MANAGING FOR PLANT DIVERSITY ON RECLAIMED GRASSLANDS[1]

Don R. Kirby[2]

Abstract. Prescribed early season cattle grazing was evaluated on two reclaimed grasslands. The first grassland was on the Indian Head Mine (IHM), Zap, ND with smooth bromegrass (Bromus inermis) prevalent on the site. The second grassland was on the Glenharold Mine (GHM), Stanton, ND and had an infestation of Japanese brome (Bromus japonicus) following reclamation. Each site was grazed by cattle from mid to late May through mid to late June (GHM) or through early to mid July (IHM). Bromegrasses are quite palatable in the early growing season and readily grazed by cattle. In this study the cattle were removed when most of the bromegrass had been grazed and warm-season grasses were rapidly growing. Live basal cover and species composition were estimated using the ten-pin, point frame. Aboveground herbaceous yields were estimated by clipping 0.25 m^2 quadrats located along randomly selected transects. On the Indian Head Mine, basal cover of native cool- and warm-season grasses increased, while basal cover of introduced cool-season grass species decreased. In addition, seasonal balance of plant species was improved. At the Glenharold Mine, Japanese brome and annual litter cover decreased from 50% to less than 1% between 1995 and 1998. Yield of Japanese brome dropped from 10% of the total in 1995 to less than 3% of the total in 1998. Early season cattle grazing is a managers tool that can decrease the dominance of introduced cool-season grasses such as bromegrasses and improve the plant species diversity and seasonal balance of reclaimed grasslands.

Additional Key Words: surface coal mining, cattle grazing, smooth bromegrass, Japanese bromegrass.

Introduction

Re-establishment of diverse, seasonally balanced native grassland plant communities following surface coal mining operations in the Northern Great Plains is a challenge due in part to limited seed sources, climate, and competitiveness of cool-season grass species (Williamson 1984). Regardless of how well revegetation plans are designed and implemented, resultant native grassland stands vary considerably in composition (Nilson et al. 1985, Krabbenhoft et al. 1993). Re-established grass stands also have the added stress of competition from weedy

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[1]Paper presented at the 2001 National Meeting of the American Society for Surface Mining and Reclamation, Albuquerque, New Mexico, June 3-7, 2001. Published by ASSMR, 3134 Montavesta Rd., Lexington KY 40502.

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introduced species such as quackgrass (Agropyron repens), Kentucky bluegrass (Poa pratensis), smooth brome (Bromus inermis) and annual bromes such as Japanese brome (Bromus japonicus) and downy brome (Bromus tectorum). As a result, reclaimed grasslands in the Northern Great Plains generally become heavily dominated by cool-season grass species, especially during the first few growing seasons following their re-establishment.

Few post-establishment management techniques for reclaimed grasslands are available to combat imbalances in plant species composition without setting the liability period clock back. Livestock grazing is one such technique acceptable for post-establishment manipulation of reclaimed grass stands. Most lands disturbed by surface mining in the western United States were rangeland grazed by livestock and wildlife and will be returned to grazing land for the primary post-mining land use (Schuman et al. 1990). Recently Cline et al. (1999), and Kirby et al. (2000) reported that early season livestock grazing on reclaimed grasslands tended to improve the seasonal balance of grass stands, while Krabbenhoft et al. (2000) suggested that early season livestock grazing could reduce infestations of annual grasses in re-established grass stands. However, limited information is available describing livestock grazing techniques having the ability to reduce aggressive introduced annual and perennial plant species in native re-established grasslands.

The objective of this paper is to describe the effects of early season livestock grazing on Japanese brome and smooth brome infestations within reclaimed grasslands in western North Dakota. This paper should provide information necessary to make grazing management recommendations for similar areas to reduce the competitiveness of introduced, aggressive, and weedy plant species.

Study Area and Methods

The research was conducted on the Glenharold and Indian Head coal mines in Oliver and Mercer Counties of west central North Dakota. The mines are located in the Missouri Plateau Physiographic Region of North Dakota. This region lays on the western edge of an area where soils are formed from glacial deposits and residuum weathered bedrock of the sedimentary Sentinel Butte formation. Agriculture is the primary land use in the area adjoining the mine. Grasses and grasslike plants dominate the native vegetative communities in the surrounding mixed grass prairie (Barker and Whitman 1988).

Glenharold Mine

In 1992, randomly located transects were sampled on the west pasture of Section 8 at the Glenharold Mine. Sampling continued in 1995 and 1998. The soils of the area were considered silty site types. Transects and portable grazing exclosures were randomly located across the 14.7 ha reclaimed area which was associated with an approximately equal amount (11 ha) of undisturbed rangeland and woodlands. Basal cover and species composition were estimated each year using the ten-pin point-frame method (Arny and Schmid 1942). During each sampling year, 2000 points were taken along two randomly located transects. In 1995 and 1998, aboveground herbaceous yields were estimated by clipping 0.25 m^2 quadrats. Two quadrats were clipped at each of ten grazing exclosures in 1995, while three were clipped during 1998.

