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GRAZING PATTERNS AND PLANT RESPONSES TO GRAZING ON MIXED-GRASS PRAIRIE VEGETATION

NON-TECHNICAL SUMMARY: Grazing systems are being developed and implemented with no knowledge of how they impact grazing patterns and how plants respond to those patterns. The purpose of this project is to determine how grazing systems and stocking rates alter how cattle graze and to determine how native grasses respond to resulting grazing patterns.

OBJECTIVES: The overall, long-term goal of our research program is to provide grazing managers on the mixed-grass prairie of the Northern Great Plains with grazing management strategies that can be used to improve their long-term sustainability. In order to accomplish that goal, we will study a variety of grazing systems, stocking rates, stocking densities, and other factors, such as drought and water quality, to determine how those factors affect grazing patterns on the major grasses of the region. We will also determine how grazing patterns, drought, and competition affect changes in species composition by evaluating their effects on western wheatgrass tiller survival and reproductive strategy. Our focus for this study will be on western wheatgrass because of its importance in these plant communities from an ecological, environmental and economic perspective. The specific objectives for this study are: 1) Document and compare patterns of grazing by cattle as influenced by grazing systems, stocking rates, stocking densities, and other factors, such as water quality, over several growing seasons to determine the effects of climatic conditions (including drought) on those patterns. 2) Determine the effects of timing and severity of defoliation, drought, and inter- and intra-specific competition, and the interactions of these factors, on the persistence and production of western wheatgrass tillers in native mixed-grass prairie.

APPROACH: Patterns of Grazing: The first study will be completed in conjunction with an ongoing AES research grant investigating the influence of water quality on livestock performance. Eight pastures will be used: 4 pastures provide low quality forage and 4 provide high quality forage. Two low quality and two high quality pastures will be randomly selected to have low quality water provided to livestock. The remaining 4 pastures will be supplied with high quality water. Yearling, crossbred steers will graze these pastures at stocking rates of approximately 0.5 AUM/ac. Fourteen 0.25m2 plots will be randomly located in each study pasture. In spring of each year, 10 western wheatgrass (WW), 5 buffalograss (BU), and 5 blue grama (BG) tillers within each plot will be marked by encircling each tiller with a colored wire ring. Height, number of leaves, grazed status and phenology will be recorded weekly during the grazing season for each marked tiller in each plot. Tillers collected outside the permanent plots will be used to determine height:weight and %height:%weight relationships. Biomass and percent canopy cover for each species in each permanent plot will be determined at the beginning, middle and end of the grazing season in each year. Density of tillers of the 3 grass species will be determined once each summer in each permanent plot. Livestock weight gains will be monitored at 28-day intervals. Additional studies, using similar techniques, will investigate stocking rate and stocking density effects on patterns of grazing. Plant Responses to Grazing: A series of 2-year studies will be conducted in 6 exclosures (25 m X 25 m). We will establish 35 microplots in each exclosure for each 2-year study. Each microplot will be isolated by a 15 cm deep section of 8 cm diam. PVC pipe inserted into the ground around each microplot in spring of Year 1 for each 2-year study. Every WW tiller within each microplot will be marked by encircling it with colored wire, each tiller with its own color. WW defoliation treatments will be randomly assigned to the microplots in all exclosures. Treatments will be every combination of 2 severity levels (30% and 60% of current biomass removed) and 3 timings (pre-apical meristem elevation stage, apical meristem elevation stage, , post-apical meristem elevation stage), plus an undefoliated control. Timing and severity of use will correspond to actual livestock grazing patterns on WW tillers recorded at the Cottonwood **Station**. All WW tillers within a microplot will receive the same timing and severity of defoliation. Five reps of each treatment will be established in each exclosure. Biweekly records of height, number of leaves, and phenology of tillers in each microplot during Year 1 will be made. In Year 2, all new tillers will be marked and their relationship to Year 1 tillers estimated. Height, number of leaves, and phenology will be collected on these tillers biweekly through the growing season. In fall of Year 2, all microplots will be excavated to reveal below-ground structures. Connections between parent and daughter tillers will be verified and all rhizome lengths will be recorded.

PROGRESS: 2004/01 TO 2004/12
Western South Dakota has continued in a drought which has lasted several years, including a severe drought beginning in mid-summer 2001, reaching its peak in 2002. Western wheatgrass tillers produced after fall rains in 2002 were evaluated in 2003 for survival and production, and results have been reported previously. Daughters of those tillers were examined in 2004 to determine if late fall defoliation affected the ability of the 2002 fall tillers to produce viable offspring. Those data have not yet been fully analyzed and the results will be reported in the future. A study was also conducted to determine the impact of

several years of drought on forage production on pastures at the Cottonwood Range and Livestock Research Station. This study utilized the six long-term stocking rate pastures (pastures 1-6), with the goal of comparing forage production in these pastures during the current drought cycle to long-term (1945-1960) forage production. Pastures have been maintained over the decades as shortgrass dominated (SG), midgrass/shortgrass co-dominated (MGSG), and midgrass dominated (MG). Forage production in 2004 was significantly less ($p=0.038$) than the long-term average (810 kg/ha vs. 1543 kg/ha for 2004 and 1945-60, respectively, all pastures combined). Forage production was 901 kg/ha for SG (compared to 1200 kg/ha long-term), 670 kg/ha for MGSG (compared to 1450 kg/ha long-term), and 859 kg/ha for MG (compared to 1980 kg/ha long-term) pastures. The 2004 production values are 75%, 46%, 43% and 52% of the long-term forage production for these pastures for SG, MGSG, MG, and all pastures combined, respectively. Clearly the current drought has had a greater impact on the production on MG and MGSG pastures than SG pastures. The MG and MGSG pastures are made up of a large component of cool-season (C3) species, which are dependent on spring precipitation and any soil moisture recharge from winter snows. Such precipitation has been minimal throughout the current drought period. The perennial shortgrass species (e.g. buffalograss and blue grama) are warm-season species (C4) and are able to access and utilize precipitation during the warmer summer months, even when amounts are small.

IMPACT: 2004/01 TO 2004/12
This study demonstrates the impact of multi-year drought on mixed-grass pastures. Stocking rates on these pastures should be reduced for at least two reasons: 1) reduced forage availability will limit forage intake by livestock, thus reducing livestock weight gains and 2) damage to the productive potential of the perennial grasses in these pastures can occur both due to overgrazing during the growing season and loss of thermal cover to protect from winterkill.

PUBLICATIONS: 2004/01 TO 2004/12
Johnson, P.S., and L. Xu. 2004. Consequences of defoliation of western wheatgrass following severe drought. Soc. Range Manage. 57:179.

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