

**VIRGINIA TECH NORTHERN VIRGINIA CENTER  
COLLEGE OF NATURAL RESOURCES**

**Course Syllabus  
Ecosystem Services  
ONLINE COURSE  
NR 5884, CRN 97575  
Fall Semester 2009**

**Semester Information:** Fall Semester, 2009, online class begins the week of August 24, 2009

**Course Number/Index:** NR 5884, CRN 97575

**Course Instructor:**

Dr. Stephanie Gripne, PhD, Forestry  
Visiting Assistant Professor  
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**Appointments:**

I am available for phone or skype appointments. Please send me an e-mail or call to set up an appointment.

**Course Description:**

Ecosystems provide multiple benefits to society. Ecosystem functions are the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of an ecosystem whereas ecosystem services are the beneficial outcomes, for the natural environment or people that result from ecosystem functions. Some of ecosystem goods such as timber, seafood, game animals, fuelwood, timber, and pharmaceutical products are traded in our market economy while other processes that generate such benefits such as purification of air and water, detoxification and decomposition of wastes, regulation of climate, regeneration of soil fertility, and production and maintenance of biodiversity are associated with market failures and not traded in the market. The process of waste disposal, for example, involves the life cycles of bacteria as well as the planet-wide cycles of major chemical elements such as carbon and nitrogen. Such processes are worth many trillions of dollars annually. Market failures occur when markets do not reflect the full social costs or benefits of a good. Market failures related to ecosystems include the facts that: (i) many ecosystems provide services that are public goods; (ii) many ecosystem services are affected by externalities; and (iii) property rights related to ecosystems and their services are often not clearly defined. Because many ecosystem services are not traded in economic markets, they are not associated with a price that could alert society to changes in their supply or deterioration of underlying ecological systems that generate them. Consequently, ecosystem services are undervalued and have been consumed faster than they have been replenished. This course will explore the growing field of ecosystem services including payments of ecosystem services. We will learn about the economic theory, politics, ecology, valuation, and challenges and opportunities as they related to ecosystem services through case studies and discussion from the perspective of both the public and private sectors.

**Course Prerequisites:** Baccalaureate degree and professional experience.

**Course Goals:** The goal for this course is for students to learn about ecosystem services and the associated theories, politics, valuation, and efforts to develop new markets using payments for ecosystem services.

**Course Objectives:**

- To develop a sophisticated understanding of the knowledge and theory of ecosystem services incorporating ecological, economic, and ethical theories supporting the field
- Students will gain a solid understanding of topics
  - Ecosystem services
  - Payments for ecosystem services
  - Ethics of ecosystem services
  - Public goods and common pool resources
  - Property rights and market allocation
- Critically examine payment for ecosystem services case studies in carbon, wetland banking, conservation banking, etc. and understand the challenges and opportunities associated with these new markets
- Focus on student development of individual research ideas, including through the final class paper presentation.

**Required Readings:**

The required books for this course are available on-line at [www.addall.com](http://www.addall.com), [www.amazon.com](http://www.amazon.com), or other online bookstores. The instructor will post on Scholar, as PDF files, a compilation of articles from scientific and professional journals, excerpts from books and newspaper clippings, and other source materials.

- Ruhl, J.B., Kraft, S.E., and Lant, C.L. 2007. *The Law and Policy of Ecosystem Services*. Island Press, Washington, DC.

