Determining an optimum stocking rate for the Missouri Coteau of North Dakota

from the **North Dakota Agricultural Experiment Station 2002 Unified Beef Cattle and Range Research Report**
(for complete report go to http://www.ext.nodak.edu/extpubs/ansci/beef/2002/beef01.htm)

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The objective of this study is to determine the stocking rate that would result in the greatest long-term economic return to the livestock producer. In the past 12 years of this study the stocking rate that would have resulted in the greatest return was 1.76 AUM/acre. However for a number of reasons we feel this stocking rate may be too heavy to recommend.

This study compares the effects of five different grazing intensities on the plant community, livestock performance and economic returns. The stocking rate which provides the maximum pounds of beef/acre is generally higher than the stocking rate which produces the maximum economic return. The stocking rate with the highest return is higher than the one which produces the maximum pounds of forage per acre. Also, there is still some question regarding the sustainability of livestock performance under the heavy stocking rates.

Introduction

A grazing intensity research project was initiated at the Central Grasslands Research Extension Center (CGREC) in 1989. The objectives are to determine the effect of grazing intensity on livestock performance and profitability and its effect on the sustainability of forage production. Only the effect on livestock performance is discussed in detail in this paper.

Procedure

Five treatments are included: no grazing, light, moderate, heavy and extreme grazing. Each treatment is replicated three times in pastures of about 30 acres each except that the no grazing treatment consists of six 0.3-acre enclosures placed on both overflow and silty range sites. Livestock are not rotated between pastures and each pasture receives the same treatment each year. We try to stock the pastures each year so that when the cattle are removed in the fall, 65%, 50%, 35% and 20% of the forage produced in an average year is remaining on the light, moderate, heavy and extreme treatments, respectively. For these pastures that means 2,063 lbs/acre, 1,623 lbs/acre, 942 lbs/acre, and 484 lbs/acre, of forage remains on the light, moderate, heavy and extreme pastures, respectively. Open heifers have been used to stock the study since 1994; prior to that bred heifers or steers had been used. Adjustments in stocking pressure are made each year based on information from previous years to better match our desired grazing intensities. The cattle are weighed before they go on pasture and when they are removed. A dollar value is assigned to each animal based on its weight and the regression relationship which was developed using weight and sale prices from local livestock auctions during the week the animals went on or were removed from the pasture. When comparing estimated economic returns from selected stocking rates, costs for land, labor and management are not included because they vary greatly from one operation to another. Regression relationships were determined each year between stocking rate and average daily gain, gain per acre and economic return per acre.

Results and Discussion

Table 1 shows the average daily gain, gain per acre and body condition scores from the different grazing intensities for the last five years, average gains by treatment from 1991 to 2002 and average body condition from 1994 to 2002. Grazing pressure was too light on the heavy and extreme treatments in the first two years of the study so there are no significant differences in average daily gains in 1989 and 1990. Following that year, average daily gain and animal body condition scores decrease with increasing grazing intensity. The rate at which average daily gain decreases with an increase in stocking rate varies greatly from year to year. The differences between years may be due to variation in forage quality or quantity, the effect of weather on the animals, their initial weight or their potential to gain. In years when the grazing season ends early, as in 2000 to 2002, there is less chance for the differences in rate of gain between the light and extreme treatments to become significant.

Table 1. Average daily gains, gains per acre, and condition scores from different stocking intensities.

Desired Grazing Intensity	Average Daily Gains (lbs/head/day)					
	1998	1999	2000	2001	2002	Average 1991-2002
Light	1.53a1	1.40a	1.12	1.44	1.34	1.39a
Moderate	1.31ab	1.30a	1.07	1.29	1.47	1.27a
Heavy	1.03b	1.19ab	0.97	1.23	1.00	1.11b
Extreme	0.60c	0.96ab	0.82	1.14	0.78	0.77c
LSD2 (0.05)	0.38	0.25	NS3	NS	NS	0.16

Average Gain (lbs/acre)

