

Lecture 02, 23 Aug 2007  
 Ecological Footprint  
 What is Conservation Biology?

Conservation Biology  
 ECOL 406R/506R  
 University of Arizona  
 Fall 2007

Kevin Bonine  
 Cathy Hulshof

1. If not in lecture Tuesday,  
 please see us after class.



Upcoming Readings  
 today: **Textbook, chapter 1; Noss 1999**  
 Tues 28 Aug: **Textbook chapter 3; Callicott 1997** (from Meffe and Carroll)  
 Thurs 30 Aug: **Textbook Ch. 3, Leopold readings**  
 [Q1 due 30 Aug if you choose to answer.]



Conservation Biology 406L/506L

Lab Friday (tomorrow)  
 1230 S or W side BSE  
 (4th and Highland)  
 Hat, water, sunscreen, close-toed shoes  
 Readings on Course Website

24 Aug. Tumamoc Hill and Introduction,  
 VAN  
 ecological research, study plots,  
 geology, Tucson basin, desert  
 vegetation, introductions and schedules



**Public Water Lecture with Peter Gleick**

Fresh water availability is a growing issue of concern across the world, but no where more than in arid lands. Tucson is no exception. Will projections of our water supply in the distant future - even in the next decade or two - be accurate? How will prolonged drought affect both water quantity and quality? What impacts will water supply have on the region's economic viability?

Sustainable Tucson is co-host of a public lecture by international water expert, Peter Gleick, along with the Water Resources Research Center (WRRC) and Institute for the Study of Planet Earth (ISPE) at the University of Arizona, and the Southern Arizona Leadership Council (SALC).

A **MacArthur Fellow** and widely published in leading scientific journals, Dr. Peter Gleick is one of the world's top experts on the impacts of climate change on water supply. His work with communities and governments across the Southwest and the world brings a broad perspective to the local discussion.

How can we define **sustainable water policies**, based on sound laws and science? To what extent will water transfers and markets - the economics of shifting water - help us reconcile growth and supplies which are limited, keeping in mind that global warming, as well as land-use changes, will likely affect both surface and groundwater systems?

Sustainable Tucson believes Dr. Gleick's vision can help inform local planning by bringing the experience of many communities to bear on Tucson's creative solutions to long-term water security.

Dr. Gleick will address water experts and other leaders at the Arizona Hydrologic Society's regional conference, "Sustainable Water, Unlimited Growth, and Quality of Life: Can We Have It All?" to be held August 27 - 30 in Tucson.

The joint planning of this public lecture amongst university departments, civic, business, and community groups, points to exciting new dialogue over water and sustainability taking place in our community.

The lecture will take place in **Tucson on August 30, at 7:30 p.m. at Temple Emanu-El - 225 N. Country Club Rd.**

Contact **Madeline Kiser** ( [mkiser@dukatucson.net](mailto:mkiser@dukatucson.net) )  
 or **Susan Williams** ( [susanleewilliams@cox.net](mailto:susanleewilliams@cox.net) ) for more information.



<http://www.sustainabletucson.org/>



<http://www.ecoalition.org/index.html>

Think Globally, Act Locally 4

**Quiz:**

What were two of the four questions that the Noss (1999) paper attempts to address?

conservation biologists today: 1) are there any robust principles of conservation biology? 2) Is advocacy an appropriate activity of conservation biologists? 3) Are we educating conservation biologists properly? 4) Is conservation biology distinct from other biological and resource management disciplines? I answer three of these

**Distinguish between Conservation and Preservation (as defined in the Noss paper).**

from what it means today. Conservation, in America at least, was strictly utilitarian and was opposed to "preservation," which meant protecting the wonders of nature, mostly for the spiritual and aesthetic enrichment of mankind (Fox 1981). Preservation today is interpreted as a hands-off approach, one option in a



**Figure 1.5** The first issue of the journal *Conservation Biology*, published in May 1987. (Photograph courtesy of E. P. Pister.)

Meffe and Carroll 1997

What is Conservation Biology?

When and what were the origins of the discipline?

