The Chewuch Weed Pilot Project
2000 Update

Pacific Biodiversity Institute
Sarah Masco
Summer 1998
Rebecca Schultze
Summer 2000

Table of Contents

The Chewuch Weed Pilot Project
Pacific Biodiversity Institute
2000 Update

Introduction

When a plant species is introduced into a new area where the plant's natural predators are absent, the potential for that specie's success is very high. When a non-native plant species out-competes the native vegetation, it can degrade wildlife habitat and soil productivity, cause economic losses, and displace native species, contributing to the endangerment and extinction of those species.

Non-natives are introduced by a variety of mechanisms. Humans introduce them as impurities in seeding activities, vehicles and animals carry seeds to new locations, and seeds can be widely dispersed by the wind. Many weeds, such as knapweed, need a large disturbance to become established in an area. Other species, like Dalmatian toadflax, spread using subterranean rhizomes, as well as seeds, and propagate easily without disturbance.

Humans have been waging battles against weeds for thousands of years. Traditional methods of reducing weed cover included burning, cutting, and hand pulling, but within the last 30-40 years humans have turned to chemical solutions to the weed problem. Currently herbicides are the standard for weed control in most areas. Unfortunately, these herbicides are not always effective. Widespread use of spray has caused weeds to become more tolerant to herbicides, because herbicide use may not affect the hardy, resistant weeds, which allows a stronger, more resistant population to be established. Many people aren't aware that even herbicides need to be applied to an area consistently, not just once. There is also a concern about the environmental and health consequences of widespread herbicide use. These concerns have led to current research in alternative weed management.

This project centers on the weed problem in the Methow Valley, in North-Central Washington. The project is a cooperative agreement between the US Environmental Protection Agency, the County Roads Department, and the citizens of the West Chewuch Road. Pacific Biodiversity Institute is providing technical support throughout the project.

The purpose of this study is to determine the species composition along the West Chewuch Road in the Methow Valley with respect to native vegetation and weeds, and to investigate the effectiveness of alternative management strategies. Specifically, the weed project aims to:

- Determine, document, and track changes in the state of the vegetation, asphalt and shoulders of the West Chewuch road and right-of-way
- Identify new weeds which are spreading into the area before they become a major problem
- Measure the effectiveness of non-chemical vegetation management
- Assess the difficulty of re-establishing vegetation in an area that has been treated with herbicides for a number of years
- Measure the effect of vegetation on properties adjacent to the roadside vegetation with regards to weed migration

Area

The Methow Valley in North Central Washington is a glacially carved valley formed around 10,000 years ago from the Cordilleran and local ice sheets. The floor of the valley contains a thick deposit of glacial alluvial outwash that remained after the glacier receded. The Methow River flows through the valley depositing sediments and creating a fertile floodplain. Average mean annual precipitation varies throughout the valley, but is about 15-20 inches per year along the West Chewuch Road. The rolling hills above the valley are much drier and are described as shrub-steppe vegetation. These upland areas are particularly susceptible to invasion by weeds due to their xeric soils, previous extensive grazing, and recent development.

Methods

This project concentrates on an area above the Chewuch River (a tributary of the Methow River). The West Chewuch Road runs north south along the Chewuch River drainage. The county road is approximately 8 miles long and has an elevation of 1700-2000 feet above sea level. The average slope of the road is minimal. A section of the road was chosen running from its southernmost end to five miles north.

The road was divided into quarter mile segments (20 segments total) in 1998 and marked on the road (with blue spray paint) and with flags at the plot corners. The first 3 sections of the road were not surveyed because the roadside was sprayed immediately before the advent of our study. Thus the survey only contains segments 4 through 20, with segment 4 relocated about 1/8 mile farther north than originally planned. In 1999 the plots were relocated, remarked with paint on the road, and the plots were remeasured and any missing flags were replaced at the corners of the plots. In 2000 the plots were again relocated, remarked, and remeasured and GPS was used to get another record of plot location.

