THE SCHOOL FOR FIELD STUDIES

Tropical Ecology of the Andes-Amazon
SFS 3830

Syllabus, Fall 2016

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Course Overview

The term biodiversity refers to the variety of life on Earth at all its levels, from genes to ecosystems. Ecology is the scientific study of interactions of organisms with one another and with the physical and chemical environment around them. In this course Tropical Ecology of the Andes-Amazon we will be looking at the biodiversity of the region and the processes that originate and sustain it at multiple scales: regional, landscape, ecosystem, habitat, communities, and species.

The overarching goal of this course is for students to be able to identify and characterize the diversity of non-human life in the Andes-Amazon region, and to understand the patterns and processes that support this diversity. Students will learn the fundamental principles of ecology through studying a diverse mosaic of ecosystems, habitats, and species along elevation gradients, succession gradients, and geomorphic features.

This course focuses on two core themes, both theoretical and practical, in tropical ecology:

1. What is biodiversity? Evolutionary origins, taxonomy
2. Why are the tropics so diverse? Interactions, ecosystem dynamics, succession

The course is closely linked to the course *Conservation Science and Practice*, where we will focus more on why biodiversity is important, what threatens it, and how to mitigate those threats. The notions of ecological connectivity and resilience will be explored conceptually and evidence for these will be sought in the field. By integrating field and classroom approaches, students will explore the science behind current local and global issues in land use, biodiversity, and climate change. The purpose of this course is to provide students the opportunity to develop a strong foundation of scientific knowledge of the natural environment and to build a tool kit of field research methodologies and analytical skills to uncover, test, and describe ecological questions.

The focus is on field-based and hands-on learning, so come prepared to get your feet wet and hands dirty.

Learning Objectives

In this course students should develop conceptual understandings and practical skills that afford them an appreciation of the diversity and complexity of the natural systems of the Andes-Amazon region. Specific learning objectives are the following:

1. Gain an understanding of ecological complexity of tropical ecosystems, evolutionary processes, and landscape patterns that underlie species diversity and co-existence.
2. Understand the richness of life forms, and their interactions (herbivory, predation, seed dispersal, pollination, coevolution).
3. Describe the structure and composition of the major ecosystems in the Andes-Amazon region.
4. An understanding of how a tropical forest functions, such as nutrient cycling, regeneration and response to disturbances, and the physiological characteristics of tropical plants.
5. Employ the field research methods and analytical tools—both qualitative and quantitative—that are used in the study of ecology and biogeography.

Assessment

Assessment Item	Value (%)
Quizzes (4)	20
FLABs: identify and describe natural patterns (4)	20
FEX: ecological study (1)	20
Final exam	35
Participation	5
TOTAL	**100**

Assessment Descriptions

Quiz

Short quizzes will be administered throughout the semester to assess periodic comprehension of the course's material. Quiz questions will be synthetic and answers will be expected in essay form.

Field Lab (FLAB): Identify and describe a natural pattern

Science is based on observation, intuition, logic and reason. Usually, we use the processes of induction and deduction to develop a hypothesis from events or patterns we see. The scientific method begins with a series of *observations*; then a *hypothesis* is formulated, and we collect data to seek patterns that could support or not support our hypothesis. In addition, we can also use experiments to test the hypothesis. Finally, we conclude on the results, thus contributing to a broad theory. The objective of field labs is to develop observation skills in the field and to learn the early steps of the process of the scientific method: observation and hypothesis development. Each student will chose a natural ecosystem to use as a natural laboratory. Students will be provided with theory and guided in the process of observation, hypothesis formulation, analysis and writing. Students will be assessed for their ability to develop and communicate a sound hypothesis based on an observation, logic reasoning, and clarity of scientific writing.

Field Exercise (FEX): Measuring biological diversity

This field exercise is designed for students learn and practice a series of different field techniques to collect data on biodiversity and ecology from the canopy to the floor of a cloud forest. You will learn how to use these techniques, collect data, and produce graphs and perform statistical tests. You will select one method to use in a mini-project and produce a written report that will focus on describing the research methods and presenting and interpreting results.

