

## [PRINCETON TROPICAL ECOLOGY COURSE \(EEB338\)](#)

### **“The diversity of tropical rainforests: beta diversity and vertical stratification”**

**February 2-22, 2009**

#### Short description

An intensive, three-week field course based at three main sites in Panama which examines the origins, maintenance and major interactions among terrestrial biota in tropical rainforests. The course will involve extensive travel and completion of research projects in the field.

#### Description

“Tropical Ecology” is an intensive, three-week field course based at three main sites in Panama which examines the origins, maintenance and major interactions among terrestrial plants and animals. The course provides the opportunity to appreciate (1) the floral and faunal turnover among three rainforest sites (beta-diversity); and (2) the floral and faunal turnover along vertical gradients, from ground to upper canopy, at two rainforest sites (vertical stratification). Participants carry out group and individual projects at the following sites, of different rainfall:

- lowland semi-deciduous forest (1,850 mm rainfall): Parque Natural Metropolitano (PNM)  
[http://striweb.si.edu/esp//physical\\_monitoring/descrip\\_pnm.htm](http://striweb.si.edu/esp//physical_monitoring/descrip_pnm.htm);
- lowland wet evergreen forest (2,131 mm rainfall): Pipeline Road, Gamboa (PRD)  
[www.icbgpanama.org/website/soberania.htm](http://www.icbgpanama.org/website/soberania.htm);
- lowland wet evergreen forest (3,152 mm rainfall): Ft Sherman in San Lorenzo (FTS)  
[http://striweb.si.edu/esp//physical\\_monitoring/descrip\\_fts.htm](http://striweb.si.edu/esp//physical_monitoring/descrip_fts.htm);

Fieldwork is supported by six orientation walks, which introduce participants to common orders and families of plants and arthropods.

The course proper consists of 14 lectures and informal group discussions, the latter facilitated by the book “An Introduction to Tropical Rain Forests” by T.C. Whitmore (1998, Oxford University Press) and additional scientific articles. The course examines the characteristics of tropical rainforests as compared to temperate forests, with examples drawn specifically from the Neotropics and Panama. The roles of contemporary and historical factors in shaping various tropical landscapes are discussed, with particular emphasis given to the formation of the Isthmian Land Bridge and subsequent floral and faunal interchange. The maintenance of local biodiversity (plant and animals, particularly arthropods) is discussed with regard to the important factors of seasonality, altitudinal gradients and vertical stratification within tropical forests. The influence of the latter is explored in the field with the help of the canopy crane system managed by STRI, which offer safe access to the upper canopy ([www.stri.org/cranes](http://www.stri.org/cranes)). The role of biotic interactions is examined with specific reference to the important forest processes of herbivory, pollination, seed dispersal and decomposition. The future and conservation of tropical rainforests represent the closing theme of this series of lectures and informal discussions.

Students are asked to carry out individual research projects in the field, which may however be collaborative. Orientation lectures, informal walks in the field and further group discussions help them

to choose such projects, and report on them with scientific standards. Research projects aiming at testing particular hypotheses with basic statistics are suggested by the course professor, but students are encouraged to propose their own projects. Students report on research projects in Word following standard publication guidelines and deliver informal PowerPoint presentations before the class.

## **Logistics**

The course is based at the school house in Gamboa where phone and email communication is possible, especially during evening hours ([www.stri.org/english/research/facilities/terrestrial/gamboa/index.php](http://www.stri.org/english/research/facilities/terrestrial/gamboa/index.php)). From Gamboa, the participants travel daily to the sites of Pipeline Road and Parque Natural Metropolitano. One trip of three days is planned to the Ft Sherman Canopy Crane in the San Lorenzo forest, with accommodation at the nearby Centro “El Tucan” in Achioté, run by the Panamanian NGO CEASPA (Centro de Estudios y Acción Social Panameño, [www.sanlorenzo.org.pa](http://www.sanlorenzo.org.pa)). There is radio contact with the station of Ft Sherman at all times. Other day excursions are planned to Altos de Campana National Park (montane rainforest) and Galeta laboratories (mangrove ecology).

## **Grading**

Grading is based on performance in the field (25%), quality of written project reports (50%), and quality of oral presentations (25%).

