THE SCHOOL FOR FIELD STUDIES

Tropical Ecology and Ecosystem Resilience
SFS 3771

Syllabus

The School for Field Studies (SFS)
Center for Ecological Resilience Studies
Atenas, Costa Rica

This syllabus may develop or change over time based on local conditions, learning opportunities, and faculty expertise. Course content may vary from semester to semester.

www.fieldstudies.org

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 present. In other words, this is a field program, and the field can change.

Course Overview

This course provides an immersive opportunity to study the extraordinary biodiversity of Costa Rica, which protects 5% of the world´s diversity. With ecosystems ranging from coastal lowlands to high mountain peaks, Costa Rica serves as a critical biological corridor between two continents and two oceans. Students will engage directly with these diverse environments, observing species and ecological interactions across a variety of unique habitats. Field studies will include our campus in Atenas, and visits to the rainforests of Guápiles and Sarapiquí, the dry forests of Santa Rosa National Park, the cloud forests of Monteverde, and the high-altitude ecosystems of Cerro de la Muerte.

The exceptional biodiversity and high levels of endemism of tropical ecosystems are under significant pressure from habitat fragmentation and human activities. In Costa Rica, as in other tropical regions, the landscape is a mosaic of diverse habitats shaped by various land-use practices that influence environmental health, biodiversity, and ecosystem services. Over the years, Costa Rica has shifted from an agriculture-based economy to one driven primarily by services, with ecotourism at its core. This transformation is supported by an extensive network of protected areas and private reserves. Nevertheless, an important question remains: are these conservation efforts sufficient to ensure the long-term sustainability of the country's natural resources for future generations?

We will delve into the resilience of ecosystems in the face of rapid environmental changes and threats. Resilience, defined as the system's capacity to absorb or withstand disturbances while maintaining its structure and functions, is a critical concept in understanding the survival of biodiversity in social-ecological systems. The course will explore the implications of reduced resilience, which can lead to increased vulnerability. Understanding these concepts will enable students to assess potential threats, implement sustainable practices, and develop strategies to secure biodiversity for future generations.

Studying these issues is crucial, especially in tropical ecosystems, where complex biological interactions intersect with significant social and economic challenges, necessitating a multidisciplinary approach. This course explores essential ecological and conservation topics, including the origins of tropical diversity, the dynamics of tropical forests and human-managed ecosystems, biodiversity assessment, climate change impacts, species extinction mechanisms, and the resilience of social-ecological systems. Through a combination of lectures, discussions, field trips, and hands-on research, students will examine how economic development affects ecosystem health across Costa Rica and evaluate strategies for sustainable conservation and management.

Learning Objectives

The Tropical Ecology course seeks to provide students with:

1) An introduction of the natural history of the major ecosystems in Costa Rica.
2) An introduction to the ecological complexity of tropical forests.
3) An understanding of the causes of the origin of tropical species diversity including historical factors such as geologic history, climatic shelters, and the Great Biotic Interchange.
4) An understanding of present-day ecological factors affecting the distribution of tropical organisms (climatic and topographic heterogeneity).
5) An understanding of the richness of life forms and biological interactions (herbivory, seed dispersal, pollination, coevolution).

6) A clear understanding of how tropical forests function, including food webs, nutrient cycling, regeneration processes, responses to disturbances, and the physiological adaptations of tropical organisms.
7) Definitions and quantifications of the biodiversity concept at different scales (ecosystem, species, and genes).
8) An understanding of how climate change affects species abundance and distribution.
9) The ability to integrate knowledge on the above topics to generate alternatives to minimize negative impacts on tropical ecosystems.
10) The necessary creativity to develop ecologically sound alternatives of land use practices and conservation mechanisms. This includes sustainable agriculture, improving habitat connectivity, climate change mitigation (e.g., carbon offset mechanisms), certifications, panarchy, and strategic alliances with stakeholders.

