Lecture 29, 06 December 2005
Conservation
Economics
Sustainability
Evaluations

Conservation Biology
ECOL 406R/506R
University of Arizona
Fall 2005

Kevin Bonine
Kathy Gerst

Conservation Biology 406R/506R

Fall 2005 Conservation Biology course presents....

A Creativity Project Exhibit

1. Creativity Recap (items in my office)
2. Economics (Van Dyke, Chapter 12)
3. Evaluations

Zeb Hoban
SEAsian fishes, NPR

Hans-Werner Herrmann
BSE 225 Wed 1-2pm
Conservation in Vietnam

Thursday, December 1, 2005

Final Exam
Forbes lobby
noon-2 pm
(1100-1300h Tues 13 Dec 2005 in this room)
Fall 2005 Conservation Biology course presents....

A Creativity Project Exhibit

a student project display integrating artistic innovations with a goal to foster the education and communication of conservation issues

- poetry
- short stories
- children's books
- music
- art
- sculpture
- and more...

Thursday, December 1, 2005

Forbes lobby  
noon-2 pm
1. Economics, Sustainability
   - Herman Daly
   - Wendell Berry

   -$-

   - Population
   - Consumption
   - Economies

   Assumptions and Goals
   - Externalities
   - Genuine Progress Indicator

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**Exponential Growth**

**Logistic Growth**

**Human Population Growth**

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Figure 14.3: Exponential growth results in a continuously accelerating curve of increase. The curve of exponential growth is shown for a population growing at a rate between time t and time t+1. During this period, the number of individuals increases from N(t-1) to N(t). Notice that the slope becomes steeper as the population increases.

*Rickles 2001*

Figure 14.4. Logistic growth follows an S-shaped curve. The curve is symmetrical about the inflection point (t). That is, accelerating and decelerating phases of population growth have the same shape.

*Rickles 2001*

Figure 18-14: Tree plantation activity - A view from far.

*Wright and Nebel 2002*
Role of Human Population Growth...

Miller, 2003 Figure 1-6 Past and projected population size for developed countries, developing countries, and the world, 1950–2100. More than 98% of the addition of 3.6 billion people between 1990 and 2030 is projected to occur in developing countries. (Data from United Nations)

Demographic Transition

Role of Human Population Growth...

Miller, 2003 Figure 11-18 Generalized model of the demographic transition.
Age Structure Diagrams
- note age of reproduction
- currently 30% under 15 (=1.7 billion)

Figure 11-12: Generalized population age structure diagrams for countries with (1) rapid (1.5-3%), (2) slow (0.3-1.4%), (3) zero (0-0.2%), and (4) negative population growth rates. (Data from Population Reference Bureau)

Value added

Wright and Nebel 2002
**Developed Countries**
1.2 billion people (~19%)
- High average per capita purchasing power
- Have 85% world’s wealth
- Use 88% natural resources
- Generate 75% waste and pollution

**Developing Countries**
- 81% of the people
- Have 15% world’s wealth
- Use 12% world’s natural resources
- Produce 25% waste and pollution

**Environmental Impact = Population \times Affluence \times Technology**

(Paul Ehrlich)

(impact of each unit of consumption)

Poor parents in a developing country need to have 70-200 children to equal the impact of 2 U.S. children

Wright and Nebel 2002

**FIGURE 23-3** Environmental economic view of economic activity. The natural environment encompasses the economy, which is constrained by the resources found within the environment.

2nd Law of Thermodynamics
Economy = system of production, distribution, and consumption of goods and services (scarcity)

Driven by wants and needs of govt, society, individuals

Decisions about
A. what goods and services
B. how produce
C. how much
D. how distribute
are made by individuals, governments, businesses

Use resources:
A. natural
B. human
C. financial
D. manufactured
to make goods and services

**Supply and Demand**

![Figure 2.1 Supply and Demand](image.png)

*FIGURE 2.1 Supply and Demand.* The market clears at price $P_0$ and quantity $Q_0$. At the higher price $P_1$, a surplus develops, so price falls. At the lower price $P_2$, there is a shortage, so price is bid up.
Traditional Neoclassical Economics (Miller 2003):

Command
- government

Capitalist Market System

Free Market
- markets
- competition
- information
- full cost pricing

- monopoly
- global free trade
- gov't subsidies/tax breaks/"insurance"
- withhold information
- maximize profits (pass costs to others, future)

Internal Market Costs

vs.

Externalities

- External to Market Forces

- Noise
- Pollution
- Acid rain
- Erosion
- Global Warming
- Eutrophication
- Disease
- Asthma
- Birth Defects
- Behavior and Intelligence
What is the purpose of the economic system?
- to what end all of this wealth? Ultimate value beyond market?

1-NeoClassical Economics (growth always good)

2-Environmental Economics (catch-all term, think cyclically)

3-Steady-State Economics (John Stuart Mill 1700’s, Herman E. Daly)
  - in = out
  - ‘Virtue and character higher goals than material wealth.’

