EEB 2208: LECTURE TOPIC 22

ECONOMICS OF CONSERVATION

Reading for this lecture

Primack: Chapters 4 and 5 (Note that I will not follow the text book too closely in this lecture – so you really need to do the reading.)
Discussion reading: Donlan, J. et al. 2005. Re-wilding North America. Nature 436: 913-914. Note that this discussion will take the form of a debate – so come prepared to argue for and against the idea of re-wilding.

Supplemental reading associated with my examples:
Costanza, R., et al. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260. click here to read
James, A.N., K.J. Gaston & A. Balmford. 2001. Can we afford to conserve biodiversity? *BioScience* 51: 43-52. click here to read
Balmford, A., K. J. Gaston, S. Blyth, A. James & V. Kapos. 2003. Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. *PNAS* 100: 1046-1050. click here to read

1. Introduction

A) WHAT IS ECONOMICS?

i) Economics is not just about money.
ii) Instead, it concerns the way in which we allocate limited resources among competing demands.
iii) Thus, the value of something depends on its utility to someone. Utility can be measured in monetary terms, but it doesn't have to be. In a broad sense, utility can simply be viewed as the capacity of something to improve someone's life.
iv) For example, you can view time in economic terms – you have a limited amount of it and need to make decisions about what to use it for – generally you will allocate relatively more time to things that are valuable to you.

B) TYPES OF VALUE, BEYOND SIMPLY USING THE PURCHASE PRICE OF AN ITEM

i) **Use value** is the value of actual uses we get from a resource now, and can be subdivided into **direct uses** (also known as **private goods**) and **indirect uses** (**public goods**)
ii) **Option value**: value of potential future use of a resource.
iii) **Existence value**: value of things we like to know exist even though we might never use or see them. This can be estimated by finding out what people are willing to pay to protect something.
iv) **Aesthetic value**: the value of things we appreciate simply for their beauty.
v) **Cultural value**: things that are important for cultural identity.
vi) **Scientific and educational value**: information or experience-rich aspects of nature.
vii) **Bequest value**: things that people want preserved so their grandchildren can see them.
viii) **Value lost**: e.g., How much less is a trip to Yellowstone worth if you do not see an elk … or a wolf?

The first 3 items on this list are illustrated in Fig. 4.3 in the textbook. Some of these forms of value also overlap – for example the concepts of bequest value and value lost could be subsumed under the idea of existence value.

C) MONEY AS THE FORM OF VALUE

i) Money can be problematic as a way to value species and the environment, because often people value biological diversity for one or more of the other reasons listed above. Only in certain circumstances can a tangible dollar amount be attributed to a biological entity, and even then assigning monetary worth to something can be extremely difficult (see Box 4.2, page 85, in the text book).

ii) But, money is often the easiest thing to quantify and to use in political and social contexts. Consequently, environmental economists have begun trying to develop ways of assigning financial values to species and ecosystems.

2. Valuing biodiversity

A) DIRECT AND INDIRECT VALUES

i) At least in principle, estimating the direct value of something is not too hard. Direct values include **consumptive uses** (e.g., the value of things like food that has been hunted or grown for local consumption), and **productive uses** (e.g., the use of things in trade).

ii) Estimating the trade value of something is reasonably simple – in essence you just find out what people will pay for it. Estimating the consumptive value is not much harder – you figure out what it would cost someone to buy an alternative product if they did not have the thing they are using. E.g., in many parts of the world people do not buy firewood, but you can estimate the value of their firewood, by determining what it would cost to provide an equivalent amount of heat and light by other means (e.g., putting in electricity).

iii) Much more difficult is determining the indirect value of something. Often these indirect costs are large, but not necessarily very tangible. Usually, the approach taken is to think of the things that a particular species or ecosystem provides for people, and then to think about what money would be lost either because those services did not exist or if something else had to be done to replace them. E.g., the water purification and flood control values of a wetland can be estimated by determining what it would cost to build a water treatment plant and flood control structures to deal with an equivalent amount of water.

B) EXAMPLE: WHAT IS AN ELEPHANT WORTH?

i) In terms of consumption, this is relatively simple to determine. One would simply need to find out what ivory is worth, what elephant meat is worth, and how much of these things one can get from an average elephant.

ii) Evaluating non-consumptive value is harder, but it is not impossible to come up with ballpark estimates. For example, one could determine what the average tourist pays to go on a safari to see elephants. One could also find out how much more they would be willing to pay (e.g., through surveys).

iii) Next, it would be important to determine how much of those "safari costs" are actually attributable to elephants. For example, in one study in Kenya, tourists said that (on average) elephants contributed about 13% of the value of their trips. By taking these numbers and multiplying by the number of visits and the total cost per visit it was possible to estimate that elephants are worth about $25 million a year to the Kenyan economy. (See text book for other examples of the value of ecotourism.)

