Plant Evolutionary Biology - Fall 2000

Textbook. D. Briggs and S. M. Walters. Plant Variation and Evolution, 3rd edition. 1997. Cambridge University Press.
Additional readings will be supplied.

Grading.	Two exams, 100 points each	200 points
	Leader, two discussion sessions, including written summary, 50 points each	100 points
	Discussion participation	100 points

Students wishing to obtain graduate credit will prepare a literature review of any of the topics discussed in class, or an approved related topic.

Rationale. The lecture and discussion course is based on the premise that there are certain evolutionary processes that are far more common in plants that in animals, and that these processes affect our ideas about the evolution of diversity. Therefore, botanists often have different views about such evolutionary fundamentals as species and speciation. Below, I follow Karl Niklas in listing five features in plants that affect our views of species concepts, speciation, and the evolution of variation. We could argue about whether these are THE differences we should consider, but the list serves as a framework, and topics we will talk about do relate back to one or more of the items on this list.

1. Plants are generally developmentally simpler than animals. The level of integration and balance among their parts is not so extensive and finely-tuned as for animals. Therefore, the developmental program of a plant is less likely to become disrupted by hybridization, and is able to withstand more profound changes.

2. Plant are sessile. Animals have patterns of movement, behavior, and sense perception that contribute to the establishment of reproductive barriers. Plants often passively receive pollen, not only from members of their own species, but from others as well.

3. Plants have an open growth pattern; embryonic cells can continue to produce more parts. Plants may live very long or reproduce vegetatively, they may exhibit intra-individual variation via somatic mutation or heteroblasty, and single or small numbers of plants can form entire new populations.

4. Infertile hybrids can become fertile following duplication of chromosome sets (polyploidy). This provides a mechanism for the persistence of otherwise disadvantaged hybrids.

5. Plants can often self-fertilize - two interfertile parents not always required. Selfing affects ability to establish new populations and the patterning of existing genetic diversity.

—(K. J. Niklas, Evolutionary Biology of Plants, pp. 65–66)

I used this list to guide my schedule of topics for the course, with the one exception being the topic of organelle evolution. There are many other aspects of plant evolution that could have been included, but were not. Our two last meetings are intended to accommodate a topic or two that are not covered here, and that you would like to learn more about, so come up with some suggestions.

Lecture and Discussion Schedule

Week 1	8/28		Organizational meeting. Introduction.	
	8/30		Intro to species.	7–28
	9/4	Discussion	Labor Day - no classes	
Week 2	9/4		Labor Day - no classes	
	9/6		Reality of species; biological species, barriers	259–263, handout
	9/11	Discussion	D. A. Levin 1979	
Week 3	9/11		Problems with biological species.	361–366
	9/13		Phylogeny and species.	Handout
	9/18	Discussion	N. D. Young 1998	
Week 4	9/18		Morphological variation within species - developmental and phenotypic plasticity	114–123
	9/20		Morphological variation within species - due to genetic differentiation	167–206
	9/25	Discussion	J. Schmitt et al. 1999	
Week 5	9/25		Measuring genetic variation within species	88–114
	9/27		Variation within species - genetic	Handout
	10/2	Discussion	D. R. Ayres and F. J. Ryan 1990	
Week 6	10/2		Speciation. Categorization	263–269
	10/4		Speciation. Gradual allopatric	270–277
	10/9	Discussion	V. Grant 1993 AND M. Fulton and S. A. Hodges 1999	
Week 7	10/9		Exchange among species - hybridization and introgression	277–308
	10/11		Exchange among species - hybrid speciation, introgression	277–308
	10/16	Discussion	Guest - Steve Brunsfeld leads discussion of T. M. Hardig et al. 2000	
Week 8	10/16		Speciation and chromosomal change	
	10/18		Chromosomal variation. Aneuploidy, and examples from plants	352–360
	10/23	Discussion	No Discussion - Exam	
Week 9	10/23		No Class - (Exam during discussion period)	
	10/25		Fixation of chromosomal variation	Handout
	10/30	Discussion	H. Lewis 1973	
Week 10	10/30		Euploidy. Categories, mechanisms.	309–318, 338–352
	11/1		Euploidy. Studies and examples	318–338
	11/6	Discussion	Guest - Linda Cook leads discussion of L. M. Cook et al. 1998	

