NREM 680: Ecosystem Ecology
Syllabus – Spring 2014
Hours: TR 9:00 a.m. – 10:15 a.m.; W 3:00 p.m – 6:00 p.m.

INSTRUCTOR

Dr. Creighton M. Litton, Associate Professor
Sherman Laboratory 240
Department of Natural Resources and Environmental Management
University of Hawai'i at Mānoa
Phone: 956-6004
Email: litton@hawaii.edu
Course website: http://www.ctahr.hawaii.edu/LittonC/teaching.html

HOURS

Lecture:	TR	9:00 a.m. – 10:15 a.m.	Sherman 111
Laboratory:	W	3:00 p.m. – 6:00 p.m.	Sherman 111
Office Hours:	T	3:00 p.m. – 4:00 p.m.	Sherman 240
	R	4:00 p.m. – 5:00 p.m. (or by appointment)	Sherman 240

PREREQUISITES

- Undergraduate, upper-division coursework in ecology and soil science
- Graduate standing
- Great attitude and willingness to learn

COURSE DESCRIPTION & OBJECTIVES

This is a 4-credit graduate level course on terrestrial ecosystem ecology (i.e., interactions between organisms & their environment as an integrated system). A range of topics will be covered focusing on the factors controlling ecosystem structure and function, with emphasis on forest ecosystems within the context of human impacts and global change. Topics will include:

- Earth's Climate System
- Geology and Soils
- Stable Isotope Ecology
- H_2O & Energy balances
- Production ecology/Carbon cycling
- Nutrient dynamics and cycling of major elements (N, P, etc.) across soil-plant- atmosphere boundaries
- Anthropogenic and natural disturbances, Succession, and Temporal and Spatial dynamics
- Global change biology (elevated CO_2, nitrogen deposition, climate change, land-use change, invasive species, etc.)

In each topical area covered, students are expected to develop an understanding of biological, ecological, and physical principles and concepts, scientific background, and quantitative skills required to understand and manage terrestrial ecosystems. Specific goals of the course are:

- To learn the basic principles and concepts of terrestrial ecosystem ecology
- To introduce current controversies and uncertainties in terrestrial ecosystem ecology
- To understand global change biology and its consequences for ecosystem processes
- To increase awareness of human dependency on ecosystem goods, services, and processes
- To increase awareness of how an understanding of ecosystem processes can be applied to the management of natural ecosystems

This course addresses the following departmental graduate student learning outcomes (SLOs):

- Students can analyze and address natural resource and environmental management problems by using appropriate methods from social and/or natural science disciplines
- Students communicate effectively, both orally and in writing, to diverse audiences including professionals, resource managers, local communities and policy makers

EXPECTATIONS

Students: Students are expected to: (*i*) complete assigned readings prior to lecture/discussion; (*ii*) arrive to class activities on time; (*iii*) be respectful of fellow students and the instructor during class and laboratory activities; (*iv*) be an active participant in class and laboratory activities; and (*v*) work respectfully and professionally with the other students in the course.

Instructor: The primary goal of the instructor is to make the course useful and, as much as possible, enjoyable. The instructor will: (*i*) be punctual, prepared, and enthusiastic for course activities; (*ii*) communicate clearly the course objectives, policies, and assignments; (*iii*) listen carefully to questions and concerns; (*iv*) grade assignments and exams fairly and return them in a timely manner; and (*v*) be available during office hours (or by appointment) to provide assistance and feedback.

COURSE STRUCTURE / APPROACH

Weekly lectures (Tues. and Thurs.) will be in an interactive format, with a weekly 'laboratory' (Wed.) that is designed to familiarize students with the peer-reviewed literature and methodology in ecosystem science via student-led discussions. Students are expected to participate actively in all aspects of the course. ***In as much, it is very important that you complete the assigned readings prior to class so that you can better participate in the lecture/discussion for that day.*** Lectures and discussions are meant to be interactive, stimulating, and informative.

LECTURES

Lectures will focus on presentation of core material and key concepts from the course textbook, with examples from the primary literature. ***Questions and discussion are encouraged and expected during lectures***. If you do not understand something, ask questions.

