

Historical Sagebrush Establishment Practices in the Powder River Basin

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Abstract

The Powder River Basin of Wyoming is a semi-arid area dominated by sagebrush grassland vegetation communities. This region includes 15 surface coal mines. Reclamation of mined lands requires re-establishment of native species to meet the post mine land use. The Wyoming Department of Environmental Quality (WDEQ) serves as the regulatory authority for the State's surface coal mines. Wyoming statutes require that the disturbance from surface coal mining activities be reclaimed to a condition at least equal to the pre-mine condition.

Big sagebrush (*Artemisia tridentata*) is one of the major shrub components of the pre-mine vegetation communities. Because of sagebrush's dominance in various portions of the basin, shrub density requirements were developed by the State and have evolved to a current shrub density standard. The evolution of the shrub density requirement has been paralleled by development of myriad shrub establishment techniques.

Successful shrub re-establishment is vital for final bond release. Most final reclamation will be evaluated for the shrub density standard on 20% of the post-mined surface. The most successful techniques should be evaluated from the over 20 years of shrub establishment experience. To see where we are going, we need to look at where we've been.

Introduction

The Powder River Basin of Northeast Wyoming includes 15 surface coal mines. Surface coal mining expanded significantly in the early 1970's. The volume of coal exported from the Basin rose steadily through the 1980's to a current total of approximately 317 million tons in 1999. (Wyoming Mining Association 1999)

The national Surface Mining Control and Reclamation Act (SMCRA) of 1977 regulates the reclamation of mined lands. The Wyoming Environmental Quality Act (WEQA) defined Wyoming's program and the Wyoming Department of Environmental Quality (WDEQ) serves as the regulatory authority for the State's surface coal mines. Wyoming statutes require mined land disturbances be reclaimed to a condition equal to the pre-mine condition and require demonstration that the land is capable of sustaining pre-mine land use. (U.S. Congress 1977, WEQA 1973)

Pre-mining land use in northeastern Wyoming is primarily grazing and wildlife habitat. The wildlife habitat portion of the land use dictates the re-establishment of the pre-mine shrub component which in this area, is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*).

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The purpose of this report is to present a brief history of regulations, planting techniques, and research in shrub re-establishment in Wyoming with particular emphasis on the Powder River Basin. Mines within the Powder River Basin were surveyed to obtain information regarding their sagebrushreclamation efforts. This history is divided into the following periods: Pre-1980, 1980 - 1989, 1990 - 1999, and 2000 and beyond.

Historical Summary

Pre-1980, Before State Program Approval

Regulation

Prior to 1980, the federal program required surface coal mine operators to restore shrubs and trees to an average density of 450 stems per acre (Code of Federal Regulations 30CFR 816.116). The original WEQA required operators to reclaim shrubs and trees to a density equal to the pre-mine density. On average, this is a difference of about nine times the stems per acre. Such a large difference in regulatory requirements caused much discussion and regulatory action after 1980 between the operators and the regulatory agencies.

Techniques

Of the mines surveyed, three were opened prior to 1980. None of those mines opened before 1980 reported planting any sagebrush in their reclamation program.

Research

Research before 1980 basically discussed the importance of soil moisture competition effects on sagebrush establishment. Cook and Lewis (1963) and McDonough and Harniss (1974) theorized sagebrush was difficult to establish due to the methods used to harvest seed, seed microclimate, and seed dormancy. Harniss and McDonough (1976) hypothesize that poor establishment from direct seeding resulted from poor seed viability. Research by Howard et al. (1979) showed that woody plants may survive the climate and soil conditions of Wyoming and Colorado, but growth was slowed by wildlife predation. These early research topics form the basis for future papers.

1980 – 1989 Period

Regulation

In 1983, the Office of Surface Mining Reclamation and Enforcement (OSMRE) adopted regulations requiring minimum shrub and tree stocking and planting arrangements for areas to be developed for fish and wildlife habitat. The planting rates were to be specified by the regulatory authorities based on local and regional conditions after consultation with State agencies responsible for the administration of the forestry and wildlife programs. Several environmental groups and the coal industry promptly sued OSMRE. A court ruling was completed in 1987 and OSMRE revised the federal rules.

During the four years of court proceedings, Governor Herschler appointed a Task Force on Regulatory Reform. One of the subcommittees was charged with developing an alternative to the

100% shrub replacement requirement. The WDEQ Land Quality Division (LQD) Rules and Regulations proposed operators meet a 10% shrub goal of the pre-mining density. This goal is one shrub per square meter on 10% of the affected area. The regulation was promulgated in 1986 with OSMRE's approval before final court ruling.

