**Lesson Plan for Santa Rita Experimental Range Vegetation Monitoring**
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**Objectives:**

Part 1:

Students will learn about common plant species on SRER through vegetation monitoring techniques using the belt transect method.

Students will analyze and present data collected in Part 1 by classifying plant species based on growth habits (grasses, forbs, shrubs)

Part 2:

Use the Scientific Method to:

- Make predictions about plant species at different locations on the range
- Analyze plant species over time using past data records and photographs of the transects
- Compare vegetation trends to precipitation and grazing history
- Compare/Contrast results to other locations on the range

**Part 1:**

Materials

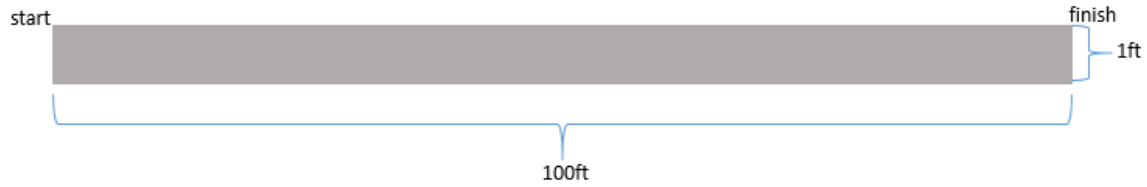
Clipboard, pen or pencil, and paper for recording data
Measuring tape that is at least 100ft long
1ft ruler
Survey flags (apx. 10)
SRER plant guide
Additional plant guide(s) *[optional]*

Background

There will be a location predesignated on SRER where students can go take vegetation measurements without disturbing other science experiments that are ongoing.

Explain that since 1972, every three years plant density measurements have been recorded on SRER. Today, we will record this data using the same procedures scientists use. We will be using a **belt transect method.** We will measure out 100ft. with measuring tape. Plant density that is within 1ft of the measuring tape will be recorded. Count each plant species only once.

Belt Transect Image:

