LANDSCAPE ECOLOGY SYLLABUS 2007

FRWS 6710-7710

John A. Bissonette

SPECIAL NOTE:

All materials and information for this class can be found on the class website, arranged as labeled modules, and accessed through the USU library class reserve site. **Reading assignments and all other information will be given on the web site Discussion Board**. Please do not post anything on the Discussion Board. That is reserved for Assignments. New information can be posted at any time so you must check this daily for updates on assignments. You can access the electronic reserves by bookmarking http://eres.usu.edu. The password is "Bis7710". If you are a MS student you should be enrolled for call number 13515 WILD 6710, if you are a Ph.D student enroll for call number 13528 WILD 7710. Starting on page 9 of this syllabus is information about student rights and responsibilities that you should read. The information can also be found on the USU URL:

http://www.usu.edu/aia/ACADEMIC/syllabusres.cfm

CALENDAR

Class is on Tuesdays and Thursdays from 10:30 to 11:45 in Engineering Rm 304. The class meets on the following dates: January 9, 11, 16, 18, 23, 25, 30, February 1, 6, 8, 13, 15 (no class on 20th go to Monday 19th classes) 22, 27. There will be no class March 1 Thursday, I will be out of town. March classes are 6, 8, with the Spring Break the week of the 19th-23rd March. Classes resume March 27, 29, April 3, 5, 12, 17, 19 (there will be no class on Monday 10 April; I will be in Tucson at the Landscape Ecology meetings). There are classes on 24th and 26th but this is no-test week. The final will be on 1 May from 9:30 to 11:30 in Engineering Rm 304.

COURSE SYNOPSIS:

This course will explore the concepts and precepts that underlie landscape ecology and are arranged into modules of different length and difficulty. The modules each include an introduction, usually in the form of a PowerPoint

presentation, required readings that will give you the necessary background to understand the material, optional readings that will enhance your knowledge of the subject matter, a discussion period to clarify important points that you may have questions about, and usually one or two written exercises that illustrate specific concepts related to the material. Our focus will be on learning appropriate theory, making distinctions between important concepts, and trying to understand how the respective roles of equilibrium concepts, such as competition, predation, and parasitism vs. the stochastic forces of anthropogenic and 'natural' disturbance regimes structure landscapes and animal communities. We will try to do this in a spatially and temporally sensitive way.

MODULES

A note on these modules: These modules reflect my best guess at what we will cover. The Landscape Ecology class is always a diverse group with very different backgrounds. My objective is to proceed at a reasonably fast pace, but with enough short reviews to cover baseline material that some of you have had but forgotten and that some of you may never have had formally. I have found that if I do not do some review of concepts that students need as background, your ability to grasp the concepts and put them into a workable framework is much more difficult. The basic concepts come from the reading. If you do not know something, look it up. I will often ask in class if you understand various concepts. If no one knows, then I know that I need to do a brief review. Your job is to be prepared; my job is to see that you understand. If we both work at it, the class should be worth your time.

OBJECTIVES FOR THIS CLASS

This class evolves each year in order to track recent developments in landscape ecology. I first gave this class as a seminar in 1988-89; it became a 3 credit class in 2000. This class is organized into several modules, each with a set of objectives. My overriding goal for you with this class is for you to understand enough about the underlying concepts and practice of landscape ecology so that when you read scientific papers and reports, or listen to presentations that involve landscape issues, you will be able to understand what was done and if it was done correctly, i.e., according to the latest accepted landscape ecological principles. At the end of the class you should be able to:

1) Sketch a brief history of the field of landscape ecology
   a) Be able to explain why landscape ecology developed as a separate field
   b) Understand and be able to explain the nature of causality. Be able to answer the question: "Why are there only middles?" when one talks about cause and effect. Be able to describe the difference between 'necessary' and 'sufficient causation' and why making the distinction is important.
      i) have a working knowledge of important definitions
2) Understand, explain, and discuss:
   a) What is a fact?
   b) What did Chamberlin say were the 3 phases of intellectual inquiry? What is the Strong Inference argument? What are its components? What is perhaps the one most important part of a strong inference approach? How does Weins EMS approach tie into strong inference? What are its limitations? What are Romesburgs three phases of 'gaining reliable knowledge?
   c) How are the concepts of multiple working hypotheses, classical scientific rigor, strong inference, ecological reality, and experimental model systems (EMS) are related, and how the idea of 'observation set' constrains ecological study results. You should be able to place these ideas into a realistic framework and be able to explain the benefits as well as the limitations of a classical, experimental approach to ecology
   d) What are the differences between induction, retroduction, and hypothetico-deductive methods in science
   e) The pre-requisites for falsifiability
   f) Make a coherent statement whey one can never 'prove' something in science, and explain what it is that we really do.
3) Understand and explain what hierarchy theory is.
   a) What is a hierarchy? How is hierarchical structuring achieved? Why has hierarchy theory has been proposed and is used as the foundation for explaining ecological complexity? What is the consequence of hierarchical structuring? What does the term "triadic" mean?"
      i) You should also be able to explain what number systems are, and explain in some detail the characteristics of the three number systems we discussed with an example of each. You should know what kinds of analyses are used in each?

b) You should understand the concept of 'transmutation' and be able to explain why the concept is important. You should be able to explain how the idea of transmutation related to extrapolation?

4) Understand the critical elements of the term 'scale'
   i) You should be able to explain the differences between interpolation and extrapolation and relate these concepts to landscape ecology and explain when is extrapolation used in landscape ecology. What is the assumption underlying extrapolation?
   b) You should be able to explain the terms 'resolution' and 'extent'
   c) You should be able to explain briefly how the term 'grain' has been used (from a study perspective, from an animal perspective, and from the actual patchiness of the landscape). You should know who argued what.
   d) You should be able to explain and distinguish between the terms/concepts of 'spatial & temporal scale' and hierarchical 'level'; at the same time you should be able to explain why the two should not be confused, and what is implied if they are.
   e) You should be able to explain what the term **scale sensitivity** means and distinguish between 'collective' and 'emergent' or scale-sensitive properties. You should be able to relate these ideas to hierarchical structuring.
   f) You should be able to define what a 'fact' is, and the implications of your definition.
   g) Finally, you should know what 'allometry' is and be able to connect that concept with the idea of viewing the landscape (grain or resolution) from an animal perspective

5) Understand and explain what a fractal is.
   a) You should be able to relate fractals to the idea of dimensions and be able to explain the difference between Euclidean and Fractal dimensions. Specifically you should be able to answer these questions: What are Euclidean dimensions? What is a Fractal dimension? What is the definition of a dimension that we developed in class? What is the geometry of nature? How can you tell? What arguments can you make to back up your assertion? What does the term 'self-similar' mean? What does the term 'self-affine' mean? What are interated function systems? What are some characteristics of fractals? Why fractals are useful for animal ecologists? (Sp use resources at different scales

because of allometric variation; A given landscape appears different for different species, i.e. different resource patterns on the same landscape; Fractal measurement a way of assessing resource availability at different scales; Visualization of resource density at many scales).

b) You should understand and be able to explain how fractals can be thought of as scaling exponents, and how, if thought of that way, can be related to the idea of viewing the landscape from an animal perspective. Further, you should be able to explain why this is critical for understand the primary lesson of 'scale'.

