of the plants, macroalgae and invertebrates that characterize mangrove and seagrass ecosystems. | L | 1.0 | **Romañach, S. S., et al. (2018).** |
| 6 | **Mangrove Biology and Ecology**<br>An introduction to the biology of mangrove trees and their adaptations for life in the marine environment as well as epibiota, below- and above-water mobile fauna and species interactions around mangroves. | L | 1.0 | **Unsworth, R. K., et al. (2015).** |
| 7 | **Seagrass Biology and Ecology**<br>An introduction to the biology of seagrasses and their adaptations for the marine environment, as well as epibiota, mobile fauna, and species interactions in seagrass beds. | L | 1.0 | |

| *No* | *Title and outline* | *Type* | *Time (hrs)* | *Readings* |
|---|---|---|---|---|
| 8 | **Mangrove and Seagrass Communities – Field ID**<br>In-water identification of organisms covered during SME05. Snorkeling required. | FEX | 1.0 | |
| 9 | **Mangrove & Seagrass ID DEX**<br>Review of organisms found and identified during the FEX | DEX | 1.0 | |
| 10 | **TCI Fisheries**<br>Taxonomy, distribution, habitat requirements, anatomy, feeding, reproduction and growth of queen conch and an overview of the conch fishery, regulations, and management strategies. | L | 2.0 | Lam, V. W., et al. (2020). |
| 11 | **Impacts of Climate Change and Hurricanes on Fisheries**<br>A look at the causes of climate change; impacts of temperature change; the process and effects of ocean acidification on marine systems. In addition, we will assess hurricane impacts on fisheries. | L | 2.0 | |
| 12 | **Conch, Lobster, Grouper Biology**<br>Taxonomy, distribution, habitat requirements, anatomy, feeding, reproduction, and growth of three species important to the history, economy and culture of the TCI. | L | 1.0 | **Gouezo, M., et al. (2019).** |
| 13 | **Coral Reef Biology**<br>An intro to the biology of corals and the ecological characteristics of coral reefs as well as reef fishes, algae, sponges and other invertebrates and their interactions with each other. | L | 1.0 | |
| 14 | **Reef Organism Behavior**<br>Reproduction, cleaning stations, and feeding strategies among reef fishes and invertebrates. | L | 1.0 | ***Reference Book:*** **Humann and DeLoach (2013).** |
| 15 | **Reef Organism ID slideshow** Taxonomic and trophic characteristics of reef fish and invertebrates. | L | 1.0 | |
| 16 | **Reef Organism ID FEX**<br>In-water identification of fishes covered during SME15. Snorkeling required. | FEX | 1.0 | |
| 17 | **Reef Organism ID DEX**<br>Desk-based review of the organisms from field ID session | DEX | 1.0 | **Grorud-Colvert, K., et al. (2021).** |
| 18 | **Introduction to MPAs and Fisheries Impacts**<br>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. | L | 1.0 | **Sala, E., et al. (2021).** |
| 19 | **Ecological Impacts of MPAs**<br>What ecological changes take place within a Marine Protected Area, and can these changes lead to benefits for fisheries beyond the boundaries of the MPA? | L | 1.0 | |

| *No* | *Title and outline* | *Type* | *Time (hrs)* | *Readings* |
|---|---|---|---|---|
| 20 | **Introduction to Marine Resource Assessment Exercise**<br>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 (*Aliger gigas*). | L | 1.0 | |
| 21 | **Marine Resource Assessment**<br>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. | FEX | 8.0 | |
| 22 | **ID Quiz**<br>A field-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. | FEX; T | 1.0 | Medley and Ninnes (1999).<br>Ulman et al., 2016. Lockhart et al. (2007). |
| 23 | **Marine Resource Assessment Analysis and Write Up**<br>Data collected during the Conch Assessment will be analyzed and a scientific poster prepared. | DEX | 1.0 | |
| 24 | **Introduction to Fisheries Management**<br>This is a desktop exercise where we will explore fisheries management practices and policy effectiveness on fisheries. | DEX | 2.0 | **Mumby et al. (2004).** |
| 25 | **Ecosystem Connectivity**<br>The biogeochemical and ecological linkages between coral reefs, seagrass meadows and mangrove forests. | L | 1.0 | **Duarte, C. M., et al. (2020).** |
| 26 | **Restoration and Rehabilitation**<br>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. | L | 1.0 | |
| 27 | **Biodiversity FEX briefing and dry run**<br>Briefing on field exercise and short report writing and an on-land practice of survey. | L | 2.0 | |
| 28 | **Biodiversity FEX**<br>In-water assessment of Biodiversity abundance. | FEX | 4.0 | |
| 29 | **Biodiversity DEX**<br>Introduction to Biodiversity indices as a measure of biodiversity and time allocated to work on the Biodiversity Report. | DEX | 1.0 | |

