Lesson: Using LandPKS for Rangeland Monitoring

Earth Academy Module 3: Soil, Grazing, and Rangeland Management

Lesson Description

This lesson is designed to introduce EARTH technicians to rangeland management through grazing, and how to monitor rangeland health. Using the LandPKS application, technicians will explore land cover as an indicator of soil and whole ecosystem health at Sequoia Riverlands Trust (SRT)-owned preserves.

Essential Questions:

- What is rangeland?
- Why should we monitor rangeland?
- What is the difference between quantitative and qualitative data?
- What does ground cover tell us about our soil health?
- How does grazing affect ground cover?
- What is erosion and how does it happen?
- How does our soil connect to climate?

Preparation

Vocabulary:

Rangeland, annual/perennial, litter, erosion, canopy

Teacher Background:

The instructor should be familiar with the LandPKS Land Cover (Vegetation) module and the LandPKS Soil Texture module, and be able to guide technicians through a full vegetation survey. For more information, see "**Resources**." This lesson will take place on an SRT preserve closest to the technicians' school. If monitoring sites have not already been designated, the instructor should choose 1-2 points for vegetation surveys at the preserve ahead of time. A random point is preferred, but the general location should bear in mind: travel time for students on foot, terrain accessibility for students and guests, historic grazing use, and fences, roads, water, and other barriers that would interfere with the vegetation survey. 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 data collection, and debrief. More time may be needed if technicians are testing soil texture.

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 and water cycle.

Materials and Equipment:

Stick(s) (may be a 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 (e.g. blue oak savanna), what animals are grazing, and SRT's role as a land manager. Connect the concepts of range management, soil, and grazing to their prior experience in Earth Academy, in school, and outside the classroom through questions.

- Why do we graze cattle, and how do they affect their environment?
- What do you know about the soil, the carbon cycle, and the water cycle?
- How can we tell if our soil is healthy?

These questions may prompt a larger discussion about ecosystem health, climate, and our goals as land managers and stewards of a healthy environment. Time permitting, use the LandPKS Habitat module to explore local species and their habitat requirements.

- What other animals might live here? What do they need in their habitat?
- How is our climate changing in the central valley of California?
- How does taking care of this preserve connect to climate change?

  SRT uses cattle as one way of managing our land. They graze the grasses and other plants on the preserve, decreasing the fire danger. They leave behind manure that fertilizes the soil. They trample old, dead plants and incorporate them back into the soil so those nutrients can be recycled. They also provide an income for a cattle rancher, and food for those of us that eat meat. Cattle can also have a negative effect on rangeland if they spend too much time in one place or graze too much. When grass is too low, soils are exposed and may erode, and the other animals that live on this preserve may not have habitat in which to survive. As land managers, we are looking to balance the benefits of using cows for preventing fire and build-up of dead plants with the costs to habitat and healthy soils when they over-graze. One way to combat climate change is to take care of our soils so they are able to hold more water, more carbon through soil micro-organisms, and support plants that provide habitat and sequester (or pull out) carbon from the atmosphere.

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.

> LandPKS—or land potential knowledge system—is a land monitoring and management tool developed by the Jornada Rangeland Research Program in New Mexico. The application was developed with the collaboration of the USDA and USAID, among other partners, to simplify the collection of data about land for managers. The app has multiple modules, but we are most interested in the Vegetation (or Land Cover) module to help us understand the health of our preserve, and how it might be changing over time. During the survey, we will walk and collect data along a line (called line-intercept) with the help of a few basic tools, including a stick, compass, and pin flags. The inspiration for the Land Cover/Vegetation module or "Stick Method" comes from herders in Africa, who tend to walk their lands with a stick. Anyone, anywhere can use this application, but it was developed in an arid place with arid landscapes in mind, just like our own. The data we are collecting is quantitative data, meaning numbers based. In past years, we have done monitoring with the Bullseye method, which is qualitative. This point we are monitoring at was also chosen randomly.

- What is the difference between quantitative and qualitative data?
- Why do we prefer quantitative data for long-term monitoring?
- Why should we be doing monitoring at a random point instead of a point we choose ourselves?

As a group, create a new site in the LandPKS application and name it. You may choose to explore the app's soil predictions for the area, or the habitat module before beginning the survey. Start a new Vegetation/Land Cover survey, and begin the survey in the Northern direction at the 5m mark. It may help to use a compass and a 25m-long transect tape to find your starting point. If a tape is not available, "pace" out to 5m with the technicians (one meter is about two large steps). Walk through both the "cover" portion and "height" portion of the 5m point with the group. Instructions for the Land Cover survey may be found under "**Appendix A**." For more information or tutorials on the vegetation cover survey, see "**Resources**." Provide opportunities for student questions and discussion during the demonstration.

- What is the difference between an annual plant and a perennial plant?
- Why is litter important for soil cover?
- How is the canopy of a tree or shrub different from that of a grass?

If needed, complete additional points along the transect until all EARTH technicians are comfortable monitoring on their own. Encourage technicians with prior experience to lead the demonstration.

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.

- Does an annual plant or perennial plant hold more carbon in the ground?
- Can you see evidence of grazing?
- Is there anything missing from this survey?

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?

At the end of the lesson, have all technicians gather and use the "report" section of the site in the LandPKS application to share vegetation monitoring results.

- 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?
- What did you like or dislike about this monitoring method?

Evaluation

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

Standards:

Next Generation Science Standards HS-LS2-2

Resources:

- 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/
- Jornada Rangeland Research Station: https://jornada.nmsu.edu/
- 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. If there is a species or two of special concern, their richness may be recorded under the "Height" tab as well. This number will appear in the final report.

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."

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