

# TROPICAL ECOSYSTEMS

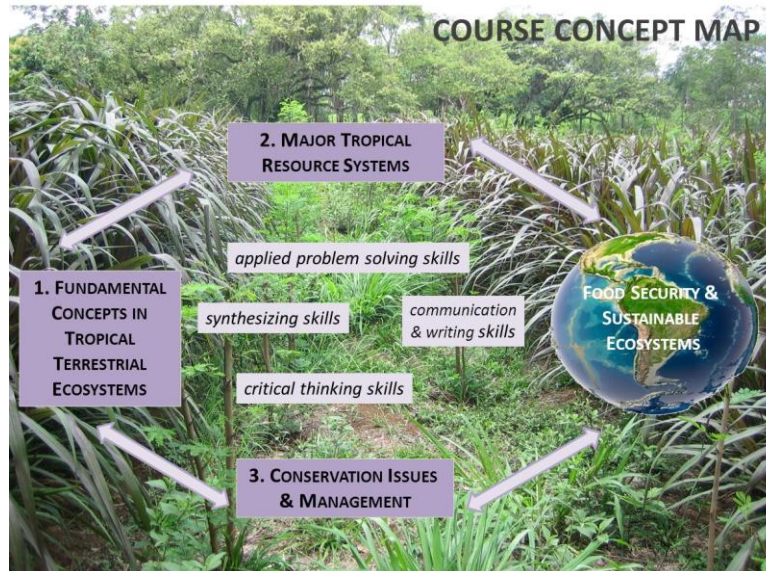
## ERS 383/ BIOL 383

### Course Outline: January 2015

"We don't need to clear the 4 to 6 percent of the Earth's surface remaining in tropical rain forests, with most of the animal and plant species living there" –E.O. Wilson

#### COURSE OVERVIEW

This course examines the fundamental concepts of terrestrial ecosystems in tropical climates. The course is divided into three major sections. The first section, *Fundamental Concepts in Tropical Terrestrial Ecosystems*, introduces tropical biomes and major tropical ecoregions. This section also includes a detailed characterization of vegetation, soils, carbon and nutrient cycling. The second section, *Major Tropical Resource Systems*, includes a detailed study of tropical forest and agroecosystems. The third section, *Conservation Issues & Management*, addresses issues of forest fragmentation and biodiversity within a framework of conservation and management. Examples using case studies will be presented. This course is available on Learn (D<sub>2</sub>L).



#### COURSE GOAL & INTENDED LEARNING OUTCOMES

##### Goal:

- To introduce the fundamental concepts of terrestrial ecosystems in the tropics, outline major tropical resource systems, and define conservation issues and their management within the framework of global change

##### Learning Outcomes:

1. Fundamental Concepts in Tropical Terrestrial Ecosystems
  - Tropical biomes: what and where are the tropics located
  - Tropical ecoregions and landforms
  - Tropical biology and ecology: characterizing vegetation, soils, and carbon and nutrient cycling
2. Major Tropical Resource Systems
  - Tropical forest ecosystems
  - Tropical agroecosystems
3. Conservation Issues & Management
  - Forest fragmentation
  - Biodiversity

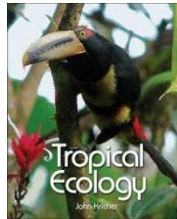
## COURSE MEETINGS TIMES & LOCATION

Lecture Times	Location
Friday from 8:30 am to 11:20 am	EV3, room 3412

## INSTRUCTIONAL TEAM

	<i>Professor</i>	<i>Teaching Assistant</i>
Name	Prof. Dr. M. Oelbermann	TBD
Contact Information	Office: EV-2, room 2008 E-mail: <a href="mailto:moelbermann@uwaterloo.ca">moelbermann@uwaterloo.ca</a> Phone: 519-888-4567 Ext. 37552	TBD
Office Hours	Monday: 11:30 am – 12:00 noon Wednesday: 9:00 am – 10:00 am Or by appointment	TBD

## REQUIRED MATERIALS



The textbook available in UW Bookstore:

Kricher, J. 2011. *Tropical Ecology*. Princeton University Press. 632 pp.

