

# **Plant Ecology – HORT 445**

**Fall 2016**

Monday 1:25-2:15p, ASI 011

Thursday 1:00-4:00p, field trips

Office hours: Monday 2:30-3:30p or by appointment, ASI 421

## **Course Description**

Plant Ecology is the study of the abundance and distribution of plants. In other words, plant ecology helps us answer questions like “Why does this forest look the way it does?” and “Why do we find different species of plants in this meadow than we did 15 years ago?” Ecology focuses on understanding ecosystems through the *processes* that shape them. We do not look at groups of plants as static and unchanging. Plant communities are dynamic, and through observation and research we try to understand where they have been and where they are going. Is this grassland turning into a forest? Is this invasive shrub pushing out the native plants? What might happen if this area were burned, or logged, or if it suffered a drought?

## **Instructional Approach**

The way we think about plant ecology shapes the way we teach plant ecology. Plant communities are not static, so we choose not to teach plant ecology with static facts. The way we think about plant ecology shapes the way we teach plant ecology. We want you to be able to look at plants in a landscape and see the processes that are shaping which plants are there and the patterns of abundance. Since every landscape is different, we cannot teach you *what* to think, so we have to teach you *how* to think.

When you leave this class, you should be able to formulate a basic question about the plant ecology of a particular place, and then use a scientific approach to answer that question. This is very different from the style of learning used in most college classes, where you learn a body of facts and then repeat them back to the professor. Our approach might be uncomfortable for some of you at first, but we think this approach to learning will serve you well in the future. Knowing how to pose a question and then answer it rigorously is an incredibly empowering skill—whether in your job or at home, whether in plant ecology or something completely unrelated. And it’s fun!

We are going to be learning together through field trips and research projects, in addition to readings and lectures. Hopefully this will be both fun and fitting, since you are about to go out into the real world. However, this means that the class cannot work without your engagement and excitement. This is why participation is worth 20% of your grade. We won’t be looking for a certain number of comments per class. Instead, our goal with this is to help create a culture where everyone contributes to field trips and discussions. We will all learn more if everyone is thinking critically.

We are excited about having you in this class and look forward to the semester together!

**Instructors:** Katy Barlow and Erynn Maynard, doctoral candidates in Ecology will teach this course. Katy is a student of Dr. Dave Mortensen, check out the Mortensen Lab website to find out more about Katy's work - <http://www.weedecologypsu.com/>. Erynn is co-advised by Dr. Margot Kaye and Dr. Eric Burkhart.

Contact information is as follows:

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**Student Learning Objectives:** By the end of this course, students should be able to:

- Define key terms in plant ecology such as succession, invasion, competition, and facilitation
- Explain how light and water interact to shape plants' responses to the environment, both as individuals and as communities
- Explain the difference between functional and taxonomic approaches to categorizing plants
- Explain the differences among individuals, populations, communities, and ecosystems
- Apply basic techniques to assess species richness and abundance in the landscape
- Distinguish among richness, evenness, and diversity and explain how each is important for understanding plant ecology
- Describe how geographic and environmental filters shape a species pool and the subsequent role of biotic interactions shaping a local plant community
- Describe how plant communities impact food webs in ecosystems
- Explain the concept of "ecosystem services" and distinguish among different types of services
- Explore the unique qualities of invasive plants that enable them to increase local abundance and spatial extent (spread)
- Describe the projected impacts of climate change on a plant species' environment and analyze the potential effects on plants and plant communities
- Communicate the importance of a plant ecology question both orally and in writing
- Analyze a self-chosen question in plant ecology, collect field data to provide insight on the question, and communicate the results and implications both orally and in writing

**Readings:** The readings we ask you to do in this class have been carefully selected to complement what we are covering in class and in the field. Discussions will depend on the readings and we expect everyone to be fully engaged in discussion. Each week's readings should be done prior to the Monday class. Occasional online quizzes will be given to ensure

everyone is keeping up with reading assignments. These quizzes and other exercises based on the readings will make up 20% of your grade.