Assessment

Assessment Item	Value (%)
Field Journal	15
Field Lab	15
Field Exercise	20
Oral Presentation	15
Comprehensive Essay or Blog	15
Participation	15
TOTAL	**100**

Field Journal (15%)

You will maintain a journal to record your field notes, observations, and summary of ideas discussed during all the activities in which the TE component is present, especially during field trips, orientation walks, and field exercises. Rubrics will emphasize content, organization, and writing quality. Students will be able to add text, drawings, diagrams, figures, and photographs.

Field Lab: Manu (15%)

The field lab will take place at the Manú Center during the first field trip. Students will learn survey techniques for birds, bats, amphibians, and reptiles, as well as skills in animal manipulation and ID.

Field Exercise: Experimental Design in Ecology (20%)

Science relies on intuition, systematic observations, and logic. The scientific method begins with an observation, from which we seek patterns and formulate hypotheses to explain them. We then conduct experiments to evaluate these hypotheses, ultimately drawing conclusions that contribute to broader theories. Our objective is to apply the scientific method to answer a question in ecology.

Students will develop their own project based on a specific research question. Working in small groups of 6 to 7, they will discuss their projects with the professor to receive feedback on theory, logistics, and equipment needed for data collection. This FEX will be conducted at Santa Rosa National Park and will provide valuable experience for the Directed Research component at the end of the semester. The FEX requires an introduction (10%) that includes research questions, hypothesis and predictions, and theoretical framework, along with a literature review. Finally, students will present a report (20%) in the form of a brief scientific paper after the field trip.

Oral Presentation (15%)

After the FEX, the students will present their research to the rest of the class. The goal is to develop the ability to efficiently communicate results to an audience, summarize relevant results in a presentation, and develop the skills to ask questions to their peers.

Comprehensive Essay or Blog (15%)

You will author an essay (max. 5-8 pages, or 5000 words), blog or similar summarizing the topics and experiences (FLABs, FEXs, field trips, study cases, etc.) from the course. A storytelling format is suggested, with pictures and infographics to communicate science and research to broader audiences. Feel free to include ideas and drawings from your Journal.

Participation (15%)

You are expected to actively participate in each academic session. This means you should read the assigned materials in advance to prepare relevant questions and engage in analytical discussions and exercises on key issues. Active participation is required not only during class discussions but also in assignments and hikes.

Grading Scheme

A	95.00 - 100.00%	B+	86.00 - 89.99%	C+	76.00 - 79.99%	D	60.00 - 69.99%
A-	90.00 - 94.99%	B	83.00 - 85.99%	C	73.00 - 75.99%	F	0.00 - 59.99%
		B-	80.00 - 82.99%	C-	70.00 - 72.99%		

General Reminders

Honor Code/Plagiarism – SFS places high expectations on their students and we hold students accountable for their behaviors. SFS students are held to the honor code below. SFS has a zero-tolerance policy towards student cheating, plagiarism, data falsification, and any other form of dishonest academic and/or research practice or behavior. Using the ideas or material of others without giving due credit is cheating and will not be tolerated. Any SFS student found to have engaged in or facilitated academic and/or research dishonesty will receive no credit (0%) for that activity.

> *"SFS does not tolerate cheating or plagiarism in any form. While participating in an SFS program, students are expected to refrain from cheating, plagiarism and any other behavior which would result in a student receiving credit for work which they did not accomplish on their own. Students are expected to report any instance of cheating or plagiarism by others."*

Deadlines – Deadlines for assignments are established to promote equity among students, to allow faculty enough time to review and return comments and grades before other assignments are due, and to avoid clashes with other activities and courses. Therefore, deadlines are firm, and extensions will only be considered under extreme circumstances. When appropriate, the files should be placed in the assigned folder within the students drive on the server. Late assignments will incur a 10% penalty for each day that

they are late. Papers submitted after 3 days of the dateline will not be accepted. Please plan to avoid such situations. Assignments will be handed back to students within one-week grading period.

