

C. M. Page†, M. L. Van Emon†, S. Spear, T. W. Murphy‡, J. G. Bowman, and W. C. Stewart†*

†Department of Animal and Range Sciences, Montana State University, Bozeman MT

‡Department of Animal Science, University of Wisconsin–Madison, Madison WI

ABSTRACT

Clinical and subclinical trace mineral deficiencies can limit productivity in western sheep production systems. The objective of the study was to quantify trace mineral status among Montana ram lambs post weaning. Based on prior research investigating forage trace mineral concentrations and trace mineral status in cattle, we hypothesized that clinical and subclinical deficiencies would be most prominent with Zn and Se. To test this hypothesis, serum samples ($n = 201$) were collected from ram lambs 8 to 10 mo of age (BW 52.8 ± 16 kg) at 21 locations throughout Montana and analyzed for Co, Cu, Fe, Mn, Mo, Se, and Zn. The two most deficient and marginally deficient minerals across Montana were Se (19% of ranches deficient; 24% of ranches marginally deficient) and Zn (14% of ranches deficient; 52% of ranches marginally deficient). All Se deficient samples were obtained from western Montana. There was considerable variation in serum trace mineral concentrations within individual flocks. Given that Se and Zn play major roles in growth, fertility, and immunity, results suggest opportunities for more effective supplementation strategies. Producers and nutritionists alike can use these results to identify mineral deficient areas and develop cost effective mineral supplementation strategies.

Introduction

Forage mineral concentrations are variable throughout regions of the United States (Mortimer et al., 1999; Mathis et al., 2004;). With over 147,040 square miles of diverse geographic makeup, the variability of trace mineral concentration of Montana's forage is undoubtedly diverse. Montana has an estimated 230,000 sheep and lambs, 210,000 of those are breeding sheep ranking Montana 7th in breeding sheep numbers in the United States (USDA-NASS, 2016). Even with a large sheep population and general knowledge of trace mineral deficiencies, specific research attempting to quantify trace mineral status in Montana sheep populations has not previously been examined.



LITERATURE CITED

Herd, T. H., W. Rumble, and W. E. Braselton. 2000. The use of blood analyses to evaluate mineral status in livestock. *Vet. Clin. N Am-Food*. 16:423-444.
 Mathis, C., and J. Sawyer. 2004. New Mexico forage mineral survey. *Proc. West. Sec. Amer. Soc. Anim. Sci.* 55
 Mortimer, R. G., D. Dargatz, and L. R. Corah. 1999. Forage analyses from cow/calf herds in 23 states. University of Tennessee. NRC. 2007. *Nutrient Requirements of sheep*. 7th ed. Natl. Acad. Press, Washington, DC.
 Ricketts, M. J., Bodner, J., Stuth, J. W., and Tolleson, D. 2002. Montana Rangeland and Livestock Mineral Study. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/technical/landuse/pasture/?cid=nrcs144p2_057072 (Accessed 15 September 2015).
 USDA-NASS. 2016. U.S. Sheep and Goat Report. <http://usda.mannlib.cornell.edu/usda/current/SheeGoat/SheeGoat-01-29-2016.pdf> (Accessed 10 March 2016).

