CIEE Monteverde, Costa Rica

Course name: Tropical Biology  
Course number: BIOL 3001 MVSU  
Programs offering course: Tropical Ecology and Conservation  
Language of instruction: English  
U.S. Semester Credits: 4 semester/6 quarter hours (20 lecture hours, 120 lab hours)  
Contact Hours: 60 hours  
Term: Summer 2019

Course Description
This course explores the variety of tropical communities, how they function, the ecological and evolutionary forces that generate and maintain their biological diversity, and why the integrity of these forests is compromised by human activities. Students will learn about global and local climate patterns, and biological response to global warming at Monteverde. They will be taught about the paradox of high tropical productivity despite poor soils, and will investigate nutrient and energy cycles. Students will explore the complexity of species interactions in tropical communities, and learn how these features impact ecosystem structure and function. They will learn about global patterns of biodiversity, and theories for the patterns. Students will contrast historical and contemporary rates of species extinction, and proximate and ultimate causes for the loss of biodiversity. They will compare intact and human-transformed tropical communities, and understand the forces that erode species and ecological functions, including those vital to human wellbeing. Finally, students will apply these lessons to conservation issues in Costa Rica that they have witnessed firsthand, and will explore how to lessen human impacts. Taxonomy and natural history of the flora and fauna of Costa Rica will be taught primarily during field trip laboratories and outings to diverse ecosystems (and reinforced in lectures as examples, as appropriate). In lecture sessions, students will participate by reading scientific literature and conducting discussions of the articles with others in the class.

Learning Objectives
Upon completion of the course the students will:

- Understand fundamental ecological concepts, such as nutrient and energy flow in ecosystems, particularly those related to tropical ecosystems and how the tropics are different from extra-tropical ecosystems.
- Understand fundamental evolutionary concepts such as speciation, extinction, natural selection, and drift, and apply these concepts to understanding the global distribution of biological diversity.
- Understand fundamental concepts of species interactions, such as competition and mutualism, comprehend how species interactions differ between tropical and extra-tropical communities, and appreciate how species diversity impacts structure, function, and conservation of these communities.
- Appreciate the full range of biological variation harbored tropical communities, and apply current evolutionary and ecological theories for how this diversity was created and is maintained.
- Identify and know the taxonomy and natural history of over 100 species.
- Understand basic taxonomy and systematics.
• Learn and employ correctly basic quantitative, experimental, or observational ecological field methods, such as population censuses, making diversity and richness estimates, capture and release methods, etc.
• Learn and employ correctly basic descriptive statistics and graphing.
• Understand the proximate and ultimate factors that erode biodiversity, particularly in the tropics, recognize how human activity is related to these, and know which species are most prone to extinction.
• Develop public speaking abilities for communicating the results of scientific studies.
• Merge language, culture, and ecology to construct a more holistic conservation ethic.
• Explore the fate of tropical biodiversity, and forge a stronger and more effective resolve to save it.

Course Requirements
In addition to traditional lectures, students read and present current literature. There is extensive time in the field learning the biodiversity of all major life zones in Costa Rica. Field trips, outings, and exercises highlight major taxa and explore their basic biology and taxonomy, or the fundamentals of a major ecosystem.

Textbook
CIEE Tropical Ecology and Conservation. 2013. Tropical Diversity Laboratory Diversity Day Handouts. San José: printed by the authors

Methods of Instruction
Students will attend lectures given by instructors, and make readings presentations, in which they read, present, and discuss current literature. Lectures and readings will focus primarily on theory and methodology. Students will attend laboratory sessions in which they carry out field experiments, collect and analyze data, and present the results in written and oral reports. In laboratory sessions, students will also participate in “Diversity days”, which immerse them in the natural history and taxonomy of important taxa or the fundamentals of major ecosystems.

Assessment and Final Grade
1. Midterm exam  30%
2. Final exam  30%
3. Laboratory  35%: field reports 20%, lab practical 10%, problem set 5%
4. Discussion participation:  5%

Weekly Schedule

Week 1 (field trip 1: classes and activities on location)
Lectures
Lecture 1 Important species and ecology of mangroves, lowland rainforests, coastal ecosystems; island-mainland contrasts; introduction to biological classification; common plant families and their identification.
Lecture 2: Theory of Island Biogeography. What the theory aspires to understand and predict; empirical patterns of species richness on islands; theoretical relationship between habitat size, extinction rate, isolation from mainland, and species richness; concept of an equilibrium S; landbridge versus volcanic islands; IBT as applied to nature reserves.