The annual survey is taken over approximately 2 weeks in late June to early July. It consists of three major components:

1) Survey for presence or absence of three select weeds: Dalmatian toadflax (*Linaria dalmatica*), common mullein (*Verbascum thapsus*), and diffuse knapweed (*Centaurea diffusa*) per quarter mile segment (both east and west side)
2) Quadrat study of percent cover by species at each quarter mile point with two quadrats on the east side of the road and two quadrats on the west. The first quadrat was measured 0-10 feet from the edge of the road; the second quadrat was adjacent to the first, measured at 10-20 feet from the road's edge. Each quadrat is 10 feet by 10 feet. (Figure 1)
3) General description of each quadrat, with emphasis on asphalt and road condition, and approximate species composition of surrounding private property (bare ground, weedy, grass, or native)

Three years of sampling have been completed (1998, 1999, 2000). Data collection should occur for at least 2 more years (2001, 2002) to get a complete data set for full analysis.

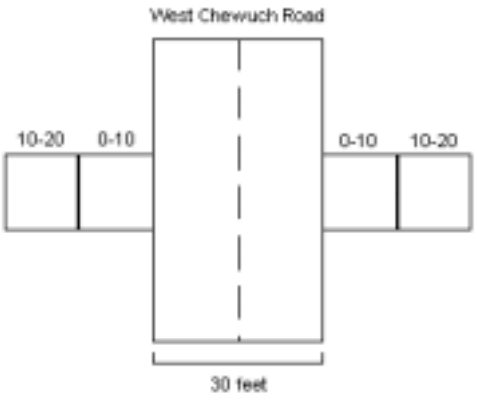

Figure 1

Results

1998

Weeds observed growing on or near the side of the road appeared to be different than weeds growing on adjacent property. Within ten feet of the road, we were likely to find *Salsola kali* (Russian Thistle)*, Setaria viridis* (Green Bristlegrass)*, Euphorbia glyptosperma, Lactuca serriola* (Prickly-leaved lettuce)*,* and *Chenopodium album* (Lamb's Quarters), as well as the occasional clover. From ten to twenty feet from the road edge, we were likely to find *Sisymbrium altimissimum* (Tumble Mustard)*, Verbascum thapsus* (Mullein)*, Centaurea diffusa* (Diffuse Knapweed)*, Linaria dalmatica* (Dalmatian Toadflax) and many species of native and non-native grasses (if the plot had bare ground we found many of the same weeds as along the road's edge). On adjacent property, the vegetation appeared to be less diverse. We often observed large monocultures of non-native grasses*, Centaurea diffusa*, dotted occasionally with native *Purshia tridentata* (Bitterbrush

We found a significant difference between the inner and outer quadrats in four areas: percent vegetated, bare, rocks, and litter. (Table 2)

Table 1. Results of two sample t-test comparing percent cover for inner (10-20) and outer (20-30) quadrats on the West Chewuch Road, Methow Valley, Washington. N= 32, alpha = 0.05. July 1998.

t-Test: Two-Sample Assuming Equal Variances

% Vegetated	*10--20*	*20--30*
Mean	20.5	65.4411765
Standard Deviation.	14.0723577	18.8454921
Variance	198.03125	355.152574
Observations	17	17
Pooled Variance	276.591912	
Hypothesized Mean Difference	0	
Df	32	
t Stat	-7.8783299	
P(T<=t) one-tail	2.7301E-09	
t Critical one-tail	1.69388841	
P(T<=t) two-tail	5.4603E-09	
t Critical two-tail	2.03693162	

% Native	*10--20*	*20--30*
Mean	29.7573773	43.3032703
Standard Deviation	21.6382189	26.0866407
Variance	468.212516	680.512822
Observations	17	17
Pooled Variance	574.362669	
Hypothesized Mean Difference	0	
Df	32	
t Stat	-1.64787399	
P(T<=t) one-tail	0.05458223	
t Critical one-tail	1.69388841	
P(T<=t) two-tail	0.10916447	
t Critical two-tail	2.03693162	

% Alien	*10--20*	*20--30*
Mean	71.8419788	56.6967297
Standard Deviation	22.4443161	26.0866407
Variance	503.747326	680.512822

% Noxious	*10--20*	*20--30*
Mean	28.8923129	24.2967655
Standard Deviation	22.9997677	28.3230196
Variance	528.989314	802.193441

