CIEE Monteverde, Costa Rica

Course name: Tropical Community Ecology
Course number: ECOL 3001 MVCR
Programs offering course: Costa Rica: Monteverde - Tropical Ecology and Conservation
Language of instruction: English
U.S. Semester Credits: 4 semester/6 quarter hours
Contact Hours: 60 hours
Term: Spring 2020

Course Description

This course explores the variety of tropical communities, how they are organized, how they function and how they are compromised by human activity. Students will build a tropical community from the ground up, both theoretically and through direct experience and experimentation in the field. They will learn to define the Tropics based upon global climate patterns, to know why tropical forests are productive despite poor soils, how plants adapt to live according to their growth form, how energy flows through Tropical communities and what this tells us about their organization and stability, the many ways species interact and how this impacts ecosystem function. Students contrast intact and human-transformed Tropical communities and assess how they are different structurally and understand how this can lead to loss of function. Ecosystem functions that are vital to human wellbeing are explored. Finally, students will extrapolate these issues to conservation and how to lessen human impact on Tropical communities.

Learning Objectives

Upon completion of the course students will:

- Understand fundamental ecological concepts, particularly those related to Tropical Ecosystems and how the Tropics are different from Temperate and Boreal forests.
- Appreciate the full range of variation in Tropical communities, where this variation comes from and how it impacts structure, function and conservation of these communities.
- Critique models of Tropical Conservation and how likely these are lessen human impact.
- Merge Language, Culture and Ecology to construct a more holistic conservation ethic.
- Tackle the biological complexity of Tropical communities, more fully appreciate their importance and forge a stronger and more effective resolve to save them.

Course Prerequisites

One year of Introductory Biology and one elective in whole organismic biology or conservation.
Methods of Instruction

Students will attend lectures and related activities. Lectures will emphasize theory and current empirical patterns. Students will read and analyze current literature. In addition, students will travel and spend extensive time in the field in different ecosystems to understand the impact of climate on their composition, structure and function. Faculty-led, short experiments in groups will emphasize patterns of diversity and species interactions.

Assessment and Final Grade

1. Midterm exam 25%
2. Final exam 40%
3. Written field report 15%
4. Oral field reports 15%
5. Participation 5%

Course Requirements

Midterm Exam
The midterm exam will include True/False, Multiple Choice, Short and Long Answer formats for material covered in lecture or in readings. These will cover objective, factual information.

Final Exam
The final exam will include True/False, Multiple Choice, Short and Long Answer formats for material covered in lecture or in readings. These will cover objective, factual information.

Written Field Report
One short experiment will result in a field report, which is written as manuscript in the style of a short note in a scientific journal. This will be no more than three pages in length and will include cited literature, data analysis, presentation and interpretation.

Oral Field Reports
Short field experiments on topic of species interaction, behavioral ecology, etc. Will require an oral presentation with specific grading rubrics. The student will be graded on how well they present and explain the project: justification, study question, methods, results and conclusions.

Participation
Students are expected to attend all lectures and activities, hand in all assignments, as well as ask questions and participate in discussions. Only students who are active participants will receive full credit. Perfect attendance and handing in all assignments will
result in 3 of 5 points. To earn beyond 3 points, students must engage fully in all lectures, activities, and discussions.

### Weekly Schedule

#### Week 1

**Topic:** Orientation; Field Trip 1 (Survey of Seasonal Tropical Ecosystems). Why Study Tropical Ecology and Conservation? Tropical ecology and the conservation agenda.

**Activities:**

**Discussion:**
Current State of Tropical Forests

**Readings:**
Malhi *et al.* (2014)
Janzen and Martin (1981)

**Assessments:**
Oral report on field experiment due

#### Week 2

**Topic:** Field Trip 1, continued. Why Study Tropical Ecology and Conservation? Tropical ecology and the conservation agenda.

**Activities:**
Outings in Lowland Moist Forest, Lowland Dry Forest Field Experiments: Diversity and Species Interactions. Statistical analyses.

**Readings:**
Seddon *et al.* (2014)
Corlett (2012)

**Assessments:**
Written field report assigned (not due)

#### Week 3

**Topic:** Defining and Distinguishing between Ecological Communities

Lecture: How to define ecological communities and distinguish between tropical communities. Hierarchy of biological organization, community assembly rules, stochastic vs. deterministic effects, empirical patterns, Tropical forests vs. temperate forests.
Activities:
Field experiments: Diversity and Species Interactions. Statistical analyses.

