Lesson: Using LandPKS for Rangeland and Species Monitoring

Earth Academy Module 5: Changing Ecosystems

Lesson Description

This lesson is designed to introduce EARTH technicians to changing environmental conditions in local ecosystems through rangeland monitoring. EARTH technicians will investigate both natural and human pressures on local species, and help Sequoia Riverlands Trust (SRT) perform species density calculations for the state threatened Striped Adobe Lily (*Fritillaria striata*) at Lewis Hill Preserve in Tulare County using the LandPKS Vegetation survey.

Essential Questions:

- How do ecosystems change over time?
- What effect do humans have on the environment?
- What makes a species threatened or endangered?
- How might a species adapt to a changing environment?

Preparation

Vocabulary:

Endemic/native, threatened, endangered, species density

Teacher Background:

The instructor should be familiar with the LandPKS Land Cover (Vegetation) module and be able to guide technicians through a full vegetation survey, including species counts. For more information, see "Resources." This lesson will take place at Lewis Hill Preserve, which is home to populations of the state threatened striped adobe lily (*Fritillaria striata*). Monitoring sites should already be chosen, and the same monitoring sites should be used annually—see "Attachments." If monitoring sites have not already been designated, the instructor should choose 1-2 **random** points for vegetation surveys at the preserve ahead of time **that fall within the adobe lily population boundaries**. These surveys must take place while the adobe lilies are visible at the preserve, generally in late February or early March. The instructor should note the GPS coordinate of the chosen survey site(s), and be prepared to navigate a student group to the site. A marking or T-post is helpful as a starting point for surveys. The instructor should allocate at least three hours for travel on the preserve, opening discussion, instruction, vegetation/species data collection, and debrief. More time may be needed if technicians are testing soil texture. The instructor should have prior years' lily survey data to compare with the data collected by the technicians, as well as survey maps to share.

Student Background:

Some EARTH technicians will have prior knowledge of this lesson and our preserves from earlier modules or participation in past years. Encourage these students to share their knowledge and lead

others. EARTH technicians should be familiar with the carbon cycle, water cycle, rangeland management and monitoring.

Materials and Equipment:

Stick(s) (preferably meter stick) with 5 markings, spaced 10cm apart

Pin flags

iPad(s) or smartphone(s) with LandPKS application

Compass (or compass application)

Rulers or meter sticks for measuring

25m-long transect tape (optional)

Objectives (5E's)

Engagement

Orient the technicians to the preserve with an opening circle. Explain the type of ecosystem we are in, what animals are grazing, and SRT's role as a land manager. Ask technicians to imagine what the preserve looked like in the recent past, and further back in history. EARTH technicians who attended Module 3 will be familiar with the LandPKS Vegetation survey—encourage these students to contribute what they have learned about land cover, soil health, and range management.

> California has a unique natural history. Prior to European settlement, Native Americans managed the land to suit the habitat of species they relied on for food, clothing, housing, and materials. As part of their management, they planted species they preferred, and used fire as a tool. In more recent history, European colonizers brought cows to the west as a source of food, and with them they brough non-native annual grasses. The vast majority of this landscape is now dominated by these non-native annual grasses. Today, we are witnessing the expansion of agriculture and development, as well as a changing climate, and the landscape is further transforming. Preserves like this one are special in that they provide a refuge for species that are under threat or endangered. SRT uses livestock as one way to manage the land. Although these cows are not native to California, they are providing an imperfect replacement for grazers that once lived in the central valley, including elk and antelope.
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> What is the difference between an annual grass and a perennial grass?
> What threats do native species face today? How do you think they will respond?
> Why should we care about protecting threatened species?

Bring EARTH technicians to the survey site. Different school groups will perform surveys at different established survey points to cover all of the points in the "furthest" lily population on the preserve. For a map and point coordinates, see (**Appendix C**). While traveling to the survey site, point out lilies that are encountered along the way, as well as native perennial grasses or wildflowers.

Exploration

Upon arrival to the survey site, explain the chosen monitoring method (LandPKS application): the application background, and why we use this particular type of quantitative survey for long-term monitoring at our preserves for those students who missed Module 3. If any EARTH technicians are present who have used the application before, encourage them to lead the demonstration.

The range monitoring survey used for this lesson will be the same method that was used in Module 3, the Vegetation/Land Cover survey. However, EARTH technicians will be asked to add a species count to the "height" portion of the survey for the Striped Adobe Lily (*Fritillaria striata*). While doing the survey demonstration, point out the adobe lilies—depending on the time of survey, the lilies may be flowering, or they may not yet be at that stage. Be sure EARTH technicians can distinguish the lilies from other bulbs on the preserve, such as Wavyleaf Soap Plant (*Chlorogalum pomeridianum).* EARTH technicians will be helping SRT estimate the Adobe Lily population on the preserve; the instructor should be prepared with survey data from previous years to share with students.

