Fall 9-1-2008

EVST 360.00: Applied Ecology

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Vicki Watson, 101 Botany, 243-5153, <Vicki.watson@umontana.edu> , office hours 10-12 Wed (usually)
Len Broberg, 106 Rankin, 243-5209, <len.broberg@umontana.edu>, 12:30-2:30 W, 11:30-1:30 pm Th
Than, M-4 Rankin, (messages243-6273), <Nathaniel.Robinson@umontana>; office hrs = lab time + appt

Purpose: Understanding the principles & concepts of ecology & how they inform real life decisions about human interactions with the environment. Will emphasize conservation of biodiversity and watersheds and design of field studies. Prerequisites: Chem 151, Bio 100, statistics, EVST 201 (or similar courses)

References: EFB6 ≡ Smith's Ecology & Field Biology 6th ed **OR** EOE ≡ Smith's Elements of Ecology
OR M = Molles' Ecology (**OR** ANY good ecology text – just read appropriate sections)
AND N ≡ E. Newman's Applied Ecology & Env. Management All in bookstore & library reserve
A collection of readings selected by the class will be available at library reserve later in semester
Also On reserve: Cox General Ecology Lab Manual – **read chapters 1-4** (other chapters based on interest).
Brower et al. Field & Lab methods for General Ecology is also a useful reference for methods.
Some items will be on e-reserve, accessible at cres.lib.umt.edu

Week Lecture Topics Overview & *references (you select your readings using table of contents & index)*

8/26 Course goals/mechanics. What is Applied Ecology? ***First chapter of most texts ; Cox chs 1-4***
9/2 **Ecological Literacy**--Ecological concepts (& methods) that inform human decisions
9/9 **Ecosystem concepts** *EFB6 Ch (2,3,4),27 OR EOE part II & Part V* OR *M Ch 17-19*
to All life and economic activity depends on earth support systems (ecosystem services);
10/2 resources/services come from ecosystems & depend on their health/integrity/**condition**.
Support systems have limited **capacity** to supply goods/services & to assimilate change.
Natural **change** contributes to diversity but makes it hard to identify human-caused change.
Support systems are **connected**—our actions have unexpected, indirect effects.
Local populations/communities/ecosystems are linked in global systems
(parts ←→whole); importance of incremental, cumulative effects
Energy flow & productivity *EFB6* ch *24 or EOE ch 23-24 OR M Ch17-18*
Material cycles (esp. water) *EFB6* ch *25-6; EOE ch 25-6* OR *M Ch 19*
Env. fate of chemicals *Newman ch 9*

10/7 **Community concepts** *EFB6 Ch 20,21,23* (read about your studied community ch 28-30);
or *EOE ch15-17; & part IV & one biome from part VI OR M Ch 13-16 & 20*
to Niche & Habitat —every species has a role (keystone, foundation, indicator, umbrella species)
10/21 Interactions/connections—competition, predation, cooperation/symbiosis, coevolution
Change – succession, disturbance, stability, resilience, flexibility, predictability, shifting baselines
Diversity—types & significance of diversity: Why and how to maintain biodiversity
*** **10/6 last day to drop or change grading 'easily'; last day to drop at all is last day of class** ****

10/23 Organisms & their adaptations; EFB6 *Ch 5 (6-8 if relevant to your study), EOE ch; M Ch 4-6*
10/28 **Population concepts** *EFB6 see below; OR EOE Ch 11-14,18-19 OR M section III & Newman Ch 10*
to What are populations and species? *EFB6 ch 10 OR EOE Ch 11, OR M Ch 8*
11-11 change in quantity—rate/regulation of growth, carrying capacity, ecofootprint *EFB6 11,1, etc*
change in quality—evolution, genetic diversity, flexibility, pop. viability analysis *EFB6 19,18, etc*

