SYLLABUS for EEOB 671 - PLANT POPULATION ECOLOGY
Autumn Quarter 2007 (5 credits; offered every other year)
2007 Call No. 20930-2

Lecture - Tuesday and Thursday 2:30 - 4:18 PM, Aronoff 104
Lab/Discussions - Wednesday 1:30-5:18 PM, Rm 0141 BI (then Aronoff 104)

Instructor: Dr. Allison Snow, Rm 376 Aronoff Lab, 2-3445, snow.1@osu.edu
TA: Amy Campbell, Rm 374 Aronoff Lab, 2-8433, Campbell.597@osu.edu
Office hours: Before or after class any time; no appointment needed.

Text: Silvertown, J.W., and D. Charlesworth. 2001 (Fourth Edition). **Introduction to Plant Population Biology**. Blackwell Scientific, Boston. 347 pp., ~$75.00 new. Earlier editions of the text are not acceptable. About five copies are available at Barnes and Noble at 1598 North High Street. To find more copies, including used copies, try SBX, UBX (College Town), or Buckeye Books. You can also order new and used copies from Amazon.com (lowest price $57). The textbook will be available on Closed Reserve in the Biological Sciences and Pharmacy (BSP) Library.

Course Structure and Philosophy

This course involves a combination of lectures, discussions, and lab exercises that include field trips. Unlike many classes at OSU, this one requires you to be a very active participant at every class and an avid reader between classes. During the lecture period, we will have a flexible schedule to allow extra time for some topics and less time for others, depending on the need for more detailed discussions. We are fortunate that the textbook provides an excellent introduction to plant population biology. Thus, we will follow the text very closely during the first six weeks of the quarter. A few guest lectures are included in the schedule. To supplement the lectures, each student is expected to present a short biographical summary of the scientific career of a leading plant population ecologist; guidelines for these "professional profiles" are described further below.

During our four-hour lab periods, we will start the quarter with several field trips, taking advantage of the nice weather. You will be introduced to local habitats and a variety of topics, including seed predation, analysis of life stages, conservation biology, and restoration ecology. Some of these trips will involve data collection, analysis, and a short lab report. Later in the quarter, we will use the lab periods for a tour of molecular marker laboratories in EEOB as well as discussions and debates. Each student is responsible for researching and discussing the assigned topics for the discussion sessions. In addition, a 15-20 page (typed double-spaced) review paper on a topic in plant population biology is required of each student. Guidelines for the review paper are described below. Other assignments for journal articles and the two lab reports will be distributed later.

Schedule

Day/Date	Topic
W Sept 19	**Introduction to the course and participants** *(end by 3:00)*
R Sept 20	**Ch 1 – Overview of plant population biology**
T Sept 25	**Ch 2, Day 1 – Variation and its inheritance**
W Sept 26	Field trip: field trip to ORWRP; hybrid cattail data collection exercise
R Sept 27	**Ch 2, Day 2 – Variation and its inheritance**
T Oct 2	**Ch 3, Day 1 – Evolutionary and ecological genetics** (Topic for review paper due)
W Oct 3	Field project: Seed predation on *Hibiscus* pop. at Stage's Pond, Circleville, OH
R Oct 4	**Ch 3, Day 2 – Evolutionary and ecological genetics**
T Oct 9	**Ch 4 – Intraspecific interactions**
W Oct 10	Field trip: Seed predation on oaks and hickories in Bohannon Woods
R Oct 11	**Ch 5 – Population dynamics**
T Oct 16	**Ch 6 – Age and stage-structured populations**
W Oct 17	Field project: Teasel demography at Highbanks Metropark
T Oct 18	**Ch 7 – Regional dynamics and metapopulations**
T Oct 22	**Ch 8 – Competition and coexistence**
W Oct 24	Discussion – Uses of life table response experiments to predict population change
R Oct 25	**MIDTERM EXAM**
T Oct 30	**Ch 9 – Plant breeding systems**
W Oct 31	Discussion – Articles on gene flow, natural selection, and local adaptation
R Nov 1	**Ch 10 – Evolution of life history traits**
T Nov 6	Guest lecture: Jennifer Windus, FWS **Managing invasive plants in Ohio**
W Nov 7	Discussion - Biological control of invasive species: is it safe?
R Nov 8	**Plant-herbivore interactions** (outline will be provided)
T Nov 13	Lecture: **Molecular markers and analyses** (outline will be provided)
W Nov 14	Snow Lab: Intro. to molecular markers labs with Dr. Patty Sweeney
R Nov 15	Guest lecture: Kristin Mercer **– Mexican maize and evolutionary ecology**
T Nov 20	Lecture: **Plant-pathogen interactions** (outline will be provided)
W, R Nov 23, 24	Free period to work on review papers; No classes on THANKSGIVING
T Nov 27	Lecture**: Plant-pollinator interactions** (outline will be provided)
W Nov 28	Brief summary of each student's review paper
R Nov 29	Brief summaries (cont.); **Course Summary by AAS**
M, Dec 3	Review papers due by 3:00 PM (send as email attachment to AAS)

