



THE SCHOOL
FOR FIELD STUDIES

Tropical Coastal Ecology

SFS 3790

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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 Overview

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

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

Learning Objectives and Outcomes

Students will:

1. Develop an understanding of the main ecological processes and interactions that occur in island marine environments;
2. Understand the biology and ecology of the species important to the economy and conservation in Bocas del Toro;
3. Be able to identify key species by observation;
4. Understand the importance of scientific information for the conservation of species and the management of marine protected areas;
5. Comprehend and be able to choose the most appropriate techniques to collect and analyze data collected in coastal and marine environments;
6. Conduct a scientific survey of a locally threatened species and write a scientific report that will be presented to local authorities;
7. Identify threats to the coastal ecosystem of Bocas del Toro and develop their own research proposal outlining how to scientifically assess this threat;
8. Improve communication skills to both scientific and broader audiences through written assignments, editing fellow students' papers, the creation of infographics, and oral presentations.

Study Topics

We will cover the following topics this semester, some of which will be overarching themes for several classes and others that will be touched on more briefly:

- Species ID and taxonomy
- Mangrove and seagrass ecosystems
- Coral reef ecosystems
- Marine ecology and species interactions
- Marine Protected Areas
- Pacific and Caribbean marine ecosystems
- Threats and impacts (fisheries, climate change, invasive species, plastic)
- Effects of tourism on local populations

Assessment

The evaluation breakdown for the course is as follows:

Assessment Item	Value (%)
Species identification quizzes	10
This week in science	10
Infographic (FEX)	10
Starfish Beach report (Case Study)	20
Field notebook (species ID and field reports)	30
Final exam	10
Participation, conduct in the field, and in-class exercises/activities	10
TOTAL	100

Species identification quizzes (10%): There will be a series of three quizzes of species identification (fish, invertebrates, and corals) to assist with identifying marine organisms in the field.

This week in science (10%): Each week students will find a recent news article within an assigned topic (i.e. fisheries) online and summarize the most important and interesting information from the article in three bullet points on a note card. Note cards will be posted each week on a bulletin board where both students and staff can read them and hopefully start some interesting conversations!

Infographic (10%): Each student will choose a paper on threats to coral reefs and create an infographic summarizing the information in a way that would be understood by the general public. This will be accompanied by a short written summary and a presentation of the topic to the class.

Starfish Beach report (20%): Students will write a complete scientific report in the style of a journal article, including an abstract, introduction, methods, results with statistics, discussion, and references. Students will also complete edits to their papers in order to improve their scientific writing skills and prepare for Directed Research. The results of this study are part of a biannual survey of Starfish Beach and will contribute to a report that will be submitted to MiAmbiente.

Field notebooks (30%): Students will be expected to keep a field notebook of marine organisms observed on field exercises. Field notebooks will also include reflections of observations in the field and of guest lectures as well as reports using data collected during field exercises. These notebooks will be collected and graded three times throughout the semester.

Final Exam (10%): The final exam will be in the style of a research proposal and will require students to use their knowledge of coastal ecosystems learned throughout the course, as well as the readings assigned and discussed throughout the semester. The assignment will require students to think critically about issues in Bocas del Toro and use their scientific writing skills.

Participation, conduct in the field, and class exercises/activities (10%): This grade will be based on: a) participation in class discussions and evidence of completing assigned readings; b) conduct in the field and working well with group members during field work and in-class exercises; and c) performance during in-class activities and presentations, such as the mangrove slides and climate change group presentations.

Grading Scheme

A	95.00 - 100%	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	<60.00%
		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 Tropical Coastal Ecology course folder on the Student Folder of the Z drive. However, it is important to take notes in class in addition to the information provided in the PDFs.

Readings: Assigned readings will be available on the student server. It is important that you read all materials before class so that we are able to have engaging class discussions and keep the topics and material reviewed in this course at a high caliber. Additional reading may be needed to complete some of the course assignments.

