

NR782/882– Forest Health

**Lecture: T-Th. 9:40-11am; Laboratory: F 1:10-3pm,
James 140, 4 Credits**

Professor: Dr. Jeff Garnas

Office hours are after class or by appointment, James 162
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Course description and objectives: Forests cover over 30% of the land surface of the Earth and are incredibly important ecologically and economically, as well as to the health of the planet. While forests show great capacity to withstand even major disturbances, these ecosystems are increasingly threatened worldwide by climate change, native and introduced insects and disease, poor management practices, land clearing, drought, fire, and pollution. This course offers an overview of the dominant threats and their causes and consequences. Focus will be directed toward monitoring and mitigation approaches as well as toward the evaluation of how anthropogenic forces, both contemporary and historical, drive small and large-scale disruptions to dynamic forest ecosystems.

Specific learning objectives:

1. develop a nuanced framework for understanding the context dependency and historical development of the concept of forest health.
2. recognize and classify the major natural and anthropogenic causes of forest disturbance
3. develop an appreciation of the interconnected nature of forest ecosystems and how apparently disparate events acting on different timescales frequently interact, with cascading effects on ecosystem integrity.
4. apply knowledge from classroom examples, case studies and from the primary literature to develop cohesive forest management practices and ideologies.

These four objectives will be achieved via 1) **in-class lectures** (including a handful of guest presenters); 2) **hands-on indoor and outdoor laboratory activities** designed to acquaint students with key aspects of the discipline; and 3) the execution of **student-led final group projects** that foster creativity and analytical rigor while integrating key concepts from the course curriculum.

Expectations

While the formal mark for participation accounts for only 5% of your grade, your active engagement in the course (lectures, labs, discussions, and group projects) is key to your success. The field of Forest Health draws on a range of disciplines including basic biology, plant, insect and microbial ecology, systematics, aspects of the physical sciences, remote sensing, basic modeling, etc.). Given such diversity we necessarily cover much of this content

at a fairly high level, though for selected topics we will achieve a depth of understanding via readings from the primary literature, class discussion, case studies and laboratory activities. It would be in your best interest to stay on top of the coursework and readings as much as possible, and to **come see me if you're feeling lost**.

Grading breakdown

Class Participation	5%
Weekly quizzes	10%
Midterm	20%
Forest threat report presentations (2)	5% each
Laboratory exercises	10%
Research Project	
Proposal/Final presentation	2%/3%
Final project write-up	15%
Final exam	25%
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Total	100%

Projects

A significant part of your final mark will be based on the design, implementation, presentation and write-up of a primary research project focused on some aspect of forest health. We will devote class and lab time to developing skills in hypothesis generation, idea refinement, experimental design and analysis. This will ideally be in small groups, though independent projects are not out of the question. Final write-ups will be completed individually.

Exams

There will be two exams: a midterm and a final. The final will be cumulative but will focus most strongly material covered since the midterm.

Readings

There is no required textbook for this course. We will be reading selected articles from the primary literature as well as chapters from various books. See Readings from the primary literature below, **but this is subject to change ... stay tuned**. All required reading can be found as a pdf on Canvas.

Optional textbook: *Edmonds, Agee and Gara (2011). Forest Health and Protection*

* Graduate students enrolled in NR 882 will have additional assignments around reading and interpreting the primary literature, including leading a 20-30 minute classroom discussion around one of the papers listed below (or a substitute therein, with permission). Details to come.

