FHWA-ID-EIS-12-01-F

Vegetation Technical Reports

Final Environmental Impact Statement

US-95 Thorncreek Road to Moscow

Project No. DHP-NH-4110(156);Key No 09294

Effects Analysis of the US Highway 95-Thorncreek Road to Moscow Project for Plant Species and Communities of Conservation Concern

Juanita Lichthardt, Research Ecologist
Idaho Department of Fish and Game
Project No. DHP-NH-4110(156)
Project Key No. 9294

1 December, 2008

INTRODUCTION

In the original biological evaluation of this project with regard to plant species and communities of conservation concern (Lichthardt 2005), I did not include an analysis of cumulative effects, nor did I address land development as a potential indirect effect of the project. This is intended to be a stand-alone document that addresses potential direct, indirect, and cumulative effects of the three remaining highway alternatives, E2, C3, and W4.

The proposed action may have direct or indirect effects on plant species and communities of conservation concern. In either case, an effect may be cumulative if it acts in an additive or synergistic way with impacts unrelated to the action. In Lichthardt (2005, p 11) I defined direct effects to Palouse Grassland remnants and target rare plant species as "soil disturbance by movement or equipment tracking within any portion of a remnant, including soil deposition occurring during or after construction." All remnants contain one or more populations of target species, and because all remnants except one are very small, any decrease in size or condition can be expected to have a negative impact on the plant populations present. None of the three action alternatives currently being considered appear to intersect a remnant.

INDIRECT EFFECTS

Indirect effects are caused by the action, but occur later in time, or are farther removed in distance. Post-construction (indirect) impacts of this project might include invasion of weeds from the highway corridor, sedimentation from fill areas, erosion due to interrupted surface drainage, or interruption of subsurface drainage patterns and water balance. Probably the most likely potential effect of the action is the introduction and/or spread of weeds from the highway corridor (Lichthardt 2005). Land development, which was not addressed in my original report, is also a potential indirect effect if its rate or pattern is changed by the project.

Weed invasion

The following is taken from Lichthardt (2005, p 11):

> *Indirect effects of the action are more difficult to predict and may operate at some distance from the roadway. Some of the environmental effects of roads can*

extend more than 90 m (300 ft) from the roadway and these include the spread of planted, roadside exotics (Forman 2000).

…Roads represent vectors of weed introduction and spread due to continuous input of weed propagules from traffic (Trombulak and Frissell 2000, Larson 2003). This is compounded by a roadside habitat with enhanced water supply from runoff, creating conditions favorable to plant establishment. The immediate roadside is also constantly disturbed, giving weed species a competitive advantage.

Although the current highway represents a corridor of propagule movement into the project area, stabilized slopes minimize the opportunity for weeds to leave the corridor. New highway construction could accelerate weed introduction by creating extensive soil disturbance. A variety of factors will determine the magnitude of this threat, most importantly the planning and success of revegetation. Although Best Management Practices will be used to stabilize and vegetate these surfaces, grass cover will take time to develop and will be initially patchy. Weed seeds will already be present in many cases, and poised to take advantage of the disturbance. So the proposed action will increase the potential for weed establishment along the highway corridor. The potential for those weeds to move from the roadside into a remnant will be dependent on their means of dispersal, distance to the remnant, and the intervening land use. In this regard, intensively managed cropland might provide a more efficient buffer to new weed invasion than native vegetation, or Conservation Reserve plantings.

These indirect effects can be expected to decrease in likelihood with increasing distance from the disturbance. Utilizing the map of alternative highway routes and remnants found in Lass and Prather (2005) to do a coarse assessment, the closest remnant to alternative W4 (M4, Map 1) appears to be 250 to 300 m away, and it is located along the portion of the corridor that is shared by alternative C3. Therefore alternatives W4 and C3 come within 300 m of the nearest remnant. In comparison, there are six remnants within 300 m of alternative E2, the closest (G1) within 80 m. Lass and Prather (2005) used a 0.6-mi buffer to represent potential short-term weed effects. Using a narrower, 500-m buffer (0.3-mi) serves to eliminate much of the overlap between alternatives. In a coarse analysis, I determined the number of remnants falling entirely, or in part, within 500 m on either side of each highway alternative (Table 1). For this analysis I combined nearby remnants that are not separated by cultivation, but by exotic-dominated vegetation.

Land development

Indirect effects of highway construction also include potential changes in rate, type, or pattern of land development. Unlike the other indirect effects, which are mitigated by distance from the highway corridor, land development may be more a function of proximity to Moscow, zoning, and highway access points.

A report on the potential for induced development resulting from this project (HDR Engineering 2005) suggests that development in the project area may currently be suppressed by uncertainty in highway routing. As for the potential for highway-induced growth, all three of the current alternatives were estimated to have a "moderate" or "moderate-to-low" potential to induce development in an area within one mile south of Moscow. Commercial and industrial uses could increase in those areas already zoned for these purposes. There are no known Palouse Grassland remnants within 1 mile south of Moscow; two of the remnants are within 1.25 miles south.

In the remainder of the study area, the potential for induced development was ranked "moderate to none." This indicates to me that the effect of highway construction on pace and type of development is difficult to predict, but opens the possibility of a moderate potential for induced development throughout the study area, with no difference among routes in this respect. The report did not address development around highway access points. Based on this report, the potential for highway-induced growth varies from moderate to none, and any effect would be primarily on the rate of growth, and not type, which has in the past been mostly residential.

CUMULATIVE EFFECTS

Cumulative effects are those resulting from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of the source of these actions. Following is a discussion of potential cumulative effects of the US Highway 95-Thorncreek Road to Moscow Project with regard to plant species and communities of conservation concern.

Past human impacts

Native Palouse vegetation has been reduced to its present endangered status primarily through its conversion to cropland, and to a lesser extent, land development. Remnants of native vegetation are threatened by exotic weed invasion and genetic isolation.

The existing remnants are mostly small, isolated islands degraded to varying extent by exotics, and generally more rocky and/or steep than most of the original Palouse. Because of their isolation, gene flow is restricted, especially gene flow by seed. The restriction of gene flow can lead to reduced fitness of a population via genetic drift (Peterson 2008).

In the study area, grassland remnants were found to be degraded primarily by annual grasses (*Bromus* spp. and *Ventenata dubia*), Kentucky bluegrass (*Poa pratensis*), and tall oatgrass (*Arrhenatherum elatius*); and hawthorn remnants by bur chervil (*Anthriscus caucalis*), and smooth brome (*Bromus inermis*)—all introduced species. There were also incidental observations of yellow starthistle (*Centaurea solstitialis*), garden cornflower (*Centaurea cyanus*), white bryony (*Bryonia alba*), Canada thistle (*Cirsium canadensis*) and common crupina (*Crupina vulgaris*).

Many weedy species are particularly adapted to disturbed soils, and highway corridors are known to be vectors of weed invasion (Trombulak and Frissell 2000). Therefore, alternatives that maximize the distance of the disturbance from remnants should result in a lesser cumulative effect of past weed invasion and invasions from the new highway corridor.

Ongoing human impacts

Ongoing human impacts to Palouse remnants in the study area include 1) herbicide drift from adjoining cropland, 2) tracking by farm and recreational vehicles, 3) invasion by perennial pasture grasses from adjoining retired fields, and 4) invasion of exotic species in general. Effects of pesticide use on pollinators could be added to this list, assuming pollinators are limiting to reproductive success. I would not anticipate items 1 and 2 to change in any predictable way due to highway construction under any of the alternatives being considered. Item 3–invasion by perennial pasture grasses–could be an issue if inappropriate plant materials–those with a tendency to leave the site–are used in the right-of-way seeding mix. Invasion of exotics in general (item 4) could be accelerated by highway construction.

To summarize, cumulative effects could potentially result from a combination of inappropriate seeding mix and ongoing invasion by non-native pasture grasses, or from the acceleration of exotic invasion by highway construction. Alternatives that maximize the distance of the disturbance from remnants should result in the least cumulative effects.

Future human impacts

Foreseeable future human impacts to Palouse Grassland remnants include land development and invasion by adventive weed species –those that have been introduced to the area, but have not yet spread.

It is probable that land development will continue to radiate outward from Moscow, into the north end of the study area, destroying remnants of Palouse Grassland communities. Ground-breaking for residential development is currently underway. The only way that loss of Palouse remnants can be prevented is by the actions of landowners who value the remnants, purchase of the parcels by a government entity or conservation group, or placement of land use restrictions on developing such sites.

Any increase in rate of development, of any kind, could result in cumulative effects with past cultivation, which initially eliminated most of these community types. The potential for highway construction to accelerate development in the study area is discussed above under Land Development.

Numerous species of exotic weeds exist in the Moscow area that were not found in any of the remnants (Lass and Prather 2007), representing future threats to remnants in the study area. Some are known to be a threat to bunchgrass grasslands and others are too recently escaped or introduced to predict their impacts. Based on the number of

weed introductions and rapidity of their expansion in recent years, it is easy to foresee new species entering and degrading remaining remnants of Palouse Grassland.

Because many exotic weeds are particularly adapted to disturbed soils, there is a high probability of cumulative effects of future weed movements and acceleration of those movements in the highway corridor. Minimizing the proximity of the disturbance to remnants, especially those of high quality, will minimize the degree to which species and communities of conservation concern are affected.

REFERENCES

Forman, R. T. T. 2000. Estimate of the area affected ecologically by the road system in the United States. Conservation Biology 14:31-35.

HDR Engineering. 2005. U.S. 95 Thorncreek Road to Moscow-community profile and induced development. HDR Engineering, Boise ID. 46 pp. plus appendices.

Larson, D. L. 2003. Native weeds and exotic plants: relationships to disturbance in mixed-grass prairie. Plant Ecology 169(2):317-333.

Lass, L. and T. Prather. 2007. A scientific evaluation for noxious and invasive weeds of the highway 95 construction project between the Uniontown cutoff and Moscow. Aquila Vision Inc. Missoula, MT. 78 pp.

Lichthardt, J. 2005. Biological evaluation of plant species and communities of conservation concern in the U.S. highway 95-Thorncreek Road to Moscow-project area. Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise, ID. 17 pp. plus appendices.

Peterson, A., I. V. Bartish, and J. Peterson. 2008. Effects of population size on genetic diversity, fitness, and pollinator community composition in fragmented populations of *Anthericum liliago* L. Plant Ecology 198:101-110.

Prather, Tim. Associate Professor of weed ecology. Department of Plant, Soil, and Entomological Sciences, University of Idaho. Personal communication on September 13, 2005.

Trombulak, S. C. and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14:18-30.

Table 1. Palouse Grassland remnants (see Table 2) within 500 m of each of three highway construction alternatives. G=grassland, S=snowberry, H=black hawthorn, A=aspen, P=ponderosa pine, and M=mixed cover.

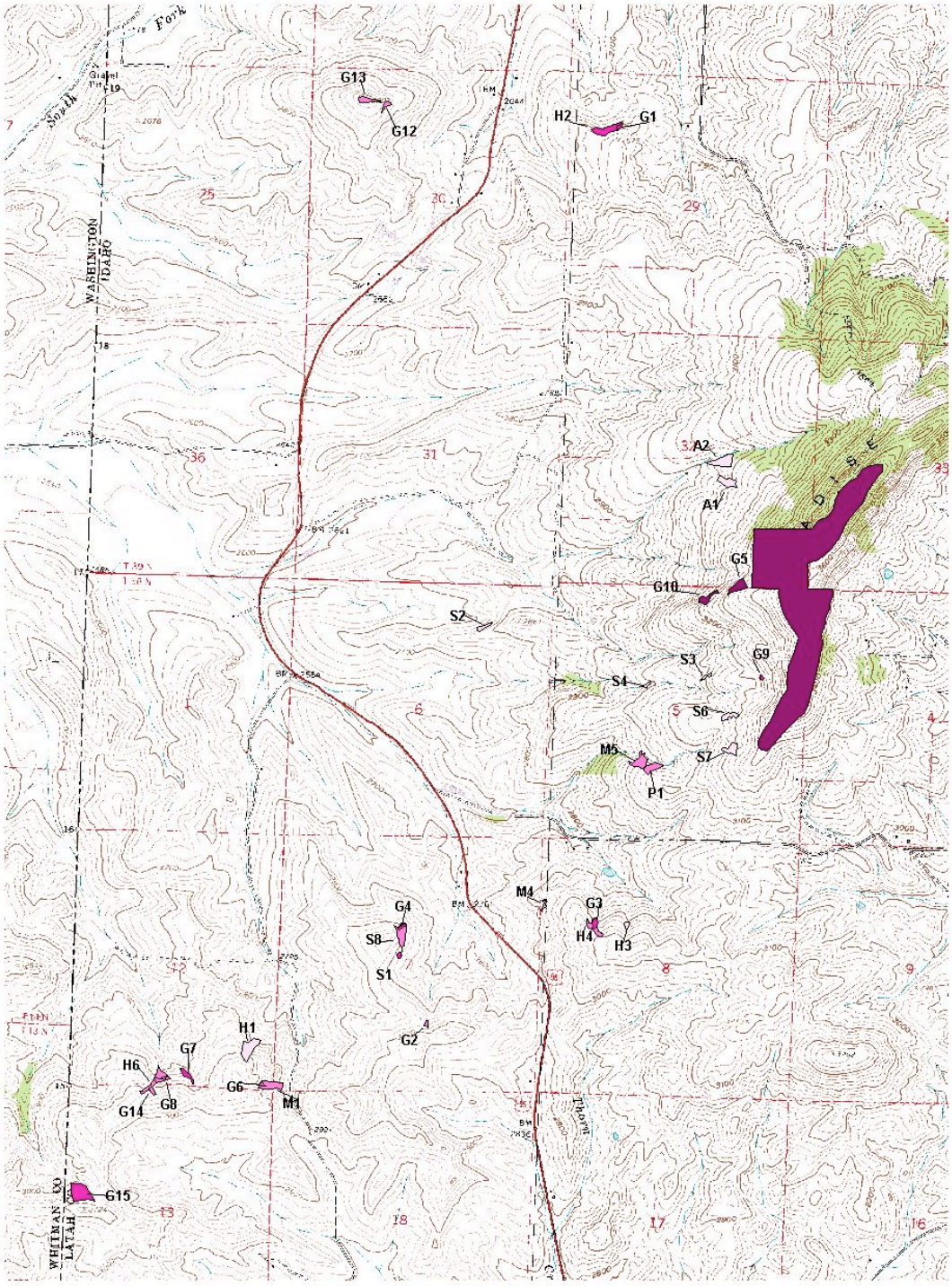
W4	C3	E2
G13/G12	S2	H2/G1
G4/S8	M4	A1/A2
M4		G10
		S4
		M5/P1
		G3/H4
		M4

Table 2. Relative conservation value of Palouse Grassland remnants based on key biodiversity factors[a] (Lichthardt, 2005).

Value class			Fescue/snowberry				Hawthorn	Snowberry	PG	PM	BL	PT	Notes
	Cons. rank:		G1				G1		G2	G2G4	G3	G3	
	Remnant	Sec.	A	B	C	Ha	Ha	Ha					
1	SEPR/G5/G10		x	x	x	14[b]		x	A		D	A	~40 ac ponderosa pine
2	G15	13	x			1.2			A		x		
	G7	12	x			0.2	0.28		D			x	Hawthorn was not mapped
	G1/H2	29	x			0.08	0.69	<.04					
	G3/H4	8	x			0.16	0.32	<.04	C			D	
	G4/S1/S8	7	x			0.08		0.77	A				
	G9	5	x			0.04			A				
3	G12/G13	30		x	x	0.44			B	x			Southeast aspect
	G8/G14/H6	12		x		0.28	0.57						
	G2	7		x		0.08			A				> 100 plants of Palouse goldenweed
	M5/P1	5		x		<.04		0.04				x	
	G6/M1	12/7			x	0.04	0.53						
4	H1	12					0.93						
	H3	8					0.12						
	S6	5						0.32	C			A	
	S4	5			x	<.04		0.08	B				
	S2	6						0.17				x	
	S3	5						0.08				x	
	S7	5						0.44					
	M4	7					0.1	x					
	A1	32											
	A2	32											

[a] G = grassland (Fescue/snowberry), S = snowberry, H = hawthorn, P = pine, A = aspen, M = mixed, SEPR = South End Paradise Ridge Conservation Site.
Sec. = section in which the remnants occur.
For Fescue/snowberry, A, B, and C are condition ranks.
"x" indicates presence
Ha = hectares (0.1 ha ~ 0.25 acre).
Species: Palouse goldenweed (PG), Palouse milkvetch (PM), broad-fruit mariposa lily (BL), Palouse thistle (PT)
For species, A, B, C, and D are population size ranks (A=largest; x = not ranked).

[b] Rank A: 7.4 ha, rank B: 2.3 ha, rank C: 4.6 ha.



Map 8: Remnants by Relative Conservation Value

1- High Value
2 - Medium High Value
3 - Medium Low Value
4 - Low Value

N

Idaho Conservation Data Center
P.O. Box 25, Boise, ID 83707 - Office (208) 334-3402, Fax (208) 334-2114 - http://fishandgame.idaho.gov/tech/CDC/

November 17, 2005

Biological Evaluation of Plant Species and Communities of Conservation Concern in the U.S. Highway 95—Thorncreek Road to Moscow—Project Area

Juanita Lichthardt

Idaho Conservation Data Center
Idaho Department of Fish and Game
PO Box 25
Boise, Idaho
83707

2005

Prepared under a cooperative agreement between:
Idaho Department of Fish and Game,
Conservation Data Center
and
Idaho Transportation Department

Project No. DHP-NH-4110(156)

Project Key No. 9294

Date: December 5, 2005

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

PROJECT DESCRIPTION, PROPOSED ACTIONS, AND ALTERNATIVES

The Idaho Transportation Department is evaluating alternatives for the widening of U.S. highway 95, from Moscow south to Thorncreek Road, into a divided four-lane highway. A number of different alternatives are being considered, including realignments and improvements of the current route, reroutes, and combinations of these. In all cases, a corridor of disturbance averaging between 70 and 90 m (240 and 300 ft) wide will be created, which could be as wide as 150 m (500 ft) in sections of deep cuts or fills. The final outcome will be a four-lane paved highway with cut and fill-slopes stabilized with rock and/or vegetation according to ITD guidelines. The Project Area is a rectangle running south 10.5 km (6.5 mi) from the south end of Moscow to Thorncreek Road and from the Washington border east to Paradise Ridge (about 5 km [3 mi]; Appendix 1, Map 1).