> The Striped Adobe Lily is a state threatened species, meaning the state of California recognizes this flower as having a very low population that faces serious threats. This is one of the few locations in California and the world where you can see this flower. SRT manages this preserve to protect this flower among many other species on the preserve. One way we do this is by moving livestock off of the preserve before and during the lily growth and bloom period. We use surveys to estimate how dense the lilies are in the areas where we know they are growing. This helps us estimate the total number of lilies on the preserve, and monitor changes in lily populations year to year.
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> If a plant grows every year from a bulb, is it annual or perennial?
> What other threatened species can you think of in the Central Valley?

Elaboration

Divide EARTH technicians into groups of 2-3 to work on their own site or one transect of a shared site. If multiple groups are working on different transects at the same site, make sure to have technicians share their data with each other at the end so each group may generate a full report in the application. Instructors should provide assistance as needed, and continue to facilitate questions and discussion while technicians are working.

Extension

Time permitting, test soil texture using the application walk-through. Use soil texture findings to help the application better predict area soils. Detailed information on your predicted local soil may be found in the application under Report -> Land Info. This information may facilitate discussion about local vegetation, erosion, and infiltration. For instructions on doing a soil texture test, see "**Appendix B**." For more information about the soil texture test, see "**Resources**."

- How does our soil type affect what grows here?
- Does the soil change the further down we dig?
- Can soil type change over time?

At the end of the lesson, have all students gather and use the "report" section of the site in the LandPKS application to share vegetation monitoring results, and the Adobe Lily species density. Total number of lilies for the entire preserve may be calculated using known lily population area extent (see **Appendix C**). With the technicians, compare the density and total population numbers for this year from previous years. Encourage discussion about what environmental conditions may be contributing to changes.

- Do these vegetation cover numbers match your experience on the preserve?
- What looks good about these numbers? Are there any areas you believe management could improve/any red flags?
- How might these numbers change over time? With different management practices?
- If lily density has changed since the last survey, what environmental conditions may be contributing to that change? Are they man-made, or natural changes?

Evaluation

EARTH technicians will receive a post-test for the module.

Standards:

Next Generation Science Standards HS-LS2-6, HS-LS4-5

Resources:

- Calflora entry on *Fritillaria striata*: https://www.calflora.org/app/taxon?crn=3645
- LandPKS application website: https://landpotential.org/
    - Vegetation and Land Cover guide: https://landpotential.org/knowledge/vegetation-landcover-video-training/
    - Soil Texture Module guide: https://landpotential.org/knowledge/how-to-soil-texture/
    - Habitat Module guide: https://landpotential.org/knowledge/intro-to-the-landpks-habitat-module/
- Sequoia Riverlands Trust website: https://sequoiariverlands.org/

Appendix A: Land Cover Protocol

Under the Data Input Tab, under the Vegetation module, select the date of data collection on the calendar, and click Cover and Structure to add a new transect. Before starting the survey, record the two dominant woody and non-woody species at the site by percent cover.

For each of the cardinal directions, one 25m long transect will be walked, and data will be collected using the Stick Method. Choose a cardinal direction in which to start.

1. Walk 5m in the direction chosen. Without looking, place the stick directly on the ground in front of you.

2. Click the 5m button. For each of the 5 evenly spaced marks on your stick, record the land cover type. The options are bare ground, tree, shrub, perennial forb, plant base, perennial grass, annual plant, herbaceous litter, woody litter, and rock fragment. Imagine an invisible line from the ground under the mark straight up to the sky, and record all cover types that intersect with that line. The line may also be created using a pin flag or blade of grass.
    a. If the line goes through tree canopy, record tree.
    b. If the line goes through bush or perennial forb canopy, record as such.
    c. If the line intersects the base of a tree, shrub, or annual grass, record plant base.
    d. If the line intersects the leaves of a grass, record either perennial grass or annual plant depending on the type of grass. This method requires that **dead annual grasses that are still rooted be counted as an annual plant and NOT herbaceous litter.**
    e. Detached leaves, plant litter, and manure are counted as herbaceous litter.
    f. Detached stick and branches are counted as woody litter.
    g. If there is no plant canopy of any kind and no litter intersecting the line, it is counted as bare ground.
3. For that same point, move to the "Height" tab at the top right corner.
    a. If at **any point** along the stick there is a plant base **or** annual plant cover, record "no basal gap." If there are no areas along the stick where plants are growing, record "basal gap."
    b. If at **any point** along the stick there is any type of plant canopy **over 10cm in height**, record "no canopy gap." If there are no areas along the stick where there is canopy cover, or plant canopy cover is less than 10cm in height, record "canopy gap."
    c. To determine the height class, visualize or measure a 1m x 1m square in front of the stick. The tallest plant growing in that square determines the height class. If your stick has 1cm markings, these may be used to measure the tallest plant.
        i. Alternatively, measure or visualize a circle around the stick with a diameter of 1m, and choose the tallest plant within that circle. Whichever method you choose, be consistent throughout the monitoring project.
    d. Record the count of the species of special concern (*Fritillaria striata*) within the quadrat, and record this under the "Height" tab. In the final report, species density will be given.
4. Repeat steps 1-3 for each point along the transect line (5m, 10m, 15m, 20m, and 25m), and then again for the three remaining cardinal directions.