Readings – The assigned readings will be available in a printed anthology and digital PDF files. Please take good care of this anthology and do not lose it. The goal of this compilation of articles is to eliminate the need for printing more copies using laser printers (reducing our impact on paper and other center resources). It is important to read the assigned readings prior to class or discussions. We will often use these as starting points or examples for class discussion or as background information for field trips. Reference and resource materials are useful starting points for your directed research. Additional references can be provided upon request.

Content Statement – Every student comes to SFS with unique life experiences, which contribute to the way various information is processed. Some of the content in this course may be intellectually or emotionally challenging but has been intentionally selected to achieve certain learning goals and/or showcase the complexity of many modern issues. If you anticipate a challenge engaging with a certain topic or find that you are struggling with certain discussions, we encourage you to talk about it with faculty, friends, family, the HWM, or access available mental health resources.

Participation – Since we offer a program that is likely more intensive than you might be used to at your home institution, missing even one lecture can have a proportionally greater effect on your final grade simply because there is little room to make up for lost time. Participation in all components of the course is mandatory, it is important that you are prompt for all activities, bring the necessary equipment for field exercises and class activities, and simply get involved.

Course Content

Type: L: Lecture, **FL:** Field Lecture, **FEX:** Field Experience, **D**: Discussion, **O**: Orientation, **L:** Lab

No	*Title and outline*	*Type*	*Time (hrs)*	*Readings*
1	**Course Introduction** a) Objectives of the Tropical Ecology course in relation to the general goals of the SFS program. b) Introduction to the Natural History of Costa Rica, and a brief overview of the ecological concepts in conservation and sustainability c) Introduction to Nature Journalism	O	1.5	
2	**Tropical Ecology Introduction** Introduction to the general ecology of tropical rainforests and natural history of representative ecosystem species.	L	2.0	Costa Rican Natural History (1983).
3	**Briefing for trip to Manú** Nature Journal and monitoring techniques	O	1.0	
4	**Trip to Manú Center** a) Hike: Rainforest ecology b) Lecture: Birds of the Caribbean Slope and bird monitoring techniques **c)** Lecture: Amphibians and reptiles of the tropical wet forest and monitoring techniques.	FL; FEX	3.5	

No	Title and outline	Type	Time (hrs)	Readings
5	**Trip to Manú Center** a) Lecture: Biodiversity in agroecosystems b) Field Practice: Bird monitoring techniques c) Field Practice: Amphibians and reptiles of the tropical wet forest and monitoring techniques.	FL; FEX	6.0	
6	**Natural History of Costa Rica** a) Geologic formation of Central American land bridge b) Biogeographic consequences of the land bridge formation for terrestrial and marine biota c) Climate and topography of Costa Rica d) Major ecosystems and species richness e) e) Tropical Dry Forest	L	1.5	Avalos, G. (2019).
7	**Diversity of tropical rainforests** a) The Latitudinal Diversity Gradient (LDG) b) Co-existence of high number of species c) Habitat heterogeneity and species richness a) Alpha and Beta diversity	L	2.0	Brown, J.H. (2014). Sherry, T. W., et al. (2020).
8	**Briefing for tip to Santa Rosa**	O	0.5	
9	**Trip to Santa Rosa** Field Exercise explanation and introduction. Review and practice of observational skills and hypothesis testing.	FL	3.5	
10	**Trip to Santa Rosa** Biodiversity Assessment: Methods and metrics to quantify biological diversity. Direct observation (plots, quadrants, transects), scientific collections, acoustic methods. Species composition data analysis, interpreting species composition graphs	L; FEX	1.5	Gibb, R., Browning, E., Glover-Kapfer, P., & Jones, K. E. (2019).
11	**Trip to Santa Rosa** Field Exercise research project design	L; D	2.0	
12	**Trip to Santa Rosa** Field Exercise data collection	FEX	9.5	
13	**Trip to Santa Rosa** Field Exercise data entry and analysis	Lab	1.5	
15	**Panarchy** Theory of Panarchy. Application in ecology and ecosystem resilience. Resilience in rural and urban environments.	L	1.0	Angeler, et al. (2016). Egerer and Buchholz (2021).
16	**Field trip to Cerro de la Muerte** Natural history of highlands of Costa Rica Exploring the montane oak forest and paramo ecosystems Ecosystem change, invasiveness, and ecosystem resilience	FL; FEX	6.0	Ceballos, Ehrlich, and Raven (2020).
17	**Cerro Vueltas Nature Journal**	Lab	2.0	
18	**Field trip to Monteverde** a) Tropical Cloud Forest Ecology	FL	1.0	Lawton, et al. (2016).