The purpose of this biological evaluation is to analyze the potential impacts of the proposed highway expansion on plant species of conservation concern and remnant native plant communities that provide habitat for these species. The occurrence and extent of rare plants and communities was assessed for the project area as a whole without regard for specific highway construction alternatives.

PROJECT AREA

Much of the project area is a typical Palouse landscape of rolling hills formed of deep wind-deposited silt (loess), often with a steeper leeward side. Drainage patterns are indistinct. Basalt bedrock is mostly deeply buried, but in places there are outcrops of granite and quartzite—basement rocks not covered by basalt or loess. In the northern third of the project area, the eastern boundary is intersected by Paradise Ridge—a long, mostly forested ridge formed of these basement rocks. Slopes rising toward its 1128-m (3700-ft) summit are more dissected than elsewhere in the project area, with shallower soils influenced increasingly by colluvium as opposed to loess. Elevations within the project area range from 760 to1095 m (2500 to 3600 ft).

BACKGROUND

The project area lies at the eastern edge of a geographic region currently and historically referred to as the Palouse. It is an intensively cultivated region that was once dominated by bunchgrass grasslands. The specific area referred to by the term Palouse varies depending on one's perspective or discipline (Caldwell 1961). Physiographically, the Palouse is an area of the Columbia plateau characterized by rolling hills of moderate to high relief, composed of deep soils formed from loess. Our knowledge of the natural vegetation of the Palouse is largely limited to the early observations of Weaver (1917) and to the extensive ecological investigations of Daubenmire (1970), both of whom were limited to studying remnants remaining after conversion of the grassland. In his analysis of the steppe (grassland and shrub/grassland) region of southeastern Washington and adjoining Idaho, Daubenmire refrained from using the term Palouse, instead referring to the different vegetation zones by their dominant species. His fescue–wheatgrass zone is

the easternmost and most mesic area of this steppe region. The project area is at the eastern edge of this zone.

Even those who use the term Palouse to refer to an ecological region disagree on its geographical limits (Caldwell 1961). One widely accepted definition is that of Bailey (1995, Figure 1) who delineated a Palouse Bioregion within a Great Plains–Palouse Dry Steppe Province.

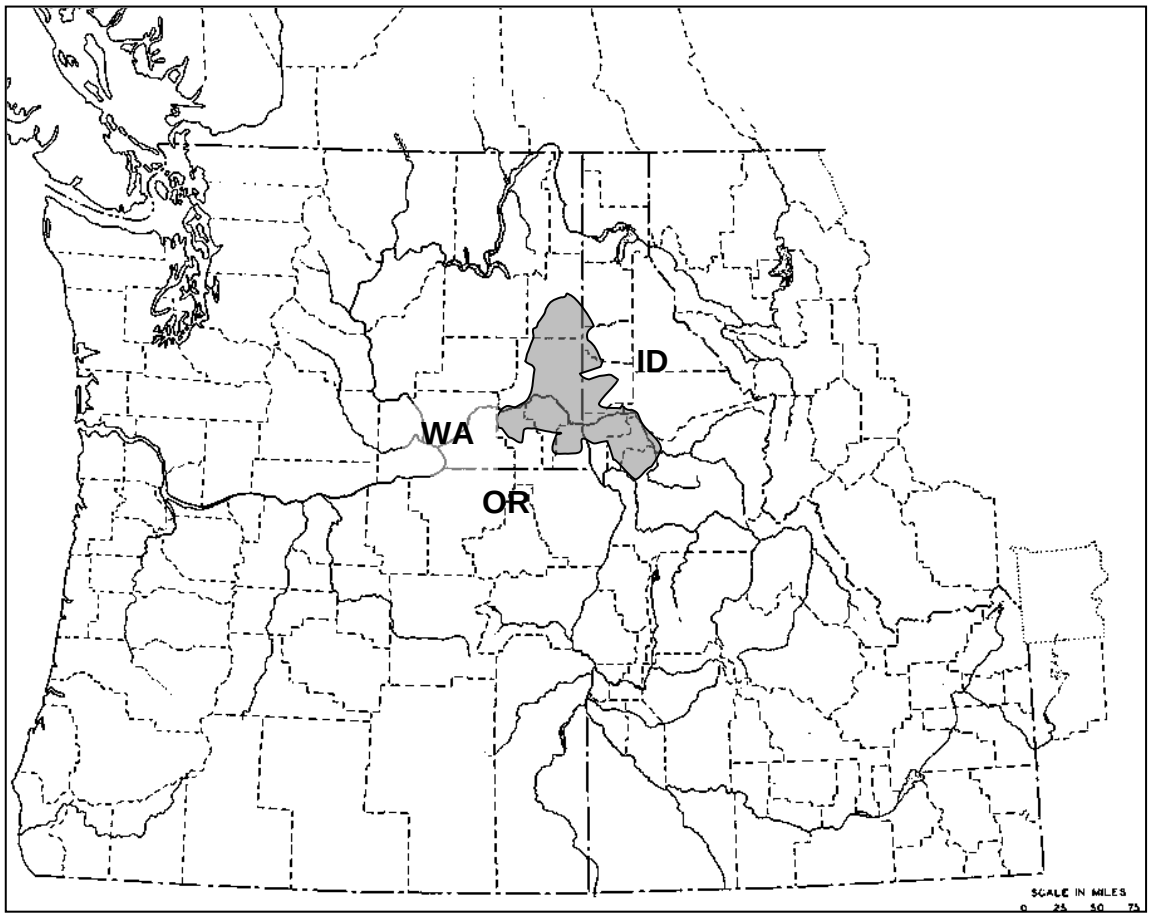


Figure 1. The Palouse Bioregion (Bailey 1995) in the context of the Pacific Northwest.

A number of plant species associated with the Palouse Bioregion are of conservation concern (Lichthardt and Moseley 1997). The reason for their rarity is that their ranges are to a large extent centered on the Palouse, which has been almost entirely converted to cultivated agriculture. As a consequence, the Palouse Grasslands, a subset of the Pacific Northwest Bunchgrass Grasslands (Idaho Natural Heritage Program et al. 1986) are considered one of the most endangered ecosystems in the United States. It is estimated that only 0.1% of these grasslands remain in a natural state (Noss et al. 1995). Several of

the bunchgrass and shrub communities described by Daubenmire (1970) are considered globally imperiled by the Natural Heritage Network (NatureServe 2005b).

METHODS

The target species (Table 1) were plants associated with the Palouse Bioregion, and tracked by the Idaho Conservation Data Center (IDCDC 2005a) due to their rarity, either globally or within Idaho. The authority used for plant names is Kartesz (1994) with the exception of *Haplopappus liatriformis* and *Aster jessicae*, which follow the older treatment of Hitchcock and Cronquist (1973).[1]

Table 1. Target species and their conservation ranks.*

Species	Common name	IDCDC rank
Aster jessicae	Jessica's aster	G2/S2
Astragalus arrectus	Palouse milkvetch	G2G4/Review
Calochortus macrocarpus var. *maculosus*	Green-band mariposa lily	G5T2/S2
Calochortus nitidus	Broad-fruit mariposa lily	G3/S3
Cirsium brevifolium	Palouse thistle	G3G4/S?
Crepis bakeri ssp. *idahoensis*	Idaho hawksbeard	G4T2/S2
Haplopappus liatriformis	Palouse goldenweed	G2/S2
Mimulus ampliatus	Ample monkey-flower	G1/S1
Silene spaldingii	Spalding's catchfly	G2/S1 (Listed: threatened)

* G indicates the global rank, T the subspecific rank (for varieties and subspecies), and S the state rank. The scale is from 1 to 5 with 1 being the most rare (see Appendix 2 for detailed definitions). Species with state ranks higher than 3 are not tracked by the IDCDC.

Patches of vegetation greater than 0.1 ha (0.25 ac) in size and not previously cultivated or seeded, were targeted for survey. Smaller areas were examined if encountered *en route*. Survey sites were identified by surveying from roads and promontories, and from a 1:75 scale orthophoto of the project area.

Native communities in the project area are not pristine, but contain some level of weeds. This raised the question of what would be considered a remnant, that is, how much degradation would be tolerated. I decided that, for our purposes, a remnant should be at least 0.04 ha (0.1 ac) in size, because few people would be willing to invest in conservation of any smaller unit. In terms of condition, the cover of exotics should be less than 50%. For forest and shrub communities, the herbaceous layer must be dominated by native species in addition to the shrub and tree layers. For bunchgrass communities, both Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass

[1] The IDCDC uses the older name until a taxon is treated by the Flora of North America Editorial Committee.

(*Pseudoroegneria spicatum*) should be present and should, in some combination, dominate the cover.

Survey work began on May 17, 2005 and was ongoing, interruptedly, until September 12. Unplowed patches with the highest potential for remnant grassland were visited first to look for the early blooming species ample monkey-flower and Idaho hawksbeard.

Rare plant locations were recorded using a hand-held GPS unit. Minimum information recorded at each location included: number of individuals, phenology, aerial extent of population/subpopulation, aspect, and associated species. This information will be entered into the IDCDC database. If distinct subpopulations were discernable a GPS reading was taken at each subpopulation. GPS accuracy was between 3.6 and 6.7 m (12 and 22 ft).

Remnants of native vegetation were also delineated with a GPS unit. Many additional GPS points were recorded to indicate sites I surveyed, but found no target species or qualifying remnants. I made notes on what I found in these locations. All spatial data collected during the surveys will be submitted to ITD to be used in their final matrix analysis.

I classified remnant vegetation into five general cover types: grassland, snowberry shrub, hawthorn, aspen, and ponderosa pine. Although different cover types usually occur together in the same landscape patch, they were delineated separately, if their size warranted, because of their different ecological roles and conservation ranks. Black hawthorn (*Crataegus douglasii*) and aspen (*Populus tremuloides*) dominate the overstory in their types. Ponderosa pine (*Pinus ponderosa*) generally occurs in closed stands except on portions of Paradise Ridge, where it forms open stands with bunchgrasses. The grassland cover type is dominated by native bunchgrasses. Snowberry shrub typically has a nearly continuous cover of common snowberry (*Symphoricarpos albus*), but in places is replaced by Nootka rose (*Rosa nutkana*).

When possible, these general cover types were further refined to habitat types (≈ecological associations) using Daubenmire's (1970) key. Two to four indicator species can often be used to determine the habitat type. Detailed community descriptions were not part of the scope for this project, but composition was described at seven grasslands by estimating the canopy cover of all readily evident species in a 10 x 10 m (33 x 33 ft) plot. This sampling was not intensive enough to identify all annuals and those perennials that become inconspicuous by mid-summer, such as Sandberg's bluegrass (*Poa secunda*).

Grassland remnants were the most intensively surveyed because they represented potential habitat for all of the target species except Jessica's aster. Grassland remnants were also ranked as to condition, A to C, with A indicating the best condition. Condition rank was based entirely on the cover and extent of non-native species. The only significant non-native species were grasses, both annual and perennial. The protocol I used was that class A grassland remnants could have patches of annual grasses, but these are restricted in extent (minor relative to size of remnant) and abundance, that is, 80-90%

of the community is intact, without exotic annuals or only sparsely infested; they have no tall oatgrass (*Arrhenatherum elatius*) or smooth brome (*Bromus inermis*),[2] and Kentucky bluegrass (*Poa pratensis*) is inconspicuous. In class B remnants, annual or perennial exotic grasses have made inroads to the extent that they cannot be excluded from the polygon. This means that tall oatgrass may be scattered within. In class C grasslands, annuals are dense and extensive and appear to have displaced bunchgrass cover in some places, but patches of equal or greater size, in good condition, are mixed in.

My ranking system is a modification of Natural Heritage methodology (NatureServe 2005a) in which plant communities or populations are ranked A-D based on condition, size, and landscape context. For this project, communities were ranked relative to others in the project area, and because they all occur in the same general landscape context the ranking system was simplified by setting them all equal in this respect. Size is a fairly objective criterion and was considered in the final analysis.

Some remnants were very distinct, with a clear boundary with adjoining cover types. More commonly, there was interfingering of exotics from adjoining vegetation, or a gradient in cover of some invading exotic that blurred the boundary. In addition to land use, these remnants are delimited by aspect and slope shape (concave, convex, straight). When one of these factors changes you generally have a change in community or condition. One problem that I encountered was that, by making the remnant smaller I could often improve the condition-class by excluding degraded portions. My approach was to include any degraded portion in which the cover of exotics was clearly less than 50%.

RESULTS

Rare Plants

Only four of the nine target species were found in the study area: Palouse milkvetch, broad-fruit mariposa lily, Palouse thistle, and Palouse goldenweed. Maps of their distribution can be found in Appendix 1, Maps 2-5. Palouse milkvetch was found in only two places, one in a grassland remnant and one on a roadcut. Broad-fruit mariposa lily was scarce, the five populations found very small, ranging from 1 to 20 individuals. Palouse thistle was occasional in stands of snowberry or ponderosa pine (more than 20 populations). Because it spreads by creeping roots, it is difficult to determine what constitutes an individual. Populations are often characterized by the number of colonies, or patches, of rosettes. A tight colony likely represents a single genetic individual (genet).

Palouse goldenweed was associated with grassland remnants only, occurring in all but two of the grassland remnants found, as well as many patches too small or too weedy to qualify as remnants (more than 10 populations and numerous subpopulations). It typically occurs as small clusters of plants consisting of a dense center and scattered

[2] They have no tall oatgrass or smooth brome in the remnant as delineated, but all have smooth brome or other weeds at or near their margins.

outlying individuals. Moscow is near the center of the global range of Palouse goldenweed, so it was not surprising to find it so consistently associated with remnants of the original grassland.

Palouse Remnants

Within the study area, one remnant had previously been documented as a conservation site by the IDCDC (2005b). Conservation sites are areas that have been surveyed by a biologist and determined to be of high conservation value, although they might not be protected or managed for biodiversity. The southern end of Paradise Ridge was designated the "South End Paradise Ridge" Conservation Site by the IDCDC in 1996 (Appendix 1, Map 6). (For simplicity I will refer to this as the "Paradise Ridge CS"). It encompasses 43 ha (106 ac), a little more than half of which is grassland; it also includes open pine woodland, pine forest, hawthorn, and ninebark (*Physocarpus malvaceus*). About 7.4 ha (18.3 ac) are A-ranked grassland and 6.9 ha (17 ac) B or C-ranked. About 8 ha (20 ac) of grassland are too dominated by annual grasses to be considered a remnant for the purpose of this survey.

In addition to the Paradise Ridge CS, thirty-two polygons were delineated representing remnant vegetation (Appendix 1, Map 6): two aspen, fourteen grassland, seven snowberry shrub, five hawthorn, one ponderosa pine, and three of mixed cover type. "Mixed" stands are either pine or hawthorn, with an amount of grassland too small to delineate out. Paradise Ridge CS is the exception; it is mapped as a mixed stand because it includes some forest and shrub, but it is primarily grassland. After the cover types were mapped I could see that two of the grasslands (G5 and G10) might more appropriately be combined and added to the Paradise Ridge CS. Except for the Paradise Ridge CS, remnants are small, ranging from 0.04 to 1.2 ha (0.1 to 3 ac). All grassland remnants border on, or include, hawthorn or snowberry shrub, but these adjoining communities did not always qualify as remnants due to either condition or size.

In many cases, more than one cover type in the same landscape patch qualify as remnants. These show up as tight clusters of different cover types on Map 6 (Appendix 1). Each cluster represents a remnant, comprised of different cover types. In Appendix 3, each remnant is briefly described as to the relative amount of each cover type, rare plants present, and factors responsible for the condition rank (in the case of grassland).

Of the 14 grassland remnants I found, I ranked seven A, five B, and two C based on the extent of degradation by weeds (Table 2). In this report I use the term "weed" to denote any exotic plant species, including pasture grasses. A limited number of weed species are responsible for degrading the condition of remnant grassland in the project area and all are grasses. A few broad-leaf weeds are present, but are sparse and low in cover. Specific weed species found within remnants and within the project area in general are discussed under *ENVIRONMENTAL BASELINE*.

Table 2. Grassland remnants (Appendix 1, Map 6) in each condition class. SEPR = South End Paradise Ridge Conservation Site.

A	B	C
G1	G2	G6
G3	G8	G13
G4	G10	SEPR (in part)
G5	G12	
G7	G14	
G9		
G15		
SEPR (in part)		

Remnants are not evenly scattered throughout the project area but are largely clustered along a corridor running between the west flank of Paradise Ridge and Bald Butte, just outside the western boundary of the project area (Appendix 1, Map 6). The sub-surface geology is likely the cause of this pattern. Paradise Ridge and Bald Butte are composed of uplifted basement rocks that protruded above lava flows, and they are apparently connected by a lower ridge that is incompletely covered by loess. Remnant vegetation is associated with outcrops along this ridge that could not be cultivated due to steepness or rockiness. Cobble-size quartzite can occasionally be found lying on the surface.

DESCRIPTIONS OF THE SPECIES AND COMMUNITIES

Species of Conservation Concern

Species of conservation concern found in the project area are: Palouse milkvetch, Palouse thistle, broad-fruit mariposa lily, and Palouse goldenweed. Descriptions of these species, their ranges, habitats, and conservation ranks can be found in Appendix 4. None of these species is federally listed and thus no critical habitat has been designated.

Populations of broad-fruit mariposa lily found in the study area have added conservation significance because they are peripheral to the range of the species. Latah County is the northernmost extent of the range of this species, which is almost entirely restricted to Idaho. Plant populations that are peripheral to a species' range may represent unique genotypes (Lesica and Allendorf 1995) making them important to conserving the genetic variation within the species. Prior to my 2005 surveys, there were only four extant occurrences of broad-fruit mariposa lily known in Latah County. The species was collected in or near the project area in 1937 and 1938, but these populations are considered extirpated (IDCDC 2005c).

The U.S. Fish and Wildlife Service requires that two species—water howellia (*Howellia aquatilis)* and Spalding's catchfly (*Silene spaldingii*)—be addressed in all federally

funded projects in Latah County. Both are listed as threatened under the Endangered Species Act.

