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Comparative Tropical Ecology

ENVI-3005 (3 credits)

Panama: Tropical Ecology, Marine Ecosystems, and Biodiversity Conservation

This syllabus is representative of a typical semester. Because courses develop and change over time to take advantage of unique learning opportunities, actual course content varies from term to term.

Course Description
This course focuses on understanding the principle marine and terrestrial ecosystems of Panama. Through a comparative approach, students learn about the dynamics and attributes of distinct yet interdependent tropical ecosystems. The course visits and conducts field exercises in cloud forests, lowland wet forest, coral reefs, seagrass beds, and coastal mangroves. Course curriculum is imparted through lectures, readings, and extensive field study.

Learning Outcomes
By the end of the course, students will have had the opportunity to develop:

- The ability to discuss in-depth the similarities and differences among the principle tropical ecosystems, including major flora, fauna, and biophysical processes.
- The capacity to think critically about ecosystem processes and their dependence on other natural phenomena.
- An acute understanding of ecological concepts and drivers that shape marine and terrestrial ecosystems in the tropics.

Language of Instruction
This course is taught in English and students will be exposed to Spanish vocabulary related to course content through in-country lectures and field visits.

Instructional Methods
SIT's teaching and learning philosophy is grounded in the experiential learning theory developed by Kolb (1984; 2015) and informed by various scholars, such as Dewey, Piaget, Lewin, among others. Experiential learning theory recognizes that learning is an active process that is not confined to the formal curriculum; "knowledge is created through the transformation of experience" (Kolb, 2015, p. 49). Learning involves both content and process. Learning is holistic and happens through various life experiences upon which students draw to generate new ways of knowing and being. Learning involves a community and is a lifelong endeavor. Learning is transformational. The suggested four step-cycle of a *concrete experience*, *reflective observation*, *abstract conceptualization*, and *active experimentation* embedded in the experiential learning model is not linear and might not always happen in that specific order, as any learning is highly context dependent. These stages of taking part in a shared experience;

reflecting on that experience by describing and interpreting it; challenging their own assumptions and beliefs to generate new knowledge; and ultimately applying new knowledge, awareness, skills, and attitudes in a variety of situations and contexts are important for students to engage in to become empowered lifelong learners.

Evaluation and Grading Criteria

Final assessment:

Tropical Forests - Module I	18%
Birds - Module II	15%
Corals - Module III	18%
Mangroves and Seagrasses - Module IV	17%
Mammals – Module V	17%
Amphibians - Module VI	15%

Grading Scale

94-100%	A	Excellent
90-93%	A-	
87-89%	B+	
84-86%	B	Above Average
80-83%	B-	
77-79%	C+	
74-76%	C	Average
70-73%	C-	
67-69%	D+	
64-66%	D	Below Average
< 64	F	Fail

Expectations and Policies

Please…

- Come prepared. Be on time, have your readings completed and ideas in mind for discussion or clarification.
- Complete assignments on schedule. This will help you keep up with your coursework and ensure you don't fall behind.
- Ask questions in class. Engage the lecturer. The speakers and professors you will meet are leaders in their fields in Panama. Take advantage of the opportunity.
- Comply with academic integrity policies (no plagiarism or cheating, nothing unethical).
- Respect differences of opinion (classmates', lecturers, local constituents engaged with on the visits). You are not expected to agree with everything you hear, but you are expected to listen across difference and consider other perspectives with respect.
- Consider your place and position in all dimensions. Demonstrate culturally appropriate behavior and expression always.

SIT Policies and Resources

Please refer to the SIT Study Abroad Handbook and the Policies section of the SIT website for all academic and student affairs policies. Students are accountable for complying with all published policies. Of particular relevance to this course are the policies regarding: academic integrity, Family Educational Rights and Privacy Act (FERPA), research and ethics in field study

and internships, late assignments, academic status, academic appeals, diversity and disability, sexual harassment and misconduct, and the student code of conduct.

Please refer to the SIT Study Abroad Handbook and SIT website for information on important resources and services provided through our central administration in Vermont, such as Library resources and research support, Disability Services, Counseling Services, Title IX information, and Equity, Diversity, and Inclusion resources.

Course Schedule

**Please be aware that topics and excursions may vary to take advantage of any emerging events, to accommodate changes in our lecturers' availability, and to respect any changes that would affect student safety. Students will be notified if this occurs.*

Module 1: Introduction to Tropical Forests and Forest Structure

Module 1 explores the principles of tropical forests and forest structure.

