Conservation & Restoration Ecology
Study Questions

Study questions should be considered just one tool for exam preparation.

Think about how to intentionally and effectively combine material from lecture notes, PowerPoint slides, class discussions (including during lab sessions), class readings, and these study questions to synthesize understanding of the course material.

Readings

Know the main point, fundamental argument, and main evidence of every reading assignment.

Understand the major points made in all readings, both those that were covered during class sessions and those that were not covered during class sessions.

(Reading assignments are chosen intentionally but are not necessarily covered during class.)

Introduction

In your own words, why is it worthwhile to study the subject matter of this course? Your answer should reference lectures, our discussions and reading materials.

Jared Diamond argues five factors have been responsible for the collapse of societies. What are those 5 factors? Which of them are related to the relationship between a society and its resource requirements? How are those causes of collapse related to resource requirements?

They are all related to the relationship between a society and its resources.

- Climate change - changes
- Environmental degradation
- Collapse of a critical trading partner
- War
- Failure to adapt values to new situation

Interpret and critique these quotes from the syllabus. How do these statements relate to the concept of sustainability? Be sure you make clear that you understand the definition of sustainability – as I use and have defined the term. In other words, define sustainability before you use the term in an answer. (Whenever you use a technical term on an exam demonstrate that you understand the correct definition of the term if that term was treated as a new concept since a previous exam.)

"The utilitarian Resource Conservation Ethic, realized within new federal conservation agencies, was committed to the efficient, scientifically informed management of natural resources, to provide "the greatest good to the

greatest number for the longest time" (Pinchot 1910:48). By contrast, the Romantic-Transcendental Preservation Ethic, overshadowed but persistent through the Progressive Era, celebrated the aesthetic and spiritual value of contact with wild nature, and inspired campaigns for the protection of parklands, refuges, forests, and "wild life."

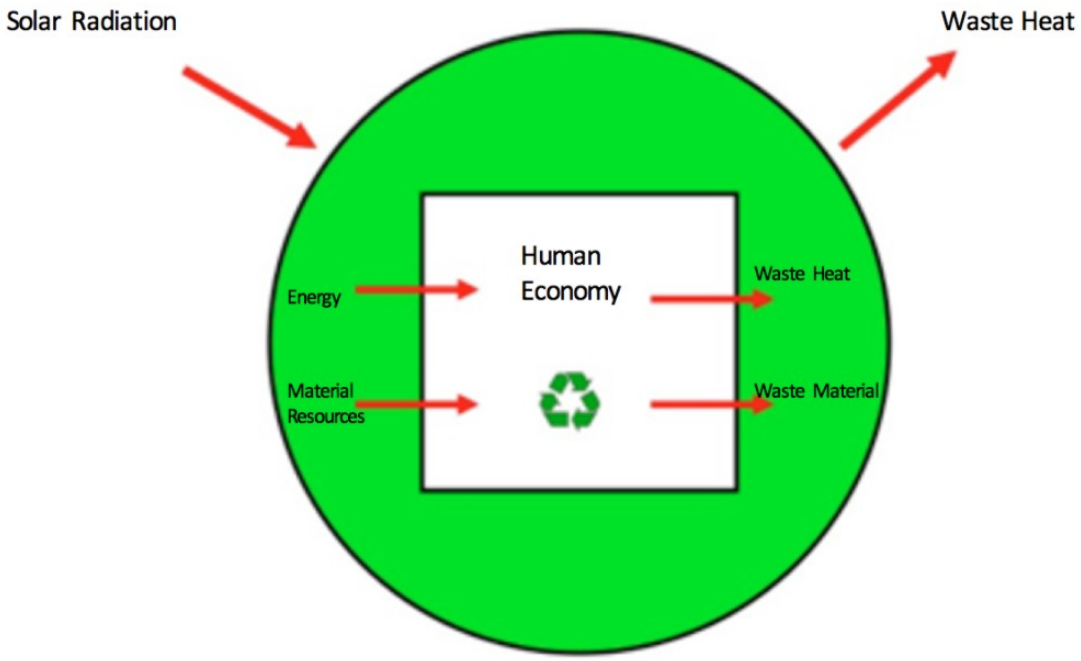
"A land ethic, Leopold wrote, 'enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land'; it 'changes the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it' (Leopold 1949:204). These ethical concepts only slowly gained ground in forestry, fisheries management, wildlife management, and other resource management disciplines; indeed, they are contentious still."