Additional (*but not required for the course*) readings to supplement the textbook will be available on Learn. These readings will be relevant to the material discussed in class; help with the assignment and provide further insight for interested students.

## COURSE ASSESSMENT

Learning Outcome	Assessment Methods (Formative & Summative)	% of overall Grade	Teaching & Learning Methods
1. Fundamental Concepts in Tropical Terrestrial Ecosystems	<ul style="list-style-type: none"> <li>• Class discussions</li> <li>• Midterm                             <ul style="list-style-type: none"> <li>▪ lectures 1 to 5</li> <li>▪ held in class</li> </ul> </li> </ul>	0 30	<ul style="list-style-type: none"> <li>• Interactive lectures</li> <li>• Case studies</li> <li>• Video presentation</li> <li>• Textbook readings</li> <li>• Course website</li> <li>• PowerPoint slides</li> </ul>
2. Major Tropical Resource Systems	<ul style="list-style-type: none"> <li>• Class discussions</li> <li>• Assignment (see assignment outline)</li> </ul>	0 30	<ul style="list-style-type: none"> <li>• Interactive lectures</li> <li>• Case studies</li> </ul>
3. Conservation Issues & Management	<ul style="list-style-type: none"> <li>• Final Exam (lectures 6 to 11)</li> </ul>	40	<ul style="list-style-type: none"> <li>• Video presentation &amp; Guest Lecture</li> <li>• Textbook readings</li> <li>• Course website</li> <li>• PowerPoint slides</li> </ul>

## SUMMARIZED SCHEDULE OF COURSE ACTIVITIES

Module #	Lecture Day	Lecture #	Topic	Reading Material
<b>1. Fundamental Concepts in Tropical Terrestrial Ecosystems</b>	Jan. 9 <sup>th</sup> , 2015	1	- Introduction - Tropical biomes - Tropical ecoregions	- Chapter 1 - Chapter 3: pp. 79-82 - Chapter 11
	Jan. 16 <sup>th</sup> , 2015	2	- Tropical vegetation - DVD: <i>The Amazon</i>	- Chapter 12: pp. 446-463 - Chapter 3
	Jan. 23 <sup>rd</sup> , 2015	3	- Tropical soils	- Chapter 10: pp. 375-389
	Jan. 30 <sup>th</sup> , 2015	4	- Nutrient cycling - Carbon & climate change - DVD: <i>Panama</i>	- Chapter 10 - Chapter 9
<b>2. Major Tropical Resource Systems</b>	Feb. 6 <sup>th</sup> , 2015	5	- Forest landscapes - Forest loss	- Chapter 12 - Chapter 15
	Feb. 13 <sup>th</sup> , 2015	--	<b>- Midterm (in class)</b>	
	Feb. 26-20, '15	--	<b>- Reading week</b>	
	Feb. 27 <sup>th</sup> , 2015	6	- Rainforest development & dynamics - DVD: <i>Classic Rainforest</i>	- Chapter 6
	Mar. 6 <sup>th</sup> , 2015	7	- Forest management - DVD: <i>Odzala</i>	
	Mar. 13 <sup>th</sup> , 2015	8	- Humans & terrestrial ecosystems <b>- Assignment due</b>	- Chapter 13
	Mar. 20 <sup>th</sup> , 2015	9	- Sustainable tropical agroecosystems - DVD: <i>Tropical Agroforestry Systems</i>	- Chapter 13: pp. 491-494
	Mar. 27 <sup>th</sup> , 2015	10	- Agroecosystems & Biodiversity - Agroecosystems & climate change	
<b>3. Conservation Issues &amp; Management</b>	Mar. 27 <sup>th</sup> , 2015	11	- Forest fragmentation - Tropical biodiversity - Final exam review	- Chapter 14 - Chapter 15: pp. 530-533