Observations	17	17
Pooled Variance	592.130074	
Hypothesized Mean Difference	0	
Df	32	
t Stat	1.81458503	
P(T<=t) one-tail	0.03948624	
t Critical one-tail	1.69388841	
P(T<=t) two-tail	0.07897248	
t Critical two-tail	2.03693162	

Observations	17	17
Pooled Variance	665.591377	
Hypothesized Mean Difference	0	
Df	32	
t Stat	0.51932935	
P(T<=t) one-tail	0.30355238	
t Critical one-tail	1.69388841	
P(T<=t) two-tail	0.60710476	
t Critical two-tail	2.03693162	

% Bare	*10--20*	*20--30*
Mean	39.6176471	9.67647059
Standard Deviation	36.0713396	13.3743472
Variance	1301.14154	178.873162
Observations	17	17
Pooled Variance	740.007353	
Hypothesized Mean Difference	0	
Df	32	
t Stat	3.20893046	
P(T<=t) one-tail	0.00151244	
t Critical one-tail	1.69388841	
P(T<=t) two-tail	0.00302488	
t Critical two-tail	2.03693162	

% Rocks	*10—20*	*20—30*
Mean	5.73529412	2.08823529
Standard Deviation	6.29513117	2.41890532
Variance	39.6286765	5.85110294
Observations	17	17
Pooled Variance	22.7398897	
Hypothesized Mean Difference	0	
Df	32	
t Stat	2.22975966	
P(T<=t) one-tail	0.01645283	
t Critical one-tail	1.69388841	
P(T<=t) two-tail	0.03290565	
t Critical two-tail	2.03693162	

% Litter	*10--20*	*20—30*
Mean	5.23529412	11.8823529
Standard Deviation	4.71075116	10.2736456
Variance	22.1911765	105.547794
Observations	17	17
Pooled Variance	63.8694853	
Hypothesized Mean Difference	0	
Df	32	
t Stat	-2.4248913	
P(T<=t) one-tail	0.01056774	
t Critical one-tail	1.69388841	
P(T<=t) two-tail	0.02113547	
t Critical two-tail	2.03693162	

1999

2000

In three years of data collection, a total of 70 native plant species and 59 non-native plant species have been found. Not every plant species was found in the plots every year. (see Appendix A.) From 1998 to 2000, 23 out of 68 total plots showed a 25% or greater change in percent cover. In 18 plots, non-native vegetation cover decreased by $\geq$ 25%, 4 plots had $\geq$25% increase in native vegetation cover, and in one plot the native cover decreased by $\geq$25%. The large changes ($\geq$25%) occurred 10-20 feet from the road edge 74% of the time.

Plot Number	Side of Road	Distance from Road Edge	Native or Non-Native	Percent Cover Change (2000-1999)
5	E	10-20	Non-Native	-54
5	W	10-20	Native	28
5	W	10-20	Non-Native	-64
6	E	10-20	Non-Native	-31
7	E	10-20	Non-Native	-42
8	E	0-10	Non-Native	-31
8	E	10-20	Non-Native	-40

8	W	10-20	Non-Native	-40
9	E	10-20	Non-Native	-46
10	E	10-20	Native	-25
11	W	10-20	Non-Native	-34
13	W	0-10	Non-Native	-57
14	E	10-20	Native	57
15	E	0-10	Non-Native	-27
15	W	0-10	Native	56
15	W	10-20	Native	109
17	E	0-10	Non-Native	-46
17	E	10-20	Non-Native	-44
19	E	10-20	Non-Native	-51
19	W	10-20	Non-Native	-45
20	E	10-20	Non-Native	-25
20	W	0-10	Non-Native	-26
20	W	10-20	Non-Native	-26

Table 2 – Plots with a Percent Cover Change $\geq$ 25%

In the survey of presence/absence of weeds along the quarter-mile segments between plots, common mullein was the only species that had a notable change in its occurrence from 1998 to 2000 (this survey was not performed in 1999). It went from low to absent along the west side of the road in 4 segments, from low to absent along the east side of the road in 4 segments, and from medium to absent along the west side of the road in 2 segments. There were no significant changes along the roadside for the occurrence of diffuse knapweed or Dalmatian toadflax.

