

Grassland Ecology: PLB 440. Lecture Outlines & Reading List 2005.

Textbooks:

Gibson, D.J. in preparation. Introduction to Grasses and Grassland Ecology. Oxford University Press. Draft chapters available at: <http://www.science.siu.edu/plant-biology/Faculty/Gibson/grassbk/index.html> .

Ladd, D. 1995. Tallgrass Prairie Wildflowers, Falcon., Guildford, CT. Recommended field guide.

Manning, R. 1995. Grassland. Penguin Books, London. This book is required.

Note: Some of the references listed below in which I am an author are available as a pdf from my web page under Research or Publications: <http://www.science.siu.edu/plant-biology/Faculty/Gibson/index.html>

Introduction

Outline:

- 1) Introduction to course.
- 2) Grasslands – definition, extent, and use.

References:

White, R., Murray, S. and Rohweder, M. (2000). Pilot Analysis of Global Ecosystems: Grassland Ecosystems Technical Report. World Resources Institute, Washington, D.C.

http://forests.wri.org//pubs_description.cfm?PubID=3057

World resources 2000-2001 (2000). People and ecosystems: the fraying web of life. World Resources Institute in collaboration with the United Nations Development Programme, The United Nations Environment Programme, and the World Bank, Washington, DC.

<http://wri.igc.org/wr2000/index.html>

Morphology

Outline:

- 1) Structure of the common Oat (*Avena sativa*).
- 2) The grass seedling, and roots.
- 3) Duration, growth forms, and culms.
- 4) Leaves: sheaths, ligules, and blades.
- 5) Flower-head or inflorescence.
- 6) Spikelets.
- 7) Slides of grasses.

References:

- Bews, J. W. 1929. *The World's Grasses*. Russel & Russel. NY.
- Chapman, G.P. & Peat, W.E. 1992. *An introduction to the grasses*. CAB International, Wallingford, UK.
- Clark, L.G., & J.B. Fisher. 1987. Vegetative morphology of grasses: shoots and roots. In: *Grass Systematics and Evolution* (T.R. Soderstrom, K.W. Hilu, C.S. Campbell, & M.E. Barkworth, eds.). Smithsonian Institution Press, Washington DC. p37-48.
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- Gould, F.W., & R.B. Shaw. 1983. *Grass Systematics*, 2nd ed. Texas A&M University Press, College Station, TX.
- Hitchcock, A.S. 1950 (1971 reproduction). *Manual of the Grasses of the United States*, 2dn ed. Volumes 1 & 2. Dover Publications Inc., New York.
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Classification

Outline:

- 1) Historical development of grass classification.
- 2) Hitchcock versus Gould.
- 3) Subfamilies & Tribes.
 - a) Summary by species; US & IL.
 - b) Photosynthetic pathways.
 - c) Pooideae.
 - d) Panicoideae.
 - e) Chlorideae.
 - f) Bambusoideae.
 - g) Oryzoideae.
 - h) Arundinoideae.

References:

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- Chapman, G.P. & Peat, W.E. 1992. *An introduction to the grasses*. CAB International, Wallingford, UK.
- Ellis, R.P. 1987. A review of comparative leaf blade anatomy in the systematics of the Poaceae: The past twenty-five years. In: *Grass Systematics and Evolution* (T.R. Soderstrom, K.W. Hilu, C.S. Campbell, & M.E. Barkworth, eds.). Smithsonian Institution Press, Washington DC. p3-10.
- Gould, F.W., & R.B. Shaw. 1983. *Grass Systematics*, 2nd ed. Texas A&M University Press, College Station, TX.
- Hitchcock, A.S. 1950 (1971 reproduction). *Manual of the Grasses of the United States*, 2nd ed. Volumes 1 & 2. Dover Publications Inc., New York.
- Mohlenbrock, R.H. 1972. *The Illustrated Flora of Illinois: Grasses: Panicum to Danthonia*. Southern Illinois University Press, Carbondale & Edwardsville, IL.
- Mohlenbrock, R.H. 1972. *The Illustrated Flora of Illinois: Grasses: Bromus to Paspalum*. Southern Illinois University Press, Carbondale & Edwardsville, IL.

Evolution

Outline:

- 1) Relationships of the Poaceae.
- 2) When the Poaceae evolved.
- 3) Conditions under which the Poaceae differentiated from other families.
- 4) Differentiation of the subfamilies.
- 5) Evolutionary relationships among the subfamilies.

