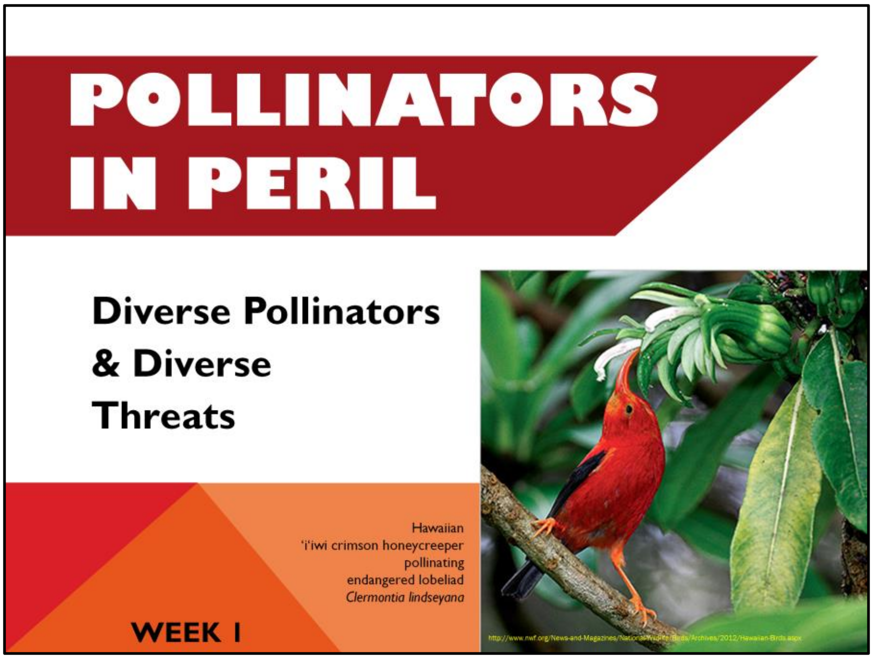
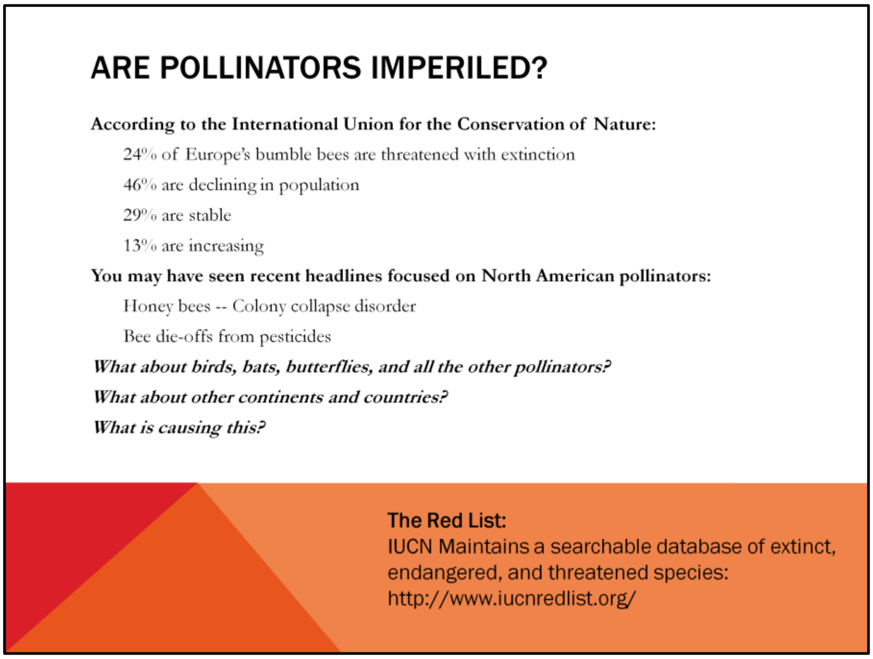
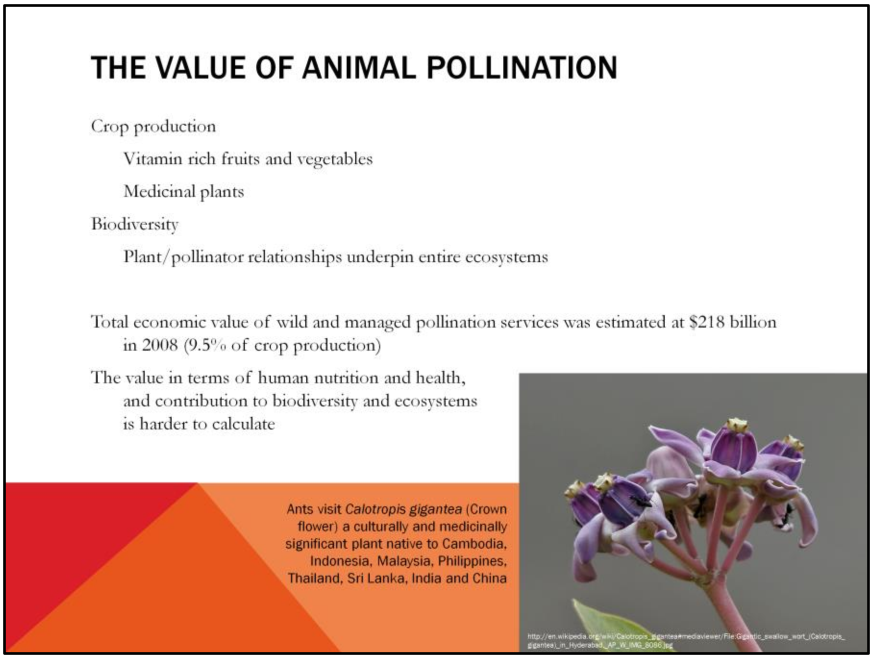