Conclusions

1998

Roadsides in the Methow Valley are generally sprayed every one to two years. The areas nearest to the road (inner quadrats) experience the heaviest application of herbicides, while the areas further from the road (outer quadrats) receive a lighter application. This may be responsible for the differential distribution of vegetation in the inner and outer quadrats. The statistical difference in bare ground also reflects this difference. Another contributing factor is that adjacent private lands may provide a seed source for the roadside weed communities; as a result the outer quadrats are reseeded more extensively than the inner quadrats.

The differences in rocks may be the result of the large rocks used in the building of the roadbed. The inner quadrats are closer and thus contain more large rocks. Another possible cause is that the dense vegetation of the outer quadrats conceals large rocks just under the surface. The amount of litter in the quadrats is related to the amount of vegetation present, as biomass is produced and released by the plants. As the outer quadrats have more vegetation, it follows that they have more litter than the inner quadrats.

We did not see a difference in percent native, noxious, or alien vegetation, possibly due to the large standard deviation we experienced in most of our statistical analyses. The analysis was somewhat insensitive, thus only picking up very strong differences between the

inner and outer quadrats. The standard deviation might be improved with a larger sample size, and by repetition of the study on a yearly basis. We may have erred in our estimates of percent cover, in which case the standard deviation could be improved by better methods. The large standard deviation may also reflect the heterogeneity of the plant communities (weed communities) along the roadsides. Perhaps there is not a significant difference in species composition between the inner and outer quadrats.

The weed counts may also be subject to some bias due to the fact that some weeding occurred along the road previous to the start of the weed survey. This is especially pertinent around segments 8-11, where a large amount of *Linaria dalmatica* and other alien species were pulled.

2000

The West Chewuch Road has had a "dead zone" along it for several years. The dead zone was considered to extend 10 feet from the road's edge and was implemented in the hopes that road break-up would not occur due to root and vegetation growth in the road bed. The "dead zone" was kept vegetation free by herbicide spray. This is one reason why there is much more bare ground in the plots adjacent to the roadside. Herbicide residue may still be impairing the establishment of a good stand of vegetation in those areas.

The plots that were located 10-20 feet from the roadside had more native vegetation, and more of those plots increased native cover from 1998 to 2000. Many plots had a decrease of both native and non-native vegetation cover from 1998 to 2000. This could be due to several factors such as a dry season causing more vegetation to dry out and thus become litter and because there were different people determining percent cover in 1998 and in 2000. Different control method used in 2000 than in 1998 for the same plot would also affect the data.

Implications

Weeds are a problem along the West Chewuch Road and in many other nearby areas. The source of weeds comes from both adjacent land and from vehicles that carry the seeds. If the roadsides are planted with a hardy but non-invasive grass or native plant species, the weeds may be out-competed. Annual rye grass has been used for this purpose at other sites with satisfactory results. The addition of vegetation to the edge of the road would slow down run off. This reduction in overall flow and in flow rate would help to curb erosion of the road and surrounding area.

Hand-pulling, mowing and disking have also been used to control weeds in other places. Used in combination, these traditional methods control the weed population more effectively than herbicides and have a much lower effect on the ecosystem. In order for these methods to become widespread, the public must be informed of their existence and effectiveness. Here are some outreach possibilities:

- Publicity: publish article in the newspaper about the alternatives to spray
  publish article about the hazards and problems involved with spray
  publish article about this pilot project
  radio ads (free ads on NPR?) discussing the above issues (2 or 3 minute sound byte)
- Education: flyers discussing the above issues, with easy to digest, easy to implement

information for the average county resident, make these widely available (feed stores, hardware stores, county weed board, etc.)
flyers with information regarding the native species endangered and threatened by invasive species.

- Involvement: volunteer work parties for weed pulling, mowing and replanting of native vegetation. Make the citizens of the Methow proud of their native species
get the county involved with successful weed control strategies

Project Direction and Future

The power of this study lies in its longevity; the yearly repetition of the survey will lead to a large and powerful dataset. The information gathered from 4 to 5 years of data will be useful in accessing changes in vegetation and roadside conditions over time and trends that occur with vegetation changes. This project will also access the type of vegetation of an area and what plant populations seem to be spreading and which appear to be contracting.

