

## **FR 5142: Tropical Forest Ecology** **Course Syllabus, Spring (3 cr.)**

**Course Instructor:**

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**Office Hours:**

11:30 to 12:00 A.M., Tues and Thurs  
Office: 220F Green Hall  
(or by arrangement)

**Location and Time**

Room 326, Green Hall  
Tuesdays and Thursdays from 10:15 - 11:30 AM

**COURSE OVERVIEW:** Welcome. FR 5142 is designed to help you gain a better understanding of Tropical Forest Ecology. We will consider ecological principles related to form, function, and development of tropical forests, at individual, community, ecosystem and regional scales. Succession, productivity, biodiversity, sustainability, agroforestry, and management alternatives will be addressed, as will natural distribution of forest types and the causes, consequences and extent of deforestation.

The first part of the course primarily covers the nature of tropical forests. What are tropical forests? What makes them different than other forests? Where are they and why do global climate patterns result in their geographic distribution? What are the different kinds of tropical forests? What controls the diversity, phenology, successional processes, and fertility in tropical forests? The second part of the course begins by recognizing the major ways in which humans are modifying these forests, and studying the reasons for and patterns of forest use, deforestation, and afforestation. This part of the course addresses the ways in which economic, social and politic drivers modulate the human interaction with the tropical forest. It also addresses the implications of deforestation and forest change on diversity and sustainability of forest ecosystem values as well as of economic sustainability in these regions.

**Prerequisite:** One undergraduate ecology course at 3000 level or above.

**Course format:** Classes will typically consist of a 40 to 50 minutes lecture, interrupted frequently by questions and comments; class discussion; student presentations; and question & answer sessions. The course emphasizes the use of active learning strategies to ensure interaction among students and instructor.

**COURSE GOAL:** Increase the students' ability to evaluate, discuss and write about key issues in Tropical Ecology via readings, lectures, discussions, questions, essays and presentations.

**COURSE OBJECTIVES:** At the completion of this course, students will be able to:

- Describe the biogeography and ecology of tropical forests, including climate, forest types, soils, vegetative structure and function, and plant and animal biodiversity and their causes.
- Evaluate the role of resource availability (light, nutrients, etc.), natural disturbances (windfall gaps, fire, etc.), and biotic factors (pollinators, dispersers, herbivores, *Homo sapiens*, etc.) in shaping the dynamics of tropical forests.
- Analyze the causes, extent, and consequences of deforestation, with reference to the recovery and sustainability of both natural and managed forest systems.

## **COURSE MATERIALS: Required readings**

*An Introduction to Tropical Rain Forests*, T.C. Whitmore, Second Edition Oxford U. Press. 1998  
Available at the St Paul Campus Books Underground store ??? (≈ \$49).

*Course Packet*: available at the St Paul Campus Cope Center (\$41.70). Other readings will either be **ON RESERVE** at the Forestry Library, NRES Building, or handed out in class

**COURSE EXPECTATIONS:** Because our class activities are dependent on the readings, each student is expected to read the materials **BEFORE** the topic is discussed in class. In addition, you will be expected to participate in class via pairs or groups discussion. The lecture and the student presentations will usually focus on the same topics, but may address either the specific readings or completely different materials, depending on the comprehensiveness or importance of the readings, their difficulty, and the overall information that needs to be covered.

## **COURSE ACTIVITIES:**

**Daily questions:** Daily questions are required for the purposes of:

- Increasing the likelihood that required reading will be completed in a timely fashion
- Providing practice at critical thinking
- Providing the instructors with feedback on your level of understanding of the content
- Helping to move classroom focus to topics which students find interesting.

For each required reading, students will prepare at least one short question or comment of intellectual depth. These daily questions or comments should be 1-3 sentences in length, should include your name, date, and be handed in at the start of each class. We will address these as time permits and in addition, these will be used to varying extent in class discussions. Every chapter in Whitmore's Text and every other article should be considered as separate readings. This means you will have 1 to 3 questions or comments to turn in at each class session.

