Eco/Evo Lab. S. Schuler (2020)

Rev. Dalrymple (2020)

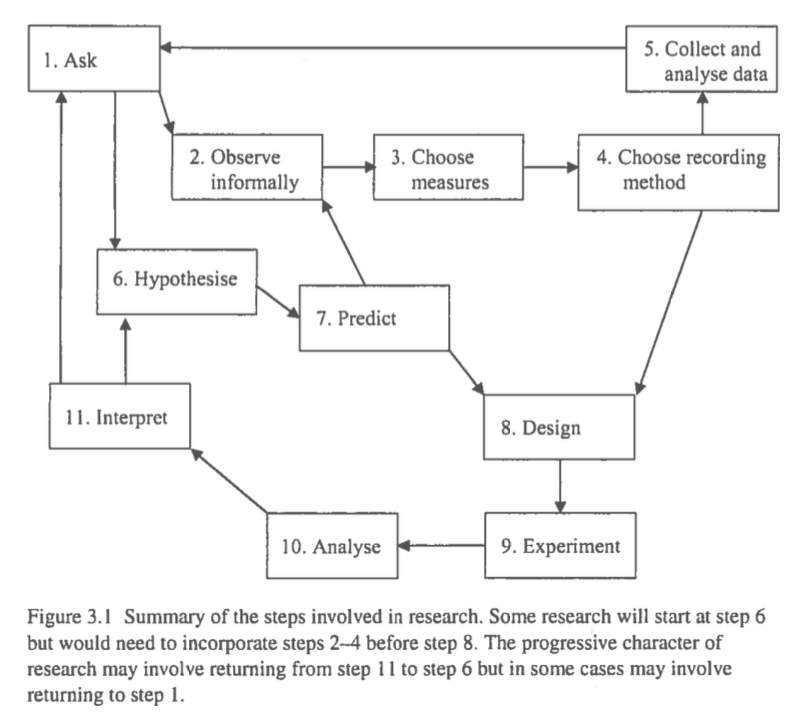
Lab 4: Vegetation Restoration

# I. INTRODUCTION

In our previous labs, we discussed various ways to describe raw data using descriptive statistics, introduced the use of inferential statistics as a means to compare data between populations, and learned graphing techniques that are helpful for visually depicting and analyzing data. Now, it is time to put all of these together through an example examining vegetation data for the purposes of restoring a degraded area. In this lab, we will cover topics related to restoration ecology, examine real datasets pertaining to restoration, follow the scientific method, run appropriate analyses, and draw conclusions about an ongoing ecological restoration project at Boise State University.

# II. THE SCIENTIFIC METHOD

So far we have focused primarily on analyzing and visualizing data, but there are many steps that precede this in ecological research. The scientific method is often presented as a linear process, but the truth is that it is much more iterative in practice. The figure below (from Measuring Behavior by Martin and Batesman) displays that well. Starting this week, you will engage in more of the early steps of the scientific process, including forming hypotheses and predictions.



# III. WHAT IS RESTORATION ECOLOGY?

Restoration ecology is almost self-explanatory, but we will define it as “renewing and restoring degraded, damaged, or decimated ecosystems through human intervention.” When an area is degraded, damaged, or decimated, this is due to human impacts. Human influences have impacted the landscape and the ecosystem dynamics to the point where they are not as economically or ecologically functional as they could be in their natural, original states. Direct influences could be anything from slash-and-burn agriculture to dumping (e.g., pollution of plastic wastes) to urbanization. This particularly means that humans *directly* contributed to damage within the environment. Indirect influences can relate to anything that humans brought to the landscape (e.g., cattle ranching, which can bring invasive species or damage riparian zones) to anything that can be carried away from the source point (e.g., pollutants that travel across countries, acid rain). Overall, restoration ecology aims to initiate or accelerate the recovery of an ecosystem with respect to its health, integrity, and sustainability.

