

## Conservation Biology

(Note: if you're interested, I have taught a class on this subject - the web page is at:)

<http://mason.gmu.edu/~alaemmer/consbiol/cblecture.html>

A working definition - determining how best to conserve (protect/preserve) organisms, particularly how to prevent them from becoming extinct.

(Note that sometimes conservation Biology can become very political - we'll see some examples):

First, why conserve?

Economic impacts:

- Food - we rely on other species for food. There are potentially still many food sources we haven't explored yet. We also need an environment good enough in which to grow food.
- Medicine - most medicines have their origins in other organisms
  - periwinkle from Madagascar - used to treat cancer
  - taxol was mentioned earlier this semester (used to treat breast cancer).
  - anticoagulants derived from bat or leech saliva.
- Clothing, shelter, etc.
  - wood, leather, sisal, cotton, etc.
- Recreation
  - parks are big business. Hunting, hiking, camping, birdwatching, photography, etc.
  - 1996 estimate puts value of these things at 87.8 billion dollars.

Spiritual values

- people derive pleasure from wildlife.
  - difficult to gage economic impact, but this is the kind of thing that gets people to participate in "save the polar bear campaigns", and similar.
- many people have a more direct religious connection with individual species or certain habitats / areas.

- Mt. Sinai, Ayers rock, etc.

### Ecological values

- species interact with each other - if one disappears, it can affect many others (e.g. otter & kelp).
- wetlands can treat waste waters (if it's done correctly)
- dunes & marshes can buffer coastal areas from storms.
- forests can increase water quality

But, this does raise an issue - what is important in one society, is not necessarily important in another. For example:

- if we decide conservation is important and want to “save” a species, we need to be aware that not all societies may feel the same way about conservation.
  - in the U.S. many people don't like snakes (rattlesnake roundups are still popular events). In India, cobras are held in very high regard (almost sacred).
  - Dogs are favorite pets in the U.S. In some parts of south east Asia, they're food.
  - even in the U.S., attitudes can change from one area to the next.
    - most people probably think Mt. Lions and Grizzly Bears are kind of neat. But what about the folks living next to Yellowstone? If we decided to re-introduce Mt. Lions into Northern Virginia, how many folks would be pro-Mt. Lion?
  - often education can help here.
    - perhaps mentioning all the mice and pests that snakes eat might help.
    - some people have changed their attitudes to bats once they figured out that they eat tons of insects. Some people even put up bat houses in their yards.

Any efforts at conservation must consider these social factors!

Main threats conservation needs to deal with (the book only mentions the first three):

#### 1) Habitat destruction

habitat is the environment an organisms lives in (the environment the organism needs to survive).

a) urbanization - some examples:

George Mason University:

- In 1979, GMU consisted (approximately) of the four original buildings, Thompson Hall, Robinson I, the Library, Lecture Hall, Student Union I, a few residence halls (behind the Student Union) a physical education building and a few odd trailers. There might have been a few other buildings like parts of the physical plant, etc.

- In 2006 (27 years later), we have built up most of the campus. Numerous new buildings (King Hall, Johnson Center, Patriot Center, Center for the Performing Arts, Student Union II, Science and Tech I & II, the "Arts(?)" buildings (not sure what the official name is), many more Residence Halls, a second Library tower, the Krasnow (sp.?) institute, aquatic fitness center, police building, Abomination Hall, several parking garages, as well as more trailers).

- Deer (admittedly, not always desirable) used to be common on campus. So were numerous species of snakes, lizards, and salamanders. Many birds (e.g. pileated woodpeckers) were often seen nesting on campus. Some things are still around, but if current trends continue, soon it'll be squirrels and crows.

- Note that not one animal was deliberately killed in all of this.

- Is this good? bad?

Other areas in Northern Virginia:

- How many people drive past a new housing development on their way to work (or GMU)? All these areas used to provide habitat for different organisms.

- An interesting display is at:

<http://www.co.fairfax.va.us/maps/timeMachine.htm#>

(provides sequence of aerial photographs starting in 1937 up to the late 1990's for several areas in the county).

- Again, is this good? bad? What are the trade-offs?

- deforestation - cutting down trees for lumber, construction or agriculture

- removal of rain forest (usually for agriculture)

- especially bad because the soil is so poor that nothing grows there after a few years.

- yet people need to survive, so they keep cutting down the trees, planting crops, moving when the crops start to die and cutting down more trees.

- up to 50% of all species live in rainforests, and an area the size of Switzerland is lost every year.

- desertification:

- turning marginal areas into deserts through overgrazing, collection of wood, agriculture in areas that can't sustain it (often turning the soil salty)

- sub Saharan Africa is particularly hard hit.

