

SYLLABUS

BIO 349/PBC 402: Plant Community Ecology Spring 2009

Time: T & Th 12:30 – 1:50
Location: Tech A110

Contact information

INSTRUCTOR: Dan Larkin • EMAIL: dlarkin@chicagobotanic.org • PHONE: 847-835-6931
OFFICE HOURS by appointment Tues. or Thurs. (around class meeting time preferred), currently in Hogan G140-B (David Taylor's office)

Course description

How many species are in a given habitat? Why these species and not others? How do they interact with each other? What controls their abundances? How is their distribution in space influenced by environmental conditions?

These are some of the broad questions addressed in **COMMUNITY ECOLOGY**, which investigates how interactions within species, between species, and between species and their environments influence community structure. Community ecology is at the center of the classic ecological hierarchy (populations → communities → ecosystems) and its tools and principles are essential for understanding the natural world:

Ecology is the science of communities. A study of the relations of a single species to the environment and conceived without reference to communities and, in the end, unrelated to the natural phenomena of its habitat and community associations is not properly included in the field of ecology.

– Victor Shelford 1929

Required text

Gurevitch, J, SM Scheiner, GA Fox. 2006. The Ecology of Plants. Sinauer Associates, Inc., Sunderland, MA. 574 pp.

Learning goals

By the end of the quarter, you should:

- Have an understanding of...
 - THE HISTORY OF PLANT COMMUNITY ECOLOGY (PCE), w/ emphasis on key figures and controversies.
 - PLANT COMMUNITY DYNAMICS, e.g., competition, zonation, succession, etc.
 - BROADER CONTROLS ON PLANT COMMUNITIES, such as disturbances, environmental factors, and trophic interactions.
 - CENTRAL THEORIES OF PCE: Community concept, plant adaptive strategies, diversity-function relationships, etc.
 - PLANT CONSERVATION ISSUES in the context of fundamental ecological principles.
- Be comfortable with ANALYTICAL TOOLS used to summarize/interpret plant community data.
- Have advanced your SKILLS IN READING AND SUMMARIZING ecological literature.
- Have gained confidence in making ORAL AND WRITTEN SCIENTIFIC PRESENTATIONS.

Student responsibilities

The value of the course will be proportional to what you put into it. In order to achieve the above learning goals and excel in the course, I expect all students to:

- **Attend class:** Discussion and participation are critical components of the course. You must be present and on time. You may miss two classes without being penalized but, beyond that, you will lose points off of your final grade for each subsequent absence.
- **Read the assigned materials:** The reading assignments will lay the foundation for understanding lectures and being able to contribute to discussions.
- **Be attentive and participate:** Participation means joining discussions, playing an active role in group activities, and contributing your insights and questions. Please let me know when something is unclear to you. And please be courteous: no cell phones, crossword puzzles, etc.
- **Complete the required assignments on time:** The assignments are a key element to learning and keeping up with the material. Extensions require a true emergency and my approval.

Assignments and grading

We will have **IN-CLASS WRITING EXERCISES** designed to evaluate your understanding of the readings and to stimulate discussion. Graduate students will be **DISCUSSION LEADERS** for assigned readings from the primary literature. There will be a take-home **MID-TERM EXAM** and an in-class **FINAL EXAM**, both consisting of short essay questions. You will also write a **REVIEW PAPER** on a PCE-related topic --with graduate students given the option of working on a **RESEARCH PROPOSAL**.

Assignment	Weighting		Grade distribution	
	Under-grad	Grad		
Attendance and participation	200	200	94 - 100	A
In-class writing exercises	50	50	90 - <94	A-
Leading paper discussions (2)		200	86 - <90	B+
Mid-term exam	200	200	82 - <86	B
Final exam	200	200	80 - <82	B-
Review paper (research proposal option for PBC 402)	200	200	76 - <80	C+
			72 - <76	C
			70 - <72	C-
			60 - <70	D
			<60	F

Academic integrity

In science, we pay respect by citing the ideas and findings of others with proper attribution. Pretending that the insights or words of others are your own is disrespectful and dishonest. Plagiarism, cheating, fabrication, or other violations will not be tolerated and could result in a failing grade for the course and further disciplinary action. NU has excellent online information about academic integrity:

www.wcas.northwestern.edu/advising/integrity/index.html

Services for students with disabilities

Any student with a documented disability needing accommodations is requested to speak directly to the Office of Services for Students with Disabilities (847-467-5530, ssd@northwestern.edu) and to me as early as possible (preferably within the first 2 weeks of class). All discussions will remain confidential.

