Feb 16, 2006

Name: _____ Pledge (sign): _____

# Env Studies 201 Test #1

**Point Total**: 100 pts possible

5 pts 1. True or false: the Hetch Hetchy valley is part of the Yosemite National Park.

True

5 pts 2. How long does it take global biodiversity to 'rebound' from a mass extinction event? Circle one:

(e) Millions of years

6 pts 3. (a) What is an ecosystem?

A *biological community* and the *abiotic surroundings* (habitat) upon which its members depend. The community consists of mutually dependent populations of biological species; its actions modify the nature of the habitat. The boundaries of the ecosystem are usually porous, in the sense that material and energy can flow into and out of the ecosystem. Boundaries between ecosystems are not always well defined.

8 pts (b) What are *ecosystem services*? In your answer, list five distinct ecosystem services and briefly describe each.

According to Daily *et al.*: 'ecosystem services are the conditions and processes through which natural ecosystems...sustain and fulfill human life.' They are the materials and services provided to humans by natural ecosystems. Ecosystem services are frequently undervalued in the marketplace. Here are some examples (this is not an exhaustive list):

- climate regulation, helping to determine climate and its variability
- water regulation, including control of floods
- pollution assimilation (waste treatment): the degradation and/or removal of chemical pollution released through human activities
- raw materials: minerals, wood, etc, used to build 'human capital'
- production of food: agricultural crops and livestock, wild plants and animals used as food sources
- pest control, particularly in agricultural applications, through normal ecosystem restraints on population (eg, predation, resource availability)
- genetic resources for pharmaceutical and agricultural uses, to create new drugs or improve breeding stocks
- erosion control, reducing the loss of productive soil and improving water quality

6 pts 4. Lynn White states that 'the victory of Christianity over paganism was the greatest psychic revolution in the history of our culture.' Explain in a little detail how, in White's view, this event contributes to modern environmental degradation.

This victory enabled humans to separate the divine from the natural. The attitude of exploitation and domination of nature now needed no apology or justification. Indeed, according to White, Judeo-Christian orthodoxy taught that it was entirely proper to appropriate nature's bounty strictly for human purposes "in a mood of indifference." This attitude made possible the development of technology—an outgrowth of natural theology, the attempt to understand God through God's creation—to cause alteration and degradation of natural ecosystems at global scales.

6 pts 5. Explain the concept of 'standing to sue' using *Sierra Club v Morton* as an example.

The Administrative Procedures Act provides that a government agency can be sued over a decision that causes damage to a party. But the party must first prove its 'standing to sue.' According to Hoban and Brooks, "standing to sue is the ability of a party to seek relief in court.' The primary requirement is for the party to show that s/he has suffered damage of some kind. Before the Mineral King case (*Sierra Club v Morton*), the emphasis on standing to sue in appealing government decisions had been on proving damage of an *economic* nature. Non-economic environmental harm was not general recognized as conferring standing to sue.

In the case of *Sierra Club v Morton*, the Sierra Club sued the Department of the Interior over the decision of the National Park Service to allow an access road through Sequoia National Park to a planned ski resort in Mineral King. The case is important for two reasons: the Sierra Club *as an organization* claimed a right to sue because its interests were harmed, and it claimed that environmental damage (to a National Park, in this case) was sufficient to confer standing. The Supreme Court readily accepted the second claim but not the first: environmental damage was sufficient to confer standing on individuals (including Sierra Club *members*) but not on the Sierra Club organization *as a whole*.

6 pts 6. (a) Conflict about federal lands generally involves competition between resource uses. List the seven major resource uses of federal lands.

- water
- minerals
- timber
- grazing
- wildlife
- ecotourism
- preservation

6 pts (b) Land owned by the federal government is divided into four major *systems* that we discussed in class. List these systems; for each system, identify the federal agency primarily responsible for its management.

- The National Park System, managed by the National Park Service. This is a 'dominant use' system; in this case, the primary purpose is recreation.
- The National Forest System, managed by the USDA Forest Service. This is a 'multiple use' system.
- The National Landscape Conservation System, managed by the Bureau of Land Management (BLM). This is a 'multiple use' system. This designation of BLM public lands is fairly recent (2000), though the BLM itself has been managing public lands since 1946.
- The National Wildlife Refuge System, managed by the Fish and Wildlife Service. This is a dominant use system, intended for wildlife management (for hunting/fishing) and preservation.

12 pts 7. Describe *dependency theory* in some detail and explain how—according to Vandermeer and Perfecto—it results in tropical rain forest destruction.

Dependency theory states that the industrialized nations of the world are wealthy, at least in part, at the expense of poor Third World countries. Third World countries support rich countries by supplying natural resources, cheap labor, and investment opportunities. Dependency theory was developed in part to explain the slow rate of development of certain Third World countries. Vandermeer and Perfecto believe that it explains how natural resources of the Third World, such as tropical rain forests, are disappearing or being degraded.