A question should indicate some depth of thought, and not just be, "why did the author want to study ABC?" A question could be something you don't understand. For example, "What is soil nitrogen mineralization and why should it vary from gaps to understory?". Alternatively, a question might be something that seems to contradict our prior knowledge. For example, "How can we reconcile these results with those of Sarah Smith who found opposite results in Borneo?". On the other hand, a question may be something that was not clarified by the paper in question. For example, in their paper, Goncalves & Wu they said that "tree diversity was greater in forests recovering after slash-and burn agriculture than in forests recovering after pasturing, because the intensity of disturbance was greater in the latter" but you might ask, "what exactly does disturbance intensity specifically affect that would in turn affect diversity of tree species"?

A positive comment could for instance indicate what you think is a novel approach made by the author; highlight an important point; make a linkage with another paper we read previously, etc.

A negative comment might indicate how and why you disagree with either the data, interpretation of data, speculation, methods, extrapolation, etc. or indicate in what way the study or analysis is limited. For example, lack of generality due to the specificity of a site, climate, etc.

Grading: Each question will be given a "check plus" for being well thought out, a "check minus" for being poorly written, a "check" if it is just O.K., and "no check" if it is missing.

## **Essays**

In order to evaluate the student's ability to synthesize the material learned in the course three take-home essays will be required. Each essay will likely involve the response to a complex question and will be **1200 to 1500 words MINIMUM**. An excellent essay will have clear organization and will be based on content use in the lecture, textbook and optional readings. It is important to cite your sources (e.g. books, articles, personal ideas, etc.). All references should be presented in a separate

page and cannot be included in the word count.

### **Exams**

There will be four mini-exams, which will approximately be 20 to 25 minutes long, and will require one paragraph to one page to answer depending on the student's ability to synthesize information. Students will choose to answer one out of three questions. A voluntary take-home final essay/exam is optional.

### **Jigsaw Exercise**

Jigsaw is a cooperative learning activity designed to promote collaborative learning, to generate multiple perspectives about the readings, and to take responsibility for sharing knowledge with other students.

Before Class: students will read the selected article from the group of readings for the particular session, and prepare a written summary of main points. Students should be prepared to share their findings with other members of class and to turn-in the written summaries.

During Class: Each student will meet with other students who have read the same article (your "expert" group) and discuss with them as to what you have identified as the author's main points. Once you have agreed on the main points, you can then discuss your own reactions to the article. Finally, each student will move into the "exchange" group, which will consist of at least one member from each of the "expert" groups. Each student will begin by presenting the author's main point(s) and then synthesize your group's reaction to the article to the other members of the "exchange" group who have not read the article.

At the end Grading: will be based on answers to one question from each individual reading (total of questions will depend on the number of groups/readings assigned). Remember that each member of an expert group is responsible to properly exchange information with other students.

### **Student Presentations/Discussions**

Presentations/discussions are designed to provide students with the opportunity to present and acquire knowledge through the exchange of information and ideas. A good presentation/discussion session will allow students to develop skills in evaluating factual evidence, articulate their ideas, and respond to their classmate's questions. Detailed instructions will be given in a separate handout.

**GRADING:** There are 100 points available in the class. In general, students who obtain at least 92 points can be assured an A, at least 82 points earns a B, 72 points earns a C, 65 to 71 points are D and less than 65 points are a failing grade. Total possible points for each activity and class effort are:

Daily questions + Jigsaws:	20
Take Home Short Essays (3):	30
Mini Exams (4):	40
Presentation/Discussion (1):	10
TOTAL:	100

The optional take home final exam will replace the mini-exam with the lowest score.

*The instructor reserves the right to change the syllabus, as the course requires. If a change is made you will be notified in class.*

## Student Presentations/Discussions

Students groups of 1 or 2 (depending of total enrollment) will make a short presentation (10 minutes) and lead a discussion (10 minutes) once or twice if class size permits, during the quarter. Discussion leadership will be evaluated based on preparation, stimulation of discussion and evidence of critical thought.

Presentations and discussions will usually focus upon the current topic or some related issue. Presenters - discussion leaders will each find **one or more papers** related to the topic/issue of the day/week and provide a brief synopsis of the objectives, methodologies, results, and meaning of the papers. Essential graphics or tables can/should be used if appropriate or helpful. Complete citations must be provided for the additional papers, which must not be from the bibliography I hand out, unless you receive permission from the instructors. There are **two main goals** for the student presentations and discussions:

**1) Provide some additional information for the class**

**2) Develop questions that will actively engage students**

Keep these two main goals in mind. Try not to get lost in tangential 20-minute descriptions of the location, techniques, data analyses, or aspects important in general but not critically important to the goals of our class. A presentation could be organized as follows:

1) Summarize the material; review the essential concepts, the methods used and the major findings.

