



Office of Extended Education • Humboldt State University

Rainforest Field Studies:

EVOLUTION AND CONSERVATION OF NEOTROPICAL DIVERSITY

Biology (BIO 180)

3 semester units

BRIEF COURSE DESCRIPTION

This course focuses on ecology, natural selection and evolution in the living forest. We will examine the concept of biodiversity in detail, and study the interactions of biology, politics and culture in the conservation of tropical ecosystems. The specific goals are to provide students with the skills necessary to 1) evaluate propositions about tropical biology and conservation from a scientific standpoint, 2) participate in scientific field studies, and 3) organize independent conservation initiatives. The foundation of this course combines contemporary theory of biodiversity and its conservation with group and independent field projects measuring diversity and testing hypotheses in tropical environments.

Course includes lectures, seminar discussions, and extensive supervised field study and research. Students are required to keep a comprehensive field journal including daily assignments, directed field observations and exercises.

Prerequisites: An introductory course in Environmental Science, biology, or physical geography is encouraged but not required. The material will be taught at an introductory level.

LEARNING OBJECTIVES

The primary objectives of the course are for students to gain a solid understanding of the following:

- The process of evolution
- Structure and function within biological communities
- Conservation biology in the neotropics
- Current conservation strategies, policies, and issues
- Natural history observation skills
- Use of Field Journal as a tool for understanding and inquiring more deeply
- Relevant field techniques in biological sciences
- Inquiry process (experimental design)

COURSE OVERVIEW

Week 1

Monkey Bay Nature Reserve

This private nature reserve lies approximately 30 miles west (this is the only edit to Monkey Bay section) of Belize City in savannah/pine ridge habitat along the Sibun River. We'll start by introducing the course, academic expectations and resources, evaluation criteria, and exploring issues of learning in a field setting (safety guidelines, appropriate behavior, and effective communication). Curriculum topics to be covered include a geologic overview of Central America (and Belize in particular), karst topography, soils and soil-forming factors, climate and climatic influences on the distribution and ecology of tropical forests, and a general introduction to ecology and natural history. Students will begin to develop observational skills; plant, bird, and animal identification skills; and be introduced to the natural history journal. This first week helps orient students to the place and provides a broad overview of ecological principles to be covered in more depth throughout the course, and of the natural history of Belize.

Week 2

Sibun River Canoe trip and Backpack up Indian Creek

We will spend 3 days canoeing the Sibun River, studying watershed processes in the headwater, mid-reach, and lower reaches. We will highlight the natural history and conservation issues relating to the Sibun River watershed. Following a layover day back at Monkey Bay to regroup, we will backpack for 3 days up Indian Creek, a tributary to the Sibun River, from the Western Highway near Monkey Bay to the Hummingbird Highway. We will deepen our experiential knowledge of the flora and fauna of Belize by discovering plants, birds, and mammals found in this tropical forest while traveling through karst, or limestone, topography. We will end the backpack at Five Blues National Park and be transported to San Ignacio for a layover day. Curriculum topics include geology and geomorphology, karst topography, stream ecology, forest structure and composition (epiphytes, lianas, stranglers), species interactions, and National Parks as a conservation tool and how they are managed in Belize.

Week 3

Las Cuevas Research Station

This remote field research station, managed by a consortium of parties, including the London Museum of Natural History, lies south of San Ignacio in the Chiquibul Forest Reserve. Here we will explore moist deciduous tropical forest in the Macal River watershed deep within the Maya Mountains. At this point, students have been exposed to and immersed in several tropical ecosystems and have developed a basic understanding of some of the flora and fauna of Belize. With this context, our stay at Las Cuevas provides an ideal opportunity for deeper studies of ecology and natural history.