LABORATORIES

Weekly laboratories will focus on student-led discussions of: (*i*) peer-reviewed literature; and (*ii*) commonly used methodology in ecosystem science.

Students will lead discussions on peer-reviewed literature that supplement lecture material, and present information on methods commonly used in terrestrial ecosystem science. **ALL students are expected to read the assignment(s) prior to class and come prepared to ask questions, discuss important points, & analyze the literature critically**.

Student discussion leaders will be assigned early in the semester. It will be the responsibility of the discussion leader to: (*i*) meet with the instructor ≥3 weeks prior to the assigned date to decide upon a discussion article (to be made available ≥1 week in advance of the discussion) and methodology for presentation; (*ii*) complete additional background readings to become an "informed expert" on the topics; (*iii*) email the instructor a list of ~10-12 questions designed to stimulate discussions ≥2 weeks prior to the discussion (to be made available to the entire class ≥1 week in advance of the discussion); (*iv*) give a presentation (~45 min.) on the day of the discussion summarizing and outlining the discussion article (scientific question and approach, methods, analyses, results, and conclusions) and chosen methodology; and (*v*) come prepared to stimulate discussion and participation by their peers (i.e., a lull in discussion will be viewed as more unfavorable on the part of the discussion leader than it will his/her peers in the class). More detailed information on the requirements of being a discussion leader will be provided early in the semester.

READING ASSIGNMENTS

COURSE TEXTBOOK (REQUIRED READINGS):

Chapin III, FS., Matson, P.A., & Vitousek, P.M. 2011. *Principles of terrestrial ecosystem ecology*. 2nd ed. Springer, New York, 529 p. (available in the University Bookstore, amazon.com, etc.)

Readings from the primary literature will also be assigned for some lectures, and all discussions. These additional readings are required and will be available in print and/or digital form to be distributed in class or downloaded from the course website.

GRADING ASSIGNMENTS

Activity	Points	% of Grade
Participation*	100	20
Discussion Leader	100	20
Midterm Exam I	100	20
Midterm Exam II	100	20
Final Exam	100	20
	500	**100**

*****Participation will be based on attendance, punctuality, attitude, and, in particular, active engagement in instructor-led lectures and student-led discussions throughout the semester.

GRADING SCALE

Letter grades will be assigned on the +/- system with grades assigned as follows:

A+	$x \geq 97$	B+	$90 > x \geq 87$	C+	$80 > x \geq 77$	D+	$70 > x \geq 67$
A	$97 > x \geq 93$	B	$87 > x \geq 83$	C	$77 > x \geq 73$	D	$67 > x \geq 63$
A-	$93 > x \geq 90$	B-	$83 > x \geq 80$	C-	$73 > x \geq 70$	F	$x < 60$

POLICIES

- Attendance to all classes and laboratories is mandatory. Please be on time.
- Students are responsible for obtaining readings, lecture notes, and handouts from the instructor, classmates or course website, and for keeping track of assignments and grades.
- Makeup assignments and excused absences will be allowed for the following cases:
  1) Emergency (e.g., family emergencies): requires a copy of itinerary, etc.
  2) Illness or sickness: requires a doctor's note, plaster cast, etc.
  3) Field work for your thesis/dissertation research: communicate with instructor prior to missing class

ACADEMIC INTEGRITY

Students are expected to conduct themselves with the utmost integrity. The *University of Hawai'i at Mānoa Student Conduct Code* defines cheating and plagiarism as follows (http://studentaffairs.manoa.hawaii.edu/policies/conduct_code/):

> **CHEATING** includes, but is not limited to: (1) use of any unauthorized assistance in taking quizzes, tests, or examinations; (2) use of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; (3) the acquisition, without permission, of tests or other academic material belonging to a member of the UH faculty, staff or student; (4) engaging in any behavior specifically prohibited by a faculty member in the course syllabus or class discussion.

> **PLAGIARISM** includes, but is not limited to, the use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.