Spalding's catchfly is known from the adjoining counties of Nez Perce and Whitman. It was a target species of this survey and, based on community composition, most of the grassland remnants appeared to be suitable habitat. However, in spite of targeted surveys at the proper time of year, no Spalding's catchfly was found. The closest known occurrences of the species are 10 miles south at Genesee and 15 miles west near Colton, Washington. Therefore I have concluded that the project will have no effect on Spalding's catchfly.

Water howellia is known from one location in Latah County. It requires partly shaded vernal ponds—shallow ponds that hold water into mid-summer but dry out by September. At Turnbull Wildlife Refuge in eastern Washington these ponds are provided by glacial potholes, and near Harvard, Idaho by old meander scars in the floodplain of the Palouse River. I believe the only place water howellia could have occurred in the study area is in the floodplain of the South Fork Palouse River. However, a road survey revealed that the floodplain is under cultivation and the stream channelized, therefore no water howellia habitat is present. For these reasons, I determined that highway development within the project area will have no effect on water howellia.

Palouse Remnants—Plant Communities of Conservation Concern

Four of the cover types I mapped—grassland, snowberry shrub, hawthorn, and ponderosa pine—represent recognized plant communities for which descriptions, distribution information, and conservation status are available through NatureServe (2005b) or published treatments (Daubenmire 1970, Tisdale 1986, Cooper et al. 1991). The exception is the aspen cover type. Aspen communities have been insufficiently studied in our region to allow classification. However, aspen cover types as a whole are of very limited occurrence in northern Idaho, so I consider these communities to be of conservation concern in our region.

Aspen cover type. The two aspen remnants in the project area are narrow and surrounded by open, previously cultivated land. Mature aspen form a solid to partly open upper canopy. The understory is dominated by a variety of shrubs, along with cow parsnip (*Heracleum maximum*). The shrub with the highest cover is ninebark (*Physocarpus* sp.). Moist-site indicators include cow parsnip, stinging nettles (*Urtica dioica*), and black hawthorn. A rather sparse forb layer is dominated by starry false Solomon seal (*Maianthemum stellatum*). These stands may represent a phase of the black hawthorn/cow parsnip ecological association described in Appendix 4, because black hawthorn is present in the understory.

Grassland cover type. Grassland remnants in the project area fall into the Idaho fescue/common snowberry (*Festuca idahoensis/Symphoricarpos albus*) habitat type described by Daubenmire (1970), which is termed an "ecological association" by NatureServe (2005b; Appendix 4). Idaho fescue/common snowberry is considered of conservation concern globally (rank G1), and is described in more detail in Appendix 4.

Composition and cover of prominent species are available for seven of these remnants in Appendix 5.

Within the project area, Idaho fescue/common snowberry can occur on any aspect, but southerly aspects tend to be degraded by exotic annual grasses, while northerly aspects have been more resilient to weed invasion.

Snowberry shrub cover type. The cover type I mapped as snowberry shrub may best coincide with the "*Symphoricarpos* series" described from the Canyon Grasslands by Tisdale (1986). In the Palouse, Daubenmire (1970) considered snowberry thicket to be a phase of Idaho fescue/common snowberry (Appendix 4). On north aspects in the project area, the common snowberry phase may be the more extensive. This community tends to have a high cover of fern-leaved desert parsley (*Lomatium dissectum*) which is the most prominent component in spring. The prominence of fern-leaved desert parsley, along with a scarcity of bunchgrasses and an abundance of Geyer's sedge (*Carex geyeri*) does not coincide well with Daubenmire's (1970) description of the common snowberry phase.

Hawthorn cover type. Although I did not quantify their composition, the hawthorn communities appear to represent the black hawthorn/cow parsnip habitat type described by Daubenmire (Appendix 4). Black hawthorn/cow parsnip is considered of conservation concern globally, and is described in more detail in Appendix 4.

In the project area hawthorn communities mostly occur as narrow stringers along minor gullies. Large portions do not contain a well-developed understory because of the dense shade, and many have understories dominated by weeds. However, a few marginal examples of this community type exist (H1, H2, and H6). The overstory can include substantial cover of serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*). Characteristic understory species are cow parsnip and stinging nettles which occur with a variety of mesic site forbs. Idaho fescue/common snowberry can occur on convex slopes adjacent to this community. This community is ranked G1 by the Natural Heritage Network (NatureServe 2005b).

Ponderosa pine cover type. Ponderosa pine remnants (P1 and also portions of the Paradise Ridge CS) include both the ponderosa pine/Idaho fescue and ponderosa pine/snowberry habitat types described by Cooper et al. (1991). These communities are ranked G4 and G4? respectively by the Natural Heritage Network (NatureServe 2005b).

ENVIRONMENTAL BASELINE

The primary land use in the project area is dryland farming, and most of the cropland has probably been under cultivation for over 120 years (Black et al. 1998). Roughly sixty-percent of the project area has been cultivated at one time. About one-tenth of the cultivated area is now enrolled in the Conservation Reserve Program and planted to perennial grasses. Only a small proportion is developed as roads, homes, intensive pastures, and farmsteads. The remainder is in native forest, shrub, or grassland in variable condition depending on the amount of weeds present. Most of these latter cover

types are associated with Paradise Ridge, a promontory on the eastern edge of the study area.

With the exception of the Paradise Ridge CS, remnants of Palouse vegetation in the project area exist as small islands within a matrix of cultivated ground and vegetation that has been degraded to some extent by weeds. Cultivated ground is of two types: 1) actively cultivated lands that produce a crop every year and generally use aerial spraying for weed control, and 2) Conservation Reserve lands that are planted to non-native perennial grasses and on which weed control is done by boom spraying. Each type of cultivated ground is associated with a different threat to rare plant conservation. In the case of active cultivation, remnants and associated rare plants are exposed to herbicides, directly or by drift. In the case of Conservation Reserve lands, remnants are exposed to colonization by rhizomatous pasture grasses that were chosen primarily for their tendency to exclude other species. During my 2005 surveys of Palouse remnants I saw limited evidence of damage to native vegetation from herbicide spraying. However, at numerous remnants I noted encroachment by tall oatgrass; large areas of native vegetation were excluded from remnant designation due to high cover of this rhizomatous perennial. Other pasture grasses were both less abundant and less obvious, due to lower height. Kentucky bluegrass and meadow foxtail (*Alopecurus pratensis*) are associated with slightly more mesic sites, and generally occur in snowberry or pine rather than grassland. Tall oatgrass was observed in all cover types except very dense hawthorn.

The primary threat to the persistence of Palouse remnants in their present state is colonization by weeds—expansion of those present as well as invasion by new arrivals. All remnants identified in the project area are bordered completely or partially by weedy vegetation. Annual grasses tend to dominate on upper, less mesic slope positions, and smooth brome or tall oatgrass on the more mesic margins.

The weeds currently responsible for degrading the condition of remnant grassland in the project area are all grasses: annual grasses, represented primarily by cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), soft brome (*Bromus hordaceus*), ventenata (*Ventenata dubia*), or some combination of these; and perennial grasses including tall oatgrass, smooth brome, meadow foxtail, and Kentucky bluegrass. The perennial grasses have most likely moved into the remnants, either by rhizomes or seed, from nearby Conservation Reserve plantings. Among the perennial grasses, tall oatgrass appears to be by far the worst invader. Broadleaf weeds are rare within native grassland communities. Small amounts of common St. John'swort (goatweed; *Hypericum perforatum*), bachelor buttons (*Centaurea cyanus*), and common crupina (*Crupina vulgaris*) were observed within remnants, where they appear to be capitalizing on small-scale natural disturbances. The native weedy annual, grassy tarweed (*Madia gracilis*) occurred in some remnants as well as in adjoining areas. Notably absent from grassland remnants are Canada thistle (*Cirsium arvense*), quackgrass (*Elymus repens*), and bindweed (*Convolvulus arvensis*) which are common in old fields.

Yellow-star thistle (*Centaurea solstitialis*) was observed twice in the project area, in degraded native vegetation. Large infestations of common St. John'swort were observed in some Conservation Reserve plantings.

Different weeds affect hawthorn communities, and two—bur chervil (*Anthriscus caucalis*) and white bryony (*Bryonia alba*)—kept many hawthorn communities from being delineated as remnants. Openings without heavy shrub cover in these communities can also be dominated by reed canarygrass (*Phalaris arundinacea*). Bur chervil often dominates the understory and white bryony is an aggressive vine in the cucumber family that climbs on, and covers, the hawthorn shrubs. I tried to exclude bur chervil infestations when I delineated hawthorn remnants, but it is often difficult to penetrate these communities to get a thorough look at what is inside.

EFFECTS OF THE PROPOSED ACTION

Depending on the route chosen, expansion and rerouting of U.S. highway 95 could have direct and/or indirect effects on rare plants and communities. Direct effects can be defined the same way for both remnants and target species, that is, as soil disturbance by movement or equipment tracking within any portion of a remnant, including soil deposition occurring during or after construction. All remnants contain populations of target species, and because all remnants except the Paradise Ridge CS are very small, any decrease in size or condition can be expected to degrade the population.

Direct effects will occur within the right-of-way (ROW) during construction, and could also occur following construction on areas adjoining the ROW. Occasionally, contractors lease land directly from adjoining landowners to be used during the construction process, causing direct effects outside the ROW. Post-construction impacts might include sedimentation from fill areas, erosion due to interrupted surface drainage, or interruption of subsurface drainage patterns and water balance.

Indirect effects of the action are more difficult to predict and may operate at some distance from the roadway. Some of the environmental effects of roads can extend more than 90 m (300 ft) from the roadway and these include the spread of planted, roadside exotics (Forman 2000).

Probably the most important potential effect of the action is the introduction of weeds along the highway corridor. Roads represent vectors of weed introduction and spread due to continuous input of weed propagules from traffic (Trombulak and Frissel 2000, Larson 2003). This is compounded by a roadside habitat with enhanced water supply from runoff, creating conditions favorable to plant establishment. The immediate roadside is also constantly disturbed, giving weed species a competitive advantage.

Although the current highway represents a corridor of propagule movement into the project area, stabilized slopes minimize the opportunity for weeds to leave the corridor. New highway construction could accelerate weed introduction by creating extensive soil disturbance. A variety of factors will determine the magnitude of this threat, most

importantly the planning and success of revegetation. Although Best Management Practices will be used to stabilize and vegetate these surfaces, grass cover will take time to develop and will be initially patchy. Weed seeds will already be present in many cases, and poised to take advantage of the disturbance. So the proposed action will increase the potential for weed establishment along the highway corridor. The potential for those weeds to move from the roadside into a remnant will be dependent on their means of dispersal, distance to the remnant, and the intervening land use. In this regard, intensively managed cropland might provide a more efficient buffer to new weed invasion than native vegetation, or Conservation Reserve plantings.

Noxious weeds that are known to be a threat to bunchgrass grasslands and occur in or around Moscow, but not currently in the delineated remnants, include yellow-star thistle, spotted knapweed (*Centaurea maculosa*), teasel (*Dipsacus fullonum*), and Dalmatian toadflax (*Linaria dalmatica*), and there are many others that could prove to be threats (Tim Prather, pers. comm.).

RECOMMENDATIONS FOR THE ANALYSIS

An objective assessment of the effects of various highway alternatives on species and communities of conservation concern can be made using a GIS analysis of the data I collected. I would make the following assumptions as part of the analysis:

- Direct effects to a remnant complex translate into the "taking" of the entire remnant because of their small size and imminent threat from weeds.

- Direct effects to any remnant complex other than Paradise Ridge CS, should be considered a taking of any species of concern supported by the remnant. Because the habitat is specific and extremely limited, the decrease in habitat size, combined with potential indirect effects of weed introduction will likely result in loss of plant populations over the relatively short term.

Also, the analysis should recognize that remnants vary in their biodiversity value and they should be weighted based on that value. In Natural Heritage methodology (NatureServe 2005a), both populations and communities ("elements" of biodiversity) are ranked as to the probability of their long-term viability. Ranks range from A to D, with A denoting the highest probability for long-term survival. This ranking considers three factors: condition, size, and landscape context.

Palouse remnants within the project area can be subjected to a similar analysis. In order to facilitate this, I first grouped cover types belonging to the same remnant, that is, occurring within the same landscape patch (Table 3; Appendix 3). The elements present in each remnant, their sizes and conservation ranks are presented in Table 3. Grassland communities were ranked on the basis of condition, and rare plants on population size. I considered the landscape context to be similar for all remnants. Rather than inventing a complex index of conservation value, remnants were simply ordered by first prioritizing

A-ranked grassland, a G1 element, then grassland size, then the presence of black hawthorn/cow parsnip (also G1), and then the presence of rare species. Among rare species, Palouse goldenweed was given the most weight because of its G2 status. Although both the grassland and hawthorn communities are considered equally imperiled, I felt that rare plant habitat and overall greater plant diversity gave the grassland community greater value.

In Table 3, remnants are ordered by decreasing conservation value based on the above elements, then they are broken into four classes as indicated by shading. A fifth class is comprised of rare plant occurrences that do not lie within remnants. These value ranks are relative to other remnants in the study area: Paradise Ridge CS exceeds the value of any other remnant due to the size of its grassland, a diversity of native communities, and numerous subpopulations of Palouse goldenweed. Second in value are remnants with A-ranked grassland, then remnants with B or C-ranked grassland, and then remnants consisting of mostly trees and/or shrubs. Remnants were then mapped by conservation value (Appendix 1, Map 8), and this layer can be superimposed over different highway alternatives.

After a draft of this report was complete and spatial data on rare plants and communities were shared with ITD, I was presented with a map, prepared by ITD, that overlaid the data over ten highway alternatives. The map appeared to be accurate with respect to locations of plant populations and cover types. It indicated that several alignments would intercept or adjoin remnants containing globally rare plant communities, which would therefore be subject to direct effects from highway construction.

Table 4 compares impacts of the possible alignments provided by ITD, on the basis of the values of the remnant(s) affected. Alignment E-3 intercepts two, moderately valuable remnants (value class 2 out of 4, Table 3). Therefore, based on considerations of plant biodiversity alone, alignment E-3 would be the least desirable alternative.

ACKNOWLEDGMENTS

Thanks to Shelley Cooke, IDCDC, for creating the maps; to Karen Gray, IDCDC, for survey work on Paradise Ridge; to Michael Mancuso, IDCDC, for a thorough review of the manuscript; and to Ed Haagen of Ed Haagen Consulting for GIS assistance.

Table 3. Relative conservation value of remnants based on key biodiversity factors.[1]

Value class			Fescue/snowberry				Hawthorn	Snowberry	PG	PM	BL	PT	Notes
	Cons. rank:		G1				G1		G2	G2G4	G3	G3	
	Remnant	Sec.	A	B	C	Ha	Ha	Ha					
1	SEPR/G5/G10		x	x	x	14[2]		x	A		D	A	~40 ac ponderosa pine
2	G15	13	x			1.2			A		x		
	G7	12	x			0.2	0.28		D			x	Hawthorn was not mapped
	G1/H2	29	x			0.08	0.69	<.04					
	G3/H4	8	x			0.16	0.32	<.04	C			D	
	G4/S1/S8	7	x			0.08		0.77	A				
	G9	5	x			0.04			A				
3	G12/G13	30		x	x	0.44			B	x			Southeast aspect
	G8/G14/H6	12		x		0.28	0.57						
	G2	7		x		0.08			A				> 100 plants of Palouse goldenweed
	M5/P1	5		x		<.04		0.04				x	
	G6/M1	12/7			x	0.04	0.53						
4	H1	12					0.93						
	H3	8					0.12						
	S6	5						0.32	C			A	
	S4	5			x	<.04		0.08	B				
	S2	6						0.17				x	
	S3	5						0.08				x	
	S7	5						0.44					
	M4	7					0.1	x					
	A1	32											
	A2	32											

[1] Remnant designations are those used in Map 6: G = grassland (Fescue/snowberry), S = snowberry, H = hawthorn, P = pine, A = aspen, M = mixed, SEPR = South End Paradise Ridge Conservation Site.
Sec. = section in which the remnants occur.
For Fescue/snowberry, A, B, and C are condition ranks.
"x" indicates presence
Ha = hectares (0.1 ha ~ 0.25 acre).
Species: Palouse goldenweed (PG), Palouse milkvetch (PM), broad-fruit mariposa lily (BL), Palouse thistle (PT)
For species, A, B, C, and D are population size ranks (A=largest; x = not ranked).

[2] Rank A: 7.4 ha (18 ac), rank B: 2.3 ha (5.7 ac), rank C: 4.6 ha (11.5 ac).

Table 4. Comparison of proposed highway alignments with respect to impacts to remnant native plant communities. Values range from 1 (highest) to 4 (lowest).

Alignment	Intercepts	Adjoins
	Remnants of value	
E-3	2, 2	
E-1	2, 4	
W-3	3, 4	
E-2		2
W-2		3

REFERENCES CITED

Bailey, R. G., compiler. 1995. Description of the ecoregions of the United States. Misc. Publication No. 1391. USDA, Forest Service, Washington, D.C. 108 pp. with separate map.

Black, A. E., E. Strand, P. Morgan, J. M. Scott, R. G. Wright, and C. Watson. 1998 Biodiversity and land-use history of the Palouse Bioregion: Pre-European to present. Pages 85-99 in: T. D. Sisk, editor. Perspectives on the Land Use History of North America: A Context for Understanding Our Changing Environment. Biological Science Report. U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR–1998-0003.

Caldwell, H. H. 1961.The Palouse in diverse disciplines. Northwest Science 35(4):115-121.

Cooper, S. V., D. E. Neiman, and D. W. Roberts. 1991. Forest habitat types of northern Idaho: A second approximation. USDA, Forest Service, Intermountain Research Station General Technical Report INT-236. 143 pp.

Daubenmire, R. F. 1970. Steppe vegetation of Washington. Washington Agricultural Experiment Station, Washington State University, Technical Bulletin 62. 129 pp.

Forman, R. T. T. 2000. Estimate of the area affected ecologically by the road system in the United States. Conservation Biology 14:31-35.

Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle. 730 pp.

Idaho Conservation Data Center. 2005a. Idaho's special status plants [web page]. Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise, Idaho. Available: <http://fishandgame.idaho.gov/cms/tech/cdc/plants/>.

Idaho Conservation Data Center. 2005b. Conservation Site Database. Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise, Idaho. Database.