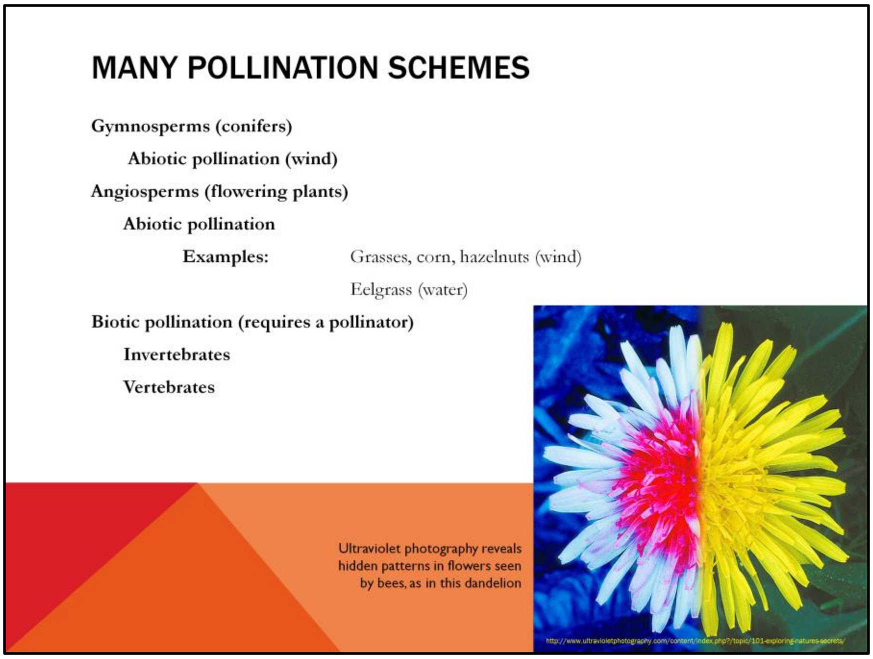
Welcome to Week 1 of Pollinators in Peril. This week we are going to introduce ourselves, pollinators, threats to pollinators, and some key concepts and ideas we will focus on this term.