What is the Anthropocene? Is the Anthropocene a useful concept? Why or why not?
The anthropocene is the "human era". This era begins with humanity's significant impact on the Earth (climate change, reduction of resources, etc.) This concept can be useful as it can help create a timeframe for humanity's impact on the planet along with allowing researchers to quantify the changes.

Summarize the main arguments of, and interpret the figures from Steffen, W. et al. 2011. The Anthropocene: from Global Change to Planetary Stewardship. *AMBIO*, 40:739-761. (Note: You should be able to do this for every reading assignment. I emphasize it here because in past years many students seem to have merely skimmed this article.)

Sustainability and Carrying Capacity

Why do ecosystems have limited carrying capacities? In other words, what circumstances and processes limit the production of biota at each trophic level? No credit for "resources are limited." You must explain the circumstances that cause resources to be limited. (What are the laws of thermodynamics and why are they relevant to the topics of this course?)
Carrying capacities exist (in other words, populations cannot grow indefinitely) because biological production is limited and each individual requires resources to survive. Biological production is limited because plant production is limited by the amount of energy plants can capture from the sun (look at the input output diagram below). Production of higher trophic levels is limited because as energy moves through the food web much is lost at each link due to energy consumed in respiration.



What is carrying capacity? How is carrying capacity rooted in the laws of thermodynamics?

The population size that the environment can support

The laws of thermodynamics

1.Neither energy nor matter can be created or destroyed, only transformed.

2.When energy is transformed some is lost as waste heat.

Look at the answer above

How does exceeding the carrying capacity affect the future carrying capacity? Why is this the case?

Exceeding the carrying capacity reduces the future carrying capacity; future carrying capacity reduced because environment can no longer sustain the original number of population

Exceeding carrying capacities reduces the sustainable level of impact that the environment can withstand in the future.

What are Herman Daly's guidelines for sustainability? Do they make sense to you? Why or why not? In other words, is sustainability compatible with violation of one or more of Herman Daly's guidelines? Why or why not?

Herman Daly's principle of sustainability

1. Rate of renewable resource depletion < rate of resource regeneration
2. Rate of nonrenewable resource depletion < rate of development of substitutes
3. Rate of waste generation < rate of waste assimilation

Are we abiding by Herman Daly's guidelines? (Hint: No.) How is that possible?

- By non-sustainable consumption of resources
- By exhausting a "one-time inheritance of natural capital"

What is I = PBAT?

An equation for thinking about options for reducing environmental impacts
Impact = P: population B: behavior A: affluence T: technology
(If there is a reduction of BAT on I, then I can take a larger P)

Give an example of a carrying capacity being exceeded.
Cod fishery, logging, water pumping

How is the concept of carrying capacity similar to the concept of sustainability?
K is depends on natural, social, built, and human capital. For communities to be able to function there to be sustainable. A community that is living off of these four capitals must be living within their Ks. K is the size of a population that can be supported by the availability of the four capitals.

Carrying capacity for people is more complicated that carrying capacity for other species because two humans of the same size may have very different levels of resource consumption and environmental impact. Is there reason to think that the current population of humans is beyond the carrying capacity for the way the 7 billion of us live? If so, what is the evidence and logic of that conclusion? (This question overlaps with some of the preceding questions.)
Currently we do not meet Herman Daly's principle of sustainability
Reduction in habitat for other species
Wilderness areas decreasing
Wild populations decreasing
Soil depth & quality decreasing
Atmospheric composition changed by human

How would ecosystem restoration affect whether I is above its sustainable level?
If degraded place were restored, production could begin again and "I" could be restored/lowered to its sustainable level in relation to the carrying capacity of the population

Ecosystem Services

What did you learn from the Millenium Ecosystem Assessment Board's statement?

- We are spending Earth's natural capital, putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted.
- At the same time, the assessment shows that the future really is in our hands. We can reverse the degradation of many ecosystem services over the next 50 years, but the changes in policy and practice required are substantial and not currently underway.
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- Humans have made unprecedented changes to ecosystems. These changes have helped to improve the lives of billions, but they weakened nature's ability to deliver other key services. The pressures on ecosystems will increase unless human attitudes and actions change.

List 8 or more types of ecosystem services? Which do you think we could do without?

