

Primary Productivity and Precipitation-Use Efficiency in Mixed-Grass Prairie: A Comparison of Northern and Southern US Sites

Author(s): Lance T. Vermeire , Rod K. Heitschmidt , Matthew J. Rinella

Source: Rangeland Ecology & Management, 62(3):230-239. 2009.

Published By: Society for Range Management

DOI: <http://dx.doi.org/10.2111/07-140R2.1>

URL: <http://www.bioone.org/doi/full/10.2111/07-140R2.1>

BioOne (www.bioone.org) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/page/terms_of_use.

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

Primary Productivity and Precipitation-Use Efficiency in Mixed-Grass Prairie: A Comparison of Northern and Southern US Sites

Lance T. Vermeire,¹ Rod K. Heitschmidt,² and Matthew J. Rinella³

Authors are ^{1,3}Rangeland Ecologists and ²Supervisory Rangeland Scientist (retired), US Department of Agriculture, Agricultural Research Service, 243 Fort Keogh Rd, Miles City, MT 59301, USA

Abstract

Precipitation-use efficiency (PUE) is a key determinant of aboveground net primary production (ANPP). We used long-term datasets to contrast ANPP and PUE estimates between northern (southeast Montana) and southern (north Texas) mixed-grass prairies. Effects of varying amounts and temporal distribution of precipitation on PUE were examined at the Montana site, using a rainout shelter and irrigation. Results show that 1) ANPP was 21% less in Montana than Texas ($188 \text{ g} \cdot \text{m}^{-2}$ vs. $237 \text{ g} \cdot \text{m}^{-2}$); 2) plant function type (PFT) composition varied between the two study locations, with cool-season perennial grasses (CSPG) dominating in Montana (52%) and warm-season perennial grasses (WSPG) dominating in Texas (47%); 3) production dynamics varied between the two sites with 90% of ANPP completed by 1 July in Montana as compared to 31 August in Texas; 4) average PUE estimates were greater in Montana ($0.56 \text{ g dry matter} \cdot \text{m}^{-2} \cdot \text{mm}^{-1}$ of precipitation) than Texas ($0.40 \text{ g} \cdot \text{m}^{-2} \cdot \text{mm}^{-1}$); and 5) contributions to PUE estimates varied among PFT and location, with CSPG estimates being greater in Montana than Texas (52% vs. 31%) and WSPG estimates being greater in Texas than Montana (47% vs. 27%). Seasonal droughts and supplemental irrigations at the Montana site substantially altered ANPP, PFT biomass composition, and PUE. Results show PUE was responsive to PFT composition relative to amount and seasonal distribution of precipitation. Therefore, one should expect changes in ANPP and PUE to occur with shifts in precipitation patterns until PFT composition becomes adjusted to the regime.

Resumen

La eficiencia del uso de la precipitación (PUE) es una clave determinante de la producción primaria aérea neta (ANPP). Utilizamos una base de datos para contrastar estimaciones de ANPP y PUE entre (el suroeste de Montana) y el sur de los pastizales mixtos (norte de Texas). El efecto de la variación y la cantidad en la distribución temporal de la vegetación en PUE se examinaron en el sitio de Montana, utilizando un refugio para la lluvia e irrigación. Los resultados muestran que: 1) ANPP fue 21% menor en el sitio de Montana, que en el sitio de Texas ($188 \text{ g} \cdot \text{m}^{-2}$ vs. $237 \text{ g} \cdot \text{m}^{-2}$); 2) la composición de los tipos funcionales de las plantas (PFT) varía entre las dos localidades, especies de gramíneas perenes de crecimiento de invierno (CSPG) dominaron en el sitio de Montana (52%) y gramíneas perenes de crecimiento de verano (WSPG) dominaron en el sitio de Texas (47%); 3) La dinámica de la producción varía entre los dos sitios con 90% de ANPP concluido para el 1 de Julio en Montana, comparado al 31 de Agosto en Texas; 4) el promedio de la estimación de PUE fue mayor en Montana ($0.56 \text{ g de materia seca} \cdot \text{m}^{-2} \cdot \text{mm}^{-1}$ de precipitación) que en Texas ($0.40 \text{ g} \cdot \text{m}^{-2} \cdot \text{mm}^{-1}$); y 5) las contribuciones a las estimaciones de PUE varían entre PFT y la del sitio, con una estimación CSPG mayor en Montana que en Texas (52% vs. 31%) y la estimación WSPG mayor en Texas que en Montana (47% vs. 27%). Las sequías estacional y la irrigación suplementaria en el sitio de Montana significativamente altera ANPP, la composición de la biomasa de PFT, y PUE. Estos resultados demuestran que PUE fue receptivo a la composición de PFT relativo a la cantidad y la distribución estacional de la precipitación. Por lo que uno debe esperar que ocurran cambios en ANPP y PUE con modificaciones en los patrones de la precipitación hasta que la composición de PFT se ajuste al sistema.

Key Words: climate change, drought, grassland, precipitation-use efficiency, primary production, rangeland, water

Research was conducted under a cooperative agreement between US Dept of Agriculture (USDA)–Agricultural Research Service and the Montana Agricultural Experiment Station. Mention of a proprietary product does not constitute a guarantee or warranty of the product by USDA, Montana Agricultural Experiment Station, or the authors, and does not imply its approval to the exclusion of other products that also might be suitable.

US Dept of Agriculture–Agricultural Research Service Northern Plains Area is an equal opportunity/affirmative action employer and all agency services are available without discrimination.

Correspondence: Dr Lance Vermeire, Agricultural Research Service, 243 Fort Keogh Road, Miles City, MT 59301 USA. Email: lance.vermeire@ars.usda.gov

Manuscript received 3 December 2007; manuscript accepted 25 March 2009.

INTRODUCTION

Precipitation is a primary determinant of the structure and function of terrestrial ecosystems (Webb et al. 1978, 1983) such as the grasslands of the Great Plains (Rosensweig 1968; Lauenroth 1979; Rutherford 1980; Le Houerou et al. 1988; McNaughton et al. 1993; Lauenroth et al. 1999). Precipitation-use efficiency (PUE) as calculated (annual aboveground net primary production [ANPP] divided by annual precipitation from Le Houerou 1984) for indigenous grasslands generally has

Download English Version:

<https://daneshyari.com/en/article/4404536>

Download Persian Version:

<https://daneshyari.com/article/4404536>

[Daneshyari.com](https://daneshyari.com)