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Comparative Tropical Ecology

ENVI-3005 (3 Credits)

Ecuador: Comparative Ecology and 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 semester to semester.

Course Description
The Comparative Tropical Ecology seminar focuses on the ecological and biological dynamics of Ecuador's ecosystems, emphasizing the most relevant biotic and abiotic elements in each environment. The course covers ecological interactions, biodiversity, bio-indicator organisms, evolutionary processes, and use of biodiversity indexes. The roles and adaptations of the major biological organisms such as plants, insects, birds, and mammals of Ecuador are also examined. Comparative analyses are made among a diversity of ecosystems and locations, including cloud forest, sub-alpine Páramo, Cloud Forest, the Amazon tropical rainforest, and the Galápagos Islands.

Learning outcomes
By the end of the course students will be able to:

- Describe the prominent features of the ecosystems studied, including soils, plants, and animals, and their interactions and dynamics
- Classify the most significant group species (including bio-indicator key species, umbrella species, and endemic species) in Ecuador, particularly in terms of plants, insects, birds and mammals
- Articulate the relevance of Ecuadorian ecosystems and their biological importance
- Discuss the importance of key bio-indicator organisms, biodiversity indexes, population structure studies, and other biological analyses
- Identify the most important evolutionary features shown by co-evolutionary biological groups, such as plants and insects

Language of Instruction
The academic content of this course is taught in both Spanish and English; all orientation and logistical issues are provided in English.

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: Ecuador's General Ecology, Páramo and Interandean Valleys

This module describes the most important ecosystems of Ecuador, and the ecosystem diversity leading to the fact that Ecuador is the country with higher concentration of biological diversity and species per space unit. In this module will be studied the páramo and interandean valleys, including the most interesting adaptations and strategies to survive in extreme environments. The analysis of these ecosystems includes their main ecological dynamics and historical events influencing Ecuador's ecological realm. Field activities and practices are developed in the páramo, as well as the introduction to the main biological indicators used during the whole program, such as plants, birds, insects and mammals.

Sessions:

- Biodiversity & Ecosystems of Ecuador: Ecuador as the highest country for concentration of species in the world considering a unit of space. Introduction to the most important ecosystems in Ecuador and their main biotic and abiotic characteristics
- Introduction to Paramo Ecology & Interandean Valleys: Field study of the main ecological characteristics of paramos and interandean valleys in Ecuador; biotic and abiotic components; important flora and fauna species; important biological/ecological adaptations to high altitude (provided in several sub-sessions during the paramo excursion)
- Mammals of Ecuadorian Paramos: Introduction to the main Mammal species in Paramo and their biological adaptations; Camelids (Lama, Alpaca, Vicuña), Andean Fox, Andean Deer, etc. (Andean Bear will be treated in Cloud Forest).
- Ornithology Field Studies in Paramo: Field Analysis of Water Birds, Main Systematics, and Applications (provided in several sub-sessions during the paramo excursion)
- Botany Field Studies in Paramo: Field Botany, Main Systematics, Field Analysis, Main Adaptation to High Altitude, and Applications (provided in several sub-sessions during the paramo excursion)
- Geology & Meteorology: Main geological components of the Andes, especially the Chimborazo Volcano region; Geological Origins (subduction and volcanism); Important rocks and abiotic elements; main weather and meteorological conditions in the interandean valleys and paramos

Instructors and Field Instructors: Xavier Silva Ph.D, Javier Robayo, Diana Serrano, Tatiana Santander, Olmedo Cayambe (Chimborazo community member) and several Chimborazo Community Members and Certified Guides

Readings & Field References:

- Silva, Xavier (2016). Ecosistemas del Ecuador. Descripción de los ecosistemas más importantes del Ecuador. *Texto inédito*
- Robayo, Javier (2016). Botánica del Ecuador. Descripción de las familias botánicas más importantes del Ecuador. *Texto inédito*

- Gentry, Alwyn H. (1996). A Field Guide to the Families and Genera of Woody Plants of Northwest South America. *University of Chicago Press*
- Tirira, Diego (2017). Mamíferos del Ecuador. Guía de campo. Prólogo de E. O. Wilson. *Ediciones Murciélago Blanco*
- Ridgely R. and P. Greenfield (2001). Birds of Ecuador, Identification Field Guide. *Ithaca, New York: Cornell University Press*

Assignments during Paramo excursion:

Conduct Paramo Section of Field Notebook
Methods Work/Exam

Module 2: Cloud Forest
This module includes the study of the main ecological, biological and evolutionary issues of Ecuadorian Cloud Forests. The analysis of these ecosystems includes their main ecological dynamics and historical events influencing Ecuador's ecological realm. Field activities and practices are developed in the cloud forest, as well as the introduction to the main biological indicators used during the whole program, such as plants, birds, insects and mammals.