- Pollination
- Water quality
- Air quality

- UV Shield from ozone
- Fertile Soil
- Insect control (spiders; bats; etc)
- Element Cycling
- Recreation/Inspiration

Characterize present human impacts on ecosystems and ecosystem services. Be specific. Refer to various lines of evidence and consider the magnitude (quantitative scale) of our impacts, not just the qualitative types of impacts. Are our impacts large? (Large is a relative term so it must be used comparatively – compared to something.)
Eroding soil, depleting aquifers, depleting fisheries,destroying forests, altering the atmosphere and oceans, depleting nonrenewable resources, releasing persistent toxins, mixing up natural assemblages of species, mass extinction

What does it mean to take a systems perspective? Give an example of taking a systems perspective. Give an example of a real instance of an individual or group failing to take a systems perspective.
To take a systems perspectives is to seek to anticipate all of the consequences of an action, both intended and unintended, desirable and undesirable.

What is the message of Aldo Leopold's essay The Land Ethic in his book A Sand County Almanac? What is the basis of his argument? Do you find his argument convincing? Why or why not?
Changing human role from conqueror to plain member.
Enlarging the boundary of community to include land as well as the members that live in that land.

How does population density correspond to precipitation around the world? Where are the major North American exceptions? How can those exceptions be explained?
Higher population density found where there is more precipitation. California & Denver metro area. Both import water from mountains. In central Texas, largest area of high population density in a relatively dry area.

Do humans have a solid understanding of how much damage to ecosystem services is compatible with sustainability? Explain your answer with reference to at least one example of poor understanding.

Ecology review

Be prepared to explain each of the basic ecological concepts listed at the end of the syllabus.

Define density dependence as the term is used in ecology. Then explain why ecologists consider density dependent processes so important.
A density dependent process is one whose per capita rate is a function of population density.

Ecologists consider density dependent processes important because, aside from direct human intervention, only density dependent processes can regulate (cause to rise when low and fall when high) population sizes. Thus, density dependent processes are critical to preventing populations from going extinct or exploding to astronomical sizes.

Experiments, hypothesis testing, describing results, statistics, and drawing conclusions from data

What is the purpose of formal experiments?

The purpose is to better understand a concept or discovery. It is done formally so that it can be properly documented and replicated by other experimenters.

What is a hypothesis?
A tentative explanation of natural phenomena, basically a prediction you intend to test.

What does it mean to test a hypothesis?

Support or refute the following statement. "The diagram to the right gives an erroneous impression that the process of science is simple, straightforward, and leads to obvious conclusions." If you argue that the statement is wrong, explain why. If you argue that the statement is correct, explain why? (Hint: Recall the material in my book chapters 4,5, 6, and 7)
Observation -> Question -> Hypothesis -> Experiment -> Conclusions
There are many different fields of science and some are much more straightforward than others. Chemistry, for example, tends to provide concrete results that can be backed up by formulas and measurements. Ecology, however, is much more complex than chemistry and has many factors, most of which cannot be controlled like chemicals in a lab. Many experiments in ecology cannot have replicates (eg. an experiment on lake Texoma can't be replicated because it is unique in and of itself) and cannot produce the same results over and over.

What are the necessary features of a well-designed experiment?
Absence of systematic error
Independent replicates
Sufficient precision of measurements to detect meaningful effects
Appropriate range of validity
No unnecessary complexity
Ability to estimate uncertainty in results

What types constraints limit the experiments that scientists can perform?
Not ethical
Not enough money to do the experiments
Technical constraints (we don't have the technology to do it)
Analytical constraints
Ethical constraints, Financial constraints, Technical constraints, Analytical constraints

What is the critical requirement of a replicate? In other words, what must be true for two items to be considered separate replicates?
Treatment applied to one replicate does not affect another.

What are some chronic dilemmas in the interpretation of experimental results. (Hint: Schulze draft chapter 6.)
Type I,II errors, honest errors, bias, extrapolation

Devise a hypothetical experiment that can serve as a basis for illustrating your answers to the previous several questions.

What should you look for when describing results in words?
Curious patterns

Magnitude of effect
Apparent patterns

What is the value of experimental statistics? When are experimental statistics useful.
Experimental statistics help us draw conclusions about whether a treatment affects one or more dependent variables.
They are useful because they

How, fundamentally, do statistical tests work?
Statistical tests provide mechanisms for making quantitative decisions about processes. The determine whether there is enough evidence to "reject" a hypothesis or not.