Timeline

Week	Date	UNH Day	Topic	Reading
1	30-Aug	T	Introduction: Importance of forests, what is forest health; major sub-disciplines	EAG Ch. 1&2; Kolb 1995
	1-Sep	Th	Ecological roles of insects and microbes in forest ecosystems	
	2-Sep	F	Lab: Assessing tree and forest health (College Woods)	
2	6-Sep	T	Current forest health projects in the Northeast: Guest: Garnas lab students	
	8-Sep	Th	A brief introduction to tree physiology: Guest lecturer: Dr. Cameron McIntire, USFS	-
	9-Sep	F	Lab: Scientific questions and hypothesis generation	
3	13-Sep	T	Tree defenses	EAG Ch. 17-18
	15-Sep	Th	Forest insects – Orders and guilds of importance, Part I	
	16-Sep	F	Lab: Field trip, regional forest health issues	
4	20-Sep	T	Forest insects – Orders and guilds of importance, Part II	EAG 21-22
	22-Sep	Th	Pheromone communication in insects (Guest lecture) / Developing a research proposal	
	23-Sep	F	Lab: Fall mushroom walk and the mycorrhizal super-highway	
5	27-Sep	T	<i>Student forest threat report I (Insects)</i>	Liebhold 1995
	29-Sep	Th	Invasion biology – forests in an interconnected world	
	30-Sep	F	Lab: Project brainstorming	
6	4-Oct	T	Insect-microbe interactions	Rock 1986
	6-Oct	Th	Remote sensing and forest health	
	7-Oct	F	Lab: Spectral imaging and forest health monitoring	
7	11-Oct	T	Midterm	EAG Ch. 1&2; Kolb 1995
	13-Oct	Th	Forest pathology – Threats from the microbial world	
	14-Oct	F	Lab: Forest Inventory Analysis (FIA) field lab	
8	18-Oct	T	Forest pathology – Threats from the microbial world	EAG Ch. 9; Dukes 2009
	20-Oct	Th	Microbial endophyte communities, form and function (Guest lecture)	
	21-Oct	F	Lab: Proposal presentations	
9	25-Oct	T	Student forest threat report I (Pathogens)	
	27-Oct	Th	Landscape scale detection of forest disturbance/decline	Garnas 2022
	28-Oct	F	Lab: Electron microscopy lab	
10	1-Nov	T	Population and community ecology of forest pests, part I	Rossmann 2008
	3-Nov	Th	Population and community ecology of forest pests, part II	
	4-Nov	F	Lab: Population dynamics practicum in Excel	
11	8-Nov	F	Lab: FIA data analysis and De Liocourt's Law	EAG Ch. 16, 19, 25
	10-Nov	Th	Forest pathology in the Northeast	
	11-Nov	F	Lab: Forest pathology survey	
12	15-Nov	T	Biological control in forest systems	EAG Ch. 3, 7
	17-Nov	Th	Abiotic threats: pollution, nutrient deficiency	
	18-Nov	F	Lab: Project data analysis – bring complete data files [real or example]	
13	22-Nov	T	Abiotic threats: fire and wind	EAG 14-15
	23-Nov	Th	Thanksgiving	
	24-Nov	F		
14	29-Nov	T	Climate impacts on forests; mitigation strategies	Grady 2015
	1-Dec	Th	Tree breeding, marker assisted selection, assisted migration	
	2-Dec	F	Lab: Final data analysis; writeup review	
15	6-Dec	T	Resistance management, landscape resistance, GMO's and CRISPR/Cas9	-
	8-Dec	Th	Class discussion: The future of forest health/Exam review	
	9-Dec	F	Lab: Student Research Project Presentations	
	14-Dec	W	Final exam, 10:30am-12:30pm, James 140	

Readings from the primary literature

- *Article pdfs will be provided via email or MyCourses*
- *List is subject to change...please refer to updated versions on MyCourses*
- *Additional readings will be available/assigned to those registered for NR882.*

Dukes, J. S., J. Pontius, D. Orwig, J. R. Garnas, V. L. Rodgers, N. Brazee, B. Cooke, K. A. Theoharides, E. E. Stange, R. Harrington, J. Ehrenfeld, J. Gurevitch, M. Lerdau, K. Stinson, R. Wick, and M. P. Ayres. 2009. Responses of insect pests, pathogens, and invasive plant species to climate change in the forests of northeastern North America: What can we predict? *Can. J. For. Res.* **39**:231-248.

Frago, E., M. Dicke, and H. C. J. Godfray. 2012. Insect symbionts as hidden players in insect-plant interactions. *Trends in Ecology & Evolution* **27**:705-711.

Garnas, J., F. Lombardero, and M. P. Ayres. *In press*. Population Dynamics. *in* J. Allison and T. D. Paine, editors. *Forest Entomology*. Springer.

Grady, K. C., T. E. Kolb, D. H. Ikeda, and T. G. Whitham. 2015. A bridge too far: cold and pathogen constraints to assisted migration of riparian forests. *Restoration Ecology* **23**:811-820.

