

## **Rangeland Soil Health and Livestock Production**

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Soil health is a buzz word that is common in many agricultural circles today. Although the concept is not necessarily new (a few decades ago soil scientists just called it soil quality) it is regaining new attention as the tools and information available to understand it emerge.

Unfortunately, much of what we know about soil health comes from wetter areas to the east and agronomic farming systems. For our semi-arid rangelands, our knowledge is limited in terms of what soil health is and how or if we can even improve it. To help generate and share knowledge on the topic, the Wyoming Stock Growers Association recently took up this topic this past June with a Soil Health Workshop that included a ranch tour of the Merlin Ranch. The program was a huge success with more than 80 ranchers, university, and agency folks attending and sharing knowledge. In this article, we want to share some of what we know, some of what we don't know, and some efforts being made to increase our knowledge about soil health on rangelands and the relation to livestock production.

In order to understand the interaction between grazing and rangeland soil health, we must first define soil health. According to the USDA Natural Resources Conservation Service (NRCS), soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans. Thus, managing soil health has importance for future generations. Soil health can be measured by its physical, chemical, and biological properties. Within each type of properties, there are specific indicators of soil health and their response to use and management – many of which are simply inherent soil properties of an area. Some of the most important indicators in terms of plant production are soil organic matter, nitrogen, soil compaction, soil aggregate stability, water holding capacity, and soil microbiological function. Soil microbiological function is a fancy way of saying the fungi and bacteria that are important for nutrient availability, and in some cases, for improving plant growth through a symbiotic relationship (such as the rhizobium that you inoculate alfalfa seed with). These soil health features and constraints are often inherent to an area due to its environment which is particularly relevant in our cold and arid ecosystems that are characterized by shallow, nutrient poor soils and sparse, patchy vegetation that result in highly erosive landscapes.

In soil health circles, the goal is to understand your soil health starting point and then work to improve it. We know that if we can increase nitrogen, increase soil water holding capacity, or decrease soil compaction that we can positively influence plant production – but most of that research came from crops research or wetter areas to the east. What we don't know, is how these

relationships can be influenced by management in the harsh rangelands of Wyoming that have certain soil features that are constrained to some degree by the environment in which they occur.

To know what might be possible we can look at the published research. Studies have shown differing soil health responses to cattle grazing. The strength and direction of the response seems to depend on soil properties, vegetation, climate, topography and land utilization. Across all of the studies available, some researchers had inconclusive results, some had positive, and some had neutral results. USDA scientists from Montana looked at a host of soil health properties in a northern mixed grass prairie consisting of needle-and-thread, blue grama, and threadleaf sedge and concluded that none of the soil health properties consistently predicted appreciable variation in plant production. An assessment of soil organic carbon and nitrogen across 24 soils in the Great Plains suggested that features like precipitation and soil texture were very strong controls of both soil health and plant production – in other words inherent environmental features strongly dictated soil health features. On a positive note, an 11 year study in Cheyenne, WY compared grazing to no grazing and found the top 30 cm of soil had greater soil carbon and nitrogen in the grazed pastures than the ungrazed pastures regardless of stocking rate. Another interesting case study from a tallgrass prairie indicated that intensive rotation grazing improved fungal:bacterial ratios and had soil organic matter, soil compaction, and soil aggregate stability similar to ungrazed areas. Other studies from the eastern United States have shown drastic improvement when plowed fields were restored to perennial grasses, a situation that is not reflective of our rangelands but could be reflective of CRP (Conservation Reserve Program) lands.

So, what then are we to expect for Wyoming rangelands. First, we have to recognize that the research that is transferable to Wyoming is limited. Moreover, there are very few studies globally that relate soil health to forage quality/quantity and livestock production. Second, we have to realize that we might be in 2 different soil health situations, (1) rangeland that is in fair condition where we need to maintain soil health or (2) rangeland that is in poor and degraded condition where we might realistically make some soil health improvements. Third, we need more research from Wyoming for Wyoming ranchers. We currently have 3 studies underway. The first project is on a private ranch about 50 miles west of Laramie, WY where we are relating soil health to forage quality and grazing capacity at the pasture level using more than a decade of grazing records. The second project is at the University of Wyoming's Sustainable Agriculture and Research and Education Center (SAREC) center near Lingle, WY where we are imposing three grazing treatments (no grazing, ultra-high density grazing, light grazing) on native rangeland in a very controlled experimental setting. The third project is using available data to develop models to determine how changes in soil health might impact ranch economics. Finally, until we have baseline soil health, forage, and grazing/livestock production information, we cannot extrapolate or detect changes on the ranch. So, record keeping and consistent data collection is important. For more information on this topic, and the results of our related research, stay tuned.