11/13-12/2 **Applying Ecological Literacy in decision making for a sustainable society**
Possible topics (reading will be assigned after class selects topics): Ecosystem Management vs CPR– N 11
Watersheds --Clark Fork case study www.epa.gov/region8/superfund/sites/mt/milltowncfr/home.html
Toxicology and setting environmental & human health standards N9; Forests (Fire) N 7
Env. Impact Assessment & Risk Assessment Population Policy, carrying capacity, ecofootprint
Ecology of Food Production N 4 (also 3,5,6) Energy, Carbon and Climate N2, Smith ch 32, CO2 calc
Pest management N 8 Pollution management N 9 Conservation of Biodiversity N 10 & 11
OR papers selected from Frontiers in Ecology that relate to research team topics

12/4 wrap up/evaluations NOTE: 'drop dead' drop deadline is last day of class.
CLASS CHOICE 12/8 from 10:10 to 12:10 or 12/11 from 3:20-5:20pm Final class meeting.

Grade based on percentage of 650 points earned
HOW to earn points (maximum possible points shown):

500 pts Take home essays;
50 pts Participation in class
100 pts Field trips & reports on same (10 pts/hr of trip & per ½ page)
reports due about one week after field trip.
See EVST calendar for times. Sign up sheets are on door at M-4 Rankin.

HOW to lose points: Unexcused absence from field trip once signed up – drop letter grade.

Late work – Assignments lose half their value after 5pm Friday of week due.
Assignments lose rest of their value at 5pm the following Friday.

Take Home Exam Essays ARE DUE THE WEEKS INDICATED on the exam;

Note Field trip signup sheets will be passed around in class.

EVENTS schedule for EVST 360 class Fall 2008

Unless a different place is specified, EVST field trips leave from the parking lot north of UM's UC (by the tennis courts). Students in EVST 101, 360 & 540 may register for a space in a UM van on a sign up list at Rankin Hall room M-2. Other UM students can ride in the UM van if there is space. Non-students need to provide their own transportation.
Community group or government agency or other department field trips that can count as field trips (or meetings) are shown in ( ) – you will need to arrange your own transportation with them. For more info (time, location, contacts) on field trips, see – www.umt.edu/conservationcalendar

Sept 3, W, – **sampling on the Clark Fork** -- bike to sites. Led by VW (meet at 102 Bot at 2 pm)
Sept 5-7, Fri-Sun, – **sampling on Clark Fork continues.** arrange to ride with VW on any of these days.
(Sept 6 (Sat) – annual Bitterroot River cleanup (from Sula to MIssoula.)
Sept 15, M, 2-5pm – **Stream assessments in Montana 360/495** (local creek) -- tentative

Sept 20, Sat, **Blackfoot Restoration Tour** – meet at 8am at north end of Van Buren Br. (East Gate parking lot). return about 6pm.

Sept 24, W, 2-5pm – **Lake assessments in MT 360/495 (**McCormick Park pond) – tentative

Sept 26 Fri – UM River Restoration Conference in UC. FREE TO STUDENTS. see www.umt.edu/rivercenter

Oct 4, Sat – **Clark Fork Superfund tour.** meet at 8am at north end of Van Buren br. (East Gate parking lot). return 6pm.

See also field trips offered by Audubon, Sierra, Native Forest Network, etc on www.umt.edu/conservationcalendar

Others field trips that will be organized (in Oct or Nov).

Missoula Wastewater Treatment tour. Then tour Ekocompost -- this business composts Missoula's sewage sludge and was started over 30 years ago by an EVST student! Leave UM at 1pm. Return to UM about 4pm.

Frenchtown pulp mill wastewater treatment system. Meet at 12:30 at UM's UC tennis courts for vanpool. Or meet at the pulp mill entrance at 1pm. Retun to UM by 4:30-5pm. Tour led by Terry McLaughlin, head wastewater plant operator.

Remember to Cite your sources using the CSE style that was used in EVST 201 (ask for a guide if needed).
Lectures, ecology texts, Newman text, Cox manual are good sources, but find some journal articles also if you can.
Point allocation & due dates for the questions are specified on the syllabus.
Restate each part of the question just before you give your answer to it.

