City Creek Watershed Fuel Reduction Demonstration Project

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Project Description: During the week of July 6-10, 2009 Drs. William Gray and Ty Harrison set up a series of three, 500 ft. roadside vegetation transects at three elevations to characterize the range of vegetation which could be impacted by future fuel reduction actions and to serve as demonstration areas for public inspection. The location of the three transects in the canyon had been chosen by consensus of a team of interested stakeholders during an earlier site visit in June.

Methods:

Photo Documentation. Nine photo points, three per transect, were permanently marked in the center of the roadway. On July 6 photos were taken by Gray both up and down the roadway from the two end and one middle points along each of the three 500 foot long transects, giving a set of 6 photos to document existing pretreatment conditions of the roadside vegetation. The photos will be repeated after the experimental treatment of fuel reduction.

Invasive Weed Inventory. A detailed listing of existing roadside weeds was made every 25 yards along each transect to document the pre-disturbance weed flora and the potential for existing weeds to move into the adjacent disturbed tree understory areas. Due to the opening of the overstory canopy to light by removal of seedling and saplings smaller than 4 inches diameter and the disturbance of the litter layer by dragging out all dead material, we anticipate the major effects will be a weed invasion into the disturbed areas from existing seed sources along the roadside. To document this we need a density estimate for existing roadside weeds. This can be quicky done by counting weeds in a three foot radius semi-circle centered on the edge of the asphalt every 25 feet along the transects. This would be the same spacing as the adjacent canopy cover sampling area (see below). A re-listing and counting of weeds after the removal disturbance will be made during the growing season next year and possibly the following year.

Pre-disturbance Vegetation Characterization. Along each permanently marked, 500 ft. transect (metal spikes in the middle of the asphalt road), a stratified random sampling technique was devised by locating twenty sampling points twenty five feet apart in the undisturbed vegetation on the north side of the roadway. A circular area 10 ft. in diameter (78.5 sq. ft.) was located perpendicular to the road and 25 to 50 yards uphill from

the north edge of the asphalt road. The circular sampling quadrats were numbered from the upper ends of the transects to the lower ends. The variable distance used for the sample plots was important in order to insure that we were sampling the undisturbed native vegetation away from the historic construction disturbance which had various widths along the road. Vertical canopy projection coverage by species was estimated by percentage for all trees and shrubs. The total canopy coverage can be over 100 % due to multiple layers of vegetation. Bigtooth Maple is very shade tolerant and forms multiple canopy layers even near the ground. These ground layers were added to the upper canopy estimates of percentage cover. The ground layer vegetation was similarly estimated for percentage cover by all species. Creeping Oregon Grape (*Mahonia repens)*, a short, woody shrub was counted as a ground layer species. This ground layer sampling documentation will allow an assessment of any herbaceous cover changes in native and weed species over time after the clearance disturbance and opening of the overstory canopy by removal of trees and shrubs under four inches in diameter.

Site Locations:

GPS locations of the reference sites (WGS84)

Lower Canyon		
Bottom	40.79906 N	111.87351 W
Center	40.79958 N	111.87293 W
Top	40.80018 N	111.87263 W
Middle Canyon		
Bottom	40.81269 N	111.83816 W
Center	40.81295 N	111.83748 W
Top	40.81303 N	111.83650 W
Upper Canyon		
Bottom	40.82059 N	111.81272 W
Center	40.82083 N	111.81188 W
Top	40.82071 N	111.81140 W

Results:

Table 1: Common Roadside Weeds by Elevation.