Each plot needs a documentation of what kind of weed control methods have been used in that plot since 1995. This is the only way to determine a link between control methods and vegetation cover. Herbicide documentation should be available, but interviewing land owners will be the best way to find out if any manual or cultural control has been used. Seeding activities should also be noted.

Each plot should have its general characteristics documented. Some plots are located in yards, some on road-cuts, and one is an approach. These differences may need to be taken into account when doing plot data comparisons.

Further statistical analyses may be done comparing the number and percent cover of specific plants in the inner and outer quadrats. Mean number of species in the quadrats may also be analyzed. Differences between the east and west sides of the road could be examined.

This project is an excellent example of how different levels of government and the general public can work together for the common good. The widespread applications involve relations between citizens and government (local, state, and federal) weed control, and the study of non-native plants in general.

Appendix A - Non-Native Plant Occurrence

Family	Genus/Species	Common Name	Class	1998	1999	2000
Amaranthaceae	Amaranthus retroflexus	Red Root Pigweed		X		
Asteraceae	Asteraceae spp. (unknown)	Aster				X
Asteraceae	Centaurea diffusa	Diffuse Knapweed	B	X		
Asteraceae	Centaurea maculosa	Spotted knapweed	B		X	
Asteraceae	Chrysanthemum leucanthemum	Oxeye Daisy		X		
Asteraceae	Cirsium arvense	Canadian Thistle	B	X		
Asteraceae	Erigeron linearis	Line-leaf fleabane				X
Asteraceae	Iva xanthifolia	Tall Marsh-elder		X		
Asteraceae	Lactuca serriola	Prickly Lettuce		X		
Asteraceae	Taraxacum officinale	Dandelion		X		
Asteraceae	Tragopogon dubius	Goat's Beard		X		
Boraginaceae	Asperugo Procumbens	Madwort				X
Boraginaceae	Lithospermum arvense	Corn Gromwell		X		
Brassicaceae	Capsella bursa-pastoris	Sheperd's Purse		X		
Brassicaceae	Cardaria draba	White Top, Hoary Pepperwort		X		
Brassicaceae	Cardaria pubescens	White Top		X		
Brassicaceae	Draba spp. (not verna)	Draba				X
Brassicaceae	Lepidium virginicum	Tall peppergrass				X
Brassicaceae	Sisymbrium altissimum	Tumble Mustard		X		
Brassicaceae	Sisymbrium loeselii	Loesel's Tumblemustard		X		
Brassicaceae	Thlapsi arvense	Field Pennycress		X		
Caryophyllaceae	Lychnis alba	White Campion		X		
Caryophyllaceae	Silene alba	White catchfly			X	
Chenopodiaceae	Chenopodium album	Lambsquarters		X		
Chenopodiaceae	Chenopodium botrys	Jerusalem Oak		X		
Chenopodiaceae	Salsola australis	Russian Thistle, Tumbleweed		X		
Euphorbiaceae	Euphorbia glyptosperma	Corregated-seeded Spurge		X		
Fabaceae	Medicago lupulina	black medic			X	
Fabaceae	Medicago sativa	Alfalfa		X		

