Ecology and Biodiversity of the Neotropics

PROVISIONAL SYLLABUS

"Delight…is a weak term to express the feelings of a naturalist who, for the first time, has wandered by himself in a Brazilian forest"

Charles Darwin, 29 Feb 1832.

When Darwin wrote these words more than 170 years ago, few people in Europe or North America had any real knowledge of the tropical Worlds. Today, rainforests are "familiar" to every schoolchild. As scientific understanding has increased, so has the appreciation of the importance of tropical ecosystems; we now recognize that the majority of the species of life on Earth are to be found in the tropics. We also know that tropical ecosystems are amongst the most endangered on Earth, and much biodiversity will be lost before it is ever documented. But what makes tropical ecosystems so diverse? How do the myriad components of this overwhelming diversity function together? How can we measure and quantify tropical biodiversity so that we may assess the successes and failures of our efforts to conserve and to restore some of this diversity?

These are the questions we propose to address in this course.

The course integrates classroom and field instruction, and is taught as two, focused, intensive blocks of 8 days duration each, followed by a field trip to a contrasting biome.

Day 1

Morning, 8:00am – Noon, Lecture Topics:

Physical Geography and Climatology of the Tropics

Patterns of Biodiversity in the Tropics.

Afternoon, 1 pm – 5 pm: Intro field work;

Identification of major plant families.

Day 2

Morning, 8:00am – Noon, Lecture Topics:

Tropical Biomes

Tropical Forest Structure and Dynamics

Afternoon, 1pm – 5pm: Intro field work;

Identification of major arthropod families classes and selected families.

Day 3

Morning, 8:00 am – Noon; Lecture Topics

Ecology of Neotropical Mammals

Ecology of Neotropical amphibians

Ecology of Neotropical Insects

Afternoon, 1pm – 5pm: Intro field work; (Continuing)

Night Exercise: 9pm- 11pm – Moth and amphibian surveys.

Days 4, 5.

Faculty-Led Field Studies

Methods for quantifying ant diversity and abundance.
Vegetation quadrat and transect studies (old growth, 2ndary forest, pasture).
Leaf area and growth form study (old growth versus 2ndary forest)
Moth diversity studies; bat netting, "froglogging".

Days 6, 7, 8.

Student-Developed (faculty guided) team projects (development, day 6; data collection, day 7, data analysis and write-up, day 8; plant ID exam on day 8). Term-paper style exam written and submitted electronically thereafter.

Student Mini-break; 2 days.

Block 2: 8 days. **Marine and Estuarine Biology**. Taught by Prof. Cheryl Baduini.

Day 11

Morning, 8:00am – Noon, Lecture Topics:
Physical Oceanography and Coastal Dynamics of Central America
Pacific vs. Carribean Oceanography
Patterns of Biodiversity in the Tropics
Intro to keeping a wildlife journal

Afternoon, 1 pm – 5 pm: Intro field work;
Lab 1: Physical Properties along a gradient from the Baru River to the Pacific
Field trip to Baru River and Beach adjacent to Baru River (located 2 km from Field Station).

Day 12

Morning, 8:00am – Noon, Lecture Topics:
Coastal Freshwater Stream and River Dynamics in Tropical Rainforest Communities

Afternoon, 1pm – 5pm: Processing of water samples in the lab;
Continuation of Lab 1: Process samples in the lab, exchange of data, Write-up

Day 13

Morning, 8:00 am – Noon; Lecture Topics
Ecology and Diversity of Mangrove Forests
Effects of Climate Change and Destruction on World Mangrove Diversity
How Costa Rican Mangrove diversity contributes on a global scale

Afternoon, 1pm – 5pm:
Lab 2: Freshwater , insect, and zooplankton sampling along a stream on the Isla del Cielo property

Day 14

8:00-5:00 PM.

Lab 2: Continuation of processing of samples from Lab 2. Insect and zooplankton identification, data exchange and lab write-up

Day 15

Morning 8:00-Noon

Lab 3: Line and quadrat sampling of mangrove abundance and diversity along the Baru River

Afternoon 1:00-5 PM

Processing of mangrove data, data exchange and lab write-up

Day 16

Morning 8:00-Noon, Lecture Topics

Tropical bird and marine turtle ecology in Costa Rica

Afternoon, 1pm-5pm

Field to Baru National Wildlife Refuge (located adjacent to Field Station)

Bird ID lists

Day 17 8:00 AM- 5 PM

Lab data analysis and write-up

Evening, Turtle Watch (season dependent)

Day 18 8:00 AM-Noon

Second Field trip to Baru National Wildlife Refuge

Afternoon, 1pm-5pm

Lab write-ups due at 5 PM

Grades based on 3 lab write-ups and wildlife journals

Student Mini-break; 2 days.

