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TEXAS RANGELAND MONITORING: LEVEL THREE

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Monitoring is an essential tool in rangeland management. Monitoring is the way to determine whether goals are being achieved with current management strategies. A sound rangeland monitoing program identifies trends and helps the manager make better decisions in managing natural resources. It also confirms good management practices while revealing potential problems early.

The Texas Rangeland Monitoring Program is a rapid, simple and inexpensive way to monitor vegetation structure and the ecological processes of semi-arid rangelands.

Level one monitors changes in plant communities and soils using permanent photo points (see AgriLife Extension publication *RWFM-PU-056, "Range Monitoring with Photo Points"*). Level two monitoring adds more detail related to rangeland health by documenting and tracking changes in the herbaceous and woody plant communities (see AgriLife Extension publication *RWFM-PU-069, "Texas Rangeland Monitoring: Level Two"*). Level three monitoring adds additional indicators related to ecological processes important to rangeland health.

RANGELAND HEALTH

Rangeland health is the degree to which the integrity of the soil, vegetation, water, air and ecological processes are balanced and sustained. Ecological processes are those that enable an ecosystem to function as it should to retain soil, capture and store water, and support a viable biotic community. These processes are nutrient cycling, energy flow, water cycling, and vegetation dynamics.

Level three monitoring uses a quantitative scoring system that ranges from 1 (nonfunctional) to 5 (fully functional as would be expected in an unaltered reference area). Each variable in the landscape pattern and the four ecological processes is scored, and then the scores are averaged to obtain a functional score for each process.

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LANDSCAPE TERRAIN AND PATTERN

Landscape patterns affect ecological function. Water and nutrients are redistributed and captured by numerous "patches" and "sinks" such as grass clumps, brush thickets, depressions, etc. Thus, the functioning of the rangeland is strongly influenced by terrain (shape and slope) and patchiness of vegetation (numbers, size and spacing). Losses can occur from fire and grazing.

To score the landscape pattern, first establish a line transect as described in AgriLife Extension publication *RWFM-PU-056*. Survey the shape of the terrain along the line to locate topographic features such as depressions and flats, and vegetation patches such as large grass plants, grass clumps, shrubs, brush thickets, etc. (Fig. 1). There are three indicators that are estimated or measured:

1. **Number of patches per unit area.** This is an estimate of the number of patches, by patch type, on the site. Count the number of patches that intersect the line transect and note what kinds of patches they are. Then document the number of patches per unit of space, such as the number per 10 feet or the number per square foot. Rate them from few (1) to many (5).

   Few (1) = no patches per 10 feet
   Many (5) = ten patches per 10 feet

Figure 1. Number, size, and the distance between patches affect the functioning of ecological processes.

2. **Patch size.** This is the area of each patch that is intercepted by the transect. Estimate the length and width of each patch and calculate its area. Rate patches small (1) or large (2).

   Small (1) = 1 square foot
   Large (5) = > 25 square feet

3. **Distance between patches.** The third indicator is the distance between patches. The closer together the vegetation patches, the less water is lost from evaporation or runoff from bare soil. Estimate or measure the distance between patches along the transect and calculate the average distance. Rate them from far apart (1) to close together (5).

   Far apart (1) = 100 feet between patches
   Close together (5) = 1 foot between patches

ECOLOGICAL PROCESSES

Nutrient cycling

Minerals and nutrients cycle through the ecological system and may be 1) removed from the soil by plants and returned to the soil as plants decay, or 2) consumed by animals and returned to the system through animal waste or decomposing bodies. Nutrients are temporarily lost to the system through livestock grazing and by being tied up in plant materials that are slow to decompose. The rate of litter breakdown is the most important indicator of mineral and nutrient cycling. In a healthy system nutrients are returned quickly. In an unhealthy system dead leaves stay on grasses and oxidize rather than decaying, and dry manure and dung pats remain intact without being broken down by insects and other decomposers. Rate litter breakdown from slow (1) to rapid (5).

Energy flow

Plants capture solar energy and convert it to carbohydrates used by the plants and/or transferred to other parts of the ecosystem. The abundance of broad-leaved plants and the closeness of plant spacing are measures of energy flow; this is measured by the extent of the live plant canopy over the transect. Note the total area of leaf and the health of plants. Rate the live canopy of plants from poor (1) to abundant (5).