The Wyoming Game and Fish Department (WGFD) petitioned WDEQ/LQD for a new shrub density standard in 1989 that would increase the density and specify the composition of shrubs to be used. The proposal would change the 10% goal to a 20% standard and address the pre-mining shrub community composition. The 20% standard was defined as 1 shrub per square meter on 20% of the land area.

The 20% standard was debated before the Land Quality Advisory Board (LQAB) several times during 1989. Subsequently the LQAB requested a committee be formed consisting of LQD, WGFD, and coal industry personnel to negotiate a compromise.

Techniques

In 1980, two mines started to incorporate big sagebrush into their permanent reclamation seed mix. Initial seed rates in 1980 through 1983 varied from 0.1 to 20 pounds of sagebrush seed per acre. The seed was broadcast with a Brillion seeder and drill seeded with a Truax drill and other types of disk or shoe drills. Vegetation sampling from one site indicated that drill seeding obtained a shrub density of 0.02 shrubs per square meter.

From 1980 to 1983 at the above-mentioned mines, grass hay mulch was applied at the rate of 2 tons per acre and 10 pounds of winter wheat per acre was seeded as a cover crop. One mine applied fertilizer regularly at the rate of 20 pounds of nitrogen and 20 pounds of phosphorus per acre. Vegetation sampling showed no sagebrush established at these sites.

By 1985, more mines included big sagebrush in their permanent reclamation seed mix. By 1989, all mines surveyed had included sagebrush in their permanent reclamation seed mix. Seeding rates were less varied and ranged from 1 to 6 pounds per acre. Fertilizers were no longer used. The technique of using a small grain stubble mulch and interseeding sagebrush was common practice at the majority of mines surveyed. Vegetation sampling of the sites planted during this time frame showed sagebrush establishment densities of 0.16, 0.46 and 1.06 shrubs per square meter.

Other methods were also being utilized to establish big sagebrush during the 1980's. Some mines purchased and planted sagebrush tublings. One mine built a range pad cutter and harvested pads of native rangeland with mature, established sagebrush plants for placement in reclaimed areas. Vegetation sampling showed little or no recorded success. No documentation described any special considerations regarding seed procurement or seed treatment practices.

Research

Research during the 1980's began to look at sagebrush establishment issues in greater detail, paralleling the trend of in-depth research of other disturbed lands issues. Williams et al. (1981) added to the pool of research by identifying vesicular arbuscular mycorrhizae (VAM) as a factor affecting sagebrush seedling establishment. Their work specifically studied VAM inoculum levels and longevity in long-term topsoil stockpile storage.

Pfannensteil and Wendt (1984) studied enhancing the establishment of sagebrush on reclamation in Colorado by direct haul placement of topsoil. C. Wayne Cook (1988) reviewed the reclamation

research literature and concluded that current research was not widely available and in particular, stated that some shrubs were still difficult to establish. His ultimate question was, “Has research contributed significantly to mined land reclamation.” By 1989 other researchers were debating the proposed shrub density increase regulation. Tessmann and Kleinman (1989) wrote a point/counterpoint paper that echoed some of the same issues discussed by Colbert and Colbert (1983) about the validity and need of using sagebrush in revegetating mined lands.

1990 – 1999 Period

Regulation

The joint shrub committee consisting of WGFD, LQD, industry personnel and special interest groups held work sessions in 1990, 1991, and 1992 to discuss the 20% standard. Finally, the Environmental Quality Council (EQC) approved a proposal for a shrub density standard of 1 shrub per square meter on 20% of the affected area. The State rule submitted in October 1992 was filed and submitted to OSMRE for public comment. The federal public comment period ran through April 1993.

Meanwhile, the 1993 Wyoming Legislature passed Enrolled Act No. 86 which became law without the Governor’s signature. Enrolled Act No. 86 inserted several paragraphs into the standards. The Enrolled Act No. 86 basically required operators, who reclaim grazing land, to re-establish shrubs on 10% of the affected surface to a density of 1 shrub per 9 square meters or to a pre-mine density, whichever is less. Shrubs stipulated for use in reclamation consisted of native shrubs from the general area identified in pre-mine surveys, but the dominant pre-mine shrub need not be the dominate post-mine shrub.

Enrolled Act No. 86 was submitted to OSMRE as a formal program amendment. After the extended public comment period, OSMRE requested that the State clarify the conflicting rule and statutory language. Wyoming responded by outlining the conflicting portions of the rule and statute and requested that OSMRE determine whether the amended statute was as stringent as the Federal law.

