EEB 2208: LECTURE TOPIC 20

MANAGEMENT

Reading for this lecture

Primack: Chapter 17

Discussion reading: Donlan, J. et al. 2005. Re-wilding North America. Nature 436: 913-914. Available on-line at: http://www.nature.com/nature/journal/v436/n7053/pdf/436913a.pdf.
Note that this discussion will take the form of a debate – so come prepared to argue for and against the idea of re-wilding (I will tell you which side you get to argue when you get to class).

1. Management is very important

A) THE WILDERNESS MYTH

i) Although a lot of the focus in nature conservation is centered on wilderness and "natural" systems, the reality is that most places on Earth (and certainly most places where there are people) are influenced hugely by humans.

ii) Consequently, most places are managed – either directly with some sort of plan, or indirectly. The decision (conscious or not) not to manage an area actively is still a management decision.

iii) Reinforcing the notion that wilderness does not really exist is the recognition that some habitats that we assume are natural have in fact been heavily influenced by humans for centuries. For example, the Norfolk Broads is an area of lakes in lowland Britain that contains many rare species. Eventually, researchers realized that these lakes were not natural, as everyone had assumed, but instead were the result of 12th century peat digging by humans.

B) EXAMPLE 1: EARLY SUCCESSIONAL HABITATS

i) Many early successional habitats would not continue to exist were it not for continuous management.

ii) For example, New England grasslands are almost entirely dependent on human management (not all of it for conservation – in fact, at present, agriculture is probably more important as a means of maintaining grasslands in the state).

iii) Most permanent prairie habitat in the region has been destroyed – examples of such areas include the Hempstead Plains on Long Island and the North Haven sand plains in Connecticut.

iv) Historically the majority of the grassland habitat was formed by natural disturbance (fire, windstorms, flooding, beavers) or by human intervention (Native American agriculture), and was ephemeral – i.e., the location of grassland patches moved around in the landscape over time.

v) Today the sources of disturbance that helped maintain early successional habitats in the past have often disappeared. Management typically involves simulating disturbance to knock back succession (i.e., through fire, grazing, cutting, …).

C) EXAMPLE 2: MANAGING PREDATORS

i) In many cases, predators are a serious conservation problem and management is necessary to keep populations in check.

ii) Various introduced predators have been mentioned earlier in the course. Another example is house cats, which are estimated to kill well over a billion wild vertebrates each year in the US. The effects of cats are especially acute because densities are much higher than native predators and because cats receive supplemental feeding. Consequently, there is no negative feedback to reduce domestic cat populations when prey populations decline.

iii) Native predators also can be a problem in cases where the ecosystem has been sufficiently altered by humans to lead to inflated predator populations. For example, when top predators (things like wolves) are removed from a system, it allows the next level of predators down the food chain (**mesopredators**: things like coyotes, skunks, etc.) to persist at higher densities than they would if those top predators were present. Without the top predators, the mesopredators have an especially large effect on the species that they prey upon.

iv) Native predators also are a problem when humans make excessive amounts of food available to them. For example, open garbage dumps have resulted in large increases in gull populations, and human garbage on beaches tends to attract and benefit species like crows, skunks, and raccoons. These increased population sizes potentially affect endangered species like piping plovers, which nest on beaches.

v) Predator management can take many forms, but usually killing predators is the most effective approach, and often the only approach that will actually have an effect. Traps, poison, shooting, etc. are all frequently used approaches.

D) EXAMPLE 3: MANAGING PEOPLE

i) Increasingly management involves managing human activities.

ii) One challenge with managing people, is that there are often many different potential user groups in an area. Some may have relatively benign effects, others are much more destructive. Even benign activities, such as birdwatching, can have a big impact unless the activities of people are well managed.

iii) Completely restricting human access to sensitive areas is one approach, but frequently this is not an option. Zoning (see text book) is another approach, such that different activities are allowed in different areas within a region that is being managed. Even something as simple as putting in pathways and creating schemes that keep people on them – like self-guided tours with signboards – can be an effective way to limit people to a small portion of a managed area.

iv) Problems with human management can be especially acute when an area is newly converted into a conservation area. Apart from anything else, you often have to contend with the people who live there and have not had to worry about conservation-based restrictions in the past. Both for ethical and strictly practical reasons, it is frequently necessary to develop ways to accommodate the needs of these people – especially in developing countries, where their survival may depend on their ability to gather food, firewood, etc.

v) Ultimately, one can always manage people through more draconian measures – either manipulating the system so as to make it no longer attractive to people or by creating and enforcing regulations that limit human activities. But often it is hard (e.g., for ethical, political, practical reasons) to create such regulations, plus enforcement can be expensive.