Week 11	11/6		Plant breeding systems - outcrossing. Dioecy, self-incompatibility, dimorphy	124–133
	11/8		Plant breeding systems - selfing and apomixis	133–142
	11/13	Discussion	E. A. Kellogg 1990	
Week 12	11/13		Plant breeding systems - consequences	143–157
	11/15		Plant breeding systems - occurrence and evolution	157–166
	11/20	Discussion	Vacation week - No classes	
Week XX	11/20– 11/26		Vacation week - No classes	
	11/27	Discussion	F. Liu et al. Genetics 1999	
Week 13	11/27		Plant conservation. Special problems in plants.	399–419
	11/29		Conservation strategies	419–433
	12/4	Discussion	N. C. Ellstrand and K. A. Schierenbeck 2000 AND L. H. Reiseberg 1991	
Week 14	12/4		Organelle origin and genome evolution	Handout
	12/6		Chloroplast evolution - parasitic plants	Handout
	12/11	Discussion	C. W. dePamphilis and J. D. Palmer 1990 AND K. H. Wolfe et al. 1992	
Week 15	12/11		Open Topic	
	12/13		Open Topic	

Discussion Papers

Date	Discussion Leader	**Topic** / Paper
9/4	XXXX	**Labor Day**
9/11		**Species concepts I**. D. A. Levin. 1979. The nature of plant species. Science 204: 381–384
9/18		**Species concepts II**. N. D. Young. 1998. Pacific coast *Iris* species delimitation using three species definitions: biological, phylogenetic, and genealogical. Biological Journal of the Linnean Society 63: 99–120.
9/25		**Morphological diversity within species: phenotypic plasticity**. J. Schmitt, S. A. Dudley, and M. Pigliucci. 1999. Manipulative approaches to testing adaptive plasticity: phytochrome-mediated shade-avoidance response in plants. American Naturalist 154: S43–S54.

10/2		**Genetic diversity within species**. D. R. Ayres and F. J. Ryan. 1990. Genetic diversity and structure of the narrow endemic *Wyethia reticulata* and its congener *W. bolanderi* (Asteraceae) using RAPD and allozyme techniques. American Journal of Botany 86: 344–353.
10/9		**Allopatric speciation**. V. Grant. 1993. Origin of floral isolation between ornithophilous and sphingophilous plant species. Proceedings of the National Academy of Sciences, USA 90: 7729–7733. AND M. Fulton and S. A. Hodges. 1999. Floral isolation between *Aquilegia formosa* and *Aquilegia pubescens*. Proceedings of the Royal Society of London, Biological Sciences 266: 2247–2252.
10/16	Guest Leader Steve Brunsfeld	**Hybridization and introgression**. T. M. Hardig, S. J. Brunsfeld, R. S. Fritz, M. Morgan, and C. M. Orians. 2000. Morphological and molecular evidence for hybridization and introgression in a willow (*Salix*) hybrid zone. Molecular Ecology 9: 9–24.
10/23	XXXX	**No discussion - Exam**
10/30		**Chromosomal change and speciation**. H. Lewis. 1973. The origin of diploid neospecies in *Clarkia*. The American Naturalist 107: 161–170.
11/6	Guest Leader Linda Cook	**Polyploidy**. L. M. Cook, P. S. Soltis, S. J. Brunsfeld, and D. E. Soltis. 1998. Multiple independent formations of *Tragopogon* tetraploids (Asteraceae): evidence from RAPD markers. Molecular Ecology 7: 1293–1302.
11/13		**Plant breeding systems and species delimitation**. E. A. Kellogg. 1990. Variation and species limits in agamospermous grasses. Systematic Botany 15: 112–123.
11/20	XXXX	**Vacation**
11/27		**Plant breeding systems: consequences**. F. Liu, D. Charlesworth, and M. Kreitman. 1999. The effect of mating system differences on nucleotide diversity at the phosphoglucose isomerase locus in the plant genus *Leavenworthia*. Genetics 151: 343–357.
12/4		**Special problems in plant conservation**. N. C. Ellstrand and K. A. Schierenbeck. 2000. Hybridization as a stimulus for the evolution of invasiveness in plants? Proceedings of the National Academy of Sciences, USA 97: 7043–7050. AND L. H. Rieseberg. 1991. Hybridization in rare plants: insights from case studies in *Cercocarpus* and *Helianthus.* Pp. 171–181 in Genetics and Conservation of Rare Plants, D. A. Falk and K. E. Holsinger, eds. Oxford University Press.
12/11		**Chloroplast genome of the achlorophyllous plant *Epifagus***. C. W. dePamphilis and J. D. Palmer. 1990. Loss of photosynthetic and chlororespiratory genes from the plastid genome of a parasitic flowering plant. Nature 348: 337–339. AND K. H. Wolfe, C. W. Morden, and J. D. Palmer. 1992. Function and evolution of a minimal plastid genome from a nonphotosynthetic parasitic plant. Proceedings of the National Academy of Sciences, USA 89: 10648–10652.