- loss of wetlands

- draining wetlands for development

- Everglades don't get enough water anymore because areas upstream have been turned into agricultural areas. Recent efforts seek to reverse this trend.

- since 1700, 53% of the world's wetlands have disappeared.

## 2) Overexploitation

- species are overused. Too many are harvested. Some simple examples:

- Cod fisheries off of New England have collapsed due to overfishing.

- over 40,000 people lost their jobs (many of whom probably would have argued strongly against quotas).

- Forests in the Mediterranean.

- the Mediterranean used to be forested. Overuse of lumber in early historic times (e.g., classical Greece) caused forests to disappear, and helped bring about the collapse of some civilizations.

- overexploitation also includes directly killing some organisms such as:

- rhino for horn, elephants for ivory, big cats for pelts

- a specific example: the African elephant:

- Range used to include most of Africa, but it has been getting smaller for centuries.

- Several factors are driving the elephant populations down:

- habitat loss - where human populations are expanding, the elephant loses out. East Africa had a growth rate of 3% for much of the 20th century (that's a doubling time of less than 23 years!!).

- illegal hunting - ivory is very valuable, and generally the case is made that poaching impacts elephant populations the most. Because of this, all ivory trade was banned in 1990. This had an immediate positive effect.

- in some countries, a little more effort was needed. Poaching in Kenya was reversed after the introduction of helicopter gun ships. (Poachers were using automatic weapons - (mention rhinos if time)).

- sometimes one government agency doesn't know what another one is doing. While in the Sudan in 1985, I was told that the ivory in Khartoum could be legally exported to the United States (according to the State Department). The elephant was already recognized as being endangered by the Fish and Wildlife Service, so obviously importing the ivory (and there was lots of it!) was illegal.

- bottom line: although elephant populations are mostly recovering, human population pressures (& resulting habitat destruction) is now becoming increasingly difficult to deal with (some governments already cull elephant herds).

- addendum - recently, poaching has picked up again. Illegal ivory is in demand in China and Japan. Some populations are declining again.

- passenger pigeon:

- estimates range between 1 and 4 billion birds before we got here.

- they used to have "shoot - offs", to see who could kill the maximum number of pigeons in a day (numbers would go into the 1000's).

- completely extinct. Last bird died in captivity in 1914.

- controlled hunting, fishing, etc. is usually not a problem.

- overall, overexploitation has led to the extinction of many species.

### 3) Introduced species.

- species that are not where they're supposed to be.

- the main problem - they outcompete or kill native species. Some examples:

- Gray squirrel in the U.K. - has driven the native red squirrel to the brink of extinction. It's also causing havoc in South Africa and the Pacific Northwest.

- Gypsy moth - escaped from a lab in New England where researchers were investigating it for silk production.

- Killer bees, Kudzu, Prickly Pear cactus, starlings

- Nile perch introduced into Lake Victoria has wiped out over 200 species of native cichlids.

- Cats, Dogs, Livestock, rats, mice, rabbits, etc.

  - incidentally, cats are estimated to kill up to 500,000,000 songbirds every year! (Keep your cat indoors!)

- reasons for introductions:

  - intentional: things like crops and livestock are understandable

  - unintentional: rats, mice, zebra mussel

  - idiocy: starlings were introduced into the U.S. because of Shakespeare.

- there have been numerous attempts to control introductions, often by introducing predators. Sometimes this helps, sometimes it makes things worse:

  - Mongoose were introduced into Hawaii to help control rats.

    - they ignored the rats and started eating the birds.

  - But often it does help - a virus that attacks Gypsy moths has been used with some success.

#### 4) Environmental factors:

- things that adversely affect the environment.

  - air pollution, water pollution, other pollution, pesticides, etc.

- some examples:

  - ozone - leads to respiratory distress. Every day, particularly in the summer, there are air quality alerts, mostly based on ozone. The irony is that ozone is needed further up in the atmosphere.

  - acid rain - nitrogen and sulfur released by industry reacts with water in atmosphere and forms acids.

    - this kills numerous organisms that rely on water.

    - vast tracts of forest have been killed.

