Grazing and Soil Health: Growing Soil and Livestock Go Together

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Overgrazing by repeatedly removing most or all vegetation causes loss of roots, which leads to soil compaction, runoff, erosion, and ultimately huge reductions in productivity (Trimble and Mendel, 1995). These and other problems that result from overgrazing are well known to most producers. This article, however, focuses on effects of proper grazing management on soil health, and how grazing might enhance soil health.

Healthy grassland and range soils have thick, dark surface horizons that absorb water and supply nutrients to diverse and productive vegetation that both forms and is formed by the soil. Virtually all the aboveground plant material produced each year and about a quarter of the roots turn over – or decompose – to build soil organic matter and provide nutrients to the next crop. Over thousands of years, this feedback loop creates soils resilient to all kinds of disturbance. The farther east you go in the prairie region, the more resilient the soils are. But, drastic disturbance can exceed the soil's ability for sustainable productivity. Over the past century, repeated plowing caused loss of around two-thirds of the original soil organic matter under Great Plains grasslands (Norton et al., 2012).

The cycle of growth and decay that sustains productive grazing land hinges on two things that are impacted by grazing management: 1) return of adequate amounts of plant residues to the soil, and 2) the diversity of plant species and functional groups maintained. Plant communities with rich mixtures of bunchgrasses, rhizomatous grasses, tap-rooted forbs, nitrogen fixers, and shrubs of many species contribute a wide variety of residues to the soil that decompose at different rates and times. This supports a huge diversity of soil microbes that cycle plant materials over the entire year, providing nutrients to growing plants. Plant residues that decompose rapidly provide nutrients, while those that are more resistant to decomposition tend to become stable soil organic matter, or humus, that gives the soil a dark color, strong structure, and absorbent qualities that enhance moisture-holding potential and resilience to disturbance.

The amount of residue left uneaten by livestock to return to the soil is one important part of maintaining soil health. This part of the equation is especially important on annual forages like the California annual grasslands, where all the plants die each summer and regenerate from seed each winter and spring (Bartolome et al., 2007). Removing too much of the plant material has immediate effects on productivity by causing erosion, poor germination, and shifts toward less desirable species. Livestock producers there are very aware of RDM – Residual Dry Matter. In perennial systems of Wyoming and Nebraska, the effect is not as immediate; plants regrow from their roots so germination conditions are less important. But removing too much plant

material, even when plants are dormant in the mid-summer or winter, will have the same effects, leaving soil exposed to erosion and depleting soil organic matter.

The diversity of species and functional groups is also an important part of soil health in grazing lands. A great deal of research in many types of plant communities has shown that more species lead to more fertile soil, more productivity, and less weed invasion (Allen and Meyer, 2014; Li et al., 2014; Norton et al., 2004). Mixtures of plants that grow at different rates, mature at different times, and have different root structures are thought to improve animal performance (Provenza et al., 2003; Soder et al., 2007), and also to increase soil microbial activity. Pastures that are all one species, either from conversion to introduced grasses like crested wheatgrass or invasion of weeds like cheatgrass, tend to end up with more shallow, less productive soils with limited biological activity (Norton et al., 2004).

A study of native-plant-dominated, crested-wheatgrass-converted, and cheatgrass-invaded sagebrush grassland soils in Utah showed that soils under the native plants had a wide variety of roots, the most organic material – especially the type that turns over rapidly, and also the most microbial activity (Norton et al., 2004). In that soil, lack of disturbance protects easily decomposed material and regulates the availability of nutrients to plants. The soil under cheatgrass had lost organic material because the dense mass of very fine roots dies each year, leaving thousands of pores that aerate the soil and accelerate decomposition of organic materials. This causes pulses of nutrient availability that favor annual weedy vegetation – almost like tillage. The soil under the 50-year-old crested wheatgrass stands was intermediate in soil organic matter content and microbial activity, probably because the presence of only one type of plant residue and roots – that all grow and turnover the same way – limits microbial diversity and causes distinct pulses alternating with periods of little microbial activity.

Proper management to maintain and enhance plant production is also the best way to maintain and enhance soil health. In native rangelands, proper rest and grazing at different times of the year can maintain or enhance diversity. In improved pastures and management-intensive situations, interseeding, especially with nitrogen-fixing legumes, and then managing to maintain them can improve both productivity and soil health. Keeping animals off wet soils, and avoiding prolonged concentration (trying not to create sacrifice areas) are other important ways to maintain the soil that sustains productive grazing lands and healthy, growing animals.

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