EEB 2208 LECTURE TOPIC 18

RESERVE NETWORKS

Reading for this lecture
Primack: Chapters 15 and 16

1. Introduction
A) RESERVE NETWORKS

i) Typically conservation reserves do not exist in isolation, but rather as a part of a network of reserves.

ii) This is good because it is often difficult or impossible to conserve a species adequately in a single site. Think about why this is a problem.

B) GENERAL PRINCIPLES

i) Ideally, any system of reserves should adhere to a few key principles.

ii) First, the system should be **representative** of the region in which it occurs – i.e., there should be an attempt to protect some of everything.

iii) Second, the system should be **resilient** to change – i.e., it should be capable of providing effective protection into the future.

iv) Finally, the system should have **redundancy** built into it – i.e., each characteristic that warrants protecting should be present at multiple sites as a back-up in case something bad happens in a particular place.

2. Reserve size
A) FAUNAL RELAXATION

i) A common phenomenon is for there to be a decline in the number of species in a reserve in the years following its creation. For example, at Mount Rainier National Park, the number of species has gradually declined such that by the mid-1970s there were only 37 out of the 68 mammal species that could potentially occur there. At least 50 species were present in the 1920s.

ii) In a study that looked at these patterns across a number of parks (by Newmark – see the text book), this pattern was found to be quite typical. There were numerous local extinctions, and extinction was more common than recolonization, resulting in a net loss of species. These extinctions were not caused by human activities such as hunting, etc. in the park.

iii) The number of extinctions varied among parks. More extinctions occurred in small parks than large, and the number of extinctions was greatest for the oldest parks.

iv) Only in the largest park were there basically no extinctions (the one exception, here, was the loss of wolves – which were unusually in that they were deliberately hunted out by people).

v) Why do you think that species disappear from parks over time? Will everything eventually go extinct in these parks (note that I'm not thinking over geological time here, but over a few hundred years)?

vi) Species that are especially likely to disappear from an area during the process of faunal relaxation are those that are typically uncommon, k-selected, and with low reproductive rates. When habitats are dynamic and constantly changing due to fragmentation, succession, etc., species that are poor dispersers also become especially vulnerable.

B) ADVANTAGES OF BIG RESERVES

i) Big reserves can support bigger population sizes.

ii) Big reserves tend to contain more species (because they can support viable populations of more species).

iii) As reserve size increases the variety of habitats included in the reserve will increase – though see the disadvantage list for a counter-argument.

iv) Large reserves typically have less "edge" habitat relative to the amount of "core" habitat. This is important because species found in "core" habitat are often those that are most vulnerable.

v) Reserve size is also important, because bigger areas are more likely to encompass entire ecosystems. This can be especially important when events happening in one part of a system influence events happening elsewhere (e.g., a lowland river reserve will be in much better shape if it also encompasses the river's headwaters, than if that land is free to be logged or polluted).

vi) Finally, it is possible that larger reserves require less management because they are large enough that ecological processes can proceed unhindered – if an area is sufficiently small then it may become necessary to manage the land actively in order to accommodate the needs of all the conservation targets.

C) DISADVANTAGES OF BIG RESERVES

i) Although there are many good arguments for creating big reserves, there are also some disadvantages to having big reserves.

ii) First, a big area is vulnerable to catastrophes because, for example, it allows disease, invasive species, fires, etc. to spread rapidly through the contiguous habitat. If protected land were subdivided then this might not be so likely to happen.

iii) Another way of looking at this is that, in practical terms, creating big reserves often means reducing the total number of reserves – this raises the concern that you don't want to have all of your "eggs in one basket".

iv) Yet another concern is that even a very large reserve cannot usually protect all of the habitats/species within a region, because habitats are often not all spatially arranged in a way that makes this possible.

v) Lastly, a purely practical issue is that large areas are not always available, in which case there is little choice but to use small reserves.