If you ever have any questions about what constitutes fair academic play, please come and talk to me. Cheating or plagiarism will result in an F for your final grade in the course. It may also lead to other serious academic repercussions beyond this course (see *University of Hawai'i at Mānoa Student Conduct Code*; http://studentaffairs.manoa.hawaii.edu/downloads/conduct_code/UHM_Student_Conduct_Code.pdf).

ACCOMMODATIONS FOR DISABILITIES:
If you feel you need reasonable accommodations because of the impact of a disability, please: (*i*) contact the KOKUA Program (http://www.hawaii.edu/kokua/) at 956-7511 or 956-7612 in room 013 of the QLCSS; and (*ii*) speak with the instructor privately to discuss your specific needs. I will be happy to work with you and the KOKUA Program to meet your access needs related to your documented disability.

FINAL CAVEAT
All material on this syllabus is subject to change at the discretion of the instructor to suit the needs of the course.

COURSE SCHEDULE – LECTURE

Week No.	Date	Lecture (TR 9:00am – 10:15am)	Reading Assignment
1	1/14 (T)	Introduction	Syllabus; Discussion Leader Guideline; Final Exam
	1/16 (R)	Ecosystem Ecology History & Concept	CMV* 3-22
2	1/21 (T)	Ecosystem Ecology History & Concept	CMV* 3-22
	1/23 (R)	Earth's Climate System	CMV 23-62
3	1/28 (T)	Earth's Climate System	CMV 23-62
	1/30 (R)	Geology & Soils	CMV 63-90
4	2/4 (T)	Geology & Soils	CMV 63-90
	2/6 (R)	Stable Isotope Ecology	Fry (2006) 21-37; West *et al.* 2006
5	2/11 (T)	Stable Isotope Ecology	Fry (2006) 21-37; West *et al.* 2006
	2/13 (R)	H_2O & Energy Balance	CMV 93-122
6	2/18 (T)	H_2O & Energy Balance	CMV 93-122
	2/20 (R)	H_2O & Energy Balance	*TBA*
7	2/25 (T)	*- Catch up day -*	
	2/27 (R)	**Midterm Exam I**	
8	3/4 (T)	Carbon Cycling - Inputs	CMV 123-156
	3/6 (R)	Carbon Cycling - Respiration Processes	CMV 157-161
9	3/11 (T)	Carbon Cycling - Production Processes	CMV 161-162; 168-181
	3/13 (R)	Carbon Cycling - NEP, NEE, NBP	CMV 208-217; 225-227; Chapin *et al.* (2006)
10	3/18 (T)	Litter and SOM Decomposition	CMV 183-208
	3/20 (R)	Litter and SOM Decomposition	CMV 183-208
11	**Spring Break (3/24 – 3/28) – Possible Fieldtrip to the Big Island**		
12	4/1 (T)	Nutrient Inputs & Losses	CMV 259-296
	4/3 (R)	Nutrient Inputs & Losses	CMV 259-296
13	4/8 (T)	Nutrient Inputs & Losses	CMV 259-296
	4/10 (R)	Nutrient Uptake & Use	CMV 229-258
14	4/15 (T)	*- Catch up day -*	
	4/17 (R)	**Midterm Exam II**	
15	4/22 (T)	Temporal & Spatial Dynamics of Ecosystem Processes	CMV 339-367
	4/24 (R)	Biodiversity & Ecosystem Processes	CMV 321-336
16	4/29 (T)	Climate Change	IPCC (2013); Anderegg *et al.* 2010
	5/1 (R)	Elevated CO_2	Ainsworth & Long (2005)
17	5/6 (T)	Managing & Sustaining Ecosystems	CMV 423-447
Final Exam: Due Thursday, May 15 @ 9:45 a.m.			

