EEB2208: LECTURE TOPIC 19

CONSERVATION IN THE MATRIX

Reading for this lecture

Primack: Chapter 18

Additional optional reading: Kareiva et al. 2007. Domesticated nature: shaping landscapes and ecosystems for human welfare. Science 316: 1866-1869. Available on-line at: http://science-mag.aaas.org/cgi/content/full/316/5833/1866

1. Existing reserve networks can only provide so much protection

A) HUMAN FOOTPRINT

i) Recent studies (e.g., that by Kareiva et al., cited above) have attempted to quantify the magnitude of humanity's impact across the globe.

ii) A clear result is that both on land and in the oceans, there is essentially nowhere that is not affected by human actions.

iii) These impacts in non-protected areas affect both what can be done within reserves and influence what can be done to complement the work done through land protection.

B) TARGETS

i) Currently the IUCN proposes that individual nations should strive to protect at least 10% of their land for conservation. Note that this goes beyond the idea that 10% of the world's surface should be protected by ensuring that protected areas are distributed across the entire globe.

ii) This would mean approximately doubling the protected area worldwide.

C) IS 10% ENOUGH – WHAT DO THE DATA SAY?

i) Rodrigues and Gaston (2001. Ecology Letters 4:601-609) conducted a survey of 21 separate studies, each of which attempted to estimate the proportion of land within a given area that was needed to protect all of the species within some target group.

ii) The mean proportion of the land that needed to be set aside to provide minimal protection (i.e., all species would be protected at a minimum of one site) was 13% – this is pretty close to the IUCN recommendation.

iii) But, across the 21 studies the proportion of land varied from less than 1% to 66%. So, in some areas much more than 10% is needed. And remember this is minimal protection – many species would be found at only one site.

iv) This study also found that the proportion of the total amount of land (not just the total area) increased with the number of species that needed to be protected. This is because, as the total number of species increases, the number with narrow ranges also increases – these "narrow range species" are not always likely to overlap, so additional land will be needed for each of them (widespread species are protected relatively quickly in a reserve system, because they are likely to be found wherever the reserves are put).

v) Another result was that protecting plants requires a greater proportion of the total area than protecting vertebrates – this is probably because plants on average have smaller ranges than vertebrates.

D) CONCLUSION

i) Reserves alone cannot meet conservation goals.

ii) Consequently, it is important to pay attention to ways of providing conservation benefits in the "matrix" habitat in which reserves are embedded. Finding ways to conserve nature, while also using land for other purposes, therefore, is an important component of conservation biology.

2. Conservation in agricultural settings

A) AGRICULTURE IS A DOMINANT LAND USE

i) Almost a third of the Earth's land surface is under some form of agriculture and about 11% is under annual cultivation.

ii) The amount of farmland continues to increase annually.

iii) Agriculture tends to be concentrated in areas that are biologically rich. Wetland habitats are often targeted, at least in part because they tend to have good soil and a good water supply.

iv) If conservation activities are going to take place outside of reserves, it is likely that we are going to need to find ways to make agriculture compatible with conservation goals.

v) The examples given below are just a few of many I could describe.

B) BIRDS IN RICE FIELDS

i) Rice is one the world's most important crops – for example it has been estimated that over half of the world's human population gets the bulk of their calories from rice.

ii) Rice paddies make up close to 10% of all cropland in the world, and rice is grown throughout the tropics and in many warm temperate areas too.

iii) Rice is unusual among crops in that it is typically (not always) grown in flooded conditions. This means that it can potentially provide habitat for wetland species – this is not so for most crops.

iv) In California, about 90% of the wetlands that were present 200 years ago have been drained. California is also one of the most important areas in North America for wintering waterbirds – 20 to 40 million ducks, geese and swans are thought to have spent the winter in the region historically (today the number is about 4-6 million).

v) Rice is an important crop in California – approx. half a million acres are grown annually. Many farmers in the region have switched from the practice of burning residual straw and stubble after harvest, to flooding their fields so that the straw decomposes. This change came about because of legislation to phase out stubble burning because of the air pollution that is created.

vi) The result of this activity is greatly increased use of fields by waterbirds – three times as many waterbirds occur in fields that farmers have intentionally flooded than in fields that are just left alone during the winter. For many species the difference in use is much greater.

vii) Over 120 species of birds occur in California rice fields. Some are rare users of the crop, but many occur in very large numbers. Overall this represents about a fifth of the species found in the state, and about half of all the families of birds in North America are represented by at least one species.

viii) Finally, there is some evidence that the presence of waterbirds in flooded fields helps increase the rate of straw decomposition – hence, there is a potential economic benefit to farmers to having the birds in the fields.

ix) Globally, similar patterns exist – 100s of waterbird species occur in rice fields, including some endangered species.

C) SHADE COFFEE

i) Another example of the way in which agricultural methods can be modified to make them more compatible with wildlife conservation is shade-grown coffee.

ii) This type of coffee is grown in areas where many of the tropical forest trees are left standing – the coffee forms an understory layer in the forest (normally forest is cleared and coffee is grown under direct sunlight).

iii) Shade coffee has many benefits – it keeps the forest somewhat intact and supports a much wider variety of organisms than sun coffee. It also has other environmental benefits, including reducing the amount of soil erosion relative to sun coffee. Fewer agricultural chemicals are typically used on shade coffee too.

iv) As in the rice example, there appear to be benefits to the farmers to managing coffee in a way that is compatible with nature conservation. For example recent studies have shown that the number of pollinators visiting coffee flowers, and the subsequent amount of pollination, both decline further away from the forest edge – suggesting a potential economic benefit of planting coffee near to forested conditions. Another study has shown that the presence of insectivorous birds and bats has a clear effect on the number of arthropods on coffee plants – whether this would translate into an effect on crop damage (or revenue) was less clear.

D) A NOTE OF CAUTION

For these examples (and others like them), it is important to realize that agricultural habitats do not generally substitute for more natural habitats – for many species, farmed land only provides habitat for part of their lives and other species do not use these habitats at all. But, agricultural land should not be considered a wasteland and there is increasing evidence that clever management approaches can improve the quality of agricultural land for wildlife while also allowing productive farming to occur.

3. Conservation elsewhere in the matrix

Although the matrix outside of reserves consists of a lot of agricultural land, there are plenty of other habitats that can contribute to nature conservation. Various examples are given in the textbook …… which you should read!