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 given on that assignment to anyone caught cheating, plagiarizing, or aiding another person to cheat, either actively or passively (e.g., allowing someone to look at your exam or your written assignment for the purposes of copying content). Unless specifically stated otherwise, all assignments should be individual pieces of work.

Appropriate use of technology: Students may use laptops during class for class purposes; however, please do not abuse this privilege. There should be no phone use during class.

Participation: Students are expected to attend every class and participate fully in all class discussions and field exercises, as well as complete all assignments. Students will be graded on their participation as well as conduct in the field.

Deadlines: Deadlines are set 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 in a timely manner.

Assignment submission: All written assignments need to be submitted via email to ckovacs@fieldstudies.org as an attached Word document (Pages or PDF are also accepted, but Word is preferred if possible) no later than the deadline. Deadlines are specified on each assignment's guidelines.

Naming assignments:

Word documents, Excel documents, and PDFs for all individual assignments, exams, reports should be saved as... **FirstName_LastName_Assignment**

Example... John_Smith_Literature Review

Citation:

Use APA citation format for all documents.

Format for Journal Article

Last, F. M., & Last, F. M. (Year Published). Article title. *Journal Name*, Volume(Issue), pages.

Example

Jacoby, W. G. (1994). Public attitudes toward government spending. *American Journal of Political Science*, 38(2), 336-361.

Field Requirements

Snorkeling gear required for every snorkel event: (you are responsible for your gear!)

- Mask
- Snorkel
- Fins
- Dive slate or waterproof notebook and pencil
- Full water bottle
- Long sleeve rash guard/shirt (required on all snorkels)
- Dry bag
- Rain jacket (It can be very cold on ride home)
- Life vest
- Waterproof camera (if you have one)
- Towel / snack (optional)

Before each field exercise, please ensure that you and your snorkel buddy have all of the required field equipment (dive slates or waterproof notebooks, pencils, transects, dive weights, etc) and that your dive slate or notebook has been set up to collect data in the field. You are responsible for bringing your equipment to the field and back to the Center, rinsing it with fresh water upon return, and storing it safely.

Course Content

Type- L: Lecture, FL: Field Lecture, W: Workshop, FEX: Field Exercise, T: Test, G: Guest Lecture

<i>Course Description</i>	<i>Type</i>	<i>Time (hrs)</i>	<i>Readings</i>
TCE 01 – Introduction to the Formation and Ecology of Panama BioMuseo in Panama City: Formation of the isthmus of Panama and its effect on the ecology of the region	FEX	1	
TCE 02 Course Introduction Course overview, expectations, content and limitations, student interests	L	1	Syllabus for Tropical Coastal Ecology
TCE 03 Introduction to Ecological Principles Ecological interactions, strategies, lifestyles, abundance, diversity, and the big picture	L/W	1.5	News article on marine ecology topic of your choosing News article: “Sea Stars Disappear from Beach in Panama”
TCE 04 Species ID and Taxonomy Taxonomic hierarchy, the organization of life, how to use cladograms	L/W	0.5	Review the structure and function of key marine species using the Caribbean species guides (Humann and Deloach) for reef fish, reef critters and corals.
TCE 05 Fish ID and Behavioral Ecology How to identify key fish species seen in the area; reproduction, behavior, and interactions in coral reef fish; and how fish behavior affects their ecology	L/W	1.5	Hawkins and Roberts (2003). Effects of fishing... Sammarco (1983). Effects of fish grazing...
TCE 06 Fish ID and Behavioral Ecology Snorkel Identify fish species based on characteristics learned in lecture. Observe and record behavior of fish as it pertains to feeding, cleaning, territoriality, and symbiotic relationships with other organisms	FEX	3	