Sessions:

- Cloud Forest General Information: Orientation to the Cloud Forest Educational Excursion; Geological Origin; Biological Adaptations; Ecological Structure; Botanical Composition; and Ecological Threats
- Botany Field Studies & Plant Ecology in Cloud Forest: Main adaptations; Vegetal Structures; Systematics; Epiphytism in the Cloud Forest, especial adaptations and ecological importance, activity and experiments (provided in several sub-sessions along the Cloud Forest Excursion)
- Forestry: Main forestry elements of the cloud forests in Ecuador; Importance of forestry studies; Forestry Analysis & Measurements (provided in several sub-sessions along the Cloud Forest Excursion)
- Ornithology Field Studies in Cloud Forest: Cloud Forest key species (provided in several sub- sessions along the Cloud Forest Excursion)
- Hummingbirds, Natural History: Especial ecological & biological features of hummingbirds; Important species (Provided in the field at Santa Lucía Cloud Forest Reserve)
- Mammals of Cloud Forest: Introduction to the main Mammal species in Cloud Forest and their biological adaptations; Andean Bear, Felines, Mountain Tapir, etc.
- Entomology Field Studies in Cloud Forest: Field Analysis, Main Systematics, Moths as Biological Indicators; Applications (provided in several sub-sessions during the Cloud Forest excursion)

Instructors and Field Instructors: Xavier Silva Ph.D, Javier Robayo, Diana Serrano, Tatiana Santander, Holger Beck (Science Director of Santa Lucía Cloud Forest Reserve Station), other Santa Lucía staff members

Readings & Field References:

- Silva, Xavier (2016). Ecosistemas del Ecuador. Descripción de los ecosistemas más importantes del Ecuador. *Texto inédito*

- Robayo, Javier (2016). Botánica del Ecuador. Descripción de las familias botánicas más importantes. *Texto inédito*
- Gentry, Alwyn H. (1996). A Field Guide to the Families and Genera of Woody Plants of Northwest South America. *University of Chicago Press*
- Ridgely R. and P. Greenfield (2001). Birds of Ecuador, Identification Field Guide. *Ithaca, New York: Cornell University Press*
- Alban, Flavia and Xavier Silva (2016). Insects of Ecuador. Description of the main Insect Orders in Ecuador. *Unpublished material*
- Silva, Xavier (2011). Ecuador's Butterfly Ecology. San Francisco de Quito University Press, *SIT Study Abroad*
- Paez-Moscoso Diego J., Juan M. Guayasamín, Mario Yanez-Munoz (2011). A new species of Andean toad (Bufonidae, Osornophryne) discovered using molecular and morphological data, with a taxonomic key for the genus. *Zoo Keys Jnl. 108: 73-97*
- Yánez-Muñoz Mario H., Eduardo Toral-Contreras, Paúl A. Meza-Ramos, Juan P. Reyes-Puig, E. Patricia Bejarano-Muñoz, Jonh J. Mueses-Cisneros and Diego Paucar (2012). New country records for five species of Pristimantis Jiménez de la Espada, 1870 from Ecuador. *Check List Journal 8 (2): 286-290*
- Tirira, Diego (2017). Mamíferos del Ecuador. Guía de campo. Prólogo de E. O. Wilson. *Ediciones Murciélago Blanco*
- Bermúdez Loor Diana K. & Juan P. Reyes Puig (2011). Dieta del tapir de montaña (Tapirus pinchaque) en tres localidades del corredor ecológico Llangantes – Sangay. *Centro de Biodiversidad IASA; Boletín Técnico 10, Serie Zoológica 7: 1-13*

Assignments during Cloud Forest excursion:

- Conduct Cloud Forest Section of Field Notebook
- Methods Work/Exam
- Conduct Cloud Forest Section of Comparative Investigation Project (CIP, see Environmental Research Methods & Ethics Course)

Module 3: Ecuador's Amazon Rainforest

This module focuses on the main ecological and biological aspects of the Ecuadorian Amazon Rainforest, including the study of the most important biotic and abiotic elements encountered in Amazonia in general.