D) THE SLOSS DEBATE

i) These issues resulted in what has been termed the SLOSS debate. SLOSS stands for Single Large Or Several Small. The idea is that if you have enough money to buy a certain amount of land to protect as a reserve, do you buy one big site or several small sites?

ii) Although it may seem obvious that a single large reserve is the best option, some researchers have pointed out the disadvantages of big reserves mentioned above, and called for some subdivision of protected areas.

iii) One especially important study involved an experiment conducted on mangrove islands. These islands had all of their arthropod faunas wiped out and the pattern of recolonization was tracked in order to test ideas originating from Island Biogeography Theory (see previous lectures and text book for more on these ideas). In one case, an island was subdivided into fragments, with the result that the fragments collectively ended up with <u>more</u> species than the original large island.

iv) One problem with this result is that even though overall richness might increase due to fragmentation, there is often still the loss of important species.

v) In general this debate has died down. People generally recognize that a big reserve is nearly always better than a small one, and that having multiple reserves is nearly always better than having only a few. When resources are limited, deciding how to trade off these two issues will often depend on the idiosyncratic details of the situation.

3. Maximizing the value of small reserves

A) RESERVE NETWORKS IN PRACTICE

i) In practice, creating really big reserves is often not an option and there is little alternative than to make do with a set of relatively small reserves.

ii) Consequently, much of reserve design theory is based around the idea that we need to figure out ways to make the most of these small sites.

B) RESERVE SHAPE

i) Because of the detrimental effects of edges, it is generally considered best to have reserves that have as low an edge:core ratio as possible. This means that you are trying to minimize the portion of the reserve influenced by edge effects.

ii) With this in mind, the ideal shape, theoretically, for a reserve would be a perfect circle.

iii) Another related issue is to minimize the amount of internal fragmentation in a reserve, as this also limits the amount of edge habitat.

C) LANDSCAPE CONTEXT

i) The features of the landscape surrounding the reserve also influence what happens within the reserve. If the surrounding landscape (the "**matrix**") is similar to the land within the reserve, then the reserve will probably be more effective at protecting species than if it is surrounded by totally different habitat.

ii) Thinking along these lines, it is good to try to create reserves that are surrounded by **buffer** habitat – land that is not as well protected as that within the reserve, but that has some lower level of protection.

D) FACILITATING MOVEMENTS

i) Yet another thing that can be done to try to increase the effective size of a reserve, is to do things that make it easier for creatures to move between the various reserves within a network.

ii) Achieving these goals can be done either by creating "stepping stones" between existing habitat patches, or by linking patches with continuous strips of habitat – referred to as **corridors**.

iii) Corridors that allow species to cross barriers of inhospitable habitat are advantageous because they allow immigration into populations that might otherwise go extinct and they facilitate gene flow between segments of the population. In other words, they allow the reserves to function as a metapopulation. In the case of the largest, most mobile species, corridors might also allow them to increase the potential home ranges or allow for a larger overall population size (i.e., if the connections are so good that the different protected patches are effectively a single site from the perspective of the organisms being conserved).

iv) Finally, linkages can be important because they help seasonal migrants move between different habitats that they need at different times of the year.

v) There are, however, potential disadvantages of corridors. They can allow disease, invasive species, etc. to spread throughout a population, thereby increasing its overall vulnerability. Also, by drawing dispersers into edge habitat they might make them more vulnerable to predators and other threats associated with edge conditions. Finally they might even create sink habitat by "fooling" individuals into settling in suboptimal edge habitats.

E) RESERVE DESIGN RULES

i) It is generally reasonable to say that it is always best to make a reserve as big as possible, that it is always good to try to minimize and protect edges (e.g., with buffers), and that creating connections between reserves is helpful.

ii) Many specific reserve design rules are described in Figure 16.1. Make sure that you understand why each of the "better" scenarios is better. Also, remember that there are exceptions to most of these rules – try to think about what some of these exceptions might be.