Weekly schedule

Week	Date	Topic	Reading* / Assignments
1	T 3/31	Introduction to the course and to plant community ecology	
	Th 4/2	History of PCE: Major figures, concepts, and controversies; the Clementsian paradigm	Morin 1999 Ch. 1, Clements 1936**
2	T 4/7	Gradient analysis, the continuum concept, and the rise of Gleasonianism	Gleason 1926**, Curtis and McIntosh 1951

Week	Date	Topic	Reading* / Assignments
	Th 4/9	Competition	Morin 1999 Ch. 2
3	T 4/14	Limits to competition: Heterogeneity, stress, and facilitation	Pennings and Callaway 1992, Callaway et al. 2002
	Th 4/16	Plant strategies	Grime 1979**
4	T 4/21	Plant functional adaptations	Reich et al. 2003**, Falster and Westoby 2005
	Th 4/23	Guest lecture by Pam Geddes (NEIU): <i>Why is the world green?</i>	Morin 1999 Ch. 6, Knight et al. 2005
5	T 4/28	Plant trophic strategies: Mutualism, allelopathy, herbivore defense	van der Heijden et al. 1998, Strauss et al. 2002, Callaway and Ridenour 2004**
	Th 4/30	Large-scale PCE: Island biogeography, assembly, neutrality, and metacommunities	Morin 1999 Ch. 11, Leibold et al. 2004**
6	T 5/5	Guest lecture by Shane Lishawa (Loyola): Succession	Morin 1999 Ch. 13; Take-home midterm exam handed out
	Th 5/7	Effects of disturbance	Hobbs and Huenneke 1992**, Turner et al. 1998
7	T 5/12	Biodiversity-stability-function debates	Morin 1999 Ch. 12, Levine 2000, Loreau et al. 2001; Midterm exam due in class
	Th 5/14	Invasive plant species: Causes and consequences	Davis et al. 2000, MacDougall and Turkington 2005**
8	T 5/19	Biotic homogenization and the vanishing present	Rooney et al. 2004**, Olden 2006
	Th 5/21	Climate change and the future of plant communities	Voigt et al. 2003**, Hawkins et al. 2008 Ch. 3-5
9	T 5/26	Applied PCE I: Restoration Ecology	Zedler and Callaway 1999, Seabloom et al. 2003**
	Th 5/28	Applied PCE II: Non-linearity, feedbacks, and alternative states	Suding et al. 2004**
10	T 6/2	No class – reading week	
	Th 6/4	Field trip to McDonald Woods (CBG) – <u>OPTIONAL</u>	
11	F 6/12	In-class FINAL EXAM: 12:00-2:00	Review paper due

* The read-by date. e.g., read Clements 1936 *before* our 4/7 meeting.

** Grad student led discussion

Citations for readings

- Callaway, R. M., R. W. Brooker, P. Choler, Z. Kikvidze, C. J. Lortie, R. Michalet, L. Paolini, F. I. Pugnaire, B. Newingham, E. T. Aschehoug, C. Armas, D. Kikodze, and B. J. Cook. 2002. Positive interactions among alpine plants increase with stress. *Nature* 417:844-848.
- Callaway, R. M., and W. M. Ridenour. 2004. Novel weapons: invasive success and the evolution of increased competitive ability. *Frontiers In Ecology And The Environment* 2:436-443.
- Clements, F. E. 1936. Nature and structure of the climax. *Journal of Ecology* 24:252-284.
- Curtis, J. T., and R. P. McIntosh. 1951. An upland forest continuum in the prairie-forest border region of Wisconsin. *Ecology* 32:476-496.
- Davis, M. A., J. P. Grime, and K. Thompson. 2000. Fluctuating resources in plant communities: a general theory of invasibility. *Journal of Ecology* 88:528-534.
- Falster, D. S., and M. Westoby. 2005. Alternative height strategies among 45 dicot rain forest species from tropical Queensland, Australia. *Journal of Ecology* 93:521-535.
- Gleason, H. A. 1926. The individualistic concept of the plant association. *Bulletin of the Torrey Botanical Club* 53:7-26.