Readings:
Gillespie (2004)
Fayle et al. (2015)

Assessment:
Written field report due

Week 4

Topic: Global Climate and Ecology

Lecture: Global Climate: Impact in Defining the Tropics and Tropical Community Types. The impact of Earth’s relationship with the sun on global rainfall and seasonality, windward/leeward effects, Costa Rican and Monteverde weather, el Niño and global warming effects, Holdridge Life Zone Classification System.

Activities:
Weather activity
Field Experiments: Diversity and Species Interactions. Statistical analyses.

Readings:
Corlett (2014)
Brodie et al (2012)
Olson et al. (2001)

Assessment:
Oral field report due.

Week 5

Topic: The Paradox of Tropical Luxuriance.

Lecture: The paradox of tropical luxuriance. The causes and consequences of Tropical soil composition and fertility, plant responses and sustained high productivity, mycorrhizae, likelihood of sustainable agriculture in the tropics.

Activities:
Soil analyses

Readings:
Townsend (2008)
Mann (2002)
Nadeau and Sullivan (2015)
Week 6
Topic: Movement of Matter and Energy through Tropical Communities.

Lecture: How energy moves, how much is captured, trophic relationships, food webs, that matter is finite and is recycled, major biogeochemical cycles, how cycles are disrupted by humans.

Readings:
Laurance, et al. (1997)
Bello et al. (2015)
Poorter et al. (2016)

Weeks 7
Topics: Plant Growth Forms.

Lecture: Plant growth forms: their ecology and physiology. Identifying and defining growth form: understory, subcanopy, canopy, lianas, vines, epiphytes, hemi-epiphytes, epiphylls. Abiotic differences experienced by different growth forms, morphological and physiological adaptations

Activities:
Plant growth form presentations

Readings:
Rundel and Gibson (1996)
Valladares et al. (2002)
Collins et al. (2015)

Assessment:
Midterm exam

Week 8
Topic: Field Trip 2. Community assemblages and ecological relationships in Atlantic Slope Forests and Caribbean Marine ecosystems

Activities:
Hikes in Atlantic Slope Forest

Week 9
Topic: Field Trip 2 (continued). Community assemblages and ecological relationships in Atlantic Slope Forests and Caribbean Marine ecosystems

Activities:
Hikes along Caribbean coastal ecosystems
Swim in coral reefs in Bocas del Toro

Week 10
Topic: Gap Dynamics and Natural Succession in Tropical Forests.
Lecture: How a gap forms, gap size distribution and frequency, succession in gaps, who wins a gap, the random walk to extinction.

Readings:
Brokaw and Busing (2000)
Chazdon (2008)
Hunter et al. (2015).

Week 11

Topic: Introduction to Species Interactions.

Lecture: Species interactions in the tropics and beyond: Mutualism, Commensalism, Parasitism, Predation, Neutralism, Ammensalism, Competition

Readings:
Janzen (1983)
Schoener et al. (2005)
Bregman et al. (2015)

Lecture: Herbivory and Plant Defenses in Tropical Forest. Defining and quantifying herbivory, how the tropics differ from temperate forests in amount and type of herbivory, physical and chemical plant defenses and their impact on herbivores, mimicry and coevolution.

Readings:
Hunt (2003)
Fine et al. (2004)
Salazar and Marquis (2012)
Leal et al. (2014)

Week 12

Topic: Pollination and Seed Dispersal.

Lecture: Pollination and Seed Dispersal: Payoffs of both partners, optimal outcrossing distances, morphological, physiological and behavioral changes, density-dependent mortality, impact on gene pool and distribution, disruption by humans and associated problems.

Readings:
Mawdsley, et al. (2008)
Wang and Smith (2002)
Betts et al. (2015)
Bruna (1999)
Hamilton (1999).
Topic: Seasonality. Patterns related to seasonality in flowering and fruiting, underlying reasons and consequences to mutualistic partners.

Readings:
Sakai (2001)

Week 13

Topic: Disturbance, Biodiversity and Community Stability.

Lecture: How high biodiversity in Tropical communities impacts its stability, including resistance to invasion, resistance, resilience, robustness, redundancy, Portfolio Effects, increase in function with biodiversity, loss of biodiversity and its impact on stability.

Readings:
Zavaleta et al. (2009)
Lewis (2009)
Basic and Blummenthal (2005).

Week 14

Topic: The Future of Tropical Forests and How to Save Them.

Lecture: The Future of Tropical Forests and How to Save Them. Personal behavior vs. government policy, regeneration and restoration, the importance of reserves, the place humans have in an intact ecosystem, the future, where to go with the knowledge gained on the program, how to make difference.

Readings:
Wright (2005)
Laurence (2005)
Tabarelli et al. (2012)
du Toit et al. (2004)
Wilson (2000)
Orr (2004)

Assessment:
Final exam

Readings


