Managing Canadian Rangelands For Sustainability and Profitability Proceedings of The First Interprovincial Range Conference in Western Canada

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Build It and They Will Come...to Admire Your Grazing System

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Abstract

Grazing studies were conducted between 1981 and 1992 at the Dickinson and Central Grasslands Research Centers, North Dakota. Objectives were to determine herbage production and disappearance, long-term plant community changes and livestock performance and production on short duration (SD) and repeated seasonlong (SL) grazing treatments. Both research centers are located within the Wheatgrass-Needlegrass Vegetation Type which extends from central and western Saskatchewan to central and western South Dakota. Selected range sites were delineated within each grazing treatment at both locations and evaluated for herbage availability and disappearance, species composition and live basal cover. Livestock weights were recorded periodically throughout the grazing season at both research locations. At both research centers, herbage production and disappearance were similar between grazing treatments, throughout the study. Species composition and live basal cover were similar on range sites between 1981 and 1987 on each grazing treatment. Species composition and live basal cover changes at both centers occurred on range sites of each grazing treatment in 1988 and 1989 in response to severe drought. Livestock performance was maintained on the SD grazing treatment despite a 10% greater stocking rate at the Dickinson Research Center and a 40% greater stocking rate at the Central Grasslands Research Center.

Introduction

Grazing systems have been the focus of much attention over the past few decades (Holechek et al. 1989). Recent attention stems largely from claims of increased carrying capacity concomitant with improved range condition (Savory 1978, 1988). However, research has shown considerable disagreement as to the advantages of grazing systems for the Northern Great Plains.

Prior to 1980, grazing research in the Northern Great Plains emphasized seasonlong (SL) (1 herd, 1 pasture) and deferred rotation (DR) grazing (1 herd, 2-4 pastures). Livestock responses generally favored SL grazing. In North Dakota and Montana, Sarvis (1941) Rogler (1944, 1951) and Currie (1978) reported moderately stocked SL grazing had superior steer gains compared to DR grazing. Hubbard (1951), Smoliak (1960) and Campbell (1961), in southern Canada, also re- ported greater livestock gains on SL grazing treatments. No differences in livestock responses on SL and DR grazing treatments were reported by Black and Clark (1942) and Whitman et al. (1943). Only Walton (1979) presented favorable livestock gains under DR grazing.

The value of DR grazing systems for range improvement was emphasized by Sarvis (1941), Rogler (1951), Hubbard (1951) and Galt and Kramer (1978). However, where livestock gains under DR grazing were not advantageous, vegetative response also did not differ from SL grazing (Rogler 1951, Smoliak 1960, Campbell 1961) with one exception. Hubbard (1951) observed that the primary forage species were better maintained under a moderately stocked DR grazing system. Walton (1979) attributed improved livestock gains under DR grazing to an improved composition and increased productivity of desirable forage species.

Recent grazing systems research has been dominated by intensive rotation systems such as short duration (SD) grazing. Dormaar et al. (1989) and Willms et al. (1990) concluded that long-term SD grazing at heavy stocking rates resulted in retrogression of Fescue Prairie and Mixed Prairie at Lethbridge, Alberta. Preliminary reports by Kirby et al. (1986) and McCartney (1990) suggested that stocking rates (numbers of livestock or length of grazing) may be increased utilizing SD grazing. Concurrent with the increased stocking rates, livestock production per hectare also increased (Kirby et al. 1986, McCartney 1990).

The purpose of this paper is to present the long- term results of SD grazing in the mixed grass prairie of North Dakota. Specific objectives of the research were: (1) determine the effect of SD and SL grazing on species composition and herbage production and disappearance, and (2) evaluate livestock production and stocking rates under SD and SL grazing management.

Study Area and Methods

Dickinson Research Center

A study was conducted between 1981 and 1989 on section 16 of the Dickinson Research Center (DRC), Ranch Headquarters (47° 14'N Lat, 102° 50'W Long) approximately 35 km northwest of Dickinson, North Dakota. Annual precipitation averages 40 cm with 70% received between 1 May and 30 September. Precipitation received between 1981 and 1989 totalled 21.6, 63.5, 39.4, 35.6, 61.0, 35.6, 19.1 and 33.0 cm, respectively. Vegetation was the Wheatgrass- Needlegrass Type of the Northern Great Plains mixed grass prairie (Barker and Whitman 1988).

Section 16 was divided into equal-sized (130 ha) SL and SD grazing treatments. The SL treatment was grazed seasonlong by an average of 20, 30 and 33 cow / calf pairs in 1981 to 1983, 1984 to 1986 and 1987 to 1989, respectively. An 8-paddock (16.25 ha), 1-herd SD grazing system was implemented and managed on a 5 day graze, 35 day rest schedule throughout the grazing season. Thirty-five cow I calf pairs grazed this treatment until 1989 when num bers were reduced by 5 pairs. Median grazing season was 20 June to 14 October (112 day average) for both treatments. Initial stocking rates, calculated by USDA, Soil Conservation Service Technical Guides (1984), were 27 cow / calf pairs (0.91 AUM/ ha) on the SL treatment and 24 cow / calf pairs (0.82 AUM/ha) on the SD treatment. Due to claims made by proponents of SD grazing, the initial stocking rate was increased 50% to 35 cow I calf pairs (1.22 AUM/ha) on the SD treatment.