| *No* | *Title and outline* | *Type* | *Time (hrs)* | *Readings* |
|---|---|---|---|---|
| 30 | **A Plastic Ocean**<br>A viewing and discussion of the documentary "A Plastic Ocean". Summary of film: https://plasticoceans.org/about-a-plastic-ocean/ | D | 2.0 | **Stafford, R., & Jones, P. J. (2019).**<br>**Lavers et al. (2022).**<br>**Lönnstedt, O. M., & Eklöv, P. (2016).** |
| 31 | **Ocean Pollution Management**<br>An overview of different types of marine pollution, how these types of pollution are managed, and a critical look into the literature surrounding plastic pollution. | L | 2.0 | |
| 32 | **Exam Review**<br>An overview of the materials covered through out the semester, practice questions, and clarifications. | D | 1.0 | |
| 33 | **Exam**<br>A four-hour written exam that will assess students' understanding of the course material. | T | 4.0 | |
| 34 | **Class wrap-up and exam debrief** | L | 1.0 | Sadler, H. E. (1997).<br>Mills, C (Ed.). (2008). |
| | **TOTAL** | | **54** | |

## Reading List

***Required readings are in bold**


1. **Duarte, C. M., Agusti, S., Barbier, E., Britten, G. L., Castilla, J. C., Gattuso, J. P., ... & Worm, B. (2020).** Rebuilding marine life. Nature, 580(7801), 39-51.
2. **Gouezo, M., Golbuu, Y., Fabricius, K., Olsudong, D., Mereb, G., Nestor, V., ... & Doropoulos, C. (2019).** Drivers of recovery and reassembly of coral reef communities. Proceedings of the Royal Society B, 286(1897), 20182908.
3. **Grorud-Colvert, K., Sullivan-Stack, J., Roberts, C., Constant, V., Horta e Costa, B., Pike, E. P., ... & Lubchenco, J. (2021).** The MPA Guide: A framework to achieve global goals for the ocean. Science, 373(6560), eabf0861.
4. **Humann and DeLoach (2013).** Reef fish identification.
5. Lam, V. W., Allison, E. H., Bell, J. D., Blythe, J., Cheung, W. W., Frölicher, T. L., ... & Sumaila, U. R. (2020). Climate change, tropical fisheries and prospects for sustainable development. Nature Reviews Earth & Environment, 1(9), 440-454.
6. **Lavers et al. (2022).** Far from a distraction: Plastic pollution and the planetary emergency, Biological Conservation, Volume 272, 2022, 109655
7. **Littler et al. (1999).** Marine plants of the Caribbean.

8. Lockhart et al., 2007. Fisheries of the Turks and Caicos Islands: Status and Threats. GCFI 58: 67-72.
9. **Lönnstedt, O. M., & Eklöv, P. (2016).** Environmentally relevant concentrations of microplastic particles influence larval fish ecology. Science, 352(6290), 1213-1216.
10. Medley and Ninnes 1999. A stock assessment for the Conch (Strombus gigas) fishery in the Turks and Caicos Islands. Bull Mar Sci 64(3): 399-406
11. Mills, C (Ed.). 2008. A History of the Turks and Caicos Islands. Macmillan: Oxford. Chapter 1; 10-13, 16; 25.
12. **Mumby et al. (2004).** Mangroves enhance the biomass of coral reef fish communities in the Caribbean. Nature, 427(6974), 533.
13. **Plumeridge, A. A., & Roberts, C. M. (2017).** Conservation targets in marine protected area management suffer from shifting baseline syndrome: A case study on the Dogger Bank. Marine pollution bulletin, 116(1-2), 395-404.
14. **Romañach, S. S., DeAngelis, D. L., Koh, H. L., Li, Y., Teh, S. Y., Barizan, R. S. R., & Zhai, L. (2018).** Conservation and restoration of mangroves: Global status, perspectives, and prognosis. Ocean & Coastal Management, 154, 72-82.
15. Sadler, H. E. 1997. Turks Islands Landfall: A History of the Turks and Caicos Islands. United Cooperative Printers Ltd: Kingston. p. 96-101; 132-151; 259-264.
16. **Sala, E., Mayorga, J., Bradley, D., Cabral, R. B., Atwood, T. B., Auber, A., ... & Lubchenco, J. (2021).** Protecting the global ocean for biodiversity, food and climate. Nature, 592(7854), 397-402.
17. **Stafford, R., & Jones, P. J. (2019).** Viewpoint–Ocean plastic pollution: A convenient but distracting truth? Marine policy, 103, 187-191.
18. Ulman et al., 2016. Conched out: Total reconstructed fisheries catches for the Turks and Caicos Islands uncover unsustainable resource usage. Frontiers in marine Science 3:71
19. **Unsworth, R. K., Collier, C. J., Waycott, M., Mckenzie, L. J., & Cullen-Unsworth, L. C. (2015).** A framework for the resilience of seagrass ecosystems. Marine pollution bulletin, 100(1), 34-46.