There is no required textbook for this course. If you want to dive deeper into the subject, the text *The Ecology of Plants* (2<sup>nd</sup> Edition) by Gurevitch, Scheiner, and Fox (2006, Sinauer Associates Inc) is a particularly helpful background resource.

**Attendance and Participation:** This class is highly participation-based and focused on active learning. We expect students to be present and engaged for every class period. It is particularly important that students not miss the Thursday afternoon lab periods, as the learning environment of these labs is difficult to replace. If you have a valid need to miss class, please let us know in advance, and we will work with you.

**Field Trips:** We will be going on field trips almost every Thursday lab period. These trips will happen rain or shine, so please dress accordingly.

**Class Projects:** The course will build toward a final small-group paper and presentation on a plant ecology topic of your choosing. This is your chance to pose a question that you find interesting and work through a scientific approach to solving it, with our guidance. There will be graded assignments throughout the semester to help your group prepare for the final paper and presentation. We will provide additional information about the class projects in the first week of the course.

The assignments will be due according to the following schedule:

Week 2: Identification of group members and topic

Week 5: Short presentation of project question and approach

Week 10: Written draft due

Week 13: Written report due

Week 15: Final presentation

**Evaluation:** Grades will be determined as follows, 15% participation, 20% reading quizzes, 5% Tait Farm lab report, 20% mid-semester exam, and 40% for the project. Quizzes and exams must be completed on your own. Quizzes will be posted on a Thursday and will be due the following Tuesday at midnight or before. There will be 4 quizzes each worth 5 points. The mid-semester take-home exam will be given on October 27 after class and due the following Thursday, November 3 at 1:00pm prior to lab.

The grading scale for the class will be as follows (number is the lowest score that will earn the respective grade).

A(95) A-(90) B+(86.8) B(83.4) B-(80) C+(76.8) C(73.4) D(60) F(<60)

**Academic Integrity:** In short: Give credit where credit is due, and don't pass off someone else's work as your own. If you hand in work with your name on it, make sure it is your work! A violation of academic integrity may result in you earning a lower grade or a failing

grade as an academic sanction. For more information see:  
<http://dus.psu.edu/handbook/integrity.html>. If you have specific questions about this, please contact one of us *before* handing in the work in question.

**Disability Statement:** Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus: <http://equity.psu.edu/ods/dcl>. For further information, please visit the Office for Disability Services Web site: <http://equity.psu.edu/ods>.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide [documentation](#). If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

## **Class Schedule**

### Week 1 – Introduction to plant ecology

8/22 Introductions and overview of the class

Ignite Sessions - Hot topics in plant ecology

8/25 Meet at the Morningstar House near student community garden

- Discuss Leopold readings

- Walk through Sutherland steps for research planning

- Practice methods of plant and insect sampling at the pollinator garden

Reading due: Leopold chapters; Sutherland's 'Reverse Planning and Ecological Census Techniques'

### Week 2 - Plant taxonomy, systematics and functional traits

8/29 Introduction to plant taxonomy and systematics, and grouping by plant functional traits

Reading due: Woodland's Contemporary Plant Systematics Chapters 1,3,6

9/1 Trip to Musser Gap

- Field trip to practice taxonomic identification and illustrate ways that functional traits guide a plant's ability to integrate the environment and its interactions with other plants

Reading due: Video – History of Pennsylvania Forests; Garnier and Navas 2012 A trait-based approach

Project due: Project groups and topics – upload a one paragraph project description

### Week 3 – Measuring plant diversity and basic research planning

9/5 Labor Day – no class

- 9/10 Trip to Rock Springs mountain slope area
- Quantify plant species richness and abundance in a field edge
  - Discuss Sutherland technique for research planning
- Reading due: Gurevitch text Chapter 12 'Community Properties'
- Quiz 1 posted

