WOODY PLANT ESTABLISHMENT ON RECLAIMED LANDS AT TRAPPER MINE IN NORTHWEST COLORADO[1]

by

William Agnew[2] [3]

Abstract. State and Federal regulations require coal mine operators to re-establish woody plants on specific postmine land use areas. Shrub re-establishment can be difficult due to wildlife depredation, competition with other vegetation and other environmental considerations. Trapper Mine has developed a shrub re-establishment program that is reasonable, practical and beneficial to the wildlife postmine land use. In 1991, the overall woody stem density (735 stems/acre) exceeded that required in our approved mining and reclamation permit.

Introduction

Regulations subsequent to the Federal Surface Mining Control and Reclamation Act of 1977 and the Colorado Surface Coal Mining Reclamation Act of 1979, require coal mine operators to reestablish woody plants (shrubs) to a density at least 90 percent of the density on an approved reference area or standard. Colorado regulations allow for a variance from the reference area standard if it can be shown that greater or lesser shrub densities will better serve the postmining land use. For areas with a wildlife land use, minimum woody plant densities, planting arrangements and methods for mitigation of potential adverse impacts are determined on the basis of local and regional conditions after consultation with appropriate state and federal agencies.

Shrubs are considered important for providing cover for game and non-game animals as well as winter forage that does not become buried by snow and is therefore inaccessible to some animals. Shrubs however, have proven to be difficult to reestablish. Saskatoon serviceberry (Amelanchier alnifolia) and Gambel's oak (Quercus gambelii) for example, two of the more dominant shrubs on the mine area, generally depend on sprouting for reproduction and are therefore difficult to start from seeding (Berg 1976).

Reestablishment of shrubs is further complicated by potential wildlife depredation and competition from grasses and forbs (Draves and Berg 1978). Newly emerging seedlings are very palatable and attractive to wildlife. These seedlings must also compete for water and nutrients with surrounding, quicker establishing grass species. If seedlings are transplanted, they must survive the initial shock due to sudden change in environment. One may reasonably assume approximately one to two years will be required for a newly planted seedling to develop root systems capable of adequately satisfying the plant's water needs.

Soil physical and chemical properties will mandate to an extent the diversity of shrubs in an area because of differential rooting requirements between various shrub species, e.g. serviceberry does best on shallow, rocky soils whereas

[1]Paper presented at the 1992 National Meeting of the American Society for Surface Mining and Reclamation, Duluth, Minnesota, June 17, 1992.

[2]Author is Manager of Environmental Quality, Trapper Mining Inc., Craig CO 81626.

[3]"Publication in this proceedings does not preclude the author from publishing this manuscript, whole or in part, in other publication outlets."

Proceedings America Society of Mining and Reclamation, 1992 pp 611-615
DOI: 10.21000/JASMR92010611

chokecherry (Prunus virginiana) prefers deeper soil.

Regardless of the difficulties involved, mine operators are still responsible for the establishment of an approved woody stem density on targeted reclaimed lands. In Trapper's case that approved woody stem density is 400 stems/acre. This paper details many of the techniques utilized at Trapper Mine to ensure the appropriate number of woody plants are established to meet a postmine revegetation success criteria.

Study Area

Trapper Mine is a surface coal mine located approximately 6½ miles south of the city of Craig, Colorado, along the northern slope of the Williams Fork Mountains. The climate is semi-arid steppe and is characterized by cold winters and moderately warm summers. The average annual precipitation is 13.9 inches, one-third of which falls in the form of snow and is the principal source of stream flow for the region. Soils are generally deep and formed in alluvium and colluvium derived from sandstone and shale. The topography is described as rolling hills with relatively steep slopes (average - 14 percent). The prevalent vegetation type is mountain shrub which interfaces with stands of big sagebrush at lower elevation and aspen types at higher elevations.

Shrub Re-establishment Techniques

Shrub reestablishment at Trapper is primarily accomplished through direct seeding of woody plants, live haul topsoil transport, mature shrub transplanting, and the establishment of potted and bareroot adapted woody plants.