Idaho Conservation Data Center. 2005c. Element Occurrence Database. Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise, Idaho.

Idaho Natural Heritage Program, Oregon Natural Heritage Database, and Washington Natural Heritage Program. 1986. Final report, phase I, 1986 National Natural Landmarks Program, Pacific Northwest Region, National Park Service. Unpublished report on file at the Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise, Idaho. 48 pp.

Kartesz, J. T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd ed. 2 vols. Timber Press, Portland, Oregon.

Larson, D. L. 2003. Native weeds and exotic plants: relationships to disturbance in mixed-grass prairie. Plant Ecology 169(2):317-333.

Lesica, P. and F. W. Allendorf. 1995. When are peripheral populations valuable for conservation? Conservation Biology 9(4):753-760.

Lichthardt. J. and R. K. Moseley. 1997. Status and conservation of the Palouse Grassland in Idaho. Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise. 28 pp. plus appendices.

NatureServe. 2005a. Element occurrence data standard/EO Ranks. Arlington, Virginia, USA: NatureServe. Available: <http://www.natureserve.org/prodservices/eodata.jsp>.

NatureServe. 2005b. NatureServe Explorer: An on-line encyclopedia life [web application]. Version 1.6. Arlington, Virginia, USA: NatureServe. Available: <http://www.natureserve.org/explorer>.

Noss, R. F., E. T. LaRoe, and J. M. Scott. 1995. Endangered ecosystems of the United States: A preliminary assessment of loss and degradation. Biological Report 28. USDI, National Biological Service, Washington, D.C. 58 pp.

Prather, Tim. Associate Professor of weed ecology. Department of Plant, Soil, and Entomological Sciences, University of Idaho. Personal communication on September 13, 2005.

Tisdale, E. W. 1986. Canyon Grasslands and associated shrublands of west-central Idaho and adjacent areas. Forest, Wildlife and Range Experiment Station, University of Idaho, Bulletin No. 40. Moscow, ID. 42 pp.

Trombulak, S. C. and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14:18-30.

Weaver, J. E. 1917. A study of the vegetation of southeast Washington and adjacent Idaho. The university studies of the University of Nebraska 17(1):1-114.

APPENDIX 1
MAPS

Map 1. Project area boundaries

Map 2. Palouse milkvetch within the study area

Map 3. Broad-fruit mariposa lily within the study area

Map 4. Palouse thistle within the study area

Map 5. Palouse goldenweed within the study area

Map 6. Remnants within the study area

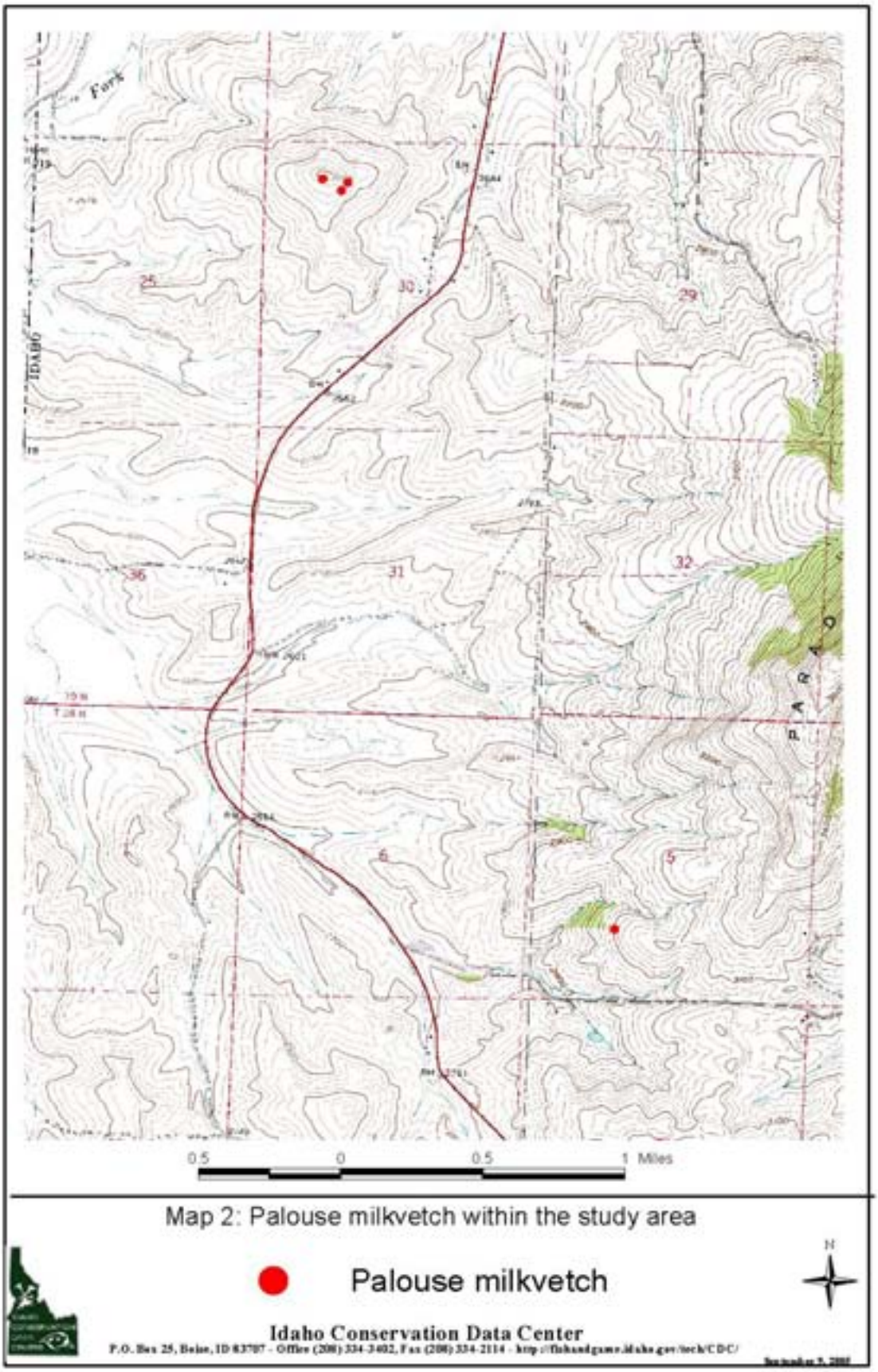
Map 7. Survey sites not meeting remnant criteria

Map 8. Remnants by relative conservation value

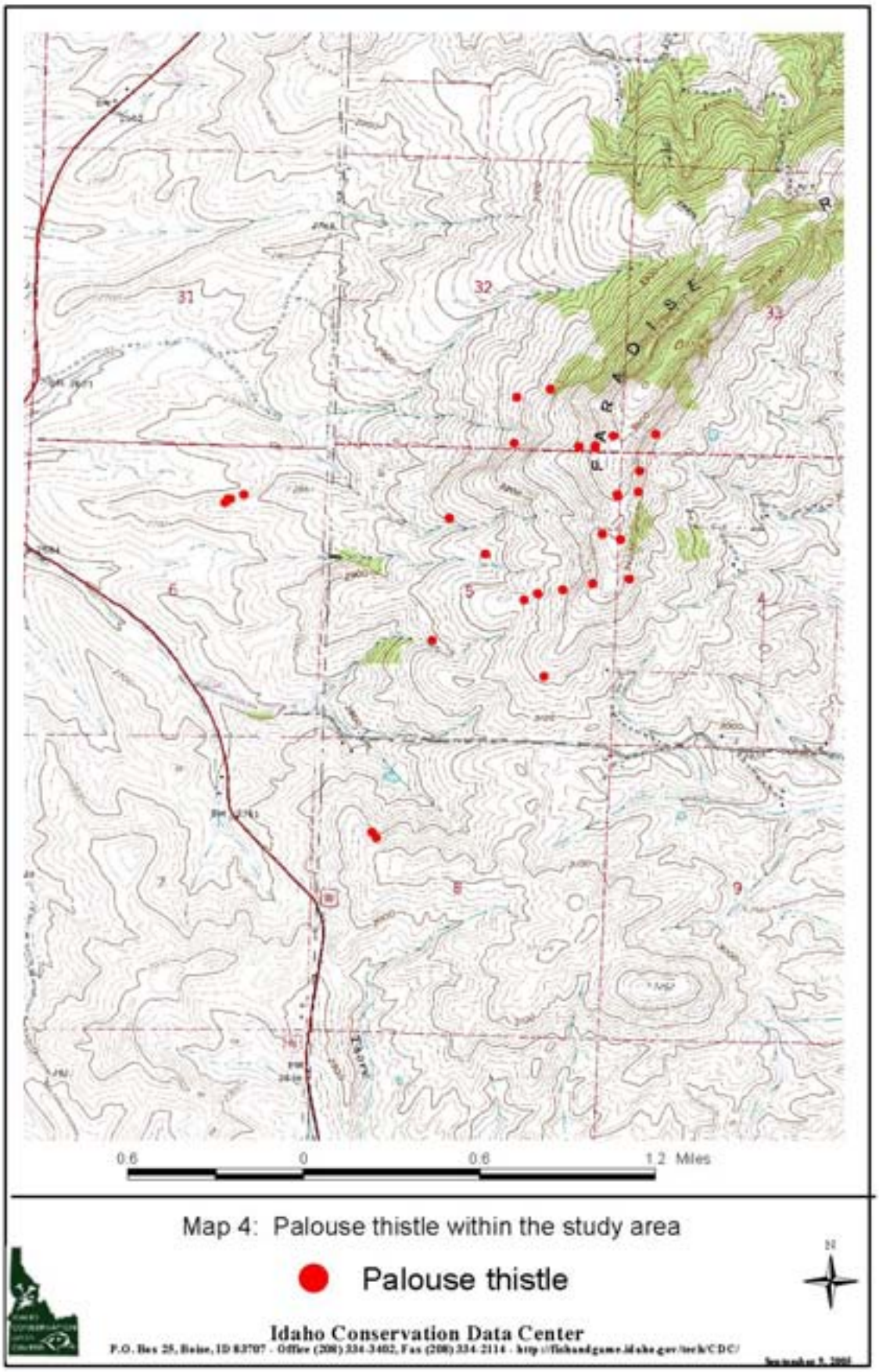
Map 1
Project Area Boundaries

N

Idaho Conservation Data Center
P.O. Box 25, Boise, ID 83707 - Office (208) 334-3402, Fax (208) 334-2114 - http://fishandgame.idaho.gov/tech/CDC/


Fork
IDAHO
25
30
29
36
31
32
6
5
0.5
0
0.5
1 Miles
Map 2: Palouse milkvetch within the study area
Palouse milkvetch
N
Idaho Conservation Data Center
P.O. Box 25, Boise, ID 83707 - Office (208) 334-3402, Fax (208) 334-2114 - http://fishandgame.idaho.gov/tech/CDC/

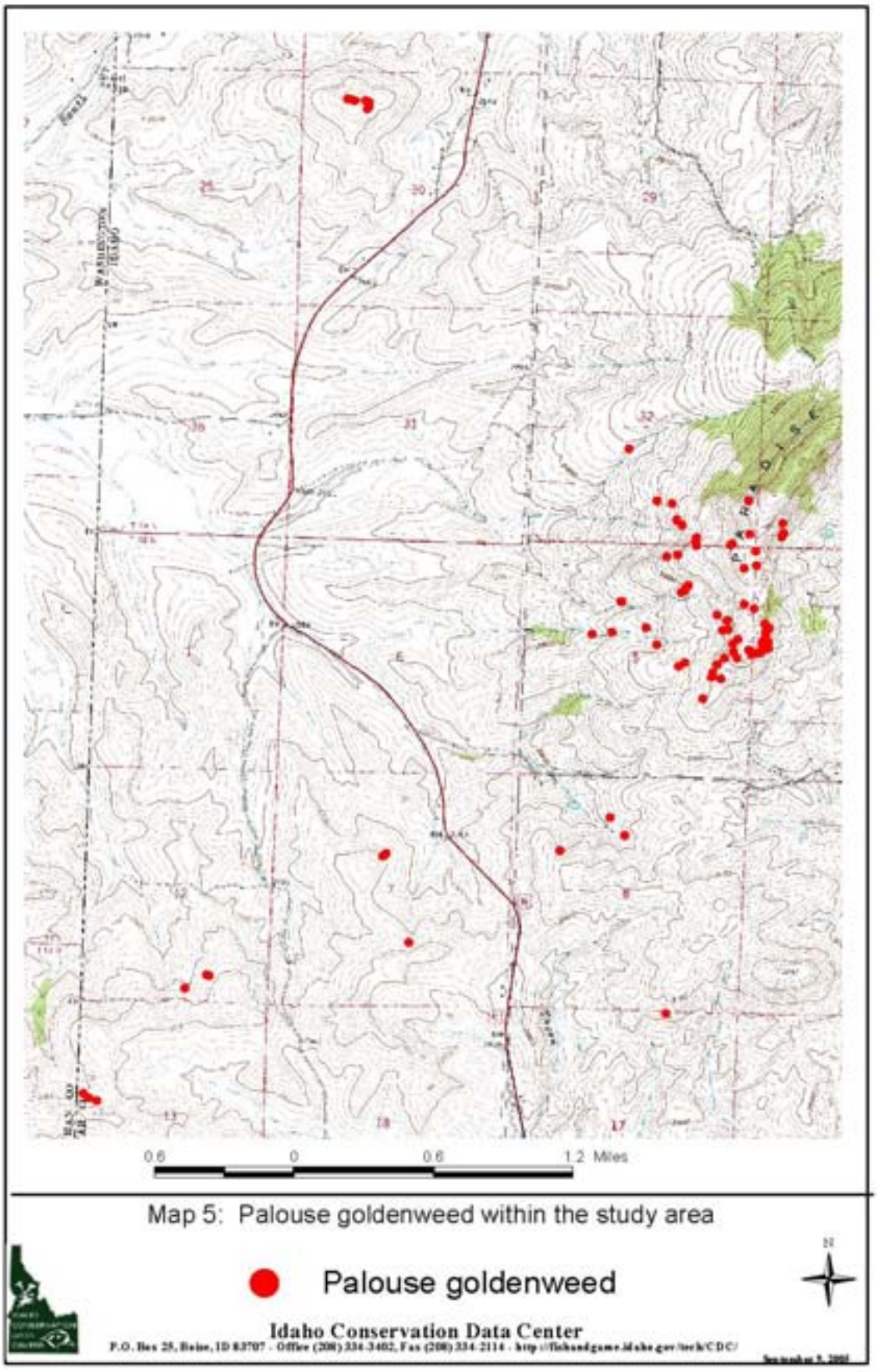

PARAD
0.7
0
0.7
1.4 Miles
Map 3: Broad-fruit mariposa lily within the study area
Broad-fruit mariposa lily
N
Idaho Conservation Data Center



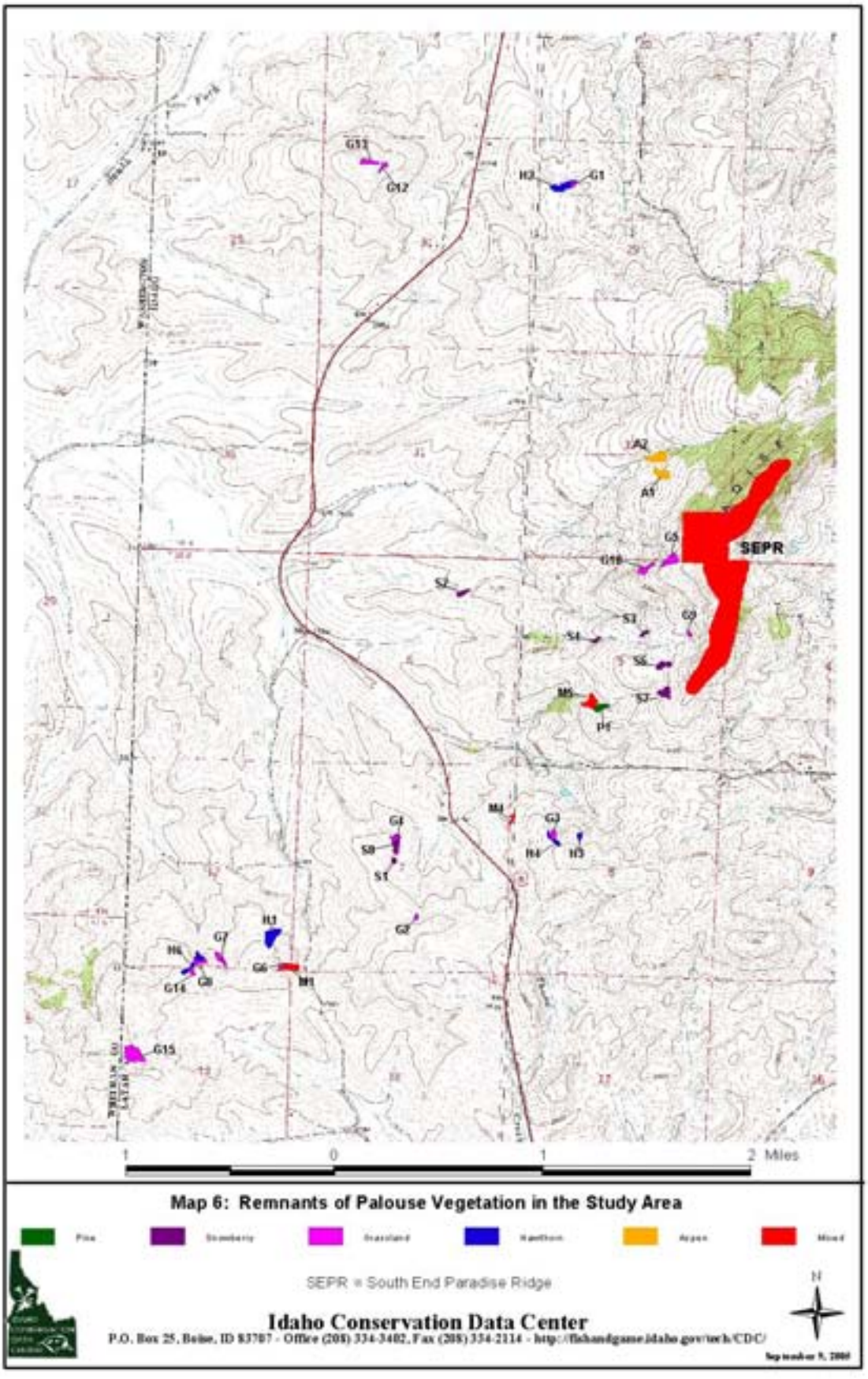
Map 4: Palouse thistle within the study area