Week 4 – Plant ecophysiology

- 9/12 Photosynthesis, nutrient uptake and water relations
- Reading due: Gurevitch text selections on 'Ecophysiological Adaptation to the Environment'
- 9/13 Quiz 1 due
- 9/15 Trip to Musser Gap - Apply ecophysiology concepts and methods to plants in contrasting environments: old fields, edges, forest understory
- Reading due: Methods and Instruments for Plant Ecophysiology

Week 5 – Plant population dynamics

- 9/19 Plant demography basics
- Applications to agroecology – Weed population dynamics and management
- Reading due: Menalled et al. 2001 'Weed aboveground and seedbank community responses to agricultural management systems'
- 9/22 Group project presentations at Morningstar House
- Project due: 15-20 minute presentation of questions and methods
- \*Tait Farm research report topic assigned

Week 6 – Plants and food web dynamics

- 9/26 Overview of food webs and pollinator networks
- Reading due: Gurevitch text selections 'Pollination Ecology' and 'Herbivory'
- 9/29 Field trip to Tait Farm – on farm examples of plant and insect interactions
- Quiz 2 posted

Week 7 - Plant community assembly – geographic filters and plant community types

- 10/3 Geographic factors of community assembly – dispersal and environmental filters (abiotic and biotic)
- Reading due: Gurevitch text selections 'Seed Dispersal'; selections from DCNR's 'Terrestrial & Palustrine Plant Communities of Pennsylvania'
- 10/4 Quiz 2 due
- 10/6 Field trip to Penn State's Rockview property and Spring Creek Canyon
- Report due: Tait Farm research topic

Week 8 – Plant community assembly – interspecific interactions

- 10/10 Local factors of community assembly – competition and facilitation
- Reading due: Gurevitch text Chapter 10 'Competition'
- 10/13 Trip to Rothrock State Forest deer exclosures
- Study the interplay between propagule pressure, plant competition and herbivory in the structuring of plant communities

Reading due: New Jersey Deer Herbivory Fact Sheet – NRCS; Deer Overpopulation Yields Disastrous Results For Forests – NPR; Begley-Miller et al. 2014 Deer Browse and Community Assembly

Week 9 – Plants and ecosystem services

10/17 Overview of ecosystem services

Reading due: Selection from the Millennium Ecosystem Assessment Report

10/20 Trip to Cover Crop Cocktails project – host Mitch Hunter

- Observe a range of the ecosystem services that plants provide (food webs and biodiversity, pollination, erosion control, nutrient retention, nutrient supply, weed suppression, clean water, recreation) and discuss methods for quantifying and comparing multiple services

Quiz 3 posted

Week 10 – Invasive plant management

10/24 Special guest speaker Art Gover on methods for managing invasive species

Reading due: Gurevitch text ‘Succession and invasive species’; PA DCNR management planning

10/25 Quiz 3 due

10/27 Trip to Arboretum successional fields and forests to learn about invasive plant management from Art Gover

Project due: Written draft of project

**\*\*\*Take-home exam upload\*\*\***

Week 11 – Plant conservation and restoration

10/31 Overview of plant conservation and restoration

Reading due: Hobbs et al. 2009 ‘Novel Ecosystems: Implications for Conservation and Restoration’

11/3 Trip to Arboretum successional fields and forests to learn about conservation and restoration from Shari Edelson and Vasiliy Lakoba

**\*\*\*Take-home exam due prior to lab\*\*\***

Week 12 – Plant ecology and climate change

11/7 Discussion of climate change and its projected impacts on wild and managed plant communities

Reading due: Selections from the report Climate Change and Agriculture in the United States: Effects and Adaptation - USDA

11/10 “Resilient Agriculture” discussion

Reading due: Selections from Lengenick book

Quiz 4 posted

Week 13 – Wrap-Up

11/14 Review of plant ecology topics covered

11/15 Quiz 4 due

11/17 Final paper due by 5pm; no class

Project due: Final paper

Week 14 – Thanksgiving (no class)

Week 15 – Wrap-Up and Small Group presentations

11/28 Future directions of plant ecology research

12/1 Meet at the Morningstar House for group presentations

Project due: Final presentation