Van Dyke Chapter 1 (p. 4)

Ethical and Conceptual Roots

- 1. Intrinsic Value (revisit in Ch.3)
- 2. Ecosystem services
- 3. Aesthetic, spiritual enrichment

Table 2.1 Ecosystem Services and Functions	
Ecosystem service <sup>a</sup>	Examples
Gas regulation	Carbon dioxide/oxygen balance, ozone for protection against ultraviolet light
Climate regulation	Greenhouse gas regulation, dimethyl sulphide production affecting cloud formation
Disturbance regulation	Storm protection, flood control, drought recovery, and other aspects controlled by vegetation structure
Water regulation	Provisioning of water for agricultural (such as irrigation) or industrial (such as milling) processes or transportation
Water supply	Provisioning of water by watersheds, reservoirs, and aquifers
Erosion control and sediment retention	Prevention of loss of soil by wind, runoff, or other removal processes; storage of silt in lakes and wetlands
Soil formation	Weathering of rock and the accumulation of organic material
Nutrient cycling	Nitrogen fixation, nitrogen, phosphorus, and other elemental or nutrient cycles
Waste treatment	Waste treatment, pollution control, detoxification
Pollination	Provisioning of pollinators for the reproduction of plant populations
Biological control	Keystone predator control of prey species; reduction of herbivory by top predators
Refugia	Nurseries, habitat for migratory species, regional habitats for locally harvested species, or overwintering grounds
Food production	Production of fish, game, crops, nuts, and fruits by hunting, gathering, subsistence farming, or fishing
Raw materials	The production of lumber, fuel, or fodder
Genetic resources	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species (pets and horticultural varieties of plants)
Recreation	Ecoscience, sport fishing, and other outdoor recreational activities
Cultural	Aesthetic, artistic, educational, spiritual, and/or scientific values of ecosystems

<sup>a</sup> Ecosystem "goods" included in ecosystem services.  
 Source: Adapted with permission from Robert Costanza et al., "The value of the world's ecosystem services and natural capital," *Nature*, May 1997.

Brennan and Withgott 2005

7

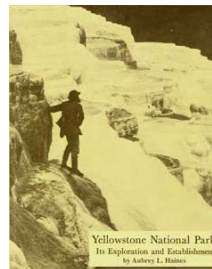
Van Dyke Chapter 1 (p. 5)

"Genuine and enduring conservation can occur only when humans knowingly use resources at less than maximum sustainable rates or forgo the use of some resources altogether." [RESTRAINT]

- Philosophy (e.g., Plato)
- Religion (e.g., Judaism)
- Nobility and their Forests

9

Modern Con Bio starts in Colter's Hell...



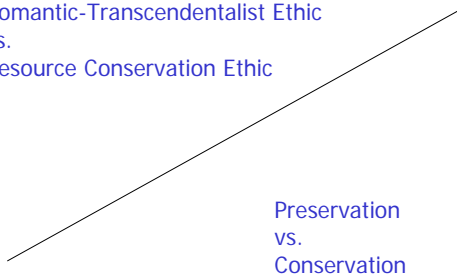
Thomas Moran on the Mammoth Terraces  
 Photograph by William H. Jackson, 1871.  
 (National Park Service)



John Colter 1807  
 (~Lewis and Clark)  
 Yellowstone Area

10

Romantic-Transcendentalist Ethic  
 vs.  
 Resource Conservation Ethic



Preservation  
 vs.  
 Conservation

11

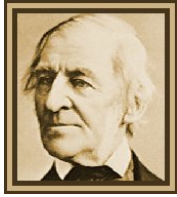
~Romantic-Transcendentalist Ethic:

- Ralph Waldo Emerson
- Henry David Thoreau
- John Muir
- Sierra Club 1892
- NGO
- Education, Lobby, Law/Politics

Yellowstone National Park 1872  
 Yosemite National Park 1890

ESA 1917 --> Nature Conservancy 1950

12



Ralph Waldo Emerson  
1803-1882

**A Successful life**  
"To laugh often and much; to win the respect of intelligent people and the affection of children; to earn the appreciation of honest critics and endure the betrayal of false friends; to appreciate beauty; to find the best in others; to leave the world a bit better, whether by a healthy child, a garden patch, or a redeemed social condition; to know even one life has breathed easier because you have lived."  
- Ralph Waldo Emerson -



Henry David Thoreau  
(1817-1862)

"Many go fishing all their lives without knowing that it is not fish they are after."