Family	Genus/Species	Common Name	Class	1998	1999	2000
Fabaceae	Melilotus alba	White Sweet-clover		X		
Fabaceae	Melilotus officianalis	Yellow Sweet-clover		X		
Fabaceae	Melilotus spp	Sweetclover		X		
Fabaceae	Trifolium dubium	Yellow Hop Clover		X		
Fabaceae	Trifolium pratense	Red Clover		X		
Fabaceae	Trifolium repens	White Clover, Dutch Clover		X		
Graminae	Agropyron cristatum	Crested Wheatgrass		X		
Graminae	Agropyron dasytachyum	Downy Wheatgrass		X		
Graminae	Agropyron intermedium	Intermediate Wheatgrass		X		
Graminae	Agropyron repens	Quack Grass		X		
Graminae	Agrostis spp	Bent spp		X		
Graminae	Agrostis stolonifera	Fiorin		X		
Graminae	Avena fatua	Oats		X		
Graminae	Bromus inermis	Hungarian Brome, Smooth Brome		X		
Graminae	Bromus japonicus	Japanese Cheat		X		
Graminae	Bromus spp	Brome spp			X	
Graminae	Bromus tectorum	Downy Cheat, Cheatgrass		X		
Graminae	Dactylis glomerata	Orchard Grass		X		
Graminae	Festuca ovina	Sheep Fescue		X		
Graminae	Festuca rubra	Red Fescue		X		
Graminae	Poa bulbosa	Bulbous Bluegrass		X		
Graminae	Poa pratensis	Kentucky Bluegrass		X		
Graminae	Poa spp. (unknown)	Bluegrass				X
Graminae	Secale cereale	Cereal Rye		X		
Graminae	Setaria viridis	Green Bristlegrass		X		
Labiateae	Labiateae family	Mint		X		
Malvaceae	Malva neglecta	Dwarf Mallow		X		
Plantaginaceae	Plantago lanceolata	Lance Leaf Plantain		X		
Polygonaceae	Polygonum convolvulus	Knot Bindweed		X		
Polygonaceae	Polygonum spp	Knotweed spp		X		
Polygonaceae	Rumex crispus	Yellow dock, curly dock			X	
Ranunculaceae	Ranunculus repens	Creeping Buttercup		X		
Rosaceae	Potentilla recta	Erect cinquefoil	B			X

Family	Genus/Species	Common Name	Class	1998	1999	2000
Scrophulariaceae	Linaria dalmatica	Dalmatian Toadflax	B-des.	X		
Scrophulariaceae	Verbascum thapsus	Common Mullein, Flannel Mullen	B	X		
Solanaceae	Solanum dulcamara	Climbing, or bittersweet Nightshade		X		

Appendix B - Native Plant Occurrence

Family	Genus/Species	Common Name	1998	1999	2000
Apiaceae	Lomatium ambiguum	Difficult nine-leaf biscuit root		X	
Apiaceae	Lomatium dissectum	Chocolate tips		X	
Asteraceae	Achillea millefolium	Common Yarrow	X		
Asteraceae	Anaphalis margaritacea	Pearly-everlasting			X
Asteraceae	Artemisia tridentata or ludoviciana	Big Sagebrush or Prairie Sage	X		
Asteraceae	Artemisia tripartita	Three-tip sagebrush			X
Asteraceae	Asteraceae spp. (unknown)	Aster			X
Asteraceae	Balsamorhiza sagittata	Arrowleaf Balsamroot	X		
Asteraceae	Chaenactis douglasii	Hoary Chaenactis	X		
Asteraceae	Conyza canadensis	Horseweed, Canadian Fleabane	X		
Asteraceae	Erigeron corymbosus	Three-nerved daisy		X	
Asteraceae	Erigeron filifolius	Threadleaf Fleabane	X		
Asteraceae	Erigeron linearis	Line-leaf fleabane			X
Asteraceae	Hieraciuim albertinum	Hairy hawkweed		X	
Asteraceae	Matricaria matricarioides	Pineapple Weed	X		
Asteraceae	Solidago canadensis	Canada Goldenrod	X		
Beriberidaceae	Berberis aquifolium or repens	Tall Oregon Grape or Creeping Oregon Grape	X		
Beriberidaceae	Berberis aquifolium	Oregon Grape	X		
Boraginaceae	Amsinckia spp	Fiddleneck spp	X		
Boraginaceae	Cryptantha spp (annual)	Annual Crypthanths	X		
Boraginaceae	Lithospermum ruderale	Western Gromwell, Columbia puccoon, stone seed	X		
Brassicaceae	Descurainia pinnata	Tansy-mustard			X
Caprifoliaceae	Symphroricarpos albus	common snowberry	X		
Chenopodiaceae	Chenopodium fremontii	Fremont's lambsquarters		X	
Cornaceae	Cornus stolonifera	Red osier dogwood		X	
Equisetaceae	Equisetem arvense	Common Horsetail	X		
Fabaceae	Astralagus miser	Weedy Milkvetch	X		
Fabaceae	Lupinus latifolius	Broad-leaf Lupine	X		
Fabaceae	Lupinus sericeus	Lupine			X