Curriculum topics include more in-depth studies into ecological principles while exploring tropical forest diversity, structure, light/treefall gaps, and succession; disturbance ecology; and processes of evolution (natural selection and adaptation, speciation, extinction, sexual selection, cooperative behavior); and the scientific method. Students will conduct a field research project to explore the process of scientific inquiry. They'll use the scientific method – from observations and hypothesis forming and testing to drawing conclusions from their research and analysis – and present their findings to the group. We will live with several Mopan Mayan people who help run Las Cuevas, who will teach us “jungle survival skills” (hunting, gathering, water collection, fire and shelter making). The recent construction of the Challilo dam in the Macal River watershed provides material for discussions on biological assessments, endangered and keystone species and their protection, and the local and global politics and economics of the dam. A two-night backpacking trip into the headwaters of the Macal River watershed allows students to better understand the natural history of this fragile and remote forest, where scarlet macaws, Baird's tapir, jaguars, and morelet's crocodile, all protected species, can be found.

At Las Cuevas, we will begin student-led discussions of articles from the course reader relating to the evolution and conservation of neotropical diversity and the natural history of Central American ecosystems. We'll also begin oral presentations on conservation or natural history topics of each student's choosing. These discussions and oral presentations will be on-going throughout the duration of the course.

Week 4

Tikal National Park, Guatemala

Tikal, part of the Maya Biosphere Reserve in the Peten region of Guatemala, contains awe-inspiring Mayan ruins within an extensive tropical forest. Here we will continue to explore tropical forest ecology and diversity as well as the role of Mayan people (both present and ancient) in the natural history of the region. Pre-Columbian land use patterns and the collapse of the classic Maya civilization will be covered. We will study bird diversity and behavior, species interactions and strategies used by trees to disperse seeds. To better appreciate the high diversity found in the tropics, we will continue our studies of evolutionary theory and the process of natural selection.

Week 5

Tobacco Caye

While on Tobacco Caye, an island in Belize's Barrier Reef, located 30 kilometers from the coastal town of Dangriga, we will dive into coral reef ecology and conservation. Basic snorkeling techniques will be taught and used to explore the rich, colorful biological diversity and intricate relationships between organisms found in coral reefs. We will also explore mangrove ecology, and discuss threats to and conservation efforts aimed at preserving fragile coastal and coral reef systems. Principles of conservation biology will be introduced, using coral reefs as models of diversity and habitat conservation.

Week 6

Maya Center and Cockscomb Basin Wildlife Sanctuary

In the village of Maya Center, we will experience a multi-day homestay with Mayan families and learn about their co-management of this local protected area. The wildlife sanctuary where jaguar research is conducted lies on the east side of the Maya Mountains. Here we will continue to refine our observation skills by studying plant-animal interactions, flowering plants, plant pollination strategies, and the relationship between vegetation communities and climatic factors. Other curriculum topics include principles of conservation biology, the role of large predators and "umbrella" or keystone species in the ecosystem, and efforts to protect large areas for the conservation of species and habitat; theories of biological diversity and both spatial and temporal patterns of diversity.

Week 7

BFREE and the Bladen Nature Reserve

Located south of Cockscomb, the Belize Foundation for Research and Environmental Education (BFREE) is a private research and educational facility located on an 1153 acre reserve next to the Bladen Nature Reserve. Biological diversity here is phenomenal, consisting of jaguars, ocelots, tapirs, spider and howler monkeys, Morelet's crocodiles, more than 300 species of birds, countless insects, and more than 180 reptiles and amphibians. Includes a six-day backpacking trip into the Bladen Nature Reserve, a protected area into which few are allowed to travel.

Curriculum topics include lectures and discussions on the Bladen Nature Reserve and its co-management, review of Protected Areas of Belize, discussions of primary conservation issues currently facing BNR, discussion of research that has occurred and is occurring within the BNR, a series of directed journal observations, Trip planning, and Leave No Trace and other wilderness ethics. We will explore more deeply into conservation biology with lectures, reading, and discussions on biological corridors, the effects of isolation and fragmentation, island biogeography, and amphibians (including the Maya Forest Anuran Monitoring Project). Student-led discussions on these topics and student presentations will also occur.