2) Relate the major findings to the purposes of the course, and

3) Provide information and questions for the class to consider and discuss. **IMPORTANT:** Each other member of the class will be required to write down a possible question related to the presentation.

These "additional" papers may shed light about further details of the processes investigated in the "required" readings; or address the way in which these processes differ in another microenvironment or site type; or address further interactions with other abiotic or biotic factors, etc.

### **HAVE A TAKE-HOME MESSAGE IN MIND FOR YOUR PRESENTATION**

**As an aid in preparing to lead presentation/discussions, consider the following items.**

*Re: Presenting information from additional papers*

What were the stated and/or implied goals of the paper? What was the context of the study (e.g., global, or limited to a certain forest type or region)? What, if anything, was interesting and/or unique about the approach or topic? What was the research design, what sampling, or data collection methods were used? What did the authors conclude? Do you agree? What were the strengths and weaknesses of the paper?

**WHAT WAS THE MAIN POINT OR CONCLUSION OF THE PAPER?**

*Re: Leading a discussion*

Be organized, concise, and brief. Get to the point. In preparing for the discussion that you will lead, it is important to search more broadly in the literature, to locate and read a few other papers related to the topic of the current paper (either corroborative or different in results, expanding the horizons of the topic, questioning the interpretation, etc.). Be ready with overheads preferably (or to draw on board) to present this "new" information to the group. Have a concrete, specific question that you present to the class.

The most successful presentations/discussions during past courses have been those that involved the class, either by surveying their knowledge or their opinions, or by getting the class involved in role playing; simulated planning or policy-making; debating; etc. Breaking the class into small working groups usually works well also.

We will be available to help the groups plan their discussion/presentation topic and delivery strategies. In addition, two days before the presentation/discussion students are required to submit a complete plan or outline for revision and fine-tuning.

**BE CREATIVE AND INNOVATIVE- THIS IS YOUR CLASS, TOO!**

## Lecture Schedule

Week	Day	Topic	Reading
1	Tu	<b>Introduction to class topic, format, structure, and expectations.</b> Choosing topics; Pre-survey-quiz; Discussion: Generalizations about tropical ecology	
	Th	<b>Climate, biogeography and vegetation structure and function</b>	Ch 1 and 2, plus 3.1 and 3.2, in Whitmore text
2	Tu	<b>Patterns of Biodiversity (I)</b>	Chapters 4 and 9 in Whitmore text, plus
	Th	<b>JIGSAW#1 KEYSTONE SPECIES &amp; does the number of species matter?</b>	Gaston, K. J. 2000. Global patterns in biodiversity. <i>Nature</i> 405:220-227.
3	Tu	continue: <b>Jigsaw</b> and lecture on <b>Patterns of Biodiversity;</b>	3.3 and 3.4 of Chapter 3 in text, plus
	Th	<b>Seasonality and Phenology</b>	Reich, PB 1995. Phenology of tropical forests: patterns, causes and consequences. <i>Canadian J Botany</i> 73: 164-174.
4	Tu	<b>Forest dynamics: gap dynamics, disturbance and biodiversity (Biodiversity II)</b>	Hubbell, SP, RB Foster, ST O'Brien, KE Harms, et al. 1999. Light-gap disturbances, recruitment limitation, and tree diversity in a neotropical forest. <i>Science</i> 283:554-557.
	Th	Video: <b>Rainforest: the puzzle of biodiversity</b>	Vandermeer, J., I G. de la Cerda, D. Boucher, I. Perfecto, and J. Ruiz. 2000. Hurricane disturbance and tropical tree species diversity. <i>Science</i> 290(788-791).
5	Tu	<b>Soils (Paul Bloom, Soil, Water, and Climate Dept.)</b>	Lal (1987). Tropical ecology and physical edaphology. pp88-99, John Wiley and Sons, NY.
	Th	<b>Forest dynamics: microsites, seedlings, and survival</b>	Chapter 7 in text, plus Augsburger, C.K. 1984. Seedling survival among tropical tree species: Interactions of dispersal distance, light-gaps and pathogens. <i>Ecology</i> 65:1712.
6	Tu	<b>Forest dynamics: reproduction, pollinators, and dispersers</b>	Chapter 5 in text, plus Bawa, KS 1990. Plant-pollinator interactions in tropical rain forests. <i>Annual Review Ecology and Systematics</i> 21:399-422.
	Th	<b>Plant nutrition</b>  <b>MINI-EXAM 1</b>	Chapter 8 in text Ewel, JJ, Mazzarino, MJ & Berish, CW (1991) Tropical soil fertility changes under monocultures and successional communities of different structure. <i>Ecological Applications</i> 1: 289-302.
7	Tu	<b>Moisture availability and tropical forests</b>  <b>FIRST ESSAY DUE</b>	William, R. J., B. A. Myers, W. J. Muller, G. A. Duff, and D. Eamus. 1997. Leaf phenology of woody species in a north Australian tropical savanna. <i>Ecology</i> 78(8):2542-2558.
	Th	<b>Tropical woodlands and savannas I.</b>  <b>STUDENT PRESENTATION</b>	Scholes, R. J., and S. R. Archer. 1997. Tree-grass interactions in savannas. <i>Annu. Rev. Ecol. Syst.</i> 28:517-544.
8	Tu	<b>Tropical woodlands and savannas II.</b>	Williams, R. J., G. D. Cook, A. M. Gill, and P. H. R. Moore. 1999. Fire regime, fire intensity and