*Chapin III, FS., Matson, P.A., & Vitousek, P.M. 2011. *Principles of Terrestrial Ecosystem Ecology*. 2nd ed. (required readings)

COURSE SCHEDULE – LABORATORY (I.E., DISCUSSIONS)

Week No.	Date (W)	Laboratory (W 3:00pm – 6:00pm)	Potential Reading Assignment*
1	1/15		
2	1/22		
3	1/29		
4	2/5		
5	2/12		
6	2/19	Stand H_2O/Energy Balance	Kagawa *et al.* (2009)
7	2/26		
8	3/5	Carbon Input	Stape *et al.* (2004)
9	3/12	Carbon Allocation	Giardina *et al.* (2003)
10	3/19	Litter / SOM Decomposition	Wieder *et al.* (2009)
11	**Spring Break (3/24 – 3/28)**		
12	4/2	Soil Carbon Pools & Fluxes	Litton *et al.* (2008)
13	4/9	Nutrients & Ecosystem Development	Selmants & Hart (2010)
14			
15	4/23	Disturbance - Carbon Balance	Clark *et al.* (2010)
16	4/30	Climate Change - Carbon Balance	Cleveland *et al.* (2010)
17	5/7	Elevated CO_2 - Carbon Balance	Norby *et al.* (2011)

**The potential reading assignments are examples of the sorts of articles that you could choose for discussion. The final choice of a discussion article will be made by each student (in consultation with the instructor).*

BIBLIOGRAPHY

Ainsworth, E. A., and S. P. Long (2005) What have we learned from 15 years of free-air CO_2 enrichment (FACE)? A meta-analytic review of the responses of photosynthesis, canopy properties and plant production to rising CO2. *New Phytologist* **165**:351-372.

Anderegg W.R.L., Prall, J.W., Harold, J. & Schneider, S.H. (2010) Expert credibility in climate change. *Proceedings of the National Academy of Sciences* **107**, 12107-12109.

Chapin, F.S., Woodwell, G.M., Randerson, J.T., *et al.* (2006) Reconciling carbon-cycle concepts, terminology, and methods. *Ecosystems* **9**, 1041-1050.

Clark K.L., Skowronski N., & Hom J. (2010) Invasive insects impact forest carbon dynamics. *Global Change Biology* **16**, 88-101.

Cleveland C.C., Wieder W.R., Reed S.C., & Townsend A.R. (2010) Experimental drought in a tropical rain forest increases soil carbon dioxide losses to the atmosphere. *Ecology* **91**, 2313-2323.

Fry, B. (2006) Stable Isotope Ecology. Springer, New York, 308 p.

Giardina, C.P., Ryan, M.G., Binkley, D. & Fownes, J.H. (2003) Primary production and carbon allocation in relation to nutrient supply in a tropical experimental forest. *Global Change Biology* **9**, 1438-1450.

IPCC (2013) Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Kagawa, A., L. Sack, K. Duarte, and S. James (2009) Hawaiian native forest conserves water relative to timber plantation: Species and stand traits influence water use. *Ecological Applications* **19**, 1429-1443.

Litton, C.M., Sandquist, D.R., Cordell, S. (2008) A non-native invasive grass increases soil carbon flux in a Hawaiian tropical dry forest. *Global Change Biology* **14**, 726-739.

Norby R.J., Warren J.M., Iversen C.M., Medlyn B.E., McMurtrie R.E. (2010) CO2 enhancement of forest productivity constrained by limited nitrogen availability. *Proceedings of the National Academy of Sciences* **107**, 19368-19373.

Selmants, P.C., Hart, S.C. (2010) Phosphorus and soil development: Does the Walker and Syers model apply to semiarid ecosystems? *Ecology* **91**, 474-484.

Stape J.L., Binkley D., & Ryan M.G. (2004) *Eucalyptus* production and the supply, use and efficiency of use of water, light and nitrogen across a geographic gradient in Brazil. *Forest Ecology and Management* **193**, 17-31.

West, J. B., G. J. Bowen, T. E. Cerling, and J. R. Ehleringer (2006) Stable isotopes as one of nature's ecological recorders. Trends in Ecology and Evolution **21**:408-414.

Wieder WR, Cleveland CC, Townsend AR (2009) Controls over leaf litter decomposition in wet tropical forests. *Ecology* **90**, 3333-3341.