# EEB 2208: LECTURE TOPIC 22

# ECONOMICS OF CONSERVATION

## Reading for this lecture

**Primack:** Chapters 4 and 5

**Supplemental reading associated with my examples:**

James et al. 2001. Can we afford to conserve biodiversity? *BioScience* 51: 43-52. click here to read: https://www.cbd.int/doc/articles/2002-/A-00486.pdf

Balmford et al. 2003. Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. *PNAS* 100: 1046-1050. click here to read: http://www.pnas.org/content/100/3/1046.full.pdf+html

## 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 does not 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 (sleeping, surfing the web, texting your friends, listening to my lecture) – generally you will allocate relatively more time to things that are valuable to you.

B) COSTS AND BENEFITS

i) Economics is, essentially, about costs and benefits. We pay (the cost) in order to get something we want (the benefit) and the relative value of the costs and benefits dictates our behavior. Payment may be in money, but it also can be in other currencies. For example, someone might devote time (the cost) to practicing finger-picking because they want to play guitar like Richard Thompson (the benefit).

ii) Markets tend to work poorly when there are costs and benefits that are not accounted for (these are called **externalities**). This situation commonly arises with use of resources that are available to everyone (e.g., air, water, biodiversity). Consequently, understanding the economics of biodiversity requires that one consider the value of those externalities (so that they are no longer "external").

iii) Example: There are costs to air and water pollution, but they are often not "paid" by the polluter. One cost might be increased health problems, which is then paid for by the people who get sick, or by taxpayers if the sick people are in a government-funded health program or lack insurance. Because there is no cost to the polluter, there is no economic reason why they should account for that cost when deciding how to behave – hence they don't stop polluting. If those costs are accounted for (e.g., by governments imposing regulations, or injured people bringing lawsuits), then the cost is no longer an externality and the polluter becomes more likely to change their practice.

iv) Because the value provided by biodiversity tends to be hard to quantify in money, and often involves resources available to everyone, they tend to be

ignored in economic analyses – i.e., they are externalities. The solution is to find ways to internalize these costs so that they are accounted for.

v) One approach is to give people ownership over biodiversity so that they can increase their benefits (this will be the topic of the final discussion reading). Another is to impose regulation so that there are costs. A third is to find ways to actually put monetary values on aspects of biodiversity.

## 2. Values

A) DIFFERENT TYPES OF VALUE

i) Values can be categorized in various ways but one of the simplest divisions is between **use values** and **non-use values**.

ii) Use values (not surprisingly) relate to the value we place on something because of the ways that we use it. Use values can be further subdivided into three categories. First, there are **direct use values**, which relate to the harvest/consumption (and, often, destruction) of a resource. Examples would be food and fuel. Second, there are **indirect uses** in which we gain things without harvesting or destroying the resource. Examples would be many supporting and cultural ecosystem services (see earlier lecture). Finally, there is **option value**, which relates to potential future benefits (i.e., we value the "option" to be able to use the resource in some way in the future). For instance, we might value deep ocean biodiversity because of the potential to develop medicines from organisms that live in extreme environments.

iii) Non-use values relate to the less tangible benefits that we place on things simply because we think they are important. Another way to look at this is to think about how much we are willing to pay simply to ensure that certain things persist even though we may never use, or even see, them (**existence value**). We might do this just because we think the thing is beautiful (**aesthetic value**), has religious or social significance (**cultural value**), has potential to teach us things (**educational value**), or simply because we want it to be there for future generations (**bequest value**).

iv) Examples of the different types of use derived from a tropical wetland are given in Primack (Fig. 4.3).

B) MONEY AS THE CURRENCY

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 indirect or non-use reasons listed above, rather than purely because of the direct use value.

ii) 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.

iii) 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.

## 3. 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 **productive uses** (e.g., the use of things in trade) and **consumptive uses** (e.g., the value of things like food that has been hunted or grown for local consumption).

ii) Estimating the trade value of something is reasonably simple – 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 (via a survey) 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 were worth about $25 million a year to the Kenyan economy (in 1993 dollars – the year of the study; $40 million today).

iv) There may also be costs that are not taken into account. For example, in parts of Africa elephants cause a lot of tree damage, which can have economic costs. So, the economic costs of that damage may also need to be accounted for.

C) WHAT IS BIODIVERSITY AS A WHOLE WORTH?

i) Arguably, this is not a very good question because without biodiversity we could not survive …. so the value is infinite.

ii) Nonetheless, people have tried to come up with estimates by attempting to determine the monetary value of all the services provided by ecosystems. The actual monetary amounts produced by these studies probably aren't terribly meaningful, but the relative magnitude of the estimates say something about the value of biodiversity.

iii) For example, 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

iv) The most valuable ecosystems on a per hectare basis (a hectare is an area 100 m x 100 m):
- 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. This is more than the gross national product of all of the world's nations combined.

vi) Not surprisingly, these numbers are disputed, but the bottom-line is that the value of these services is immense.

## 4. 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 first estimated that a good reserve system would cost about $28 billion/year. To provide supporting conservation efforts in the surrounding matrix would require an additional $289 billion/year for a total cost of $317 billion/year. McCarthy et al. (2012, discussion paper) is more recent but provides numbers of a similar order of magnitude.

ii) These amounts are a lot of money, but are small relative to the value of the Earth's ecosystems. In this context, it seems like this may be a reasonable amount to pay to insure against the loss of the assets in question.

iii) 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 were 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? Especially, given what we could lose without them.

iv) A breakdown of those subsidies, to give you a sense of where the money is going, follows (note, these numbers are a few years old now):
- $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.

## 5. Using trade to conserve

A) OWNERSHIP AND TRADE PROVIDES AN INCENTIVE

i) Increasingly, people interested in conserving biodiversity are recognizing that when people own something, and can make money from it, they are more likely to take care of it.

ii) This idea is being used to devise mechanisms to protect biological diversity.

B) ITQs IN FISHERIES MANAGEMENT

i) An example is the idea of individually transferable quotas (ITQs), which is gaining favor in fisheries management. Here, the idea is that the total amount of fish that can be harvested sustainably is first determined. That amount is then divided up among individual fishers so that each person "owns" a share in the fishery. Fishers can then choose to catch their quota, or they can sell the right to catch it to someone else. This creates a market for the "right" to catch fish.

ii) A comprehensive study of the ITQ approach found that fisheries that use this method are much less likely to collapse than those that do not.

C) TRADE IN ENDANGERED SPECIES

i) Similar arguments have been made for allowing trade in endangered species. We will come back to this in the final discussion paper.