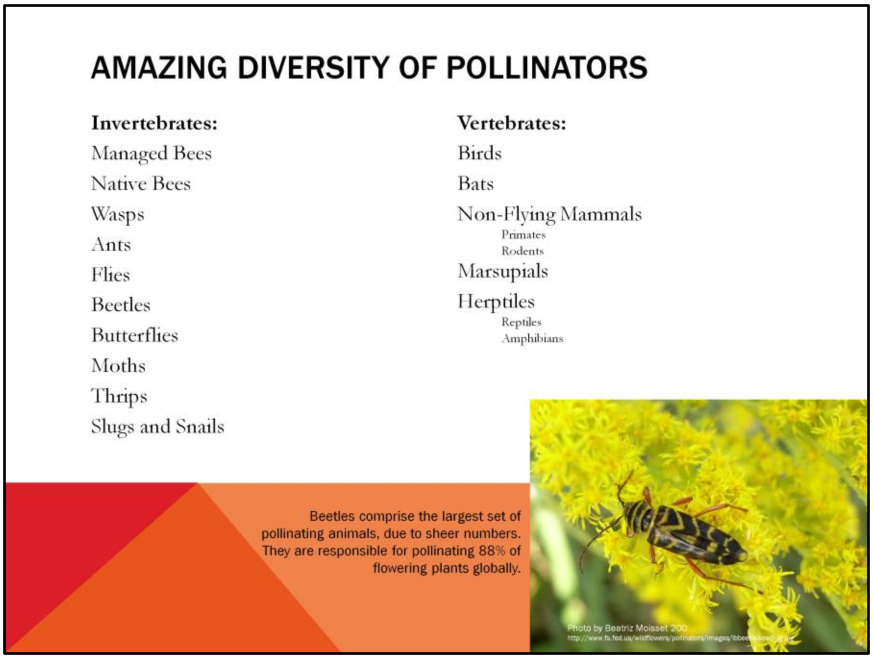
Are pollinators really in trouble? There are many ways to ask this question. You can ask whether an individual species is endangered or threatened, or whether it's population has shifted in response to changes in habitat. You can also ask about the plants that depend on that pollinator, and whether they are declining or increasing. Do changes in the relationships between pollinators and plants affect whole ecosystems? Is there a tipping point when crop plant's won't be sufficiently pollinated, and food production will be affected? The statistics shown above are an example of how researchers, governments, and other institutions are starting to look at overall trends. We are still struggling to understand just what it is we are losing. While these numbers from Europe are worrisome, it is important to consider that current knowledge of shifts in pollinator populations is limited to world locations where research has already been active over time.



As human populations grow, the land needed for growing food continues to increase. Many of the crops that provide much of the world's calories such as corn and rice do not require insect pollinators. However, pollinators are responsible for pollinating many of the foods that provide essential vitamins to our diet. In other words, we may not starve to death without pollinators, but it is likely we would suffer from malnutrition. Pollinators are also responsible for pollinating plants that are grown for medicine. Because pollinators are keystone species in many ecosystems, it is difficult to place a true value on their activities.

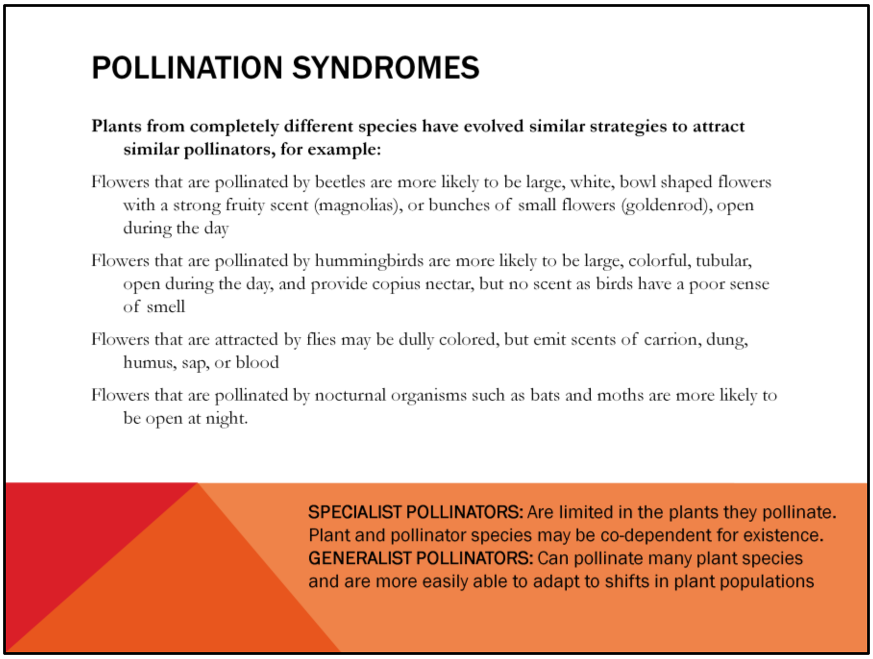


Not all plants reproduce via seed, but for those that do, pollination is essential. Of the more than 230,000 plant species worldwide, more than 200,000 are flowering plants, or angiosperms. While some angiosperms are wind pollinated, the majority require animal pollination. By carrying pollen from one plant to another, pollinators are especially important for maintaining the genetic diversity of plants, which allows them to adapt to environmental change.