## **Course Professor**

Dr Yves Basset, STRI. Ph +507 212 8233 (w), +507 264 9529 (h), email [bassety@si.edu](mailto:bassety@si.edu), web pages:  
<http://striweb.si.edu/basset/>  
[www.naturalsciences.be/cb/ants/projects/ibisca\\_main.htm](http://www.naturalsciences.be/cb/ants/projects/ibisca_main.htm)  
[www.entu.cas.cz/png/parataxoweb.htm](http://www.entu.cas.cz/png/parataxoweb.htm)

## **Teaching assistant - Panama**

Angie Estrada, email [angiestrada@gmail.com](mailto:angiestrada@gmail.com) , cell 6 742 0966

## **Confirmed guest lecturers (13 lectures in total)**

Carlos Jaramillo (STRI, geological history of Panama)  
Héctor Barrios (University of Panama, biodiversity)  
Bill Laurance (STRI, rainforest conservation)  
David Roubik (STRI, pollination systems)  
Lider Sucre (Biodiversity Museum, nature conservation)  
Catherine Potvin (McGill University, carbon sequestration)  
Joe Wright (STRI, forest ecology)

**Guest for orientation walks:** Héctor Barrios.

## Required reading (please read this material before attending the course)

### *Book (1)*

Whitmore, T.C. 1998. An Introduction to Tropical Rain Forests. 2<sup>nd</sup> edition. Oxford University Press.

### *Articles (5)*

#### **Local Factors**

Janzen, D.H. 1970. Herbivores and the number of tree species in tropical forests. *The American Naturalist*, **104**, 501-528.

#### **Biodiversity**

Erwin, T.L. 1982. Tropical forests: their richness in Coleoptera and other arthropod species. *The Coleopterists Bulletin*, **36**, 74-75.

Leigh, E.G.Jr., Davidar, P., Dick, C.W., Puyravaud, J.-P., Terborgh, J., ter Steege, H. & Wright, S.J. 2004. Why do some tropical forests have so many species of trees? *Biotropica*, **36**, 447-473.

#### **Conservation**

Ferraz, G., Russell, G.J., Stouffer, P.C., Bierregaard, R.O. Jr., Pimm, S.L. & Lovejoy, T.E. 2003. Rates of species loss from Amazonian forest fragments. *Proceedings of the National Academy of Sciences of the United States of America*, **100**, 14069-14073.

Terborgh, J. 1992. Maintenance of diversity in tropical forests. *Biotropica* **24**, 283-292.

## Suggested reading

Chazdon, R.L. & Whitmore, T.C. (eds) 2002. Foundations of Tropical Forest Biology: Classic Papers with Commentaries. University of Chicago Press, Chicago.

Coley, P.D. 1980. Effects of leaf age and plant life history patterns on herbivory. *Nature*, **284**, 545-546.

Connell, J.H. 1978. Diversity in tropical rain forests and coral reefs. *Science*, **199**, 1302-1310.

Kricher, J. 1997. A Neotropical Companion. An introduction to the animals, plants & ecosystems of the new world tropics. Princeton University Press.

Leigh EG, Jr. 1999. Tropical Forest Ecology. A View from Barro Colorado Island. Oxford University Press, New York.

Lowman, M.D. & Rinker, H.B. (eds) 2004. Forest Canopies. 2nd edition. Elsevier Academic Press.

Richards, P.W. 1998. The Tropical Rainforest. 2nd edition. Cambridge University Press.

Myers, N. 1988. Tropical forests: much more than stocks of wood. *Journal of Tropical Ecology*, **4**, 209-221.

Terborgh, J. 1986. Keystone plant resources in the tropical forest. In Conservation Biology. The Science of Scarcity and Diversity:(ed M.E. Soulé) pp. 330-344, Sinauer, Sunderland.

## **Course material**

Pdf files of scientific articles (required reading) and all Power point presentations by the course professor will be provided. Complimentary copy of the booklet “The International Canopy Crane Network” will also be available.

## **Lectures**

1. Aims of the course and introduction of the participants (Basset)
2. What is special about tropical rainforests (Basset)
3. How to carry out a research project and some examples (Basset)
4. The minimum to know about stats and introduction to JMP 8.0 (Basset)
5. A brief geological history of Neotropical rainforests (Jaramillo)
6. Emerging threats and research challenges in the tropics (Laurance)
7. Biomuseo's story: how Panama changed the world, 3 million years ago (Sucre)
8. Seasonal, altitudinal and vertical gradients in tropical rainforests (Basset)
9. The consequences of hunting pressure in the tropics (Wright)
10. Plant, animals and their interactions with regard to forest processes (Basset)
11. Reducing emission from deforestation: local and international perspectives (Potvin)
12. Biodiversity in tropical rainforests (Barrios)
13. Pollination in tropical rainforests (Roubik)
14. Global Ecology: insect-plant interactions in tropical rainforests (Basset)

## **Research projects**

See pdf and ppt files (on our web pages) for a description of suggested research projects. Students need to choose their own individual projects.