2. Management as an experiment

A) GENERAL PRINCIPLES

i) All management activities should be viewed as experiments. After all, management involves deciding to do one thing rather than another, and hopefully will result in someone learning something about the effectiveness of the management used.

ii) All too often, however, this is not how management is viewed, and consequently, we do not learn as much as we could/should. Adherence to a few basic experimental design principles would help a lot.

B) EXPERIMENTAL DESIGN

i) Ideally an experiment is designed with a **control** – a location (or even better a set of locations) that <u>does not</u> receive the management treatment. Controls are important because they allow you to compare what happened when you apply a particular type of management to what happens when you don't. Without a control you can never be sure if the outcome was due to the management, or to some other thing that happened to coincide with it.

ii) Often, there are several different management options. Ideally these alternatives should be directly compared by applying each separately to different experimental units. If this is done simultaneously and under the same conditions then it will be possible to directly compare the alternatives and decide which is most effective.

iii) One major problem with doing management is that you need to be able to assess whether changes that occurred were due to the management activities. In other words, you need to make sure that there isn't some other thing that changed and that confounded your experiment. Various ways of dealing with potentially confounding factors are described below.

iv) Finally, it is really important to follow-up on any piece of management to evaluate its effectiveness. This may seem totally obvious but it is very common for some form of management to be done, and then for no one to monitor what happens. Particularly troublesome is the fact that many organizations now judge "success" based on whether a management action was done, not whether it worked (I am not making this up).

C) AVOIDING CONFOUNDING FACTORS

i) <u>Replication</u>. One good way of reducing the chance that some unknown thing is confounding an experiment is to repeat the experiment. This could involve using multiple sites (e.g., each management treatment gets applied to several different sites), or by conducting the experiment several different times. In general, the more the experiment is repeated, the less likely it is that something unknown is confounding the results, so it is good to have as many replicates as possible. Controls should also be replicated, because a control is simply a different type of experimental treatment.

ii) <u>Independent experimental units</u>. Replication is a good idea, but it only works well if all of the units that are being experimented on are independent of each other. E.g., if you wanted to compare two different captive breeding methods for an endangered species and you used one on 30 animals at one zoo and the other on 30 animals at another zoo, you would have some level of replication. But, there could be lots of things that differ between the two zoos in addition to the captive breeding method. Consequently, any difference in success could be due to one of those other things. The problem here is that the replicates are not **independent** of each other (i.e., because they "depend" on which zoo they occur at). Another term for this is **pseudoreplication** – because it seems like you are replicating, but really you are identifying the wrong thing as an experimental unit (in this case the experimental units should be zoos, not individual animals) and so the apparent replication does not really address the problem.

iii) <u>Randomization</u>. Another key idea in experimental design is that the management treatments are applied to experimental units randomly – note that **random** DOES NOT mean haphazard. Unlike in common usage, in this context it has a very specific meaning – that every experimental unit has an <u>equal probability</u> of receiving a particular form of management. Randomization is very important because it ensures that some unknown bias does not influence the way that management treatments are assigned. Unfortunately, in many cases it is not possible to be completely random for logistical reasons. E.g., if a big piece of machinery is needed to do the work, it may be prohibitively expensive to move it around all over the place, meaning that one has to apply the management the machinery is needed for only to a set of sites that are close to each other.

iv) <u>Interspersing treatments</u>. Regardless of whether you are able to randomize or not, it is important to ensure that the different treatments are well interspersed amongst each other. Again, this reduces the chance that there is some unknown factor (e.g., a gradient from east to west across the set of sites) that confounds the experiment.