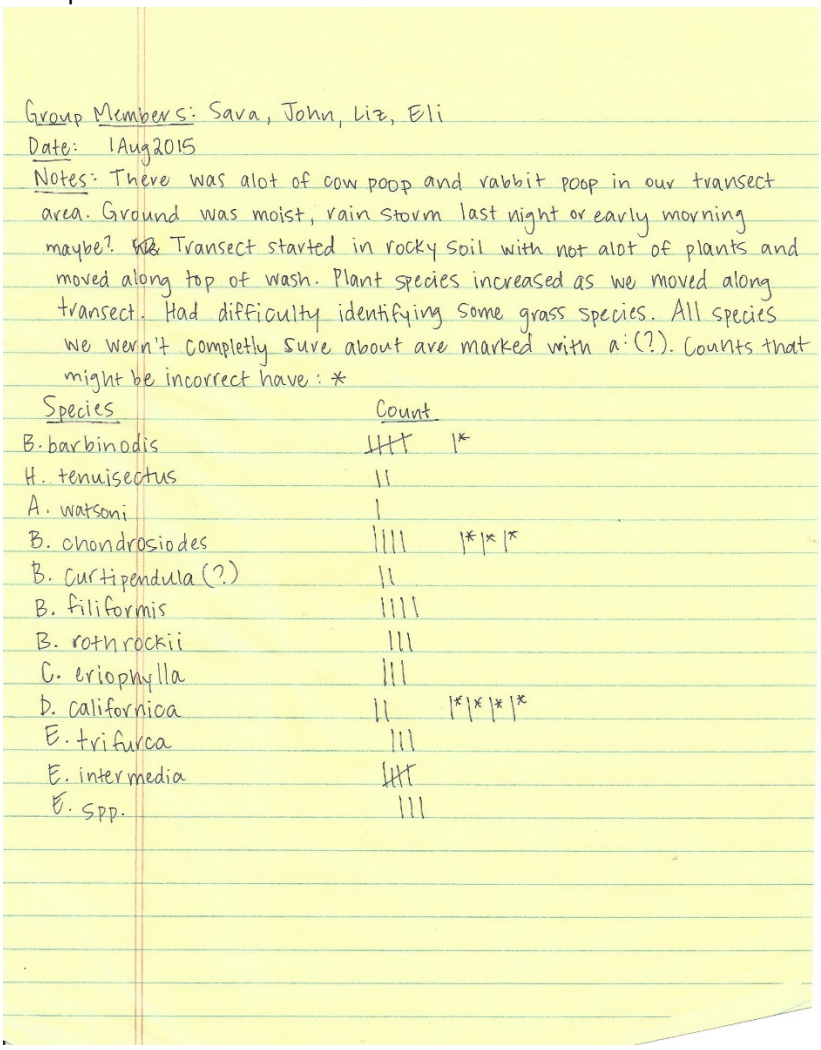



Procedure

1. Separate class into 3-4 groups depending on size of class. Usually about 4-5 students/ group ensures everyone will have tasks throughout the lesson.
2. Mark a starting location for each group. Make sure groups don't end up overlapping eachother when they measure out their transects. Try to use a variety of locations--- have groups go off in different directions, if there's an elevation change have some groups survey along it and others not, aim for a variety of vegetation, if possible.

3. Have each group measure out 100ft. and mark the ending location with a survey flag.
4. Have students record important information about their transect. Some useful information that might affect vegetation includes: past weather (if known), location of transect, or evidence of predators (scat, fur, etc.)
5. Count all plant species within the transect using the plant species guide. Don't worry too much about making sure you have the right species if it's hard to tell. Different grass species can be difficult to distinguish. It is more important to count the individual than it is to accurately identify it.

Example Datasheet:



Group Members: Sava, John, Liz, Eli
Date: 1Aug2015
Notes: There was alot of cow poop and rabbit poop in our transect area. Ground was moist, rain storm last night or early morning maybe? Transect started in rocky soil with not alot of plants and moved along top of wash. Plant species increased as we moved along transect. Had difficulty identifying some grass species. All species we weren't completly sure about are marked with a (?). Counts that might be incorrect have: *

| Species | Count |
|---|---|
| B. barbinodis | 𝍸 \|* |
| H. tenuisectus | \|\| |
| A. watsoni | \| |
| B. chondrosiodes | \|\|\|\| \|*\|*\|* |
| B. curtipendula (?) | \|\| |
| B. filiformis | \|\|\|\| |
| B. rothrockii | \|\|\| |
| C. eriophylla | \|\|\| |
| D. californica | \|\| \|*\|*\|*\|* |
| E. trifurca | \|\|\| |
| E. intermedia | 𝍸 |
| E. spp. | \|\|\| |

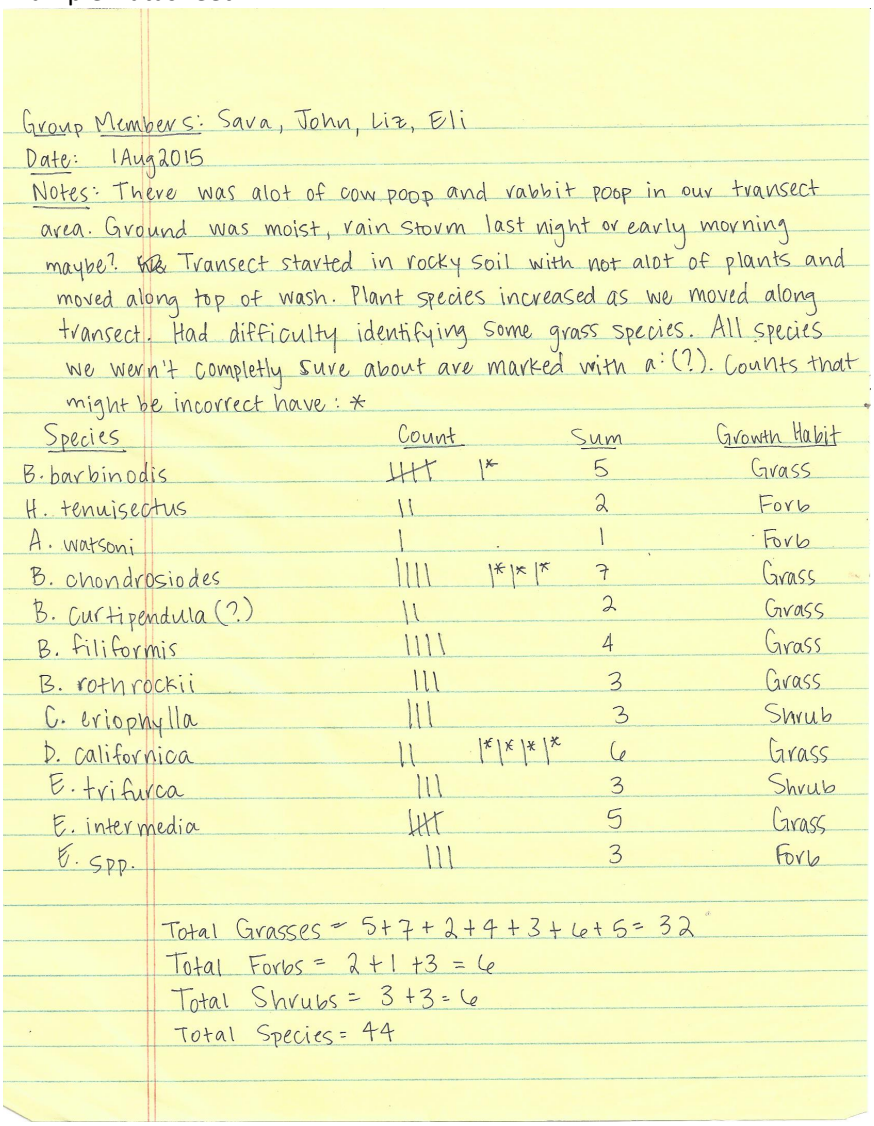
*note—this is a hypothetical datasheet for purposes of providing an example*