"Beware of all enterprises that require new clothes. "

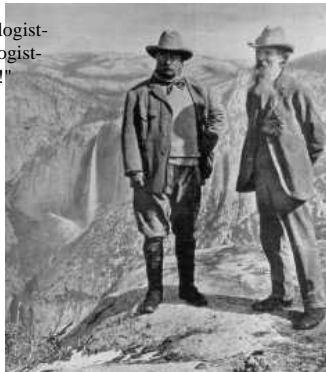
"It is not worthwhile to go around the world to count the cats in Zanzibar. "

"Wherever a man goes, men will pursue him and paw him with their dirty institutions, and, if they can, constrain him to belong to their desperate oddfellow society. "

"poetico-trampo-geologist-botanist and ornithologist-naturalist etc. etc. !!!!!"



John Muir  
(1838-1914)



15

Teddy Roosevelt  
(president 1901-1909)

~resource conservation ethic:



Figure 1.3 VanDyke 2003  
Theodore Roosevelt, the twenty-sixth president of the United States (1901-1909), greatly supported the role of the federal government in conservation.

"To Roosevelt, it was clear that a handful of individuals and their companies were reaping most of the profits from natural resources that rightfully belonged to all citizens." Van Dyke 2003, p. 10

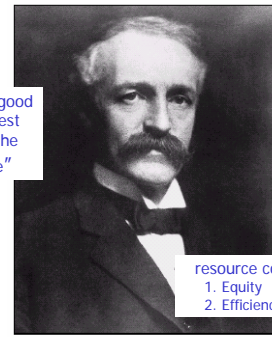
early 1900s "Trustbuster"

Resources for use, but forever.

National Wildlife Refuge System (52 designations by TR)

17

"The greatest good for the greatest number for the longest time"



Gifford Pinchot

resource conservation ethic:  
1. Equity  
2. Efficiency

Figure 1.4 VanDyke 2003  
Gifford Pinchot, early head of the U.S. Forest Service and father of the resource conservation ethic. From an original staff of only 123 in 1899, Pinchot built the Forest Service to an organization of 1,500 people administering 150 million acres of public land within 10 years.

18

Sustainable Use  
Maximum Sustained Yield

USE those resources!



19

Modern Conservation Biology  
- National Parks  
- U.S.

Transferable?

20



**Aldo Leopold**  
*Game Management* 1932  
  
*A Sand County Almanac* (1966)  
-evolution/ecology land ethic

Figure 1.5 Van Dyke 2003  
Aldo Leopold, early twentieth-century conservationist and father of the modern land ethic.

Land Health and the A-B Cleavage

Commodities (A)  
vs. Processes (B)

21

**Rachel Carson**  
*Silent Spring* 1962

- Bioaccumulation
- Levels and scale
- Environmental degradation threaten *human health*
- Increased Public Awareness

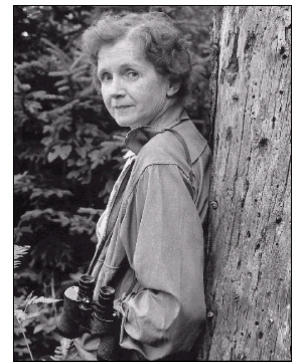


Figure 1.6 Van Dyke 2003  
Rachel Carson, U.S. Fish and Wildlife Service biologist and author of *Silent Spring* (1962), a seminal book in the modern environmental movement.

308 PART TWO Environmental Problems and the Search for Solutions

### The SURECCC Story

#### Pesticides and Child Development in Mexico's Yaqui Valley

With specially trained and big animal eyes, one set of pictures shows the scars of sick figures drawn by young children everywhere. Next to them is another group of drawings, mostly disconnected scribbles and lines, resembling nothing. Both sets of pictures are intended to depict people. The main difference identified between the two groups of young artists: long-term pesticide exposure.

Children's drawings are not a typical tool of toxicology, but Elizabeth Guillen, an anthropologist, wanted to try one. She was interested in the effects of pesticides on children. She devised tests to measure childhood development based on techniques from anthropology and medicine. Searching for a study site, Guillen found the Yaqui Valley region of northwestern Mexico.

The Yaqui Valley is farming country, worked for generations by the indigenous group that gave the region its name. Synthetic pesticides arrived in the area in the 1940s. Some Yaqui embraced the agricultural innovations, spraying their farms in the valley to increase their yields. Yaqui farmers in the surrounding foothills, however, generally chose to bypass the chemicals and to continue following more traditional farming practices. Although differing in farming techniques,

**Drawings by children in the foothills**

**Drawings by children in the valley**

Elizabeth Guillen's study in Mexico's Yaqui Valley offers a startling example of apparent neurological effects of pesticide poisoning. Using children from foothills areas where pesticides were not common and from comparable regions of people. Children from the valley drew stick figures that were not clearly people. Adapted from Elizabeth A. Guillen, et al., *Environmental Health Perspectives*, 1994.