Family	Common Name	Scientific Name	Lower transect	Middle transect	Upper transect
ASTERACEAE	Burdock	Arctium minus	Present	Present	Present
ASTERACEAE	Bull Thistle	Cirsium vulgare		Present	
ASTERACEAE	Prickly Lettuce	Lactuca serriola	Present	Present	Present
ASTERACEAE	Scotch Thistle	Onopordum acanthium		Present	
ASTERACEAE	Dandelion	Taraxacum officinale	Present	Present	Present
ASTERACEAE	Yellow Salsify	Tragopogon dubius	Present	Present	
BORAGINACEAE	Houndstongue	Cynoglossum officinale	Present	Present	Present
BORAGINACEAE	White Stoneseed	Lithospermum arvense			Present
BRASSICACEAE	Dyer's Woad	Isatis tinctoria	Present		
CONVOLVULACEAE	Field Bindweed	Convolvulus arvensis		Present	
FABACEAE	Black Medick	Medicago lupulina	Present		
FABACEAE	Yelloe Sweetclover	Melilotus officinalis	Present	Present	
POACEAE	Rattlesnake Brome	Bromus briziformis	Present	Present	
POACEAE	Smooth Brome	Bromus inermis	Present	Present	
POACEAE	Japanese brome	Bromus japonicus	Present	Present	
POACEAE	Cheat Grass	Bromus tectorum	Present		
POACEAE	Orchard Grass	Dactylis glomerata	Present	Present	Present
POACEAE	Barnyard Grass	Echinochloa crus-galli	Present		
POACEAE	Foxtail Barley	Hordeum jubatum		Present	
POACEAE	Kentucky Bluegrass	Poa pratensis	Present		
POLYGONACEAE	Patience Dock	Rumex patientia		Present	
SOLANACEAE	Bittersweet Nightshade	Solanum dulcamara	Present		Present

Table 2: Lower Transect. Maple/Oak Vegetation Type Values are in percent. Asterisk denotes introduced or weed species.

Layer	Species	Quadrat Number			Average Total Cover (%)																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree/Shrub	Bigtooth Maple (*Acer grandidentatum)*	100	90	90	100	90	20	100	100	50	40	40	90	50	10	60	80	50	50	90	30
	Gambell Oak (*Quercus gambellii*)			80		90	90			50	60	30			50	90		70			30
	Western Chokecherry (*Prunus virginiana* var. *melanocarpa*)		10								2				20				5		
	*Green Ash (*Fraxinus americana*)			20							10								5	1	
	Saskatoon Serviceberry (*Amelanchier alnifolia*)				5																

	*Tartarian Honeysuckle (*Lonicera tartarica*)										10			10							
	Box Elder (*Acer negundo*)																				30
Ground	Litter	30	59	97	97	97	80	95	95	90	60	45	60	84	80	93	94	99	93	85	96
	Creeping Oregon Grape (*Mahonia repens*)	15			3		10	3			10	50	10			3					
	Blue Wildrye (*Elymus glaucous*)		1			3		2	2	10	30	5	30	5	15	1	3	1			1
	False Solomon's Seal (Smilacina stellata)	15	40	3					3												
	*Dandelion (*Taraxacum officionale*)													1	5	1	1		2	15	1
	*Burdock (*Arctium minus*)													10							
	*Kentucky Bluegrass															1					

	(*Poa pratensis*)																				
	*Houndstongue (*Cynoglossum officionale*)															1					
	*Wild lettuce (*Lactuca serriola*)																1		1		1
	Spring Parsley (*Lomatium dissectum*)																1				1
	*Dalmatian Toadflax (*Linaria dalmatica*)																		2		
	*Dyer's Woad (*Isatis tinctoria*)																		1		
	Aster sp.																		1		

Table 3: Middle Transect, Maple/Oak vegetation Type. Values are in percent. Asterisk denotes exotic species

Layer	Species	Quadrat Number																				Average Total Cover (%)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Tree/Shrub	Bigtooth Maple (*Acer grandidentatum)*	80	50	30	95	80	20	10	80	120	50	40	5	90	120	90	90	90	30	90	100	**68**
	Gambell Oak (*Quercus gambellii*)			20		80	60	80	10		20	30	50	90								**22**
	Western Chokecherry (*Prunus virginiana* var. *melanocarpa*)		10	30	5	10	20	10	2		10	10			2	5						**6**
	Blue Elderberry (*Sambucus cerulea*)	30			2																	**2**
	Saskatoon Serviceberry (*Amelanchier alnifolia*)																	1				**0.1**
	White Fir (Abies concolor)											1										**0.1**
Ground	Litter		10	75	76		43	40	68	80	90	65	58	98	100	86	59	60	19	47	96	**59**
	Creeping Oregon Grape (*Mahonia repens*)		30	20	20		30	50	30	10	10	5	40				10	30	40	30	1	**18**
	Blue Wildrye (*Elymus glaucous*)	10	30	5	3		25		1				1			10	20	30	40		1	**9**
	False Solomon's Seal (*Smilacina stellata*)	50																				**3**
	*Dandelion (*Taraxacum officionale*)								1													**0.1**

