Are Insect Pollinators Choosy about Colors?

Submitted by: Ian Grettenberger, Pennsylvania State University, State College, PA

Grade levels targeted: K-5 (but could be adapted to middle school students)

Tying this into a general insect-module would be very good, especially if different levels of insect taxonomy are taught. This would include identifying the major orders of insects, such as flies (Diptera) (Fig. 1), beetles (Coleoptera) (Fig. 2), bees and wasps (Hymenoptera) (Fig. 3) and butterflies and moths (Lepidoptera) (Fig. 4).

Observations:

Insects provide the important service of pollination, both in the natural world and in agricultural systems. For example, the Food and Agriculture Organization of the United Nations estimates that about 70 out of the 100 crop species that provide 90 percent of the global food supply are bee pollinated, with several other species pollinated by other insects such as wasps, flies, beetles, butterflies and moths.

There are many, many species of pollinators that represent several different groups of insects. These insects are attracted to flowers by their size, shape, color and smell as they search for the pollen and nectar awards offered by the flowers. However, different groups and species of insects focus on different types of flowers, and color can play an important role in flower choice.

One way scientists can examine the relative attractiveness of different colors to many types of pollinators is by using pan traps (Fig. 5). These cheap and simple traps consist of colored bowls filled with water that mimic flowers. When an insect is fooled into thinking the colored bowls are flowers, they are trapped in the water.

Question(s):

How choosy are insects about flower color?

What colors do you think different groups of insects (e.g. bumblebees) are attracted to?

Hints to form hypothesis:

Think about pollinators around your home, garden, local woods, or school and what colors of flowers they are foraging on. Do these flower colors correspond to any of the bowl colors? Think about the different colors of flowers you see in the same places and whether certain colors of flowers predominate. Pollinators could be most attracted to the most common color of flowers.

Hypotheses:

Insects as a whole will be most attracted to a certain color, but some insects may be most attracted to one specific color over others

Materials needed

- 3 blue plastic bowls
- 3 yellow plastic bowls
- 3 green plastic bowls
- 3 white plastic bowls
- Liquid dishwashing detergent
- Water
- Magnifying glasses for identification (if needed)
- White tray and plastic/foam egg carton for sorting (optional)

The Experiment:

- Find an open place, perhaps in your yard or in a nearby park. Arrange the bowls in groups of four, one of each color, placed about two feet apart in a square. The position of each bowl in the arrangement should be randomly chosen.

    - *Randomization* is important in science because it prevents the researcher from influencing the results of the experiment, in this case by placing different colored pan traps in certain positions. This can be done by assigning each color a number and pulling numbers to assign each pan trap to a position.

    - The four different groups containing one of each color serve as replicates. *Replication* is crucial in designing an experiment because as scientists we frequently try to observe something. We use replicates to "do it again" and to make sure we have conducted our experiment correctly and have observed what is scientifically true. This experiment should be replicated through time by repeating the same experiment several weeks apart. If you do this, you would know if what you observed the first time is consistent across time.

- Add water to the pan trap until it is almost full. Add several drops of dishwashing liquid. This breaks the surface tension of the water and ensures that visiting insects will be trapped.

- Check the pan traps two days later. One day may not allow enough time to catch enough insects to count. However, the traps could also be checked after one day and if enough insects are present, the trapping period could be ended.

- Identify and count the insects in each pan trap. Pouring the contents of the pan trap into a white tray help you pick out insects easier. Divide the insects into groups such as beetles, flies, bees and wasps, and butterflies or moths and count them per group. Plastic or foam

egg cartons can be used to sort the contents of the pan trap into groups. If other lower groupings of insect seem to be very abundant (such as a bumblebees, which would otherwise be lumped in with all wasps and bees), they can be counted separately. Unidentified insects can be put into an "Other" group. Tally up numbers for each pan trap and then average the numbers for the four bowls of each color

  - Example: White bowl #1 = 5 flies, white bowl #2= 9 flies, white bowls #3 and #4 = 7 flies. Average for white-colored bowls = 7 flies.

- Repeat the experiment 3-4 times, at least 5 days apart as mentioned earlier in the discussion on replication.

Results:

Present the results for all insects and the common groups in a series of bar charts (Fig. 6a-c and 7). Label the graph axes with order names (e.g. Coleoptera).

Discussion:

Discuss your results and whether your results appear to confirm or reject your hypothesis. Can you say anything about color preferences of insect pollinators? Do your graphs from different weeks look the same? Discuss future experiments you may want to perform based on your results.

References

Information on pollinators: http://www.fao.org/ag/magazine/0512sp1.htm

Keys to the major insect orders for help in identification if needed:

http://www.ca.uky.edu/entomology/dept/images/stfairorder.pdf
http://www.sci.sdsu.edu/classes/bio462/easykey.html

For graph creation with elementary-aged students: http://nces.ed.gov/nceskids/createagraph/

Estimated time required to conduct the experiment:

- 30 minutes to set up on first day
- 1.5-3.5 hours to identify insects and discuss results (depends on level of identification)

Estimated cost: <$30

Contact: For help or more information about this project, please contact the author- Ian Grettenberger at img103@psu.edu

Figure 1: A fly (Order: Diptera). Some flies called hoverflies (not pictured), look like bees, but only have one pair of wings.

