Changes in Vegetation at the Monticello, Utah, Disposal Site

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The Monticello Disposal Site, located just south of the town of Monticello, Utah, contains a uranium mill tailings disposal cell with a vegetated cover. Successful long-term performance of the cover is in part dependent upon the success of the cover's plantings. The plants remove moisture from the cover's soil layer, thus minimizing percolation through the tailings and preventing leaching of contaminants from the tailings into groundwater. Since 2000, when revegetation was complete, annual monitoring has been conducted at the site to track the development of the plant communities and to compare them to final success criteria. This paper summarizes changes in vegetation across the site over seven growing seasons.

Monticello is located at the base of the Abajo Mountains in southeastern Utah at an elevation of 7,066 feet. The area receives approximately 15 inches of precipitation per year. Natural climax vegetation is piñon-juniper woodland where soils are relatively shallow and sagebrush steppe where soils are deeper. The disposal cell cover was designed to mimic the deeper soils of sagebrush steppe and its associated plant community. Table 1 shows the seed mix sown on the cell cover and adjacent areas. Standard revegetation techniques and materials were used, including inorganic soil amendments, drill seeding, and crimped straw mulch. No portion of the revegetated area was irrigated. In addition, three subspecies of live sagebrush shrubs were planted at a density of 400 per acre after seeding.

Table 1. Seed Mix Used in 2000 Revegetation of the Monticello Disposal Cell Cover

Scientific Name	Common Name	Variety	Origin	#PLS/Acre[a]
Achillea millefolium	White yarrow	–	NZ[b]	0.12
Achnatherum hymenoides	Indian ricegrass	Nezpar	CAN	2.00
Pascopyrum smithii	Western wheatgrass	Rosana	WA	3.00
Artemisia tridentata[c]	Big sagebrush	–	UT	0.25
Aster tanacetifolia	Prairie aster	–	CA	0.05
Astragalus cicer	Cicer milkvetch	Oxley	CAN	1.60
Bromus marginatus	Mountain bromegrass	Bromar	WA	4.00
Elymus lanceolatus	Thickspike wheatgrass	Critana	WA	3.00
Ericameria nauseosa	Rabbitbrush	–	UT	1.50
Erigeron speciosus	Aspen daisy	–	UT	0.15
Hesperostipa comata	Needle and thread grass	–	WY	2.00
Linum lewisii	Lewis blue flax	Appar	WA	2.00
Pleuraphis jamesii	Galleta grass	Viva	TX	1.00
Purshia tridentata	Antelope bitterbrush	–	ID	1.00
Sphaeralcea coccinea	Scarlet globemallow	–	UT	0.50
Sphaeralcea grossulariifolia	Gooseberry leaf globemallow	–	UT	0.50

[a] #PLS/Acre = pounds of pure live seed per acre
[b] Text on seed label reads "NZ," but probable origin of seed is Nevada (NV)
[c] Three subspecies of *A. tridentata* were seeded: ssp. *tridentata* (basin big sagebrush), ssp. *vaseyana* (mountain big sagebrush), and ssp. *wyomingensis* (Wyoming big sagebrush).

Establishment of perennial grass species has progressed well across the site, as shown by the graph in Figure 1. Figure 2 illustrates changes in weedy species. Shrubs have not increased

during all seven monitoring years; cover percentages of big sagebrush and rabbitbrush have remained below 4 and 1 percent, respectively.

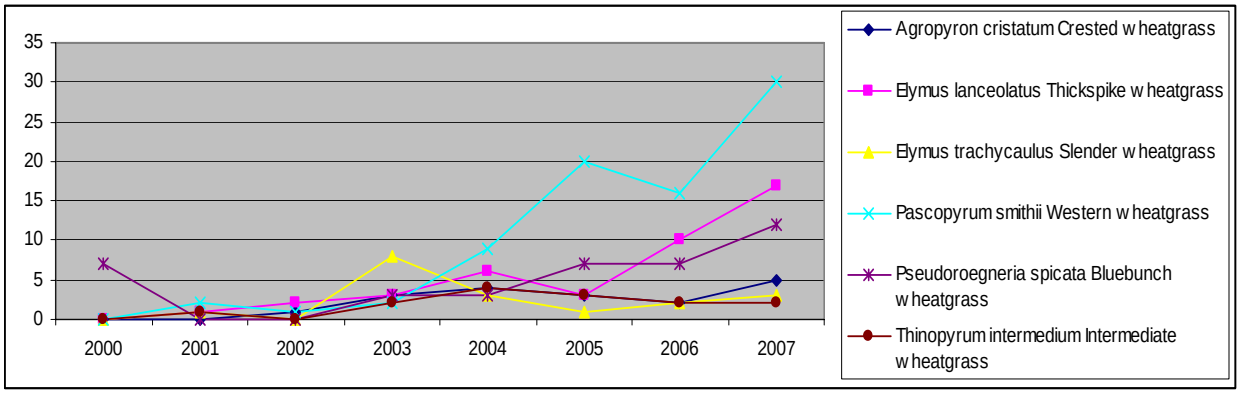

Figure 1. Changes in Major Grass Species (Percent Total Cover on Disposal Cell)

