EFFECTS OF WILDLIFE UTILIZATION ON WYOMING BIG SAGEBRUSH GROWTH AND SURVIVAL ON RECLAIMED MINE LANDS[1]

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Abstract: Ensuring Wyoming big sagebrush (*Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle & Young) survival remains a challenge on many mines even years after initial establishment. Wildlife utilization may be a major influence on its survival. A wildlife exclosure was erected in June 2001 on a portion of a study initiated in 1990 at the North Antelope/Rochelle Mine in northeastern Wyoming. Investigations focused on the influence of wildlife utilization on big sagebrush survival and growth under 3 grass seeding rates, inside and outside of the exclosure. Growth, browsing, and survival were evaluated on 72 marked sagebrush plants inside and outside of the exclosure. Permanent 1 m^2 quadrats established in 1990 and 2 x 12 m belt transects were utilized to estimate big sagebrush density both inside and outside of the wildlife exclosure. Big sagebrush mortality, based on the 72 marked plants, was 24 outside the exclosure and 8 inside the exclosure for 2001-2002. Grass seeding rate had no effect on mortality inside the exclosure; however, mortality outside was lowest in the highest grass-seeding rate, 32 kg ha^{-1}. The higher grass-seeding rate appears to have enhanced big sagebrush survival although a specific ecological explanation is not clear from our data. Other research has shown similar responses whether browsed by livestock or wildlife. Big sagebrush browsing outside of the exclosure was 100% on the marked sagebrush plants and no browsing was evident inside the exclosure. Fecal pellet group and individual pellet data along with bite characteristics on the sagebrush leaders indicated that rabbits were the major browsers. Annual leader length (new growth on sagebrush) averaged 44.3 mm inside the exclosure and only 16.8 mm outside the exclosure for the 2 years. Findings of this research has shown that wildlife utilization can significantly impact shrub growth and survival on reclaimed mine lands, making it difficult to achieve the shrub density requirement for bond release.

Additional Key Words: Reclamation, deer, rabbits, browse, shrubs

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Introduction:

Wyoming state law requires reestablishment of Wyoming big sagebrush (*Artemisia tridentata* ssp. w*yomingensis*) on surface coal mined lands if it was present in the pre-mine ecosystem and wildlife habitat is to be a post-mine land use. Big sagebrush is critical for many wildlife species because it provides critical winter browse and cover (Beetle 1960, Johnson and Anderson 1984). Considerable research has been completed in the past decade to develop cultural practices to enhance establishment of big sagebrush (Schuman *et al*. 1998, Bowen *et al*. 2002, Williams *et al*. 2002). However, excessive wildlife utilization of big sagebrush on some mines seems to have had significant impact on its survival (Olson *et al*. 2000). The objective of this research was to quantify the effect of wildlife utilization on big sagebrush survival and growth.

Methods and Materials:

In June 2001, a portion of a Wyoming big sagebrush establishment study initiated by Schuman et al. (1998) in 1990 was selected to assess the effect of wildlife utilization on growth and survival of big sagebrush (Partlow 2003). The study site was on the North Antelope Coal mine 100 km south of Gillette, Wyoming. The initial research study encompassed approximately 1.2 ha of leveled coal mine spoil, half of which had been topsoiled with direct-haul soil and the other half with 5-year old stockpiled topsoil. In this study, data on sagebrush growth, browsing and survival were only collected on direct-haul topsoil plots. Topsoil used on the study was a complex of two soil series both of which were Ustic Torrorthents (Schuman et al. 1998). The original sagebrush establishment study was a split-split plot randomized complete block design with 2 topsoil treatments (direct-haul and stockpiled), 4 mulch treatments (stubble, straw, stubble + straw, and control), and 3 grass seeding rates (0, 16, and 32 kg PLS/ha). Sagebrush was seeded across all plots at 2.2 kg PLS/ha. For greater detail of the original study design see Schuman et al. (1998). In June 2001, a wildlife exclosure was constructed (90 by 30 m by 3.1 m tall) which enclosed half of each replicated direct-haul topsoil treatment plots. This resulted in a uniform number of the grass seeding treatment subplots being inside and outside of the exclosure. The exclosure was constructed of woven wire approximately 2.4 m high, with

0.5 m high small mesh wire attached to the lower portion of the woven wire and extended horizontally against the ground to exclude smaller mammals such as rabbits. Permanent 1-m quadrats established in the original study and newly established 24-m^2 belt transects were used to assess sagebrush density inside and outside of the exclosure. Within each seeding rate subplot 4 sagebrush seedlings were selected and marked with a plastic zip-tie near the plant base, resulting in 72 marked plants both inside and outside the exclosure. These plants were used to assess cumulative growth by measuring plant leader length and to assess wildlife utilization and survival. Measurements were made in June and September 2001 and April and September 2002.

Results and Discussion:

Big sagebrush density was not different inside and outside the exclosure in 2001, but was significantly higher inside the exclosure in 2002. Wildlife utilization of big sagebrush plants outside of the exclosure between June 2001 and September 2002 resulted in the death of 24 marked plants compared to only 8 plants dying inside the exclosure. One hundred percent of marked big sagebrush plants outside the exclosure were browsed by wildlife compared to zero utilization of sagebrush plants inside the exclosure. Big sagebrush mean leader length inside the exclosure was significantly greater (38-48 mm) than outside the exclosure (16-18 mm), generally averaging at least two times longer in length.

Grass seeding rates had little effect on sagebrush density in 2001-2002. However, sagebrush survival outside the exclosure was greater in the 32 kg/ha grass seeding rate when survival from 1991 through 2002 is considered. Winter wildlife utilization was also significantly less on sagebrush plants growing in the 32 kg/ha grass seeding rate outside the exclosure. Utilization was 52, 43, and 22% in the 0, 16 and 32 kg/ha grass seeding rate treatments, respectively. Greater big sagebrush utilization in the two lower grass seeding rate treatments resulted in greater sagebrush mortality than observed in the higher grass seeding rate. Other researchers have also observed reduced wildlife utilization and/or mortality of big sagebrush when plants are in sheltered areas compared to open areas of a plant community or landscape (Schuman and Belden 2002, Owens and Norton 1992). However, we are unable to fully explain this response to grass seeding rates but the consistent trend of reduced winter utilization and greater survival are significant.

These research findings clearly show the impact of excessive wildlife utilization on Wyoming big sagebrush reestablishment success on a reclaimed mined site. Evaluation of browsed stems and fecal group and pellet count data indicate the major browser at this site was rabbits. Management strategies that reduce rabbit populations, such as enhancing raptor habitat and reducing rabbit habitat such as large rock piles on the reclaimed areas, might lead to reduced mortality of sagebrush seedlings.

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