- Taught by Dr. Eric Manzané, Smithsonian Tropical Research Institute
- Site: El Cope National Park, Coclé

Module I Objectives

The objectives of this module include teaching students to:

a. Recognize the role biophysical factors play in driving biodiversity, abundance, and structure in tropical ecosystems.
b. Understand how tropical ecosystems function from an ecological and evolutionary perspective.
c. Comprehend general concepts of forest structure
d. Grasp tropical forest dynamics, including disturbance, succession and other processes
e. Calculate, use, and compare distinct biodiversity indices

Module I Readings

a. Kricher, J. (2011). Biogeography and evolution in the Tropics. In: *Tropical ecology*. Princeton University Press. 38-78 pp.
b. Kricher, J. (2011). Inside tropical rain forests: biodiversity. In: *Tropical ecology*. Princeton University Press. 109-153 pp.
c. Kricher, J. (2011). Inside tropical rain forests: structure. In: *Tropical ecology*. Princeton University Press. 79-108 pp.

Optional further reading:

a. Comita, L. S., Queenborough, S. A., Murphy, S. J., Eck, J. L., Xu, K., Krishnadas, M., ... & Zhu, Y. (2014). Testing predictions of the Janzen–Connell hypothesis: a meta-analysis of experimental evidence for distance-and density-dependent seed and seedling survival. *Journal of Ecology*,*102*(4), 845-856.
b. Violle, Cyrille, et al. "Let the concept of trait be functional!." *Oikos* 116.5 (2007): 882-892.
c. Mosley J et al. 2011 How to collect, press, and mount plants. Montguide, Montana State University Extension Service.

d. Lavorel, S., & Garnier, E. (2002). Predicting changes in community composition and ecosystem functioning from plant traits: revisiting the Holy Grail. *Functional ecology*, *16*(5), 545-556.
e. Student Handout 1A

Module I Evaluation

a. Oral presentations 50%
b. Quiz 30%
c. Field work and participation 20%

Module II: Seagrass and Mangrove Ecology

In the seagrass and mangrove ecology module, students will examine mangrove and seagrass bed diversity, production, phenology, and structure in the Caribbean. Module V also takes place in the Guna Yala Comarca.

- Taught by Professor Gabriel Jacome
- Site: Boca del Drago, Bocas del Toro

Module II Objectives

The learning objectives for this module include introducing students to:

a. Mangrove ecosystems and dynamics
b. Role of mangroves as nurseries of marine life
c. Key role of seagrass beds in marine ecosystem interdependency
d. Biodiversity in seagrass beds

Module II Readings

Please read the following articles prior to attending the module:

- Lopez Calderon et al. 2013 Decadal increase in seagrass biomass and temperature at the CARICOMP site in Bocas del Toro, Panama. International Journal of Tropical Biology 61(4): 1815-1826.
- Donato, D. C., Kauffman, J. B., Murdiyarso, D., Kurnianto, S., Stidham, M., & Kanninen, M. (2011). Mangroves among the most carbon-rich forests in the tropics. *Nature geoscience*, *4*(5), 293-297.
- Cheng A 2016 Benthic algae and diatom communities in seagrass meadows under three different human impact regimes in Bocas del Toro, Panamá. SIT Digital Collection.

Optional further reading:

- van Tussoenbroek et al. 2014 Caribbean-wide long-term study of seagrass beds reveals local variations, shifts in community structure and occasional collapse. PLoS ONE 9(3): e90600.
- Orth RH et al. 2006 A global crisis for seagrass ecosystems. BioScience 56(12): 987-996.

Module II Evaluation

a. Oral presentations 40%
b. Quiz 40%
c. Field work and participation 20%

Module III: Birds of the Neotropics

In Module III, students engage in field study of the birds of the lowland wet forests where the Pacific and the Caribbean meet and Central and South America come together. The convergence of so many life zones and ecological conditions makes this an ideal site to study Neotropical birds and bird diversity.

- Taught by Professor Chelina Batista, Universidad de Barcelona
- Site: Soberanía National Park, Gamboa

Module III Objectives

The learning objectives for Module III include introducing students to:

a. Avian diversity of Panama
b. Bird ecology in the Neotropics
c. Avian migration in the Western Hemisphere

Module III Readings

Please read the following articles prior to the beginning of the module:

- Robinson WD et al. 2000 Forest bird community structure in central Panama: Influence of spatial scale and biogeography: Ecological Monographs 70(2): 209-235.
- Robinson WD 2001Changes in abundance of birds in a Neotropical forest fragment over 25 years: a review. Animal Biodiversity and Conservation 24(2): 51-65.
- Bael, SA et al. 2013 Bird communities in forested and human-modified landscapes of Central Panama: a baseline survey for a native species reforestation treatment. International Journal of Biodiversity Science, Ecosystem Services & Management, 9(4), 281-289.