Sessions:

- Amazon Seminar: Introduction to Amazon Ecology; Geological Origin; Amazon Soils; Hydrology; Meteorology & Weather
- Ecology, Main Ecosystems and Ecological Issues: Terra Firme; Varzea; Igapó; Moretales; Lake
- & River Ecosystems; Important biotic and abiotic elements; Resilience of the different Amazon habitats and succession
- Botany & Plant Ecology Field Studies in Amazon: Forest Strata, Lianas, Medicinal & Useful Plants, Systematics; Pollination, Herbivory and Seed Dispersal in Amazon (provided in several sub-sessions during the Amazon excursion)
- Forestry: Main forestry elements; Forest Structure; Importance of forestry studies; Forestry Analysis & Measurements (provided in several sub-sessions during the Amazon Excursion)
- Ornithology Field Studies in Amazon: Field Analysis, Main Systematics, and Applications (provided in several sub-sessions during the Amazon excursion)

- Entomology Field Studies in Amazon: Field Analysis, Main Systematics, Applications (provided in several sub-sessions during the Amazon excursion)
- The Great American Interchange: Paleontology, Mammal species interchange between North and South America (lecture during Amazon Excursion)
- Mammal Field Studies in Amazon: Especially Primates and Chiroptera; Field investigation and main characteristics (provided in several sub-sessions during the Amazon excursion)
- Fish Field Studies in Amazon: Analysis of the most important fish species in the Ecuadorian Amazon Basin (weather and other conditions permitting)

Instructors & Field Instructors: Héctor Vargas (Certified Naturalist Amazon Guide), Xavier Silva Ph.D, Javier Robayo, Diana Serrano, Tatiana Santander, plus other local Community Members

Readings & Field References:

- Robayo, Javier (2016). Botánica del Ecuador. Descripción de las familias botánicas más importantes. *Texto inédito*
- Gentry, Alwyn H. (1996). A Field Guide to the Families and Genera of Woody Plants of Northwest South America. *University of Chicago Press*
- Ridgely R. and P. Greenfield (2001). Birds of Ecuador, Identification Field Guide. *Ithaca, New York: Cornell University Press*
- Alban, Flavia and Xavier Silva (2016). Insects of Ecuador. Description of the main Insect Orders in Ecuador. *Unpublished material*
- Silva, Xavier (2011). Ecuador's Butterfly Ecology. *San Francisco de Quito University Press, SIT Study Abroad*
- Tirira, Diego (2017). Mamíferos del Ecuador. Guía de campo. Prólogo de E. O. Wilson. *Ediciones Murciélago Blanco*

Assignments during Amazon excursion:

- Conduct Amazon Section of Field Notebook
- Methods Work/Exam
- Conduct Amazon Section of Comparative Investigation Project (CIP, see Environmental Research Methods & Ethics Course)

Module 4: Galapagos
The Galapagos module provides an introduction to the study of geology, oceanography, biology and land ecosystems of the archipelago. The most important evolutionary features of the Galapagos are analyzed.

Sessions:

- Galapagos Seminar & Galapagos General Information: Introduction to Galapagos Ecology; and Ecological Issues (The workshop includes a lecture, then group analysis in working groups, and a plenary session)
- Geology and Geological Origin: Different types of geological elements and their importance in the fauna/flora evolution in the islands; Shield Volcanos; Different types of lava

- Oceanography of the Galapagos: Main oceanography conditions in the Galapagos Archipelago; Temperature influence; Isoclines; Salinity; Up-Wellings and other important elements
- Main Land Ecosystems & Life Zones: Lower (dry), Intermediate, and High (humid) Ecological Life Zones; Importance and interactions with local fauna & flora
- Evolution & Endemism: Study of the main evolutionary factors in the Galapagos Archipelago; Endemism and the most important endemic species
- Introduced species and their influence in the land and aquatic ecosystems; Plants, Vertebrates, and Invertebrates
- Botany Field Studies in Galapagos: Native, Endemic, and Introduced Species; Tropical Dry Forest Plants and Adaptations (provided in several sub-sessions during the Galapagos excursion)
- Ornithology Field Studies in Galapagos: Native, Endemic, Introduced Species, and Evolutionary Adaptations (provided in several sub-sessions during the Galapagos excursion)
- Reef Fish and Other Marine Life in Galapagos: Study of marine ecosystems through snorkeling activities (provided in several sub-sessions during the Galapagos excursion)