## Course Schedule

Date	Week	Topic	Reading Assignment
24-Aug	1	Problem: Ecosystem Health Decline	Foley, J.A., DeFries, R., et al. (2005) Global consequences of land use. <i>Science</i> 309: 570-574.
			Fewer Creatures Great and Small. <i>The Economist</i> 16 Oct. 2008.
			Danielsen, F., Sørensen, et al. (2005) The Asian tsunami: a protective role for coastal vegetation. <i>Science</i> 310: 643.
31-Aug	2	Ecosystem Services: The Beginnings	Ellison, K. and Daily, G.C. (2003) Making conservation profitable. <i>Conservation Magazine</i> 4(2).
			Daily, G.C., Soderqvist, T., et al. (2000) The value of nature and the nature of value. <i>Science</i> 289: 395-396.
		Millennium Ecosystem Assessment	Millennium Ecosystem Assessment. (2005) <i>Ecosystems and Human Well-being: Synthesis</i> . Island Press, Washington, DC.
			• Read "Summary for Decision-makers" p.1-24. Skim remainder of document as you have time.
			Rescuing Environmentalism. <i>The Economist</i> 21 April 2005.
Ecosystem Services: Ethics & Philosophical Dilemma	McCauley, D.J. (2006) Selling out on nature. <i>Nature</i> 433: 27-28.		
	Letters responding to McCauley (2006)		
7-Sep	3	Conservation Planning	Balvanera, P., Daily, G.C., et al. (2001) Conserving biodiversity and ecosystem services. <i>Science</i> 291: 2047.
			Daily, G. C. (1999) Developing a scientific basis for managing Earth's life support systems. <i>Conservation Ecology</i> 3(2): 14. [online] URL: <a href="http://www.consecol.org/vol3/iss2/art14/">http://www.consecol.org/vol3/iss2/art14/</a>
		Ecology	LPES Ch. 1: Ecology
		Ecology	Kremen, C. and Ostfeld, R.S. (2005) A call to ecologists: measuring, analyzing, and managing ecosystem services. <i>Frontiers in Ecology and the Environment</i> 3(10): 540-548.
			Heal, G., Daily, G.C., et al. (2001) Protecting natural capital through ecosystem service districts. <i>Stanford Environmental Law Journal</i> 20(2): 333-364.
14-Sep	4	Geography	LPES Ch. 2: Geography
		Economics	LPES Ch. 3: Economics
		Economics	Balmford, A., Bruner, A., et al. (2002) Economic reasons for conserving wild nature. <i>Science</i> 297: 950-953.
			Gelling, P. "Forest loss in Sumatra becomes a global issue." <i>The New York Times</i> 6 Dec. 2007.

14-Sep	4	Geography	LPES Ch. 2: Geography
		Economics	LPES Ch. 3: Economics
		Economics	Balmford, A., Bruner, A., et al. (2002) Economic reasons for conserving wild nature. <i>Science</i> 297: 950-953. Gelling, P. "Forest loss in Sumatra becomes a global issue." <i>The New York Times</i> 6 Dec. 2007.
21-Sep	5	Payments for Ecosystem Services:	Engel, S., Pagiola, S., and Wunder, S. (2008) Designing payments for environmental services in theory and practice: an overview of the issues. <i>Ecological Economics</i> 65: 663-674. Dreber, A. and Nowak, M.A. (2008) Gambling for global goods. <i>PNAS</i> 105: 2261-2262.
		Economics: Benefit Cost Analysis	Goulder, L.H. and Stavins, R.N. (2002) Discounting: An eye on the future. <i>Nature</i> 419: 673-674.
		Economics Economics Valuation 1: Philosophical Foundations & Empirical Methods	Goulder, L.H. and Kennedy, D. (1997) "Ch. 3: Valuing ecosystem services: philosophical bases and empirical methods." In: Daily, G.C. (ed.) <i>Nature's Services: Societal Dependence on Natural Ecosystems</i> . Island Press, Washington, DC. Brown, T.C., Bergstrom, J.C., and Loomis, J.B. (2007) Defining, valuing, and providing ecosystem goods and services. <i>Natural Resources Journal</i> 47(2): 329-376.
28-Sep	6	Economics Valuation 2: Continued Discussion of Empirical Methods and Case Studies	Costanza, R. d'Arge, R., et al. (1997) The value of the world's ecosystem services and natural capital. <i>Nature</i> 387: 253-260. Sathirathai, S and Barbier, E. (2001) Valuing mangrove conservation in Southern Thailand. <i>Contemporary Economic Policy</i> 19: 109-122.
		Economics Valuation 3: More Case Studies	Cleveland, C.J., Betke, M., et al. (2006) Economic value of the pest control service provided by Brazilian free-tailed bats in south-central Texas. <i>Frontiers in Ecology and the Environment</i> 4(5): 238-243. Hougner, C., Colding, J., and Soderqvist, T. (2005) Economic valuation of a seed dispersal service in the Stockholm National Urban Park, Sweden. <i>Ecological Economics</i> 59: 364-374.
		Law and Policy: Part 1	LPES Ch. 4: Property Rights
5-Oct	7	Law and Policy: Part 2	LPES Ch. 5: Regulation and (Optional) Ch. 6: Social Norms
		Law and Policy: Part 3	Jack, B.K., Kousky, C., and Sims, K.R.E. (2008) Designing payments for ecosystem services: lessons from previous experience with incentive-based mechanisms. <i>PNAS</i> 105: 9465-9470.