R Dec 6 **FINAL EXAM** from 1:30-3:30

Grading

This course places more emphasis on participation and independent study and less emphasis on exams. Your course grade will be determined from the following:

Participation in class discussions, presentations – 20%
Lab Reports (two) – 20%
Review Paper - 20% (due Monday, Dec. 3rd, 3:00 PM)
Midterm Exam - 20% (Thursday, Oct. 25th , 2:30-4:30 PM)
Final Exam – 20% (Thursday, Dec. 6th , 1:30-3:18 PM)

Grades will be determined on a percentage basis (for example, 80 - 83 = B-, 84 - 86 = B, 87 -89 = B+, 90-93 = A-, >93 = A)

Detailed Outline for Class Periods Based on the Textbook:

(read these sections of the text before class)

Chapter 1 – Introduction

1.1 Plants
1.2 Population biology
1.3 Some consequences of being a plant

Chapter 2 – Variation and its inheritance

Day 1:
2.1 Introduction
2.2 Types of trait
2.3 Genotype and phenotype
2.4 Quantitative inheritance
Featuring journal article: Galen (1997) in Evolution

Day 2:
2.5 Discrete genetic variation (intro to molecular markers)
2.6 Mutation
2.7 Plant breeding systems and genetic variability
2.8 Consequences of inbreeding, outbreeding, and asexual selection
2.9 Summary

Chapter 3 – Evolutionary and ecological genetics

Day 1:
3.1 Introduction
3.2 Gene and genotype frequencies without selection
3.3 Gene flow

Day 2:

3.4 Patterns of genetic diversity in plant populations
3.5 Natural selection
3.6 Summary

Chapter 4 – Interspecific interactions

4.1 Introduction
4.2 Yield and density
4.3 Self-thinning
4.4 Size variation
4.5 Influence of neighbors
4.5 Size, density, and fitness
4.7 Population regulation: density dependence
4.8 Summary

Chapter 5 – Population dynamics

5.1 Introduction
5.2 Demographic parameters
5.3 Annuals with no seed bank
5.4 Density-dependent dynamics
5.5 Seeds in the soil
5.6 Summary

Chapter 6 – Dynamics of age and stage-structured populations

6.1 Introduction
6.2 Stochasticity, disturbance, and recruitment
6.3 Population models with age and stage structure
6.4 Annuals with a seed bank
6.5 Perennials
6.6 Summary

Chapter 7 – Regional dynamics and metapopulations

7.1 Introduction
7.2 The classic metapopulation model
7.3 Regional dynamics of plants
7.4 Extinction
7.5 Genetic and evolutionary consequences of regional dynamics
7.7 Invasions
7.8 Phylogeography
7.9 Summary

Chapter 8 – Competition and coexistence

8.1 Introduction
8.2 The variety of interactions between plants
8.3 Competition (skim this section, except 8.3.3)
8.4 Coexistence
8.5 Summary

Chapter 9 – Plant breeding systems (cont. from Ch. 2)

9.1 Introduction
9.2 Evolution of sex
9.3 Selection pressures on the selfing rate
9.4 Self-incompatibility
9.5 Evolution of separate sexes (skim this section)
9.6 Summary

Chapter 10 – Other life history traits

10.1 Introduction
10.2 Reproductive maturity
10.3 Mast variation in seed crop size
10.4 Seeds
10.5 Clonal growth
10.6 Senescence and death
10.7 Life history strategies
10.8 Summary

Guidelines for review papers: (~15-20 double-spaced typed pages)

You are expected to read at least 10 data-rich articles from peer-reviewed journals and summarize their findings in a review paper. Many of the papers you need will probably be cited in a recent paper on the subject you choose. To decide on a topic, look through recent issues of Ecology, Ecological Applications, Evolution, American Naturalist, Oecologia, the American Journal of Botany, Molcular Ecology, Conservation Biology, or other journals and find an article that catches your interest. Another great place to get ideas is Trends in Ecology and Evolution, as long as you don't "copy" your favorite review too closely. You can also get ideas from papers that are cited in Silvertown and Charlesworth.

