Name ________________________

Pollinator Diversity Lab

Objectives

- Learn the variety of pollinators in a community garden through monitoring.
- Learn the importance of pollinator diversity.

Introduction

Pollinators play an important role in every ecosystem. For humans, more than 1/3 of the food that we eat relies on pollinators for production. More than 75% of all crop species depend on pollinators to produce fruits or seeds, supplying >35% of global crop biomass (Klein et al. 2007) and pollination services for food production are valued at >$200 billion annually worldwide (Gallai et al. 2009). Unfortunately, in recent years there have been drastic declines in the diversity of native pollinators. Given that pollinator density and diversity are essential for optimal crop yields for many species (Klein et al. 2007), reductions in biodiversity-mediated ecosystem services can lead to dramatic declines in crop yields (e.g., Klein et al. 2003).

Habitat loss or degradation are cited as the principal factors responsible for the decline of pollinator richness and abundance. Competition with European honeybees is also thought to exacerbate the challenges that native pollinators face. Even though honeybees are very efficient pollinators, and were previously thought to singlehandedly be able to provide the pollination services for numerous commercial crops, they too have been experiencing drastic abundance declines. Restoring and maintaining native pollinator species is thus crucial for maintaining agricultural production.

When studying different organisms and the interactions with their environment, ecologists use different metrics to ask questions about the populations or communities. The metrics used depend on the questions of interests and of the feasibility to collect data. For example, you can collect data on abundance of individuals of a certain group (e.g. number of butterflies) or density (e.g. number of butterflies in your garden observed in 30mins) if you are interested in determining if a certain flower you planted is attracting more butterflies to your garden.

You could be also interested in determining if the flower is attracting more types of butterflies. In this case, you would have to not only determine the number of individuals, but the number of species (i.e. species richness) or the number of individuals per species (i.e. diversity). Of course, this is only possible if you are able to tell the different species apart (it's easy with butterflies but it gets harder with smaller, less colorful groups). As an ecologist, you then have to decide which metric to use. Often, abundance and diversity metrics are positively correlated and thus it is ok to use the one that can be collected more efficiently.

Pollinator-dependent plants form the base of most food webs, and as a result, almost all species are directly or indirectly influenced by pollinators. For all the important work they do, most people only know two different pollinators; the honey bee and the bumblebee. The reality is that there are more than 3,000 bee species and more than 40 different kinds of bumblebees in North America alone. Important pollinators besides bees include flies, wasps, moths, beetles, hummingbirds, bats, and other animals. In this lab, you will be investigating the diversity of pollinators found in a local garden.

Use a pollinator identification guide to familiarize students with the different types of pollinators by sight. The ODA guide to Oregon Pollinators is located in the back of this curriculum guide. Review the data collection sheet as well.

Pollinators vary widely depending on the time of year and weather conditions, so surveying several times during the season is a better idea than only once to understand population changes through time,

Give pairs of 2 students a transect to monitor (typically choose a long row in the garden, with one student looking left, right, and the other recording the data. Try to make sure the transects are equally spaced, and of equal length.

Only collect pollinators visiting the reproductive parts of the flower. Visit a wide variety of flower types. Only identify it to the taxonomic level the students are comfortable with (e.g. Honey bee, bumble bee, butterfly, etc.). Advanced students could learn how to discern from among the different groups (e.g., species of bumble bee). The name of the flower should also be recorded.

Honey bee

Hover Fly

Wasp

The data can be summarized, diversity of groups of pollinators can be graphed using bar graphs; data can be grouped by which pollinators visited which type of flower. Diversity indexes can be calculated. There are numerous online diversity calculators, such as:
http://ipmnet.org/tiw/tools.aspx

Materials

- Pollinator identification sheets
- Data Sheet
- Clipboard

Procedure

1. Students should form groups of three. Two students will monitor a transect, one will record data (roles will switch for each transect).
2. Fill out the top of your data sheet with your names, the date, time, location, weather conditions, and transect number.
3. To record data, your group will walk along the transect for five minutes, recording every pollinator seen visiting a flower along the transect on your data sheet.
4. Only record pollinators within three feet (about an arm's length) of the transect line.
5. Try not to record the same pollinator multiple times, even if it visits different flowers along your transect.
6. Use your pollinator ID sheets to help identify each floral visitor. If you are not able to identify the species, describe the size, color, and appearance on the data sheet. It may also be helpful to use your phone to take a picture of the pollinator for help with identification.
7. Record the type of flower that each pollinator is visiting during the observation. If you do not know the flower type, record the color and a brief description.
8. At the end of five minutes, rotate to a new transect, and switch roles with one of the members of your group. You will survey a total of three different transects.

Results

Using your data sheets, record your total pollinator counts in the data table below. After recording your data, also record the class totals for each group of pollinators.

Pollinator								
Group Results								
Class Results								

Results, continued

Pollinator								
Group Results								
Class Results								

Graph

Using a piece of graph paper or a computer, graph the results. Be sure to label the X and Y axis, and title your graph. Attach the graph to your lab.