12-Oct	8	Ecosystem Services and Individual Choices: What's in Your Breakfast?	Loder, N., Finkel, E., Meisner, C., and Ronald, P. (2008) The problem of what to eat. Conservation Magazine 9(3). <ul style="list-style-type: none"> <li>• NOTE: Focus on pages 1-6 but feel free to read the rest if interested.</li> </ul> "Green pedicure." The Economist 19 May 2008. Morgan, R. "Beyond carbon: scientists worry about nitrogen's effects." The New York Times 2 Sep. 2008.
		The State of Ecosystem Service Markets	Forest Trends and the Ecosystem Marketplace. (2008) Payments for ecosystem services: market profiles.
		Case Studies: PES Aquatic Systems - Coastal and Ocean Ecosystem Services	Worm, B., Barbier, E.B., et al. (2006) Impacts of biodiversity loss on ocean ecosystem services. Science 314: 787-790. Barbier, E.B., Koch, E.W., et al. (2008) Coastal ecosystem-based management with nonlinear ecological functions and values. Science 319: 321-323.
19-Oct	9	Case Studies: PES Carbon Markets	LPES Ch. 15: Ecosystem Services and Pollution Trading II: Carbon Trading to Ameliorate Global Warming Barnes, P., Costanza, R., Hawken, P., Orr, D., Ostrom, E., Umana, A., and Young, O. (2008) Creating an Earth Atmospheric Trust. Science 319: 724.
		Case Studies: PES Carbon REDD	Gullison, R.E., Frumhoff, P.C., et al. (2007) Tropical forests and climate policy. Science 316: 985-986. Miles, L. and Kapos, V. (2008) Reducing greenhouse gas emissions from deforestation and forest degradation: global land-use implications. Science 320: 1454-1455. Pearce, F. (2008) Do Trees Grow on Money? Conservation Magazine 9(2).
		Case Studies: PES Carbon Working Landscapes	Goldstein, J.H., Daily, G.C., et al. (2006) Business strategies for conservation on private lands: koa forestry as a case study. PNAS 103: 10140-10145. Nelson, E., Polasky, S., et al. (2008) Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape. PNAS 105: 9471-9476.
26-Oct	10	Case Studies: PES Watershed Services	Echavarria, M. (2002) Ch. 6: Financing watershed conservation: The FONAG water fund in Quito, Ecuador. In: Pagiola, S., Bishop, J., and Landell-Mills, N. Selling Forest Environmental Services. Earthscan, London. Daily, G.C. and Ellison, K. (2002) "Ch. 4: Napa, California: how a town can live with a river and not get soaked." The New Economy of Nature: The Quest to Make Conservation Profitable. Island Press, Washington, DC.
		Case Studies: PES Mitigation Banking - Wetlands and Species	Bayon, R. (2008) "Ch. 9: Banking on Biodiversity." State of the World 2008: Innovations for a Sustainable Economy. WorldWatch Institute, Washington, DC.

