LESSON TWELVE:

Evaluating the Health of Rangeland Ecosystems

Rangeland Health:

- Is a rapid assessment that evaluates how well ecological process are functioning on a site
- Evaluates the water cycle, energy flow and nutrient cycle
- Assesses three components called attributes. These attributes are
  - *Soil and Site Stability*
  - *Hydrologic Function*
  - *Biotic Integrity*
- Identifies how the condition of the attributes present on the land differs from the expected condition of the attributes in the reference state
- Uses measurements or observation of 17 key indicators to asses the three attributes.
- Rates the indicators based on the degree of departure or difference from what is expected in the reference state for the ecological site

Photo: Eastern Red Cedar encroachment in loamy upland rangeland.

Rangeland Health and Ecological Sites

Rangeland health assessments use attributes and indicators as an index of how well ecological processes are functioning.

Measuring actual energy flow, movement of water through the watershed, and/or surveying the entire plant, animal and microbial communities would be very costly and time consuming.

This would require a number of specialized scientists to collect and interpret the data.

Measuring and observing the 17 indicators used in rangeland health assessments is relatively quick and can be completed by ranchers, agency personnel and others with a general understanding of ecological principles.

The expected condition for these indicators varies from ecological site to ecological site.

Photo: Sands Ecological site in reference state.

Indicator 1: Rills

Rills are a small erosional features formed when raindrops join together and flow down the slope moving soil in the process.

Some soils are more susceptible to rills than others. On some ecological sites, rills are a common, expected feature, but rills are not expected in the reference state on most sites.

As slope increases, and/or the amount of cover decreases, the potential for rills increases.

As rills get closer together, deeper and wider, erosion increases.

Rills apply to soil/site stability and hydrologic function.

Photo: Badlands site on which rills are part of the Reference State

Indicator 2: Water Flow Patterns

Water flow patterns are paths that water takes as it moves across the land. Water flow patterns follow microtopography.

Obstructions like plant bases and rocks cause the water flow to change directions, making the patterns winding instead of straight.

As slope increases, and/or the amount of cover decreases, the potential for water flow patterns increase.

Water flow patterns apply to soil/site stability and hydrologic function.

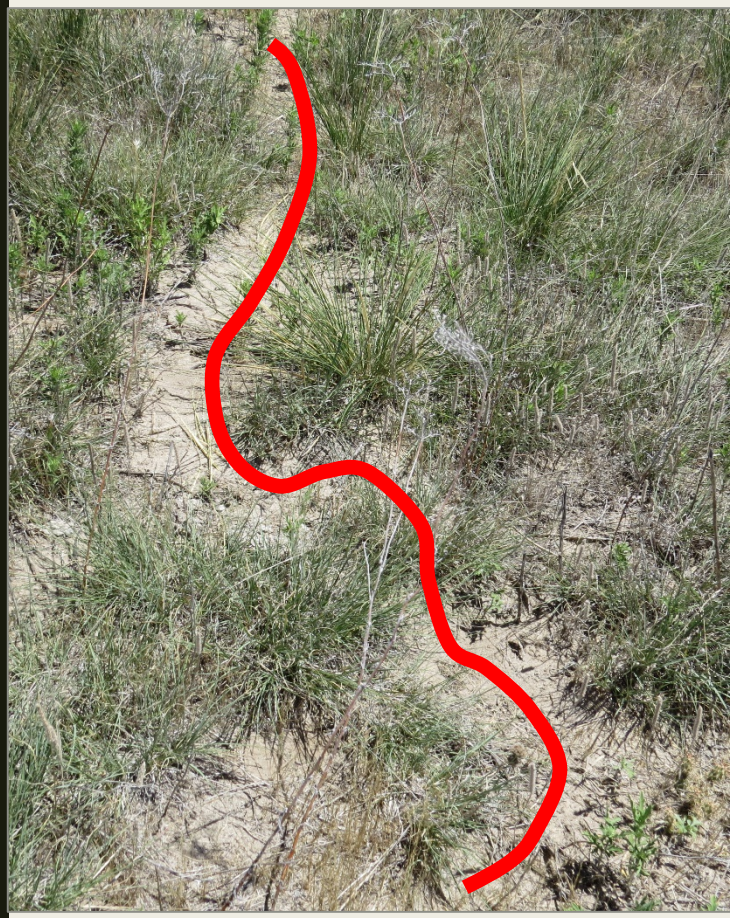

Photo: Water flow pattern in a bunchgrass dominated site.