Week 8

Barranco

Barranco is a small, remote Garifuna village in southern Belize. For 3 days we will intertwine our lives with the Garinagu people, exploring their village and lifeways, traveling up the Temash River and learning how to cast nets for fishing, harvesting and processing cassava (their main food staple), and learning their traditional drumming, dancing, and spirituality. Curriculum includes lectures, hands-on projects, and an inquiry into culture exercise.

Week 9

Belize Agroforestry Research Center (BARC)

At BARC, located in the southern Maya Mountains, we will use the study of rainforests as a model to learn about sustainable landscape design. Guest instructors will lead us in discussions of permaculture, agroforestry, and other sustainable uses of forests. Students will participate in a number of farm tours, and critical thinking exercises related to the incorporation of ecological patterns and processes into food production systems. We will study the impacts of traditional and modern land use practices on tropical forest ecosystems. With local Mayan guides, we will explore the source of the Columbia River.

We will also explore ways to transfer the knowledge and wisdom gained from our tropical field studies to our lives back at home by considering the choices we make and opportunities we create.

COURSE OUTLINE

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| <p>I. Science as a way of knowing</p> <ul style="list-style-type: none">A. Hypothesis testing and scientific inquiryB. The role of intuition in scientific insightC. Perceptual biases in information gathering <p>II. Processes of Evolution</p> <ul style="list-style-type: none">A. Evolutionary time and the history of life on earthB. Natural selection and adaptationC. Speciation and extinctionD. Sexual selectionE. Cooperative behavior <p>III. Biological Communities -- Structure and Function</p> <ul style="list-style-type: none">A. Community ecology in space and timeB. Biotic and abiotic interactions/ population effectsC. Neotropical history, refugia and diversity | <p>IV. Biological Diversity</p> <ul style="list-style-type: none">A. Patterns in space and timeB. Theories of diversityC. "Stability" and biodiversity <p>V. Conservation Biology</p> <ul style="list-style-type: none">A. Population size and the probability of extinctionB. Genetic variation: what is a viable population?C. Conservation of megafaunaD. Coral reefs as models for habitat conservationE. Habitat destruction and avian systems <p>VI. Parasitism and Disease: Neglected Forces in Ecology</p> <ul style="list-style-type: none">A. Humans and other animalsB. Parasites, disease, and habitat disturbance. |
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REQUIRED TEXTS

Kricher, J.C. 1996. *A Neotropical Companion*. Princeton University Press.

Course Reader: instructor-compiled selection of readings from a variety of books and journals (available at cost from instructor once accepted to the program).

- Balick, M. , Arvigo, R, and L Romero. The development of an ethnobiomedical Forest Reserve in Belize. *Conservation Biology* 8 (1): 316-317.
- Benyus, Janine. 1997. *Biomimicry: Innovation Inspired by Nature*. Introduction. P. 1-10. New York, NY: William Morrow and Company Inc.
- Boles, E. 1999. *The Sibun River Watershed Atlas*. Belize: The Government Printer. Selections.
- Emmons, K. M. 1996. *Cockscomb Basin Wildlife Sanctuary: its history, flora, and fauna for visitors, teachers and scientists*. Caye Caulker, Belize: Producciones de la Hamaca, and Gays Mills, WI.: Orung-utan Press. Pp. 44-63.
- Forsyth, A. and K. Miyata. 1984. *Tropical Nature: Life and Death in the Rain Forests of Central and South America*. New York: Touchstone. Chapter 2.
- Gallagher, D. (ed.). 1997. *The Florida Keys Environmental Story*. Big Pine Key, FL: Seacamp Assoc., Inc. Chapter by Booker, J. entitled Mangrove Communities.
- Gliessman, S. R. 2004. *Agroecosystem Analysis*. Agronomy Monographs no. 43. Agroecology and Agroecosystems. P. 19-29.