6. Sum and categorize the plants in each transect as either: grasses, forbs, or shrubs

Definitions of Grasses, Forbs, and Shrubs:
**Grasses**- vegetation consisting of typically short plants with long narrow leaves, growing wild or cultivated on lawns and pasture
**Forbs**- vascular (having tissue that conduct water, sap, and nutrients) plants without significant woody tissue above the ground.

**Shrubs**- perennial (plant that lives more than 2 years), multi-stemmed woody plant that is usually less than 4-5 meters in height. Shrubs typically have several stems arising from or near the ground. (cactus and cholla are shrubs)

Example Datasheet:



Group Members: Sara, John, Liz, Eli
Date: 1Aug2015
Notes: There was alot of cow poop and rabbit poop in our transect area. Ground was moist, rain storm last night or early morning maybe? Transect started in rocky soil with not alot of plants and moved along top of wash. Plant species increased as we moved along transect. Had difficulty identifying some grass species. All species we weren't completly sure about are marked with a: (?). Counts that might be incorrect have: *

| Species | Count | Sum | Growth Habit |
|---|---|---|---|
| B. barbinodis | 𝍸 \|* | 5 | Grass |
| H. tenuisectus | \|\| | 2 | Forb |
| A. watsoni | \| | 1 | Forb |
| B. chondrosiodes | \|\|\|\| \|*\|*\|* | 7 | Grass |
| B. curtipendula (?) | \|\| | 2 | Grass |
| B. filiformis | \|\|\|\| | 4 | Grass |
| B. rothrockii | \|\|\| | 3 | Grass |
| C. eriophylla | \|\|\| | 3 | Shrub |
| D. californica | \|\| \|*\|*\|*\|* | 6 | Grass |
| E. trifurca | \|\|\| | 3 | Shrub |
| E. intermedia | 𝍸 | 5 | Grass |
| E. spp. | \|\|\| | 3 | Forb |

Total Grasses = 5+7+2+4+3+6+5 = 32
Total Forbs = 2+1+3 = 6
Total Shrubs = 3+3 = 6
Total Species = 44

*note—this is a hypothetical datasheet for purposes of providing an example*

7. Present and compare group results. Questions to consider:
-Why do you think your group got high/low numbers of grasses, forbs, or shrubs?
-Why did other groups get higher/lower numbers of grasses, forbs, or shrubs?
-Which group had the greatest overall diversity of plant species?
-Which group had the least overall diversity of plant species?
-Which group had the highest density or diversity of grass, forb, and/or shrub species? Why?
-Which group had the lowest density or diversity of grass, forb, and/or shrub species? Why?