Consider the ecological diversity of our planet. From the arctic to the hottest desert, pollinators are involved in plant reproduction. Even so, in preparing this class, I have been astonished to learn about the diversity of pollinators. Lemurs and honey possums are of course very cute, many birds are brightly colored, and bats are fascinating. Bees have been featured in the headlines in recent years. Beetles comprise the largest group of pollinating animals. Many other invertebrates contribute to pollination, although some, such as slugs, may lack the glamor illustrated in the Moving Art film.

Most terrestrial plants are rooted in the ground, yet need to exchange genetic information with other members of their species for sexual reproduction. To get their pollen to another plant of the same species, they use many strategies to attract pollinators. Most familiar are the nectar and pollen rewards that provide pollinators with carbohydrates, protein, and lipids. Plants may also provide shelter, display patterns only bees can see, or emit alluring scents. Some orchids emit scents that mimic female wasp pheromones, inducing male wasps to attempt to mate with the flowers, inadvertently spreading pollen between plants. Once they lave lured them in, plants also have multiple mechanisms for placing the pollen on the pollinator. Pollinators generally have physical characteristics that facilitate pollen transport, such as the hairs of a honey bee shown above.



There are commonalities in the coevolution of plants and pollinators, which are termed pollination syndromes. These are simply sets of plant characteristics that match specific types of pollinators. Some pollinators are highly specialized, and adapted to pollinate a limited set of plants. Plants, in turn, may be specialized for fertilization by a limited number of pollinators. In these cases, the loss of a plant or a pollinator can have devastating consequences. In contrast, generalist pollinators are able to pollinate many types of plants, which enables them to adapt to multiple environments.