C) WHAT IS BIODIVERSITY AS A WHOLE WORTH?

i) Valuing ecological services is much more complex, but several people have tried. One of the first global attempts was by Robert Costanza and colleagues, published in 1997 (see link, above, to read the paper).

ii) In this study, the authors estimated the monetary value that each major ecosystem type contributes for various types of service. Listed below (and in class) are just a few highlights.

iii) The following were among the most valuable functions provided by the Earth's ecosystems:
- Nutrient cycling is worth $17.1 trillion per year
- Water regulation and supply: $2.7 trillion per year
- Waste treatment: $2.3 trillion per year
- Food production: $1.4 trillion per year
- Recreation: $0.8 trillion per year
- Climate regulation: $0.7 trillion per year

iv) The most valuable ecosystems on a per hectare basis (a hectare is an area 100 m x 100 m) were:
- Estuaries: $23,000 per hectare per year
- Seagrass and algae beds: $19,000 per hectare per year
- Wetlands: $15,000 per hectare per year
- Note, that these are some of the most threatened and limited (in terms of their area) ecosystems on Earth.

v) In terms of total value, marine ecosystems were estimated to be worth $21 trillion per year, and terrestrial ecosystems $12 trillion per year.

vi) Just to give you a sense of the relative worth of different terrestrial ecosystems, here are the numbers for a few of them:
- Wetlands: $4,800 billion per year
- Forests: $4,700 billion per year
- Lakes and rivers: $1,700 billion per year
- Grassland and rangeland: $900 billion per year
- Cropland: $130 billion per year

vii) The total estimated value of all of this came to $33.3 trillion/year. This compared to a gross national product of all of the world's countries of only $18 trillion/year.

viii) Not surprisingly, these numbers are disputed. Another set of estimates made at around the same time came up with a number closer to $3 trillion (i.e., an order of magnitude smaller). Nonetheless, even these lower numbers amount to an awful lot of money. Thus, this is another example of a situation where the science is not certain, but the general result/conclusion is still quite clear.

3. What does conservation cost?

A) COMPREHENSIVE GLOBAL BIODIVERSITY PROTECTION

i) A study by James et al. (2001, see the link above) set out to estimate what it would cost to do an adequate job of protecting global biodiversity. They split their estimates into two parts. First, the cost of creating a decent reserve system; and second, the cost of providing good protection in the surrounding matrix.

ii) To create a reserve system that is representative, and to ensure that there are sufficient funds to manage and maintain this system, the authors estimated that it would take about $28 billion a year. To provide supporting conservation efforts in the surrounding matrix would require an additional $289 billion. The total cost was estimated to be $317 billion.

iii) This amount is a lot of money, but it is only about 0.1-1% of the total value of the Earth's ecosystems (using the Costanza et al. figures given above; if more conservative estimates of the value of ecosystems are used, it is still only 1-10% of the total value). In this context, it seems like this may be a reasonable amount to pay to insure against the loss of the assets in question.

iv) Another useful comparison is against the amount that the world's society pays to subsidize other activities. These subsidies are the amount of money governments spend in order to support activities that otherwise might not be financially viable. Overall, these subsidies are estimated to amount to $950-1450 billion a year – far more than the cost of protecting biological diversity. In other words, we are willing to spend far more on these other unprofitable services, so why not do the same with ecosystem services?

v) A breakdown of those subsidies, to give you a sense of where the money is going, follows:
- $325 billion for agriculture
- $225 billion for automobile users
- $205 billion for energy users
- $60 billion for water users
- $55 billion for manufacturing industries
- $35 billion for forestry
- $25 billion for mining
- $20 billion for fisheries

B) HOW DO COSTS VARY?

i) In a third study, Balmford et al. (2003) looked at the cost of implementing different field-based conservation programs (139 projects in 37 countries all over the world).

ii) They found enormous regional variation in costs, ranging from less than 10 cents/km^2/year to more than $1 million/km^2/year. Not surprisingly, costs were high in developed areas (e.g., western Europe) and much lower in increasingly remote places (e.g., arctic Russia, Mongolia, etc.). They also showed that the cost of doing conservation in zoos is higher even than doing *in situ* conservation in the most expensive parts of the world.

iii) They also found that the ratio of conservation benefits to economic costs were greatest in many developing countries (including many with very high species richness). Despite, this potential for a high return for relatively little cost, they discovered that there is little investment in conservation in many of these areas.

iv) Their conclusion was that a lot could be done in terms of improving biodiversity protection for relatively low cost, if areas are targeted appropriately.