4-Sustainable Development (Lester Brown)
  - do away with many subsidies
  - replace income tax with environmental tax

Stocks and Flows, \( \rightarrow \) Entropy
Nicolas Georges-Roegen
~“a Cadillac now means fewer human lives later”
Utility vs. Throughput
Economic Growth vs. Development
- efficiency, sophistication, utility

[Nonrival (air to breathe) or nonexclusive goods (UV protection from ozone)]

- Producer Pays/Polluter Pays
  - Dramatically less waste (packaging, scrubber sludge)
- Taxation/Subsidies
- Pollution Rights
- Precautionary Principle

Government strategies and regulation
- Stable, democratic government required?
NEPA, ESA, Clean Air, Clean Water...

- Work b/c require full and open disclosure of process and those involved.

- How do Cheney secret meetings with industry leaders to plan energy policy fit in?

SDCP and findings from economic analyses...

Wright and Nebel 2002

C: ~$436 billion
B: >$6.8 trillion
1:16 -> C:B

The Clean Air Act (1970, 1977, and 1990) has been the subject of open political warfare between those who think its cost has been too high for utility, auto, labor, and consumers and those who think the health and environmental benefits were justified. Compliance has altered patterns of industrial production, employment, and capital investment. Although these expenditures must be viewed as investments that have generated benefits and opportunities, the significant costs to industry and state and local governments of reducing air pollution from electric generating stations and refineries in California and other states have been substantial. The efforts of the Reagan Administration to reduce these costs were thwarted by the Nation's continued need for electric power. The air pollution benefits of the CAA have led to lower mortality and morbidity rates, reduced hospitalization, and increased life expectancy. The benefits of the CAA have been realized through a combination of regulatory and non-regulatory measures, including the installation of pollution control equipment, the use of cleaner fuels, and the development of more efficient technologies. The costs and benefits of the CAA have been estimated to be $436 billion in 1990 dollars, while the benefits of the Clean Air Act have been estimated to be $8 trillion in 1990 dollars. These estimates are based on a 1:16 cost-benefit ratio. The CAA has had a significant impact on the health and welfare of the American people, and its benefits continue to be realized today.
Herman Daly
Former Environmental Economist with Worldbank
Professor at U. Maryland

Utility vs. Throughput
Utility not measurable; it is an experience

Circulatory system vs. digestive system
(perpetual motion machine)

Wealth vs. Ilth (accumulation of goods vs. bads)

Micro vs. Macro economics
(MR=MC vs. endless)

If resources infinite then price = 0,
but if pay for resources then can redistribute wealth

Center for the Advancement of the
Steady State Economy

http://www.steadystate.org/Index.html
Index of Sustainable Economic Welfare
(p. 355 Van Dyke 2003)

1. Income Distribution
2. Net Capital Growth
3. Natural Resource Depletion/Environmental Damage
4. Unpaid Household Labor
   (social and environmental justice)

Figure 12.9
The hourglass analogy of economist Nicole Geoguen-Kiranges illustrates the relationship between entropy and economic throughput. The sand in the upper part of the hourglass represents high-entropy resources, while low-entropy wastes are produced. Regardless of the consumption rate, the sand in the upper half is destined to run out.

Figure 23-3
Environmental economic view of economic activity. The natural environment encompasses the economy, which is constrained by the resources found within the environment.

Wright and Nebel 2002

2nd Law of Thermodynamics
Figure 2-5: Comparison of the gross domestic product (GDP) and genuine progress indicator (GPI, left) and the per capita values for these indicators (right) in the United States between 1960 and 1998. (Data from Clifford Cobb, Mary Sue Goodman, and Mathis Vanneman).

Genuine Progress Indicator

Index of Sustainable Economic Welfare

Vs.

Positive DISCOUNT RATE
Conventional Neoclassical Economics

- Private Property
- Economic Growth always good
- Allocate based on price
- More always better for an individual (utility curves)

Figure 2.2: Conventional view of economic activity. In a market economic system, economic goods and services flow between households and businesses in a closed loop. In many economics textbooks, such market economic systems are shown, as here, as if they were self-contained and thus independent of the natural resources that support all economies and all life. The model reinforces the idea that unlimited economic growth of any kind is sustainable.

Figure 3.3: An Indifference Curve. An indifference map is a set of indifference curves that describes a person’s preferences. Any market basket on an indifference curve $I_2$, such as market basket $A$, is preferred to any market basket on curve $I_1$, like basket $B$, which is seen to be preferred to any market basket on $I_1$, such as $D$.

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Pindyck and Rubinfeld 1992
4 SPIKES

1. Global Climate Change
2. Extinction
3. Consumption
4. Population

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

*Ecosystem "services" are linked to ecosystem "processes."

Source: Adapted with permission from Robert Costanza et al., "The value of the world’s ecosystems services and natural capital," Nature, May 1997.

Brennan and Withgott 2005

Thanks to Kathy Gerst

Evaluations