**Important: students should plan research projects before attending the course.**

## **Web site**

[http://striweb.si.edu/princeton/courses/tropical\\_ecology.html](http://striweb.si.edu/princeton/courses/tropical_ecology.html)

Where you will be able to download some material for the course and get useful information, especially about research projects.

## Preliminary schedule

(Laboratory work optional during evenings; GSH = Gamboa School House; PRD = Pipeline Road, Gamboa; PNM = Parque Natural Metropolitano, near Panama City; FTS = San Lorenzo near Colon)

### **Jan. 31 and Feb. 1** (Saturday and Sunday)

Arrival and setting at GSH; rest day; breakfast, lunch and dinner at 7am, 12 noon and 6pm.

### **Feb. 2** (Monday)

#### **Welcome and introduction**

7:00am Breakfast at GSH  
8:30am Welcome by Nelida Gomez (STRI) and security matters  
10:00am Aims of the course and introduction of the participants (Basset)  
11:00am What is so special about tropical rainforests (Basset)  
12 noon Lunch GSH  
1:00pm Orientation walk in Gamboa: Pipeline Road (Barrios)  
3:00pm Optional shopping (Albrook)  
5:30pm Welcome drinks at the Gamboa Rainforest Resort  
6:30pm Dinner GSH  
7:00pm Group discussion: choice of research projects (optional)

### **Feb. 3** (Tuesday)

#### **Orientation for group and individual projects**

7:00am Breakfast GSH  
9:00am How to carry out a research project and some examples (Basset)  
10:00am Group discussion: choice of research projects  
12 noon Lunch GSH  
1:00pm Orientation walk near Gamboa: Camino de Plantacion (Barrios)  
6:00pm Dinner GSH  
7:00pm The minimum to know about stats and introduction to JMP 8.0 (Basset)  
8:00pm Group discussion: choice of research projects

### **Feb. 4** (Wednesday)

#### **Altos de Campana**

7:00am Breakfast GSH  
8:00am Transfer Altos de Campana National Park  
9:45am Orientation walk (Barrios)  
1:00pm Bag lunch in the field  
4:15pm Transfer Gamboa  
6:00pm Dinner GSH  
7:00pm A brief geological history of Neotropical rainforests (Jaramillo)  
8:00pm Group discussion: choice of research projects

### **Feb. 5** (Thursday)

#### **Choice of research projects**

7:00am Breakfast GSH  
8:00am Pilot studies in Pipeline Road  
1:00pm Bag lunch in the field  
1:30pm Pilot studies in Pipeline Road  
6:00pm Dinner GSH  
7:00pm Emerging threats and research challenges in the tropics (Laurance)  
8:00pm Group discussion: research projects

<b>Feb. 6</b> (Friday)	<b>Pipeline Road day 1</b>
7:00am	Breakfast GSH
8:00am	PRD research projects
1:00pm	Bag lunch in the field
1:30pm	PRD research projects
6:00pm	Dinner GSH
7:00pm	Biomuseo's story: how Panama changed the world, 3 million years ago (Sucre)
8:00pm	Group discussion: research projects
<b>Feb. 7</b> (Saturday)	<b>Pipeline Road day 2</b>
7:00am	Breakfast GSH
8:00am	PRD research projects
1:00pm	Bag lunch in the field
1:30pm	PRD research projects
6:00pm	Dinner GSH
7:00pm	Seasonal, altitudinal and vertical gradients in tropical rainforests (Basset)
8:00pm	Group discussion: research projects
<b>Feb. 8</b> (Sunday)	<b>Rest day</b>
7:00am	Breakfast GSH
8:00am	Optional: rest / study time / shopping in Panama City
6:00pm	Dinner GSH
<b>Feb. 9</b> (Monday)	<b>Pipeline Road day 3</b>
7:00am	Breakfast GSH
8:00am	PRD research projects
1:00pm	Bag lunch in the field
1:30pm	PRD research projects
6:00pm	Dinner GSH
7:00pm	The consequences of hunting pressure in the tropics (Wright)
8:00pm	Group discussion: research projects
<b>Feb. 10</b> (Tuesday)	<b>Mangrove ecology: visit of the Galeta laboratory</b>
7:00am	Breakfast GSH
8:00am	Transfer to Galeta laboratory, Colon
10:00am	Mangrove ecology (Marianne Ackers?)
12 noon	Lunch Galeta
1:00pm	Mangrove ecology (Marianne Ackers?)
3:00pm	Transfer to Gamboa (possibly fossil hunt)
6:00pm	Dinner GSH
7:00pm	Plant, animals and their interactions with regard to forest processes (Basset)
8:00pm	Group discussion: research projects
<b>Feb. 11</b> (Wednesday)	<b>Parque Natural Metropolitano canopy crane day 1</b>
7:00am	Breakfast GSH
8:00am	Transfer to Parque Metropolitano canopy crane; orientation walk; PNM research projects
1:00pm	Bag lunch in the field
1:30pm	PNM research projects