Define p-value.
The chance of obtaining at least as pronounced a pattern in data on the basis of chance alone

What is wrong with the following statement? "The p-value is the probability that the pattern observed in the data is due to chance."
A p-value is the chance of obtaining at least as pronounced a pattern in data on the basis of chance alone.
A p value indicates the chance of the data being randomly chosen being only 5%
This statement above does not take account for the confidence of 95% that the data is not simply random?

What four categorically different outcomes can result from a statistical test of an hypothesis? In other words, experiments lead to two fundamental alternative conclusions, each of which can be correct or incorrect. Hint: What are type one and type II errors. Explain.
Type one error- false positive- an incorrect conclusion where one variable affects another- statistics have a significant result when there is no relationship between the variables and the population
Type two error- false negative (a miss)- failure to detect that one variable affects another- statistics do not produce significant results when there actually is a relationship between the variables and the population
It supports the hypothesis
It rejects the hypothesis and there is no evidence that supports the hypothesis

Assuming that the following description of measured values is correct, and that patient 1 was given an experimental drug while patient 2 was given a placebo, why would sentence 1 be acceptable, but sentences 2 and 3 be unacceptable?

1. **"We measured a higher blood pressure for patient 1 than patient 2."**
2. **"Patient 1 has higher blood pressure than patient 2."**
3. **"The drug works to reduce blood pressure."**

Assume you used big swimming pools to test the hypothesis that replacing ocean water with energy drinks increases the flying ability of flying fish. Which of the following statements could be acceptable descriptions of results or acceptable conclusions (assuming they accurately reflect the data), and which would never be acceptable? Explain why each statement either could be or could not be acceptable.
"The data are consistent with the hypothesis that energy drink exposure increases the average flight distance of flying fish."
"We have proved the hypothesis that energy drinks help flying fish fly."
"Submersion in energy drinks does not affect flights of flying fish."

“The hypothesis that energy drinks increase flight distances is wrong.”
“The data do not support the hypothesis that energy drinks increase flying fish flight distances.”
“We have proved our hypothesis correct that energy drinks increase flying fish flight distances.”
“The apparent pattern in the flight distances was due to chance.”
“The p-value shows that the apparent pattern in the flight distances was due to chance.”

In case you have never seen them do so, here is a video of flying fish.
https://www.youtube.com/watch?v=bk7McNUjWgw

---- end of material for exam #1, 2017 ----

Prairies

What climatic conditions are required for prairies to occur?
Annual precipitation of 25~100 cm/year
-10~20 C degree

- Temperate grasslands have pronounced annual fluctuations in temperature with hot summers and cold winters.
    - The annual temperature variation produces specific growing seasons for plants. Plant growth is possible when temperatures are warm enough to sustain plant growth and when ample water is available, which occurs in the spring, summer, and fall. During much of the winter, temperatures are low, and water, which is stored in the form of ice, is not available for plant growth.
- Annual precipitation ranges from 25 cm to 75 cm (9.8–29.5 in). Because of relatively lower annual precipitation in temperate grasslands, there are few trees except for those found growing along rivers or streams.
- The dominant vegetation tends to consist of grasses and some prairies sustain populations of grazing animals Figure 44.17. The vegetation is very dense and the soils are fertile because the subsurface of the soil is packed with the roots and rhizomes (underground stems) of these grasses. The roots and rhizomes act to anchor plants into the ground and replenish the organic material (humus) in the soil when they die and decay.

What are the key ecological features of intact tallgrass prairie?

The landscape of North Central Texas was historically a mixture of tallgrass prairies and woodlands. Under what conditions did the prairies occur? Under what conditions did the woodlands occur? What factors are thought to have been responsible for this distribution? Sure, soil type. But how is soil type thought to have determined the distribution of ecosystem types?

Prior to the arrival of settlers of Western European descent, the Blackland Prairie region supported a thriving ecosystem and human cultures. Within a few decades of colonization by the settlers the ecosystem was largely eliminated and the economic base of the original settler economy had been decimated. Describe this history in more detail, with particular attention to factors that led to nonsustainability of the land use by settlers.

What were the consequences of destruction of the Blackland Prairie?

