EEB 2208: TOPIC 18

CONSERVATION RESERVES

Background for this topic

Primack: Chapter 15
Sodhi and Ehrlich: Chapter 11
Protected Planet Report: Tracking progress towards global targets for protected areas. On-line at: http://www.protectedplanet.net/

1. What land is currently protected?

A) GLOBALLY

i) >160,000 sites
ii) ~15% of the Earth's land surface. About 4% of Earth's land surface is strictly protected.
iii) Much less protection in marine systems. Currently ~3%, though this is increasing. And ~8% of territorial waters are protected (these are areas that are "owned" by nations – so mostly coastal water up to 12 nautical miles offshore; very little ocean beyond this zone has protection). Exactly what protections apply in these areas varies a lot. E.g., in the US, 86% of the area included in marine protected areas is available for multiple use (including activities such as fishing, recreational boating, etc.).
iv) These numbers are constantly changing. You can check out the World Database on Protected Areas for more details, and updated numbers: http://www.wdpa.org/

B) IN THE UNITED STATES

i) National Parks, National Wildlife Refuges (NWR) and National Forests occupy >1,650,000 km^2. This is almost the size of Alaska.
ii) Much of this land is not completely protected (e.g., you can hunt on many NWRs) and is not used just for nature conservation (e.g., most National Parks cater largely to tourism; logging occurs on National Forest lands).
iii) For detailed information on US protected areas, go to http://gapanalysis.usgs.gov/padus/.
iv) For information on US marine protected areas, see http://oceanservice.noaa.gov/ecosystems/mpa/.

C) WHAT IS NOT PROTECTED?

i) In 2010, the Convention on Biological Diversity set specific targets for how much land should be protected. These targets were one of 20 "Aichi Targets" (named after the region of Japan where they were agreed upon). Target 11 aims to protect 17% of global terrestrial habitat and 10% of marine habitat by 2020. Individual countries also set their own national goals.
ii) A 2015 study by Butchart et al. attempted to determine how close we are to achieving these targets. It found that, although the amount of protected area is increasing steadily, many countries have failed to reach their goals.
iii) They also found that a lot of individual species of conservation concern have no protection at all, and that many have inadequate protection.
iv) Overall, they concluded that we would still need to double the amount of protection globally, to meet all the targets for individual countries, ecological regions, and species. Much of this additional protection would need to be in poorer countries.

D) NOT ALL PROTECTED LAND HAS HIGH BIOLOGICAL CONSERVATION VALUE

i) Many parks are created to protect land that has scenic beauty, e.g., National Parks tend to be found in dramatic mountainous areas.
ii) Stunning rock and ice often predominates: ~7% of protected lands globally are in Greenland, which is not well known as a biodiversity hot spot.
iii) The distribution of parks does not overlap very well with areas of high species diversity or endemism.
iv) For example, almost all (95%) of the alpine and subalpine habitat in California is protected. But, very little (10%) of the chaparral, coastal scrub, or grassland habitats that harbor many of the state's rarest and threatened species is protected.

2. How is land selected for protection?

A) BIOLOGICAL CRITERIA

i) Areas with high species richness.
ii) Areas with lots of endemic species. For example, BirdLife International has its Endemic Bird Area program, which identifies sites with high numbers of species that have small ranges.
iii) **Focal species** are sometimes used to identify priority areas. These can be **"indicator" species** – those that in some way indicate the presence of an area that is considered to be a high conservation priority. For example, northern spotted owls in the Pacific Northwest are often viewed as an indicator of high priority sites because they tend to be found in old growth forest. Note, that many things get called indicator species, without anyone ever attempting to figure out what it is that they indicate … this is not a good use of the concept.
iv) **Flagship species** are those that give conservation efforts a higher profile and thus attract attention to an area. Often it is easier to get public and political support for protecting an area if there are high-profile, flashy species involved.
v) Ecosystem criteria are also sometimes used to prioritize areas. Rare ecosystems might be favored. In other cases, attempts might be made to ensure that all ecosystem types are represented within a reserve system (i.e., ensuring that the system is **representative** of what biodiversity is present in the area; more on this next time).

B) EXISTING PROTECTION

i) The suite of sites already protected in an area influences how new sites are selected.
ii) Habitats or species that are already well protected may receive less attention than those that are not so well protected. E.g., globally, temperate rainforests are much better protected than grasslands, so grassland conservation should perhaps be a higher priority than temperate rainforest protection.
iii) New sites are often selected to complement the existing set of sites in other ways – e.g., priority may be given to land that is adjacent to an existing reserve to help make it bigger.
iv) GAP analysis is a formal way of deciding how to select new sites to add to an existing reserve system. The basic components are:
    - Identify what biodiversity is in an area.