6) Understand and be able to explain the progression of idea of how landscapes have been viewed.
   a) Understand and be able to explain what the elements of landscape pattern are. Specifically, What are the elements of the landscape that can be measured? (Patches, matrix, and corridors) What are the different kinds of patches? (Disturbance, remnant, resource, introduced) Does the kind of patch make a difference? What effect does patch shape and size have on patch attributes? (Affects core areas-expand) How is the matrix defined? What are the different kinds of corridors? [Disturbance, matrix, natural, remnant, (line, strip, stream networks)] What is a matrix corridor? Is this a contradiction of terms? What is the default assumption about landscape pattern that seems to characterize most conservation biology studies? (They assume remnant patches. Why?)
   b) What effect does aspect have on landscape pattern? Describe the effect for Utah. Can you remember the equation? What is an azimuth? What is the shape of the index when graphed?
   c) Understand and be able to explain the consequences of the use of the 'schematic' or Island Biogeographic' view (an early observation set) of landscape pattern. What are the inherent limitations of this 'view'? You should be able to trace the idea of gradients in landscape pattern from its beginning to the current (2006) ideas of "Continuum and Umwelt", and be able to contrast and compare not only the importance of these ideas, but their benefits and limitations as workable concepts.
   d) What are the elements of the idea of fragmentation as a disruption in continuity? How is this concept different from just thinking of fragmentation as spatial? What insights can one gain by expanding the

idea of fragmentation? What does temporal fragmentation mean? Think about resource availability. Can they be spatially fragmented? Can they be temporally fragmented at the same time? What are the implications for animals trying to live in an environment where the habitat is spatially fragmented, and resources are both spatially and temporally fragmented. How might one study how animals respond to these concerns?

7) After completing these 6 modules, you should have the fundamentals for understanding the theoretical and practical basis for landscape ecology, and should be able to explain why landscape ecology has developed as a distinct science. The remaining modules will entail trying to place these concepts into a practical framework. You should be able to:
8) Understand the benefits and limitations of 'fragmentation' metrics.
   a) Specifically, you should be able to name and define the two basic categories of metrics; i.e., those that measure composition and those that measure spatial arrangement or 'configuration.
   b) You will need to know some basic statistics that are used in the problem sets for this section
   c) You should be able to explain what Boolean logic is and what Venn diagrams are and be able to distinguish between the different logical operators
   d) You should understand and be able to describe the major problem one encounters when using landscape metrics.
   e) You should also be able to name and briefly describe those metrics that are 'independent".
9) Understand the arguments regarding what structures the world?
   a) You should be able to distinguish between 'equilibrium" and 'non-equilibrium" theories of biodiversity. Specifically, you should know what the 'intermediate disturbance hypothesis' is and be able to explain how it 'structures' biodiversity. You should be able to define the following:
   b) **STATIC EQUILIBRIUM**: ABSOLUTE CONSTANCY OVER TIME
   c) **QUASI-STEADY STATE**: PERSISTENT VARIATIONS SMALL ENOUGH TO BE IGNORED
   d) **CLASSIC STATIC STABILITY**:CONSTANCY UNLESS DISTURBED ABILITY & TENDENCY TO RETURN TO A STATE OF CONSTANCY AFTER DISTURBANCE

e) **WHAT IS A DISTURBANCE REGIME?** CHARACTERIZES A LANDSCAPE, AND REFERS TO THE SPATIAL AND TEMPORAL DYNAMICS OF DISTURBANCES OVER LONGER TIME PERIODS
f) You should be able to differentiate between the idea of STABILITY and EQUILIBRIUM OR CONSTANCY. Use a diagram if you need to