Hulcr, J., and R. R. Dunn. 2011. The sudden emergence of pathogenicity in insect-fungus symbioses threatens naive forest ecosystems. *Proceedings of the Royal Society B: Biological Sciences* **278**:2866-2873.

Kolb, T. E., M. R. Wagner, and W. W. Covington. 1995. Forest health from different perspectives. Pages 5-13 *in* L. G. Eskew, editor. *Forest health through silviculture: Proceedings of the 1995 National Silviculture Workshop*. Gen. Tech. Rep. RM-GTR-267. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Mescalero, New Mexico.

Liebhold, A., W. Macdonald, D. Bergdahl, and V. Maestro. 1995. Invasion by exotic forest pests: A threat to forest ecosystems. *Forest Science* **41**:1-49.

Liebhold, A., and P. Tobin. 2008. Population ecology of insect invasions and their management. *Annual Review of Entomology* **53**:387-408.

Lovett, G. M., M. Weiss, A. M. Liebhold, T. P. Holmes, B. Leung, K. F. Lambert, D. A. Orwig, F. T. Campbell, J. Rosenthal, D. G. McCullough, R. Wildova, M. P. Ayres, C. D. Canham, D. R. Foster, S. L. LaDeau, and T. Weldy. 2016. Nonnative forest insects and pathogens in the United States: Impacts and policy options. *Ecological Applications* **26**:1437-1455.

Rock, B. N., J. E. Vogelmann, D. L. Williams, A. F. Vogelmann, and T. Hoshizaki. 1986. Remote Detection of Forest Damage. *Bioscience* **36**:439-445.

Rossman, A. Y., and M. E. Palm-Hernandez. 2008. Systematics of plant pathogenic fungi: Why it matters. *Plant Disease* **92**:1376-1386.

Some fine (but important) print

University Academic Honesty Policy: An increasing number of colleagues are making note on their syllabi of the importance of the University Academic Honesty Policy. Given the vigilance of the University in rooting out dishonesty, we strongly encourage this practice. Many colleagues also include in their syllabi the link for the tutorial on plagiarism as well. The links to these websites are as follows: [University Academic Honesty Policy](#); [Tutorial on Plagiarism](#)

Accommodations for students with disabilities: If you are a student with a documented disability or believe you may have a disability that requires accommodations, please contact Student Accessibility Services (SAS) at 201 Smith Hall. Accommodation letters are created by SAS with the student. Please follow-up with your instructor as soon as possible to ensure timely implementation of the identified accommodations in the letter. For more information refer to www.unh.edu/studentaccessibility or contact SAS at 603.862.2607, 711 (Relay NH) or sas.office@unh.edu

Emotional or mental health issues: Stress can creep into our lives from various sources and can seriously impact academic success. If, during the semester, you find emotional or mental health issues are affecting that success, please contact Psychological and Counseling Services (PACS) (3rd fl, Smith Hall; 603 862-2090/TTY: 7-1-1) which provides counseling appointments and other mental health services. (<https://www.unh.edu/pacs/>)

Center for Academic Resources (CFAR): Provides services and resources to support undergraduate students in their pursuit of academic success. (<https://www.unh.edu/cfar>)

Connors Writing Center: Offers free, one-on-one writing conferences to current members of the UNH community: students, faculty and staff. We work with writers from all disciplines on many different kinds of academic writing. Our fifty-minute conferences are conducted by trained writing assistants, who are UNH undergraduate and graduate students. Collaboration is the core of the Connors Writing Center approach. Together, writer and writing assistant work to brainstorm and find a path through the revision process. We're here to support, assist, help, guide, and learn from writers. (<https://www.unh.edu/writing/cwc>).

Sexual Harassment and Rape Prevention Program (SHARPP): Provides free and confidential advocacy and direct services to survivors. (<https://www.unh.edu/sharpp>)

Covid-specific details: *We'll see – all systems go at the present time. Please continue to test as per university protocols, and please self-isolate if you are feeling sick. **We'll discuss masking as a class...I guess plan to bring/wear one on day 1 just in case that is what we decide on.***