- *Native Species eliminated*
- *Soil fertility lost*
- *Forage production decimated*
- *Floods*

- *Reservoirs fill with sediment*
- *Groundwater not recharged*
- *Little food produced*
- *Tree populations allowed to rise*

Compare and contrast the history and consequences of land use in Greece, the Indus Valley, the northern tier of Africa (review the Dale and Carter reading if necessary), and the Blackland Prairie region (most populated region) of Texas.

Explain the conundrum that millions of bison lived on the Great Plains without degrading the productivity of the ecosystem but in most cases cattle have degraded the productivity of ranches. What factors are responsible for this contrast?

What are the five main objectives of the Sneed Prairie restoration?

What methods to restore the Sneed Prairie are used on the various fields?

Describe the design of the Sneed prairie restoration experiment? What constitutes a replicate at Sneed?

Describe the logic of the Sneed experiment treatments.

Describe some of the factors that can be expected to complicate the interpretation of results from the Sneed restoration experiment. Hint: one example has to do with prior land use.

Eutrophication

Would a person taking a systems perspective consider a lake in isolation from its watershed? Why or why not?

What are some key aspects of water quality?

What are the characteristics of a eutrophic water body (lake, river, bay)?

What causes eutrophication?

What is undesirable about eutrophication? Why are these circumstances undesirable?

How does water become depleted of oxygen?

What alternative or complementary approaches are available for attempting to overcome eutrophication?

Why might efforts to overcome eutrophication be unsuccessful?

Explain why nutrient rich, small shallow ponds have alternative possible stable states.

Use both the example of small ponds and the example of tallgrass prairies and woodlands to illustrate the

concept of alternative stable states and explain how it is that alternative stable states (rather than just one possible stable state) are possible.

Biodiversity

What are the 3 categories (levels/types) of biodiversity?

Define species richness

Define species diversity

What natural factors increase species diversity on local scales (within an ecosystem)?

What natural factors increase species diversity on regional or global scales?

Explain why each of those factors increase species diversity, or, in the case of latitude, some of the hypothesis for why high diversity is associated with low latitudes.

What is a disturbance? How do disturbances affect species diversity?

What are the predictions of the theory of island biogeography?

Explain the logic of the theory of island biogeography, and its predictions.

Where are some biodiversity "hot spots?" Hint: see assigned reading.

Is biodiversity thought to be associated with ecosystem functioning? In other words, does ecosystem functioning decline as biodiversity declines (within an ecosystem type)?

What is the evidence for your answer to the previous question?

Explain these graphs

Define stability and resilience as ecosystem ecologists use those terms.

Is there any evidence that stability of an ecosystem is a function of its species diversity? If so, what is it?

What are the implications of the observation that ecosystem functioning and ecosystem stability are a function of species richness?

Extinction & Extirpation

What is the point of the analogy to the rivets of an airplane?

How do current extinction rates compare to past extinction rates?

How are current extinction rates estimated?

What is the primary cause of modern extinctions?

What characteristics (features of the species themselves) cause some species to be more susceptible to extinction than other species?

What are the basic threats to small populations (that make them particularly susceptible to extinction)?

What is some of the empirical evidence that small population size is a risk factor for extinction?

How does the risk of extinction of individual populations depend on the size of the habitat? On the distance from other populations of the same species? Explain both.

What is a metapopulation?

Which agencies administer the Endangered Species Act?

What protections are afforded to "listed" species?

How is "take," as in take a species, defined in the context of the Endangered Species Act?

What is the next step after listing a species?

What are the problematic aspects of the Endangered Species Act?

- end of study questions for 2017 mid-term exam #2 -

Threats to Biodiversity and Ecosystem Services

What are the main types of threats to biodiversity and ecosystem services?

- Habitat destruction
  - Agriculture (conversion, desertification)
  - Badly managed ranching
  - Non sustainable logging
  - Urbanization
- Habitat alteration
  - Selective logging (non clear cutting)
  - Alteration to river flows (dams, levees, water diversion)
  - Food web alteration (e.g. by predator removal)
- Habitat fragmentation
  - Agriculture, ranching, logging, roads, fences, dams
- Overharvesting (overexploitation)
  - Deforestation
  - Large fish removal
  - Herbivore removal
- Invasive species
- Pollution
- Climate change

Which type of threat is most important at present?

- Idk this is probably in a paper i didnt read

What type of threat to biodiversity and ecosystem services is expected to grow in importance over the next few decades?

