**Weeds: Tricks of the Trade**

 Seeds come in all shapes and sizes. How might the size and shape of a seed impact its ability to be a successful weed? In front of you, you’ll find 15 mystery plants. On each card is a picture of the plant, a picture of its seed, and the size of its seed. It’s your job to guess how these characteristics will affect its success as a weed.

**Make a prediction:**

Place the cards in order from what you think will make the best weed to what you think will make the worst weeds.

 Ranking as a Weed Mystery Plant Number

Best! 1 \_\_\_\_\_\_\_\_\_

 2 \_\_\_\_\_\_\_\_\_

 3 \_\_\_\_\_\_\_\_\_

 4 \_\_\_\_\_\_\_\_\_

 5 \_\_\_\_\_\_\_\_\_

 6 \_\_\_\_\_\_\_\_\_

 7 \_\_\_\_\_\_\_\_\_

 8 \_\_\_\_\_\_\_\_\_

 9 \_\_\_\_\_\_\_\_\_

 10 \_\_\_\_\_\_\_\_\_

 11 \_\_\_\_\_\_\_\_\_

 12 \_\_\_\_\_\_\_\_\_

 13 \_\_\_\_\_\_\_\_\_

 14 \_\_\_\_\_\_\_\_\_

Worst 15 \_\_\_\_\_\_\_\_\_

**Seed Dispersal**

 Different plants have different strategies for sending their seeds out into the world. Some seeds are carried by the wind. Others are eaten by birds and grow where they poop. Others stick to the fur of animals as they walk by and fall off somewhere else. How might these dispersal mechanisms affect a plant’s ability as a weed?

**Make a prediction:**

Rank each dispersal strategy by their effectiveness for weeds. 1 = most successful as a weed.

3 = least successful as a weed.

 Wind \_\_\_\_

 Birds \_\_\_\_

 Animal fur \_\_\_\_

**The data:** Below are the data for the prevalence of each weed species in our BEST plots for each of three dispersal strategies: wind, birds, and animal fur. The more places a weed is found, the more common the weed is. For each dispersal strategy, make a histogram of how common species with this strategy are as weeds in the BEST plots.

***Hint:*** A *histogram* is a graph that plots the count or frequency of items (y-axis) that fall into each category (x-axis). On the graph below you’ll graph the number of plants species (y-axis) that are found at 1 school, 2 schools, 3 schools, etc (x-axis). Let’s go through an example. To make a bar for plants found at 2 schools, first count the number of species with “2” under # of schools. Then make a bar of this height in the 2 schools category (see below).

|  |  |  |
| --- | --- | --- |
| **Dispersal****Mechanism** | **Species** | **# of Schools** |
| Birds | Riverbank grape | 1 |
| Bird | Poison ivy | 1 |
| Birds | Black nightshade | 1 |
| Birds | Black raspberry | 1 |
| Birds | Dewberry | 1 |
| Birds | Multiflora rose | 1 |
| Birds | Virginia creeper | 1 |
| Birds | White mulberry | 1 |
| Birds | Bush honeysuckle | 1 |
| Birds | Gray dogwood | 1 |
| ***Birds*** | ***Crab apple*** | ***2*** |
| Birds | Pokeweed | 11 |

**Total # of bird dispersed species:** 12

 rare common

1. How many bird dispersed species are found at only one school? ***10 species***
2. In general, are bird dispersed weeds common (found in many places) or rare (found in few places) in our plots? Explain using evidence from the graph.