# DETAILED SCHEDULE OF COURSE ACTIVITIES

## MODULE I: TROPICAL BIOMES

### LECTURE 1

#### Introduction

- Introduction to ERS 383/BIOL 383: Tropical Ecosystems
- Course syllabus
- Course expectations

#### What and Where are the Tropics (Chapter 1)

- Historical perspectives on tropical ecosystems
- Location of the tropics
- Tropical climates and seasons

#### Tropical Ecoregions (Chapter 3 pp. 79-82; Chapter 11; Chapter 12 pp. 446-463)

- Tropical rainforests (Chapter 3, pp. 79-82)
- Tropical and neotropical savannas
- Tropical dry forests
- Tropical wetlands and riverine ecosystems (Chapter 12 pp. 446-463)

## MODULE 2: TROPICAL BIOLOGY AND ECOLOGY

### LECTURE 2

#### Characteristics of Tropical Vegetation (Chapter 3)

- Stratification and stature
- Roots, trunks, bark and crowns
- Leaves
- Flowers, fruits, seeds and vegetative reproduction
- Climbers, lianas, stranglers and epiphytes
- Deciduous behavior

*DVD: The Amazon – Land of the Flooded Forest: Journey into a tropical jungle where terrestrial rains annually transform the dry forest floor into a watery world. Watch river dolphins navigate the flooded treetops and the masterful hunting techniques of the electric eel and notorious piranha (55 minutes).*

### LECTURE 3

#### Tropical Soils (Chapter 10 pp. 375-389)

- What is soil and tropical soil mineralogy
- Tropical soil chemistry, physics, biology and soil organic matter
- What are tropical soils?
- Soil formation & factors influencing soil formation
- Types of tropical soils
- Undisturbed and disturbed tropical soils
- Processes of tropical soil degradation
- The paradox of exuberant vegetation and poor soils: the case of tropical forest removal

### LECTURE 4

### **Nutrient Cycling (Chapter 10)**

- Nutrient cycling and the soil community
- Factors affecting nutrient cycling
- Rapid nutrient recycling
- Tropical soil types and nutrient cycling
- Nitrogen and phosphorus

### **Carbon and Climate Change (Chapter 9)**

- Primary and net productivity
- Carbon in pioneer and successional species
- What is a carbon sink?
- Seasonal fluxes and carbon losses
- Climate change and tropical forests

*DVD: Panama – Venture beyond the dense and green curtain, into the rainforest that thrives in splendid isolation on a Panamanian island. Marvel at the complex interactions among the exotic species that live, feed, breed and die here (50 minutes).*

## **MODULE 3: TROPICAL FOREST ECOSYSTEMS**

### **LECTURE 5**

#### **Tropical Forested Landscapes and Landforms (Chapter 12)**

- Montane and neotropical montane forests
- High elevation tropical ecosystems
- Mangroves
- Tropical dry forests

#### **The Driving Forces Behind Tropical Forest Cover Loss (Chapter 15)**

- Global forest cover: then and now
- Removal of valuable hardwood tree species
- Fuel wood and paper industries
- Grazing land and agriculture
- Subsistence farming
- The influence of governments
- The effects of deforestation: local, regional and global
- What can be done to reduce tropical forest removal

### **LECTURE 6**

#### **Rainforest Development and Dynamics (Chapter 6)**

- Secondary succession in the tropics
- Early succession in the tropics
- Effect of ENSO on second-growth rainforests
- Resilient pastures: secondary succession in Amazonia
- Disturbance impacts and regeneration pathways
- Fire as disturbance in the tropics
- When succession does not succeed
- Forest gaps and tree demographics

*DVD: Classic Rainforest – The tropical rainforests of the world are home to nearly half of the animal species on earth. More than 2500 mm of rainfall each year sustain this lush environment where some of the most fascinating examples of natural adaptation can be found. Journey to the dense rainforests of Costa Rica and watch as leaf-cutting ants carry sections of leaves many times their weight to underground fungus gardens; a basilisk lizard walks on water, and howler monkeys bark in the sun. (56 minutes).*

## **LECTURE 7**

### **Tropical Forest Management (not in textbook)**

- Historical overview of logging in the tropics
- Conventional timber harvest
- Sustainable timber harvest
- Plantation forest: good, bad or indifferent?