1) **Scientific methods, approaches, and processes (due Sept 26 at 5pm)**

Identify a research project to use as an example (or construct your own like the students in 495),
State the main overall question addressed by the research project;
then briefly outline the design of the project – what will be measured/observed, when, where, how and why?

Explain the following terms (ie define, give importance to scientific process, illustrate with your study):

The scientific cycle, induction vs deduction, description vs experimental manipulation, reductionist vs holistic approaches (include advantages/disadvantages), control/reference, replication, QA/QC (accuracy, precision, representativeness, comparability, completeness) and use of models (what are they & how are they used in ecological field science?). Even if a concept does not seem directly applicable to your study, give a short definition & example.

2) **Ecosystems/Material Cycles (Due Oct 10)**

Consider the ecosystem where you are conducting your study. Draw a system diagram (box & arrow model) that shows the key parts and processes in this system, given the question your study is addressing. State & EXPLAIN the ecosystem's boundaries in space and time and the key parts & processes and other concepts or factors which you feel are important to consider when conducting your study (these should appear in your diagram).
Summarize the climate of the area using tables like those at www.wrcc.dri.edu/climsum.html
Briefly describe the soil types found at your study site. (can find this at http://websoilsurvey.nrcs.usda.gov/app/)
What is the role of the water cycle in affecting the productivity of this ecosystem and the kind of community it can support?
Which other material cycle besides the water cycle do you think is most important in limiting this ecosystem's productivity and the kind of community it can support? Explain your evidence. How have humans altered the water cycle and this other cycle and what have been the effects on ecosystem productivity & human use?
What important services does this ecosystem provide to humans and how have those services been affected by human activity?
Info on ecosystem services at: www.actionbioscience.org/environment/esa.html

3) **Community/Succession/Disturbance (Due Oct 24)**

Consider the community where you are conducting your study. What kind of community is it? What system did you use to classify this community? Go beyond the basic ecology text in describing your type of community. Find a reference on that particular type of community (stream, wetland, prairie, etc.) & be as specific as you can.
Some guidance at: http://www.worldwildlife.org/wildworld/ for global ecoregions;
National Vegetation Classification Standard (NVCS) (Version 2.0), FGDC-STD-005-2008.
For MT ecoregions, ecosystems & communities: http://nhp.nris.state.mt.us/community/index.asp
http://nhp.nris.state.mt.us/community/Types/332B.asp bitterroot valley
See also Habeck, Hansen, and Pfister references on the list of references.
What processes control succession at this site? That is, first briefly indicate what sorts of factors control succession in most communities, then state which are most important here and explain why they are important here.
What sorts of human disturbances affect this site and how are they like & unlike natural disturbances to which this community is adapted? Give your definition of community 'health' &/or 'integrity'. If you were asked to evaluate this community's current condition & track changes over time, what would you consider the most important attributes or processes to monitor?

Choose ONE of these population questions to answer (Due Nov 7)

4a) **Regulation of Population numbers**

Using a local population of a species of concern to you, explain what factors you think most affect its rate of growth r when its numbers are well below the carrying capacity K (for example, when it has invaded a new habitat that it has not formerly occupied). Explain what factors you think are most important in determining K for a population of that species in a specific area that you designate. How could you use life tables to help you determine which factors have the greatest effect on this population's numbers?

Propose a hypothetical (but reasonable & defendable) set of population levels for your population at two points in time and a K for this population. Then demonstrate that you know how to use the exponential growth equation to estimate r and to project future population levels and how to use the logistic growth equation to estimate when the population will approach K (ie be within 5% of K). You can do this iteratively. An excel spreadsheet works well.

4b**) Adaptations and Population genetics**
Using a local species of concern to you, explain some ways in which it has adapted (or may be adapting) to human changes of the environment. Include examples of a variety of kinds of adaptation (such as structural, physiological, developmental, life history, behavioral). What environmental factors most limit its range? What human actions are most likely to shrink or expand its range? Explain your answers.