Yaqui in the valley and foothills continued to share the same culture, diet, education system, income levels, and family structure. At the time of the study, in 1994, valley farmers planted crops twice a year, applying pesticides up to 40 times from planting to harvest. A previous study conducted in the valley in 1990, focusing on areas with the largest farms, had indicated high levels of multiple pesticides.

Brennan and Withgott 2005

23

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Brennan and Withgott 2005

Journal of Wildlife Management (1937)  
Wildlife Society Bulletin

vs.

Conservation Biology  
Biological Conservation

(~movement from individual game species to large scale and generalized approaches)



Meffe and Carroll 1997

Figure 1.1 The first issue of the journal Conservation Biology, published in May 1987. (Photograph courtesy of E. P. Posen.)

1985

the founding of the Society for Conservation Biology (SCB), with the explicit mission "to help develop the scientific and technical means for the protection, maintenance, and restoration of life on this planet – its species, its ecological and evolutionary processes, and its particular and total environment."

(from Noss 1999)

26

Is conservation biology a distinct discipline?

- Biodiversity (levels and scales)
- Prevent degradation and loss



1. Scarcity and Abundance
2. Value laden and mission driven
3. Diversity and complexity good  
Untimely extinction bad
4. Evolution is good (genotypic variation)  
-process
5. Biotic diversity has intrinsic value

(~Soulé's normative postulates)  
(see 8 traits in Van Dyke Ch1, p. 15)

27

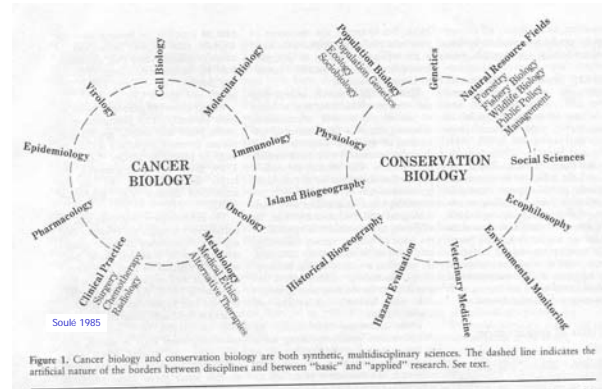


Figure 1. Cancer biology and conservation biology are both synthetic, multidisciplinary sciences. The dashed line indicates the artificial nature of the borders between disciplines and between "basic" and "applied" research. See text.

6. Crisis Discipline?

28

"In crisis disciplines, one must act before knowing all the facts; crisis disciplines are thus a mixture of science and art, and their pursuit requires intuition as well as information" (Soulé 1985).

-Noss 1999

29

Problems Addressed by Conservation Biologists:

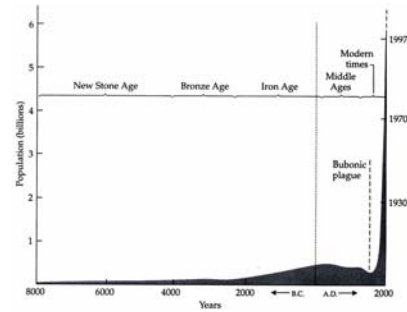
- 1 Genetic Diversity  
variation, inbreeding, drift, hybridization
- 2 Species  
MVP, PVA  
small populations  
declining populations  
metapopulations
- 3 Habitat  
loss, fragmentation, isolation, heterogeneity
- 4 Ecosystem Processes  
scale
- 5 Human sustainability  
the crux

systems. Nevertheless, conservation biologists increasingly recognize that the proximate and ultimate threats to biodiversity virtually all have to do with humans.

Noss 1999, p. 118

31

### Humans on planet Earth



Meffe and Carroll 1997

32

1948!!!

In 1948 G. Evelyn Hutchinson warned of the dangers of the expanding human population and the disruption of geochemical cycles, one outcome of which could be global warming.

(from Noss 1999)

33

For Today, please calculate your ecological footprint TWICE:

Once for your life here in the U.S.  
A second time using the same information, but choose a different country.

<http://www.earthday.net/footprint/index.asp>

Frequently Asked Questions re: Ecological Footprint:  
[http://www.rprogress.org/ecological\\_footprint/footprint\\_FAQs.htm](http://www.rprogress.org/ecological_footprint/footprint_FAQs.htm)

Bring the Numbers to Class on Thursday.  
Convert to Acres.