Family	Genus/Species	Common Name	1998	1999	2000
Fabaceae	Vicia villosa + Vicia americana	Wooly Vetch	X		
Graminae	Agropyron spicatum	Blue-bunch Wheatgrass	X		
Graminae	Agrostis spp	Bent spp	X		
Graminae	Bromus carinatus	California Brome	X		
Graminae	Bromus spp	Brome spp		X	
Graminae	Calamagrostis canadensis	Blue Reed	X		
Graminae	Elymus glaucus	Blue wildrye; western rye-grass			X
Graminae	Festuca idahoensis	Idaho Fescue	X		
Graminae	Phalaris arundinacea	Reed-canary grass			X
Graminae	Poa spp. (unknown)	Bluegrass			X
Graminae	Sporobolus cryptandrus	Sand Dropseed	X		
Graminae	Stipa comata	Needle-and-Thread	X		
Graminae	Stipa occidentalis	Western Needlegrass	X		
Hydrophyllaceae	Phacelia hastata	Silverleaf Phacelia	X		
Hydrophyllaceae	Phacelia linearis	Threadleaf Phacelia	X		
Juncaceae	Carex spp	Carex spp	X		
Juncaceae	Juncus ensifolius	Dagger-leaf Rush	X		
Labiateae	Labiateae family	Mint	X		
Liliaceae	Brodiea douglasii	Wild hyacinth		X	
Liliaceae	Smilacina stellata	False Solomon's Seal	X		
Loasaceae	Mentzalia albicaulis	White-stemmed Mentzelia		X	
Loasaceae	Mentzelia dispersa or laevicanlis	Mentzelia spp	X		
Onagraceae	Epilobium angustifolium	Fireweed	X		
Onagraceae	Epilobium minutum	Small fireweed		X	
Onagraceae	Epilobium paniculatum	Autumn Willow-weed	X		
Orchidaceae	Habenaria spp	Bog Orchid	X		
Pinaceae	Pinus ponderosa	Ponderosa Pine	X		
Plantaginaceae	Plantago major	Common Plantain	X		
Polemoniaceae	Collomia grandiflora	Large-flowered Collomia	X		
Polemoniaceae	Collomia linearis	Narrow-leaf Collomia	X		
Polemoniaceae	Collomia tenella	Chinese pagodas		X	
Polemoniaceae	Microsteris gracilis	Pink Microsteris			X
Polygonaceae	Eriogonum elatum	Tall Desert Buckwheat	X		

Family	Genus/Species	Common Name	1998	1999	2000
Polygonaceae	Eriogonum heracleoides	Wyeth Buckwheat	X		
Polygonaceae	Eriogonum niveum	Snow Desert Buckwheat	X		
Polygonaceae	Polygonum douglasii	Douglas' Knotweed	X		
Polygonaceae	Polygonum minimum	Dwarf Knotweed	X		
Ranunculaceae	Clematis ligusticifolia	Western Clematis	X		
Ranunculaceae	Delphinium nuttallianum	Larkspur			X
Rosaceae	Amelanchier alnifolia	Serviceberry		X	
Rosaceae	Prunus virginiana	Common Chokecherry	X		
Rosaceae	Purshia tridentata	Bitterbrush	X		
Rosaceae	Rosa woodsii	Wildrose	X		
Rosaceae	Rubus idaeus	Raspberry		X	
Rosaceae	Rubus spp	Raspberry	X		
Salicaceae	Populus trichocarpa	Black Cottonwood	X		
Scrophulariaceae	Collinsia parviflora	Small-flowered Bue-eyed Mary			X

Appendix C - Monitoring Component, Protocols and Forms

The current state of the roadway will be determined using Form A - Roadway Condition, Form B - Presence/Absence of Selected Weeds, Form C - Survey of All Weeds along Road and Form D - Detailed Quadrat

Form A - Roadway Condition

This data will include the condition of the road and shoulder and the type of vegetation beside the road for rectangles 10 feet wide and extending a distance 30 feet from the centerline of the road. The rectangles will be located every 1/4 mile along the 5 mile length of the road.