2-Nov	11	Case Studies: PES Contracts	Stoneham, G., Chaudhri, V., et al. (2003) Auctions for conservation contracts: an empirical examination of Victoria's BushTender trial. <i>Australian Journal of Agricultural and Resource Economics</i> 47: 477-500.
		Case Studies: PES Contracts	Eigenraam, M., Strappazon, L., et al. (2007) Designing frameworks to deliver unknown information to support market-based instruments. <i>Agricultural Economics</i> 37: 261-269.
		Ecosystem Services and Investments	Hanson, C., Ranganathan, J., Iceland, C., and Finisdore, J. (2008) The Corporate Ecosystem Services Review: Guidelines for identifying business risks and opportunities arising from ecosystem change, version 1.0.
		Ecosystem Services and Investments	McKenzie, E., McKenney, B., and Morris, B. "Ecosystem services: can ecosystem services work for your conservation project?" The Natural Capital Project. Accessed online 11 Jan. 2009: <a href="http://www.naturalcapitalproject.org/ConEX/ConEx_A_CanESWork_for_you_FIN">http://www.naturalcapitalproject.org/ConEX/ConEx_A_CanESWork_for_you_FIN</a>
		Ecosystem Services and Investments	McKenney, B., Morris, B., and McKenzie, E. "Framework for assessing the viability of an ecosystem service approach to conservation: the top 10 screening criteria." The Natural Capital Project. Accessed online 11 Jan. 2009: <a href="http://www.naturalcapitalproject">http://www.naturalcapitalproject</a>
		Ecosystem Services and Investments	Goldman, R.L., Tallis, H., Kareiva, P., and Daily, G.C. (2008) Field evidence that ecosystem service projects support biodiversity and diversify options. <i>Proceedings of the National Academy of Sciences</i> 105: 9445-9448.
9-Nov	12	PES and Poverty Alleviation: Part 1 – Introduction	Pagiola, S., Arcenas, A., and Platais, G. (2005) Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. <i>World Development</i> 33(2): 237-253.
		PES and Poverty Alleviation: Part 2 – Case Studies	Liu, J., Li, S., et al. (2008) Ecological and socioeconomic effects of China's policies for ecosystem services. <i>PNAS</i> 105: 9477-9482.
		Ecosystem Services - Restoration & Evaluation	Aronson, J., Clewell, A.F., Blignaut, J.N., and Milton, S.J. (2006) Ecological restoration: a new frontier for nature conservation and economics. <i>Journal of Nature Conservation</i> 3-4: 135-139.
		Ecosystem Services - Restoration & Evaluation	Dodds, W.K., Wilson, K.C., et al. (2008) Comparing ecosystem goods and services provided by restored and native lands. <i>BioScience</i> 58:837-845.

16-Nov	13	Case Studies: PES Water South Africa	Woodworth, P. (2006) Working for water in South Africa: saving the world on a single budget? World Policy Journal 23(2): 31-43.
		Case Studies: Large Scale Restoration Florida	Doyle, M. and Drew, C. (2008) "Part 1: Everglades." Large-scale Ecosystem Restoration: Five Case Studies from the United States. Island Press, Washington, DC.
		Ecosystem Services: Tools for Mapping	Natural Capital Project. (2008) "InVEST: Integrated Valuation of Ecosystem Services & Tradeoffs." Accessed online 11 Jan. 2009: <a href="http://www.naturalcapitalproject.org/ConEX/ConEx_A_NatCap_InVEST_4page_final.pdf">http://www.naturalcapitalproject.org/ConEX/ConEx_A_NatCap_InVEST_4page_final.pdf</a>
23-Nov	14	Ecosystem Services: Tools for Mapping	Nelson, E., Mendoza, G., et al. (In press) Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. <i>Frontiers in Ecology and the Environment</i> .
			Daily, G.C., Polasky, S., et al. (2009) Ecosystem services in decision making: time to deliver. <i>Frontiers in Ecology and the Environment</i> 7(1): 21-28.
			Ellison, K. (2009) Ecosystem services – out of the wilderness? <i>Frontiers in Ecology and the Environment</i> 7(1): 60.

**Grades:** I use the following grading scale:

<b>A+</b>	100-97	<b>B+</b>	87-89	<b>C+</b>	77-79	<b>D+</b>	67-69	<b>F</b>	59 and below
<b>A</b>	94-96	<b>B</b>	84-86	<b>C</b>	74-76	<b>D</b>	64-66		
<b>A-</b>	90-93	<b>B-</b>	80-83	<b>C-</b>	70-73	<b>D-</b>	60-63		

**ALL PAPERS ARE DUE BY 5 PM AND VIA DROPBOX ON SCHOLAR UNLESS OTHERWISE SPECIFIED OR AN ALTERNATE TIME AND DATE ARE PREARRANGED WITH THE INSTRUCTOR**

I will convene three conference calls to check in with students. I expect your full participation in these calls since the calls count toward your participation grade.

If you have a scheduling conflict, you must inform me prior to the call. Anyone who misses the call(s) is responsible for getting the notes or information discussed on the call.

All calls are at 6:00 pm eastern time and usually last 30-60 minutes. The call in number is (218) 339-3600, passcode: 238318#. We will schedule multiple conference calls during the semester if the class finds that helpful.

