**Variation in Sagebrush Seed Weights**

**Introduction**

Big sagebrush species (*Artemisia tridentata*) are foundational to North American cold deserts, providing a habitat and a food source to a variety of species (Busso & Perryman, 2005; Richardson et. al., 2015). However the ecosystems have been continually disrupted by invasive species (such as cheatgrass - *Bromus tectorum*), fires, and humans. As such, sagebrush restoration efforts are crucial to the survival of this species and the ecosystems as a whole (Schlaepfer, Lauenroth, Bradford, 2014).



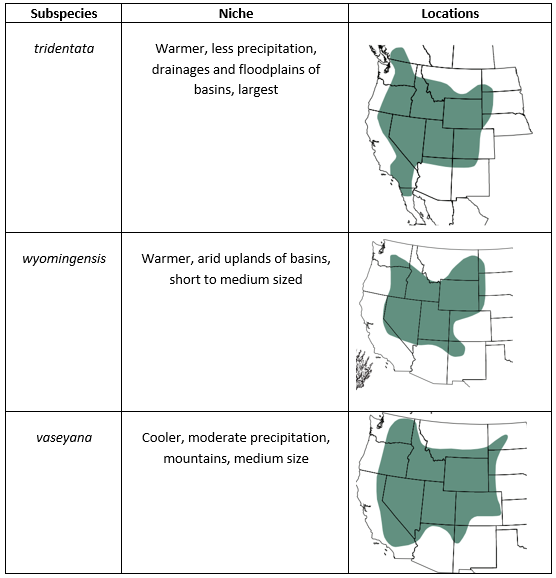
*Figure 1: Example of a big sagebrush plant.*

One particular research area of interest is the seed weight of sagebrush plants and how weight can affect the survival of the seedling and subsequent generations. Research has shown that an increase in seed weight can have a positive influence on the emergence and survival of the plant and subsequent generations (Busso & Perryman, 2005). However, it is unclear how seed weight varies across different subspecies and sampling locations. Different subspecies of big sagebrush occupy different ecological niches (Table 1) that can influence the survival and reproduction of the plant. This has led researchers to wonder: *How does sampling location affect variation in seed weights of Big Sagebrush subspecies?*

**Your Task**

Within your group you will explore the research question: *How does sampling location affect variation in seed weights of Big Sagebrush subspecies?* First, you will explore the relationship of seed weight to sampling location and climate information using the data found in Table 2. Then based on your findings, you will make a claim supported by the evidence you found in the data. Lastly, you will provide reasoning for your claim and evaluate your claim. After each group has had time to develop their explanations, we will have a class discussion and share-out of ideas.

*Table 1: Comparison of big sagebrush (Artemisia tridentata) subspecies and their respective ecological niches (Richardson et al., 2015).*

**

**Data**

See Table 2 for pertinent information regarding the guiding question such as sampling location, subspecies, climate information, and the average seed weights. Also, see this [link](https://www.google.com/maps/d/u/0/edit?mid=1v60XX5-LP7vPmBCvjr1ad_eqH7YnR9B8&usp=sharing) for a map of the sampling locations.

In order to determine the average seed weight value, 10 seeds were collected and weighed from 6-12 individual sagebrush plants. The weights of the individual plants were then averaged to determine an average population seed weight.

*Table 2: Average population seed weight data for each sampling location with relevant information regarding each sampling location.*

| **State** | **Sampling Location** | **Subspecies** | **Annual Precipitation (mm)** | **Elevation (m)** | **Min Temp**  **(°C)** | **Max Temp**  **(°C)** | **Avg Seed Weight (mg)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Idaho | Bannock Highway | *tridentata* | 418 | 1811 | -10.7 | 27.8 | 1.75 |
| Scout Mountain | *tridentata* | 416 | 1776 | -10.4 | 27.2 | 1.54 |
| King Hill | *tridentata* | 263 | 858 | -5.8 | 34.2 | 2.78 |
| Firth Lava Beds | *tridentata* | 283 | 1391 | -10.8 | 30.5 | 1.98 |
| Gibson Jack | *tridentata* | 320 | 1388 | -9.5 | 31.3 | 2.20 |
| Howe Creek | *tridentata* | 221 | 1574 | -13.8 | 30.2 | 1.63 |
| Oregon | Burns Junction | *wyomingensis* | 222 | 1188 | -7.3 | 32.5 | 3.40 |
| Hines Court | *wyomingensis* | 283 | 1318 | -8.6 | 29.8 | 2.82 |
| Crooked River | *tridentata* | 291 | 1053 | -6.7 | 30.4 | 1.92 |
| Utah | La Sal | *vaseyana* | 308 | 2358 | -8.7 | 33 | 2.97 |
| British Columbia | Kobau | *vaseyana* | 631 | 1848 | -11.9 | 22.5 | 2.87 |
| Station | *tridentata* | 334 | 347 | -5.0 | 27.7 | 2.92 |

**Develop Your Argument**

What is your group’s answer to the research question: *How does sampling location affect variation in seed weights of Big Sagebrush subspecies?*

As a group, discuss, decide, and depict on your groups’ poster paper:

1. The **claim** you want to make about the variation in the seed weights of different sagebrush populations.
2. How you **used the data** collected to make your claim. This is the scientific evidence to support the validity of your claim.
3. A **justification** to convince someone outside of this class that the data collected was biologically meaningful to answer the research question AND the **reasons why** (given what we know about the biology of sagebrush) your claim about variation in seed weights is valid based on the evidence. This is important biological reasoning to support the validity of your claim.

*Remember: you can write, diagram, graph, draw, etc. on your poster paper.*

You might organize the information above on your poster paper by spacing it out as depicted in the example below:

| Make your claim (#1) | |
| --- | --- |
| Describe how you used the data (#2) | Draw, graph, diagram how you used the data (#2) |
| A **justification** to convince someone outside of this class that the data collected was biologically meaningful to answer the research question AND the **reasons why** (given what we know about the biology of sagebrush) your claim about variation in seed weights is valid based on the evidence. This is important biological reasoning to support the validity of your claim.  *(*#3; *drawings and diagrams could be useful here too!)* | |

*Figure 2: Example of a whiteboard design that demonstrates space for the necessary components of an argument*

After each group has finished their argument, there will be a class discussion where your group can share your argument and ideas. You will likely hear arguments that differ from yours, in order to determine if their argument is convincing or not, consider the following questions (your group could also use them to evaluate your own argument!):

* How was the data analyzed and why?
  + Is that method free from errors? What are these errors and why or why not?
* Why does the evidence support your claim?
  + Why did you decide to use that particular evidence and not another?
* Were there other claims your group explored before deciding on your current one? If so, why was that previous claim rejected?
* Are there other factors that could be influencing the Sagebrush seed weights?

**References**

Busso, C. A., & Perryman, B. L. (2005). Seed weight variation of Wyoming sagebrush in

Northern Nevada. *Biocell,* 29(3), 279-285.

Richardson, B. A., H. G. Ortiz, S. L. Carlson, D. M. Jaeger, and N. L. Shaw. 2015. Genetic and

environmental effects on seed weight in subspecies of big sagebrush: applications for

restoration. Ecosphere 6(10):201. http://dx.doi.org/ 10.1890/ES15-00249.1

Schlaepfer, D. R., Lauenroth, W. K., & Bradford, J. B. (2014). Natural regeneration processes in

big sagebrush (Artemisia tridentata). *Rangeland Ecology & Management*, *67*(4),

344-357.