Source: http://drujohnwigsinkiwi.wordpress.com/2007/01/09/flee-fly-flo-

Figure 2: A beetle (Order: Coleoptera)

Source:
http://www.ent.iastate.edu/imagegal/coleoptera/scarabaeidae/japanese_beetle_adult.html

Figure 3: A bee (Order: Hymenoptera). Bees are typically hairy, but can also be metallic green.

Source: http://tomwhelan.wordpress.com/2008/05/25/green-metallic-bee/

Figure 4: A butterfly (Order: Lepidoptera)

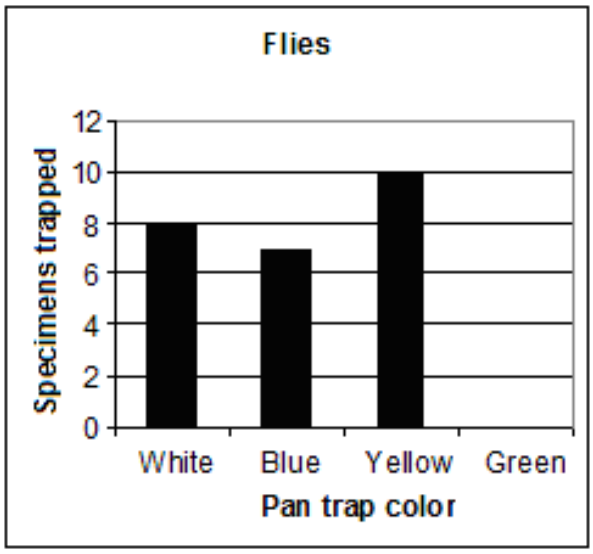
Source: http://en.butterflycorner.net/Nymphalis-polychloros-Large-Tortoiseshell-Grosser-Fuchs-Le-Grand-Tortue.418.0.html

Figure 5: A yellow pan trap

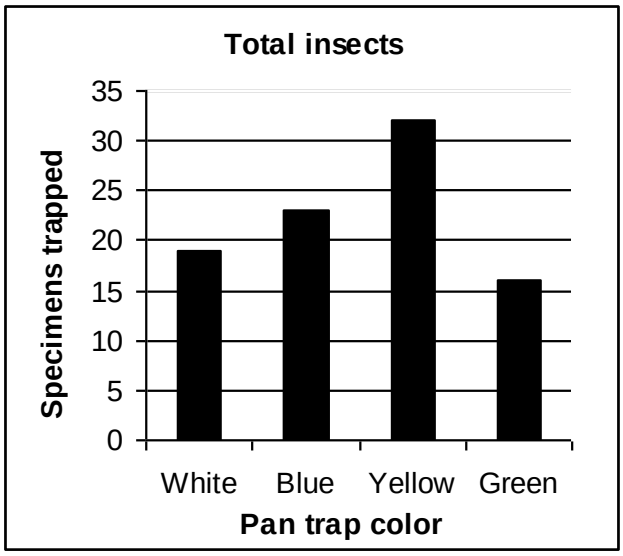
Source: http://www.landcareresearch.co.nz/research/biocons/invertebrates/idsurveillance/Yellowpan.asp

Figure 6: Sample bar graphs created with Microsoft Excel

a.



b.


Total insects
Specimens trapped
35
30
25
20
15
10
5
0
White
Blue
Yellow
Green
Pan trap color

c.

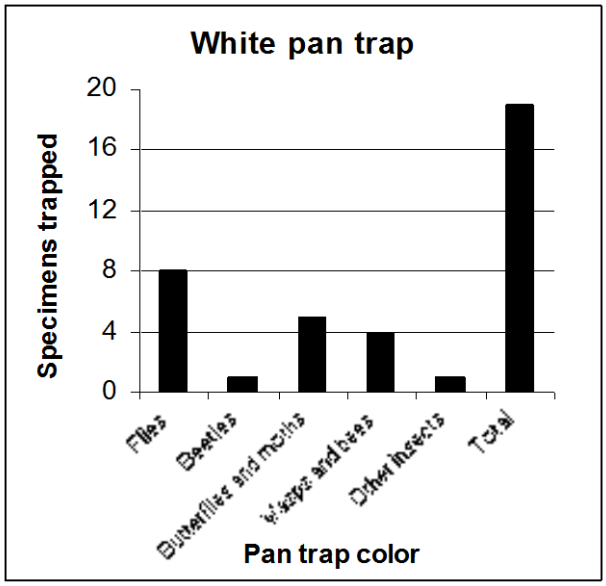

White pan trap
Specimens trapped
20
16
12
8
4
0
Flies
Beetles
Butterflies and moths
Wasps and bees
Other insects
Total
Pan trap color

Figure 6: Sample bar graph created at http://nces.ed.gov/nceskids/createagraph/