The reclaimed pasture was seeded in early June of 1989. The site was rotary mowed during four of its first 8 years of establishment. Grazing was implemented during year nine in the spring of 1997. The site was grazed by 47 cow/calf pairs from May 24^{th} - June 22^{nd}. During 1998, 48 cow/calf pairs grazed from May 16^{th} - June 17^{th}. The average stocking rate during these years was 1.9 animal unit months per ha (AUM/ha).

Indian Head Mine

In 1989, three transects, each containing ten sampling points, were established on the reclaimed site on the Indian Head Mine. The sites contained clay loam soils before mining. Vegetative cover was estimated each year using the ten-pin point-frame method. Ten frame (100 points) readings were taken randomly at each sampling location (10 per transect) along transects. Aboveground herbaceous yields were estimated by clipping a 0.25 m^2 quadrat at each sampling location at peak standing crop.

The 26.7 hectare reclaimed area was seeded, mulched and crimped in 1986 and hayed in 1987. Grazing was implemented in 1994 and continued annually through 1998 with a stocking rate of 0.74 to 0.84 AUM/ha. Grazing began each year in mid-May and continued to late July.

Results

Glenharold Mine

In 1992, Japanese brome and annual litter from the previous year's growth was estimated to be 66% of the total ground cover (Fig. 1). Little change was evident by 1995 with annual grass still at 50% ground cover. However, following two seasons of intensive early season grazing, annual grass levels fell below 1% of the total cover by 1998 (Fig. 1).

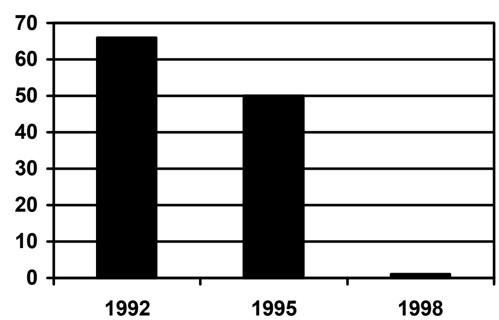

Figure 1. Relative cover (%) of Japanese brome and annual litter on the Glenharold Mine, Stanton, North Dakota.

A positive trend in plant species seasonality occurred during the study. An increase in warm-season grasses occurred for both cover and yield measurements. The relative percentage of warm-season grass cover went from 17% in 1995 to 42% in 1998 (Fig. 2).

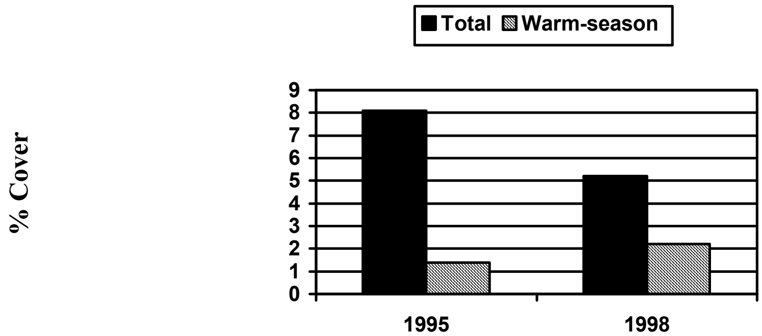

Figure 2. Total and warm-season basal cover (%) on the Glenharold Mine, Stanton, North Dakota.

Japanese brome yields averaged 264 kg/ha (10% of the total) in 1995 (Fig. 3). Yield dropped to 52 kg/ha (3% of the total) in 1998. Warm-season grass yields exhibited an equal but opposite trend by increasing from 8 to 28% of the total yield by 1998 (Fig. 3). Japanese brome was present in 40% of the clipped plots in 1995 and only 15% of the clipped plots in 1998 (data not presented).

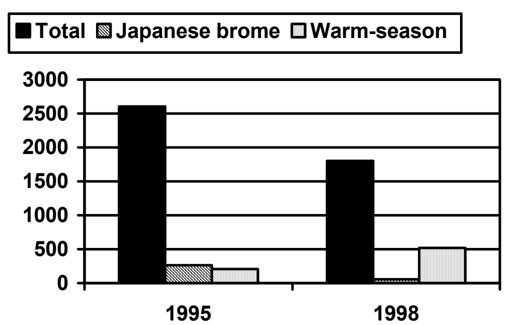

Figure 3. Total herbaceous, Japanese brome, and warm-season grass yields (kg/ha) on the Glenharold Mine, Stanton, North Dakota.