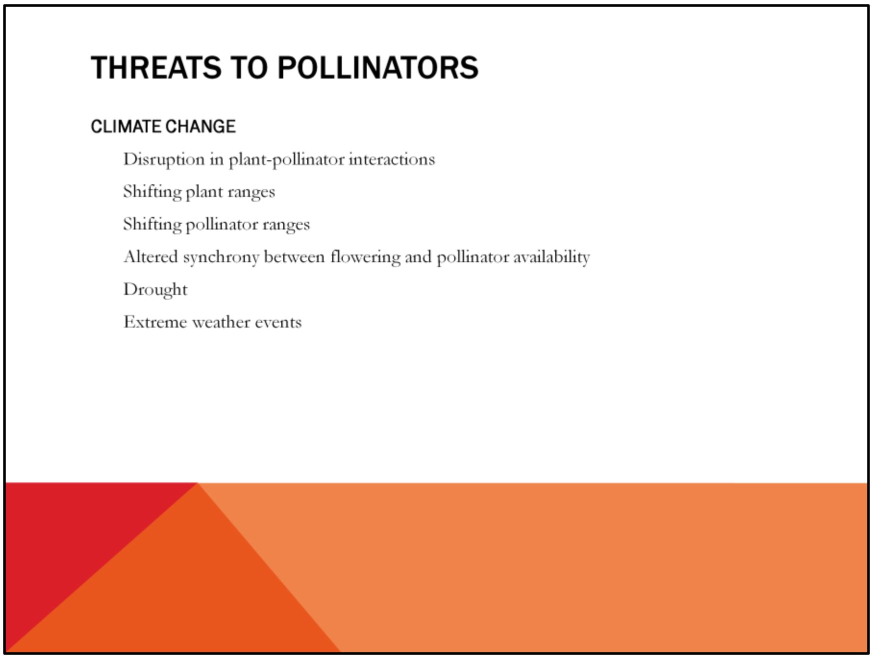
THREATS TO POLLINATORS

LAND USE INTENSIFICATION

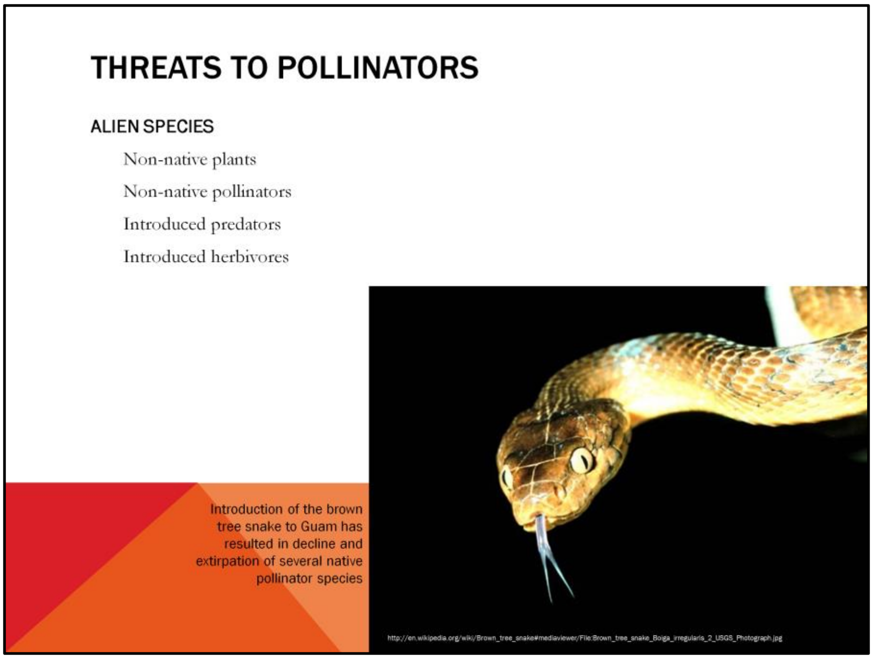
- **Urbanization**
- **Agricultural Practices**
  - Land clearing
  - Grazing
  - Monocultures
  - Herbicide use
  - Insecticide use
- **Ecotourism**
- **Human collection of rare plants**

Some pesticides are believed to have low toxicity for bees, and are applied during pollination, as in this picture of fungicides applied to almonds during bloom. Herbicides are used to eliminate vegetation under the trees.

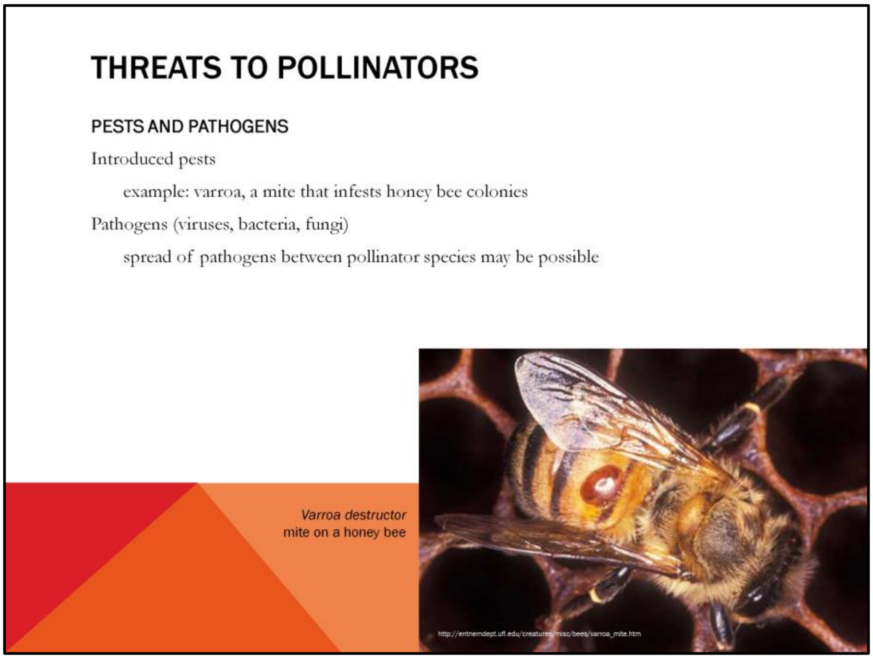
Let's talk about some of the threats that pollinators face. We will go into these threats in more detail in the weeks to come. If you read the news about pollinators in the last few years, you might be tempted to conclude that bees are going extinct due to pesticide use, and you may not have heard other types of pollinators mentioned. Land use in general, and agricultural practices specifically, definitely do take their toll on ecosystems, including pollinators. The human population is increasing, which increases the need for cultivated land to grow food, timber, and other products. In order to squeeze more food out of less land, agricultural practices are increasingly intensive. Uncultivated land is diminishing, leaving less forage for pollinators. Habitat may be fragmented, which may impede the movement and migration of pollinators between plant populations. While pesticides are certainly a concern, how much attention should be given to other aspects of land use intensification? Does this affect other important species besides bees?



