Conservation Biology – FOR 315 – Overview[1]

Human enterprises:

1) transform the land and sea – through land clearing, forestry, grazing, urbanization, mining, trawling, dredging, etc.;
2) alter the major biogeochemical cycles – of carbon, nitrogen, water, synthetic chemicals, etc.; and
3) add or remove species and genetically distinct populations – via habitat alteration or loss, hunting, fishing, and introductions and invasions of species

Human domination of the Earth has resulted in these consequences:

1) from 1/3 to ½ of the land surface has been transformed by human action;
2) the carbon dioxide concentration in the atmosphere has increased by nearly 30% since the beginning of the Industrial Revolution;
3) more atmospheric nitrogen is fixed by humanity than by all natural terrestrial sources combined;
4) more than half of all accessible surface fresh water is put to use by humanity;
5) about ¼ of the bird species on Earth have been driven to extinction; and
6) approximately 2/3 of major marine fisheries are fully exploited, overexploited, or depleted.

New chemicals and other human disturbances have changed the functioning of the Earth system including:

1) disruptions to global climate;
2) depletion of stratospheric ozone;
3) irreversible losses of biological diversity; and
4) changes in the structure and functioning of ecosystems around the world.

> The conclusions from this overview are inescapable: during the last few decades, humans have emerged as a new force of nature. We are modifying physical, chemical, and biological systems in new ways, at faster rates, and over larger spatial scales than ever recorded on Earth. Humans have unwittingly embarked upon a grand experiment with our planet. The outcome of this experiment is unknown, but has profound implications for all of life on Earth. An assessment from the Ecological Society of America entitled the Sustainable Biosphere Initiative states that "environmental problems resulting from human activities have begun to threaten the sustainability of Earth's life support systems. . . . Among the most critical challenges facing humanity are the conservation, restoration and wise management of the Earth's resources" (*21*).

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[1] From: Lubchenco, J. 1998. Entering the century of the environment: A new social contract for science. Science 279:491-497.

Most people believe that ignoring environmental problems is the best course of action or denying that there are no problems whatsoever. Calvin & Hobbs, comic strip characters from the 1990s, helped to point out the challenges to combating ignorance and inaction…

Calvin and Hobbes are riding along in their red wagon, careening through the woods:

Calvin: "It's true, Hobbes, ignorance *is* bliss!

Once you know things, you start seeing problems everywhere . . .

. . . and once you see problems, you feel like you ought to try to fix them . . .

. . . and fixing problems always seems to require personal change . . .

. . . and change means doing things that aren't fun!

I say phooey to that!"

Moving downhill, they begin to pick up speed.

Calvin (looking back at Hobbes): "But if you're willfully stupid, you don't know any better, so you can keep doing whatever you like!

The secret to happiness is short-term, stupid self-interest!"

Hobbes (looking concerned): "We're heading for that cliff!"

Calvin (hands over his eyes): "I don't want to know about it."

They fly off the cliff:

"Waaaugghhh!"

After crash landing,

Hobbes: "I'm not sure I can stand so much bliss."

Calvin: "Careful! We don't want to learn anything from this."

From Calvin & Hobbs, by B. Watterson. 17 May 1992. Distributed by Universal Press Syndicate.

Leopold quote:

One of the penalties of an ecological education is that one lives alone in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise.

The government tells us we need flood control and comes to straighten the creek in our pasture. The engineer on the job tells us the creek is now able to carry off more flood water, but in the process we lost our old willows where the cows switched flies in the noon shade, and where the owl hooted on a winter night. We lost the little marshy spot where our fringed gentians bloomed.

Some engineers are beginning to have a feeling in their bones that the meanderings of a creek not only improve the landscape but are a necessary part of the hydrologic functioning. The ecologist sees clearly that for similar reasons we can get along with less channel improvement on Round River.

Leopold, Aldo: ***Round River***, Oxford University Press, New York, 1993, pg. 165.

Energy concepts (from Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders, Co., Philadelphia, PA):

> The *first law of thermodynamics* states that energy may transformed from one type to another but is never created or destroyed. Light, for example, is one form of energy, for it can be transformed into work, heat or potential energy of food, depending on the situation, but none of it is destroyed. The ***second law of thermodynamics*** may be stated in several ways, including the following: No process involving an energy transformation will spontaneously occur unless there is a degradation of the energy from a concentrated form into a dispersed form. For example, heat in a hot object will spontaneously tend to become dispersed into the cooler surroundings. The *second law of thermodynamics* may also be stated as follows: Because some energy is always dispersed into unavailable heat energy, no spontaneous transformation of energy (light, for example) into potential energy (protoplasm, for example) is 100 per cent efficient.
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> Organisms, ecosystems and the entire biosphere possess the essential thermodynamic characteristic of being able to create and maintain a high state of internal order, or a condition of low entropy (a measure of disorder or the amount of unavailable energy in a system). Low entropy is achieved by a continual dissipation of energy of high utility (light or food, for example) to energy of low utility (heat, for example). In the ecosystem, "order" in terms of a complex biomass structure is maintained by the total community respiration which continually "pumps out disorder."

From the 1st class (2nd law of thermodynamics):

1. Heat flows spontaneously from a hot body to a cool one.
2. One cannot convert heat completely into useful work.
3. **Every isolated system becomes disordered in time**.