Lecture 3. History of Costa Rican conservation. National parks and protected areas; system of national conservation areas; components of conservation areas and their integration and coordination; key legislation; innovative economic policy for conservation

Activities
Hikes: Ecology of Highland Oak Forest and Paramo, Coastal Mangrove Forest and Lowland Pacific Wet Forest, Islands

Readings
Courchamp *et al.* 2015. Fundamental ecology is fundamental.
Masters *et al.* 2012. *CIEE Handbook of Plant Taxonomy*.

Evaluations
Discussion Topic 1: Tropical Conservation with Costa Rica as model

Week 2 (field trip 1 continued: classes and activities on location)

Lectures
Lecture 4. Important species and ecology of transitional and seasonally dry tropical forests.
Lecture 5. Introduction to plant growth forms
Lecture 6: Introduction to Mammal Diversity
Lecture 7 Introduction to Herp Diversity

Activities
Hikes: Ecology of Moist Forest and Seasonal Dry Forest; herp night hike
Group Field Experiments
Mammal Camera Traps

Readings
Janzen & Martin. 1982. Neotropical anachronisms: the fruits the gomphotheres ate.

Evaluations
Laboratory: Field Report 1
Discussion Topic 2: Building a National Park System, Guanacaste Conservation Area Regeneration

Week 3

Lectures
Lecture 8. Important species and ecology of cloud forests.
Lecture 9. Global climate, climate and communities, and climate change in the Tropics. The impact of Earth’s relationship with the sun on global rainfall and seasonality,
windward/leeward effects, Holdridge Life Zones; Costa Rica and Monteverde weather, el Niño and global warming. Close-up on climate and climate change in Monteverde

Lecture 10: Tropical soils; seasonality in the tropics. Causes and consequences of tropical soil composition and fertility, agents of decomposition and recycling, the role of mycorrhizae.

Activities
Hike in the Monteverde Cloud Forest
Plant Diversity Workshop

Readings

Evaluations
Laboratory: Lab Practical

Week 4
Lectures

Activities
Group Field Experiment
Insect Diversity Workshop
Plant Growth Forms Workshop
Bird Diversity Workshop

Readings
Salazar & Marquis. 2012. Herbivore pressure increases toward the equator.
Rundel & Gibson. 1996. Adaptive strategies of growth form and physiological ecology in neotropical lowland rain forest plant
Scheffer. 2104. Why trees and shrubs but rarely trubs?

Evaluations
Laboratory: Field report 2
Midterm Exam

Week 5
Lectures
Lecture 12: Distribution of biodiversity. Concept of biodiversity; levels of biological organization; the concept of species and its relationship to biodiversity; the latitudinal gradient in species richness; definitions and patterns of endemism; hotspots of biological diversity. Criteria and methodology for hotspot designation; spatial distribution and congruence of hotspots; conservation priority-setting
Activities (field trip 2; lectures and activities on location)
- Hike to Atlantic slope
- Fungal Diversity Workshop
- Bird Walks and Mist-netting
- Night Hike

Readings
- Caley et al. 2014. Global species richness estimates have not converged.
- Stork & Habel. 2014. Can biodiversity hotspots protect more than tropical forest plants and vertebrates?
- Scheffers et al. 2012. What we know and don’t know about Earth’s missing biodiversity.

Week 6

Lectures
- Lecture 13: Theories for the latitudinal gradient in species richness, Part 1. Evolutionary processes in the tropics: Theory of evolution, natural selection; models of selection (stabilizing, directional, and divergent); genetic drift; models of speciation (allopatric and parapatric); speciation and extinction in the tropics
- Lecture 14: Theories for the latitudinal gradient in species richness, Part 2. Ecological processes that affect species coexistence in the tropics: species interactions, concept of niche, productivity and resource availability, dispersal, metacommunities

Readings
- Brown. 2014. Why are there so many species in the Tropics?
- Gillman et al. 2015. Latitude, productivity and species richness.

Evaluations
- None

Week 7

Lectures
- Lecture 15: Tropical forests under pressure. Major anthropogenic influences on tropical forests (land-use change, poaching, invasive species, global warming).
- Lecture 16: The loss of biodiversity. Historical and contemporary rates of biodiversity; proximate and ultimate causes; extinction-prone taxa; the case of tropical amphibian extinctions; changing climate, disease outbreak, negative synergisms

Activities
- Workshop on Species Diversity and Richness Calculations

Readings
- Galetti et al. 2013. Functional extinction of birds drives rapid evolutionary changes in seed size.

Evaluations
- Laboratory: Problem set

Week 8

Lectures
Lecture 17: Future of Tropical Biodiversity. Prospects for global biodiversity; relationship between population growth, resource consumption and environmental degradation; environmental ethics and activism; philosophy of denial, techno-fixes, stoic resignation, and tragic optimism

Readings

Week 9 (Departure week)
Evaluation
Final Exam

Course Materials

Readings