Indicator 3: Pedestals and Terracettes

Pedestals are plants that look elevated because soil has been eroded away from the plant bases.

Terracettes are benches of soil deposited behind obstacles and are caused by soil moved by water.

Pedestals and terracettes apply to soil/site stability and hydrologic function.

Photo: Pedestalled plant found in a steep hillside that had recently been burned in a prescribed fire.

Indicator 4: Bare Ground

Bare ground is exposed soil that is susceptible to raindrop splash.

The amount of bare ground is a direct indicator of the likelihood of accelerated wind or water erosion and of site stability.

A site with bare soil in a few large patches is less stable than the same amount of bare ground in small patches.

Bare ground applies to soil/site stability and hydrologic function.

Photo: Large patch of bare ground in rangeland.

Indicator 5: Gullies

A gully is a channel that has been cut into the soil by moving water.

Gullies usually follow natural drainages and are caused by accelerated water flow and resulting downcutting of soil.

On some ecological sites, gullies are expected in the reference state.

Gullies apply to soil/site stability and hydrologic function.

Photo: Active gully in smooth bromegrass invaded rangeland.

Indicator 6: Wind-Scoured, Blowouts, and Depositional Areas

Blowouts occur as the soil surface crust is worn by abrasion.

Physical crusts protect the soil surface from wind erosion.

Deposition of soil particles occur where vegetation is tall enough to slow the wind velocity enough for suspended soil particles to settle from the wind.

Wind scoured areas, blowouts and depositional areas apply to soil/site stability.

Photo: Blowout which is beginning to become stabilized by presence of blowout grass and forbs.

Indicator 7: Litter Movement

Litter is dead plant material in contact with the soil surface.

Litter indicates wind or water erosion.

Litter movement depends upon the amount of bare space in the community and storm intensity.

The greater distance litter is moved from the point of origin, the larger the litter and the more volume of litter moved, the more erosion is occurring.

Litter movement applies to soil/site stability.

Photo: There is a small amount of litter accumulation near the middle of this photo.

Indicator 8: Soil Surface Resistance to Erosion

The more organic material and soil aggregates present in the soil surface, the more the surface resists erosion.

Soil surfaces are stabilized by soil organic matter that has been fully incorporated into aggregates, the adhesion of decomposing organic matter to the soil surface, and biological crusts.

Presence of one or more of the above features indicates that the soil surface is resistant to erosion.

Soil surface resistance to erosion applies to soil/site stability, hydrologic function and biotic integrity.

Photo: The surface of the soil in this photo does not have the stabilizing organic matter or crusts which help the soil resist erosion.

Indicator 9: Soil Surface Loss or Degradation

Loss or degradation of part or all of the soil surface layer or horizon indicates a loss of site potential.

On most sites, the surface soil has the highest organic matter and nutrient content.

This controls water infiltration and successful seedling establishment.

Erosion reduces the soil organic matter which leads to further degradation of soil structure.

Soil surface loss or degradation applies to soil/site stability, hydrologic function and biotic integrity.

Photo: Soil which has lost the surface layer. Remaining soil has very little organic matter and few nutrients.

Indicator 10: Plant Community Composition Relative to Infiltration

Plant growth form influences the amount of water that can infiltrate into the soil.

Changes in the plant community can impact infiltration. Different plants have different rooting patterns and depths, different amount of ground covered by plant bases and different spatial distribution.

Shifts from bunchgrasses to short grasses, from grasses to shrubs, or from perennial to annual plants can reduce water infiltration and increase soil erosion.

Plant Community Composition applies to soil/site stability, hydrologic function and biotic integrity.

Photo: Plant community which has changed from the reference plant community. Warm season tall and mid-grasses that would be in the reference state are not present.

Indicator 11: Compaction Layer

A compaction layer is a layer of dense soil that occurs near (usually 6” in rangelands) the soil surface.

Compaction is caused by disturbance of the soil surface. Compaction layers can be caused by heavy equipment, farm machinery and heavy grazing of meadows when the soil is very wet.

In Nebraska, the most common place to find compacted soils are rangelands that were cropland and seeded back to grass. The compacted layer is a plow pan.