The export-oriented nature of Third World countries encourages what Vandermeer and Perfecto termed the 'disarticulated' nature of their economies, meaning that there is little incentive for Third World businesses and governments to improve the spending power of the lower classes in their countries, since natives are not their main customers. Indeed, keeping the lower classes poor helps them cut costs and increase their profits. Export agricultural operations also cause local overpopulation in the rain forests, which are thus destroyed by the subsistence farming that results from large layoffs that occur during downturns in the global marketplace.

Third World governments exploit their natural resources—such as tropical rain forests—in order to feed their economies with money from First World countries. This is the ultimate driver of rain forest destruction, and the Dependency Theory asserts that this action benefits First World countries much more than the local governments. It also explains why international institutions—which largely exist to serve First World interests—have little incentive to change things.

12 pts 8. It has been proposed that a loss in diversity impairs ecosystem functioning. What are the main hypotheses proposed to explain this impact? Briefly explain each hypothesis.

The basic prediction is that more diverse ecosystems are superior in two respects: they are *more efficient* at using their resources, and they are *more stable* under conditions of changing environmental conditions. Higher resource efficiency means that rates of energy transfer and materials flow–ie, levels of ecosystem functioning—will be higher. Services provided by the ecosystem to humans will be available in greater quantity and quality. Greater ecosystem stability is important because it means that the level of ecosystem functioning will be maintained (or quickly restored) in the event of both gradual and sudden changes in environmental conditions (eg, drought, fire, climate change). Stability implies that there is less oscillation in the level of functioning with time, and also less effect of short- and long-term environmental changes—such as drought, fire or climate change—on functioning levels. Lets examine the reasons behind these two claims: greater efficiency and stability with increasing biological diversity.

Higher diversity results in greater efficiency for two basic reasons. First of all, there is a higher chance that a diverse ecosystem will contain very highly efficient species; this is called the *sampling effect*. Natural selection pressures will also tend to favor increasing efficiency in resource use, since less efficient species will be out-competed and die off. Secondly, higher species diversity generally means that more resources will be used in an ecosystem; in other words, more ecosystem niches will be occupied. This is the *complementarity effect*.

Greater ecosystem stability is favored by higher diversity partly because of the *portfolio effect*. More species means that there is a greater probability that more species exist that thrive under the new conditions. In other words, populations of various species can rise and fall with changing conditions, but the overall level of functioning will remain high. In terms of long-term environmental changes, a more genetically diverse ecosystem will have a *higher evolutionary potential*, meaning that species will be better able to adapt to the new conditions by developing favorable traits.

6 pts 9. (a) What exactly is optimized when a *Pareto optimum* is achieved?

Every member of a society has his or her preferences, a set of needs and desires that s/he would like to meet. The more of them that are satisfied, and the better they are satisfied, the 'happier' the individual will be. A Pareto Optimum is a situation where it is not possible to make one person happier without decreasing the happiness of another. Note that this is not quite the same as maximizing aggregate happiness since there cannot be losers in a true Pareto optimum.

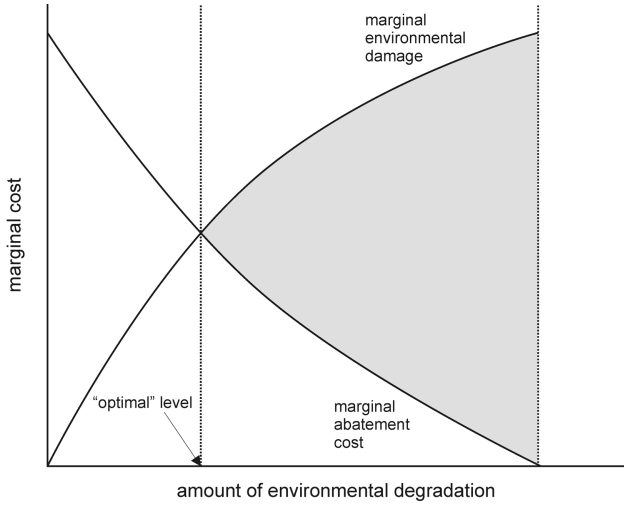
16 pts (b) Explain *in detail* how cost-benefit analysis (CBA), coupled with the potential compensation criterion, leads to a Pareto optimum when applied to environmental problems.

In CBA, the aggregate wealth of society is maximized. It is assumed that aggregate happiness is also maximized (ie, that wealth is a suitable proxy for happiness). A Pareto optimum is then achieved when the losers under CBA are compensated by the winners.

One can apply this process to environmental decisions as follows. It is necessary that environmental degradation can be described incrementally: acres of forest cleared, tons of pollutant emitted, etc. We need to know two things:

- the *marginal abatement cost* (MAC) for each unit of degradation that is avoided. Imagine that a company is participating in some action destructive to the environment. The MAC is the additional cost for each incremental improvement, for example, each ton of a pollutant that is *not* emitted.
- the *marginal environmental damage* (MED) for each additional unit of degradation. This is the (incremental) society cost of environmental destruction. For example, increased pollution can result in increased health care costs. Or an acre of forest may mean loss of ecosystem goods/services and decreased water quality.