**Online Participation & Discussion: 20%**  
**Weekly Papers: 40%, 10 2-page assignments**  
**Final Paper: 40%**

Online participation and discussion (20%)

Students are expected to contribute to the learning environment by participating in online discussions and weekly study questions. Students will also play an active role in learning and teaching classmates by sharing their professional work experiences online. The online class replaces attending a class in person. You are expected to spend between 2.5-3 hours weekly interacting online on the discussion board. This time does not include time spent preparing for class, writing assignments or completing the readings.

Weekly Papers (40%)

Individual readings will be assigned for each week. Students must respond to four (10) separate readings by developing a response paper. Response papers should integrate summaries reading assignment with a personal intellectual response. Papers should be 2 to 2 1/2 pages long.

Final Paper (40%)

Term papers must be completed by the end of the course. The paper must include research. These papers count for 40% of the course grade. Potential term paper topics: The term paper can be in the form of a literature review or, for more advanced students, development of a theoretical or empirical model designed to investigate a specific hypothesis. Term papers can potentially expand on topics already covered in the course.

Literature reviews should be sufficiently narrow so that no more than around 10 articles are required for a thorough review. An extended abstract (2 pages double spaced) and bibliography should be posted on the Scholar by October 15. Final papers are due December 7. The final paper should be 8-12 pages in length, double spaced 12 point font, including tables, figures, and bibliography. Please review your potential paper topic with me before getting started.

### **Graduate Honor Code**

The tenets of the Virginia Tech Graduate Honor Code will be strictly enforced in this course, and all assignments shall be subject to the stipulations of the Graduate Honor Code as outlined in the 2001-2003 Graduate Catalog. For more information on the Graduate Honor Code, please refer to the GHS Constitution, located online at <http://fbox.vt.edu/studentinfo/gradhonor/> Please contact the instructor immediately if you have questions.

### **Plagiarism and Academic Honesty Policy**

The Virginia Tech Honor System is in effect for this course. Please take the time to read this document and make sure that you understand your responsibilities as a student. The Graduate Honor System can be accessed online at <http://filebox.vt.edu/studentinfo/gradhonor/>. The Undergraduate Honor System can be accessed online at <http://www.honorsystem.vt.edu/>. The following statement, taken from the Graduate Honor System, describes the types of violations covered under the Honor System:

All forms of academic work performed by any graduate student enrolled on a part-time or full-time basis under any of the admission categories shall be subject to the stipulations of the Graduate Honor Code. Such work includes, but is not limited to, course work, labwork, thesis or dissertation work, research, teaching, and extension. Violations of the Graduate Honor Code are categorized as follows: Cheating, Plagiarism, Falsification, and Academic Sabotage ....Cheating is defined as the giving or receiving of any unauthorized aid, assistance, or unfair advantage in any form of academic work ....Plagiarism is a specific form of cheating, and is defined as the copying of the language, structure, idea, and/or thoughts of another and claiming or attempting to imply that it is one's own original work ....Students who falsify, orally, in writing, or via electronic media, any circumstance relevant to their academic work shall be guilty of a violation of this Code ....Academic sabotage is purposeful vandalism directed against any academic endeavor or equipment (from the Virginia Tech Graduate Honor System, accessible online at: <http://filebox.vt.edu/studentinfo/gradhonor/>).

Be advised that plagiarism or other forms of violations of the Virginia Tech Honor System will not be tolerated.

### **Special Accommodations**

Students with special needs or circumstances are encouraged to schedule a meeting with the instructor after the as soon as possible. Please do not wait till later in the semester. In all cases, please feel free to contact the instructor should you have any questions.

**Syllabus Revisions:** This syllabus can be considered a contract between students and the instructor describing the course content and expectations. Please also read it carefully and reference it regularly to keep on top of class assignments and readings.

\*\*\* As the class progresses throughout the semester, we may decide to make modifications to the course syllabus to best serve our learning goals. If this occurs, I will clearly announce these changes in class, including posting an updated electronic syllabus. Once the revised syllabus is posted (if needed), the student is responsible for following the updated schedule. The course syllabus is likely to change to accommodate current events and the needs and interests of the students.

**Expectations of the Instructor**

1. Be open to feedback on the course and be flexible in order to make appropriate changes to meet student needs.
2. Be fair in assessment of student learning.
3. It is my hope and expectation that we will all work together to make this course an outstanding experience for all involved.