Successful restoration will depend on the realistic goals and objectives that are set by land managers and other affiliated parties. Most of the time, people think that restoration means that the habitat should be restored to its original state, *but that is not always the case*. Sometimes, other confounding factors and the welfare of humans are considered when restoring an area, so the next best thing would be to create a landscape that has a highly functioning and diverse ecosystem. For instance, in NW Indiana in Newton County, there used to be the largest lake in Indiana called Beaver Lake. However, this lake was drained in 1880 for irrigation and was gone within just 2 years. Subdivision developments and other human encroachments made it nearly impossible to restore the area back to a lake when the Nature Conservancy bought land parcels. They decided to restore the area to native tallgrass prairies, and now even have bison on the landscape. Therefore, restoration goals and objectives typically reflect societal choices. But these goals can be extremely challenging, and the list goes on from there.

Restoration can come in all sizes and shapes, with differing objectives and goals to meet. Examples of projects that can be done when restoring an area range from reintroductions of native species, such as wolves to Yellowstone, to reforestation of an agricultural land to increase deer habitat. Take some time to reflect on other restoration initiatives that you may know of.

Ecosystems provide many useful benefits to humans, wildlife, and all aspects of nature generally. We can categorize their benefits into two portions: services and functions. Ecosystem services are processes that occur within an ecosystem that provide benefits to humanity, such as water purification, detoxification, and pollination of our crops. Ecosystem functions are ecological processes that control the fluxes of energy, nutrients, and organic matter through an environment, such as the water cycle, nutrient recycling, and organic matter breakdown. All of these services and functions are worth *billions of dollars annually* in the USA, meaning that we should try our best to conserve and protect natural ecosystems!

The most effective way to reduce loss of ecosystem services and functions is to slow habitat loss, which is the leading cause extinction and ecosystem dysfunction. One way to do this is to conserve current viable habitat, which is the carefully planned management of natural resources in or to protect and prevent exploitation. The second method is to restore degraded habitat, which involves restoration ecology practices that we will discuss further.

There are 10 major steps for ecological restoration. Here they are as listed:

1. Inventory area and describe current conditions
2. Investigate historic conditions
3. Interpret the original system by examining nearby natural areas
4. Develop goals and objectives
5. Create a timeline for the plan
6. Design a monitoring plan to evaluate success
7. Implement the actual work
8. Maintain good records
9. Review and revise progress based on records
10. Most importantly, share the results.

While the steps look very simple in writing, actually conducting restoration work takes a lot of time and effort, with many challenges to face. Some of the most important things to consider is the scope of the project in terms of time and space. Restoration is also expensive in some cases, so it is important to budget. Involving the public can be difficult, but their opinions need to be heard. Gaps in knowledge can also lead to implementing bad restoration practices even though intentions are good, and result in failed restoration. Maintaining records and revising progress can also be difficult, which is why following the steps is necessary to avoid issues and complete projects that will hopefully result in restoring natural areas.

# IV. NATIVE PLANT RESTORATION PROJECT

The Intermountain Bird Observatory (IBO) is a non-profit, 501(c)(3), research and community outreach unit of Boise State University funded primarily through grants, contracts, and donations from individuals. One of the current projects the IBO is currently working on is the Native Plant Restoration Project at the Diane Moore Nature Center just outside Boise along Highway 21 before the Lucky Peak Dam. Due to the site’s proximity to the Boise River, the area was once flooded every year, which allowed it support cottonwoods and other riparian plants. Installation of the diversion dam ended the natural floods and allowed many invasive species, including cheat grass, to establish. Further, unmanaged vehicle use and bridge construction, among other human activities, have been sources of disturbance in the habitat.

Heidi Ware Carlisle, Education and Outreach Director at the IBO, and about 150 community volunteers, planted over 2,000 native plants (of 22 species) at IBO’s River Research Center in 2018 and 2019. The project, in partnership with the College of Western Idaho, the Golden Eagle Audubon Society, the Native Plant Network, and Idaho Fish and Game, aims to restore habitat for pollinators and birds at this important wildlife area along the Boise River. Although many plant species have been planted to attract pollinators (i.e., milkweed for monarchs) and songbirds (i.e., golden currants for orioles), the benefits will be far reaching and will impact many species of mammals, birds, insects, and fishes.