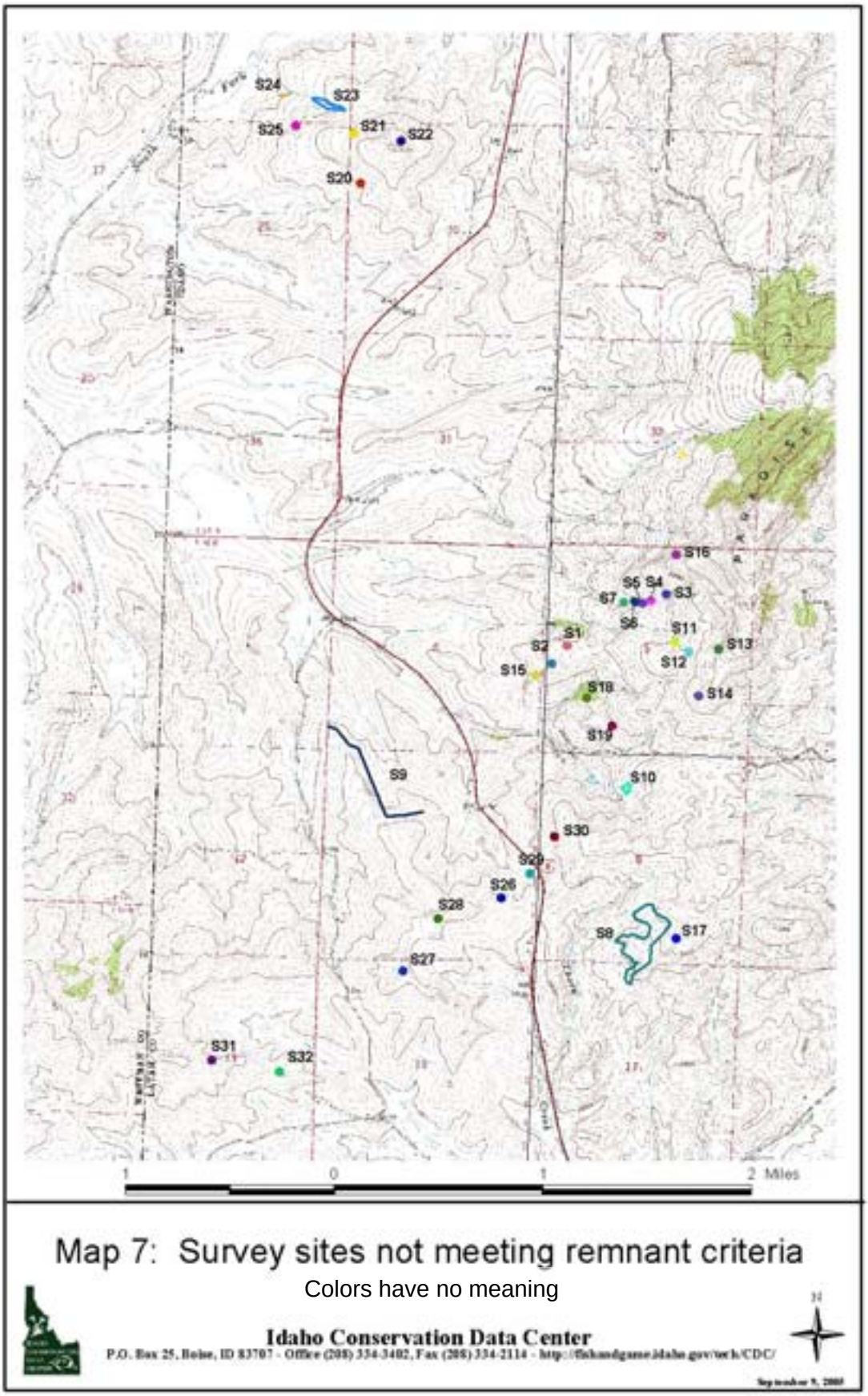
Palouse thistle

Idaho Conservation Data Center



Map 5: Palouse goldenweed within the study area


SEPR
1
0
1
2 Miles
Map 6: Remnants of Palouse Vegetation in the Study Area
SEPR = South End Paradise Ridge
N
Idaho Conservation Data Center
P.O. Box 25, Boise, ID 83707 - Office (208) 334-3402, Fax (208) 334-2114 - http://fishandgame.idaho.gov/cdc/

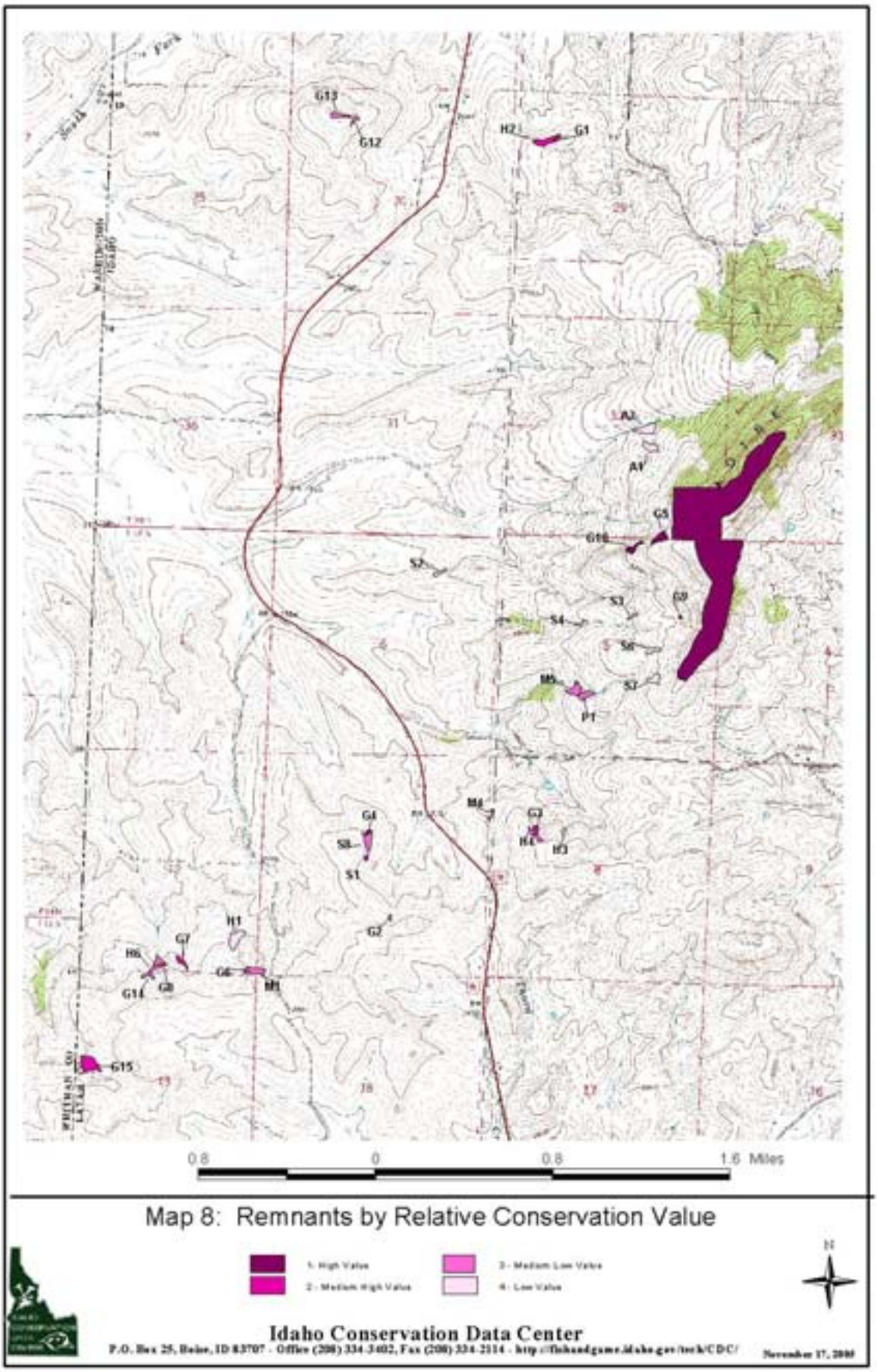


Map 7: Survey sites not meeting remnant criteria

Colors have no meaning

Idaho Conservation Data Center

P.O. Box 25, Boise, ID 83707 - Office (208) 334-3402, Fax (208) 334-2114 - http://fishandgame.idaho.gov/tech/CDC/


G13
G12
H2
G1
A2
A1
G5
G10
S2
S3
G9
S4
S6
M5
S7
P1
M4
G4
S8
S1
G2
H1
G7
H6
G6
M1
G14
G8
G15
0.8
0
0.8
1.6 Miles
Map 8: Remnants by Relative Conservation Value
1 - High Value
2 - Medium High Value
3 - Medium Low Value
4 - Low Value
N
Idaho Conservation Data Center
P.O. Box 25, Boise, ID 83707 - Office (208) 334-3402, Fax (208) 334-2114 - http://fishandgame.idaho.gov/tech/CDC/
November 17, 2005

APPENDIX 2
EXPLANATION OF CONSERVATION RANKS

Explanation of Conservation Ranks
(NatureServe 2005a)

Rank	Definition
State ranks	
S1	Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state. Typically 5 or fewer occurrences or very few remaining individuals (<1,000).
S2	Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state. Typically 6 to 20 occurrences or few remaining individuals (1,000-3,000).
S3	Vulnerable in the state because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21-100 occurrences or between 3,000 and 10,000 individuals.
S4	Uncommon but not rare, and usually widespread in the state. Possible cause for long-term concern. Usually more than 100 occurrences and more than 10,000 individuals.
S5	Secure–Common, widespread, and abundant in the state. Essentially ineradicable under present conditions. Typically with considerably more than 100 occurrences and more than 10,000 individuals.
SX	Considered extirpated from the state.
Review	Not ranked, but potentially with cause for concern. Data requested by IDCDC.
Global ranks	
G1	Critically imperiled globally because of extreme rarity or because some factor (s) make it especially vulnerable to extinction. Typically fewer than six occurrences or very few remaining individuals.
G2	Imperiled globally because of rarity or because of some other factor making it very vulnerable to extinction or elimination. Typically 6 to 20 occurrences or few remaining individuals (1,000-3,000).
G3	Vulnerable globally either because very rare and local throughout its range, found only within a restricted range, or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.
G4	Apparently secure–Uncommon but not rare (although it may be rare in parts of its range, particularly at the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly case for long-term concern. Typically more than 100 occurrences and more than 10,0000 individuals.
Qualifiers	
?	Inexact numeric rank.
G#G#	Range rank—used to indicate the range of uncertainty about the exact status of the element.

APPENDIX 3
REMNANT DESCRIPTIONS

Remnant Descriptions

Ordered as in Table 3 of the text—from greatest to least biodiversity value. The code indicates the cover type: G (grassland), S (snowberry), H (hawthorn), P (ponderosa pine), A (aspen), and M (mixed).

SEPR/G5/G10	The South End Paradise Ridge Conservation Site, plus A-, and B-ranked grassland on the north side of a main ridge running west from the site (G5 and G10). Tall oatgrass dominates much of the area to the north of G5 and G10. This remnant complex includes ponderosa pine/Idaho fescue, Idaho fescue/common snowberry, snowberry shrub, hawthorn, and ninebark shrub. The hawthorn occurs mostly as scattered individuals and small patches. About 8 ha (20 ac) is degraded and does not meet the criteria for a remnant. Rare plants: a large population of Palouse goldenweed consisting of numerous subpopulations linked by high quality habitat. At least 20 subpopulations in the remnant proper, and many more near its margins. A locally rare, noxious weed, common crupina, was observed in G10.
G15	Exceptionally large, 1.2 ha (2.9 ac), patch of mostly grassland (A-ranked) with a large population of Palouse goldenweed (166 counted). Broad-fruit mariposa lily is also present, but was well past flower at the time of the site visit, so population size could not be estimated. Tall oatgrass is present and spreading at the downslope, west corner.
G7	0.2 ha (0.6 ac) of A-ranked grassland that adjoins a large hawthorn stand. The hawthorn was not delineated or carefully surveyed. A small colony of Palouse thistle is included. There are a couple of patches of annual grasses as large as 10 m^2 (100 ft^2). Three Palouse goldenweed plants were observed where this borders on degraded grassland.
G1/H2	0.7 ha (1.7 ac) of dense, tall hawthorn and on a convex slope, 0.08 ha (0.2 ac) of A-ranked grassland. No rare species were found although Palouse goldenweed occurred there historically The grassland is extremely diverse and in outstanding condition. Pasture grasses are present outside the area delineated but not in the remnant. Large portions of hawthorn are infested with bur-chervil but these were excluded from the polygon to the extent possible.
G3/H?	This 0.5-ha (1.3-ac) polygon includes 0.16 ha (0.4 ac) of A-ranked grassland and the rest is hawthorn, with some snowberry where they meet. Ten Palouse goldenweed plants were counted and two small colonies of Palouse thistle. Smooth brome adjoins the grassland, but is not invading. No tall oatgrass is present. The only serious detractor is the annual grass ventenata which mostly occurs in one patch.
G4/S1/S8	M3 is a 0.7-ha (1.7-ac) remnant of which 0.2 ac is A-ranked grassland and the rest is snowberry shrub. Both communities are in good condition as delineated but portions of the landscape patch have been completely degraded to annual weeds. S1 is separated from the rest of the remnant by a large degraded gap. Ninety-four Palouse goldenweed plants were counted in the grassland portion.
G9	A rocky knob with a very small, 0.05-ha (0.12 ac) A-ranked grassland containing a population of about 70 Palouse goldenweed. This is near class A grassland and additional Palouse goldenweed populations in the South End Paradise Ridge CS and surrounded by native grassland and shrubland in poorer condition.
G12/G13	G12 is a 0.16-ha (0.4-ac) B-ranked grassland on a southeast aspect. The aspect is unique in the project area as is the population of about 20 Palouse milkvetch which occurred in no other remnant. It adjoins a patch of tall oatgrass which is also scattered in

	parts of the remnant. G13 occupies the level summit above and is C-ranked due to a mosaic of annual grasses and native bunchgrasses. A total of 36 Palouse goldenweed plants were counted in the two remnants.
G8/G14/H6	Two small areas of B-ranked grassland totaling about 0.26 ha (0.65 ac); part of a larger grassland remnant that is infested to varying degree by tall oatgrass, the advancing edge of which blurs the margins of remaining intact grassland. Much of the adjoining grassland has been invaded by tall oatgrass, the advancing edge of which blurs remnant boundaries. There are some incursions of annual grasses within the polygons. H6 is an adjoining stringer.
G2	A very small grassland remnant degraded by annual grasses (rank = B); smooth brome adjoins. Supports a very large population of Palouse goldenweed (200-300 estimated).
M5/P1	M5 is roughly half snowberry and half ponderosa pine/snowberry. There is a small amount of C-ranked grassland associated. The rank is due to scattered tall oatgrass and a patch of tall oatgrass within. The snowberry community is in good condition and contains a population of Palouse thistle. P1 is a ponderosa pine/snowberry community type.
G6/M1	0.6 ha (slightly more than 0.1 ac) of grassland adjoining hawthorn thicket. No rare plants.
H1	Large, 0.9 ha (2.3-ac) hawthorn thicket in a deep swale surrounded by cultivation. Black hawthorn/cow parsnip community type with elderberry (*Sambucus* sp.), aspen, stinging nettles (*Urtica dioica*), tall ragwort (*Senecio serra*), black cap (*Rubus leucodermis*), and native rose (*Rosa* spp.). Bur chervil is high in places.
H3	A 0.12-ha (0.3-ac) hawthorn thicket. Hawthorn/cow parsnip community type with stinging nettles. Very low herbaceous cover within.
S6	A 0.3-ha (0.76-ac) remnant of mostly snowberry, but also including a minor amount of hawthorn at the lower slope and some grassland on the upper slope. Contains the most vigorous population of Palouse thistle found in the project area; 23 separate patches were counted with three flowering stems. There is also a population of 21 Palouse goldenweed. Landscape context is degraded grassland. Tall oatgrass is present and invading.
S4	Very small patch adjoining gully and including a small patch of grassland with >50 Palouse goldenweed. Grassland is B-rank due to annual grasses. Scattered hawthorn.
S2	North-facing "eyebrow" entirely surrounded by cultivation. About 0.2 ha (0.4 ac) of snowberry, snowberry plus rose, cow parsnip, and scattered hawthorn. Five large colonies of Palouse thistle.
S3	A 0.08-ha (0.2-ac) patch of snowberry and rose on a low ridge running off of Paradise Ridge. Includes a small amount of grassland; one colony of Palouse thistle.
S7	One acre. A minor amount of high quality grassland is included (about 1/8); one colony of Palouse thistle.
M4	A short slope with very small amounts of three cover types: hawthorn, snowberry, and grassland; locally high annual grasses in the grassland portion; 0.1 ha (0.26 ac) total.
A1	Aspen/cow parsnip community with elderberry, chokecherry (*Prunus virginiana*), native rose, and >10% cover of stinging nettles. Condition poor due to bur chervil.
A2	This aspen stand is large enough to represent some internal condition not controlled by its border on open areas and much of the delineated portion is not infested with weeds. The community might be described as aspen/ninebark (*Physocarpus* sp.)/cow parsnip. There are scattered black hawthorn in the understory 2-3 m (6-10 ft) tall.

APPENDIX 4

SPECIES AND COMMUNITY ACCOUNTS

1. Palouse milkvetch (*Astragalus arrectus*)
2. Broad-fruit mariposa lily (*Calochortus nitidus*)
3. Palouse thistle (*Cirsium brevifolium*)
4. Palouse goldenweed (*Haplopappus liatriformis*)
5. Black hawthorn/cow parsnip (*Crataegus douglasii/Heracleum maximum*) ecological association
6. Idaho fescue/common snowberry (*Festuca idahoensis/Symphoricarpos albus*) ecological association

Palouse milkvetch
***Astragalus arrectus* Gray**

Family: Fabaceae (pea family)

Conservation rank: G2G4; this rank reflects a lack of knowledge about the species. This species is not currently ranked in Idaho pending additional data collection. Very few occurrences have been recorded in Idaho thus far. It is ranked S2 in Washington.