D) REALITY STRIKES

i) If possible, management should be designed with these experimental ideals in mind.

ii) In reality, however, it is often not possible to do this because of constraints on what is possible. E.g., if you only have one site to manage, you might not be able to replicate. Equally, ensuring that management units are independent may not be possible – e.g., if they are all lakes along the same river system (and thereby linked by the same water flow).

iii) Even, if these goals cannot be met, it is still valuable to view the management as an experiment, and to ask questions such as: What are the management goals? What happens after the management action takes place? How can management be modified based on what has happened previously? This approach is referred to as **adaptive management**, and it recognizes that the way that something is managed can be adapted as we learn more about the system and are better able to achieve the conservation goals that have been set. But, this is only true if you collect data and track the consequences of a given management action.

3. When management goes wrong

A) EXAMPLE 1: RHINO HORN REMOVAL IN AFRICA

i) Problem: Rhinos are poached for their horns, with the result that populations have declined and extinction is a real danger in many areas.

ii) A proposed solution to this problem is simply to go out and remove the horns from the rhinos so that there is no incentive for poachers to kill them. Sounds like a perfect answer, doesn't it?

iii) Unfortunately, this approach does not work very well for several reasons. First, horns grow back relatively quickly and the horn is sufficiently valuable that it doesn't take a fully grown horn for poaching to be worthwhile. Second, most poaching happens at night, so poachers don't know if the rhino they've killed has a horn or not until <u>after</u> they have killed it. To make the system work, every rhino in the population would need to have it's horn removed, and removal would have to be repeated relatively frequently, so that poachers know there is no chance of ever killing a rhino with any horn left. Finally, it turns out that females without horns are much more likely to lose their young – suggesting that horns are important for defense against predators.

B) EXAMPLE 2: WOOD DUCK NEST BOXES

i) Problem: Populations have declined and in many areas the population size is now limited by the availability of tree cavities that are suitable for nesting in.

ii) The proposed solution is to put up nest boxes, and this has been done extensively for decades.

iii) Natural cavities and nest boxes differ in several significant ways. Natural sites are typically found deep in the forest, are widely spaced apart, and are well hidden. In contrast, nest boxes are usually put up in obvious, accessible places (so that they can be refound and monitored), and they are often clumped together (also to make monitoring easier, plus to increase the overall number of nest sites).

iv) Unfortunately, the characteristics of nest boxes create problems. This is because wood ducks are **intraspecific brood parasites**: that is they lay eggs in the nests of other females of the same species. Under natural conditions, about 1 in 4 nests are parasitized. But, when nests are easy to find (as is the case for artificial nests), parasitism rates go up.

v) Studies show that, in areas where nest density is high (and therefore where a lot of eggs are laid), the proportion that actually hatch declines. This is because excessive parasitism causes a lot more female-female aggression (even resulting in death and egg trampling), plus nests often end up with excessively large clutches (which causes eggs to get crushed and for it to be impossible for the female to incubate efficiently).

vi) When populations are modeled, simulations show that high parasitism rates greatly increase the risk of population extinction.

vii) Hence, traditional nest box placement can, paradoxically, result in population declines. Instead, nest boxes should be put out in a way that mimics natural nest distributions – widely spaced and well hidden so as to minimize parasitism rates.

C) GENERAL LESSONS

i) Both of these examples demonstrate the need to really understand the biology of a species, and to take their biology into account, when devising a management plan. In both of these examples behavior was important – in the rhino case the behavioral interactions between rhinos and their predators (both predators on the young, and human predators on adults); in the duck example, it was intraspecific behavior that mattered.

ii) Often it would be difficult or impossible to guess that these issues might be a problem ahead of time – e.g., the importance of rhino horns in predator defense only became clear after some rhinos had them removed. Consequently, it is critical to follow up on management to examine the consequences.

iii) Finally, these examples demonstrate the value of treating management as an experiment. The results of the rhino work became apparent precisely because someone treated horn removal as an experiment and compared what happens to rhinos with and without horns. Likewise, people had been using wood duck boxes for decades before a behavioral ecologist studying brood parasitism came along and started to experimentally study the system and figure out what was really going on.