Mineral Concentration Patterns among Our Major Rangeland Grasses

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Introduction

Ranchers and forage managers need knowledge of the mineral content of their forages to assure efficient growth, reproduction, and strong immune responses from their animals. Despite a long history of livestock grazing in the northern Great Basin, annual and seasonal mineral concentrations of many of the region's prominent forages have not been measured. Because cattle in the sagebrush-steppe typically derive 85–90 percent of their annual rangeland diet from grass, an assay of our most prominent grasses provides a relatively accurate depiction of their mineral status. We addressed this problem with monthly sampling of grasses (April through November) during 1992, a drier than average year (86 percent of average precipitation), and 1993 when precipitation was 167 percent of average, about 10 inches per year.

Experimental Protocol

Six study locations near Burns, Oregon, were selected, with each supporting a broad array of grasses. All sites were characterized by Wyoming big sagebrush, which dominates most of the landscape in the region. On a north-south line the sites spanned 47 miles and on an east-west axis encompassed 73 miles. Once a month, for 8 months each year (April-November), each site was visited and samples of seven grasses were collected. Forages included in the study were Sandberg's bluegrass, cheatgrass, bottlebrush squirreltail, bluebunch wheatgrass, Idaho fescue, Thurber's needlegrass, and giant wildrye. Samples were assayed for phosphorus, potassium, calcium, magnesium, manganese, iron, copper, zinc, and sodium.

Results and Discussion

Generally, mineral concentrations averaged about 41 percent higher among the grasses for the drier (1992) of the 2 years (Fig. 1). Growth restriction during drought is accompanied by mineral concentration in a reduced standing crop. Conversely, dilution of mineral concentrations with more favorable growing conditions is frequently seen and attributed to accumulation of more stem material under optimal conditions.

Of major interest are those minerals that occurred at deficient levels among grasses on a year-round basis. These included copper, zinc, and sodium, and their deficiencies should most definitely be given some consideration by stockmen (Fig. 1).

Lactating beef cattle need about 9.6 parts per million (ppm) of copper in their diet, and our grasses furnish less than half the needed level at their peak. A wide array of symptoms accompany copper deficiencies, and their diversity may be linked to complex interactions involving other minerals. Some of the clinical signs include bleaching of hair, nervous symptoms (ataxia) in calves whose dams experienced deficiency during pregnancy, lameness, and swelling of joints. Serum assays of beef cattle at the Eastern Oregon Agricultural Research Center (EOARC) revealed marginal copper levels; nevertheless, through 1988 clinical symptoms had not been noted. Recently, however, some herds in southeast Oregon have developed health and reproductive disorders attributed to copper deficiency. Consequently, many producers have begun monitoring the copper status of their animals and have become more attentive to their mineral programs.

Zinc requirements for beef cattle forage are about 29 ppm. Over the months sampled, our grasses supplied from two-thirds to less than one-third of the needed levels. Zinc deficiencies can cause parakeratosis (inflamed skin around nose and mouth), stiffness of joints, alopecia, breaks in skin around the hoof, and retarded growth. Deficiencies have been induced experimentally in calves, but no applied reports of zinc deficiencies have occurred in sheep or cattle. However, researchers in Idaho have seen improved gains among zinc-supplemented calves.

Sodium concentrations varied considerably among the grasses, with substantial monthly differences between years (Fig. 1). To meet requirements for beef cattle, forages should contain about 672 ppm of sodium. All of our forages were deficient throughout both years. The highest sodium content attained by any of the grasses was Sandberg's bluegrass in late October of 1992, and it averaged only 177 ppm.

Among animals, sodium is found primarily in extracellular fluids. In conjunction with potassium and chlorine, it assists with maintaining osmotic pressure, acid-base equilibrium, nutrient passage into cells,