10) It would be good to review: "S" & "T" parameters
   a) S = size of disturbance/ landscape extent
   b) T = disturbance interval / recovery time
   c) Implications when T = 1 (dynamic, recovery times = disturbance time); T < 1 (unstable); T > 1 (stable)
   d) S < 1 (relative smaller areas are disturbed); S = 1 (total area is disturbed)
   e) You should be able to relate to incorporation. What values of T and S would allow incorporation
11) You should know and understand what Milankovitch cycles and sun cycles are and what part they play in weather patterns over the long term. You should be able to defend your perception of what causes or is responsible for global warming.
   a) Understand and be able to discuss some of the papers that relate landscape patterns to species responses.
      i) What does it mean to say that a population is 'spatially structured'? We say a population is spatially structured when the population elements (animal distribution or habitat occupied is not contiguous.
      ii) What does it mean to say that a population shows 'spatially complicated population dynamics'? The population shows spatially complicated dynamics when average or mean values of reproduction, survivorship, recruitment, etc. do not apply to all parts of the population. Usually, but not always, spatially complicated dynamics are a result of spatial variability.
      iii) What are the three possibilities relative to spatial structure and spatially complicated dynamics?
12) Understand some of the philosophical bases for ecological thought.We will read some of the papers that discuss ecological 'laws'. You should understand, be able to define and explain concepts that may not have been familiar to you before. You should also be able to discuss why it is or is not important to 'have ecological laws'.

GRADING:

Grading is based on total accumulation of points, and will depend upon three to four in-class tests, the exercises and problem sets, on short spot quizzes, and on participation in class during discussion and including questions that you ask at the beginning of each class or during the discussion periods.

Sentient participation in class discussion is required. You will be expected to come to class having read the assignments and prepared to discuss the issues. At the beginning of class I will often ask you to write a brief, 5 minute answer to a question that we either have discussed previously or that comes from the reading. What I am expecting here is that as you read you will come across questions or ideas that are not fully answered or are not clear. Make a note of these questions and bring to class. Questions that probe the concepts we are discussing and show that you are thinking of the material will be reflected in your grade. At times, you will also be expected to lead class discussion focusing on specific readings. YOU WILL DO WELL IF YOU READ THE ASSIGNMENTS, THINK ABOUT THE ISSUES & ARE PREPARED TO DISCUSS THE ISSUES IN CLASS

Required reading for this class will include chapters from two books. The basic text that we will read from is Landscape Ecology in Theory and Practice: Pattern and Process. The second book is Learning Landscape Ecology and contains most of the exercises that we will do in the course. Both are available in the University bookstore. There are other books that address aspects of the subject; see the end of the syllabus for a partial list of other relevant books. I have also put manuscripts in PDF format on electronic course reserve for you. Not all will be assigned reading. Many are for additional information on subjects specific to the class that you may wish to look at.

REQUIRED CLASS TEXTS (you will use them as background and for take home exercises)

a) Gergel, S. E., and M. G. Turner. 2001. Learning Landscape Ecology. Springer, New York, 316 pp. (with CD-ROM) ISBN 0-387-95254-3

ADDITIONAL READING

There is a "must-read" book that I believe every serious graduate student should have on her/his shelf. HOW TO READ A BOOK by M. J. Adler & C. Van Doren (1972 Simon & Shuster – ISBN 0-671-21209-5 Pbk.) details the levels of reading (elementary, inspectional, analytical, and syntopical) and the characteristics of each. Graduate students should be reading at least at the third level, and striving for the fourth. This is not required but most highly recommended.

Class material will be taken from many sources including the following. You may wish to search for these in the Library and consult them for background material.

1 Pickett, S. T. A., J. Kolasa, and C. G. Jones. 1994. Ecological understanding: the nature of theory and the theory of nature. Academic Press, San Diego, CA. 206pp.

2 Gilovich, T. 1991. How we know what isn't so: the fallibility of human reason in everyday life. The Free Press (div. of Macmillan, Inc. New York. 216 pp. (a very nice assessment of how we fall from objectivity—highly recommended. You will recognize yourself in these pages!!)

