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Relationships Between Chihuahuan Desert Perennial Grass Production and Precipitation

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Abstract

Perennial grass production on the Chihuahuan Desert Rangeland Research Center in south-central New Mexico was correlated with precipitation characteristics over a 34-year period. Total December through September precipitation was highly correlated ($r = +0.77$, $n = 34$) with perennial grass production. Practical generalized indices were developed that could be broadly applied by managers for predicting perennial grass production from precipitation characteristics. Perennial grass production and precipitation data on 3 separate pastures were collected over a 6-year period to evaluate the reliability of models to predict perennial grass production. Simple linear, 2-variable, quadratic, and polynomial regression models gave perennial grass production estimates that were well correlated with actual values ($r = +0.85$ to $+0.91$, $n = 17$) across the 3 pastures. The quadratic regression model ($Y = 4.04 - 0.24X + 0.012\ X^2$, X = December through September precipitation, Y = forage production, $n = 34$, $r = 0.85$) gave the most accurate predicted values. Our quadratic regression model should be of practical use to ranchers and range managers on Chihuahuan Desert upland rangelands receiving 200–300 mm annual precipitation, with loamy to sandy loam soils and in mid- to late-seral ecological condition. These conditions match those generally found on Chihuahuan Desert Uplands. We consider our quadratic regression model to be highly useful over large areas to ranchers in southern New Mexico, southeastern Arizona, southwestern Texas, and north-central Mexico.

Resumen

La producción de zacates perennes en el Centro de Investigación de Pastizales del Desierto Chihuahuense en la región sur-central de New Mexico se correlacionó con las características de precipitación de un periodo de 34 años. La precipitación total de Septiembre a Diciembre estuvo altamente correlacionada ($r = +0.77$, $n = 34$) con la producción de zacates perennes. Se desarrollaron índices prácticos generalizados que pudieran ser aplicados ampliamente por los manejadores para predecir la producción de zacates perennes a partir de las características de precipitación. Los datos de precipitación y producción delos zacates perennes de tres potreros separados se colectaron en un periodo de 6 años para evaluar la confiabilidad delos modelos para predecir la producción de zacates perennes. Modelos de regresión lineal simple, de dos variables cuadráticos y polinomiales dieron estimaciones de la producción de zacates perennes que estuvieron bien correlacionados con los valores actuales ($r = +0.85$ a $+0.91$, $n = 17$) a través de los 3 potreros. El modelo cuadrático de regresión ($Y = 4.04 - 0.24X + 0.012\ X^2$, X = precipitación de Septiembre a Diciembre, Y = producción de forraje, $n = 34$, $r = 0.85$) dio los valores de predicción más certeros. Nuestro modelo de regresión cuadrática debe ser de uso practico para los rancheros y manejadores de pastizales de la parte alta del Desierto Chihuahuense que reciben una precipitación anual de 200–300 mm y con suelos de textura franca a arenosa y con una condición ecológica de etapa seral media a final. Estas condiciones se cumplen para aquellas áreas generalmente encontradas las tierras altas del desierto Chihuahuense. Consideramos que nuestro modelo cuadrático de regresión pudiera ser altamente útil para los rancheros de grandes áreas del sur de New México, Arizona y Suroeste de Texas y el Norte-centro de México.

Key Words: cattle, climate, forage, rainfall, rangelands

INTRODUCTION

Stocking rate is considered the most important aspect of successful range management (Vallentine 1990; Heady and Child 1994; Holechek et al. 2004). Sound procedures for determining sustainable stocking rates for particular rangelands have been available for many years (Holechek 1988; Troxel and White 1989; Holechek and Pieper 1992; Galt et al. 2000). Various stocking rate procedures all depend on reliable estimates of annual forage production. Determination of forage production is typically time consuming and expensive. It has long been recognized that forage production on rangelands is closely associated with annual precipitation amount and timing. Regression equations that are reasonably reliable for predicting forage production from precipitation characteristics have been developed for some rangeland biomes, including sagebrush-grassland (Sneva and Hyder 1962), mountain grassland (Mueggler 1983), pinyon-juniper (Pieper et al. 1971), midgrass prairie (Launchbaugh 1967), and Sonoran desert grassland (Cable

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