COMMUNITY ECOLOGY - BISC 618

INSTRUCTOR - STEPHEN BREWER
CLASS TIME: 9:00 A.M. – 9:50 A.M., MWF
CLASS LOCATION: 114 SHOEMAKER
OFFICE - 412 SHOEMAKER, PH. 915-1077, HOURS – 9:50 to 10:30, AFTER CLASS, 1:00 to 2:00 P.M., WF OR BY APPOINTMENT
E-MAIL - JBREWER@OLEMISS.EDU

Course Description: This course examines the variables that determine the composition of multi-species assemblages in nature. Topics covered include succession, the climax community, biogeography, equilibrium and non-equilibrium concepts of species diversity, trophic cascades, community invasibility, community evolution, biodiversity-ecosystem function relationships and landscape ecology.

Prerequisites: General Ecology (BISC 322) or equivalent; An introductory statistics course is *strongly* recommended.

Expectations: All students will be introduced to the primary scientific literature in community ecology and will become familiar with current academic debates in the field. Knowledge and understanding of topics and issues in community ecology will be tested using a midterm and a final exam (together worth 80% of the final grade). Class discussions (worth 20% of the final grade) are designed to foster independent learning and thoughtful discussion of cutting edge topics in community ecology, which will be of significant value in an academic or other professional career.

OUTLINE FOR COMMUNITY ECOLOGY FALL 2014

History and Origin of Community Ecology

What is a Community?
Clements, Succession, and the Climax Community
The Environmental "Sieve" and Community Assembly Rules
Types of Interactions - Competition, Predation, Grazing, Facilitation, Parasitism, Mutualism

Niche Theory and Competition

- Niche Theory and Competitive Exclusion
  - Lotka-Volterra Predictions and Species Coexistence
  - Mechanisms of Resource Competition

Mechanisms of Species Coexistence

- What is Species Diversity?
- Beyond Expectations: The Reality of Species-Rich Communities
- The Maintenance of Species Diversity I. Local Species Coexistence
  - Niches and Trade-Offs
    - Environmental Heterogeneity and Niche Partitioning
      - The Resource-Ratio Hypothesis
    - Density- and Frequency-Dependent Mortality and Apparent Competition: Effects of Pathogens and Predators
  - Disturbance-Mediated Coexistence and the Rate of Competitive Displacement
    - Intermediate Disturbance Hypothesis
    - Huston's Dynamic Equilibrium Hypothesis
    - Direct Regeneration Following Disturbance
    - Neutral Theory and Lottery Models: Coexistence of Competitively-Equivalent Species
    - The Storage Effect
  - The Stress Gradient Hypothesis
    - The Relative Importance of Competition and Positive Interactions along Stress Gradients
  - Reconciling Disturbance/Stress Hypotheses with Equilibrium Coexistence Theory
    - Disturbance-Mediated Competition
    - Frequency vs. Intensity of Competitive Interactions along Stress Gradients
- The Maintenance of Species Diversity II. Regional Species Coexistence
  - Metacommunities
    - Review of Levins' Metapopulation Model
    - Extension to Two or More Species
      - Spatial Heterogeneity and Coexistence of Metapopulations
      - Competition, Dispersal, Available Habitat, and the Fugitive Concept
  - Island and Continental Biogeography
    - Species-Area Relations
    - The Equilibrium Theory of Island Biogeography

Evolutionary Perspectives on Community Ecology – The Origin of Species Diversity

- Convergent Evolution, Phylogenetic Conservatism, and Community Assembly
- Coevolution of Communities

Top-Down vs. Bottom-Up Control of Communities

Food Web Theory
Trophic Cascades
Menge and Sutherland's Model

Applied Community Ecology

Relevance of Diversity Feedbacks to Biological Invasions
    Diversity and Community Invasibility
    Random versus Non-Random Species Losses
Species Diversity Feedbacks on Ecosystem Processes
    Diversity and Productivity
    Problems with Diversity Experiments
    The Insurance Hypothesis and Community Bet-Hedging
Relevance of Species Diversity to Biodiversity Conservation
    Diversity and Ecosystem Services
    Local, Regional, and Global Declines in Diversity

EXAMINATIONS

There will be two essay-type take-home exams. The first will be assigned at mid-term, the second near the end of the semester. You will be required to cite references and include an annotated bibliography with each answer.

Grades

Mid-Term Exam - 40%
Final Exam - 40%
Leading Class Discussion on Assigned Readings (Four to Six Papers) – 20%

ASSIGNED READING FOR COMMUNITY ECOLOGY

History and Origin of Community Ecology: Do Communities Exist?

August 29

Booth B.D. and D.W. Larson. 1999. Impact of language, history, and choice of system on the study of assembly rules. Pp. 206-229.

Connell, J.H. and R.O. Slatyer. 1977. Mechanisms of succession in natural communities and their role in community stability and organization. Amer. Nat. 111:1119-1144.

Sept. 5

Dull, R.A., Nevle, R.J, Woods, W.I., Bird, D.K., Avnery, S. and William M. Denevan, W.M. 2010. The Columbian Encounter and the Little Ice Age: Abrupt Land Use Change, Fire, and Greenhouse Forcing, Annals of the Association of American Geographers, 100:755-771.

Chapman, H. H. 1932. Is the longleaf type a fire climax? Ecology 13:328-324.