	*Orchardgrass (*Dactylis glomerata*)	30	20							10						1				20		**5**
	*Kentucky Bluegrass (*Poa pratensis*)	10	10					10								1	10				1	**2**
	*Dogbane (*Apocynum androsaemifolium*)						2															**0.1**
	Western Snowberry (*Symphorycarpos occidentalis*)											30										**2**
	Giant Lomatium (*Lomatium dissectum*)						1						1	1			1		1	1	1	**0.4**
	*Goatsbeard (*Tragopogon dubius*)				1																	**0.1**
	*Dandelion (*Taraxacum officionale*)													1		2				2		**0.3**

Table 3: Table 3. Upper Transect. Maple/White Fir Vegetation Type. Values are in percent. Asterisk denotes exotic species.

Layer	Species	Quadrat Number																				Average Total Cover (%)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Tree/Shrub	Bigtooth Maple (*Acer grandidentatum)*		10	25	5	80	90	90	100	90	90	50	120	50	90	20	160	60	50	50	90	**66**
	Box Elder (*Acer negundo*)									50												**3**
	Western Chokecherry (*Prunus virginiana* var. *melanocarpa*)				40	3	1													10		**3**
	Blue Elderberry (*Sambucus cerulea*)																		10			**0.5**
	Saskatoon Serviceberry (*Amelanchier alnifolia*)	5																				**0.3**
	White Fir (Abies concolor)	90	75	100	60	20	90	25	5	10	25	50		50	20	120		60	50	10		**43**
	Whitestem Gooseberry (*Ribes inerme*)	1																				**0.1**
	Lanceleaf Cottonwood (*Populus X acuminata*)		25																			**1.3**
	Douglas Fir (*Pseudotsuga menziesii*)															2						**0.1**
Ground	Litter	98	98	100	95	1	100	98	100	95	94	98	99	100	99	100	99	80	68	10	83	**86**

	Creeping Oregon Grape (*Mahonia repens*)	1	1		5	1				4	5	1	1		1			20	30	80	10	**8**
	Blue Wildrye (*Elymus glaucous*)		1					2		1		1							2	5	1	**0.7**
	Rocky Mountain Sedge (Carex backii)										1									1		**0.1**
	False Solomon's Seal (*Smilacina stellata*)	1																				**0.1**
	Fringed Brome (*Bromus ciliata*)																1			2		**0.2**
	Twincrest Onion (*Allium biseptrum*)																			1	1	**0.1**
	Western Sweet Cicely (*Osmorhiza occidentalis*)																			1		**0.1**
	*Kentucky Bluegrass (*Poa pratensis*)																		2			**0.1**
	Western Snowberry (*Symphorycarpos occidentalis*)											1										**0.1**
	Houndstongue (*Cynoglossum officinale*)																				5	**0.3**

Discussion:

Trees. The percent cover by Bigtooth Maple is surprisingly consistent between 66 to 68 percent canopy cover in all three transect areas. However the amount of Gambell Oak decreased from 32 to 22 percent from the Lower to the Middle Transect and is entirely absent at the Upper Transect. White Fir becomes abundant at 43 percent cover at the Upper Transect area and is clearly reproducing under the shade of the maples. White Fir is virtually absent from both the Lower and Middle Transect areas. Fuel minimization will undoubtedly remove the young fir trees from the understory and will set back the natural successional sequence currently underway there where evergreen conifers gradually replace the deciduous maples over one hundred years. This is what low intensity ground fires would do naturally.