- Horwich, R. H. and J. Lyon. 1993. *A Belizean Rainforest*. Gay Mills, WI: Orang-utan Press. 2nd Ed. Selections. Pp. 338-291.
- Kirkpatrick, R.D. and A. M. Cartwright. 1975. List of Mammals Known to Occur in Belize. *Biotropica* 7(2) 136-140.
- Marynowski, S. 1992. *Paseo Pantera: the Great American Biotic Interchange*. Special Issue of *Wild Earth: The Wildlands Project*, pp. 71-74.
- Myers, N. 1989. Extinction Rates Past and Present. *BioScience*, 39 (1).
- Myers, N. 2000. Biodiversity Hotspots for conservation priorities. *Nature* 403; February 24, 2000. Pp. 853-858.
- Noss, R. F. and A.Y. Cooperrider. 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity*. Washington, D.C.: Island Press. Selections.
- Perkins, J. S. and A. Carr. 1985. The Belize Barrier Reef: Status and Prospect for Conservation Management. *Biological Conservation*: 0006-3207. England: Elsevier Applied Science Publishers.
- Pimm, Stuart and Peter Raven. 2000. Extinction by Numbers. *Nature* 43; February 24, 2000. Pp. 843-845.
- Primack, R. B. 1998. *Timber, Tourists, and Temples: Conservation and Development in the Maya Forest of Belize, Guatemala, and Mexico*. Introduction: The Maya Forest and Chapter 9: Forest Management and Conservation in Belize.
- Quammen, D. 1996. Evolution, Extinction, and the Laboratories of Habitat. *The Amicus Journal*, Summer 1996. pp. 36-39.
- Root, Terry. 2003. Fingerprints of global warming on wild animals and plants. *Nature* 421; January 2, 2003. Pp 57-60.
- Suzuki, D. 2003. *The David Suzuki Reader: a lifetime of ideas from a leading activist and thinker*. Why the bravest position is biocentrism. Vancouver: Greystone Books. Pp. 277-279.
- Suzuki, D. and Amanda McConnell. 2002. *The Sacred Balance: Rediscovering our Place in Nature*. Ch. 6 Protected by our kin. Vancouver: Greystone Books. Pp. 123-156.
- Terborgh, J. 1988. The Big Things That Run the World – A Sequel to E. O. Wilson. *Conservation Biology* 2 (4): 402-403.
- Terborgh, J. 1992. Maintenance of Diversity in Tropical Forests. *Biotropica* 24(2b): 283-292.
- Wallace, D. R. 1997. *The Monkey's Bridge: Mysteries of Evolution in Central America* San Francisco, CA: Sierra Club Books. Prologue.
- Wilson, E.O. 1987. The Little Things That Run the World (the Importance and Conservation of Invertebrates). *Conservation Biology* 1 (4): 344-346.
- Wilson, E.O. 1989. Threats to Biodiversity. *Scientific American*, Sept. 1989: 108-116.
- Wilson, E. O. 1992. *The Diversity of Life*. Cambridge, MA: Belknap Press of Harvard University Press. Selections.
- Wilson, R and J. 1985. *Watching Fishes: Life and Behavior on Coral Reefs*. Chapter 1: Coral Reefs. New York, NY: Harper and Row.
- Young, A. 1994. *The Chocolate Tree: A Natural History of Cacao*. Washington: Smithsonian Institution Press. Selections.