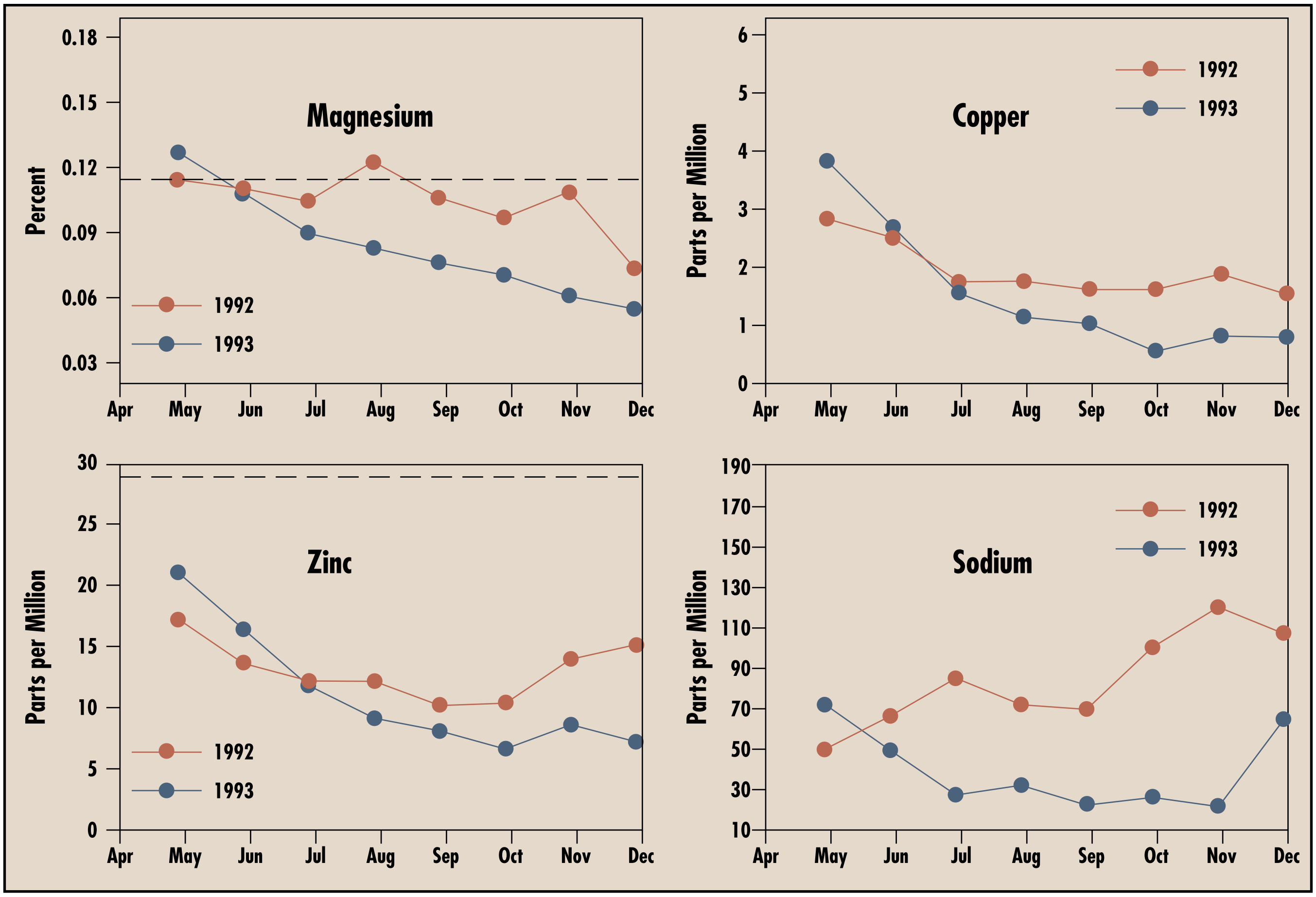

Figure 1. Mean monthly magnesium, zinc, copper, and sodium concentration of common rangeland grasses sampled from late April through late November in 1992 and 1993 near Burns, Oregon. Dashed lines, if present, denote required dietary concentrations. Required concentrations for copper and sodium are 9.6 and 672 parts per million, respectively.

and water metabolism. Animals have considerable ability to conserve sodium, but that luxury is not available to lactating cattle suffering from a lack of salt in the diet. Prolonged deficiencies cause loss of appetite, decreased growth or weight loss, unthrifty appearance, and reduced milk production, but supplemental salt can also stimulate weight gains among animals that are not showing signs of deficiencies.

The dietary magnesium requirement for lactating cows is about 0.115 percent. Forages were at or above this level for 2 of 8 months in 1992 and only 1 of 8 months in 1993 (Fig. 1). Magnesium is especially important for cellular and nervous system functioning among all animals. Lactating animals also transfer large amounts of magnesium to their calves, and they extract the needed quantities from their body reserves to sustain their calf when forages are deficient. Grass tetany generally occurs during early spring, when grasses are exhibiting rapid vegetative growth and lactation demands of cattle are peaking. That being the case, cattle should have supplemental sources of magnesium whenever their diet is deficient.

Other minerals that were seasonally deficient in our forages were calcium, phosphorus, potassium, and manganese. Calcium and manganese were largely deficient for cattle early in the growing season with levels increasing as the grasses matured into summer. Phosphorus and potassium levels were typically adequate early in the growing season and declined to deficient levels by July and August.

Iron is not an issue in our area because levels were more than adequate among all grasses for all periods sampled. However, high levels of iron can potentially lower copper availability and exacerbate management problems associated with copper deficiencies.

Conclusions and Management Implications

Given the logistical demands of determining forage nutritive value and supplement delivery in extensive pastures, ranchers for the most part cannot respond to seasonal mineral dynamics. Most likely, the best approach is to use a supplement formulation to correct all known year-round and potential seasonal deficiencies of their forages. Based on our findings, mineral supplementation is probably more of an issue during what we perceive as good forage years than when plant growth and development are arrested by drought.

When formulating mineral supplements, one should remember that mineral excesses are capable of inducing other deficiencies. For cattle pasturing in the northern sagebrush-steppe, we recommend that eight of the nine minerals evaluated in this study be added to the mix, and these include calcium, magnesium, copper, phosphorus, potassium, zinc, manganese, and sodium. Adequate concentrations of iron were available on a year-round basis. Those interested in a more detailed account on the mineral concentration dynamics of a particular grass should contact the EOARC in Burns and request a reprint of:

Ganskopp and Bohnert. 2003. “Mineral concentration dynamics of 7 northern Great Basin grasses,” *Journal of Range Management* 54:640–647.