Description: Erect perennial with a woody taproot. Stems slender and numerous, in clumps, 20-40 cm (8-16) inches long; leaves pinnately compound with 21-31 linear-oblong leaflets. Racemes of 15 to 35 yellowish-white pea-like flowers about 13 mm (0.5 inch) long. Fruit is an erect pod with a short stalk (stipe). Flowers from late April to early July.

Distribution: Palouse milkvetch is endemic to the inland northwest, where it was found historically along the lower Snake, Clearwater, and Palouse rivers in Idaho and scattered throughout the Palouse region and in the central Washington scablands.

Habitat: Grassy hillsides, sagebrush flats, river bluffs, and open, ponderosa pine-Douglas-fir forests in grassy or shrub dominated openings, at elevations between 300 and 1220 m (1000 and 4000 ft); growing on all aspects and on sites ranging from rocky and dry to mesic. As with all legumes, symbiotic nitrogen fixation allows this species to grow on nitrogen-poor soils.

Ecology: Fire may play a role in population dynamics.

Source:
Washington Natural Heritage Program. 1999. Rare Plant Guide. Available: <www.dnr.wa.gov/nhp/refdesk/fguide/htm/fgmain.htm>.

Broad-fruit mariposa lily
***Calochortus nitidus* Douglas**

Family: Liliaceae (lily family)

Conservation rank: G3/S3

Conservation rank note: Latah County is the northernmost extent of the range of this species. Prior to 2005 surveys, there were only four extant occurrences of broad-fruit mariposa lily in the county. Two herbarium specimens from the project area dated from the 1930s and had no specific location data.

Description: A perennial from a deep bulb. Stems are single and erect, 20-40 cm (8-16 inches) tall, with a single, broad, flat basal leaf about 1 inch wide, and usually a small leaf about midway up. A pair of narrow, reduced leaves subtends the inflorescence. The one to four showy flowers are pink to lavender, with three, broadly oval petals. Petals have deep purple crescent on the lower inside with several long hairs. Fruit capsules are erect, nearly circular in outline, with three distinct wings. Plants bloom in early to mid-July. (Adapted from Caicco 1988.)

Similar species: *C. macrocarpus* has green stripes on the center of the petals and linear, unwinged fruits. *C. eurycarpus* has a purple blotch on white to cream petals rather than a purple crescent on lavender petals.

Distribution: This species is almost entirely restricted to Idaho, ranging from near Whitebird in Idaho County north to Latah County. It occurred historically in Washington, but only one known population remains (rank = S1), and it is very rare in northeastern Oregon (S1). Latah County populations are peripheral to the range of the species. It is now most common in Canyon Grasslands along the Snake River, and at higher elevation in the grassland/forest ecotone.

Habitat: Open habitats in the Palouse and Canyon Grasslands, mountain balds, forest openings, and mountain meadows. Rocky, well-drained as well as seasonally moist sites. Plants occur on all aspects, mostly between 1070 to 1680 m (3500 to 5500 ft) elevation.

Life cycle: Reproduction is by seed only. Bulbs do not produce offsets (Ownbey 1940).

References cited:

Caicco, S. L. 1988. Status report for *Calochortus nitidus*. Unpublished report prepared for Idaho Department of Parks and Recreation. Conservation Data Center, Idaho Department of Fish and Game, Boise. 54 pp. plus appendices.

Ownbey, M. 1940. Monograph of the genus *Calochortus*. Annals of the Missouri Botanical Garden 27(4):371-560.

More information:

Caicco, S. L. 1989. Second-year results of an investigation into the life history and population dynamics of *Calochortus nitidus* Dougl. (Liliaceae). Conservation Data Center, Idaho Department of Fish and Game, Boise. 11 pp. plus appendices.

Mancuso, M. 1996. Report on the conservation status of *Calochortus nitidus*. Unpublished report prepared for the Idaho Department of Parks and Recreation, Boise, Idaho. 48 pp. plus appendices.

U.S. Department of Interior, Bureau of Land Management. 1991. Conservation Agreement for *Calochortus nitidus* (broad-fruit mariposa lily). Draft. U.S. Department of Interior, Bureau of Land Management, Coeur d'Alene District. 6 pp.

Palouse thistle
***Cirsium brevifolium* Nuttall**

Family: Asteraceae (sunflower family)

Conservation rank: G3/S2

Description: A white-flowered (or creamy-white) thistle similar in appearance to wavy-leaved thistle (*C. undulatum*), but spreading by creeping roots. Stems 3-13 dm (12-50 inches) tall; leaves spine-tipped, bright green and nearly hairless above, with a pure-white, felty covering below. Flowering stems much less numerous than the vegetative rosettes. Flowers from June to October.

Distribution: Northeastern Oregon (S3), eastern Washington (not ranked), and adjoining portions of Idaho.

Habitat: Typically occurs in grassland areas including Palouse Grassland and central Washington scablands. Also in sagebrush and dry forests adjoining the grasslands.

Response to disturbance: Can proliferate along roadsides (Cronquist 1955). During 2005 surveys, was never observed in Conservation Reserve plantings (author's observation).

Reference:
Cronquist, A. 1955. Vascular Plants of the Pacific Northwest. Part 5: Compositae. University of Washington Press, Seattle. 343 pp.

Palouse goldenweed/smallhead goldenweed
***Haplopappus liatriformis* (Greene) St. John**

Synonym: *Pyrrocoma liatriformis* Greene

Conservation rank: G2/S2

General description: Perennial from a stout taproot, with one to several stems up to about 9 dm (3 ft) tall. Basal leaves are clustered, generally long, narrow, and stiff, while the stem leaves get progressively smaller going up the stem. Leaves usually have a rough texture, the margins entire, or with a few sharp teeth. The narrow, elongate inflorescence is comprised of several flower heads. Individual flower heads are less than 1 inch across and approximately 13 mm (0.5 in) high. The involucral bracts that subtend each flower head are green, firm, pointed, and pubescent. The heads have 13-21 yellow ray flowers, which are less than 13 mm (0.5 in) in length and are attached to a disk (receptacle) which is seldom over 2 cm (0.8 in) wide. Seeds have a tuft of capillary bristles which allow them to float on wind currents (IDCDC 2005).

Similar-appearing taxa: Columbia goldenweed (*H. carthamoides*) can be confused with Palouse goldenweed and the two sometimes occur together. Columbia goldenweed has larger flower heads, but less conspicuous ray flowers (these often absent), and larger involucral bracts. It often occurs in rocky, thinner soil sites as well. Plants intermediate between these two taxa, possibly hybrids, are known from one site in Washington (Gamon 1991).

Threats: Subject to grasshopper herbivory and insect seed predation. Exotic weed invasion is a serious threat throughout its range.

Distribution: Palouse goldenweed is largely endemic to the Palouse region of southeastern Washington and adjacent northwestern Idaho, encompassing a range of approximately 80 by 190 km (120 by 50 mi). Most populations are in Idaho, ranging from northern Latah County, south to northern Idaho County, and east to near Kamiah in Idaho County. In Washington, it is known from Whitman and Spokane counties, but with only a single occurrence in Spokane County. An outlying occurrence is known from near the Tri-cities in Benton County, Washington.

Habitat: Most commonly occupies mesic Palouse and Canyon Grassland communities and transition zones between open grassland and ponderosa pine habitats. Habitats are bunchgrass-dominated and often with scattered patches of deciduous shrubs. Elevations from 610 to 1460 m (2000 to 4800 ft).

References cited:

Gamon, J. 1991. Report on the status of *Haplopappus liatriformis* (Greene) St. John. Report prepared by Washington and Idaho Natural Heritage Programs for Idaho Department of Parks and Recreation and the Washington Department of Natural

Resources, with Section 6 funding from U.S. Fish and Wildlife Service, Region 1. 45 pp. plus appendices.

IDCDC. 2005. Idaho Conservation Data Center. Idaho's special status plants [web page]. Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise, Idaho. Available: <http://fishandgame.idaho.gov/cms/tech/cdc/plants/>.

More information:

Lichthardt. J. and R. K. Moseley. 1997. Status and conservation of the Palouse Grassland in Idaho. Idaho Department of Fish and Game, Idaho Conservation Data Center, Boise, Idaho. 28 pp. plus appendices.

Mancuso, M. and R. K. Moseley. 1994. Vegetation description, rare plant inventory, and vegetation monitoring for Craig Mountain, Idaho. Unpublished report prepared for Bonneville Power Administration. 146 pp. plus appendices.

Black hawthorn/cow parsnip ecological association
Crataegus douglasii/Heracleum maximum

Conservation rank: G1/S1

Concept: This community was first described by Daubenmire (1970) and has been recognized in more recent treatments as well (Bourgeron and Engelking 1994). Because aspen (*Populus tremuloides*) sometimes occurs as an upper canopy, the two aspen stands identified in the project area may represent a phase of this association. However, these aspen stands have ninebark (*Physocarpus* sp.) as a major understory component, and this is not mentioned in the description of the (quaking aspen)/black hawthorn/cow parsnip ecological association (NatureServe 2005).

Description: This community consists of a nearly complete cover of woody plants growing about 4.5-8 m (15-25 ft) tall, with black hawthorn the most dominant. The understory is dominated by cow parsnip, Fendler's water-leaf (*Hydrophyllum fendleri*), stinging nettles (*Urtica dioica*), or some combination of these. Nootka rose (*Rosa nutkana*), Wood's rose (*Rosa woodsii*), and common snowberry (*Symphoricarpos albus*) are not significant members of this community but often border on it and precede hawthorn on these sites following disturbance. The species composition is in stark contrast to that of the Idaho fescue/common snowberry association that it often adjoins. Rather, it contains species characteristic of forests in the adjacent mountains such as enchanter's nightshade (*Circaea alpina*), red-osier dogwood (*Cornus sericea*), wild rye (*Elymus glauca*), large-leaf geum (*Geum macrophyllum*), sweet cicely (*Osmorhiza chilensis)*, and bracken fern (*Pteridium aquilinum*). Quaking aspen can form an intermittent overstory. (Adapted from Daubenmire 1970.)

Distribution: Eastern Washington and Oregon, and adjacent Idaho (NatureServe 2005).

Sites: This community was once extensive on floodplain sites in the eastern Palouse that have been converted to grain cropping or permanent pasture. It also occurs on concave, northerly slopes where seepage comes close to the surface, and in V-shaped ravines.

Threats: This community type is seriously threatened by two aggressive weeds: bur chervil (*Anthriscus caucalis*) and white bryony (*Bryonia alba*).

References cited:

Bourgeron, P. S. and L. D. Engelking, editors. 1994. A preliminary vegetation classification of the western United States. The Nature Conservancy, Western Heritage Task Force, Boulder, Colorado. 175 pp. plus appendix.

NatureServe. 2005. NatureServe Explorer: An on-line encyclopedia life. [web application]. Version 1.6. Arlington, Virginia, USA: NatureServe. Available: <http://www.natureserve.org/>.

Idaho fescue/common snowberry ecological association
Festuca idahoensis/Symphoricarpos albus

Conservation Rank: G1/S1

Conservation comment: Bunchgrass communities similar to Idaho fescue/common snowberry are extensive in the Canyon Grasslands of the lower Snake and Clearwater canyons, but historically these have been classified as distinct types (Tisdale 1986) and they are currently considered ecologically distinct from the Idaho fescue/common snowberry ecological association (NatureServe 2005).

Description: This grassland community was first described and named by Daubenmire (1970). It occurs at the upper end of a moisture gradient within the Palouse Grassland and is characterized by the presence of both Idaho fescue and bluebunch wheatgrass (*Pseudoroegneria spicatum*), an abundance and prominence of forbs, and the consistent but inconspicuous presence of common snowberry. Other shrubs that may be inconspicuous among the bunchgrasses are Nootka rose (*Rosa nutkana*) and birch-leaved spiraea (*Spiraea betulifolia*). In localized areas snowberry may be largely replaced by one of these shrubs, or by dogbane (*Apocynum androsaemifolium*) (author's observation). This community included large patches of shrub thicket dominated by common snowberry, or rose and snowberry, which Daubenmire considered a phase of the Idaho fescue/common snowberry habitat type in spite of the fact that they are dominated by shrub cover.

Distribution: The historical range of this community type was the Palouse Region southeastern Washington and adjoining portions of Idaho and Oregon—a region in which the grassland has been nearly completely converted to cultivated agriculture.

References cited:

Daubenmire, R. F. 1970. Steppe vegetation of Washington. Washington Agricultural Experiment Station, Washington State University, Technical Bulletin 62. 129 pp.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.6. Arlington, Virginia, USA: NatureServe. Available: <http://www.natureserve.org/explorer>.

Tisdale, E. W. 1986. Canyon Grasslands and associated shrublands of west-central Idaho and adjacent areas. Forest, Wildlife and Range Experiment Station, University of Idaho, Bulletin No. 40. Moscow, ID. 42 pp.

Idaho fescue/common snowberry ecological association, snowberry phase
***Festuca idahoensis/Symphoricarpos albus, S. albus* phase**

Conservation Rank: The Natural Heritage Network does not rank this phase, nor is it mentioned in their description of the association (NatureServe 2005).

Description: This phase differs sharply in structure and composition from the bunchgrass community in which it occurs. It consists of shrub thickets less than 2 m (6 ft) tall, mostly consisting of a layer of snowberry under 1 m (3 ft). If present, the taller shrub layer may contain rose (*Rosa nutkana* or *R. woodsii*), chokecherry (*Prunus virginiana*), serviceberry (*Amelanchier alnifolia*), and scattered hawthorn (*Crataegus douglasii*). Daubenmire (1970) considered this a phase of Idaho fescue/common snowberry because there was no consistent difference in their floras, only a reversal of the dominance of shrubs vs. forbs. Tisdale (1986) described a similar community in the Canyon Grasslands which he called the "*Symphoricarpos albus* series" because he thought it might include multiple habitat types.

In the Thorncreek Road to Moscow project area, snowberry communities are consistent with the overstory components described by both Daubenmire and Tisdale, but not the understory. A diversity of forbs can be present including tall forbs such as fern-leaved desert parsley (*Lomatium dissectum*), sticky geranium (*Geranium viscosissimum*), little sunflower (*Helianthella uniflora*), Palouse thistle, and cow parsnip. Fern-leaved desert parsley is generally abundant and is very prominent in the spring when it is flowering. Palouse thistle is strongly associated with this community. Other common forbs are wild iris (*Iris missouriensis*), northern bedstraw (*Galium boreale*), and sticky cinquefoil (*Potentilla glandulosa*). Bunchgrasses are scarce or absent, being replaced by Geyer sedge (*Carex geyeri*), which can be high in cover where the snowberry canopy is open, and which did not occur in any of Daubenmire's plots within the snowberry phase.

Based on observations made during this survey, the snowberry phase is more susceptible than Idaho fescue/common snowberry to invasion by meadow foxtail (*Alopecurus pratensis*), Kentucky bluegrass (*Poa pratensis*), and Canada thistle (*Cirsium arvensis*).

References cited:

Daubenmire, R. F. 1970. Steppe vegetation of Washington. Washington Agricultural Experiment Station, Washington State University, Technical Bulletin 62. 129 pp.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.6. Arlington, Virginia, USA: NatureServe. Available: <http://www.natureserve.org/explorer>.

Tisdale, E. W. 1986. Canyon Grasslands and associated shrublands of west-central Idaho and adjacent areas. Forest, Wildlife and Range Experiment Station, University of Idaho, Bulletin No. 40. Moscow, ID. 42 pp.

APPENDIX 5
CANOPY COVER BY SPECIES
FOR SELECTED GRASSLAND REMNANTS

Appendix 5. Canopy cover[1] by species for selected grassland remnants.

Life form[2]	Species	G1	G2	G3	G4	G7	G9	G12
S	*Amelanchier alnifolia*					1		
S	*Physocarpus malvaceus*	3						
S	*Prunus virginiana*	+		1		+		+
S	*Rosa nutkana* or *woodsii*	3		+	+	0.1	+	+
S	*Spiraea betulifolia*	+	OP			+	+	+
S	*Symphoricarpos albus*	1	1	10	1	10	3	1
PG	*Alopecurus pratensis*						+	
PG	*Arrhenatherum elatius*							+
PG	*Calamagrostis rubescens*					+		
PG	*Carex geyeri*	1		0.1	3	10		
PG	*Festuca idahoensis*	20	10	3	3	20	10	50
PG	*Koeleria cristata*		+	+	+	+	+	+
PG	*Poa secunda*			0.1			1	
PG	*Poa pratensis*	+	+			3		
PG	*Pseudoroegneria spicata*	60	20	30	50	10	30	20
AG	*Bromus japonicus*		+	1				3
AG	*Bromus mollis*	+						
AG	*Bromus tectorum*			0.1				
AG	*Poa bulbosa*		+					
AG	*Ventenata dubia*						3	1
AF	*Borage*	+		+				
AF	*Collinsia parviflora*			+				
AF	*Draba verna*			+				
AF	*Epilobium paniculatum*			+				+
AF	*Rumex acetosella*			+				
PF	*Achillea millefolium*	+	+	0.1	+	+	+	+
PF	*Apocynum androsaemifolium*		+	0.1				
PF	*Aster occidentalis*	1		0.1				
PF	*Astragalus arrectus*							+
PF	*Balsamorhiza sagittata*	3		1	3	+	10	10
PF	*Besseya rubra*	3		1	+	+		
PF	*Brodiaea douglasii*	+						
PF	*Calochortus elegans*	+		+				
PF	*Castilleja lutescens*	+		+	+	+		
PF	*Castilleja sp.*		1					+
PF	*Delphinium* sp.	+						
PF	*Erythronium grandiflorum*	+						

PF	*Gaillardia aristata*	1				+		+
PF	*Galium aparine*	1		OP				
PF	*Galium boreale*	+	+	+		3		
PF	*Gentiana affinis*	+		OP		+		
PF	*Geranium viscosissimum*	10	+			1		
PF	*Geum triflorum*	40	10	30	3	10		
PF	*Habenaria unalascensis*					+		
PF	*Haplopappus carthemoides*						+	
PF	*Haplopappus liatriformis*		1	+	1		OP	OP
PF	*Helianthella uniflora*	3		1	3		1	50
PF	*Heuchera cylindrica*	3	+	1		1		
PF	*Hieracium albertinum*	3	+		+	1	1	+
PF	*Hypericum perforatum*	+		0.1	+			+
PF	*Iris missouriensis*	1		OP	+			1
PF	*Lithospermum ruderale*	1		+			+	+
PF	*Lomatium dissectum*		1		3		1	3
PF	*Lomatium grayi*							+
PF	*Lomatium macrocarpum*							+
PF	*Lomatium triternatum*	1	1		+			
PF	*Lupinus* spp.	+		0.1	1	3	+	+
PF	*Penstemon*			OP				
PF	*Potentilla glandulosa*	+	1	OP	+	10		
PF	*Potentilla gracilis*	1		1	1	1		+
PF	*Senecio integerrimus*	1		0.1				
PF	*Silene douglasii*			OP		+		
PF	*Sisyrinchium sp.*	+						
PF	*Solidago missouriensis*	+		0.1	+	+		1
PF	*Viola adunca*	+						
PF	*Wyethia amplexifolius*	1			40			3
PF	*Zygadenus venenosus*	+	+		+			+
	Moss and lichen	NA	50	20	NA	NA	+	+
	Bare soil	NA	NA	90	3	NA	30	90

[1] + = <1%; 1=0.1-1%; 3=1-5%; remaining values, 10 through 90 are midpoints of 10% cover classes; NA=not assessed; OP=outside plot.