	Th	<b>STUDENT PRESENTATION</b> <b>(catch up) STUDENT PRESENTATION</b>	tree survival in a tropical savanna in northern...
9		<b>SPRING BREAK</b>	
10	Tu	<b>Plant-herbivore interactions</b>  <b>SECOND ESSAY QUESTION hand-out</b>	Coley, P.D. 1988. Effects of plant growth rate and leaf life on the amount and type of anti-herbivore defense. <i>Oecologia</i> . 74:531-536 Lowman, MD. 1992. Herbivory in Australian rain forests, with particular reference to the canopies of <i>Doryphora sassafras</i> (Monimiaceae). <i>Biotropica</i> 24 :263-272.
	Th	<b>The role of vines in rain forest gap dynamics (Stefan Schnitzer, guest)</b>	pp. 123-134 and 137-149, "Global biodiversity-losses and threats". In: Principles of Conservation Biology, 2nd edition, 1997, Meffe, CR. Carrol, and contributors. Sinauer Associates Inc. Press.
11	Tu	<b>Causes and extent of deforestation 1</b>  <b>STUDENT PRESENTATION</b> <b>START ON JIGSAW READINGS</b>	Chapter 10 in text, plus Hecht, SB. 1993. The logic of livestock and deforestation in Amazonia. <i>BioScience</i> 43:687-695.
	Th	<b>Causes and extent of deforestation 2</b>  <b>STUDENT PRESENTATION</b> <b>JIGSAW #2</b>	Skole D & Tucker C 1993. Tropical deforestation and habitat fragmentation in the Amazon: Satellite Data from 1978-1988. <i>Science</i> 260:1905-1909.
12	Tu	<b>Causes and extent of deforestation 3: Governance and development in Amazonia</b>  <b>MINI-EXAM</b>	<b>from WEB;</b> Laurance et al. 2001. Future of Amazon Science 291 (5503):438 Nepstad et al. 2002; Frontier governance in Amazonia Science 295:629
	Th	<b>Secondary succession: forest recovery after slash-and-burn agriculture, pasture, and timber production, part 1</b>	(review Chapter 8 in text again), plus Saldarriaga, JG & C Uhl 1991. Recovery of forest vegetation following slash-and-burn agriculture in the Upper Rio Negro. pp 303-312 In: Rain Forest Regeneration and Management, (eds. A Gomez-Pompa, TC Whitmore and M Hadley).
13	Tu	<b>George Weiblen: Fig wasps and fruit bats: pollination and dispersal in tropical forests</b> <b>SECOND ESSAY DUE</b> <b>THIRD ESSAY hand-out</b>	
	Th	<b>Secondary succession: forest recovery after slash-and-burn agriculture, pasture, and timber production, continued</b> <b>STUDENT PRESENTATION</b>	Uhl, C, R Buschbacher, and EAS Serrao. 1988. Abandoned pastures in eastern Amazonia. I. Patterns of plant succession. <i>J Ecol</i> 73:663-681.
14	Tu	<b>Secondary succession: forest recovery after slash-and-burn agriculture, pasture, and timber production, continued</b>	Curran, L. M., I. Caniago, G. D. Paoli, D. Astianti, M. Kusneti, M. Leighton, C. E. Nirarita, and H. Haeruman. 1999. Impact of El Niño and logging on canopy tree recruitment in Borneo. <i>Science</i> 286:2184-2188. Walker, B. 1995. Conserving biological diversity through ecosystem resilience. <i>Conservation Biology</i> 9(4):747-752. Hill, C. J. 1995. Linear strips of rain forest vegetation as potential dispersal corridors for rain forest insects <i>Conservation Biology</i> 9(6):1559-1566.
	Th	<b>Forest management, deforestation,</b>	Chapter 11 and epilogue ter Steege, H., R. Boot, L. Brouwer, D. Hammond,