***While one species, pokeweed, is fairly common, in general bird dispersed species are fairly rare in our plots. Most species are only found at one school. You can see this from the graph- there is a very large bar at 1 and very few bars on the right side of the graph.***

 Now let’s look at species dispersed by animal fur…

|  |  |  |
| --- | --- | --- |
| **Dispersal****Mechanism** | **Species** | **# of Schools** |
| Animal fur | Violet | 1 |
| Animal fur | Hairy-lens grass | 1 |
| Animal fur | Ryegrass | 1 |
| Animal fur | White avens | 1 |
| Animal fur | Crane’s-bill | 1 |
| Animal fur | Goose grass | 1 |
| Animal fur | Hairy crabgrass | 1 |
| Animal fur | Sand bur | 1 |
| Animal fur | Tumbleweed | 1 |
| Animal fur | Witch grass | 2 |
| Animal fur | Ox-eye daisy | 2 |
| Animal fur | Redtop | 2 |
| Animal fur | Orchard grass | 3 |
| Animal fur | Slender sand sedge | 3 |
| Animal fur | Redroot amaranth | 3 |
| Animal fur | Yarrow | 3 |
| Animal fur | Bitter dock | 4 |
| Animal fur | Timothy grass | 4 |
| Animal fur | Fall witch grass | 4 |
| Animal fur | Cheat grass | 5 |
| Animal fur | Sheep fescue | 6 |
| Animal fur | Love grass | 6 |
| Animal fur | Queen-anne’s lace | 6 |
| Animal fur | Yellow foxtail | 8 |
| Animal fur | Lamb’s-quarters | 9 |
| Animal fur | Common ragweed | 10 |
| Animal fur | Quackgrass | 11 |
| Animal fur | Kentucky bluegrass | 12 |
| Animal fur | Smooth crabgrass | 16 |

**Total # of animal fur dispersed species:** 29

 rare common

1. In general, are animal fur dispersed weeds common (found in many places) or rare (found in few places) in our plots? Explain using evidence from the graph.

***There are many ways of answering this, but the general conclusion should be that a handful of species are very common (for example found at 8-16 schools), while some species are still rare and only found at a couple schools.***

|  |  |  |
| --- | --- | --- |
| **Dispersal****Mechanism** | **Species** | **# of Schools** |
| Wind | Elm | 1 |
| Wind | Gray goldenrod | 1 |
| Wind | King-devil | 1 |
| Wind | Canada thistle | 1 |
| Wind | Russian knapweed | 1 |
| Wind | Catalpa | 1 |
| Wind | Box elder | 1 |
| Wind | Spiny lettuce | 2 |
| Wind | Cat’s-ear | 2 |
| Wind | Cudweed | 2 |
| Wind | Tree-of-heaven | 2 |
| Wind | Maple | 2 |
| Wind | Chicory | 3 |
| Wind | Spotted knapweed | 3 |
| Wind | Bull thistle | 4 |
| Wind | Flat-topped goldenrod | 5 |
| Wind | Annual fleabane | 5 |
| Wind | Dandelion | 10 |
| Wind | Canada goldenrod | 10 |
| Wind | Frost aster | 11 |
| Wind | Horseweed | 13 |

**Total # of wind dispersed species:** 21

 rare common

1. In general, are wind dispersed weeds common (found in many places) or rare (found in few places) in our plots? Explain using evidence from the graph.

***There are many ways of answering this, but the general conclusion should be that a handful of species are very common (for example found at 8-16 schools), while some species are still rare and only found at a couple schools.***

**Wrap-up Dispersal Questions**

1. Which dispersal strategy is used by the largest number of weed species? Which dispersal strategy is used by the fewest? Explain.

***Animal dispersal is most common (29 total species) and bird dispersal is least common (12 total species).***

1. More common and successful weeds are found at a greater number of schools. Which dispersal strategy (or strategies) makes the best weeds? Explain using your graphs.

***A case can be made for either animal dispersal or wind dispersal making the most successful weeds. This should be supported by the finding that there are more species on the right side of the graphs, whereas most of the species on the bird graph are on the left side.***

1. Does having this successful dispersal strategy guarantee that a weed species will be common in the BEST plots?

***The spread in all the graphs shows that having a particular dispersal strategy doesn’t guarantee a species will be common (found at lots of schools) or rare (found at few schools). Even with animal fur where one species is found in 16 locations, there are still plenty of species only found in one location.***

**Seed Banks**

 As you saw above, just because a plant has a particular dispersal strategy, it doesn’t guarantee it will be a successful weed. Dispersal determines how a plant can get to our plots, but some seeds may have already been there before we planted our plots. When seeds fall into the soil, some don’t sprout but stay alive dormant in the soil. This collection of dormant seeds is called the ***seed bank***. When the plants above are disturbed (like when we put in our BEST plots!), some of these seeds will start to grow. If you take soil from outside and keep it warm and wet, you can even grow these dormant seeds yourself!

