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ESTABLISHING SHRUBS TO ACHIEVE BOND RELEASE ON COLORADO COAL MINES — A DEMONSTRATION OF METHODS.

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Project Description and Objectives:

The purpose of this project was to evaluate the long-term response (7 years after implementation) of various shrub establishment techniques at three coal mine sites within mountain shrub habitats in northwestern Colorado. Research plots were established in the autumn of 2000 and initially monitored for four growing seasons (2001-2004). In this study, we collected data on these plots during the summer of 2007 in order to evaluate these methods over a longer and more ecologically-meaningful time frame. Results from this study have provided critical information regarding what is, or is not feasible for shrub establishment in these habitats. Increasing shrub establishment will result in improved wildlife habitat and long-term surface stabilization.

Applicability to Mining and Reclamation:

This study determined best management practices for enhancing shrub establishment in mountain shrub zones of the Rocky Mountains. Overall, it seems that successful shrub establishment is possible in mountain shrub communities of the Rocky Mountains so long as important factors that reduce shrub establishment are considered and alleviated in reclamation planning. This information will be useful for any land manager interested in establishing shrubs in this region after a variety of surface disturbances.

Methodology:

The goal of this study was to evaluate methods for enhancing shrub establishment after mining. To meet this goal, study plots were established in 2000 to evaluate reclamation techniques to overcome obstacles to shrub establishment. The experimental design used large-scale



ABOVE PHOTO: Robust serviceberry transplants inside the fenced area at Seneca Mine in 2007.

demonstration plots that were constructed with normal reclamation equipment to test shrub establishment techniques that have commercial practicality. Plots were established at three surface mines (Colowyo, Trapper, and Seneca) in northwestern Colorado. Several treatments were tested to evaluate shrub establishment on spoil material, 15 cm of topsoil, and 46 cm of topsoil. Plots were strip seeded with native seed mixes, alternating rows of herbaceous species and shrub species. Native shrub transplants were planted at one mine. Half of each treatment was fenced to prevent browsing. In 2007, the vegetation in each test plot was evaluated to determine the relative success of the various treatments for establishing shrubs.

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Highlights:

Colowyo Mine: Of the three sites, shrub establishment was greatest at Colowyo mine. Establishment of mountain big sagebrush, the dominant late-seral shrub in the region, was very good in nearly all plots at Colowyo where this species occupied as much as 23% ground cover. In general, shrub densities have declined or remained steady over time in the plots at Colowyo. Some declines are likely attributed to natural thinning of dense shrub populations or removal by browsers. Increases in shrub densities over time in some plots can be attributed to the delayed establishment of silver sagebrush at this site, which did not appear in most plots until 2004. In general, shrub establishment at Colowyo has been better in fenced plots relative to unfenced plots. Results from Colowyo mine indicate that the autumn 2000 seeding operation was very successful as most of the seeded species continued to be found on the site in 2007. Lewis flax, big sagebrush, silver sagebrush, and western yarrow are seeded species that have established in all plots. The seeded grass species are also well established. The long-term nature of shrub persistence in these plots is of concern due to the reputation of annual bromes for displacing shrubs.

Trapper Mine: Shrub establishment at Trapper mine was slow relative to the other sites, likely due to dry conditions after the spring 2001 seeding. The poor initial establishment may also be related to the spring planting not providing proper vernalization of the seed. As a result of poor establishment of seeded species, the site was quickly colonized and dominated by weedy herbaceous species. However, by 2007 shrubs and other seeded species had appeared in the Trapper plots. Most of the vegetative cover in demonstration plots at Trapper continues to be weedy invasive species, especially the annual grasses, cheatgrass and Japanese brome. These weedy annual grasses have increased in recent years while weedy forbs such as Russian thistle and tall tumble mustard have declined. The recent increase in dominance of these weedy grasses in the Trapper plots may pose a long-term threat to the establishing shrubs. Despite the poor initial (2001-2004) establishment of shrubs and the dominance of weeds at the Trapper site, there was modest

establishment of some shrub species at Trapper by 2007, especially within the fenced portion of the plots. The lack of substantial shrub cover outside the fence despite the presence of some individual shrubs, might be due to the small stature of these browsed shrubs and the dominance of weeds in the unfenced portion of the plots.

Seneca Mine: Shrub establishment at Seneca mine was intermediate relative to Trapper and Colowyo mines. While shrub density was low at Seneca relative to Colowyo, the shrubs at Seneca were very robust at this site as indicated by height measures. The large size of these shrubs is likely due to the fact that transplants were used. Shrub transplants planted in some of the plots continued to show high survival (61%) in 2007 and many flowering and fruiting shrubs were observed at this time. Among all of the mines, Seneca was the only location where the tall shrub species such as serviceberry and chokecherry became established. These species did not establish well from seeding on the other mines, whereas they did establish from the transplants at Seneca. Similar to the other sites, the initial dominance of weedy forbs such as Russian thistle has subsided at Seneca. However, the recently established invasive weeds, yellow sweet clover and Japanese brome, are now dominant species in most plots at Seneca. It is likely that yellow sweet clover will not be a persistent problem, but Japanese brome is of concern.

Results/Findings:

This study indicated that shrub establishment was favored by fencing to exclude big game. However, the long-term potential success of shrubs that have established outside the fence, where browsing occurred, is unknown. Secondly, the use of shrub transplants may increase initial success, but the observed success of seeding several shrub species such as sagebrush and bitterbrush illustrate the potential utility of this less-costly approach. However, the establishment of tall shrub species such as serviceberry and chokecherry may require the use of transplants and protection from browsing. Results from this study also indicate that lesser amounts of topsoil (15 cm) appear to be better for shrub establishment relative to deeper topsoil treatments (50 cm) or no topsoil.

Website Information:

The final project report can be found at <http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/2006appscience/CompletedProjects/COEstabShrubs2006FR.pdf>

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