

EEB 2208: LECTURE TOPIC 12

DISEASE

Reading for this lecture

Primack: Chapter 10.

Discussion paper: Rohr et al. 2008. Agrochemicals increase trematode infections in a declining amphibian species. *Nature* 455: 1235-1239.

Optional readings (papers that I will mention in class):

LaDeau, S.L., A.M. Kilpatrick and P.P. Marra, 2007. West Nile virus emergence and large-scale declines of North American bird populations, *Nature* 447: 710–713.

Haydon et al. 2006. Low-coverage vaccination strategies for the conservation of endangered species. *Nature* 443: 692-695.

1. Introduction

- i) Diseases affect a relatively small proportion of endangered species, compared to most of the things we have talked out. Nonetheless, 1 in 10 endangered vertebrates in the US are affected by disease. It is quite likely that the very low percentages for invertebrates and plants are a result of our poor knowledge of disease in these groups.
- ii) Probably the greatest threats come from emerging new diseases. Very often these will be diseases that are also introduced species. West Nile Virus is an example of a new disease that has been introduced into an area (see below).
- iii) But, changing conditions can also result in new outbreaks of diseases that have been present in an area for a long time. For example, if changes in habitat availability concentrates individuals into a small area, the rate of transmission is likely to go up, making a large outbreak more likely.
- iv) The effects of existing diseases in an area can also be amplified by the fact that a species has become endangered through other means. For example, if a species is so rare that it must be brought into captivity, then it is likely to be exposed to diseases that it might not otherwise encounter. As populations decrease in size, they are likely to become more inbred (this is especially true in captivity), which might make them more vulnerable to disease. In fact, simply by having a small population a species is increasingly vulnerable to a disease outbreak, just because there are fewer individuals that are likely to have the genetic ability, overall good health, or simply good luck, to avoid succumbing to the disease.

2. Examples of emerging disease

A) WEST NILE VIRUS IN THE AMERICAS

- i) This disease first appeared in North America in the late 1990s, with the first cases in NY, NJ and CT.
- ii) It has now spread to the West Coast and south into Central America.
- iii) Humans are affected by the disease, with several 1000 cases and 100s of deaths since it's arrival.
- iv) It is primarily a virus that passes between birds and mosquitoes, however. To date it has been found in over 170 species of North American birds.
- v) The most recent research (see LaDeau et al. paper cited above) shows that population declines in several susceptible bird species coincide with the appearance of the disease.

B) AVIAN POX AND MALARIA IN HAWAIIAN FOREST BIRDS

- i) Hawaiian forest birds are one of the most endangered groups of birds in the world.
- ii) They are plagued by a host of threats, but one that is increasingly seen as important is disease. Both avian malaria and avian pox have been introduced to the islands by humans, along with the biting insects (e.g., mosquitoes) that transmit them.
- iii) Native Hawaiian species are more susceptible to these diseases than many non-native birds (i.e., species that originated from areas where the diseases were present), and current distributions of some native species seem to be limited to areas where there are few disease vectors.

- iv) Recent research suggests that at least one species ('Amakihi) can coexist with avian malaria, and has perhaps evolved resistance to the disease. Most species, however, seem likely to be extirpated from areas with the disease.

C) CHESTNUT BLIGHT AND AMERICAN CHESTNUT TREES

- i) A century ago, the American chestnut was a dominant tree in eastern forests. Now it is almost entirely gone, due to the introduction of a new fungal disease that kills mature trees.
- ii) Chestnut blight (*Cryphonectria parasitica*) was introduced to North America from Asia in 1904. It rapidly spread throughout the range of the tree in only a few decades.
- iii) Chestnuts persist, but only in isolated places or as root sprouts.
- iv) For more information on chestnuts, check out this link to the American Chestnut Foundation: <http://www.acf.org/>.

3. Example of existing disease

A) RABIES IN ETHIOPIAN WOLF

- v) In some cases it is possible to address disease problems through direct intervention.
- vi) For example, the Ethiopian wolf has a small population and has suffered serious declines due to rabies.
- vii) Researchers, however, have shown that it should be possible to slow the spread of the disease by vaccinating as few as 30% of the animals in the population.
- viii) The trick is to identify when/where outbreaks occur and then target those individuals that are most likely to contribute to disease spread (i.e., you need to know something about the basic biology of the population).
- ix) This result is important because vaccinating the entire population is viewed as impractical.