 In 1879, Dr. Beal placed seeds from several different plants found around East Lansing into glass jars. The jars are still stored in secret somewhere on the campus of Michigan State University. Every five to ten years someone will dig up another jar and see which seeds can still sprout. These seeds that can still grow are considered ***viable***. One hundred and twenty years later some species are still going!

 The type of weeds found in the BEST plots might reflect the seeds already present in the seed bank when the plots were planted. How might a species’ ability to survive in the seed bank- the seed’s viability in years- reflect its ability to be a successful weed?

**Make a prediction**:

How will the lifespan of a seed in the seed bank affect its prevalence in our BEST plots? Do you think seeds that can stay dormant longer will be more or less common in our plots?

**The data**: Below is a list of some of the weed species found in our BEST, the number of schools where they are present, and their maximum viability in the seed bank measured through the Beal experiment. **Using the data below, plot the relationship between seed viability and the number of schools where the weeds were found.**

|  |  |  |
| --- | --- | --- |
| **Common Name** | **Maximum Viability (Yrs)** | **# of Schools** |
| Common ragweed | 40 | 10 |
| White clover | 5 | 10 |
| Lamb’s-quarters | 40 | 9 |
| Yellow foxtail | 30 | 8 |
| Common evening-primrose | 80 | 5 |
| Common mullein | 100 | 5 |
| Bitter dock | 80 | 4 |
| Redroot amaranth | 40 | 3 |
| Common plantain | 40 | 2 |
| Purslane | 40 | 2 |
| Sheperd’s purse | 35 | 1 |
| Common chickweed | 30 | 1 |
| Moth mullein | 120 | 1 |

1. What is the relationship between viability in the seed bank and the number of school where a weed species is found?

***It appears as though species that are viable for long time in the seed bank are not found at a lot of schools.***

1. Is the relationship between seed viability and commonness as a weed clean or noisy?

***The relationship is rather noisy (sketch a best fit line if you are uncertain).***

1. What are some other reasons, besides the seed’s viability, why Common Plantain was only found at 2 schools?

***Many possible answers here. As we’ve seen previously, it could have to do with its dispersal strategy. It could also be due to other factors we haven’t considered yet- it only grows in certain types of environments that are present only at a couple schools, there may not be many source plants near many schools, it may not be a good competitor and has been excluded from the plots already, etc….***

**Final Wrap-Up**

 Let’s revisit the sorting cards from the beginning of the exercise. Turns out 5 of these cards are common weeds in our BEST plots, 5 are very uncommon weeds, and 5 are species we actually planted in the plots. Below is the real ranking based on the number of schools were each species was found. If the ranking for two plants is the same, it means they are both just as common.

 Ranking as a Weed # of Schools Mystery Plant Number Plant Name

Best! 1 16 #1 *Smooth crabgrass*

 1 16 #4 *English plantain*

 2 13 #3 *Wood sorrel*

 3 12 #5 *Kentucky bluegrass*

 4 11 #2 *Quackgrass*

Worst 5 1 #6 *Sheperd’s purse*

 5 1 #7 *King-devil*

 5 1 #8 *Multiflora rose*

 5 1 #9 *Black nightshade*

 5 1 #10 *Common chickweed*

 Planted - #11 *Big bluestem*

 Planted - #12 *Prairie Junegrass*

 Planted - #13 *Wild bergamot*

 Planted - #14 *Prairie coneflower*

 Planted - #15 *Stiff goldenrod*

1. How is your predicted ranking from the first page different from the actual ranking above? How is it similar?
2. Based on what you learned in this exercise, what factors might explain why wood sorrel is such a common weed?

***Many possible answers here, but should mention something covered in the exercises or the powerpoint- dispersal strategy, seed bank viability, clonal reproduction, landscape influences.***