Five range sites, thin claypan, shallow, sandy, silty and clayey, comprised nearly all of section 16. Herbage production was estimated for each range site and treatment by clipping two 0.25 m^2 plots within 10 randomly located portable exclosures. Herbage disappearance was estimated by clipping 20 uncaged "paired" plots on each range site of each grazing treatment. Long-term changes in plant species composition and basal area were deter mined using the line intercept method (Whitman and Siggeirsson 1954). Four permanently located, 10 m transects were measured on each range site and treatment.

Livestock weights were recorded at the initiation and termination of the trials, and at 28 day intervals throughout the grazing season. Performance (average daily gain) and production (kg/ha) of livestock were determined for each grazing trial.

Central Grasslands Research Center
A second study was conducted between 1982 and 1992 on section 25 of the Central Grasslands Research Center (CGRC) 46° 70'N Lat, 99° 40'W Long) approximately 70 km southwest of James town, North Dakota. Average annual precipita tion is 45.4 cm while 58.4, 48.3, 50.8, 45.7, 67.3, 40.5, 21.3, 45.9, 41.9, 35.3 and 38.7 cm were received in 1982 through 1992, respectively. The CGRC is located within the Wheatgrass-Needle grass Type also (Barker and Whitman 1988).

Two 130 ha SL and SD grazing treatments were established on the section with the SD treatment subdivided into 8-16.25 ha paddocks. The SL treatment was grazed seasonlong by 30, 40 and 45 cow/calf pairs (1.85 AUM/ha) in 1982, 1983 and 1984 to 1992, respectively. Allocated cow / calf pairs on the SD treatment were 45, 60, 65 and 60 (2.67 AUM/ha) for 1982, 1983, 1984 to 1991 and 1992, respectively. Between 1982 and 1987, cattle grazing the SD treatment were rotated on a 5 day graze, 35 day rest schedule. Grazing periods, thereafter, averaged 3 to 5 days during herbage growth and 7 to 10 days when herbage was dormant. Median grazing season was 24 May to 1

November (160 days) on both treatments.

Two range sites, silty and overflow, comprised over 80% of section 25. Herbage production and disappearance was estimated for both range sites in each grazing treatment by clipping 20 "paired" grazed and ungrazed 0.25 m^2 plots. Long-term species composition and basal area changes were evaluated using the 10-point frame technique (Amy and Schmid 1942). A total of 2,000 points were annually recorded on each range site of both grazing treatments.

Livestock were weighed at the initiation, midpoint and termination of grazing seasons. Livestock performance and production were determined for each grazing treatment.

Statistical Analysis

Differences in average herbage production and disappearance, and cow and calf performance between grazing treatments were determined with t-tests (Steel and Torrie 1960). Basal cover was converted to relative basal cover to reduce annual environmental influences. Basal cover changes between similar range sites across treatments, and among years were determined using principal components analysis (Ludwig and Reynolds 1988). Significant principal components were identified using Fisher's Proportionality Test (P<0.05). Multiresponse permutation procedures (Biondini et al. 1988) was used to determine differences in principal components (P<O.l).

Results and Discussion

Dickinson Research Center

There was no difference (P>O.l) in average annual herbage production between the grazing treatments (Table 1). Large year-to-year variations were evident and largely the result of differences in amount and timing of precipitation. Disappearance of herbage tended to be greater on the SD grazing treatment reflecting the overall greater stocking rate on this treatment. These results agree with conclusions by Hart et al. (1988) and Ralphs et al. (1990) that precipitation and stocking rate have greater influences on range herbage production and use than do grazing systems.

Plant basal cover and species composition did not differ (P>O.l) between similar range sites within and across grazing treatments for the years 1981 through 1987 (data not shown). In 1988, basal cover of prairie junegrass *(Koe!eria pyramidata* [Lamb.] Beauv.), green needlegrass *(Stipa viridula* Trin.) and bluegrasses *(Poa* spp.) declined on all range sites of both treatments (Table 2). Concurrently, basal cover of blue grama *(Bouteloua gracilis* [H.B.K.] Lag. ex Griffiths) and buffalograss *(Buchloe dactyloides* [Nutt.] Englm.) increased. With continued drought in 1989, basal cover of short warm-season grasses decreased on all range sites while forbs, low growing shrubs *(Artemisia* spp.) and cacti *(Opuntia* spp.) increased.

Species composition and basal cover changes on both grazing treatments were similar and first occurred in 1988 in response to severe drought conditions. These results suggest that grazing system and stocking rate, under the study conditions, were less influential than precipitation on range vegetation. Dahl (1986) and Hart et al. (1988)

reported similar vegetation changes in long-term grazing studies where vegetation was mainly influenced by precipitation events.