In this week’s lab, you will have the opportunity to analyze data collected to monitor the success of the restoration project. **Your participation in analyzing and interpreting findings within these datasets will directly aid the IBO in understanding their management goals for restoring the riparian area!**

*If you’re interested in signing up to volunteer with the IBO to participate in bird banding, Adopt-A-Plot, and other various activities, please visit this link to be added to the email contact list (currently not accepting volunteers in 2020 due to COVID-19):* <https://www.boisestate.edu/ibo/get-involved/volunteer/>

Lab 4 Exercise

# PART 1

The native plang restoration project was designed with 45 10x10 m plots spread across three different habitat zones (sandy, gravel, and sandy-loam soil). One threat to the successful establishment of native plant seedlings is competition from weeds. Therefore, the restoration team also imposed experimental treatments to control weeds. In one weed treatment they placed a burlap mat over the ground (Figure 1). The second weed treatment they scattered native grass (*Poa secunda*) seeds between the plants. They also left some area as controls for comparison.

A picture containing grass, tree, hill

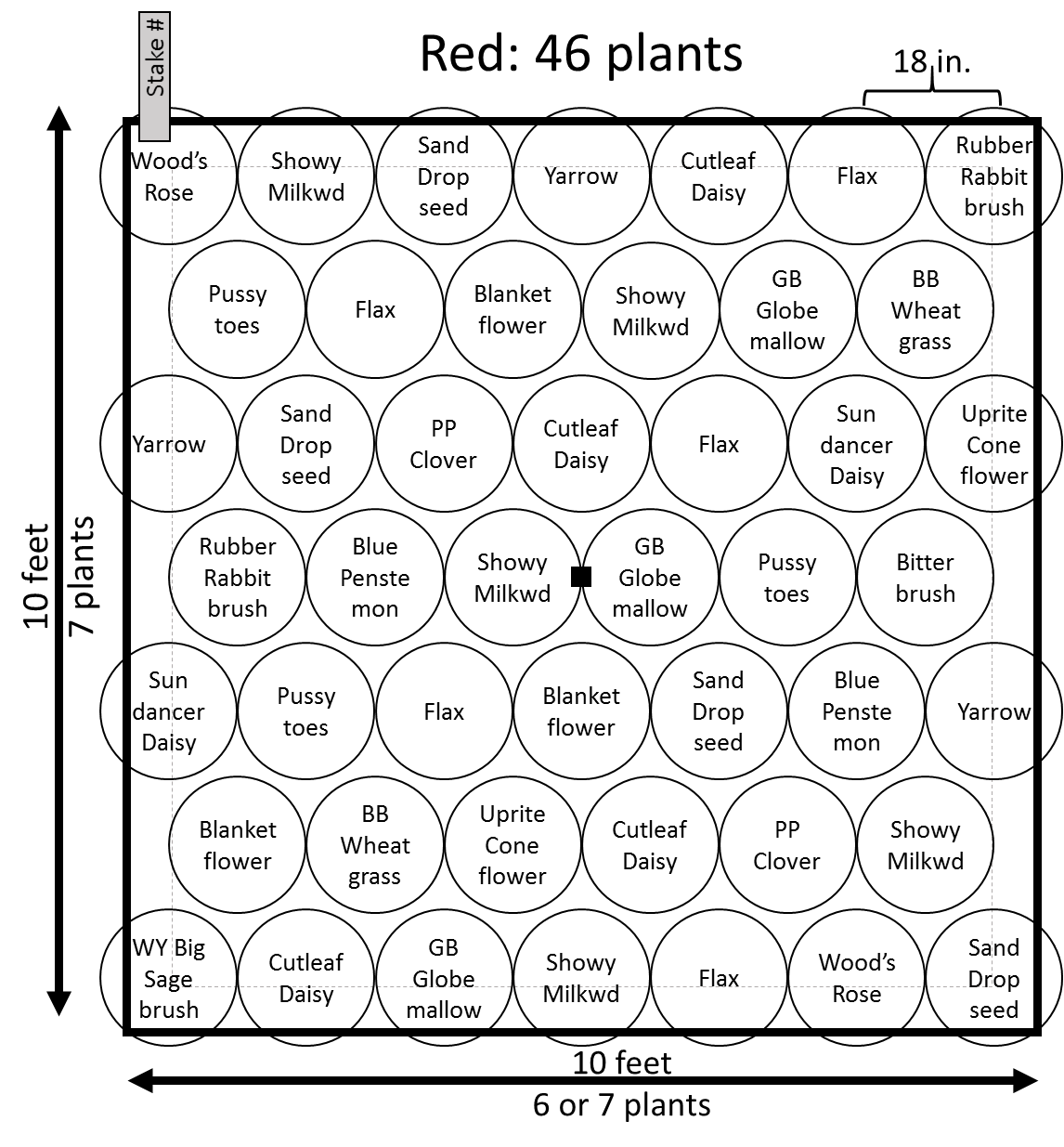
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Figure 2. Example layout of native plants within a plot.