[2] S=shrub; PG=perennial grass; AG=annual grass; AF=annual forb; PF=perennial forb.

"Creative Minds Creative Solutions"

A Scientific Evaluation for Noxious and Invasive Weeds of the Highway 95 Construction Project between the Uniontown Cutoff and Moscow.

Drs. Larry Lass and Tim Prather

Tuesday, January 22, 2007

AquilaVision Inc
1121 East Broadway, Suite 105
Montana Technology Enterprise Center
Missoula, Mt 59802
(406) 532-3260
www.aquilavision.com
info@aquilavision.com

Table of Contents

Summary of Findings

Roads form corridors of movement for plants as well as vehicles. There is a strong correlation between roads and weeds. Multiple introductions may be required prior to successful establishment, therefore, strategies should be implemented that reduce multiple introductions. Weeds can disperse along roads measured in feet per year but there also is potential for long-distance movement. For example, an infestation of leafy spurge was found near Syringa, Idaho along Highway 12 over 100 miles from the nearest infestations in Montana. During construction, there is opportunity for equipment and materials to move weed seeds long distances as well. Prevention methods that include use of clean equipment and weed-free materials reduce the possibility of long-distance weed movement dramatically. Road-side weed control programs further inhibit the ability of species to establish and subsequently impact both agricultural and natural systems. Weedy species that disperse within the project area are less likely to establish if competitive plant communities are in place adjacent to the highway. Plant species providing the competitive barrier adjacent to the road surface should be able to withstand maintenance activities and not selected based on nativity. Vegetation outside the high competitive barrier area should fill the open niches with native species where possible. However, maintaining native species should be a lower priority than removing weedy species within the highway corridor. Establishing a plant survey program to detect newly invading species will reduce establishment of new infestations within agricultural and natural systems. If new invasive species are found they should be subjected to an eradication program. Early detection and rapid response are inexpensive approaches to weed management that minimize the impact of the invasive species through successful removal and minimize the impact of control activities because of the small scale of the eradication action.

Introduction

Roads are corridors for movement for more than vehicles. There is strong evidence that plant species also move along these travel corridors. Plant movement can take place during construction of a road and afterwards as vehicles travel the roads. Minimizing weed impacts resulting from road construction and use have long-term positive effects on both agricultural and natural production systems. The Palouse hosts a productive agricultural industry and also Palouse Prairie. The prairie lands of the Palouse are less than 1% of the original size and the focus of many local conservationists (Noss et al. 1995). Efforts to conserve and expand existing prairie remnants require minimizing the direct effects of highway construction and indirect effects of roadways serving as corridors for movement of invasive plant species. The highway project has the potential to minimize the negative impacts on the one prairie remnant of noted importance (Weddel and Lichthardt 1998) as well as smaller remnants. Executive Order 13112 signed on February 3, 1999, addresses federal agency responsibilities with respect to invasive plant species. As a partially federally funded action, the project is subject to the provisions of EO 13112. This project is a scientific evaluation of noxious and invasive plant species that should be considered to meet federal requirements.

Palouse Prairie

Methods (parameters used to perform analysis)

Invasive and noxious weed baseline data were collected from published reports and herbarium specimens. These data were used for effects analysis and identification of species to address in this document for development of mitigation measures. Weed species profiles were created from existing resources gathered from scientific literature that included biological information on each plant and techniques used to prevent, control, and manage noxious and invasive species. Information from the baseline conditions, species profiles and additional search of scientific literature for direct and indirect effects of road construction and roadways as corridors for movement were used to identify direct, indirect and cumulative effects. A summary was created that details important considerations with respect to baseline conditions, species profiles and effects analysis. Mitigation measures were developed to address the direct, indirect and cumulative effects of noxious and invasive weeds on remaining prairie remnants and agricultural production.

Baseline Conditions (of the project area)

Background information on the noxious and invasive plant species impacting Palouse Prairie remnants was obtained from prior plant surveys that include areas where rare plants occur and where weeds occur. Results show Latah County has 51 highly invasive

plant species and about 260 non-native invaders that impact agricultural, rangeland, pastures, and forests (Table 1). Adjacent counties have an additional 32 weedy species not found in the county (Table 1). Latah County and adjacent counties have 27 highly invasive species in common. They are buffalobur (Solanum rostratum), burr chervil (Anthriscus caucalis), Canada thistle (Cirsium arvense), common tansy (Tanacetum vulgare), Dalmatian toadflax (Linaria dalmatica), diffuse knapweed (Centaurea diffusa), field bindweed, (Convolvulus arvensis), field horsetail (Equisetum arvense), Japanese knotweed (Polygonum cuspidatum), jointed goatgrass (Aegilops cylindrica), kochia (Kochia scoparia), leafy spurge (Euphorbia esula), orange hawkweed (Hieracium aurantiacum), oxeye daisy (Chrysanthemum leucanthemum), poison hemlock (Conium maculatum), reed canarygrass, (Phalaris arundinacea), rush skeletonweed (Chondrilla juncea), Russian knapweed (Centaurea repens), Scotch broom (Cytisus scoparius), Scotch thistle (Onopordum acanthium), spotted knapweed (Centaurea maculosa), St. Johnswort (Hypericum perforatum), sulfur cinquefoil (Potentilla recta), ventenata (Ventenata dubia), yellow starthistle (Centaurea solstitialis) and yellow toadflax (Linaria vulgaris). Latah county and adjacent counties with Highway 95 passing through them (Benewah and Nez Perce) have 26 highly invasive species in common (list from above plus common crupina (Crupina vulgaris).

Past vegetation surveys in the project area found common crupina, ventenata, downy brome, Japanese brome, jointed goatgrass, field bindweed, meadow foxtail and Canada thistle. All of these weeds are serious problems of pastures and rangelands in the Pacific Northwest and many have been deemed noxious and regulated by the State of Idaho or adjacent states.

Table 1. Invasive plants in Latah County and adjacent counties.

Genus	Species	Common Name	Noxious	Latah	Benewah	Clearwater	NezPerce	Whitman
Aegilops	cylindrica	jointed goatgrass	ID,OR,WA	X	X	X	X	X
Agropyron	repens	quackgrass	OR,WY	X	X	X	X	X
Alopecurus	myosuroides	black twitch	WA	X				X
Ambrosia	artemisiifolia	common ragweed	OR	X			X	
Ambrosia	tomentosa	skeletonleaf bursage	ID,OR,WY				X	
Amorpha	fruticosa	indigobush	WA	X				
Anchusa	arvensis	small bugloss	WA	X	X			X
Anchusa	officinalis	common bugloss	OR,WA	X				
Anthriscus	caucalis	bur chervil	WA	X				X
Arctium	minus	common burdock	WY	X			X	X
Artemisia	absinthium	absinth wormwood	WA	X	X	X		X
Bryonia	alba	white bryony	WA	X			X	X
Cardaria	draba	hoary cress	ID,MT,OR,WA,WY	X		X	X	X
Cardaria	pubescens	hairy whitetop	OR,WA,WY	X				X
Cardaria	spp.	whitetop	ID,MT,OR,WA,WY					X
Carduus	acanthoides	plumeless thistle	OR,WA,WY			X	X	
Carduus	nutans	musk thistle	ID,OR,WA,WY			X	X	X
Carduus	pycnocephalus	Italian thistle	OR,WA	X				X
Cenchrus	longispinus	longspine sandbur	WA				X	
Centaurea	diffusa	diffuse knapweed	ID,MT,OR,WA,WY	X	X	X	X	X
Centaurea	jacea	brown knapweed	WA					X
Centaurea	macrocephala	bighead knapweed	OR,WA					X
Centaurea	maculosa	spotted knapweed	ID,MT,OR,WA,WY	X	X	X	X	X
Centaurea	nigra	black knapweed	WA					X
Centaurea	pratensis	meadow knapweed	ID,OR,WA	X		X		X
Centaurea	repens	Russian knapweed	ID,MT,OR,WA,WY	X	X	X	X	X
Centaurea	solstitialis	yellow starthistle	ID,MT,OR,WA	X	X	X	X	X
Chondrilla	juncea	rush skeletonweed	ID,MT,OR,WA	X	X	X	X	X
Chrysanthemum	leucanthemum	oxeye daisy	MT,WA,WY	X	X	X	X	X
Cirsium	arvense	Canada thistle	ID,MT,OR,WA,WY	X	X	X	X	X
Cirsium	vulgare	bull thistle	OR,WA	X		X	X	X
Conium	maculatum	poison hemlock	ID,OR,WA	X	X	X	X	X
Convolvulus	arvensis	field bindweed	ID,MT,OR,WA,WY	X	X	X	X	X
Crupina	vulgaris	common crupina	ID,MT,OR,WA	X	X	X	X	
Cuscuta	approximata	clustered dodder	OR,WA	X				
Cynoglossum	officinale	houndstongue	MT,OR,WA,WY	X			X	X
Cyperus	esculentus	yellow nutsedge	OR,WA					X
Cytisus	scoparius	Scotch broom	ID,OR,WA	X	X	X	X	X
Daucus	carota	wild carrot	WA	X		X	X	X
Echium	vulgare	blueweed	WA	X		X		X
Equisetum	arvense	field horsetail	OR	X	X	X	X	X
Equisetum	telmateia	giant horsetail	OR			X		
Euphorbia	dentata	toothed spurge	ID				X	
Euphorbia	esula	leafy spurge	ID,MT,OR,WA,WY	X	X	X	X	X
Euphorbia	myrsinites	myrtle spurge	WA,WA	X			X	

Table 1. Continued.

Genus	Species	Common Name	Noxious	Latah	Benewah	Clearwater	NezPerce	Whitman
Geranium	robertianum	herb Robert	WA					X
Gypsophila	paniculata	baby's breath	WA					X
Halogeton	glomeratus	halogeton	OR					X
Hedera	helix	English ivy	OR,WA	X				
Hemizonia	pungens	spikeweed	OR,WA					
Hieracium	aurantiacum	orange hawkweed	ID,MT,OR,WA	X	X	X	X	X
Hieracium	pratense	meadow hawkweed	ID,MT,OR,WA	X	X	X		
Hyoscyamus	niger	black henbane	ID,WA	X		X	X	X
Hypericum	perforatum	St. Johnswort	MT,OR,WA,WY	X	X	X	X	X
Hypochaeris	radicata	spotted cats ear	WA	X				X
Isatis	tinctoria	dyer's woad	ID,MT,OR,WA,WY	X		X		
Kochia	scoparia	kochia	OR,WA	X	X	X	X	X
Lepidium	latifolium	perennial pepperweed	ID,MT,OR,WA,WY			X	X	X
Lepyrodiclis	holosteoides	lepyrodiclis	OR,WA				X	X
Linaria	dalmatica	dalmatian toadflax	ID,MT,OR,WA,WY	X	X	X	X	X
Linaria	vulgaris	yellow toadflax	ID,MT,OR,WA,WY	X	X	X	X	X
Lythrum	salicaria	purple loosestrife	ID,OR,WA,WY	X	X	X		
Matricaria	maritima	scentless chamomile	WA	X			X	X
Milium	vernale	spring millet grass	ID		X		X	
Mirabilis	nyctaginea	wild four o'clock	WA				X	
Myriophyllum	brasiliense	parrotfeather	WA	X			X	
Myriophyllum	spicatum	Eurasian watermilfoil	ID,MT,OR,WA					X
Nardus	stricta	moor matgrass	ID,OR	X		X		
Onopordum	acanthium	Scotch thistle	ID,OR,WA,WY	X	X	X	X	X
Panicum	miliaceum	wild proso millet	OR	X		X	X	X
Phalaris	arundinacea	reed canarygrass	WA	X	X	X	X	X
Polygonum	cuspidatum	Japanese knotweed	OR,WA	X	X	X	X	X
Potentilla	recta	sulfur cinquefoil	MT,OR,WA	X	X	X	X	X
Ranunculus	acris	tall buttercup	MT		X			
Rorippa	austriaca	Austrian fieldcress	WA					X
Rorippa	sylvestris	yellow fieldcress	OR					X
Rubus	discolor	Himalaya blackberry	OR				X	
Salvia	aethiopis	Mediterranean sage	OR,WA			X		
Secale	cereale	cultivated rye	WA	X			X	X
Senecio	jacobaea	tansy ragwort	ID,MT,OR,WA	X	X			X
Solanum	elaeagnifolium	silverleaf nightshade	ID,OR,WA			X	X	
Solanum	rostratum	buffalobur	ID,OR,WA	X	X	X	X	X
Sonchus	arvensis	perennial sowthistle	ID,WA,WY		X	X		X
Sorghum	halepense	Johnsongrass	ID,OR,WA		X	X		X
Taeniatherum	caput-medusae	medusahead	OR	X			X	X
Tanacetum	vulgare	common tansy	MT,WA,WY	X	X	X	X	X
Torilis	arvensis	field hedge-parsley	WA			X		
Tribulus	terrestris	puncturevine	ID,OR,WA	X		X	X	X
Vaccaria	hispanica	cowcockle					X	X
Xanthium	spinosum	spinycocklebur	OR,WA				X	X
Zygophyllum	fabago	Syrian beancaper	ID,OR,WA					X

Recently seeded rights-of-way south of the project area were sampled to determine which weed species were present, using those species as indicators of initial weed problems within the project area. Weeds found at most sites included Canada Thistle, common mullein, downy brome, and prickly lettuce (Table 2). Established sites usually had reed canarygrass. Sites with exposed soil always had annual bromes and ventenata. Individual plants or small infestations were noted along the proposed Highway 95 Corridor; however large infestations of St. John's wort, burr chervil, and reed canarygrass were found. Problem invasive plants along the current Highway 95 right-of-way include ventenata, field bindweed, reed canarygrass, tall oatgrass, and blackgrass where infestations were larger than a half-acre.

Figure 1. Roadside survey site for Jacksha Road.

Figure 2. Roadside survey site for Freeze Road.

Table 2. Roadside weed survey.

Location			Jacksha Road	Ekl Road	Top of Grade	Thorn Creek Road	Martinson Road	Horse Road	Kluss Road	Top of Lewiston Grade	Sanders Road	Brenner Road	North March Hill Base	Clean up area March Hill	Skyline Drive	Rest area	Strong Lane	Deep Creek Road	Browns Lane	Mountain Home Road	Explate Lane	Freeze Road
UTM X			498376	498156	499944	500333	500772	501899	504338	496480	513302	513294	512080	511417	510214	509793	509134	508546	508153	506249	505968	505270
UTM Y			5146077	5147593	5145941	5143795	5143410	5141831	5139937	5147951	5211830	5213727	5213057	5211707	5211319	5209836	5208782	5208375	5204418	5204494	5204360	5200780
Type of planting1			E	E	E	N	U	N	N	E	E	E	N	N	N	N	N	N	N	E	E	E
Common Name	Genus	Species																				
annual sowthistle	Sonchus	oleraceus							X				X				X	X				
bacherlor button	Centaurea	cyanus							X													
biennial wormwood	Artemisia	biennis									X											
broadleaf plantain	Plantago	major													X							
buckhorn plantain	Plantago	lanceolata													X		X					X
bull thistle	Cirsium	vulgare		X							X		X	X	X	X		X	X	X	X	
bur chervil	Anthriscus	caucalis								X												
California brome	Bromus	carinatus																X				
Canada thistle	Cirsium	arvense	X					X			X	X	X	X	X	X	X	X	X	X	X	X
cheeseweed	Malva	neglecta	X																			
cluster tarweed	Madia	glomerata		X									X	X		X	X		X	X	X	
coastal fiddleneck	Amsinckia	intermedia														X	X	X				
common mullien	Verbascum	thapsus				X	X	X	X		X		X	X	X		X		X		X	X
common tansy	Tanacetum	vulgare							X		X	X		X	X	X	X	X	X	X	X	X
curly dock	Rumex	crispus										X	X									X
dandelion	Taraxacum	officinale															X					X
downy Brome	Bromus	tectorum	X		X	X	X	X	X	X				X	X			X	X	X	X	X
field Pennycress	Thlaspi	arvense				X													X			
fireweed	Epilobium	angustifolium												X								
goatsbeard	Tragopogon	dubius															X					
gumweed	Grindelia	squarrosa								X												
horseweed	Conyza	canadensis						X		X			X		X	X	X	X		X	X	
Japanese Brome	Bromus	japonicus								X				X				X		X	X	X
kochia	Kochia	scoparia	X	X																		
lambsquarter	Chenopodium	album						X		X				X					X			
leafy spurge	Euphorbia	esula														X						
lowland cudweed	Gamphalium	palustre							X													
mayweed chamomile	Anthemis	cotula				X	X		X								X	X	X			X
meadow brome	Bromus	biebersteinii	X	X	X						X	X			X	X					X	X
oxeye daisy	Chrysanthemum	leucanthemum											X	X	X	X	X	X	X			

Type of planting (E = established; N = new; U = unplanted)