Exam

The final exam is closed-book. You will be given time to study for the exam; a class period will be designated as review. You will be examined on what you have been exposed to in class (lectures, discussions, etc.) and in the field, and what you have been asked to read. The exams allow students to draw on multiple concepts and experiences, and to synthesize information.

Grading Scheme

A	95.00 – 100.00%	B+	86.00 – 89.99%	C+	76.00 – 79.99%	D	60.00-69.00%
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 - All readings are optional but reviewing them is strongly encouraged as they will enhance your understanding of the lecture and field lecture material, and serve as examples of how to write scientific papers. Readings are available as PDFs on the Student Drive or from internet hyperlinks. The reading list might be updated or changed during the course of the semester.

Plagiarism - Using the ideas and material of others without giving due credit, is cheating and will not be tolerated. A grade of zero will be assigned if anyone is caught cheating or aiding another person to cheat actively or passively (e.g., allowing someone to look at your exam). All assignments unless specifically stated should be individual pieces of work.

Deadlines - Deadlines for written and oral assignments are instated for several reasons: They are a part of working life to which students need to become accustomed and promote equity among students, and deadlines allow faculty time to review and return assignments before others are due. Assignments will be handed back to students after a one-week grading period. Late assignments will incur a 10% penalty for each day that they are late. No assignment will be accepted after three days.

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 program is mandatory because your actions can significantly affect the experience you and your classmates have while at SFS. Therefore, it is important that you are prompt for all land and water based activities, bring the necessary equipment for field exercises and directed research, and simply get involved.

Course Content

Type: L-Lecture, **FL-** Field Lecture, **FEX-** Field Exercise, **FLAB-** Field Lab Exercise, **LAB-** Lab Exercise

Code (Type)	*Hrs*	*Lecture Title and Description*	*Readings*
TE1 (L)	**0.5**	**The Navel of the World: The western Amazon as a global biodiversity hotspot** This lecture will introduce the subject of tropical ecology as a multidisciplinary endeavor that includes principles of biology, geology, and climatology, and that aims to understand why the tropics of the Earth, and western Amazonian forests in particular, are Life's powerhouse, generating the most intricate manifestation of matter known	
TE2 (L/LAB/FL)	**3**	**The blessed belt: the where and how of the Tropics** This field lecture will explore how terrestrial astronomy and the interaction between water, air, and landmasses generate tropical ecosystems.	Forsyth and Miyata 1984. In the realms of the Tropics. SFS Library Killen *et al*. 2007

Code (Type)	***Hrs***	***Lecture Title and Description***	***Readings***
TE3 (FL)	**4**	**A recipe for biodiversity: how South America's geologic history shaped the World's richest biota** Compared to its sister tropical continents, South America harbors by far the highest biological diversity. Learn how the interplay of size, geology, and geographical location has created the best conditions on Earth for the accumulation of species. **Quiz 1**	Hoorn *et al*. 2010
TE4 (LAB)	**2**	**Predicting distributions** In this lab we will explore the tropical climate from the classroom and predict species distributions using known collection localities and the software DIVA-GIS	
TE5 (FL)	**2**	**A fuzzy tale: mammals and the biogeography of the Neotropics** This lecture and field lecture will describe the evolution and assemblage of the South American mammalian fauna and the mid-domain effect as an explanation of the uneven distribution of biological diversity. **Quiz 2**	Barnosky *et al.* 2004
TE6 (FL/FLAB 1)	**6**	**Life is green: how photosynthesis fuels life on Earth** A walk on the Mantanay reserve will allow students to experience a relict Andean forest. There, we will explore the concepts of the carbon cycle, primary productivity, ecological succession, biomass, and habitat heterogeneity.	Girardin *et al*. 2010
TE7 (FL)	**1**	**Orchids: a cloud forest evolutionary success** With a staggering array of shapes and colors, orchids are the richest plant family in the world. Learn how to recognize them and how reproductive specialization may have led to such a high species richness	
TE8 (FL)	**0.5**	**Above the clouds: the dynamics of the Andean tree line** This field lecture discusses the dynamic nature of the Andean treeline ecotone and the importance of managing it to conserve biodiversity under climate change. **FLAB 1 due**	Lutz *et al*. 2013
TE9 (FL)	**4**	**Into the clouds: ecology and carbon balance in the cloud forest** Cloud forests thrive under conditions of higher humidity and more unstable soils than other forests, this field lecture illustrates the effects that these abiotic conditions have on cloud forest ecology and global carbon balance.	Feeley *et al*. 2011

