Runoff and Soil Erosion from Two Rangeland Sites

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Introduction

Effective management of vegetation can prevent erosion from accelerating past a critical threshold. Determining this threshold is often difficult on shortgrass steppe which evolved from continuous year round ungulate grazing. This study used rainfall simulations for measuring runoff within two existing variable grazing intensity pasture studies located at Central Plains Experimental Range (CPER), Nunn, CO and High Plains Grasslands Research Station (HPGRS), Cheyenne, WY. Three consecutive years of rangeland rainfall simulation measurements were conducted in Nunn, CO to better understand dynamic annual conditions and interactions of grazing and plant productivity on runoff and infiltration. Rainfall simulations conducted in Cheyenne, WY were to better understand the differences between continuous and short rotational grazing systems at a single point in time.

Figure 5, Photo of Heavy Grazing Pasture

Methods

Runoff was measured at two sites (avg. precip. ~380 mm/yr) with a "Swanson" rotating boom rainfall simulator (Figure 1). At each location, one rainfall simulation applied water on (2) 3 x 10 m plots at controlled intensities of 60 and 110 mm/hr (each grazing intensity, CPER n=4 & HPGRS n=2 plots). Three soil moisture conditions were assessed during each simulation-when the sandy loam soil was dry, 30 minutes later with a wet run of 60 mm/hr, followed immediately by a very wet run of 110 mm/hr. CPER had three treatments of light moderate and heavy grazing. HPGRS had five treatments, three short time period grazing durations on light, moderate and heavy grazed intensities, and two continuously grazed moderate and heavily grazed intensities. Rainfall intensities were ~100 and ~1000 year average recurrence intervals. HPGRS and CPER simulations were conducted within 3-ha enclosures which excluded cattle from each plot at the onset and for the duration of this study (CPER, three consecutive years from 1992-1994, 1993 data not shown; HPGRS 1993 only).

Figure 1, Photo of Swanson Rotating Boom

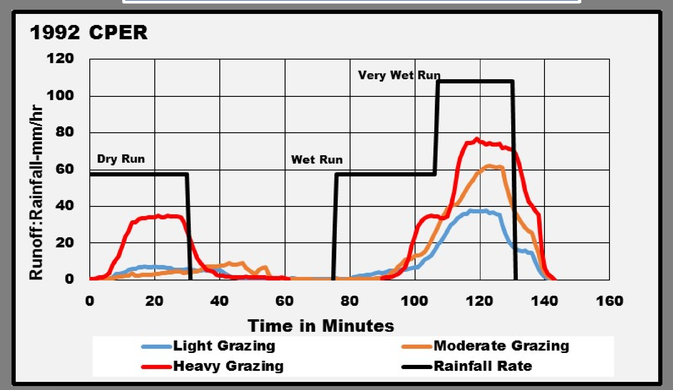

Figure 2, Mean Runoff Rate on Grazing Intensities Plots-CPER 1992

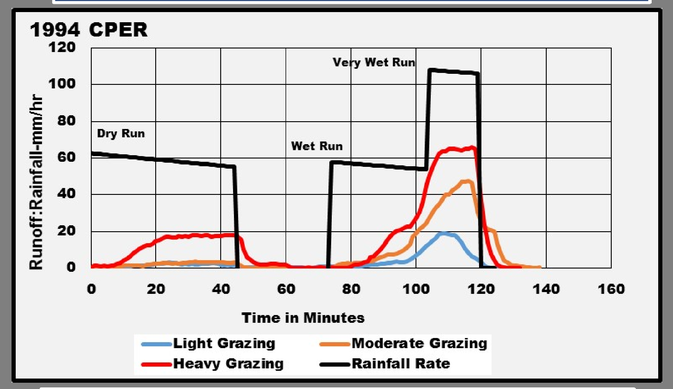

Figure 3, Mean Runoff Rate on Grazing Intensities Plots-CPER 1993

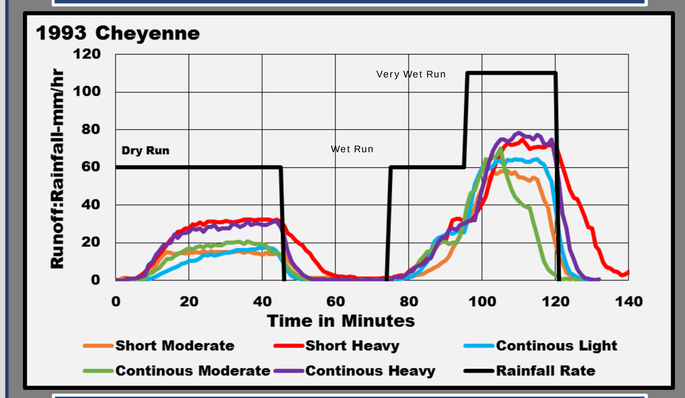

Figure 4, Mean Runoff Rate on Grazing Intensities Plots-HPGRS 1993

Site Information

CPER has a long term controlled grazing study (53+ years) with (*Bouteloua gracilis* (H.B.K.) and *Buchloe dactyloides* (Nutt.) Engleman) remaining at the end of the year. HPGRS also had a long term controlled grazing study (12 years) including *Bouteloua gracilis* (H.B.K.) and *Pascopyrum smithii* (Rydb.) as dominant plant species.

Findings

At CPER the differing effects of grazing treatments on runoff were most evident during the very wet (110 mm/hr) rainfall rate (Figures 2 and 3). The time difference between simulator runs ('92 vs'94) were most evident on the heavy grazing treatment with very little change over time on the light and moderate grazing treatments. Runoff decreased ~50% from 1992 to 1994 during the dry run heavy grazing treatment. (Figures 2 and 3).

At HPGRS, the effects of continuous vs short rotational grazing periods were most prevalent on the dry run (~60 mm/hr) with a lesser effect on the very wet run (~110 mm/hr) (Figure 4). The greatest runoff resulted from heavy grazing, with minimal differences measured between the light and moderate grazing treatments (Figure 4).

Impact

Prescribed grazing which includes rest, can dramatically reduce the threshold (critical point) of erosion initiation from runoff due to heavy grazing in the short term. Reducing the runoff rate lowers the potential for soil erosion and increases water availability for plant growth. Future use of this data will be to enhance Ecological Site Descriptions with key Eco-hydrological information. In addition, the complete dataset will be stored on the USDA-ARS Agricultural, Runoff, Erosion, and Salinity (ARES) database hosted through the USDA National Agricultural Library.

Figure 6, Photo of Light Grazing Pasture