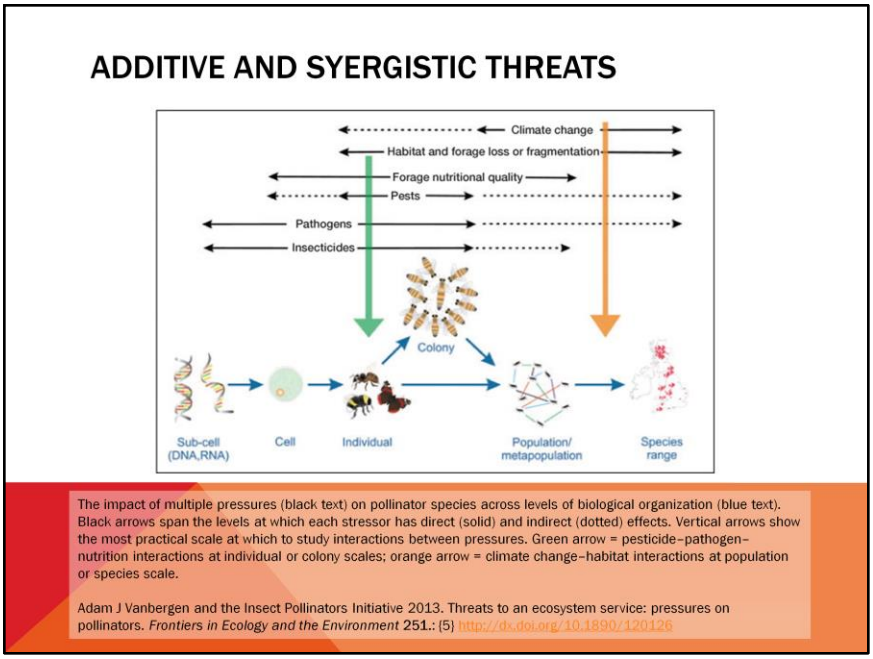
The effects of climate change on plant/pollinator interactions have yet to be fully understood. There are concerns that climate change will disrupt these interactions. For example, the areas that plants and pollinators have adapted to live in may shift, and no longer overlap. Plants could bloom earlier, before pollinators have emerged. Drought could affect bloom timing or plant or pollinator survival. Extreme weather events could affect pollination activity.



What happens when a new plant arrives with lots of very attractive nectar and pollen for native pollinators? What happens when a non-native pollinator competes with native pollinators? What will happen to the plant, if a predator eats all the pollinators, or an herbivore eats all the plants? Unfortunately, examples of alien species affecting pollination networks are not uncommon, and are the result of human activity.



Although pesticides are often in the news as a possible reason or bee decline, the varroa mite has a very significant impact on honey bees. The varroa mite is also a vector of many viruses. It is possible that when multiple bee species visit the same flower, pests and pathogens may transfer from one to the other. The varroa mite came to the United States in 1987, and is a parasite of an Asian honey bee, which is adapted to it. There are other bee parasites around the world that have the potential to infect honey bees.



All of the threats we have mentioned can occur simultaneously, particularly in agricultural settings. This makes it challenging to research threats to pollinators, as expertise in many scientific disciplines is required. Additionally, the species not depicted on this graph is *Homo sapiens.* As human behavior is at the root of both problems and solutions related to pollinators, the human dimension must also be considered. The fact that pollinator problems cross geographical borders and span many societies and cultures is what makes this a truly Global Issue.