Course Library (additional reference carried on the course for reference and research; titles may vary):

- Coe, Michael. 1987. *The Maya*. Thames and Hudson Inc. 4th ed.
- Coe, W. R. 1988. *Tikal: A Handbook of the Ancient Maya Ruins*
- Emmons, L. 1990. *Neotropical Rainforest Mammals: A Field Guide*. University of Chicago Press.
- Forsyth, A. and K. Miyata. 1984. *Tropical Nature*. Charles Scribner's and Sons.
- Horwich, R. H. and J. Lyon. 1993. *A Belizean Rainforest*. Orang-utan Press. 2nd Ed.
- Peterson, R.T. and E. Chalif. 1973. *Mexican Birds*. Peterson Field Guides. Houghton-Mifflin Co.
- Jones, H. L. 2003. *Birds of Belize*. University of Texas Press.
- Emmons, K. M. and others. 1996. *Cockscomb Basin Wildlife Sanctuary: its history, flora, and fauna for visitors, teachers and scientists*. Producciones de la Hamaca and Orung-utan Press.
- Kaplan, E. H. 1982. *A Field Guide to Coral Reefs: Caribbean and Florida*
- Wallace, D. R. 1997. *The Monkey's Bridge: Mysteries of Evolution in Central America*. Sierra Club Books.

EVALUATION

Students will be evaluated according to the following requirements:

- 25%: Ecology/Natural History Oral Presentation
- 25%: Field Research Project
- 25%: Conservation, Neotropical Diversity Exercises, participation
- 25%: Final Exam

The grades used in this course will be as follows:

A+	98-100	B-	80-82	D	63-66
A	93-97	C+	77-79	D-	60-62
A-	90-92	C	73-76	F	Below 60
		C-	70-72		
B+	87-89	D+	67-69		
B	83-86				

COURSE SCHEDULE

The course overview section above details the course schedule in the context of the locations where we will be studying. The following table indicates the planned class meetings for this course throughout the program:

<i>week</i>	<i>Topics</i>	<i>Readings</i>	<i>Assignments</i>	<i>Class hours</i>
#1	Savannah community: structure and function; Belize Zoo: fauna of Belize and their conservation; Sibun River Watershed: abiotic and biotic interactions;	Kricher, Appendix Kricher, Ch. 1 Tropical Climates and Ecosystems; Barry; Marynowski; Orr	Belize zoo exercise; Macroinvertebrate exercise	10
#2	Science as a Way of Knowing: Hypothesis testing/Scientific inquiry: macroinvertebrates	Boles;		
#3	Biological Diversity; role of intuition in scientific inquiry; Directed Scientific Inquiry Projects: ant ecology; Research Question and Hypothesis; Data Collection, Analysis, Write-ups;	Wilson; Kricher, Ch. 3; Forsyth; Primack	Field Research Project; Student Presentations; discussion	15
#4	Processes of Evolution; theories of biodiversity	Wilson,1987 &Terbough,1988. Terbough,1992	Discussions; Ecology/Natural History Oral Presentation	10
#5	Principles of conservation biology; coral reefs as models of diversity and habitat conservation; coral reef ecology 1 (evolutionary patterns); coral reef ecology 2 (species interactions, niche partitioning among reef fish); reef types and coral conservation;	Perkins; Gallagher; Wilson, 1985; Benyus; Kricher, Ch. 11	Discussion; Ecology/Natural History Oral Presentation	8
#6	review biological communities, flora, fauna; Conservation Biology; Biological Corridors; conservation of megafauna; the Great American Biotic Interchange;	Balick; selections from Emmons; Marynowski, 1992; Wallace, 1997; Myers, 1989.	Discussion; Ecology/Natural History Oral Presentation	6
#7	biological corridors, the effects of isolation and fragmentation, island biogeography, and amphibians (including the Maya Forest Anuran Monitoring Project).	Suzuki, 2002 and 2003; Quammen; Noss; Myers, 2000; Root.	Discussion; Ecology/Natural History Oral Presentation; Conservation & Neotropical Diversity Exercises	8
#8	local natural and cultural history; drumming, dancing celebration		Discussion; Ecology/Natural History Oral Presentation	2
#9	Food, Politics, and the Loss of Genetic Diversity; biodiversity and plant propagation; farm tour	Young; Gliessman;	Discussion; Ecology/Natural History Oral Presentation; farm tour exercise; Final Exam	4
				Total: 63