- Idk this is probably in a paper i didnt read

What are some particular examples (cases) of each contemporary (happening now) type of threat?

Given that these threats are not hard to understand, why have we generally failed to prevent them?

What sorts of activities or actions are most responsible for habitat destruction and transformation on land?

What sorts of activities or actions are most responsible for habitat destruction and transformation in aquatic environments?

What were the consequences of the extinction of wolves from Yellowstone? Explain the biological interactions that caused all of those changes to result from the extinction of Yellowstone wolves.

Were hunters and gatherers ever guilty of overharvesting?

Are contemporary humans guilty of overharvesting? Duh. Give some examples.

Have humans proved to be good at sustainably harvesting renewable resources? Include examples in your response.

Give some examples of problematic nonnative species and the consequences of their dispersal by humans.

Do humans make a serious effort to prevent the establishment or spread of non-native species? Explain.

Describe several types or categories (not specific examples) of pollutants that have potential to harm biodiversity.

- Acidification- high levels of acid in the environment (acid rain, acidification of lakes)
- Nutrient pollution- eutrophication (high toxicity in aquatic environments)
- Sediment pollution- runoff of sediments causing excess/ buildup of sediments (especially in water)
- Heavy metals- lead, mercury, etc buildup in the environment
- Invented Organic Material- high concentrations in the environment (ex: estrogen mimicking materials, PCBs)
- Greenhouse Gases- not directly toxic but change the climate
- Stratospheric Ozone Depleting Substances- chlorofluorocarbons, flame retardants, etc
- Tropospheric Ozone-Generating Compounds- volatile organic compounds
- Noise- interferes with communication
- Light- interferes with predator-prey interactions and circadian rhythms

Why do increases in greenhouse gas concentrations cause the planet to get warmer? (Explain the cause and effect process.)

- Parked Car Effect- light comes through the glass as electromagnetic radiation and is absorbed or converted into heat. The car seats give off infrared radiation, which is what warms the air and seats in the car. The glass isn't transparent to the infrared radiation.
- The ozone layer acts as the "car glass" and traps the light that comes in, but the heat is not released from the atmosphere (car window).

Ecological Restoration

What are the goals of ecosystem restoration? Which goal or goals do you consider most important? Is your judgment case-specific?

1. Return of the historic ecosystem
2. Reestablishment of ecosystem services
3. Conservation of particular species
4. Create a nice place for people to visit

- 2 and 3 are probably the most important

What would constitute success in a restoration project?

What different approaches are taken to ecological restoration?

How does the condition of an ecosystem affect decisions about approaches to its restoration?

Explain the design, logic, strengths, and shortcomings of the Sneed Prairie Restoration project.

What are the various challenges to successful restoration? Explain each. (Note: The list of types of challenges is long.)

Give some real or hypothetical examplease of how the various types of challenges complicate restoration efforts?

Which of these challenges have been addressed in the design and procedures of the Sneed Prairie Restoration, and how have they been addressed.

Which challenges are not specifically addressed by the design or procedures of the Sneed restoration? Why would anyone ignore a complicating factor in this way? What are some of the possible consequences of failing to intentionally address these factors? How could they be addressed?

Conservation

Discuss the issue of conservation priorities. How are the issues of hot spots, vulnerability, and reversibility relevant to conservation priorities?

Describe both the values and the limitations of preserves? If your first response is brief, elaborate.

Is conservation compatible with human land use? Give some examples to illustrate your answer.

Explain the various incentives that foster conservation on private lands in the U.S.

Reflection on this semester's topics

BIOL majors and minors – How has the material of this course affected your perspective on the subject of biology? How is this material relevant to the other courses you have taken, and vice-versa?

ENVS majors and minors – How has the material of this course affected your understanding of environmental problems or the potential for solutions? How is this material relevant to the other courses you have taken, and vice-versa?

Everyone – What do you think are the two or three most important insights that have resulted from your study of this material. Has anything seemed compelling? If so, what?

Note:

The final will emphasize the material since the mid-term exam but will be comprehensive in the sense that topics that were covered earlier in the semester are relevant to topics covered later in the semester so they cannot be completely separated. In other words, some question answers may require reference to or integration of material from both earlier and later in the semester. Also, the final may repeat one or more questions from earlier mid-terms. Make sure you understand all of the questions from the mid-terms: you should have an email from me with answers to the questions on the two mid-term exams.