Temperature and Precipitation Affect Steer Weight Gains Differentially by Stocking Rate in Northern Mixed-Grass Prairie

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Temperature and Precipitation Affect Steer Weight Gains Differentially by Stocking Rate in Northern Mixed-Grass Prairie

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Abstract

Cattle weight gain responses to seasonal weather variability are difficult to predict for rangelands because few long-term (>20 yr) studies have been conducted. However, an increased understanding of temperature and precipitation influences on cattle weight gains is needed to optimize stocking rates and reduce enterprise risk associated with climatic variability. Yearling steer weight gain data collected at the USDA-ARS High Plains Grasslands Research Station at light, moderate, and heavy stocking rates for 30 years (1982–2011) were used to examine the effects of spring (April–June) and summer (July–September) temperature and precipitation, as well as prior-growing-season (prior April–September) and fall/winter (October–March) precipitation, on beef production ($kg \cdot ha^{-1}$). At heavier stocking rates, steer production was more sensitive to seasonal weather variations. A novel finding was that temperature (relatively cool springs and warm summers) played a large predictive role on beef production. At heavier stocking rates, beef production was highest during years with cool, wet springs and warm, wet summers, corresponding to optimum growth conditions for this mixed C_3–C_4 plant community. The novelty and utility of these findings may increase the efficacy of stocking rate decision support tools. The parsimonious model structure presented here includes three-month seasonal clusters that are forecasted and freely available from the US National Oceanic and Atmospheric Administration up to a year in advance. These seasonal weather forecasts can provide ranchers with an increased predictive capacity to adjust stocking rates (in advance of the grazing season) according to predicted seasonal weather conditions, thereby reducing enterprise risk.

Key Words: beef cattle production, climate variability, decision support tools, grazing management, model averaging, semiarid rangeland

INTRODUCTION

Much has been ascertained over the last six decades regarding rangeland management practices and beef production (Holechek et al. 1998; Briske et al. 2011), but understanding the influence of climatic variables such as temperature and precipitation on cattle weight gains remains problematic. There are few long-term studies undertaken in resource management (Lindenmayer et al. 2012) and beef production (Briske et al. 2011), although such studies are invaluable. Of the few studies that have addressed long-term cattle weight gains (e.g., Willms et al. 1986; Hart and Ashby 1998; Derner et al. 2008), only Derner et al. (2008) examined the influence of precipitation on cattle weight gains, finding that higher spring (April–June) precipitation totals increased beef production in northern mixed-grass prairie. Further elucidating the effects of precipitation (and temperature) on beef production would assist in modeling efforts to help ranchers maximize production and minimize enterprise risk (Derner et al. 2012).

Previous modeling efforts have examined the effects that climate change may have either directly or indirectly on beef production (e.g., Hanson et al. 1993; Andales et al. 2005; Mader et al. 2009; Ritten et al. 2010; Torell et al. 2010). These models, however, were not founded on data that originally and directly linked long-term cattle weight gains to corresponding climatic variability. Climatic variability and timing of precipitation influences productivity of grasslands (Craine et al. 2012), as well as bison weight gains in tallgrass prairie (Craine et al. 2009). Inclusion of relationships between climatic variability and beef production from long-term data would increase the accuracy and reliability of predicted cattle weight gains. Given that temperature and precipitation data, as well as forecasts, can easily be gathered from multiple sources such as the US National Oceanic and Atmospheric Administration (NOAA),[1] models including the effects of temperature and precipitation on beef production would have more utility for livestock producers. Accordingly, a direct linkage between seasonal weather variability and cattle weight gains was the primary relationship explored here.

Data on yearling steer weight gains, along with temperature and precipitation, have been collected at the USDA-ARS High

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[1]http://www.noaa.gov