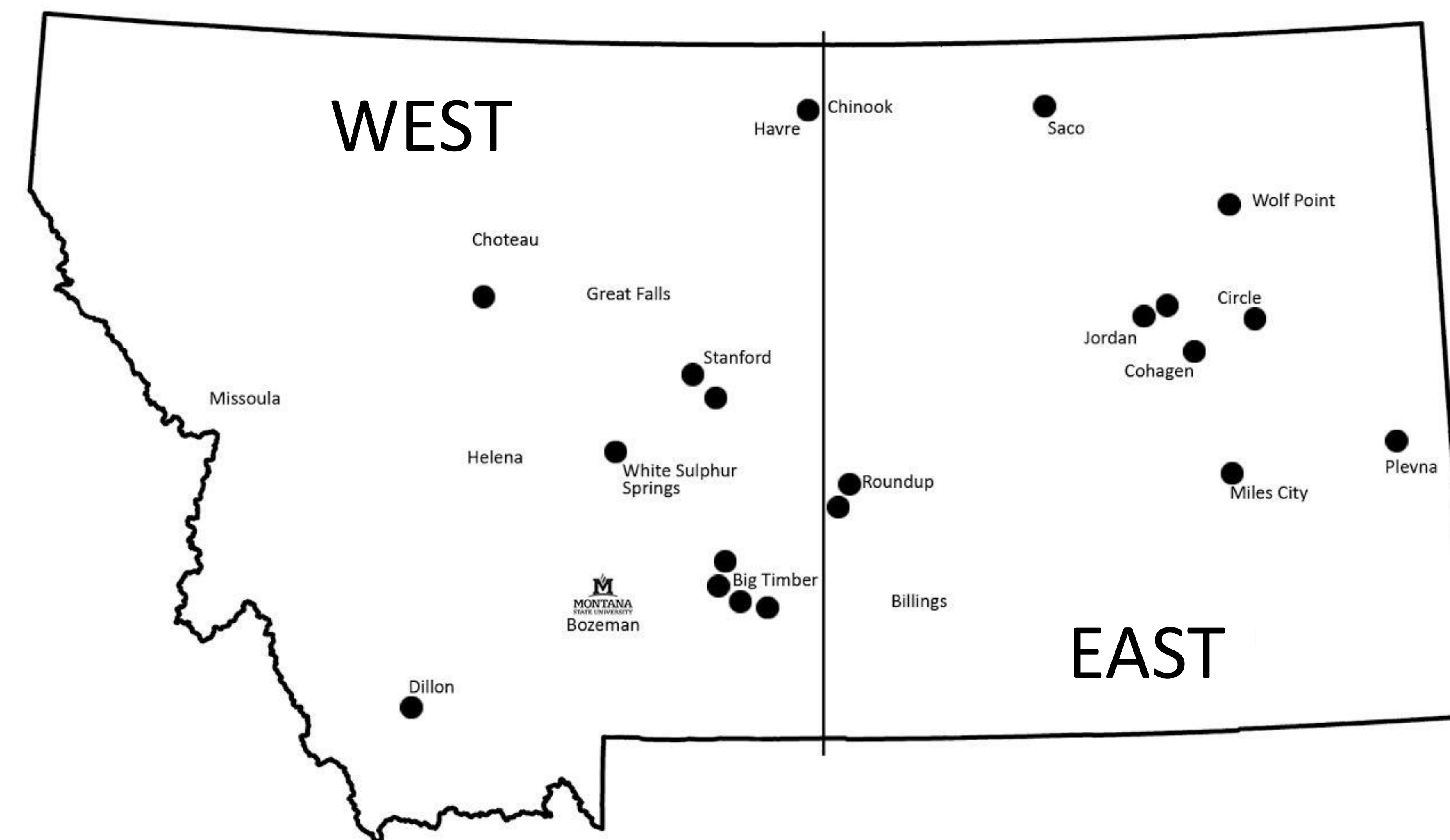


Figure 1: Map of sampling locations and longitudinal division of East and West regions