The topic you choose must deal with methods and concepts in population biology, not systematics, physiology, community ecology, etc., and most or all of the papers should describe wild or weedy plants rather than cultivated ones. It's fine to choose a topic related to your future research interests, but don't pick one that you are totally familiar with already. A few examples of possible topics are:

1) Genetic variation in populations of rare, endemic plants.
2) Evidence for heritable variation in floral traits (or seed size, resistance to herbivores, etc.).
3) Effects of seed predators (and/or pollinators) on plant reproductive success.
4) Methods for documenting inbreeding and inbreeding depression in natural populations.
5) The spread and ecological impact of a major invasive species.
6) Effects of herbivores on the establishment of tree seedlings.
7) Effects of intraspecific competition on the establishment of size hierarchies in plant populations.
8) Release from native predators and pathogens as a cause of invasiveness in plants.
9) New types of molecular markers for plant population ecology.

Suggestions for more general reviews:

10) The strengths and limitations of using *Arabidopsis* as a model study species for plant population biologists.
11) The contrasting effects of hybridization on local adaptation – a stimulus for adaptation *vs*. a cause of maladaptation.
12) The strengths and weaknesses of matrix models and related life cycle approaches for predicting population dynamics.
13) The effects of outcrossing rates on the potential for local adaptation in plant populations.
14) Evidence for declining pollinator populations and the ecological and economic consequences of pollinator declines.

Feel free to discuss your ideas for a topic with me. A tentative title and one reference on your subject are due on October 2nd, in class. If your topic seems inappropriate for any reason, I'll let you know at the next class.

Your paper will be graded based on its organization, content, and clarity (suggestion: read Strunk and White for inspiration). Headings for 3 or 4 sub-questions are recommended. Start the paper with a general discussion about why the topic is important (how does it help us answer fundamental questions in ecology or evolution?), and end the paper with a summary and recommendations for further research. This format is similar to what you would include in the introductory section of an NSF proposal. You don't need to describe every paper you read, but you should highlight a few of the best papers where appropriate. Revise your first draft several times - make every attempt to write clearly and concisely, and if possible have a friend critique your review before you turn it in. Send a copy of your paper to me as an email attachment by 3:00 PM on Friday, December 2nd. We will hear brief oral summaries of your findings during the last two class periods (use a few PowerPoint slides).

Guidelines for profiles of population ecologists

You will use the internet and other resources to learn about the professional development of a well known plant population biologist and summarize their contributions in a short PowerPoint presentation. Questions to address include: where did they get their PhD, where are they now, how have their research interests evolved, what are some of their key papers, and what are some of their other professional accomplishments? For senior researchers, have any of their graduate students become famous population ecologists? You should summarize your findings in a colorful, well-organized 10-15 min. PowerPoint presentation. Include a few photos of people and their study systems when possible. These talks will provide an entertaining and informative view of the professional lives of leading researchers. A sign-up sheet for these presentations will be distributed in class.

<u>General references</u> – Many are on Closed Reserve in BSP Library

Begon, M., J. L. Harper, and C. R. Townsend. 1990. Ecology: Individuals, Populations, and Communities. Sinauer Assoc., Mass.

Karp, A., et al. 1998. Molecular tools for screening biodiversity. Chapman and Hall, NY.

Dirzo, J. and J. Sarukhan (eds.). 1984. Perspectives on Plant Population Ecology. Sinauer Assoc., Mass.

Endler, J. A. 1986. Natural Selection in the Wild. Princeton Univ. Press., N.J.

Futuyma, D. J. 1986. Evolutionary Biology. Sinauer Assoc., Mass.

Gurevitch, J., S. Scheiner, and G. Fox. 2002. The Ecology of Plants. Sinauer Assoc., Mass.

Harper, J. L. 1977. Population Biology of Plants. Academic Press, London.

Hartl, D. L. 1988. A Primer of Population Genetics. Sinauer Assoc., Mass.

Howe, H. F., and L. C. Westoby. 1988. Ecological Relationships of Plants and Animals. Oxford Univ. Press, NY.

Lovett-Doust, J., and L. Lovett-Doust (eds.). 1988. Plant Reproductive Ecology: Patterns and Strategies. Oxford Univ. Press, NY.

Real, L. (ed.) 1983. Pollination Biology. Academic Press, NY.

Wilson, E. O., and W. H. Bossert. 1971. A Primer of Population Biology. Sinauer Assoc., Mass.

<u>On Writing</u>:

Day, R. A. 1979. How to Write and Publish a Scientific Paper. ISI Press, Penn.

Strunk, W., and E. B. White. 1972. The Elements of Style. Macmillan, NY.