**conservation strategies and biodiversity**

**STUDENT PRESENTATION**

15 Tu **Agroforestry & natural resource (Dean Current, CINRAM, Forest Resources)**

Th **Coffee and Conservation**

16 Tu **Community Forestry (Kristen Nelson, Forest Resources)**

**THIRD ESSAY DUE**

Th **MINI-EXAM 3**

**CLASS DEBATE?**

Does biodiversity matter to the ecology of tropical forest? Does tropical deforestation matter? Is tropical ecology any different than temperate ecology? Can we manage tropical forest by transferring experiences from MN?

- P. van der Hout, V. G. Jetten, Z. Khan, A. M. Polak, D. Raaimakers, and R. Zagt. 1995. Basic and applied research for sound rain forest management in Guyana. *Ecological Applications* 5(4):904-910.
- Case studies from Principles of Conservation Biology, 2<sup>nd</sup> edition, 1997, Meffe, CR Carroll, and contributors. Sinauer Associates Inc. Press.
- pp. 441-451 (Managing beyond borders: the Costa Rican National System of Conservation Areas).
- pp 603-608 (Sustainable tropical forestry: the Palcazú Project)
- Current, D & Scherr, S.J. 1995. Farmer costs and benefits from agroforestry and farm forestry projects in Central America and the Caribbean: implications for policy. *Agroforestry Systems*. 30:87-103.
- Rice, R.A. & Ward, Justin. R. 1996. Coffee, conservation and commerce in the western hemisphere. Smithsonian Migratory Bird Center, Natural Resources Defense Council.

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FINALS WEEK

**JIGSAW#1 Reading**

- Mills, L.S., Soule, M.E., and Doak, D.F. 1993. The keystone-species concept in ecology and conservation. *Bioscience*. 43:219-224
- Terborgh, J. 1986. Keystone plant resources in the tropical forest. In: Soule, M.E. (ed). *Conservation Biology. The science of Scarcity and diversity*. Sinauer Associates Inc, Sunderland, MA. Cap. 15 pp:330-344
- Ehrlich P.R. 1994. Biodiversity and ecosystem function: Need we Know more? In: Detlef-Schulze, E. & Mooney, H.A. (eds) *Biodiversity and ecosystem function*. Springer-Verlag. Berlin. pp:VII-XI
- Lawton, J.H. & Brown, V.K. 1994. Redundancy in Ecosystems In: Detlef-Schulze, E. & Mooney, H.A. (eds) *Biodiversity and ecosystem function*. Springer-Verlag. Berlin. Chap 12 pp: 255-270.
- Bond, W. J. 1993. "Keystone species." In: Detlef-Schulze, E. & Mooney, H.A. (eds) *Biodiversity and ecosystem function*. Springer-Verlag. Berlin: 237-253.

**Jigsaw #2 Reading:**

- WILLIAM F. LAURANCE 1,2 \*, ANA K. M. ALBERNAZ 2 AND CARLOS DA COSTA 2. Is deforestation accelerating in the Brazilian Amazon? *Environmental Conservation* 28 (4): 305-311
- PHILIP M. FEARNside\* Soybean cultivation as a threat to the environment in Brazil. *Environmental Conservation* 28 (1): 23-38
- Zarin et al. 2001. *Forest Ecology and Management* 154:383-393
- Turner et al. 2001. *Forest Ecology and Management* 154:353-370
- Nepstad et al. 2001. *Forest Ecology and Management* 154:395-407
- Nepstad et al. 1999. Large-scale impoverishment of Amazonian forests by logging and fire. *Nature* 398:505-508