| Site | Location | Elevation (m) |
|---|---|---|

**Part 2:**

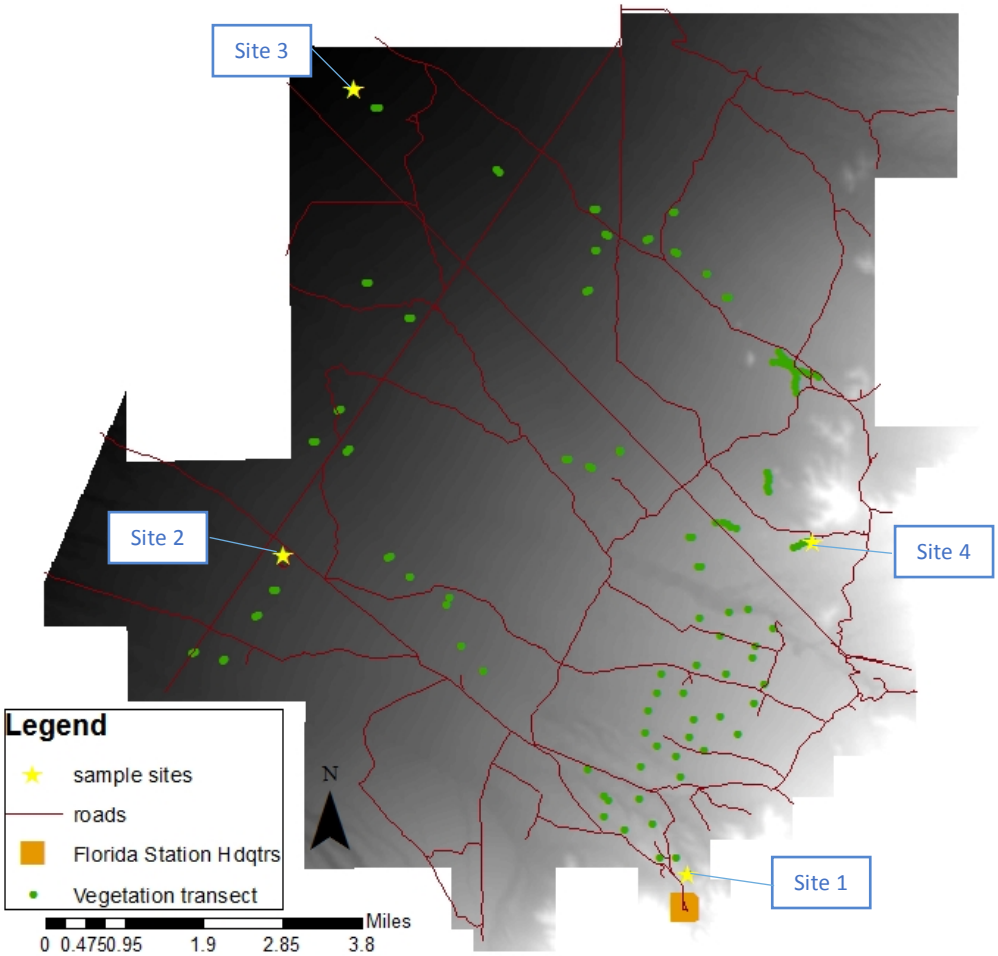
Materials

Pen or pencil
paper
SRER plant guide
Additional plant guide(s) *[optional]*
Datasets—4 total
Graphing paper or computer with excel
Calculator

Background

Vegetation transects have been ongoing at 132 sites on SRER since 1972 (green points on map). Density was measured every 3 years between 1972-1984 and 1991-2015. Today, we will analyze the data collected at 4 of these sites (yellow stars on map). One of these sites had a fire in 1994 (site on the east). We will analyze the number of grasses, forbs, and shrubs at each of the sites. We will analyze trends in vegetation and make inferences about whether or not these trends can be explained by past precipitation or cattle grazing records. We will compare vegetation across the sites and see the effects fire had on vegetation.

Map of vegetation transects at SRER:



| | | |
|---|---|---|
| 1 | Pasture 8 Transect 14 | 1269 |
| 2 | Pasture 12B Transect 7W | 981 |
| 3 | Pasture 5N Transect 11W | 883 |
| 4 | Pasture 6A Transect 1 | 1284 |

Procedure

1. Separate class into 4 groups and give each group a data set.

*Notes on datasets:*

Each dataset contains: plant density data, plant transect photos, precipitation data, and cattle grazing data

*Plant Density Data*

- This is the total number of each plant species occurring in the belt transect performed at each site.
- "xxx" values mean no data is available because a reading was not made. Assume all of these values equal 0 when analyzing data.

*Plant Transect Photos*

-These are all available photos of the plant transects. Some of the photo dates might not align with sample dates, but you should still be able to visualize differences in vegetation over time.