Explain the purpose of population viability analysis and what factors are considered in conducting a population viability analysis on a population. Be sure to explain how genetic considerations (inbreeding, genetic drift, adaptability to change) are used in determining the minimum viable population MVP and why genetic factors should NOT be the SOLE consideration in determining MVP size.

4c) **Species conservation**
Select a local species that is considered threatened/endangered due to human actions and another local species that is considered to be increasing due to human actions. Contrast differences in their life history strategies, migratory habits, niche (way of making a living), behavior and/or other relevant factors, that help explain why one is in trouble and the other is doing better as a result of human change. What are the conservation implications of this information (ie what could humans do to reduce threats to the declining species and avoid encouraging the expanding species) ?

Choose just one of these (5a thu 5d) DUE Nov 21

5a) **Restoration Ecology**
Imagine that you have been asked to restore the community and ecosystem that are at the site where you are doing your study. Construct a plan to accomplish this. Be sure to state clearly your restoration goal(s) (ie, what sort of community/ecosystem will you try to restore—give your reference site or other guiding idea). What would constitute successful restoration? Give some SMART objectives (specific, measurable, achievable, respectful, tractable). Indicate any studies you feel need to be undertaken before proceeding with the restoration.
State what actions need to be taken. Explain how & why you are using both 'active' & 'passive' restoration actions.
Describe monitoring needed to determine that the restoration is successful (what, where, when, how long, why).
How might climate change & ongoing development affect your efforts and how can your restoration efforts mitigate these effects?

5b) **Clark Fork Restoration**--Parts of the Clark Fork floodplain are contaminated with acidity & heavy metals associated with historic mine wastes that washed down the river during floods.
i) describe how you would identify which areas are contaminated above background levels (& how you determine background levels) & which are sufficiently toxic to reduce plant productivity; & which may be a human health hazard. You may use existing info &/or new measurements. Explain how measurements are made & evaluated.
ii) describe how you would design & conduct studies to determine whether soil amendments significantly improve plant health & production and whether reclaimed areas reach the health or condition of uncontaminated areas. Define what you mean by health or condition (does it include productivity, diversity, similarity to reference sites?)

5c) **Critique the Milltown reservoir restoration plan** . This is the state of Montana's plan to restore the confluence of the Clark Fork & Blackfoot Rivers after removal of Milltown Reservoir & its contaminated sediments. (ask for guidance on what should be in a critique). The plan is at the UM & Missoula Public libraries, and online at:
http://www.doj.state.mt.us/lands/naturalresource/milltowndam.asp. **OR comment on Clark Fork River Restoration Plan**
http://doj.mt.gov/lands/naturalresource/resources/claims/ucfr/restorationplan2008.pdf

5d) Propose your own applied ecology question – must be approved by Watson.

Bonus (25pts, email to Watson by Dec 5) –Many ecologists think all citizens need **basic ecological literacy** if we are to build a sustainable society. State & briefly explain 5 ecological principles that help guide us to a more sustainable society. Here's how:

1) Assume that you embrace the following philosophical/ethical world view: We humans wish to build an equitable & sustainable society that shares the earth with all of creation. By an equitable, sustainable society, we mean a society that meets the needs of all members of the present generation using methods that will pass onto future generations a world just as capable of meeting their needs. By sharing the earth with all of creation, we mean maintain the earth's biodiversity.

2) **State** about 5 ecological principles or concepts that you feel would best guide humans toward this goal when they make personal lifestyle choices and social decisions. Ecological principles are scientific statements about the way we think the world's systems work, and they are generally widely accepted by professional ecologists/environmental scientists.
State each principle in at least one complete sentence so that it could be recognized by someone who has taken a class in ecological literacy.

3) Finally, **explain** briefly a) how this principle helps an individual to make a specific life style choice
and b) how it helps society to make an important social decision.