Average daily gain of calves on the two grazing treatments were similar throughout the study (Table 1). Bryant et al. (1989) and Taylor (1989) reported decreased livestock performance when using greater-than-recommended stocking rates under SD grazing compared with moderately stocked continuous grazing. Hart et al. (1988) concluded that decreased performance by live stock was caused by increased grazing pressure regardless of grazing system. This study's results would support Hart's conclusion. Cattle were removed when herbage use approximated 50%. In this way, grazing pressure apparently did not reach the level of depressing calf gains.

Stocking rates were quite variable from year-to- year on both grazing treatments. Initial stocking rates, based on a 4.5 month grazing season, were 0.82 AUM/ha (24 cow /calf pairs) and 0.91 AUM/ ha (27 cow / calf pairs) for the SD and SL grazing treatments, respectively. Actual stocking rates achieved over the last three years averaged 0.87 AUM/ha or a 5% increase for the SD treatment and 0.87 AUM/ha or a 5% decrease for the SL treatment. This would suggest that SD grazing may increase stocking rates by a few percentage points over moderate continuous grazing. Maintenance of stocking rates or a lengthening of grazing season during drought were not improved utilizing SD over SL grazing in this study.

Central Grasslands Research Center

Eleven-year average herbage production and disappearance was not different (P>O.l) between grazing treatments (Table 3). As at Dickinson,
large annual variation in herbage production was evident on both grazing treatments closely paralleling the timing and amount of seasonal precipitation received. Increased herbage production through advanced plant succession or induced regrowth following a grazing event (Savory and Parsons 1980, Savory 1983) was not exhibited under SD grazing in this study. Similar results were reported by Dormaar et al. (1989), Willms et al. (1990) and McCartney (1990) for Northern Great Plains rangelands.

Plant basal cover did not change each year between similar range sites on the grazing treatments with one exception. In 1985, basal cover was greater (P>O.l) for both range sites on the SL treatment (Table 4). Annual basal cover changes followed a similar trend on both grazing treatments. Between 1982 and 1985, wet years, basal cover increased on both range sites and grazing treatments. Drought conditions between the fall of 1987 and the spring of 1989 decreased basal cover of vegetation on both range sites and grazing treatments. These results are consistent with the Dickinson findings as well as those reported by Dahl (1986) and Hart et al. (1988). Average daily gain of calves was similar between grazing treatments throughout the study (Table 3). As at Dickinson, grazing pressure (herbage disappearance) was monitored throughout the grazing season on both treatments to prevent overuse of vegetation and depression of livestock performance. This performance data supports Hart et al.'s (1988) conclusion that decreased livestock performance is strongly correlated with grazing pressure regardless of the grazing method.

Stocking rate of the SD treatment (2.67 AUM/ ha) was 45% greater than that of the SL treatment (1.85 AUM/ha) despite both treatments having similar annual herbage disappearance. The explanation for this is not obvious but likely a set of interacting factors. Vegetative factors such as increased herbage production, and improved species composition and basal area could be eliminated as they were not evident under SD grazing; therefore, likely contributing little to increased stocking rates. Improved forage harvest efficiency, however, probably contributed significantly to the increased SD stocking rate. Allison and Kothmann (1979), Stuth et al. (1981) and Allison et al. (1982) reported harvest efficiency of grazed forage by livestock improved as stocking pressure increased.

Conclusions

The major objective of a grazing system is to maintain or improve forage resources while maximizing livestock production per unit area. Short duration grazing has been somewhat universally proposed to double or triple stocking rates regardless of range condition. Greater animal impacts on energy, nutrient and water cycles from increased stocking presumably increase herbage yields hence carrying capacity. The results of this study reject this hypothesis, though some benefits from SD grazing were achieved.

There was no discernable advance in plant succession under SD grazing management despite significantly higher stocking densities at both research locations. Herbage yield, cover, density, diversity and species composition remained similar between the range sites on grazing treatments throughout the study. Significant plant community changes only occurred during and following drought. These community changes were similar between grazing treatments at both research locations.

Livestock performance was maintained under SD grazing despite 10% and 45% increases in stocking rates at the DRC and CGRC, respectively. Presumably individual animal performance was maintained through management of grazing intensity. Livestock were removed from grazing treatments when approximately 50% of the herbage was utilized; therefore, forage intake should never have been restrictive. Since livestock performance was similar between treatments and stocking rates were greater on the SD treatment at both research sites, livestock production per unit area was greater on the SD treatment.

Short duration grazing increased stocking rates over moderately stocked, continuous grazing at both research sites. However, applying stocking rates under SD grazing management greater than those achieved in this study should result in range deterioration. A majority of privately grazed rangelands in the Northern Great Plains are presently overstocked when compared to a moderate stocking rate. Therefore, the stocking rate increases for SD grazing experienced at both research locations may not be significantly greater than those rates presently utilized on most privately owned rangelands. However, adoption of a rotation grazing system should allow maintenance of stocking rates on most privately owned range- land concurrent with maintenance or improvement of forage resources not possible under heavy continuous grazing.

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