<u>Indian Head Mine</u>

Total plant species basal cover ranged between 3.1 and 6.6% over the study period (Fig. 4). The basal cover of smooth brome decreased from approximately 50% of the relative cover in 1989 to just 6% in 1998 following the initiation of spring grazing (Fig. 4).

A positive trend in plant species seasonality occurred during the study as evidenced by an increase in warm-season grass relative to total basal cover (Fig. 5). For 1989 and 1990, warm-season grass species averaged 29% of the total basal cover. For the period 1996 to 1998, warm-season grasses averaged 54% of the total basal cover of the study site.

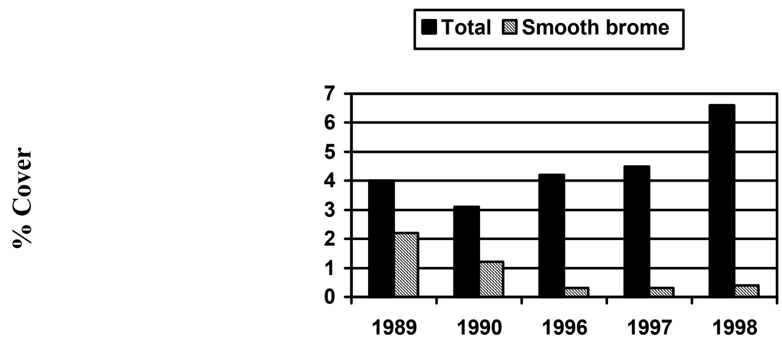

Figure 4. Total and smooth brome basal cover (%) on the Indian Head Mine, Zap, North Dakota.

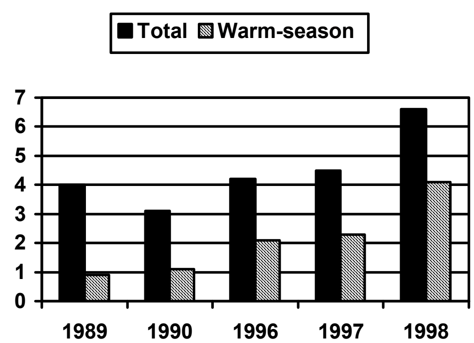

Figure 5. Total and warm-season grass basal cover (%) on the Indian Head Mine, Zap, North Dakota.

Smooth brome yields averaged 6% of the total in 1989 and 1990 (Fig. 6). Yield was only 16 and 40 kg/ha in 1996 and 1997 following early season livestock grazing. Concurrently, warm-season grass yields averaged 6% of total yield in 1989 and 1990 and increased to nearly 25% of the total average yield in 1996 and 1997. This resulted in a better balance of cool- and warm-season grasses occupying the site.

Conclusions

Early season livestock grazing decreased the cover and yields of introduced brome grasses at both mines. Concurrently warm-season grass cover and yield increased as a percentage of the total. This increase in warm-season grasses resulted in a positive trend in the seasonal balance of plant species on both reclaimed grasslands. This positive trend in seasonality occurred despite an unusually wet spring climatic cycle, which tends to favor cool-season grass dominance.

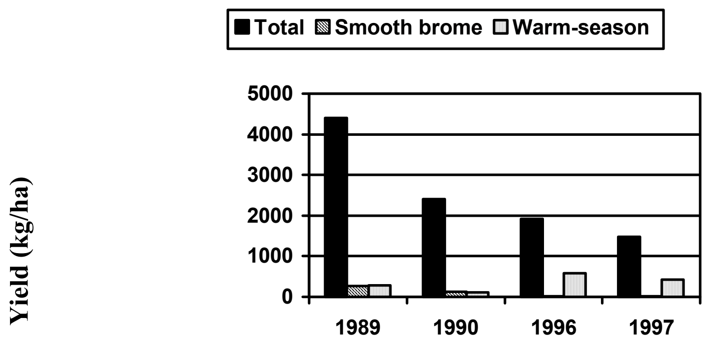

Figure 6. Total herbaceous, smooth brome, and warm-season grass yields (kg/ha) on the Indian Head Mine, Zap, North Dakota.

Management of diverse reclaimed grasslands should be aggressive and initiated soon after stand establishment to prevent cool-season grass species, including introduced species, from becoming too dominant. Grazing should be implemented 2 to 3 years after seeding. Introduced bromegrasses grow earlier than most native grasses and are quite palatable to livestock. Early season grazing can reduce seed set of annual species and the competitive advantage of early growth species, such as smooth brome, to improve seasonal balance on re-established grasslands.

The reclaimed grasslands in this study lie within an area primarily used for livestock grazing. Grazing reclaimed grasslands can, therefore, indicate their sustainability under the intended future agricultural use. In addition, income from grazing leases have the potential to offset mine costs for development, such as water and fencing, and maintenance, such as weed spraying, during the reclamation liability period.

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