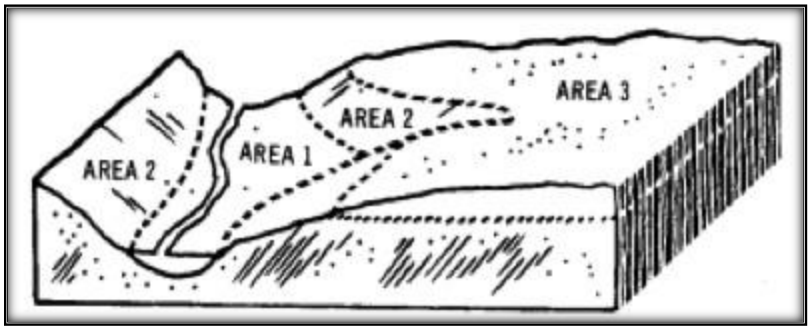
Rangeland soil health: how to assess it in ways that inform livestock management

Row-crop farmers translate soil test results to management decisions in a straightforward way: subtract soil test nutrient levels from estimated of crop needs and apply the difference as fertilizer. For ranchers, soil tests are used in detective work: trying to uncover reasons that rangelands may not be functioning to their potential.

Ranchers could approach soil testing with this question: *Is degraded soil constraining range productivity, biodiversity, or soil water properties in ways that I can address with the management tools at hand*?



Example of soil sampling zones. From Ohio State University Fact Sheet AGF-513.

Productivity, biodiversity, and water properties (including infiltration, holding capacity, and resistance to erosion) are functions that typically define rangeland soil health. Each soil type has its own potential for performing these functions, which varies with management history, topography, and underlying geology. The drawing shows how a landscape might be split into zones that have different levels of vulnerability to erosion, compaction, and degradation. Within each zone, an area performing soil functions at or near the potential provides a benchmark for assessing management effects. Reference areas are long-term grazing exclosures or areas that receive less pressure.

Many soil health indicators can be assessed directly, without sending samples and your credit card number to a lab. Fast, simple techniques include: soil resistance to penetration with an old hunting knife, soil texture, structure, moisture (after a nice rain), surface horizon color and thickness, amount of bare soil, signs of rill and sheet erosion, and visible salt accumulation. Other useful field techniques are more involved. Measuring infiltration rate, pH, and nitrogen or phosphorus content require buying simple tools or soil kits.

Sending samples to a lab can provide an excellent baseline and help calibrate your field observations. Proper sampling procedures ensure lab data truly represents soil health. **How and where to sample**: collect at least three composite samples from each zone and associated reference site. The best way is to follow a zig-zag path, placing at least 20 samples into a bucket. In a patchy plant community, collect samples from each patch in proportion to its part of the zone. Thoroughly mix and fill at least one quart zip-lock bag. **How deep to sample**: the best is to sample the surface horizon, which is most impacted by management. This could vary from 2 or 3 inches on slopes or hill tops to a foot or more in swales. Note the average depth for each composite sample. Sampling at constant depth may include subsoil in some samples and not others, giving an inaccurate picture of soil properties. **When to sample**: mid-summer when everything is dry makes proper handling of samples easier. Disturbance from sampling stimulates decomposition and changes dynamic soil properties, especially with moisture. Variable moisture among samples can skew the results. **Sample handling**: air dry the samples immediately after collecting them. Set them out on a bench or shop floor with the bags rolled open if they're nearly dry to begin with. If

they're moist, pour them out on a paper plate. They should be dry in 24 to 48 hours. Avoid letting the bags set out in the sun or in a vehicle. They get very warm and microbes become very active.

The standard soil fertility analysis offered by many labs provides good information. Make sure it includes soil organic matter. Check with your local UW Extension Office for a recommended lab. Other properties that indicate soil function, like salt content, water holding capacity, mineralizable carbon and nitrogen, and others can be added at extra cost. The plant-available nutrients provided by the standard fertility test have a very different meaning for rangelands than for croplands. For crops, they mean you can buy less fertilizer. In healthy, undisturbed soils with perennial plant communities, most plant-available nutrients come from decomposing organic material and are taken up by plants and microbes as fast as they're released. Healthy soil should usually have high total nitrogen content, for example, but little plant-available nitrogen. Higher contents of plant-available nutrients indicate disturbance where release rates are exceeding uptake rates. This can be caused by disturbance that accelerates decomposition, or by disruption of plant/microbe populations that slows uptake. Plant-available nutrients, especially nitrogen, are vulnerable to loss by several pathways, and they indicate a degrading soil system.

The results of field observations and lab tests might point to deferring grazing to allow plant establishment on vulnerable areas, fencing or herding to change traffic patterns, or even active repair of gullies. More details on techniques and interpreting results can be found in my rangeland soil health manual, posted as a developing document on my Wyoming Soil Management Web site (https://soilmanagement.wordpress.com). Contact me at 307-766-5082 or jnorton4@uwyo.edu with questions or if you'd rather receive a paper copy.