- Grime, J. P. 1979. Chapter 1. Primary strategies in the established phase. Pages 7-55 in J. P. Grime, editor. *Plant Strategies and Vegetation Processes*. John Wiley & Sons, New York.
- Hawkins, B., S. Sharrock, and K. Havens. 2008. *Plants and climate change: which future?*, Botanic Gardens Conservation International, Richmond, UK.
- Heneghan, L., J. Steffen, and K. Fagen. 2007. Interactions of an introduced shrub and introduced earthworms in an Illinois urban woodland: Impact on leaf litter decomposition. *Pedobiologia* 50:543-551.
- Hobbs, R. J., and L. F. Huenneke. 1992. Disturbance, diversity, and invasion: Implications for conservation. *Conservation Biology* 6:324-337.
- Knight, T. M., M. W. McCoy, J. M. Chase, K. A. McCoy, and R. D. Holt. 2005. Trophic cascades across ecosystems. *Nature* 437:880-883.
- Leibold, M. A., M. Holyoak, N. Mouquet, P. Amarasekare, J. M. Chase, M. F. Hoopes, R. D. Holt, J. B. Shurin, R. Law, D. Tilman, M. Loreau, and A. Gonzalez. 2004. The metacommunity concept: a framework for multi-scale community ecology. *Ecology Letters* 7:601-613.
- Levine, J. M. 2000. Species diversity and biological invasions: Relating local process to community pattern. *Science* 288:852-854.
- Loreau, M., S. Naeem, P. Inchausti, J. Bengtsson, J. P. Grime, A. Hector, D. U. Hooper, M. A. Huston, D. Raffaelli, B. Schmid, D. Tilman, and D. A. Wardle. 2001. Ecology - Biodiversity and ecosystem functioning: Current knowledge and future challenges. *Science* 294:804-808.
- MacDougall, A. S., and R. Turkington. 2005. Are invasive species the drivers or passengers of change in degraded ecosystems? *Ecology* 86:42-55.
- Madritch, M. D., and R. L. Lindroth. 2009. Removal of invasive shrubs reduces exotic earthworm populations. *Biological Invasions* 11:663-671.
- Morin, P. J. 1999. *Community Ecology*. Blackwell Science, Malden, MA.
- Olden, J. D. 2006. Biotic homogenization: a new research agenda for conservation biogeography. *Journal of Biogeography* 33:2027-2039.
- Pennings, S. C., and R. M. Callaway. 1992. Salt marsh plant zonation: The relative importance of competition and physical factors. *Ecology* 73:681-690.
- Reich, P. B., I. J. Wright, J. Cavender-Bares, J. M. Craine, J. Oleksyn, M. Westoby, and M. B. Walters. 2003. The evolution of plant functional variation: Traits, spectra, and strategies. *International Journal of Plant Sciences* 164:S143-S164.
- Rooney, T. P., S. M. Wiegmann, D. A. Rogers, and D. M. Waller. 2004. Biotic impoverishment and homogenization in unfragmented forest understory communities. *Conservation Biology* 18:787-798.
- Seabloom, E. W., W. S. Harpole, O. J. Reichman, and D. Tilman. 2003. Invasion, competitive dominance, and resource use by exotic and native California grassland species. *Proceedings of the National Academy of Sciences of the United States of America* 100:13384-13389.
- Strauss, S. Y., J. A. Rudgers, J. A. Lau, and R. E. Irwin. 2002. Direct and ecological costs of resistance to herbivory. *Trends in Ecology & Evolution* 17:278-285.
- Suding, K. N., K. L. Gross, and G. R. Houseman. 2004. Alternative states and positive feedbacks in restoration ecology. *Trends in Ecology & Evolution* 19:46-53.
- Turner, M. G., W. L. Baker, C. J. Peterson, and R. K. Peet. 1998. Factors influencing succession: Lessons from large, infrequent natural disturbances. *Ecosystems* 1:511-523.
- van der Heijden, M. G. A., J. N. Klironomos, M. Ursic, P. Moutoglis, R. Streitwolf-Engel, T. Boller, A. Wiemken, and I. R. Sanders. 1998. Mycorrhizal fungal diversity determines plant biodiversity, ecosystem variability and productivity. *Nature* 396:69-72.
- Voigt, W., J. Perner, A. J. Davis, T. Eggers, J. Schumacher, R. Bahrman, B. Fabian, W. Heinrich, G. Kohler, D. Lichter, R. Marstaller, and F. W. Sander. 2003. Trophic levels are differentially sensitive to climate. *Ecology* 84:2444-2453.
- Zedler, J. B., and J. C. Callaway. 1999. Tracking wetland restoration: Do mitigation sites follow desired trajectories? *Restoration Ecology* 7:69-73.