Instructors: Lenin Villacis (Certified Naturalist Galapagos Guide), Xavier Silva Ph.D, Javier Robayo, Diana Serrano

Readings & Field References:

- Humann, Paul and Ned Deloach (2003). Reef Fish Identification: Galápagos. *Jacksonville, FL: New World Publications, Inc.*
- Fitter, Julian, Daniel Fitter, and David Hosking (2001). Wildlife of the Galapagos. *Harper Collins: London*
- Hickman, Jr., Cleveland P (1998). A Field Guide to Sea Stars and other Echinoderms of Galapagos. *Sugar Spring Press: Lexington*
- Hickman, Jr., Cleveland P. and Todd L. Zimmerman (2000). A Field Guide to Crustaceans of Galapagos. *Sugar Spring Press: Lexington*
- Hickman, Jr., Cleveland P and Yves Finet (2000). A Field Guide to Marine Molluscs of Galapagos. *Sugar Spring Press: Lexington*
- Silva, Xavier (2016). Ecosistemas del Ecuador. Descripción de los ecosistemas más importantes del Ecuador. *Texto inédito*
- McMullen Conley k. (1999). Flowering Plants of the Galapagos (Field Guide). *Cornell University Press*
- Robayo, Javier (2016). Botánica del Ecuador. Descripción de las familias botánicas más importantes. *Texto inédito*
- Heinzel, Herman and Barnaby Hall (2000). Galapagos Diary. A complete guide to the archipelago's birdlife. *University of California Press*
- Silva, Xavier (2012). Galapagos Pocket Guide (Third edition). *Pentagraphic press*
- Weiner, Jonathan (1995). The Beak of the Finch. *New York: Vintage Books*
- Greehan, John, Pennsylvania State University (2001). Biogeography and evolution of the Galapagos: integration of the biological and geological evidence. *Biological Journal of the Linnean Society 74: 267–287*

Assignments during Galapagos excursion:

- Conduct Galapagos Section of Field Notebook

Evaluation and Grading Criteria

Assignments:

Ecology/Biology Article Analysis: This assignment consists of a short analysis (2 to 3 pages single space) of a science article in the fields of ecology and/or biology. Students chose one article that is related to her/his ISP potential topic. Students should provide their personal arguments and include support materials, such as citations of other science articles. The student needs to include her/his article of choice as part of the report.

Field Notebook: This assignment is composed by the ecological and biological field reports on the ecosystems visited during the semester. The Field Notebook contains ecological, biological, conservation, and sustainability observations gained on your own in the field, and includes information from a wide variety of field sources, such as field guided sessions during excursions, field activities and direct observations at hikes (see more on Assignment Expectations, Guidelines & Rubrics chapter).

Final Exam: The final examination contains questions from all lectures & field activities, plus selected required articles that will be indicated by your AD.

Participation: Evaluates student's participation during this course. Participation is based on:

- Preparation, attendance, and attitude in all lectures, discussions, activities, and excursions
- Active contribution in periodic group meetings
- Completion of written assignments
- Completion of assigned readings
- Culturally respectful behavior, flexibility, punctuality and enthusiasm

Assessment:

Ecology Article Analysis Report	25%
Field Notebook	40%
Final Exam	30%
Participation	5%

Grading Scale:

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

Program Expectations

Readings Both required and optional readings will be distributed to students during Orientation Week. Readings are organized by ecosystems: Ecuador General; Galapagos/Coast; Cloud Forest/ Páramo; and Amazon. Optional readings are designed to complement and expand upon the information provided on required readings and on the information covered by lectures, offering different points of view as well as more in-depth discussion of the topics. We recommend students to keep up with the optional readings throughout the semester. Readings should be properly cited in your assignments.

Assignments Timely completion of all assignments is expected. Late hand-ins will be penalized. All assignments are evaluated according to organization, analytical quality, depth of understanding, argumentation, and presentation of evidence.

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.