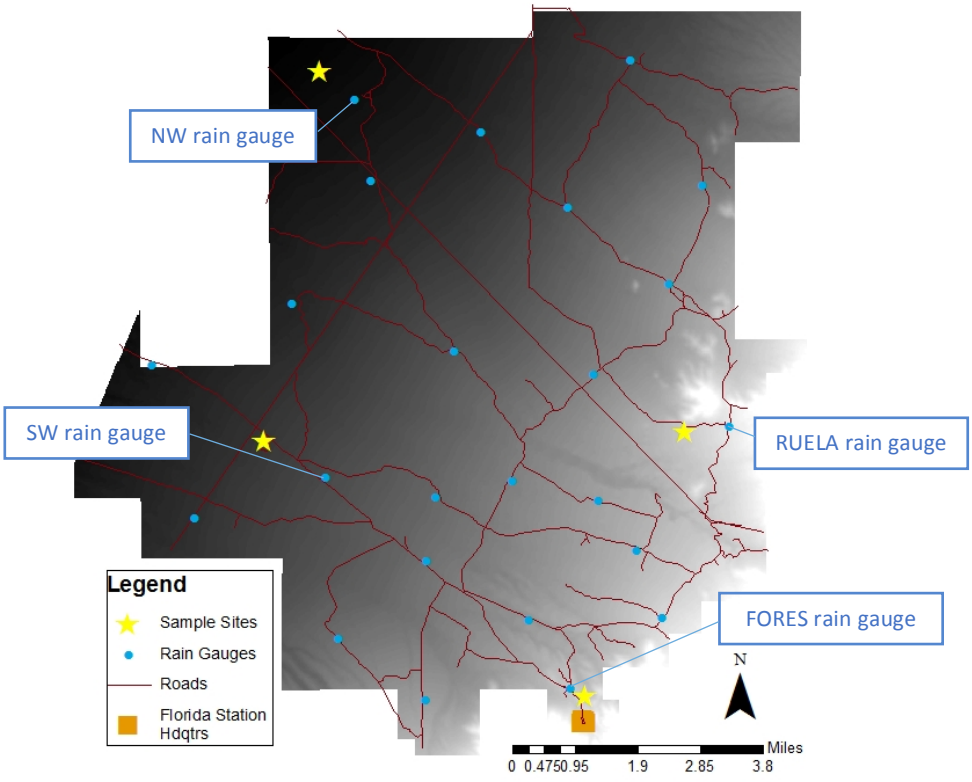
*Precipitation Data*

- These reading are taken from the rain gauge located nearest to your site (see image below)

*Cattle Grazing Data*

- As we know, many researchers at SRER are studying cattle grazing. This data is the total number of cows present in the site for each year.

Map of rain gauges at SRER:



2. Form a hypotheses about the plant density data using *if, then, because* statements. For example, *if* there is more cows in the site for a certain year, *then* there will be less grass density, *because* cows eat grass. As a group develop **2 hypotheses**: 1 for your site and 1 across sites
*Things to consider:* findings from Part 1, elevation at each site, What effect do you think cattle grazing or precipitation will have on vegetation? What do you know about the vegetation history of SRER? How will fire affect vegetation?

3. Analyze the data for your site
- Classify each plant species as grass, forb, or shrub using the definitions provided in Part 1 and the SRER plant species guide.
- Sum the total number of grasses, forbs, and shrubs for each year.
- If possible, graph these values over time
- Look at diversity: Both within each of these classifications and the overall plant diversity at the site
- Are there any surprises?
- How did the vegetation change over time?
- Compare results to the plant transect photos. Can you see how the results compare to actual photographs?
- Compare results to the cattle grazing and precipitation data. Are there similarities or differences? For example, do higher levels of cows affect vegetation? Does more or less rain for a specific time have an effect on vegetation trends?

4. Re-visit the hypothesis for your site
- Do your results support or reject your initial hypothesis?
- Have you learned more information that might help explain why the results support (or reject) your hypothesis. For example, did the precipitation and cattle grazing data help you explain the vegetation density data?
- Are you convinced by the results? Do you need more information to say whether or not your hypothesis was supported or rejected? (Think about Part 1: How similar or different was each group's results?)
- What are some additional questions that have arisen through this analysis?
-Do you have ideas for future questions or research?

4. Share results. Have each group present their initial hypothesis, vegetation density data over time, and their conclusions (#4). Remind students to consider their "across sites" hypotheses. As each group presents, encourage students to ask questions that will help them decide if their "across sites" hypothesis is supported or rejected. For example, if GroupA developed an "across sites" hypothesis that involved cattle grazing and the group presenting (GroupB) did not include this data, GroupA should ask GroupB what their cattle grazing data was and how it compared to their vegetation density data.

5. Get back into groups and give students 5 minutes to decide if their "across sites" hypothesis was supported or rejects by the information they heard. Re-visit the points in #4.

6. Have each group share their final conclusions. Was their "across sites" hypothesis supported or not and why?