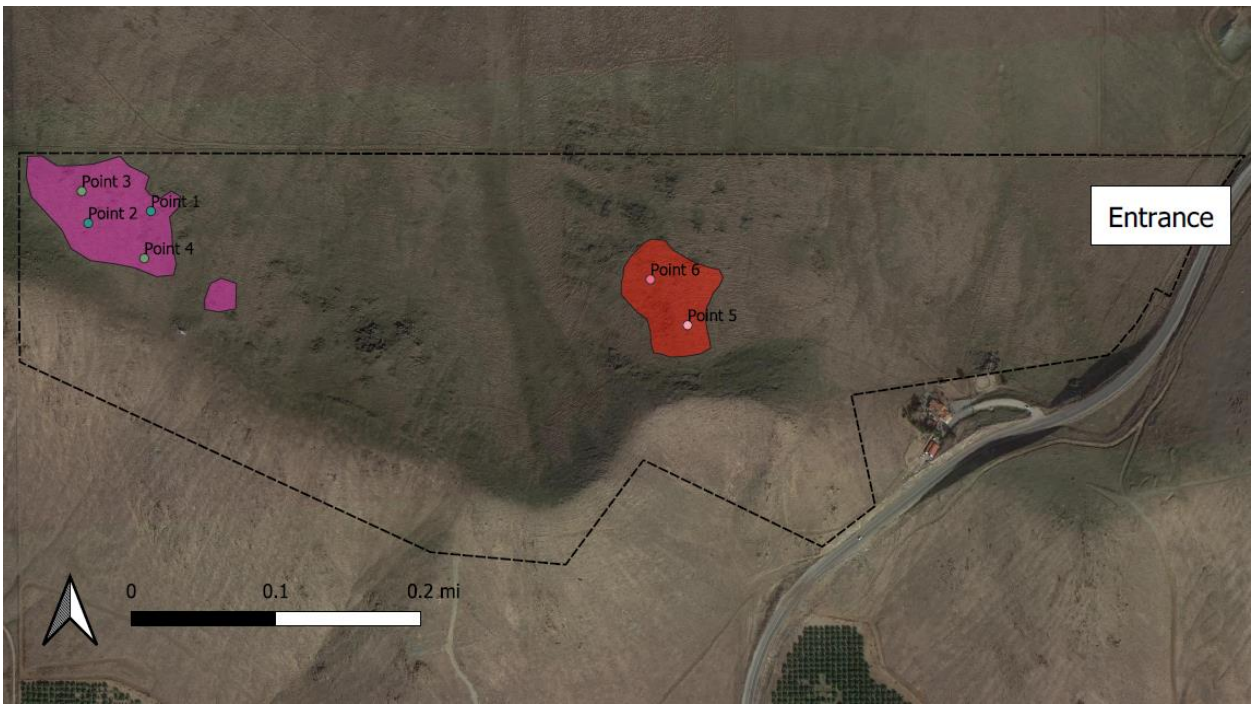
Appendix B: Soil Texture Protocol

For greater accuracy in soil type predictions, soil testing may be conducted using the LandPKS application. Under the "Data Input" tab, under LandInfo, select "Soil Texture" to begin. Using a shovel, dig a small hole down to bedrock, 120 cm, or as far as you are willing to go. The deeper you dig, the more accurate the soil ID will be. For each 10cm increment dug, collect a large handful of soil and set aside. It may help to have a tarp to set soil on, and labels on the tarp to keep track of the depth the soil came from. For topsoil and each 10cm increment of soil dug up:

1. Approximate and record the rock fragment volume.
2. Determine soil texture. The application will walk you through this if you choose "guide me."
    a. Wet a small handful of soil, and determine if the wet soil forms a ball.
    b. If it forms a ball, make a fist and squeeze the soil between your thumb and index finger to determine if it forms a ribbon.
    c. If it does form a ribbon, determine the maximum length of the ribbon that you can form.
    d. Then, if prompted, determine the soil feel (gritty, smooth, or not gritty or smooth).
3. If while digging you hit the bedrock, record the depth of the bedrock.

After completing the Soil Texture module, the app will have optimized soil ID predictions under the "Report" tab under "Soil ID."

Appendix C: Lewis Hill Lily Monitoring Information



Map of Lewis Hill Preserve known Lily population extents. Red polygon represents "nearest" lily population, pink polygon represents" furthest" lily population.

In spring 2021, average lily density calculated by EARTH technicians in the "farthest" population was **1.5 lilies/m^2**.

The area of the "nearest" patch is 9,645 m^2.

The area of the "farthest" patch is 14,920 m^2.

Established Survey Point Locations:

Point Name	Latitude	Longitude
Point 1	36.108559	-119.016256
Point 2	36.108440	-119.017031
Point 3	36.108758	-119.017111
Point 4	36.108089	-119.016338
Point 5	36.107422	-119.009620
Point 6	36.107878	-119.010079

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