By January 1994, OSMRE rejected the State rule and State statute and required six amendments be added to Wyoming’s program. The legislature responded by drafting proposed changes in Enrolled Act 86. Governor Sullivan signed Enrolled Act No. 24 (1994) that fulfilled part of OSMRE’s requirements and the State requested a time extension to address the remainder of amendments.

Additional draft legislation was proposed to satisfy the remainder of OSMRE’s required amendments. The changes were signed into law, in February 1995, by Governor Geringer as Enrolled Act No. 8. This Act changed the definition of critical and crucial fish and wildlife habitat and resulted in subsequent changes to the vegetation related rules and regulations. Re-establishment of shrubs basically required operators who reclaim mined lands to re-establish shrubs on 20% of the affected surface to a density of 1 shrub per square meter. Three other variations on this shrub density requirement allowed operators to develop site specific shrub reclamation bond release commitments to reflect the pre-mining shrub vegetation community.

Operators were required to delineate the land currently affected as of August 6, 1996 that would still be regulated by the 1980-1989 regulation of 1 shrub per square meter on 10% of the affected lands. Lands affected after that date would be subject to the new 20% shrub density rule.

Techniques

While mail between Wyoming and OSMRE was flying fast and furious, operators continued to plant sagebrush. Rates of pure live seed in approved mixes varied between the mines surveyed from 0.5 pounds per acre to 10 pounds per acre. The majority of sagebrush was broadcast through a drill or by hand, and one mine still applied small amounts of sagebrush seed by hydroseeding. One mine planted a few small areas with sagebrush tublings. None of the surveyed mines were applying nitrogen any more, although a few occasionally applied phosphorus.

All were using a grain stubble mulch or cover crop to assist in sagebrush establishment. By 1995, most were showing results in sagebrush density through vegetation surveys. Many operators established and monitored permanent shrub transects to evaluate sagebrush re-establishment success.

Densities reported from these surveys ranged from 0.01 sagebrush per square meter to 2.72 sagebrush plants per square meter. One mine showed slightly elevated densities in areas where topsoil was directly placed. Some transects showed increasing density trends; some showed declining trends, and die-off of previously observed sagebrush plants.

More mines showed seed origin as Wyoming instead of unknown, indicating the increased awareness of obtaining locally grown seed. The above planting techniques also indicate that these operators were incorporating the state-of-the-art technology into their shrub reclamation programs.

Research

In the 1990's, research seemed to become further focused. Cockrell et al. (1995) and Schuman et al. (1998) conducted extensive field research on the effect of topsoil management, mulching practices, and plant competition on initial sagebrush seedling establishment. McArthur et al. (1995) reviewed establishment attributes of big sagebrush and rubber rabbitbrush (*Chrysothamnus nauseosus*) and their use and performance in reclamation plantings.

The Wyoming Abandoned Coal Mine Land Research Program (AML) has provided funds and a platform for many reclamation research projects. Through the AML program, Schuman et al. (1998) examined effective strategies to establish big sagebrush on mined lands in the Powder River Basin. Booth et al. (1996) added to available information on post-harvest and pre-planting seed treatment on sagebrush seedling vigor. One of the most recent AML studies still in progress is research to evaluate the seeding rate of cool-season grasses and their competitive effect on sagebrush seedling establishment, as well as sagebrush seeding rate effects on sagebrush re-establishment density (Fortier et al. 1999).

2000 and Beyond

Several things became noticeable during the review of the history of the shrub establishment regulations. It appeared that mines are incorporating actual sagebrush seeding and establishment techniques from the wealth of successful research results and that sagebrush is beginning to be successfully established in reclaimed areas.

Sagebrush reclamation success and research has shown a consistently improving trend. By comparison, the development of shrub regulations was erratic. This might suggest that the attention focused on the increasing regulations, not the presence of the regulations themselves, led to the increased focus on sagebrush establishment research.

Future issues in sagebrush establishment might include; techniques to ensure long-term survival of plants after initial re-establishment; and development of other vital wildlife habitat features. As stated in the beginning of this paper, not only is industry required to reclaim mined land disturbances to a condition equal to the pre-mine condition; they are also required to demonstrate that the land is capable of sustaining the pre-mine land use. Reclamation of wildlife habitat consists of more components than big sagebrush. However, regulations and rules, from the early 1980 to present, have focused on sagebrush establishment. Perhaps it is time, with out extensive regulations and rule making that accompanied sagebrush, to expand reclamation efforts to include other components of wildlife habitat.

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The references listed represent only a small portion of the wealth of research that has been and is currently being conducted on sagebrush.

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