- carbon dioxide [see text].
  - implicated in global warming
  - acts as a greenhouse gas (easy to prove with physics).
  - greenhouse effect - area becomes warmer because heat is trapped:
    - a simple example is a closed car in the summer.
  - increased levels of CO<sub>2</sub> trap heat that would otherwise escape back into space.
    - CO<sub>2</sub> levels have risen from 274 ppm to 370 ppm in the last 100 years (again, a simple fact).
  - fossil fuel use has increased from 1 to 7 billion tons of oil (or equivalent) in the last 50 years (again, a fact).
  - one problem is that it is difficult to tell long and short term effects apart.
  - BUT, most scientists do not argue about the greenhouse effect; they argue about the extent of it (how bad things will be).
    - Rising levels of CO<sub>2</sub> have been implicated in increased incidence of heatwaves, droughts & fires, melting of glaciers & icecaps, rising temperatures (incl. sea temperatures).
    - Coastal parts of the U.S., such as New York, New Orleans or Los Angeles may wind up with parts under water. Some countries may disappear completely.
- pesticides (some examples)
  - DDT - very effective (initially), and seemed to have lots of benefits.
    - drawbacks:
      - it doesn't break down quickly
      - insects have become resistant
      - it is biomagnified. As one moves up the food chain, each predator gets more and more DDT in it's system.
      - almost wiped out our birds of prey, including the bald eagle until DDT was banned in the U.S.

- some other “problem pesticides” include malathion and paraquat.

## 5) Overpopulation

- the driving force behind most of the other problems.

- we’ve already discussed this, so just a few more words.

- one of the best ways to combat increased populations is through family planning, in particular, providing access to education and birth control.

- this can get into politics or religion quickly:

- (the Catholic Church frowns on birth control)

- but, it is cheap (0.2% of the U.S. budget could provide family planning to everyone on the globe that wants it).

- if this is not addressed, all the other things on our list (habitat destruction, overexploitation, etc. will only get worse).

Some ways in which we can help conserve species:

### 1) Study the animal (or other organism)! We need to know:

- what kind of food it needs
- what habitat it requires (and how much)
- what predators it has
- how it reproduces
- etc.

if we don’t know this, we can’t protect the animal.

- suppose we want to set up a reserve - we need to make sure all the requirements of the animal are met *within* the reserve!

- if we set up a reserve and move endangered animals into it, they may go extinct if the right food or habitat is not available.

- this has happened many times (some pacific island birds are good examples).

### 2) Legislation - this can very valuable.

- can be used to control or prohibit hunting of endangered species, etc.

- needs to be backed up with enforcement!

### 3) Controlling predators

- can backfire, but has been shown effective in some instances:

- something called the great winged petrel recovered well after introduced cats were eliminated (cats had killed over 48,000 petrels in a single year before they were eliminated).

#### 4) Manage wild areas for food, shelter, etc.

- sometimes all that's needed is to set up ponds (extra water), or add some food, add shelter (e.g. bird boxes), or corridors to the available habitat (see p. 777 for an example of a corridor).

- some populations don't need a high degree of protection, but just don't have the right habitat available anymore.

#### 5) Zoos

- often animals are placed in zoos

- the hope here is that they will breed in the zoo.

- if the zoo can breed enough of the animals, then perhaps they can be returned to the wild.

- there are lots of problems with this, but some success stories:

- black footed ferret.

- one of the problems is that the habitat the animal came from is often gone. Pandas have this problem (there's very little panda habitat left).

#### 5) Reserves

- setting up reserves can be a good way to help plants and animals.

- but reserves require:

- the right food, habitat, etc. as mentioned.

- appropriate protection from interference.

- possible augmentation by buffer zones.

- we'll finish with an example of a reserve:

#### Nairobi National Park in Kenya:

- ideally located for visitors, as it's only about ½ hour from the center of town.

- fairly small at 44 km<sup>2</sup>. Even though it's small, it has a fairly diverse population of organisms, primarily because it encloses several different kinds of

habitat.

- bounded on three sides by a fence, that prevents many animals from crossing. The city and the main highway to Mombassa are on the other side of the fence.

- the south is open to the Athi plains.

The Nairobi National Park is a little like a miniature Serengeti. It has a resident population of animals, but during certain times of the year, numerous other animals migrate into the park from the plains (wildebeeste, various gazelles, associated predators, etc.).

- realizing the importance of the Athi plains, the WWF together with private donations provided funding for the purchase of a large part of these plains.

- the money disappeared. Kenya was one of the most corrupt countries on earth, and it's only recently that this has improved.

  - but there is a new attempt to raise money for a leasing scheme. Perhaps with the better accountability in government now, it might yet succeed.

- but in the meantime, increasing population pressures (remember, Kenya has just about the highest population growth in the world) lead to an increase in building along the south side of the park.

  - numerous farms and livestock have moved into this area, and migration routes are increasingly restricted.

  - This may eventually lead to a park closed on four sides, or a sort of open air zoo.

  - Cattle and other animals can be seen on occasion in the park, once again indicating that population pressures are having a negative impact.

- this shows some of the problems in creating and maintaining a reserve. You can't just set up a reserve and ignore what's happening.