3 Bodkin, D. B. 1990. Discordant Harmonies. Oxford Univ. Press, New York. 241pp. (we read this in 1994. This is a nice discourse on the discordant nature of nature)

4 Gleick, J. 1988. Chaos: making a new science. Penguin Books. 352 pp. (this is one of the easiest books to understand the elements of chaos and fractals)

5 Forman, R.T.T., and M. Godron. 1986. Landscape Ecology. John Wiley & Sons, New York. 619 pp. (this is the first "textbook" on landscape ecology and is of historical interest)

6 O'Neill, R.V., D.L. De Angelis, J.B. Waide, and T.F.H. Allen. 1986. A hierarchical concept of ecosystems. Monogr. in Pop. Biol. #23. Princeton Univ. Press. 253 pp. (presents a fundamental view that unifies the nutrient cycling and energy flow view of ecology with the

population dynamics approach; emphasizes rate-structured hierarchies as the framework; must read this one)

7 Cronon, W. 1983. Changes in the land: Indians, colonists, and the ecology of New England. Hill and Wang, New York. 241 pp. (one of the nicest works emphasizing the temporal dynamics and their importance in understanding landscape dynamics; written by an historian)

8 Kuhn, T. S. 1962 (1970 ed) The structure of scientific revolutions. Univ. Chicago Press, Chicago, IL. 210 pp. (*several zerox copies of this will be available* (provides a nice explanation of how paradigms change in science)

9 Pickett, S.T.A., and P.S. White (eds. . 1985. The ecology of natural disturbance and patch dynamics. Academic Press, Inc. 472 pp. (One of the earlier works that tries to assemble conceptual papers on the topic)

10 Walters, C. 1986. Adaptive management of renewable resources. Macmillan Publ. Co., New York. 374 pp. (an approach increasingly being used by management agencies, albeit perhaps imperfectly)

11 Harris, L. D. 1984. The fragmented forest: island biogeography theory and the preservation of biotic diversity. Univ. Chicago Press, Chicago, IL. 211 pp. (an earlier work on fragmentation effects)

12 Quantitative methods in landscape ecology. 1991. M. G. Turner and R. H. Gardner (eds.) Ecological Studies 82. Springer-Verlag, New York. 536 pp. (a nice compendium of methods in this fast evolving field!)

13 Forest island dynamics in man-dominated landscapes. 1981. R. L. Burgess and D. M. Sharpe (eds. . Ecological studies 41. Springer-Verlag, New York. 310 pp.

14 Changing landscapes: an ecological perspective. 1989. I.S. Zonneveld and R. T. T. Forman (eds). Springer-Verlag, New York. 286 pp.

15 T. F. H. Allen, and T. W. Hoekstra. 1992. Towards a unified ecology. Columbia University Press, New York. 384pp. (this is perhaps one of

the most innovative and difficult to grasp [at first] concepts. A real thought-provoker)

16 Peak, D., and M. Frame. 1994. Chaos under control: the art and science of complexity. W. H. Freeman & Co., N. Y. 408pp. (one of the best written books on the topic; highly recommended for every serious ecology graduate student)

17 Brown, J. H. 1995. Macroecology. Univ. Chicago Press, Chicago. 269pp.

18 Edwards, P. J., R. M. May, and N. R. Webb. eds. 1994. Large-scale ecology and conservation biology. The 35th Symposium of the British Ecological Society for Conservation Biology. Blackwell Scientific Publications, London.375pp.

19 Szaro, R. C., and D. W. Johnson. 1966. Biodiversity in managed landscapes. Oxford University Press, Oxford. 778pp

20 Farina, A. 1998. Principles and methods in landscape ecology. Chapman and Hall, New York. 235.

21 Turner, M. G., R. H. Gardner, and R. V. O'Neill. 2001. Landscape Ecology in Theory and practice. Springer, New York.401pp.

22 Klopatek, J. M. And R. H. Gardner. eds. 1999. Landscape Ecological Analysis. Springer, New York. 400pp.

23 Boitani, L. and T. K. Fuller. 2000. eds. Research Techniques in Animal Ecology: Controversies and consequences. Columbia University Press, New York. 442pp.