<p>TCE 07 Algae and Marine Plant Taxonomy and Ecology Taxonomy of phytoplankton, macro algae, and marine plants; the beneficial and harmful roles of algae; seagrass ecology</p>	L	1.5	<p>Field Guide to Common Marine Algae of the Bocas del Toro Area - I and II (PDFs)</p> <p>News article of your choosing on algae</p> <p>Carruthers et al. (2005). Lagoon scale processes...</p>
<p>TCE 08 Mangrove Ecology Lifecycle, importance, threats, features and identification</p>	L	1.5	<p>Mumby et al. (2004). Mangroves enhance the biomass of coral reef fish communities in the Caribbean.</p>
<p>TCE 09 Seagrass and Algae Survey + Mangrove Exploration Use a transect and quadrats to conduct a survey of seagrass and algae cover, identify key species in the field; explore marine life in nearby mangroves</p>	FEX	2	<p>Field Guide to Common Marine Algae of the Bocas del Toro Area - I and II (PDF guides)</p>
<p>TCE 10 Impact of Development on Coastal Ecosystems Panama's mangrove laws; Bocas' history of filling mangroves; coastal development; shoreline stabilization</p>	L	1	<p>Catellanos-Galindo (2018). Panama's impotent mangrove laws.</p>
<p>TCE 11 Seagrass and Algae Survey – Data Analysis and Discussion Discussions on the seagrass and mangrove habitats observed, analysis of data collected in the field</p>	L/W	1.5	<p>Mumby (2004) and Carruthers (2005)</p>
<p>TCE 12 Invertebrate Taxonomy and Ecology Taxonomy, anatomy, and ecology of marine invertebrates; discussion of key invertebrates and issues facing them in Bocas</p>	L	2	<p>Collin et al. (2005). Photographic identification guide to some common marine invertebrates of Bocas Del Toro, Panama.</p> <p>Student choice of scientific article to discuss in class – see folder for options</p>

<p>TCE 13 Conducting Surveys with Transects Discussion of field techniques and practice conducting snorkel surveys using a transect</p>	W	1	Hill and Wilkinson (2004). Methods for Ecological Monitoring of Coral Reefs.
<p>TCE 14 Invertebrate and Fish Surveys in Reef and Mangroves Survey for key invertebrates; examine life on and around mangrove roots; survey for fish in mangroves</p>	FEX	3	
<p>TCE 15 Coral Reefs Coral taxonomy, coral reef ecology, reef structure, the importance of structural complexity of reefs and the decline of 3D reefs in Bocas</p>	L	1.5	<p>News article of your choosing on coral reefs</p> <p>Aronson and Precht (2016). Physical and Biological Drivers of Coral-Reef Dynamics.</p> <p>Graham and Nash (2013). The importance of structural complexity in coral reef...</p>
<p>TCE 16 Invertebrate and Fish Surveys on a Man-made Structure Survey for key invertebrates and fish on an artificial reef and compare to life on mangroves and the reef</p>	FEX	2.5	
<p>TCE 17 Data Analysis and Discussion of Invertebrate Surveys Discussion of observations and analysis of results from field surveys</p>	W	1	
<p>TCE 18 Chasing Coral Viewing of the documentary and discussion of coral bleaching</p>	L	2	
<p>TCE 19 Global Threats to Coral Reef Ecosystems Climate change, bleaching, ocean acidification, plastics, harvesting, destructive fishing, pollutants, disease How to monitor reef health</p>	L	1.5	<p>Scientific paper of your choice on a threat to coral reefs, see folder on Z drive for several options or find your own</p>