35

### Ecological Footprint



The big choices seem to matter the most:

- transportation
- food (unprocessed, local, trophic level)
- housing
- reproduction



Recycling etc. important, but not as big an impact

Paper or Plastic? - Bring your own.

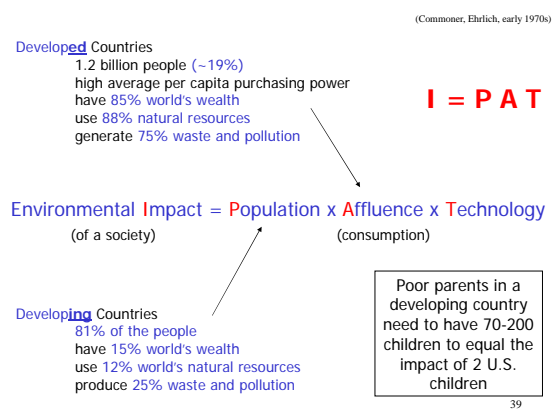
36



37

**Ecological Footprint**

- Reproduction
- Housing
- Travel
- Food
- Etc.



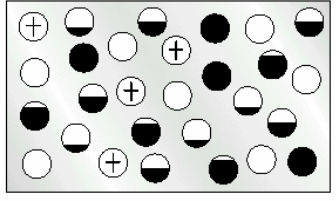
39

One of **Commoner's** lasting legacies is his **four laws** of ecology, as written in *The Closing Circle* in 1971. The four laws are:

1. **Everything is Connected to Everything Else.** There is one ecosphere for all living organisms and what affects one, affects all.
2. **Everything Must Go Somewhere.** There is no "waste" in nature and there is no "away" to which things can be thrown.
3. **Nature Knows Best.** Humankind has fashioned technology to improve upon nature, but such change in a natural system is, says Commoner, "likely to be detrimental to that system."
4. **There Is No Such Thing as a Free Lunch.** In nature, both sides of the equation must balance, for every gain there is a cost, and all debts are eventually paid.

40

**Theoretical Basis of Conservation Biology?**

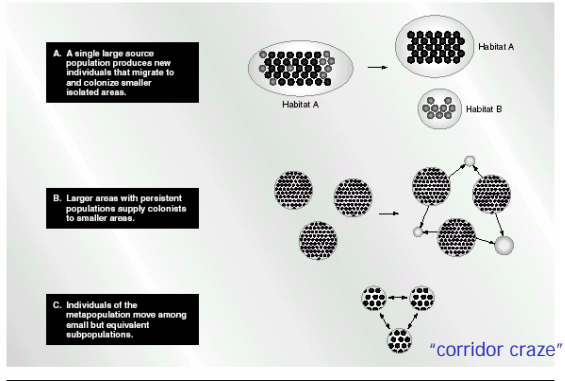


- Metapopulations
- Island Biogeography  
MacArthur and Wilson 1963
- Testable Hypotheses
- Thresholds

**Figure 1.8**  
Diagrammatic representation of an arrangement of local populations ("metapopulation") based on Andrewartha and Birch (1954). Empty circles represent favorable habitats that individuals do not occupy. Partially or completely filled circles represent favorable habitats and relative densities of individuals in them as a proportion of the habitats' maximum capacity. Crosses indicate habitats in which local populations recently became extinct.

Van Dyke 2003

41



**Figure 1.9** Van Dyke 2003  
Three variations of the metapopulation concept. Although different in detail, all represent metapopulations as spatially distinct groups (subpopulations) that disperse to or among physically separated habitats.

Noss 1999

Is there a special conservation biology?

Origins

Soulé et al. 1978+

SCB 1986

*Conservation Biology* 1987



Ideas

- Precautionary Principle
- Value Laden
- Species differences...
- Umbrella species
- Advocacy



Pattern and Generality vs. Special Case

p. 116, Noss 1999

44



Responsible Advocacy?

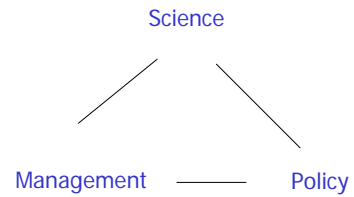
Ethical Advocacy?

p.117, Noss 1999:

tropical rainforest

vs.

economic development program



Is ConBio distinct discipline?

45

46