Figure 1. One of the native plant restoration plots with the burlap mat treatment. Native plantings are surrounded by mesh collars to prevent herbivory. Photo credit: Kim Bahruth.

The first dataset that we will explore is survival of native plants one year after they were planted. In each of the 45 restoration plots, approximately 46 native plants were planted (Figure 2) and IBO interns monitored the plots in 2019 to see how many of the plants were alive or dead They also noted the soil type at each plot (sandy, sandy-loam, or gravel) and the weed treatment implemented:

***C*** *= control, where no weeding of non-desirables took place,*

***B*** *= burlap weed mat installed to prevent weeds, and*

***N*** *= POSE (Poa secunda) native grass planted after removal of non-desirables*

Open the Lab 4 Datasets Excel file (Item 4.7 in the Lab 4 Blackboard folder). Open the **Plant survival** tab. Follow the directions in the text box on the Excel worksheet to complete the table, and answer the following questions.

* + - 1. Before you analyze the data, form a hypothesis for how you think weeding in general will affect native plant survival.
      2. Predictions are related to hypotheses, but they are specific to the way an experiment was designed. They make explicit how you think a treatment will affect the dependent variable in your study, if your hypothesis is true. A helpful way to formulate a prediction is: “If my hypothesis is true, then…”. When you finish that sentence you should state how the dependent variable will compare between the different treatments.
      3. Which test should be used to perform the analysis?
      4. Recall that whenever we run statistical analyses, we have a null hypothesis and an alternative hypothesis. What are the null and alternative statistical hypotheses for this analysis? Make sure you use the appropriate mathematical notation.

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Time to run our selected analysis in the Excel document. Complete the analysis within the Excel worksheet; refer to the previous lab handouts if you need guidance in running the analysis.

* + - 1. Take a look at the output and understand what results you have derived from the analysis. Do the results support or reject the null hypothesis?

After reviewing the analysis, it is important to relate the information back to the original research question that was determined at the beginning of the process. The conclusions should be appropriate to the design of the study, and should essentially provide the IBO land managers with a sense of direction that their restoration efforts are heading.

* + - 1. Write up a short paragraph (3-6 sentences) summarizing the findings and answering the research question.

# PART 2

The next dataset that you will examine focuses on one iconic plant species in the restoration plots, Wyoming big sagebrush (*Artemisia tridentata* sp. *wyomingensis*). Student volunteers visited the plots and measured the height of each sagebrush plant in the plots. They also recorded the weeding treatment and soil type that each sagebrush was growing on. Within the Excel document, select **Sagebrush height** at the bottom of the screen to review the data.

For this lab exercise, we will be focusing on how weeding treatment impacted sagebrush growth. One of the IBO’s restoration management goals is to find a weeding treatment that significantly contributes to sagebrush performance, which is recorded as growth (e.g., height).

* + - 1. Use your statistical analysis output to fill in the mean percent survival of native plants based on weed preventative treatment below:

| Weed Treatment | Mean sagebrush height (m) |
| --- | --- |
| Burlap |  |
| Control |  |
| Native Grass |  |

* + - 1. What was the p-value of the analysis you did? Based on this p-value, what statistical and biological conclusions can you make?