- Determine the conservation goals (i.e., what needs to be protected).
- Determine what is already protected.
- Determine which sites do the best job of filling in any "gaps" in protection.
- Target these areas.
- Go back and repeat the process iteratively until all goals are met.

C) ECONOMICS

i) Many things that have nothing to do with biology or conservation goals also influence how sites get prioritized. Many of these things relate to economics.

ii) Land must be affordable for it to be bought and protected. This is why it is relatively easy to protect remote lands in the Arctic, desert, or mountains. Protecting equivalent areas of coastal wetlands or lowland forests is generally much more expensive.

iii) One of the main things that affects cost is the competing demands for the land. Coastal, lowland areas tend to be where people live; hence land in these areas is more expensive than in more remote regions. Equally, if some consumable product (e.g., oil, wood) can be produced from a piece of land then it will be harder to set it aside for conservation.

iv) Yet another criterion is that an area might be selected because it protects an ecosystem that provides valuable services (e.g., a wetland that helps with flood control). Increasingly, the value of these services is being quantified in a way that helps influence the economic decisions that often affect reserve selection (see previous lecture on ecosystem services).

D) AVAILABILITY

i) For land to be bought and protected, someone has to be willing to sell it. Especially in areas where a lot of land is in private ownership, this can be a major impediment to achieving an idealized reserve system.

E) ACCESSIBILITY

i) Another important feature is that reserve lands often need to be accessible to people. Many protected areas serve multiple functions (other than nature conservation), and most (especially big reserves) are owned and administered by governments. Consequently, there is often a need to make them accessible to the tax-payers who pay the bills and consequently feel that they have a right to visit the sites.

ii) This can sometimes make it easier to argue for protecting a piece of land that it is easy for people to visit. In contrast, a key argument against protecting places like the Arctic National Wildlife Refuge (ANWR) is that it is somewhere that hardly any Americans have been to, nor are many ever likely to go there.

3. The spatial arrangement of protected land matters

A) METAPOPULATIONS

i) For many species it is not essential that the protected area is all in one contiguous block. This is because some populations can persist as subdivided populations. This situation is referred to as a **metapopulation** – a group of partly isolated populations connected to each other by dispersal.

ii) In a metapopulation the connections among segments are essential – if no movement exists, the metapopulation will cease to exist and there will just be a set of separate populations.

iii) Example: Bay checkerspot butterfly. This butterfly is an endangered subspecies only found in the San Francisco Bay area. It is a habitat specialist, relying on certain plants that are only found on specific soils (serpentine). The habitat for this species is naturally fragmented, but this fragmentation has been exacerbated by human development.

B) SOURCES AND SINKS

i) Another important concept that relates to metapopulations is the idea that there are source populations and sink populations.

ii) A **source population** is one in which reproduction exceeds mortality – meaning that the population produces more individuals than are needed to maintain a stable population size.

iii) A **sink population** is one where there are not enough births to match the number of deaths. These populations will decline, unless there is immigration to make up the shortfall.

iv) In a metapopulation, this immigration can come from source populations. Hence, it is possible for a population in a habitat patch (or reserve) to appear to be stable, but in fact to be a sink. In this case, the population is only maintained because there is a constant inflow of "excess" individuals from elsewhere. If this flow is cut off, then the population would decline. Consequently, what happens in one part of a metapopulation can affect what happens elsewhere and the loss of one piece of habitat can result in a population decline in another piece where conditions have not changed.

C) ARE SINKS WORTHLESS?

i) This might lead you to conclude that sink populations should not be protected (or at least should be a low priority) – and a lot of effort is placed on identifying sources, and prioritizing protection of these sites. But, the situation may not be this simple.

ii) In particular, there are several cases when sink habitat might be important. For example:

- If the site is a "**pseudo-sink**." This is a site that can switch from having a net loss of individuals to having a net gain. For instance, if the population density is high, breeding and survival rates may be suppressed, e.g., because individuals have to compete a lot with each other. If the population were to decline a bit, however, the amount of competition caused by the high densities might also decline, causing the birth and/or survival rates to increase. (This phenomenon is known as "**density-dependence**" because the birth and death rates depend on what the density is.)
- Whether a site is a source or a sink might change over time – in some years it could be a source, in others it could be a sink, e.g., depending on the weather.
- Protecting some sites that are sinks might be valuable if there are only a limited number of potential sites where a species exists. By doing this, the range size is maximized and genetic variation within the entire population could benefit. Also, it may become possible to turn a sink population into a source population through management.