*DVD: Odzala – Islands in the Forest: Hidden deep inside the Republic of Congo lays Odzala National park, a dense, isolated rainforest that humans seldom visit. From forest elephants and lowland gorillas to water buffalo and cattle egrets show their coexistence around a swampy watering hole called a bai (53 minutes).*

## **MODULE 4: TROPICAL AGROECOSYSTEMS**

### **LECTURE 8**

#### **Humans as Part of Tropical Ecosystems (Chapter 13)**

- Human impact on ecology: traditional agriculture in tropical environments
- Hunting and gathering: the first human societies
- Emergence of tropical crops
- From simple beginnings: the discovery of agriculture
- Agriculture in the neotropics
- Agroforestry and hillside farming
- Ethnobotany
- Semi-commercial farming systems: tropical beverage crops
- Conventional agroecosystems: the commercialization of agriculture using plantation crops

### **LECTURE 9**

#### **Sustainable Tropical Agroecosystems: An Old Idea Made Modern (Chapter 13, pp. 491-494)**

- The principles of complex agroecosystems & examples of complex agroecosystems in the tropics
- A detailed look at agroforestry systems
- Historical perspectives on agroforestry
- Types of agroforestry systems
- Why do we need agroforestry: what are the benefits
- What is the role of multipurpose trees
- Can agroforestry stop deforestation
- Coffee and cacao agroforestry systems

*Guest Lecturer Dr. N. Thevathasan: Ghana case study using agroforestry land-use systems to enhance income and food security.*

## LECTURE 10

### Tropical Agroecosystems and Biodiversity (not in textbook)

- Ecological role of biodiversity in modern agroecosystems
- What happens if biodiversity is lost in modern agriculture?
- Biodiversity in complex agroecosystems
- Biodiversity in cacao agroecosystems: a case study from Costa Rica

### Tropical Agroecosystems and Climate Change (not in textbook)

- Potential impacts of climate change on agriculture in the tropics
- Biophysical responses to increased atmospheric greenhouse gas concentrations
- Adaptation to climate change and the limits of adaptation in the tropics
- Agroforestry as an adaptive agroecosystem: a case study from Costa Rica

## MODULE 5: CONSERVATION ISSUES IN TROPICAL ECOSYSTEMS

### LECTURE 11

#### Forest Fragmentation (Chapter 14)

- Fragmentation
- Case studies of fragmentation: effects on wildlife
- Fragmentation, edge effects and matrix suitability
- Connectivity corridors
- The meso-American biological corridor: case study

#### Biodiversity (Chapter 14) and Conservation (Chapter 15, pp. 530-533)

- Approaches to understanding biodiversity
- Dealing with potential loss of biodiversity
- Biodiversity hotspots
- Ecosystem services

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### STUDENT CONDUCT AND APPROPRIATE BEHAVIOUR

I encourage students to study together, however each student is expected to individually fulfill the requirements of the assignment, presentation, and exams. It is the responsibility of each student to be aware of what constitutes responsible behaviour in class, what constitutes plagiarism, and your rights and responsibilities with respect to these issues.

**Academic Integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [www.uwaterloo.ca/academicintegrity/](http://www.uwaterloo.ca/academicintegrity/). Students who are unsure what constitutes an academic offence are requested to visit the on-line tutorial at: <http://www.lib.uwaterloo.ca/ait/>

**Note for students with disabilities:** The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm). When in doubt, please contact your Undergraduate Advisor for details.

**Discipline:** A student is expected to know what constitutes academic integrity, to avoid committing academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, [www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm). For typical penalties, check Guidelines for Assessment of Penalties, [www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm](http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm)

**Appeals:** A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 - (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals). See: [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm)

**Consequences of Academic Offences:**

ENV students are strongly encouraged to review the material provided by the university's Academic Integrity office (see: <http://uwaterloo.ca/academicintegrity/Students/index.html>).