No	Title and outline	Type	Time (hrs)	Readings
	b) Physical environment of premontane forests c) Forest structure, dynamics, and species diversity d) Animal-plant interaction			Newcomer, Camacho Céspedes and Stallcup (2022).
19	**Field trip to Monteverde** a) Natural history of tropical cloud forest species b) Introduction to the general ecology of tropical cloud forests and natural history of various representative species of this ecosystem.	FL	4.0	
20	**Climate Change and species extinction** a) Tropical forest changes and Climate Change (CC) b) Implications of CC on tropical biodiversity c) Predicting future negative impacts through understanding and monitoring biodiversity	L	1.5	Zipkin and DiRenzo (2022).
22	**FEX presentations**	D	1.5	
	Total hours		**53**	
	UMN Instructional Hours*		**63.6**	

**UMN defines* an instructional hour as a 50-minute block. SFS syllabi are written in full 60-minute hours for programming purposes. Therefore 50 full hours = 60 UMN instructional hours (for four credit courses) and 25 full hours = 30 UMN instructional hours (for two credit courses).*

Reading List

1. Angeler, D. G., Allen, C. R., Garmestani, A. S., Gunderson, L. H., & Linkov, I. (2016). Panarchy use in environmental science for risk and resilience planning. Environment Systems and Decisions, 36(3), 225-228.
2. Avalos, G. (2019). Still searching the rich coast: Biodiversity of Costa Rica, numbers, processes, patterns, and challenges. In Global Biodiversity (pp. 101-135). Apple Academic Press.
3. Brown, J.H. (2014). Why are there so many species in the tropics? J. Biogeogr 41, 8-22.
4. Ceballos, G., Ehrlich, P. R., & Raven, P. H. (2020). Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction. Proceedings of the National Academy of Sciences, 117(24), 13596-13602.
5. Costa Rican Natural History. (1983). Ed. Daniel H. Janzen, Univ. of Chicago Press (Available in SFS Library) and online PDF
6. Egerer, M., Buchholz, S. (2021). Reframing urban "wildlife" to promote inclusive conservation science and practice. Biodivers Conserv 30, 2255–2266.
7. Gibb, R., Browning, E., Glover-Kapfer, P., & Jones, K. E. (2019). Emerging opportunities and challenges for passive acoustics in ecological assessment and monitoring. Methods in Ecology and Evolution, 10(2), 169-185.

8. Lawton, R. O., Lawton, M. F., Lawton, R. M., & Daniels, J. D. (2016). The montane cloud forests of the volcanic cordilleras. Costa Rican Ecosystems, 415-450.
9. Newcomer, Q., Camacho Céspedes, F., & Stallcup, L. (2022). The Monteverde Cloud Forest: evolution of a biodiversity island in Costa Rica. In Biodiversity Islands: Strategies for Conservation in Human-Dominated Environments (pp. 237-278). Cham: Springer International Publishing.
10. Sherry, T. W., Kent, C. M., Sánchez, N. V., & Şekercioğlu, Ç. H. (2020). Insectivorous birds in the Neotropics: Ecological radiations, specialization, and coexistence in species-rich communities. The Auk, 137(4), ukaa049.
11. Zipkin, E. F., & DiRenzo, G. V. (2022). Biodiversity is decimated by the cascading effects of the amphibian-killing chytrid fungus. PLoS pathogens, 18(7), e1010624.