	1998	1999	2000	2001	2002	Average 1991-2002
Light	28.29c	36.50b	33.03c	43.18c	20.06	24.39c
Moderate	62.25b	59.73b	42.39bc	59.88bc	37.90	48.51b
Heavy	97.86a	93.93a	58.24ab	67.15b	33.57	77.13a
Extreme	67.98b	108.49a	74.44a	108.27a	38.96	81.35a
LSD (0.05)	29.59	24.31	17.52	23.74	NS	12.73

Condition Score

	1998	1999	2000	2001	2002	Average 1994-2002
Light	5.81a	5.72a	5.18a	5.78	5.22	5.39a
Moderate	5.71ab	5.65ab	5.20a	5.52	5.18	5.29ab
Heavy	5.21b	5.54bc	5.01a	5.43	5.18	5.13b
Extreme	4.65c	5.41c	4.61b	5.24	5.05	4.78c
LSD (0.05)	0.53	0.18	0.31	NS	NS	0.21

1Means in the same column followed by the same letter are not significantly different at p=0.05.
2LSD=least significant difference.
3Means not significantly different.

Initially, gain/acre increases as the stocking rate increases but there comes a point when further increases in stocking rates result in reduced gain/acre. All years except 2001 had at least one observation of a stocking rate higher than the rate projected to give the maximum gain/per acre for the year. Since we can't predict ahead of time what stocking rate would give the maximum gain/acre in a particular year, it would be impossible to stock each year for maximum gain/acre. In retrospect, if we were to pick one stocking rate that would have resulted in the maximum gain/acre over this 12-year period it would have been 2.14 AUM/acre. We predict that if we had stocked at this level each year, gain per acre would have ranged from a loss of 44.6 lbs/acre in 2002 to a gain of 148.9 lbs/acre in 1993 with an average of 78.3 lbs/acre. Because so little forage was produced in 2002, the grazing season was cut short and none of the pastures were actually stocked that heavily.

If cattle prices were constant, then return/acre would peak at a stocking rate somewhere below maximum gain/acre with the exact point depending on carrying costs (interest, death loss, salt and mineral, vet cost, transportation, labor and land). However, when cattle are worth more per hundredweight in the spring than they are in the fall it causes the point of maximum return/acre to occur at a lower stocking rate. When they are worth more in the fall, it causes the maximum return to occur at a higher stocking rate. Obviously we can't know ahead of time what the optimum stocking rate for a particular year is going to be. If we were to pick one constant stocking rate that would have provided the maximum return/acre over this last 12-year period it would have been 1.76 AUM/acre. Although the average return per acre is higher under the optimum rate there were four years with negative returns while only one year had a negative return under the moderate stocking rate. (Costs for land, labor and management have not been subtracted). In all but three years (1992, 1996 and 1999), the stocking rate with the greatest economic return was less than the rate with the greatest gain per acre.

Recommendations

Results of the past 12 years indicate that the stocking rate that would have provided the greatest return was 1.76 AUM/acre. However, for a number of reasons we feel this stocking rate may be too heavy to recommend. First, the extreme and heavy grazed pastures have been deteriorating in condition through the course of the study and may not be able to support the rates of gain we have seen in the past. Also, we have had higher-than-average precipitation through much of this period. The average annual precipitation for the first 13 years of this study was 19.06 inches compared to the 51-year average of 17.99 inches. As we move into a period of drier weather, forage production and annual gains are reduced. Both profits and losses are higher at higher stocking rates depending on the difference between spring and fall livestock prices. The producer would experience more years with negative returns at the higher stocking rates.

It appears that the moderate stocking rate may be too conservative if maximizing profit is the objective. In only three out of 12 years, returns would have been higher with a stocking rate less than the moderate rate of 0.96 AUM/acre. In all other years, a higher stocking rate would have resulted in higher returns. For a stocker operation in this area, the optimum stocking rate would fall in the range of 0.96 to 1.76 AUM/acre. In lower rainfall areas farther west in the state, these values would be reduced.

These stocking recommendations cannot be applied to a cow-calf operation because calf gains are largely dependent on the cows' milk production. Higher stocking rates could reduce the cows' condition and conception rates and result in higher overwintering costs to bring the cows back to condition to calve in the spring.

More information on this and other research conducted at the Central Grassland Research Center is available at: http://www.ag.ndsu.nodak.edu/streeter/