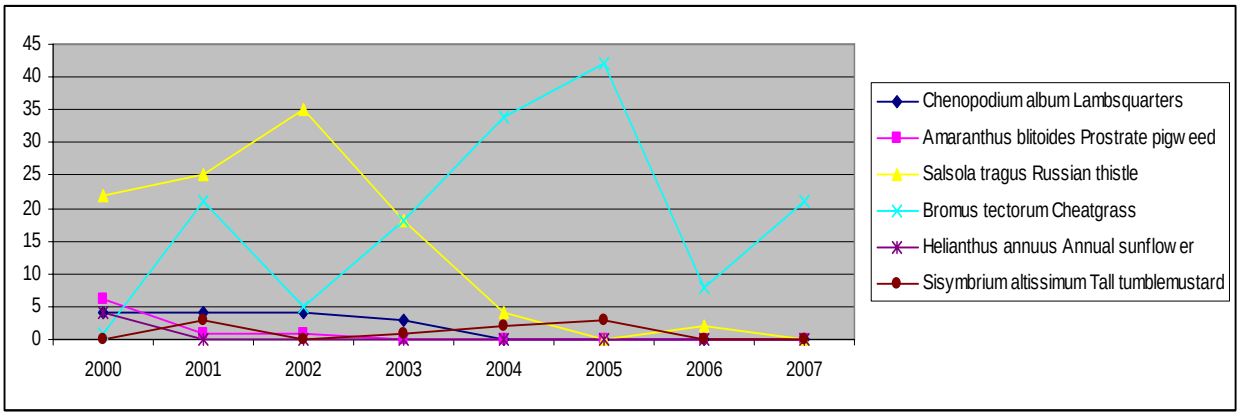

Figure 2. Changes in Major Weedy Species (Percent Total Cover on Disposal Cell)

Western wheatgrass has become the dominant perennial grass on the Monticello disposal cell cover over time, followed by thickspike wheatgrass and bluebunch wheatgrass. Bluebunch, slender, crested, and intermediate wheatgrass species were not included in the seed mix and probably colonized the site from surrounding areas, where they are common. Concurrent with the rise in perennial grasses is a sharp drop in cover of annual weeds, particularly Russian thistle. Cover of weedy cheatgrass rose substantially between 2002 and 2005 as it colonized spaces between other grasses and shrubs. The sharp drop in 2006 coincided with an outbreak of montane voles (*Microtus montanus*). This rodent species feeds on shrub roots and grass seeds; seed predation is the most reasonable explanation for the drop in cheatgrass cover observed during this time period.

Shrub establishment has remained slow on the site in spite of reseeding efforts in 2005. Drought conditions in the months after sowing in both 2000 and 2005 may have inhibited germination of rabbitbrush and big sagebrush seed. Both seedings occurred in late spring and early summer,

although the best windows for seeding these species would be in fall or winter. These seeds are small and short lived; few of them would have remained viable into the next growing season.

Of the original 400 live sagebrush plants installed per acre in 2000, approximately 100 were still living in 2007. Monitoring data indicate that transplant shock, water stress, heat stress, or other factors associated with the planting process may account for approximately 25 percent of these losses. Although seedling sagebrush, which probably germinated from parent plants during high rainfall months in 2003, has been observed on the cover, these gains have been offset by shrub damage and loss due to the vole outbreak of 2006. In 2007, live rabbitbrush was planted on the cover using seedlings grown from both local plants and commercial seed. Initial monitoring in spring 2008 indicates that approximately 15 percent of the local seedlings have survived, compared to approximately 8 percent of the commercial seedlings. It is hoped that in spite of the low survival rates, the remaining rabbitbrush seedlings will increase and eventually provide a seed source for the cover's plant community.

In summary, native revegetation of the Monticello disposal cell cover has been highly successful with the exception of shrub density, a parameter crucial to the long-term performance of the cell's vegetated cover. Monitoring results indicate that at this site, control was not necessary for annual weeds such as Russian thistle, which diminished naturally over time as perennial grasses became established. Cheatgrass has persisted, however, and if it should again reach high densities at the site, chemical control may be considered. Shrubs have proven difficult to establish, even when planted live, because rainfall events do not always coincide with planting events. Timing is crucial when planting small-sized shrub seed such as sagebrush and rabbitbrush, and multiple plantings may be required if these species of shrubs must be established at the site.