Surrette, S.B., J.S. Brewer and S.M. Aquilani. 2008. Current and historical composition and size structure of upland forests across a soil gradient in north Mississippi. Southeastern Naturalist 7:27-48.

Niche Theory, Competition, and Positive Interactions

Sept. 10

Stress Tolerance, Competition, and Positive Interactions

Bertness 1991 - Zonation of *Spartina patens* and *Spartina alterniflora* in a New England salt marsh. Ecology 72:138-148.

Booth, M.G. and J.D. Hoeksema. 2010. Mycorrhizal networks counteract competitive effects of canopy trees on seedling survival. Ecology 91:2294-2302.

Sept. 17

Mechanisms of Resource Competition

Dybzinski, R. and D. Tilman. 2007. Resource use patterns predict long-term outcomes of plant competition for nutrients and light. American Naturalist 170:305-318.

Brewer, J. S. 2003. Why don't carnivorous pitcher plants compete with non-carnivorous plants for nutrients? Ecology 84:451-462.

Mechanisms of Local Species Coexistence

Sept 24

Density-Dependent Predation and Disease

Paine, R. T.1966. Food web complexity and stability. American Naturalist 100:65-75.

Klironomos, JN. 2002. Feedback with soil biota contributes to plant rarity and invasiveness in communities. Nature 417 (6884) 67-70.

Sept 29

Disturbance-Mediated Coexistence; Rates of Competitive Displacement

Brewer J.S., C.A. Bertz, J.B. Cannon, J.D. Chesser, and E.E. Maynard. 2012. Do natural disturbances or the forestry practices that follow them convert forests to early-successional communities? Ecological Applications 22:442–458.

Beckage, B., W.J. Platt, and L.J. Gross. 2009. Vegetation, fire, and feedbacks: a disturbance-mediated model of savannas. American Naturalist v. 174.

Oct 1 - Midterm Exam - Handed Out

Oct. 3

Reconciling Disturbance/Stress Hypotheses with Equilibrium Coexistence Theory

Brewer, J.S. 2011. Disturbance-mediated competition between perennial plants along a resource-supply gradient. Journal of Ecology 99:1219-1228.

Hart, S. P. and D. J. Marshall 2013. Environmental stress, facilitation, competition, and coexistence. Ecology 94:2719–2731.

Oct 8 - Midterm Exam Due

Coexistence of Competitively Equivalent Species

Stevens, M.H.M. and W.P Carson. 1999. Plant density determines species richness along an experimental fertility gradient. Ecology 80:455-465.

Adler, P.B., S.P. Ellner, and J.M. Levine. 2010. Coexistence of perennial plants: an embarrassment of niches. Ecology Letters 13:1019-1029.

Metacommunities and Regional Species Coexistence

Oct. 15

Spatial Competition and Species Coexistence

Nee, S. and R.M. May. 1992. Dynamics of metapopulations: habitat destruction and competitive coexistence. J. of Animal Ecology 61:37-40.

Island Biogeography

Lomolino, M. V., J. H. Brown, and R. Davis. 1989. Island biogeography of montane forest mammals in the American Southwest. Ecology 70:180-194.

Oct. 20 and 22 - NO LECTURE; Brewer away at conference.

Evolutionary Perspectives on Community Ecology
Oct 27

Losos, J.B. 1996. Phylogenetic perspectives on community ecology. Ecology 77:1344-1354.

Callaway, R.M., J.L. Hierro, and A.S. Thorpe. Evolutionary trajectories in plant and soil microbial communities: Centaurea invasions and the geographic mosaic of coevolution. Chapter 13, pp. 341-363.

Top-Down vs. Bottom-Up Control of Community Structure
Nov 3

Terborgh, J. et al. 2001. Ecological meltdown in predator-free forest fragments. Science 294:1923-1926.

Kurten, E. L. 2013. Cascading effects of contemporaneous defaunation on tropical forest communities. Biological Conservation 163:22-32.

Applied Community Ecology

Relevance of Diversity Feedbacks to Biological Invasions

Nov 10

Zavaleta, E.S. and K.B. Hulvey. 2004. Realistic species losses disproportionately reduce grassland resistance to biological invaders. Science 306: (Nov 12) 1175-1177.

Brewer, J.S. 2010. A potential conflict between preserving regional plant diversity and biotic resistance to an invasive grass, *Microstegium vimineum*. Natural Areas Journal 30:279-293.

Relevance of Diversity Feedbacks to Ecosystem Processes

Nov 17

Flombaum, P. and O.E. Sala. 2008. Higher effect of plant species diversity on productivity in natural than artificial ecosystems. PNAS 105:6087-6090.

Smith, M.D. and A.K. Knapp. 2003. Dominant species maintain ecosystem function with non-random species loss. Ecology Letters 6:509-517.

Dec 1 – Final Exam Handed Out

Relevance of Species Diversity to Conservation

Dec. 5

Schwartz, M.W., C.A. Brigham, J.D. Hoeksema, K.G. Lyons, M.H. Mills, and P.J. van Mantgem. 2000. Linking biodiversity to ecosystem function: implications for conservation ecology. Oecologia 122:297–305. **Library**

Velland, M. and 8 others. 2013. Global meta-analysis reveals no net change in local-scale plant biodiversity over time. PNAS 110:19456-19459.

Dec. 10 - Final Exam Due (11:00 am, Wednesday)