References:

- Gould, F.W., & R.B. Shaw. 1983. Grass Systematics, 2nd ed. Texas A&M University Press, College Station, TX.
- Grass Phylogeny Working Group. 2000. Phylogeny and subfamilial classification of the grasses (Poaceae). <http://www.virtualherbarium.org/grass/gpwg/default.htm> .
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- Stebbins, G.L. 1982. Major trends of evolution in the Poaceae and their possible significance. In: Grasses and Grasslands: Systematics and Ecology (J.R. Estes, R.J. Tyrl & J.N. Brunken, eds.). Univ. of Oklahoma Press, Norman, OK. pp 3-36.
- Stebbins, G.L. 1987. Grass systematics and evolution: Past, present and future. In: Grass Systematics and Evolution (T.R. Soderstrom, K.W. Hilu, C.S. Campbell, & M.E. Barkworth, eds.). Smithsonian Institution Press, Washington DC. p359-367.
- Thomasson, J.R. 1987. Fossil grasses: 1820-1986 and beyond. In: Grass Systematics and Evolution (T.R. Soderstrom, K.W. Hilu, C.S. Campbell, & M.E. Barkworth, eds.). Smithsonian Institution Press, Washington DC. p159-167.
- Zhang, W. 2000. Phylogeny of the grass family (Poaceae) from *rpl16* intron sequence data. *Molecular Phylogenetics and Evolution* 15: 135-146.

World Grasslands

Outline:

1. Climate
2. Soil
3. Topography
4. Biotic factors & fire.
5. Major World Grasslands:
 - Highgrass tropical savanna
 - Tropical & subtropical bunchgrass savannas
 - Tropical mountain grasslands
 - Temperate & alpine meadows
 - Temperate pastures
 - Temperate climax grasslands a) N. American, b) Russian steppe c) Grasslands associated with evergreen sclerophyllous vegetation, d) Temperate grasslands of the southern hemisphere
 - Semi-desert and desert grasslands
6. The Serengeti

References:

- Belesky, A.J. 1986. Revegetation of artificial disturbances in grasslands of the Serengeti National Park, Tanzania. *Journal of Ecology* 74: 937-951.
- Belsky, A.J. 1988. Regional influences on small-scale vegetational heterogeneity within grasslands in the Serengeti National Park, Tanzania. *Vegetatio* 74: 3-10.
- Bews, J. W. 1929. *The World's Grasses*. Russel & Russel. NY.
- Bourliève, F. 1983. Tropical savanna. *Ecosystems of the World* 13. Elsevier, Amsterdam.
- Breymeyer, A.I. 1990. Managed grasslands: regional studies. *Ecosystems of the World* 17A. Elsevier, Amsterdam.
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- Coupland, R.T. 1993. Natural grasslands: Eastern hemisphere and résumé. *Ecosystems of the World* 8B. Elsevier, Amsterdam.
- Hnatiuk, R.J. 1993. Grasslands of the sub-antarctic islands. In: R.T. Coupland (ed.) *Natural grasslands: Eastern hemisphere and résumé*. *Ecosystems of the World* 8B. Elsevier, Amsterdam. p411-434.
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- Snaydon, R.W. 1997. *Managed Grassland: Analytical studies*. *Ecosystems of the World* 17B. Elsevier, Amsterdam.

North American Grasslands

Outline:

- 1) History, origin, and climate.
- 2) True Prairie (*Stipa-Sporobolus*).
- 3) Coastal Prairie (*Stipa-Andropogon*).
- 4) Mixed Prairie (*Stipa-Bouteloua*).
- 5) Fescue Prairie (*Festuca* consociation).
- 6) Palouse Prairie (*Agropyron-Festuca*).
- 7) Pacific Prairie (*Stipa-Poa*).
- 8) Desert Plains Grassland (*Aristida-Bouteloua*).