TCE 20 Coral Reef Health in a Protected Area Survey for markers of decline in reef health within a MPA, subsequent class discussion and data analysis	FEX, W	3	
TCE 21 Sea Turtle Ecology and Threats in Bocas del Toro	GL	1.5	
TCE 22 Field Methods for Sea Star Surveys Workshop to learn field methods and prepare for sea star surveys	W	1	Guzman and Guevara (2002). Annual reproductive cycle, spatial distribution, and size structure of <i>Oreaster reticulatus</i> in Bocas del Toro
TCE 23 Impact of Tourism on Sea Stars Survey of sea stars at Starfish Beach and a nearby mangrove site	FEX	4	
TCE 24 Scientific Writing	L	1	Scientific Writing 101 (PDF)
TCE 25 Introduction to Statistics and Data Analysis of Sea Star Surveys How and when to use t-tests, ANOVA, and correlation analysis; use of statistical analysis program Past3; analysis and discussion of data from sea star surveys	L/W	3	Download Past3 before class https://folk.uio.no/ohammer/past/ Past3 Reference Manual
TCE 26 Fisheries in Bocas Del Toro	GL/L	1.5	News article of your choosing on Fisheries
TCE 27 Invasive Species Global and regional: what are they, what are the impacts, how do they get there?	L	1	Seebens, et al. (2013). The risk of marine bioinvasion caused by global shipping. Green, et al. (2012). Invasive lionfish drive Atlantic coral reef fish declines. Stellers, et al. (2015). The introduced alga...
TCE 28 Lionfish Dissection	W	1.5	

<p>TCE 29 Climate Change and the Marine Environment Work with data to assess how our climate have changed over time and discuss potential impacts</p>	L/W	3	<p>Hoegh-Guldberg, <i>et al.</i> (2010). The Impact of Climate Change on the World's Marine Ecosystems. <i>Science</i>, 328, 1523-1528.</p> <p>News article of your choosing on climate change</p>
<p>TCE 30 MPA Design and Theory Ecological and socio-economic factors, size, SLOSS debate, buffer zones; discussion on the success of IBMP</p>	L	1	<p>Watson, <i>et al.</i> (2014). The performance and potential of protected areas.</p> <p>News article of your choosing on MPAs</p>
<p>TCE 31 MPA Design Workshop Take on the roles of various stakeholders and debate the appropriate design of a MPA</p>	W	1	<p>Guerron-Montero (2005). Marine Protected Areas in Panama: Grassroots activism and advocacy.</p>
<p>TCE 32 Editing Scientific Writing and Constructive Criticism</p>	W	1	
<p>TCE 33 Oceanography and Marine Ecology of the Caribbean and Pacific Coasts The significance of the formation of Panama in the creation of differences between the two oceans, the differences in tides and physical conditions, and the effect on marine life.</p>	L	2	
<p>TCE 34 Pacific Coral Reefs Conduct a snorkel survey to identify new species and assess similarities and differences between marine life on the Caribbean and Pacific coasts</p>	FEX	2	
<p>TCE 35 Pacific Coastal Ecosystems Explore the sandy and rocky intertidal zones of Pacific islands</p>	FEX	1	
<p>TCE 36 Studying Dolphin Populations Ecology of coastal marine mammals and the methods employed to study them. Threats facing dolphins in Bocas del Toro</p>	L	1.5	<p>May-Collorcado. Panacetacea: Protocol for field methods. Read pages 17-26</p> <p><i>Choice of one of four articles on Bocas' dolphin population:</i></p>

<p>TCE 37 The Effects of Tourism on the Bocas Dolphin Population</p> <p>Assess the impacts of tourism on the resident population of Dolphins in Bocas Del Toro</p>	FL/W	1.5	<p>Sitar et al. (2016). Boat operators in Bocas del Toro...</p> <p>Sitar et al. (2017). Tourists' perspectives on dolphin...</p> <p>Barragan-Barrera et al. (2017). High genetic structure...</p> <p>May-Collado et al. (2014). The dolphin watching Industry...</p>
<p>TCE 38 Plastic Ocean</p> <p>Viewing and discussion of the documentary Plastic Ocean</p>	L	2	
<p>TCE 39 Plastic Pollution</p> <p>Plastics pollution in the ocean; microplastic; Bocas' waste management system and recent ban on single-use plastics</p>	L	1	<p>News article of choice on solutions to marine issues</p> <p>https://orbmedia.org/stories/Invisibles_plastics/</p>
<p>TCE 40 Final Exam</p>	T	2	
Total Hours		67	