Direct Seeding

The selection of woody plants which are adapted to the climate and soils at Trapper is one of the most important steps in achieving shrub reestablishment success. Trapper works closely with the local Soil Conservation Service and the Upper Colorado Environmental Plant Center to develop a shrub reestablishment program that will provide cost effective results and promote big game use. All seed used for shrub establishment is collected from within the Intermountain region. Regraded and retopsoiled areas are generally contour drill seeded with some broadcasting employed for steep slopes (>3:1). Shrub species are seeded at pure life seed (PLS) rates of 5-8 PLS pounds/acre (8 PLS seeds/sq foot) simultaneously with grasses and forbs planting. Woody plants seeded include Saskatoon serviceberry, big sagebrush (Artemisia tridentata), true mountain-mahogany (Cercocarpus montanus), New Mexican forestiera (Forestiera neomexicana), common chokecherry, antelope bitterbrush (Purshia tridenta), Wood's rose (Rosa woodsii), blueberry elder (Sambucus caerulea), and mountain snowberry (Symphoricarpos oreophilus).

Livehaul Topsoil Transport

Whenever practical, in-place topsoil is picked up with scrapers and transported directly to replacement areas. Frequently, dense stands of shrubs/trees must be eliminated or pulverized before topsoil can be salvaged. This process may occur using a conventional dozer blade, heavy industrial disc, industrial grade rotoclearer, or other suitable equipment. These techniques have the advantage of retaining adequate native seed, root mass and organic material in the upper soil profile, thus stimulating re-sprouting or seed germination of targeted native plants.

Another process used to effectively eliminate dense stands of native shrubs/threes is the use of prescribed burning. In 1989, Trapper conducted a 250-acre prescribed burn in advance of one active pit. Burning stimulates many woody species to sprout back from the roots. By live-hauling seedling shrubs from the burn area, Trapper can possibly save thousands of dollars in seed costs and increase woody stem densities on reclaim areas. Various madge rotoclear studies have also been established on replaced topsoil plots to evaluate the woody plant establishment associated with this technique. This technique relies on the mechanical mulching of woody plants followed by live haul topsoil transport. To date, the results of this technique are inconclusive.

Mature Shrub Transplanting

Since 1977, various mature shrub transplanting techniques have been tried at Trapper Mine. Trials using a tree spade, dryland sodder, scrapers and three classes of front-end loaders have been performed.

Small scale shrub transplanting was initiated in 1981 and became the basis for adopting larger scale efforts. The shrub clump concept was initiated in 1982. These mature transplant areas consist of at least 250 transplanted shrub pads placed in a 1.6-acre clump. A pad consists of the volume of mature shrubs that can be transported in a 4-7 bcy loader bucket. Clumps are spaced about 1,400 feet apart to maximize their utilization by wildlife. Thirteen shrub clumps have been established at Trapper to date.

Mature shrubs are salvaged in advance of topsoil stripping operations and transplanted to carefully selected establishment areas. Transplanting is performed in the fall following the first killing frost and may extend into December depending on weather conditions. After placement in small prepared dozer basins, topsoil is pushed and compacted around each pad. Since 1986, supplemental watering and increased topsoil replacement depths (3') have been used to increase pad survival.

Seedling Plant Establishment

Each year Trapper plants thousands of containerized and bare root woody plants within reconstructed drainages and on vegetated sideslopes outside of permanent vegetation transects. Plant materials adapted to both mesic and xeric conditions are planted. A seedling clump trial consisting of six woody species (1,850 plants) was established in 1988 to evaluate bareroot and containerized stock survival. An additional 2,000 seedlings were interplanted in 1990. Plant materials studies testing accessions of many woody species was established in 1987. Over 30 woody plant varieties are being evaluated annually by Trapper and SCS personnel. The site specific collection of seed from plant materials growing on the minesite has improved seedling survival. Seeds are collected and shipped to a nursery where they are established in small containers and allowed to grow in a controlled environment.

Sampling Methods

Woody stem densities on reclaimed land are calculated using the point-center-quarter (PCQ) method (Dix 1961). Five PCQ's are conducted on each randomly selected permanent line transect at 20-m spacing. The density of line transects equates to approximate one-100m line transect per 8 acres of reclamation. Six permanent line transects were established in each reclaim year dating back to 1981. A reclaim year is defined as the year the area was topsoiled and planted to permanent vegetation. Distances from the center of each PCQ to the nearest live stem in each quarter was recorded and the plant specimen identified.

Following the year of establishment and each year thereafter, mature shrub transplant survival is estimated by inventorying individual shrub pads within each 1.6-acre clump and includes overstory regeneration and sprouting from the pad base. Additionally, 10 percent of the established pads are randomly sampled to determine the total number of stems (by species) represented in each pad. Determination of live overstory is accomplished by observing and counting viable buds and leaves for individual pads.