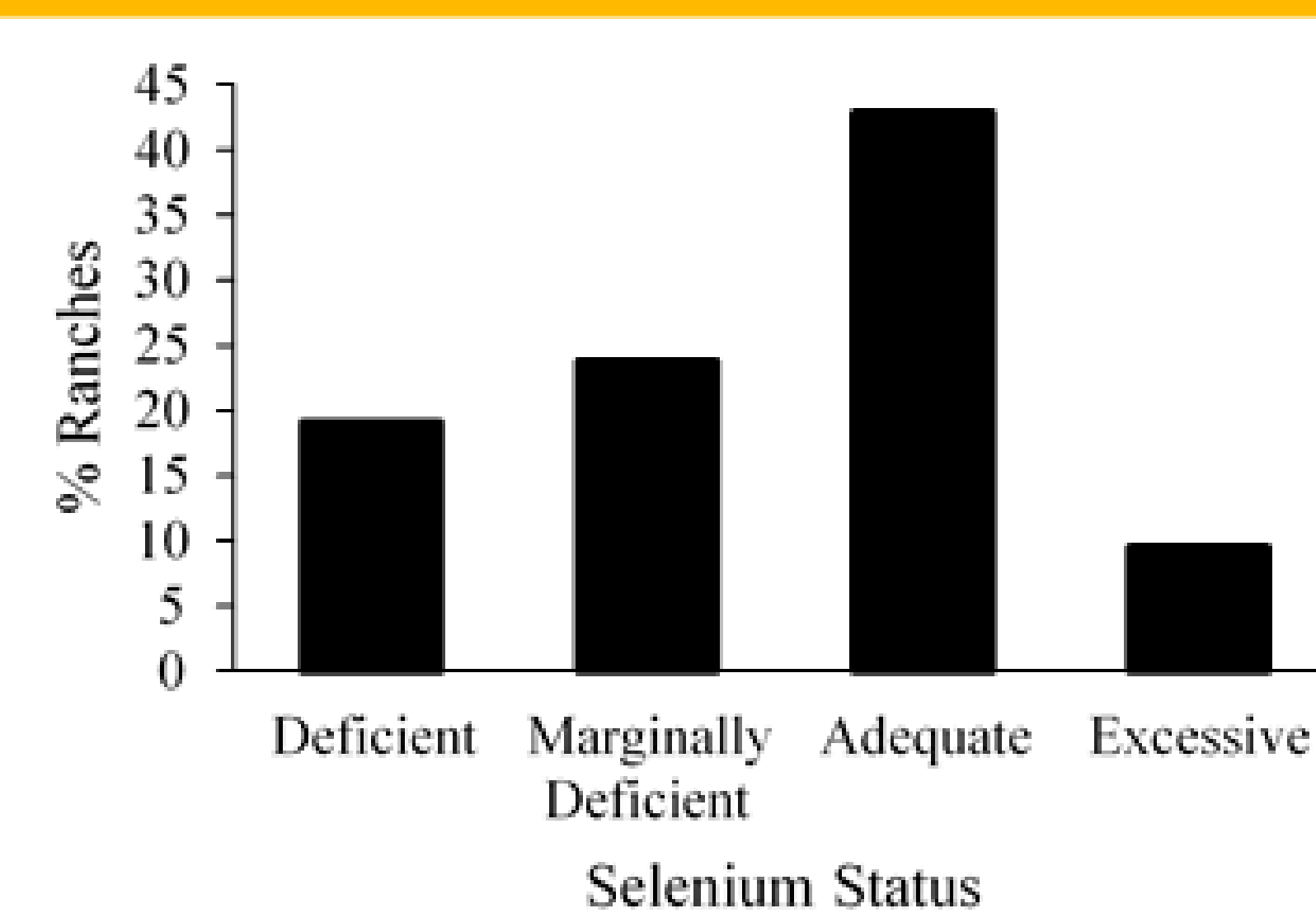


Figure 2: Distribution of Se status across 21 Montana sheep operations. Deficient: < 50 ng/mL; Marginally deficient: 50 to 90 ng/mL; Adequate: 110 to 160 ng/mL; and Toxic: > 160 ng/mL (Herd, 2000).