Module III Evaluation

a. Oral presentation 25%
b. Participation in the field 50%
c. Quiz 25%

Module IV: Introduction to Coral Reef Ecology

Module IV takes place in the Guna Yala Comarca, an autonomous indigenous reserve on the Caribbean coast. Students spend twelve days on a small island called Porvenir learning about tropical marine ecosystems.

- Taught by Dr. Juan Maté, Smithsonian Tropical Research Institute
- Site: Porvenir Island, Guna Yala

Module IV Learning Objectives

Learning objectives for Module IV include introducing students to:

a. Caribbean coral reef biology and ecology
b. Identification of marine organisms and their classification

Module IV Readings

Please read the following articles prior to attending the module:

- Clifton et al. 1997 A field guide to the reefs of Caribbean Panama with an emphasis on Western San Blas. Proc. 8th Int. Coral Reef Sym 1:167-184.
- S Andrefouet and H Guzman 2005 Coral reef distribution, status, and geomorphology-biodiversity relationship in Kuna Yala (San Blas) archipelago, Caribbean Panama. Coral Reefs 24:31-42.

- Guzmán, H. M., Guevara, C., & Castillo, A. (2003). Natural disturbances and mining of Panamanian coral reefs by indigenous people. *Conservation Biology*, *17*(5), 1396-1401.
- Lessios, H. A. (2005). *Diadema antillarum* populations in Panama twenty years following mass mortality. *Coral Reefs*, *24*(1), 125-127.
- Wilson, D. T. (2001). Patterns of replenishment of coral-reef fishes in the nearshore waters of the San Blas Archipelago, Caribbean Panama. *Marine Biology*, *139*(4), 735-753.

Module IV Evaluation

a. Analysis and presentation of data during daily reports 40%
b. Quiz 50%
c. Active class and field participation 10%

Module V: Mammals of the Neotropics

In the forest of the Cordillera Central in the Nusagandi mountain range of the Mesoamerican Biological Corridor, students study mammals of the Neotropics.

- Taught by Instructor Melva Olmos, Panthera
- Site: Nusagandi Mountain Range, Mesoamerican Biological Corridor

Module V Objectives

The learning objectives for module VI include introducing students to:

a. Common families and species of the mammals of the Neotropics
b. Ecology of local fauna in Panama and Central America

Module V Readings

- Maffei L et al. 2010 Abundance/Density case study: Jaguars in the Americas. In: O'Connell, A. F., Nichols, J. D., & Karanth, K. U. (Eds.). *Camera traps in animal ecology: methods and analyses*. Springer Science & Business Media.
- Elbroch, L. M., Hoogesteijn, R., & Quigley, H. (2016). Cougars (*Puma concolor*) Killed by North American Porcupines (*Erethizon dorsatum*). *The Canadian Field-Naturalist*, *130*(1), 53-55.
- Khorozyan, I., Ghoddousi, A., Soofi, M., & Waltert, M. (2015). Big cats kill more livestock when wild prey reaches a minimum threshold. *Biological Conservation*, *192*, 268-275.
- Moreno et al. (2015) Causes of jaguar killing in Panama – a long term survey using interviews. IUCN Newsletter CatNews, 40-43.

Module V Evaluation

a. Oral presentations 40%
b. Quiz 50%
c. Collaboration in the field 10%

Module VI: Amphibians of the Neotropics

At the foot of the El Gaital National Monument protected area, in the cloud forest of the extinct El Valle volcanic crater, students will study amphibians of the Neotropics.

- Taught by Instructor Edgardo Griffith, EVACC Foundation
- Site: El Valle, Coclé

Module VI Objectives

The learning objectives for module VII include introducing students to:

a. Common families and species of Neotropical amphibians
b. Introduction to amphibian ecology
c. Threats to Neotropical amphibians

Module VI Readings

- Kolbert, E. (2014). *The sixth extinction: An unnatural history*. A&C Black. Chapter 1, 4-22.
- Professor Griffith will distribute additional readings.

Module VI Evaluation

a. Quiz 55%
b. Collaboration in the field 35%
c. In-class participation 10%