Analysis Questions

1. What was the most common pollinator in this survey? What might be some reasons why it is the most common?

2. What was the least common pollinator? What might be some reasons it is not as frequent?

3. How many total species of pollinators were observed? Why is it important to have more than just honeybees in an ecosystem? (Describe at least two reasons)

4. Why are pollinators an important to humans?

5. Why are pollinators important to ecosystems?

6. Research has shown that pollinator numbers are declining across the United States. What are some of the reasons their populations are decreasing? (It's ok to look up answers to this question)

7. What are some ways people can help pollinator populations recover?

Teacher Resources for Pollinator Diversity Lab

- Students do not need to be experts on pollinator identification before completing this activity, but some familiarity with local species will be helpful.

- The activity can be completed using different levels of taxonomic identification, depending on the level of your students. For more advanced students, you may want them to attempt to identify the specific species, but beginners may want to use more general terms (honey bee, bumblebee, butterfly, etc).

- The attached guide for identifying common Western pollinators or one of the PDF's at the bottom of the page should be printed for students before starting the activity.

- Transects should be laid out by the instructor before beginning the survey. 50 feet is a good length for surveying, but this distance can be adjusted, depending on the layout of the area you are surveying. Ideally, each transect will be the same length, evenly spaced, and in the same direction. A tape measure, or even string or rope will work for the transect lines.

- This activity is adopted from the Xerces Society bee monitoring protocol. The original document has useful information about bee identification and laying out transects. http://www.xerces.org/wp-content/uploads/2014/09/StreamlinedBeeMonitoring_web.pdf

- The following PDF's are excellent resources for identifying Western bees.

- https://www.portlandoregon.gov/parks/article/585770

- http://www.xerces.org/wp-content/uploads/2010/06/CA_CSM_pocket_guide.pdf

- http://nevadabugs.org/wp-content/uploads/2017/03/Nevada-Bee-Guide-small-size.pdf

Key to Identifying Bees – A

Common bees of the Portland area and their habits and preferences are as follows (photos taken by John Notis unless otherwise noted):

Bee

Pollen carrying structures on hind legs

Note: Only female bees have pollen carrying structures.

European Honey Bee

Apis mellifera 12-15 mm Medium

Torpedo shaped body with striped abdomen & fuzzy thorax. Moist clumps of pollen on upper hind legs. Dangle their legs as they fly. Makes buzzing sound. Lives in large perennial colonies.

Bumble Bee

Genus: *Bombus* 11-23 mm Med.-Extra Large

Large round very hairy bees. Entire body fuzzy mostly black with yellow, black, white, brown and orange stripes—diverse coloring, by species. Moist pollen carried on upper hind legs. First to appear in spring & last to disappear in fall. Social bee.

Long-Horned Bee (Chap Leg; Hairy Leg)

Genus: *Melissodes* 9-15 mm Small-Med.

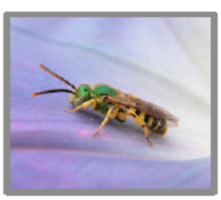
Very long antennae on males & hairy back legs on females. Large stout bees. Large brush-like hairs on back legs to carry pollen. Active mid-summer –fall. Solitary.

Kwiaht / CC BY-NC

Mining Bee (Tickle; Dark)

Genus: *Andrena* 4-17 mm Tiny- Med.

Carry pollen on the upper part of their hind legs, in their **"armpits."** Black, dull blue, green bees, bands of pale hair on abdomens. First bees to emerge in spring. Solitary.



Green Sweat Bee (Metallic green)

Genus: *Agapostemon* 7-12 mm Small-Med.

Green head & thorax, sometimes with black & yellow striped abdomen. Carry pollen on hind legs & on some hairs on underside of body. Narrow body. Fast fliers. Nests in rotting wood. Solitary.

Sweat Bee (Small sweat; Dark)

Genus: *Halictus or Lasioglossum* 7-15 mm Small-Med.

Dark medium sized narrow bodied bees. Have pale-colored abdominal hair bands makes them look striped. Brush of hair on upper part of hind legs. Fast, with jagged movements.

Bee

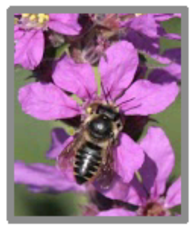
Pollen carrying structures on hind legs (continued)

Small Carpenter Bee (Tiny)
Genus: *Ceratina* 4-8 mm Tiny

Tiny to small sturdy, narrow bodied. **Their abdomens have a unique shield-like shape with a pointed tip**. White face markings (white nose) on males. Far away looks black but up close will be metallic blue/green. Nest in stems. Emerge in spring and stay active until fall. Solitary.

Thick pollen carrying hair on underside of abdomen

Striped Hairy Belly Bee (Leafcutter Bee; Dark; Hairy)
Genus: "Large jaw" *Megachile* 10-20mm Med.-Large



Robust, wide body & head, smoky color with large mandibles. They cut small pieces of leaves and flowers to line their nest cells. Solitary.

Metallic Hairy Belly Bee (Mason Bees)
Genus: *Osmia* 6-12mm Small

Rounded heads & **round, wide abdomens** without stripes. Color from metallic blue to green or black. Called mason bees because they use mud to make their nest cells. Early spring bee. Solitary

Mostly hairless

Cuckoo Bee
Genus: *Nomada* 3-15 mm Tiny-Med.

Look similar to a wasp with black, red, yellow bodies & markings. Small hairs on faces. Antennae look thick. Females don't make their own nests; they lay their eggs in the nests of other bees. Their larvae feed on the pollen collected by host bees. Nest parasites.