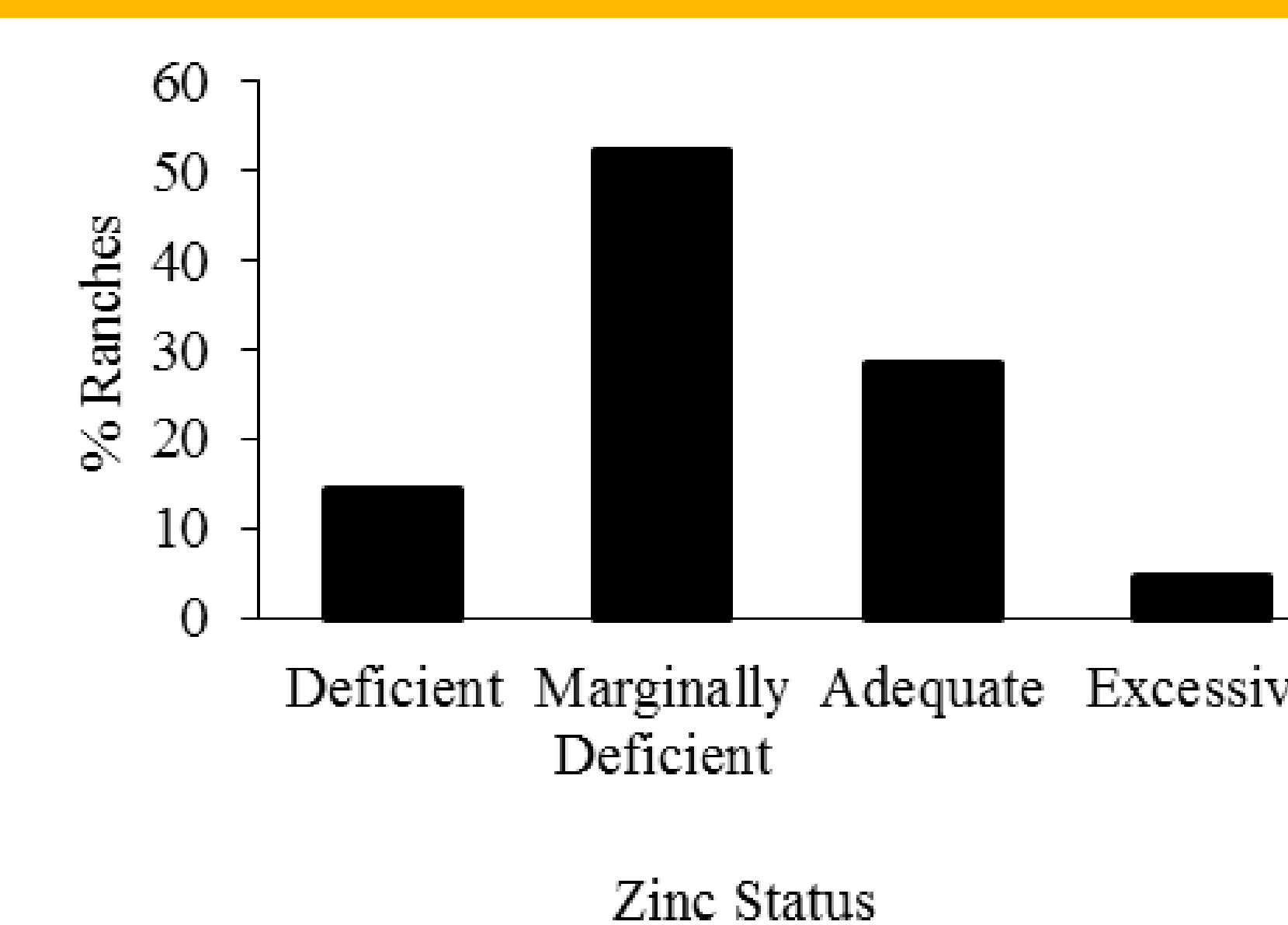


Figure 3: Distribution of Zn status across 21 Montana sheep operations. Deficient: < 0.6 µg/mL; Marginally deficient: 0.6 to 0.8 µg/mL; Adequate: 0.8 to 1.2 µg/mL; and Toxic: > 1.2 µg/mL (Herd, 2000).

Table 1. Minimum, maximum, mean, median and standard error of serum trace mineral concentrations from Montana ram lambs ($n = 201$)

Trace Mineral	Minimum	Maximum	Mean	Median	Standard Error
Se (ng/mL)	16.00	197.00	111.42	122.00	3.310
Zn (µg/mL)	0.30	1.74	0.73	0.71	0.015
Co (ng/mL)	0.09	6.22	1.00	0.50	0.079
Cu (µg/mL)	0.30	1.61	0.84	0.80	0.016
Fe (µg/dL)	26.00	350.00	154.85	149.00	3.682
Mn (ng/mL)	0.70	31.30	2.56	1.80	0.225
Mo (ng/mL)	2.80	456.50	40.14	15.40	5.001

Acknowledgments

Support for this study was provided by the National Sheep Industry Improvement Center. The authors would also like to express appreciation to Weston Helle, Monica Ebert and the ranches that allowed access to their sheep.

Objective

- Quantify trace mineral status in ram lamb sub-populations to identify deficiencies during early post weaning periods of ram lamb development

Hypothesis

- Clinical and subclinical deficiencies are most prominent in regards to Se and Zn, based on prior research investigating forage trace mineral concentrations (Mortimer et al., 1999) and trace mineral status in Montana range cattle (Ricketts et al., 2002).

Materials and Methods

- From September 24, 2015 to November 23, 2015, serum samples were collected.
- Montana was divided into an east and west region. 11 from the west and 10 from the east ($n=21$) Ranches. (Figure 1).
- Blood samples were drawn within 2 mo post weaning
- Approximate age of the animals were 8 to 10 mo (BW 52.8 ± 16 kg).
- All blood samples were collected via jugular venipuncture into 13 × 100 mm trace mineral royal blue top vacutainer tubes (Covidien, Mansfield, MA) without any additives.
- 201 serum samples were sent for analysis at Michigan State University Diagnostic Center for Population and Animal Health. Serum trace mineral analysis included Co, Cu, Fe, Mn, Mo, Se, and Zn concentrations.
- Reference ranges for sheep serum trace mineral concentrations were provided by T. Herdt at the MSU Diagnostic Center for Population and Animal Health.
- Ranch ($n = 21$) was the experimental unit and data was analyzed using the MEANS, UNIVARIATE and FREQ procedures of SAS.

Results and Discussion

- All trace minerals were found to be adequate in blood serum status with the exception of Se and Zn.
- Se and Zn were the two most deficient and marginally deficient trace minerals among Montana ram lambs.
- All Se deficient samples were from the western side of Montana.
- Se (19% of ranches deficient; 24% of ranches marginally deficient)
- Zn (14% of ranches deficient; 52% of ranches marginally deficient)
- There was considerable variation in serum trace mineral concentrations within individual flocks.

Implications

- Trace mineral deficiencies exist among Montana ram lamb populations.
- Variability exists among individual flocks, likely because of varied consumption and basal diet concentrations.
- On average selenium levels were lower in animals in western Montana, while zinc was lower in animals sampled from operations located in the eastern half of the state.