Compaction layers restrict root growth and water infiltration.

Compaction layer applies to soil/site stability, hydrologic function and biotic integrity.

Photo: Soil with a compaction layer approximately 4” from the soil surface. A compaction layer is indicated by a horizontal break in the soil profile and a sharp difference in soil texture.

Indicator 12: Functional / Structural Groups

Functional or structural groups are a set of plants grouped together on an ecological basis. The grouping is because of similar height and volume or similar roots systems, life cycle, nitrogen fixing ability or photosynthetic pathway (C^3 or C^4).

Functional composition and diversity impact ecosystem processes and are important for plant productivity and plant nutrient content.

Functional/structural groups applies to biotic integrity.

Photo: Mixed grass prairie with multiple functional groups – tall, warm season, sod forming grasses; cool season bunch grasses; warm season bunch grasses; warm season short grasses; legumes and other forbs.

Indicator 13: Plant Mortality / Decadence

This indicator relates to the proportion of dead, dying, mature and young plants in the community.

A healthy plant community has a large population of young and mature plants and few dead and dying plants.

A large number of dead and dying plants within a plant community will lead to an increase in weeds and invasive plants.

Plant mortality/decadence applies to biotic integrity.

Photo: Blue grama/buffalograss plant community after 2012 drought showing extensive death loss.

Indicator 14: Litter Amount

Litter is dead plant material that is detached from the plant base.

Litter that is in contact with the soil surface is a source of soil organic matter and raw materials for on-site nutrient cycling.

Litter also reduces soil temperatures, which reduces evaporation from the soil surface and increases the amount of water infiltration into the soil.

Too much litter has a negative impact on native grasses

Litter amount applies to hydrologic function and biotic integrity.

Photo: Mixed grass prairie that has been grazed intensively leaving very little plant material and virtually no litter.

Indicator 15: Annual Production

Annual production is the net amount of above-ground plant material produced within a year.

It indicates the efficiency of energy captured by plants and the availability to herbivores.

All production including native, introduced, and invasive are included in the measurements.

High annual production indicates that the system has maintained its production potential, but not all highly productive plant communities are equal. A weedy plant community may be very productive, but not healthy. This health departure is captured with other indicators.

Annual production applies to biotic integrity.

Photo: Big bluestem exhibiting high productivity.

Indicator 16: Invasive Plants

Invasive plants are

A). Plants that are not part of the reference plant community (introduced)

B). Plants that are only a minor part of the reference plant community that have the potential to dominate the site if not controlled by management.

C). Not plants that become dominant as a short term response to a disturbance and then go back to being a minor part of the community.

Invasive plants applies to biotic integrity.

Photo: Common mullein which has taken over an ungrazed grassland.

Indicator 17: Reproductive Capability of Perennial Plants

Reproductive Capability applies to seed production and tiller production. This indicator is greatly influenced by weather.

Annual plants are not evaluated with this indicator.

Reproductive capability applies to biotic integrity.

Photo: Reproductive tillers of sand bluestem.

Evaluating the Health of Rangeland

Identify the Ecological Site

Obtain the Ecological Site Description

Complete the observations and measurements for the indicators.

Rate each indicator 1-5 on how the site differs from the reference state which is called departure from the reference.

1 is no departure from the reference and 5 is total or extreme departure from the reference.

Rate each of the three attributes based on the indicator departures.

Use the information to develop management plan and to determine what items to monitor to evaluate success of the plan.

Rangeland Health Summary

- Rangeland Health is an assessment used to determine how well the ecosystem processes on a site are functioning.
- Ecosystem processes evaluated include energy flow, mineral cycle, and nutrient cycle.
- Seventeen indicators are observed or measured to determine how the site compares to the reference condition for the ecological site.
- Three components called attributes are rated based on their level of departure from the reference.
- The three attributes are soil and site stability, hydrologic function and biotic integrity.

Photo: Vegetation clipping to determine production for rangeland health assessment.

Rangeland Health

ACTIVITIES

- Go to a prairie or rangeland pasture and look for rangeland health indicators.
- Measure the amount of bare ground or litter cover present on a site. See Monitoring Lesson for description of how to measure ground cover
- Discuss as a team what management actions could reverse departures from the reference state

REFERENCES

Interpreting Indicators of Rangeland Health, version 4,

END OF LESSON ELEVEN