The two curves are shown in the following figure in a typical situation.




Let's imagine a particular activity with no abatement whatsoever and ask the question: according to a cost-benefit perspective, how much abatement should be implemented? For any particular abatement level, the total abatement cost is the area under the MAC curve from no abatement (zero cost) to the abatement level. And the total benefit of abatement is the area under the MED curve from no abatement to the chosen abatement level. The *net* cost to society at that abatement level—due to the environmental damage resulting from insufficient abatement—would be the difference in the two areas: the areas between the MAC and MED curves from zero abatement to the desired abatement level.

According to CBA, an additional abatement 'unit' should be added as long as marginal cost due to the environmental damage is larger than the marginal cost of abatement (ie, as long as $MED > MAC$). Using this reasoning, the benefits from further abatement continue until the two curves cross (see the figure). From this point on, further abatement will cost more than will be gained from the resulting environmental improvement. The point where $MED = MAC$ marks the 'economically optimal' level of environmental degradation.

The optimal level results in the greatest economic efficiency. This is the level of environmental degradation that maximizes the wealth of society *as a whole*. However, abatement will result in winners (eg, citizens living near a power plant who gained from the abatement) and losers (whomever has to ultimately pay for the abatement). So a Pareto optimum can be obtained only if the winners compensate the losers. For example, a company can pass its abatement cost to the customers who ultimately gain from the abatement. Then the winners should still come out ahead—the cost of abatement is less than the environmental benefits, after all—but there will be no losers. Cost-benefit analysis coupled with compensation has resulted in a Pareto optimum.

6 pts (c) List the main criticisms of depending too heavily on CBA to guide environmental policy

The following answers build on one another.

Applying CBA to environmental decisions means—as outlined in the previous answer—that we use estimates of the marginal abatement costs and the marginal environmental damage to estimate an economically efficient level of environmental degradation. This level occurs when the marginal costs and benefits are equal. The first criticisms below concern our ability to accurately determine this 'break even' point. In other words, they are problems of implementation. The last criticisms are aimed at the entire philosophy of the CBA approach; in other words, they are made by critics who maintain that the CBA approach is flawed even if implemented perfectly.

- CBA is based partly on knowledge of the environmental damage function: assigning a monetary value to the effects of environmental degradation. But the state of the natural sciences may not be up to the task of assessing the true impacts of a particular act (pollution discharge, species extinction, etc) on environmental systems and human well-being. Thus, the consumer *cannot* be fully informed of the consequences of an action and an environmental damage function will not be accurate (and will usually underestimate the actual damage to human well-being).
- Even in the event of full scientific understanding, assigning monetary values to nonmarket ecosystem goods and services is too difficult. For example, gauging consumer willingness to pay will be flawed if the consumer does not know enough science to accurately value environmental degradation. And methods such as contingent valuation depend on consumer response to a 'make-believe' market that may not accurately reflect the true value the consumer assigns to the environment.
- Abatement costs also contain uncertainty and bias, though usually not to the same degree as the damage function.
- Incorporating future generations in cost-benefit analysis is even more problematic, as uncertainties in environmental benefits and opportunity costs are compounded when extrapolated into the future. The practice of discounting is subject to bias through the (frequently arbitrary) choice of the discount rate. Critics maintain that this practice underestimates the value of ecosystem services to future generations. (Often CBA does not include future generations at all, in which case critics charge that the results are inherently flawed.)

The net effect of the previous four points is that economically optimal level of environmental degradation is so biased and uncertain as to be useless in practice. Uncertainty can possibly be dealt with if its magnitude (and density function) were known, but bias by its very nature is unknown.

Finally, criticisms of a perfectly implemented CBA are:

- There is a difference between consumer preferences and citizen values. This is Mark Sagoff's main complaint: not everything—and in particular, ethical values—can be assigned a monetary value. Another way of putting it is this: even in the absence of any scientific uncertainty and with perfect implementation, the application of CBA maximizes aggregate societal wealth. But aggregate happiness is not necessarily maximized thereby.
- A 'majority vote' using money (willingness to pay) inherently skews the result towards the one most favored by the richer segment of society—which, after all, has more money to 'vote' with. In other words, the rich have more voting power than the poor to determine the economically optimal level of environmental degradation.
- Maximizing aggregate happiness—which is the goal of the utilitarian ethical system—is not a worthy goal even if it could be achieved by CBA. A Kantian—'rights-based'—system of ethics is a better alternative. For example, one may hold that it is morally reprehensible to maximize aggregate happiness if it means increasing the incidences of cancer in a minority population.
- Both utilitarian and Kantian ethical systems are based on the human perspective. But some hold that we have a duty to respect nonhuman species. CBA has an explicit anthropocentric focus, ignoring the intrinsic value of other species.