Code (Type)	Hrs	Lecture Title and Description	Readings
TE9 (FL)	**1**	**Subtle transitions: biotic boundaries along the Andean slope** Major but hard to see ecological changes take place at mid elevations (1000 m and 2000 m) in the Andes. This field lecture takes us to the cloud forest/lower montane/lowland forest transition and illustrates the taxonomic and physiological changes that take place at these elevations.	
TE10 (L/FL)	**7**	**The sea of trees: plant diversity and forest types in the Amazon** Learn how the combination of different rainfall and temperature regimes with different geologic substrates produces forests of different diversity, structure, and community composition. Learn common plant families of the Amazon understory. **Quiz 3**	Gentry 1988
TE11 (L/ FEX 2)	**3**	**Six-legged crowds: insects as the world dominant life form** This field lecture and exercise will introduce insect evolution, major body plans and modes of metamorphosis. Especial emphasis will be made on dung beetles as a tropical adaptive radiation and indicators of forest health.	Larsen *et al*. 2006
TE12 (FEX 2)	**4**	**Endless forms most beautiful: the theory and practice of biological diversity** With this lecture and exercise we will discuss the species concept and use the insect data to practice methods to measure biological diversity. **FLAB 2 due**	Tuomisto 2010. Parts 1 and 2.
TE13 (FL/FLAB)	**6**	**Rainbow wars: how herbivory enhances species diversity and gaudy colors** This field lecture will explore the coevolution of herbivory and plant defenses as an arms race that enhances tropical biodiversity. The striking herbivory side effects of aposematic coloration and mimicry rings will be observed in the field with a focus on butterflies.	Mallet and Gilbert 1995
TE8 (FEX 1)	**10**	**The sex life of plants: pollination and seed dispersal strategies in the tropics** The intricate interdependency between flowering plants and animals as pollinators and seed dispersers will be explored in this lecture and field exercise. Pollination and dispersal syndromes will be explained and matched to their animal counterparts.	Fenster *et al*. 2004 Futuyma and Agrawal 2009. http://www.pnas.org/content/106/43/18054.full

Code (Type)	Hrs	Lecture Title and Description	Readings
TE16 (FL)	**0.5**	**Mother of God: lowland rivers and floodplain forest dynamics** On this boat trip down the Madre de Dios river we will see how different floodplain substrates produce different river courses which in turn have different consequences for the dynamics of floodplain forests and the connectivity of populations on opposite river banks. **FEX due**	Salo et al. 1983
TE17 (FL)	**1**	**Salts of the earth: Soils and the ecology of sodium in the western Amazon** This lecture introduces the components of soil ecology and describes the importance of sodium in the diet of animals, the geographic reasons for its scarcity in western Amazonia, the behaviors acquired to obtain it, and its effect on mammal ecology and conservation.	Dudley *et al*. 2012
TE14 (FL/FLAB 3)	**3**	**Bats: an adaptive radiation in the tropical night** No mammal group is more diverse in the amazon than bats. Learn how their flight anatomy and echolocation have allowed bats to fill in a unique terrestrial niche.	Denzinger and Schnitzler 2013
TE18 (L/FL)	**3**	**Our quiet ancestors: aquatic ecology in the world's largest river system** The Amazon drainage is home to the greatest diversity of fresh water fish on Earth. This lecture will show how the peculiar history of the Amazon river drainage has shaped its modern fish fauna and its predators. Course conclusions. **Quiz 4**	Barthem *et al*. 1991
TE19 (L)	**2**	**Review for Final Exam**	
TE20 (L)	**2**	**Final Exam**	
	65.5	**TOTAL CONTACT HOURS**	

Course Bibliography

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