Results

Based on 1991 shrub density estimates for reclaimed lands having a postmine land use to benefit wildlife (737 acres), the approximate woody stem density is 735 woody stems/acre. Shrub establishment from direct seeding and livehauling of topsoil accounted for a woody stem density of 507 stems/acre. Antelope bitterbrush, big sagebrush and mountain snowberry are the most abundant shrubs on reclaim areas which were livehauled and direct seeded. Similarly, these species plus Saskatoon Serviceberry, common chokecherry and gambel oak are abundant on undisturbed areas. In 1985, Trapper established two 4-acre no seed plots to evaluate the regeneration of shrubs via the livehauling of topsoil. Based on 1988 results, woody stem densities were higher on the non-seeded plots (1,236 stems/acre) than on seeded plots (974 stems/acre). In order to quantify these results, Trapper established a larger (56-acre) no seed plot in 1989. Initial inventories indicate lower woody stem densities than those recorded in the 1985 no-seed plot. Trapper continues to evaluate our no-seed plot success.

Shrub clumps, each having a 46-acre area of influence, contributed an average of 208 woody stems/acre to the total woody stem density. Overall shrub clump survival ranged from 43 percent to 100 percent (Table 1). Mountain snowberry, big sagebrush and common

Table 1. 1991 Survey of Shrub Clumps Established from 1982-1990 at Trapper Mine.

Year Est	Location	Total Survival %	% Bottom Sprouting				% Live Overstory								Woody stem contribution from individual clumps (stems/acre)
			Service-berry	Choke-cherry	W.Rose	G.Oak	Service-berry	Choke-cherry	G.Oak	W.Rose	B.Sage-brush	Snow-berry	Bitter-brush	Rabbit-brush	
1982	South Enfield	55	88	9	4	1	53	3	0	0	25	100	0	<1	15,225
1984	North Derringer	49	61	17	0	14	37	7	0	0	100	100	5	3	3,456
1984	South Derringer	43	72	17	4	9	46	9	0	4	100	100	6	1	4,450
1984	North Enfield	84	57	90	7	<1	31	46	0	0	32	100	7	0	10,825
1985	South Derringer	96	68	69	10	0	69	58	0	2	69	100	0	0	13,475
1985	North Derringer	70	63	27	3	0	64	27	0	0	59	91	0	0	9,800
1986	North Enfield	65	69	37	7	<1	48	28	0	0	34	100	0	0	6,225
1986	South Enfield	95	76	41	5	<1	78	35	0	1	11	94	<1	<1	9,000
1987	South Derringer	87	67	41	6	3	66	34	0	0	43	100	<1	<1	14,238
1987	North Derringer	86	72	19	2	5	71	14	0	1	57	87	1	<1	7,881
1989	North Derringer	97	80	6	2	3	83	4	0	0	18	87	<1	<1	9,081
1990	South Ashmore	100	51	54	11	40	74	50	36	0	2	41	<1	<1	11,525
1990	South Derringer	100	27	46	3	3	95	62	0	0	9	63	<1	<1	8,994

Note: Percent Bottom sprouting and live overstory are based on surviving pads within individual shrub clumps.

WA/jb 3/92
[EQ\ASSMR01]

chokecherry are the most successfully transplanted shrubs. The establishment of seedling shrubs on reclaim areas contributed an average of 20 stems/acre.

Overall, the woody stem density on Trapper's reclaimed lands exceeds that required in our approved mining and reclamation permit. Initial studies show a 30 fold increase in woody stem densities within our burn area when compared to preburn densities. Ensuring that many of these acres will be livehaul transported will presumably ensure higher shrub densities for future reclamation.

Trapper's current program for shrub reestablishment is a reasonable and practical approach to ensure future compliance with appropriate state and federal regulations. The impact that Trapper's reclamation activity has had on big game animals is very positive. Reclamation activity has provided a mosaic of plant community vegetation patterns that are beneficial to big game animals. Large concentrations of elk (up to 500 individuals), deer and pronghorn are commonly sighted on reclaim areas. The combination of adequate hiding cover, water and high-palatable vegetation make the reclaimed mine site a highly desirable location for wildlife inhabitation.

Literature Cited

Berg, W.A. 1976. Species selection and plant soils relationships. p 152. In: Reclamation of Western Surface Mined Lands, proceedings from a workshop of western surface mined lands, March 1-3, 1976. Ecology Consultants Inc.

Dix, R.L. 1961. An application of the point-centered quarter method to the sampling of grassland vegetation. J. Range Management. 14:63-69. http://dx.doi.org/10.2307/3894717

Draves, R.W. and W.A. Berg. 1978. Establishment of mature shrubs on disturbed lands in the mountain shrub vegetation type. Dept. Agron., Colorado State University. 97p.