24 Gaddis, J. L. 2002. The Landscape of History. Oxford University Press, New York, N.Y. 192 pp.

ACADEMIC RESPONSIBILITIES

For more information, please contact:

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Academic Freedom and Professional Responsibilities (Faculty Code)

Academic freedom is the right to teach, study, discuss, investigate, discover, create, and publish freely. Academic freedom protects the rights of faculty members in teaching and of students in learning. Freedom in research is fundamental to the advancement of truth. Faculty members are entitled to full freedom in teaching, research, and creative activities, subject to the limitations imposed by professional responsibility. Faculty Code Policy #403 further defines academic freedom and professional responsibilities: http://personnel.usu.edu/policies/403.htm. Top

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Academic Integrity - "The Honor System"

Each student has the right and duty to pursue his or her academic experience free of dishonesty. The Honor System is designed to establish the higher level of conduct expected and required of all Utah State University students.

The Honor Pledge: To enhance the learning environment at Utah State University and to develop student academic integrity, each student agrees to the following Honor Pledge: "I pledge, on my honor, to conduct myself with the foremost level of academic integrity." A student who lives by the Honor Pledge is a student who does more than not cheat, falsify, or plagiarize. A student who lives by the Honor Pledge:

- Espouses academic integrity as an underlying and essential principle of the Utah State University community;
- Understands that each act of academic dishonesty devalues every degree that is awarded by this institution; and
- Is a welcomed and valued member of Utah State University. Top

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Course Fees

Courses that utilize course fees are required to identify the amount of the course fee and explain the purpose of the course fee on the syllabus given to students. Course fee information not included on the syllabus will result in the course fee automatically being deleted. Top

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Grievance Process (Student Code)

Students who feel they have been unfairly treated [in matters other than (i) discipline or (ii) admission, residency, employment, traffic, and parking - which are addressed by procedures separate and independent from the Student Code] may file a grievance through the channels and procedures described in the Student Code: http://studentlife.tsc.usu.edu/stuserv/pdf/student_code.pdf (Article VII. Grievances, pages 25-30). Top

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Plagiarism

Plagiarism includes knowingly "representing, by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes the unacknowledged used of materials prepared by another person or agency engaged in the selling of term papers or other academic materials." The penalties for plagiarism are severe. They include warning or reprimand, grade adjustment, probation, suspension, expulsion, withholding of transcripts, denial or revocation of degrees, and referral to psychological counseling. Top

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Sexual Harassment

Sexual harassment is defined by the Affirmative Action/Equal Employment Opportunity Commission as any "unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature." If you feel you are a victim of sexual harassment, you may talk to or file a complaint with the Affirmative Action/Equal Employment Opportunity Office located in Old Main, Room 161, or call the AA/EEO Office at 797-1266. Top

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Students with Disabilities

The Americans with Disabilities Act states: "Reasonable accommodation will be provided for all persons with disabilities in order to ensure equal participation within the

program. If a student has a disability that will likely require some accommodation by the instructor, the student must contact the instructor and document the disability through the Disability Resource Center (797-2444), preferably during the first week of the course. Any request for special consideration relating to attendance, pedagogy, taking of examinations, etc., must be discussed with and approved by the instructor. In cooperation with the Disability Resource Center, course materials can be provided in alternative format, large print, audio, diskette, or Braille." Top

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University Grading Scale

- A 100-93%
- A- 92-90%
- B+ 89-87%
- B 86-83%
- B- 82-80%
- C+ 79-77%
- C 76-73%
- C- 72-70%
- D 69-60%
- F Below 60%

Top

Withdrawal Policy and "I" Grade Policy

Students are required to complete all courses for which they are registered by the end of the semester. In some cases, a student may be unable to complete all of the coursework because of extenuating circumstances, but not due to poor performance or to retain financial aid. The term 'extenuating' circumstances includes: (1) incapacitating illness which prevents a student from attending classes for a minimum period of two weeks, (2) a death in the immediate family, (3) financial responsibilities requiring a student to alter a work schedule to secure employment, (4) change in work schedule as required by an employer, or (5) other emergencies deemed appropriate by the instructor. Top