5:00pm Transfer Gamboa  
6:00pm Dinner GSH  
7:00pm Reducing emission from deforestation: local and international perspectives (Potvin)  
8:00pm Group discussion: research projects

**Feb. 12 (Thursday) Parque Natural Metropolitano canopy crane day 2**  
7:00am Breakfast GSH  
8:00am Transfer to Parque Metropolitano canopy crane; PNM research projects  
1:00pm Bag lunch in the field  
1:30pm PNM research projects  
5:00pm Transfer Gamboa  
6:00pm Dinner GSH  
7:00pm Biodiversity in tropical rainforests (Barrios)  
8:00pm Group discussion: research projects

**Feb. 13 (Friday) Parque Natural Metropolitano canopy crane day 3**  
7:00am Breakfast GSH  
8:00am Transfer to Parque Metropolitano canopy crane; PNM research projects  
1:00pm Bag lunch in the field  
1:30pm PNM research projects  
5:00pm Transfer Gamboa  
6:00pm Dinner GSH  
7:00pm Pollination systems in tropical rainforests (Roubik)  
8:00pm Group discussion: research projects

**Feb. 14 (Saturday) Laboratory work and study time**  
7:00am Breakfast GSH  
8:00am Laboratory work and study time  
Optional trip to STRI library (morning only)  
12 noon Lunch GSH  
1:00pm Laboratory work and study time  
6:00pm Dinner GSH  
7:00pm Global Ecology: insect-plant interactions in tropical rainforests (Basset)  
8:00pm Group discussion: research projects

**Feb. 15 (Sunday) Rest day**  
7:00am Breakfast GSH  
8:00am Optional: rest / study time / shopping in Panama City  
6:00pm Dinner GSH

**Feb. 16 (Monday) Ft Sherman canopy crane day 1**  
6:00am Breakfast GSH  
6:30am Transfer to Centro El Tucan in Achiote and settling in  
10:30am Transfer to the Ft Sherman canopy crane  
1:00pm Bag lunch in the field  
1:30pm FTS research projects  
5:00pm Transfer to Centro El Tucan  
6:00pm Dinner Centro El Tucan

<b>Feb. 17</b> (Tuesday)	<b>Ft Sherman canopy crane day 2</b>
7:00am	Breakfast at Centro El Tucan
8:00am	Transfer to the Ft Sherman canopy crane; FTS research projects
1:00pm	Bag lunch in the field
1:30pm	FTS research projects
5:00pm	Transfer to Centro El Tucan
6:00pm	Dinner Centro El Tucan
<b>Feb. 18</b> (Wednesday)	<b>Ft Sherman canopy crane day 3</b>
7:00am	Breakfast at Centro El Tucan
8:00am	Transfer to the Ft Sherman canopy crane; FTS research projects
1:00pm	Bag lunch in the field
1:30pm	FTS research projects
4:00pm	Transfer to Gamboa
7:00pm	Dinner GSH
<b>Feb. 19</b> (Thursday)	<b>Rest day</b>
7:00am	Breakfast GSH
8:00am	Optional: rest / study time / shopping in Panama City
6:00pm	Dinner GSH
<b>Feb. 20</b> (Friday)	<b>Laboratory work and study time</b>
7:00am	Breakfast GSH
8:00am	Laboratory work and study time
	Optional trip to STRI library
12 noon	Lunch GSH/Corotu Tupper restaurant
1:00pm	Laboratory work and study time
5:00pm	Optional transfer to Gamboa
6:00pm	Dinner GSH
7:00pm	Group discussion: research projects
<b>Feb. 21</b> (Saturday)	<b>Study and report preparation time</b>
7:00am	Breakfast GSH
8:00am	Study time
12 noon	Lunch GSH
1:00pm	Study time
6:00pm	Dinner GSH
<b>Feb. 22</b> (Sunday)	<b>Final exam and farewell</b>
7:00am	Breakfast GSH
8:00am	Exam: all written reports collected by Professor
8:00am	Exam: oral presentation of research projects (15 min. + 5 min. discussion)
12 noon	Lunch GSH
1:00pm	Exam: oral presentation of research projects (15 min. + 5 min. discussion)
6:00pm	Dinner GSH and Farewell