Poor (1) = 0 percent
Abundant (5) = > 75 percent

Water cycling

While the amount and timing of rainfall are important, the productivity of rangeland is more closely tied to the amount of soil moisture captured when it rains and the presence of desirable plant species to use that moisture. Current and past management practices determine how much rainfall penetrates the soil, the kinds of plants on the land, and the amount of runoff, sediment and non-point source pollutants that leave the property. Factors that affect how much rainfall penetrates the soil, runs off or evaporates include the type and density of vegetative cover, the intensity of rain, the amount of moisture in the soil before the rain, the capacity of the soil to hold water, and the slope of the land.

There are three indicators of the functioning of the water cycle.

- **Soil capping.** Hard, capped soil and compaction layers indicate a problem with water infiltration, aeration and seed germination (Fig. 2). Associated signs are litter dams, rills and gullies, water runoff patterns, etc. Rate soil capping from mature capping (1) to no capping (5).
- **Plant pedestaling.** Erosion (by wind or water) moves soil from around the bases of plants, exposing root crowns and leaving roots on small platforms or pedestals (Fig. 3). Extreme pedestaling may kill plants. Rate pedestaling from extreme (1) to none (5).

Figure 2. Compacted or capped soil inhibits aeration, water infiltration and seedling establishment.

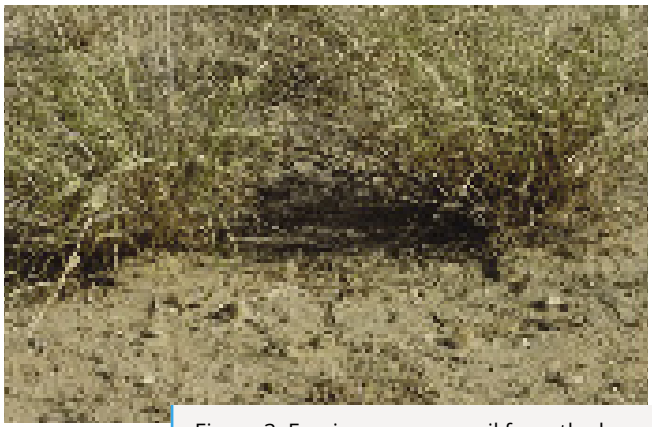

Figure 3. Erosion removes soil from the base of plants, leaving them on a “pedestal.”

- **Bareground.** Good vegetative cover slows the movement of water and lessens the impact of raindrops on the soil surface. The greater the impact and the faster the water moves, the more soil will be washed away. The slower the movement of water, the more time there is for it to soak into the soil. Monitoring the amount of bare ground and evidence of erosion will show how management is affecting the soil surface. Rate the amount of bare ground from high (1) to low (5).

  High percentage (1) = > 75 percent
  Low percentage (5) = < 25 percent

Vegetation dynamics. The status of vegetation is the key to the land's stability, resiliency, productivity and health. The kinds (species) and classes (grasses, forbs, woody plants, etc.) of plants affect both the water cycle and the nutrient cycle. There are two indicators of vegetation dynamics.

- **Species diversity.** A wide diversity of species indicates an advanced plant community (Fig. 4). Variety allows for full use of resources at all times of the year. Rate species diversity from simple (1) to complex (5).

  Simple (1) = < 5
  Complex (5) = > 25

Figure 4. A wide diversity of plant species indicates an advanced plant community.

- **Annuals vs. perennials.** If annual plants dominate the landscape, the plant community is weak, production is low, root systems are weak, there are few energy-collecting broadleaf plants, and plants contribute little to soil cover and stability. Count the perennials and rate them from few (1) to many (5).

  Few (1) = < 5 percent perennials
  Many (5) = > 50 percent perennials

INTERPRETING RANGELAND HEALTH

When all indicators have been evaluated and rated they can be scored and plotted. This will give a "snapshot" of the health of that particular range site. The more "high" ratings there are, the more functional the rangeland system. Lower ratings indicate potential problems. Having several "snapshots" over time allows the manager to see trends and take corrective actions if necessary.

Managers must know what is happening on their lands. They must check for signs of increasing bare ground, reduced litter, lower forage production, changing plant species, and stream bank erosion. These signs indicate whether the land is healthy or deteriorating. If there are problems, management practices can be changed before the land degrades further. Learning to read the landscape will pay off in greater productivity now and sustainable production in the future.

For additional information *http://texnat.tamu.edu.*