Shrubs. There are no trends in shrub understory diversity which is basically low with only two to four shrub species being common. Oregon Grape is the most common ground cover species at 5 and 8 percent cover on the lower and upper transect areas respectively. It increases to 18 percent on the middle transect where it thrives in the light shade of the Maple/Oak canopy. Apparently the dryness at lower elevations and dense shade at the upper elevations under the conifers affect the abundance of this evergreen ground cover. We would expect this species to increase with fuel removal at all elevations due to canopy shade release. All the native shrubs, Western Chokecherry, Saskatoon Serviceberry, Blue Elderberry, Whitestem Gooseberry, and Creeping Oregon Grape as well as the Gambel Oak and Bigtooth canopy trees are fire resistant and will crown sprout after fires or cutting and will be expected to increase in density and abundance immediately after fuel clearance. We wonder if this is a self defeating manipulation where short-term fuel removal will result in even more shrub and tree biomass in the long term.

Grasses and Forbs. The herbaceous cover, not including Creeping Oregon Grape, averages 13% on the Lower Transect, 23 % on the Middle Transect and only 6% on the Upper Transect. Like the abundance of Oregon Grape, the grasses and forbs are probably responding to the more abundant light under the deciduous tree canopy at the lower elevations. Blue Wildrye is certainly the most abundant grass at 6%and 9% cover on the Lower and Middle Transect, decreasing to less than 1 % on the Upper Transect due to heavier shade. We would expect the abundance of Blue Wildrye (*Elymus glaucus*) to increase with fuel removal and canopy opening. The grass is a typical, shade-tolerant species of the Wasatch Foothill Maple and Oak community and appears to require the partial shade of the canopy, rarely being found in openings away from these trees. But it is clearly more abundant when the forest canopy is more open. The occurrence of the Rocky Mountain Sedge (*Carex backii*) is noteworthy on the Upper Transect. It occurs at the southern limit of its North American distribution here along the Wasatch Front and may be a Pleistocene or moist Holocene relict. It apparently requires the heavy shade of a dense maple forest and probably the more favorable moisture conditions found there. Most other sedge species are rhizomatous and found in wetlands but this species, similar to the Elk Sedge (*Carex geyeri*), is found in

upland soils in the shade of maples or aspen trees. The Rocky Mountain sedge is probably more shade tolerant than the Elk Sedge which is found nearby in City Creek in openings on north-facing slopes under maples and oaks.

Introduced Species. The Lower Transect sample plots clearly have a greater abundance of introduced woody and herbaceous species and even some noxious weeds which require control such as Dalmatian Toadflax and Dyer's Woad. Some are dispersed by birds (Tartarian Honeysuckle, Western Hackberry, Russian Olive, Japanese Yew) some by wind (Green Ash, Wild Lettuce, Dandelion, Siberian elm), and some by deer (Burdock and Houndstongue). The abundance of these non native species in the Lower Transect area is probably due to the proximity of human disturbance, equipment and traffic near the mouth of the canyon. The transect is less than a quarter mile from the entry gate. We expect all of these weeds, which benefit by even minor disturbances of the soil surface or opening of the tree canopy, to increase in density and abundance at all elevations since a seed source is already on or adjacent to these sample plots. The permanently marked sample areas will be re-evaluated after one and two growing seasons after fuel reduction manipulations in order to document the predicted short term increase in the weed flora. Similar to the predicted stimulation of native shrub and herbaceous growth by canopy thinning, we predict that these non-native weeds and shrubs will increase in number and abundance due to more light at the ground surface. This hypothesis should be easily tested by quantitative % cover data collected before and after the fuel removal on these permanently marked sample areas.

Recommendation for Fuel Removal. Due to the importance of maple twigs near the ground layer and evergreen Creeping Oregon Grape as the dominant ground layer species, we suggest that both of these be left intact and not removed during fuel clearance. This will help decrease the contemplated weed invasion of the disturbed area by maintaining heavy shade and neither of these species are important fuel materials.