Field Trip. 7 days. (days 21- 28).

The goal here is to provide some experience of a tropical biome very different to that of the Dominical field station. The most likely destination will be the Cuerici Field Station, located at 2900 m in the Talamanca Range (conveniently reached from Dominical). The biome is Oak (Cloud) forest, transitioning to open paramo at 3200 m. Students would be bused to Cuerici on day 1; with field work on days 2, 3 , 4, 5 and 6 and bused back to Dominical on day 7.

READING LIST

Pre-Course Text:

Kricher, J. (1997) A Neotropical Companion. Princeton University Press. 451p.

Scientific Papers

- Papageorgis: Mimicry in Neotropical Butterflies. Am. Sci. 63: 522-532
- Weber: The Attines. Fungus culturing Ants. Am. Sci. 60: 448-456
- Jordan and Herrera: Tropical Rain Forests: Are nutrients really critical? Am. Nat. 117: 167-180
- Oster and Oster: The great Breadfruit scheme. Nat. Hist. 94: 35-41
- Estrada et al: Observations on the fruiting and dispersers of Cercropia..... Biotrop. 16: 315-318
- Andrade and Carauta: The Cercropia-Azteca association: A case of mutualism? Biiotrop. 14: 15
- Kunz et al: Harem social organization in cave roosting Artibeus jamaicensis. Biotrop. 15: 133-138
- Brokaw: Gap-phase regeneration in a tropical forest. Ecol. 66: 682-687
- Ewel et al.: Slash and burn impacts on a Costa Rican wet forest site. Ecol. 62: 816-829
- Golley et al.: The structure and metabolism of a Puerto Rican Red Mangrove forest in May. Ecol. 43: 9-19
- Rockwood: Plant selection and foraging patterns in two species of leaf cutter ants. Ecol. 57: 48-61
- Martin: The biochemical basis of the fungus - attine ant symbiosis. Science 169: 16-20
- Forman: Canopy lichens with blue-green algae: A nitrogen source in a Colombian rain forest. Ecology 56: 1176-1184
- Janzen: Co-evolution of mutualism between ants and acacias in Central America. Evol. 20: 249-275
- Rutzer, K.& C. Feller. 1988. Mangrove Swamp Communities. Oceanus 30(4):18-24.
- Laurance et al. 1997. Biomass Collapse in Amazonian Forest Fragments. Science 278:1117-1119.
- Hubbel et al. 1999. Light-Gap disturbances, Recruitment Limitation, and Tree Diversity in a Neotropical Forest. Science 283:554-557..
- Mueller, U., Rehner, S., and T. Schultz. 1998. The Evolution of Agriculture in Ants. Science 281: 2034-2038.
- Arita, H. and M.B. Fenton. 1997. Flight and Echolocation in the Ecology and Evolution of Bats TREE 12(2)::53-58.
- Lieberman, M. and D. Lieberman.1994. Patterns of Density & Dispersion of Forest Trees. Ch. 8, 106-119. In La Selva, Ecology and Natural History of a Neotropical Rainforest, University of Chicago Press.
- Denslow, J.S.& Gary S Hartshorn. 1994. Tree-fall Gap Environments and Forest Dynamic Processes.Ch. 9, 120-127. In La Selva, Ecology and Natural History of a Neotropical Rainforest, University of Chicago Press.

- Levey, D.J. & Gary Stiles. 1994. Birds: Ecology, Behavior and Taxonomic Affinities. Ch. 17, 217-228. In La Selva, Ecology and Natural History of a Neotropical Rainforest, University of Chicago Press.
- John Terborgh, et al. 1996. Tropical Tree Communities: A test of the Nonequilibrium Hypothesis. Ecology 77(2):561-567.
- Connell, J.H. 1978. Diversity in Tropical Rainforests and Coral Reefs. Science 199:1302-1310.