References:

- Abrams, M.D. & D.J. Gibson. 1991. Effects of fire exclusion on tallgrass prairie and gallery forest communities in eastern Kansas. In: S.C. Nodvin & T.A. Waldrop (eds.) Fire and the environment: ecological and cultural perspectives. Southeastern Forest Experiment Station, Asheville, NC. pp 3-10.
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- Whitcomb, R.F. 1987. North american forests and grasslands: biotic conservation. In: (eds. D.A. Saunders, G.W. Arnold, A.A. Burbridge, & A.J.M. Hopkins) Nature Conservation: The role of remnants of native vegetation. Surry Beatty & Sons Pty. Ltd. in assoc with CSIRO and CALM, Australia. pp163-176.

Illinois Grasslands

Outline:

- 1) Original extent.
- 2) Tallgrass prairie.
- 3) Sand prairies.
- 4) Hill prairies & barrens.

References:

- Anderson, R.C. 1970. Prairies in the prairie state. *Trans. Ill. Acad. Sci.*, 63: 214-221.
- Anderson, R.C. 1970. Prairie history, management and restoration in Southern Illinois. In: (J.H. Zimmerman, ed.) Proceedings of the second midwest Prairie Conference, Univ. Wisconsin, Madison, Wisconsin. pp 15-21.
- Anderson, R.C. 1991. Illinois prairies: A historical perspective. *Illinois Nat. Hist. Surv. Bull.* 34: 384-391.
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Disturbance

Outline:

1. Disturbance defined
2. Types of Disturbance
3. Patch Dynamics Perspective

- Briggs, J.M. & Knapp, A.K. 1995. Interannual variability in primary production in tallgrass prairie: climate, soil moisture, topographic position and fire as determinants of aboveground biomass. *American Journal of Botany* 82: 1024-1030.
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- Grime, J.P. 1979. Plant strategies and vegetation processes. Wiley Interscience, Chichester, UK.
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Range Management

Outline:

- 1) History
- 2) Range-condition evaluation.
- 3) Literature examples.

References:

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- Jensen, P.N. & C.M. Schumacher. 1969. Changes in prairie plant composition. *J. Range Mgt.* 22: 57-60.
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- Stoddart, L.A., A.D. Smith, & T.W. Box. 1975. Range Management, 3rd ed. McGraw-Hill Book Co., New York.
- Westoby, M., Walker, B., & I. Noy-Meir. 1989. Opportunistic management for rangelands not at equilibrium. *J. Range Mgt.*, 42: 266-274.

Fungal Associates: Mycorrhizae and endophytes

Outline:

- 1) What are mycorrhizae?
- 2) Effects on grasslands.
- 3) Endophytes.
- 4) Effects on grasslands.

References:

- Allen, M.F. 1991. *The Ecology of Mycorrhizae*. Cambridge University Press, Cambridge, UK.
- Anderson, R.C., A.E. Liberta, & L.A. Dickman. 1984. Interaction of vascular plants and vesicular-arbuscular mycorrhizal fungi across a soil moisture-nutrient gradient. *Oecologia* 64: 111-117.
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- Spyreas, G., Gibson, D.J., & Basinger, M. 2001. Endophyte infection levels of native and naturalized Fescues in Illinois and England. *Journal of the Torrey Botanical Society*, 128: 25-34.

Ecotypes: Genecology of Grasses

Outline:

1. Polyploidy

- Chromosome numbers in Poaceae.
- *Themeda triandra* in S. Africa.
- North American Prairie.

2. Ecotypes

- Heavy metal tolerance.
- Flowering times in the Gt. Plains.
- *Koeleria cristata*.
- Molecular sampling of Arkansas and IL *Andropogon gerardii*.

References:

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Physiology: Photosynthesis

Outline:

1. Pathways of CO₂ uptake.
2. Ecological examples:
 - Photosynthetic rates
 - C₃ vs. C₄ distributions.
 - Global Warming.

References:

- Archer, S. 1984. The distribution of photosynthetic pathway types on a mixed-grass prairie hillside. *American Midland Naturalist* 111: 138-142.
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The Park Grass Experiment

Outline:

1. History.
2. Stability.
3. Trends and outbreaks.
4. Explanatory variables.
5. Resource ratios.
6. Evolution.

References:

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Modelling

Outline:

1. What models are.
2. The CENTURY model.
3. The Hurley Pasture model.
4. Schwinning & Parson's grass-legume model.
5. ECOTONE and invasive weeds in grasslands.

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Online sources:

Century model: <http://www.nrel.colostate.edu/projects/century5>

Hurley Pasture model: <http://www.nbu.ac.uk/efm/pasture.htm>