Form B - Presence/Absence of Selected Weeds

This form will be used to record high or low presence or absence of toadflax, knapweed and mullein in the road easement and adjacent property along the entire 5 mile length of road. One page of this form will be used for each of the 3 weeds and the locations will be indicated as distances from the start of the road where the weed is present or absent.

Form C - Survey of All Weeds along Road

This survey will identify all noxious weeds present along the 5 mile length of road.

Form D - Detailed Quadrat

This form will quantify the vegetation in the Roadway Condition rectangles. All vegetation will be surveyed for percent cover and frequency of occurrence. Vegetation on adjacent private property will be noted. Not all Roadway Condition rectangles will be detailed in Quadrant Forms. Number to be determined by time constraints.

Conduct of Monitoring

Surveys along a roadway present a low but unavoidable hazard from the passing vehicles. Surveyors will wear fluorescent vests at all times and take precautions to avoid exposure to traffic.

Chewuch Road Pilot Project Methodology Notes

Measuring Stem Frequency –

For rhizomatous grasses note and count the number of stems.
For other grasses note and count clumps.

High frequency – 100 + stems
Medium freuquency – 10 to 100 stems
Low frequency – 1 to 10 stems

On data spreadsheet, 3 = high frequency
2 = medium frequency
1 = low frequency

Calculate litter as % cover as viewed from above.

Rocks are defined as being over $\geq$ 3 inches in diameter

Form A - Roadway Condition

This form is to be taken every quarter mile along roadway to give a general measure of the condition. This data will be include the condition of the road and shoulder and the type of vegetation beside the road for rectangles 10 feet wide and extending a distance 30 feet from the centerline of the road.

Date_____

Survey Person_____

Road Segment_____Measured from Start of West Chewuch Road at Highway 20

	East Side	West Side	
Asphalt Condition	_____	_____	1-unbroken, 2-broken, 3-severely broken
Road Shoulder	_____	_____	1-uneroded, 2-broken, 3-severely broken
General cover 10-20 ft from cntrline	_____	_____	1-bare ground, 2-weedy, 3-grass 4-native vegetation
Primary Veg	_____	_____	
Weeds	_____	_____	
General cover 20-30 ft from cntrline	_____	_____	1-bare ground, 2-weedy, 3-grass 4-native vegetation
Primary Veg	_____	_____	
Weeds	_____	_____	

Vegetation on Adjacent Property — 1-bare ground, 2-weedy, 3-grass 4-native vegetation

Primary Veg	_____	_____
Weeds	_____	_____

Comments and follow-up activities_____

_____

_____

_____

Form B - Presence/Absence of Selected Weeds

This form is to be taken along roadway to give a general measure of the percent cover or absence of selected weeds along the roadside and on adjacent property to the Chewuch Road. Use the code 1 - High (100-10%), 2 - Medium (10 - 1%), 3 - Low (1-0%), 4 - Absent

Date_____

Survey Person_____

Weed _____

Road Segment Start	Stop	East Side ROADSIDE – ADJACENT	West Side ROADSIDE -- ADJACENT
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Form - C Survey for Weeds

Date_____

Survey Person_____

The following list of weeds were identified along the Project roadway

Weed Name	Location if weed is of very low occurrence
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Form D Vegetation Quadrat

The following vegetation quadrat was made to quantitatively record vegetation at the same locations as the Road Condition Survey along the roadway. A pair of flags is placed at the outside edge of the easement on each side of the quadrat and lines one foot long are marked on the asphalt. at the sides of the quadrat.. The quadrat is to be 10 feet wide and will extend from the edge of the asphalt a nominal 10 feet from centerline to a distance of 30 feet. The 20 foot distance will be broken into two parts, each 10 feet long. Within each section the spp code will be recorded with the % cover and frequency of occurrence.

For frequency: High (100 + stems/clumps), Medium (10-100 stems/clumps), Low (1-10 stems/clumps).

Date_____

Survey Person_____

Location of Quadrat_____ East _____ West_____ (check one)

Additional Comments_____

First Part - 10 - 20 feet from centerline			Second Part - 20 - 30 feet from centerline		
ssp Code	% Cover	Frequency	ssp Code	% Cover	Frequency
Bare			Bare		
Litter			Litter		
Rocks			Rocks		