Table 2. Continued

Location			Jacksha Road	Eld Road	Top of Grade	Thorn Creek Road	Martinson Road	Howe Road	Khuss Road	Top of Lewiston Grade	Sanders Road	Brenner Road	North Marsh Hill Base	Chain up area Marsh Hill	Skyline Drive	Rest area	Strong Lane	Deep Creek Road	Browns Lane	Mountain Home Road	Poplate Lane	Freeze Road
UTM X			490276	490156	490944	500333	500771	503899	504338	498430	513202	513294	512090	511417	510114	509793	509134	508944	508413	507249	506988	507270
UTM Y			5149077	5147593	5145941	5143798	5143410	5141831	5139927	5145595	5215830	5213727	5212057	5211707	5211319	5209834	5208782	5208177	5204418	5204494	5204390	5200790
Type of planting1			E	E	E	N	U	N	N	E	E	E	N	N	N	N	N	N	N	E	E	E
Common Name	Genus	Species																				
oxeye daisy	Chrysanthemum	leucanthemum											X	X	X	X	X	X	X			
pineapple weed	Matricaria	matricarioides							X								X					
prickley lettuce	Lactuca	serriola		X	X	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X
prostrate knotweed	Polygonum	aviculare	X				X				X		X	X		X	X	X	X			
quackgrass	Agropyron	repens			X		X		X			X		X							X	
red sorrow	Rumex	acetosella											X		X	X			X			
redroot pigweed	Amaranthus	retroflexus					X															
redstem filaree	Erodium	cicutarium														X	X		X	X		
reed canarygrass	Phalaris	arundinacea	X	X			X	X			X	X						X	X	X	X	
rush skeletonweed	Chondrilla	juncea								X												
Russian thistle	Salsola	iberica								X												
scentless chamomile	Matricaria	maritima						X	X				X							X		
shepard purse	Capsella	bursa-pastoris				X																
smallseed falseflax	Camelina	microcarpa															X					
smartweed	Polygonum	lapathifolium						X	X				X		X				X			
smooth brome	Bromus	inermis	X	X	X						X		X	X	X			X			X	
spotted knapweed	Centaurea	biebersteinii											X	X						X	X	
St. Johnswort	Hypericum	perforatum					X						X			X						
sulfur cinquefoil	Potentilla	recta													X		X	X				
tumble Mustard	Sisymbrium	altissimum							X	X									X			
vertenata	Verbena	bulata		X	X					X					X	X		X	X			
wildoat	Avena	fatua	X				X	X	X													X
willow weed	Epilobium	paniculatum					X	X					X	X	X		X	X		X		
witchweed	Panicum	capillare					X	X								X				X		X
yarrow	Achillea	lanulosa												X					X			
yellow starthistle	Centaurea	solstitialis								X												

Type of planting (E = established; N = new; U = unplanted)

Effects Analysis (direct, indirect & cumulative effects)

Effects of the project can be defined in terms of direct, indirect and cumulative effects. Effects from construction of the highway, seeding, maintenance, and vehicle use will be summarized and categorized.

Area of Impact.

Roads are a common dispersal vector for weeds. Increasing road density from 1 mile per square mile to 20 miles per square mile has been shown to increase the number of non-native species by five fold (Kalin et al. 2000). Improved roadways contained more weedy species than unimproved roads (Braithwaite et al. 1989 and Parendes and Jones 2000). Research in Yellowstone National Park shows the establishment of a road system will likely introduce more than 60 new weed species to naturalized areas (Rew and Maxwell 2006, Rew et al. 2005, 2006). Yellow starthsitle was found more frequently adjacent to roads, but at distance to 0.6 miles, yellow starthistle still was encountered (Gelbard and Harrison 2005). The construction and use of the new Highway 95 route is expected to also have the potential to introduce non-native species. The change in weed management from a cropping system to a right-of-ways system will provide a new seed bed for establishment and spread.

Results of the Yellowstone study further show once established along the road the invasive weeds rapidly spread away from the road system (Rew and Maxwell 2006, Rew et al. 2005, 2006, and undated). Most of the 63 species found in the Yellowstone study were within 300 feet of the road, but several could be found more than 0.6 miles from the road and as far away as 1.2 miles from the road. If the area of impact is defined as 95% of the weed species falling within a distance from the road then the impact distance could be defined as 0.6 miles. These estimates were developed from a study of range and forest lands. Presence of agricultural land likely modifies estimates of the area of impact, possibly reducing the area of impact. Land in Conservation Reserve Program should not be considered for reducing an area of impact. Maps showing the proposed construction route with 0.6 miles suggest most of the prairie remnants will be impacted in the short term based on the Yellowstone project. If time is extended to long term all prairie remnants have the potential of being impacted.

A plant community susceptibility project led by Region 4 of the US Forest Service and The Nature Conservancy found lower susceptibility to invasion in areas of greater biomass by counting the number of species considered invasive. As a result, grassland plant communities were more susceptible to invasion than forest plant communities. Within the three alignments, all are within a grassland type, the most susceptible to invasion.

Direct Effects

1. The number of road cuts and fills and amount of soil moved to establish the road bed will directly affect the number of invasive weed introduced.

Potential alignments that require importation of fill materials increase the potential for bringing new species to the construction site.

2. Construction will create disturbed soil conditions ideal for new species introduction without competitive vegetation. Alignments with steep road cuts and fills with south and west aspects will be dryer sites and competitive vegetation will be difficult and slow to establish leaving open spaces for invasion.

3. Primary and secondary material used for construction can introduce invasive weeds. A common source of contamination comes from stock-piled material located near invasive weeds prior to use for the project. Weed-free designations only indicates the material left the producer in a weed-free condition and not its status when used at the construction site.

4. Equipment used for the construction can be a source of invasive weed introduction. Common sources of contamination occur by transporting equipment from an infested site to the new construction site without cleaning the equipment. Subcontractors with focused specific tasks tend to move specialized equipment greater distances increasing the potential for the introduction of a new invader not known to Latah County.

5. Construction workers and their vehicles are potential sources of invasive weed introduction. The staging area used for the Highway 95 construction near Marsh Hill (north of Potlatch, ID) had seven invasive species present after construction while only two invasive species were found at a site along the highway outside the construction area.

Indirect Effects

Indirect effects include vehicle travel along the highway and competitive ability of seed mixes used along the highway.

1. Increasing the existing 2 lane road to 4 lanes is expected to increase traffic and potential opportunities for new invasions from adjacent counties.

2. Completion of the Highway 95 project between Nevada and Canada will increase the number of regional travelers and potential to introduce invasive weeds not known to the area.

3. Wide road shoulders allow vehicles to stop and increases the potential for seed spread, particularly small-seeded species.

4. Road cuts and fills with south and west aspects will be more susceptible to invasion because competitive plant communities in these areas are difficult to establish.

5. Road-side weed programs focused on a wide range of broadleaf species will allow weedy grass species to spread.

6. A detection program has yet to be implemented that allows detection of newly established infestations and subsequently removing them. Removing infestations when they are small is most effective. (Rejmanek and Pitcairn, 2002).

7. Areas within 0.6 miles of the highway are at greatest risk to invasion (see figures 3 to 6 below). Agricultural land is impacted in all three alignments. More Palouse Prairie is affected by the eastern alignment.

8. Areas extending east of the highway have a slightly elevated risk to invasion by wind dispersed species like Canada thistle, prickly lettuce, and tumble mustard. Plants with seeds like prickly lettuce can move greatter distances, more than 1 mile, in grasslands (Soons et al 2004) Seeds of Canada thistle moved nearly 0.6 miles with the wind (Tackenberg 2003). The risk significantly decreases as the distance from the road increased to 0.6 miles. Agricultural lands are impacted in all alignments. Many prairie remnants at risk to invasive species with wind dispersed mechanisms.

Cumulative Effects

1. Erosion provides a disturbed area within plant communities. Ensure the plants selected have soil holding abilities. Steep, smooth slopes allow water to accelerate over the surface and cause erosion. Cut banks should be designed to minimize accelerated movement of water across them.

2. Vehicles transport seed, particularly small-seeded species, along roads. As vehicles travel the highway, opportunity for multiple introductions of weedy species increases.

Based on the analysis provided in this report the area of impact for direct effects will be where the soil is disturbed by construction and indirect effects and cumulative effects could extend 0.6 miles from the new highway for most weed species. Areas extending east of the road may have a slightly elevated risk of invasion by wind dispersed species like tumble mustard, prickly lettuce and Canada thistle beyond 0.6 miles. The 0.6 miles area is identified as the zone adjacent to the highway construction and operation that has a high probability of being invaded by noxious and invasive weeds that are present or may move to the corridor during construction and use of the new highway.

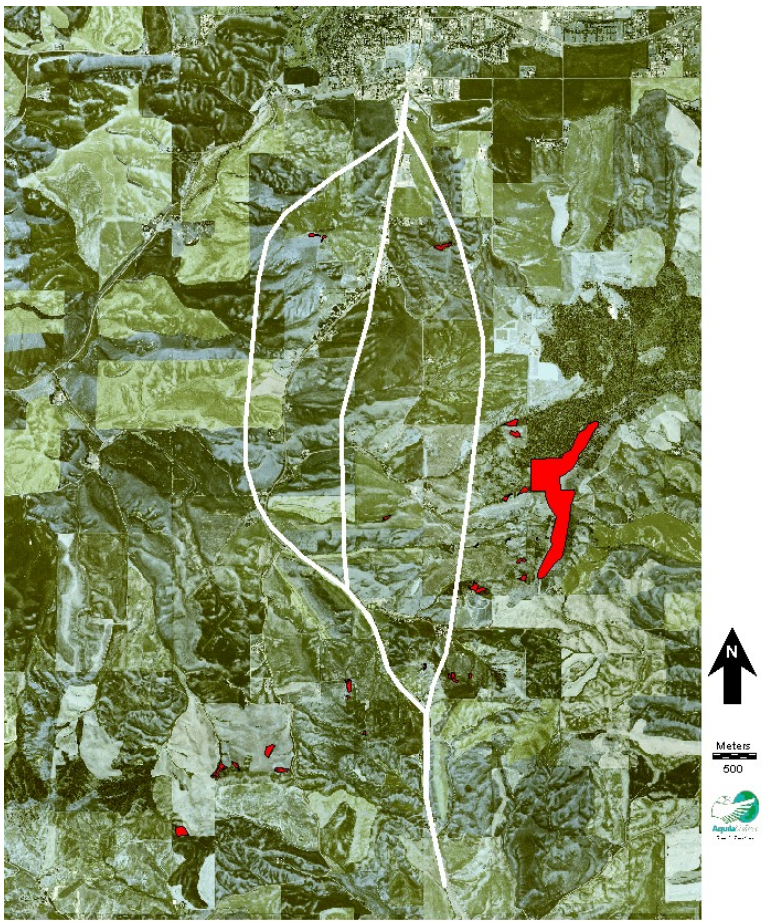


Figure 3. Three proposed routes (white) showing prairie remnants (red).

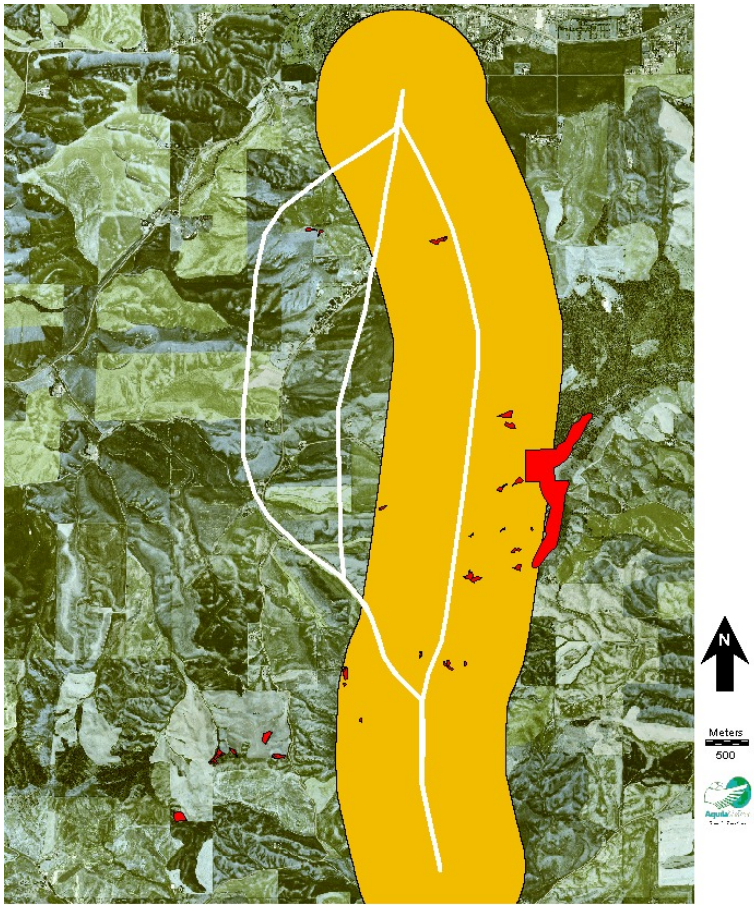


Figure 4. E2 route with 0.6 miles (yellow) buffer showing potential weed effect on prairie remnants (red).

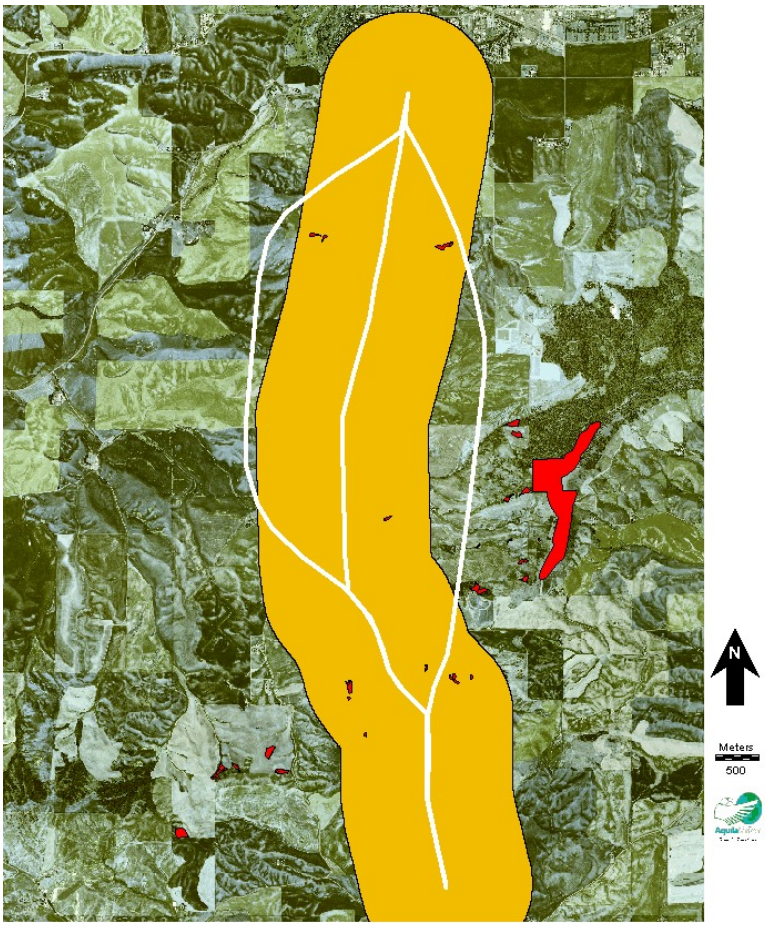


Figure 5. C-3 route with 0.6 miles (yellow) buffer showing potential weed effect on prairie remnants (red).

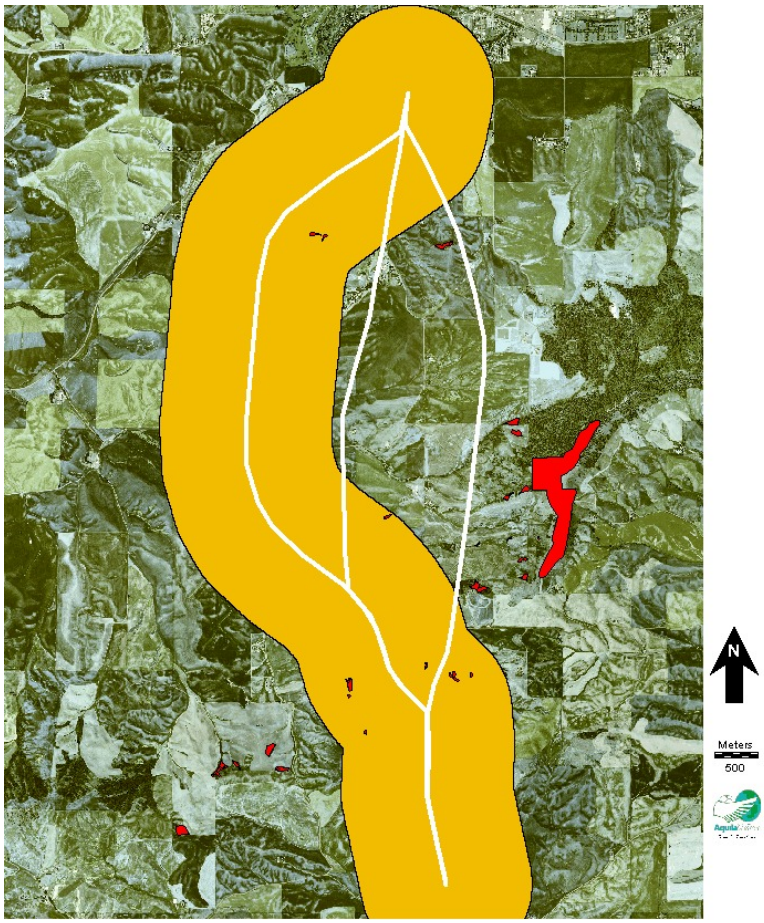


Figure 6. W-4 route with 0.6 miles (yellow) buffer showing potential weed effect on prairie remnants (red).

Species Profiles (species of concern for project area)

Species profiles were created for the invasive species that are found within and adjacent to the project area and have demonstrated their ability to become problems within native grasslands. Demonstrated ability will be defined as entering existing prairie with the ability to produce more than 20% foliar cover or have demonstrated ability to dominate other grasslands of Latah County or adjacent counties.

The list of species of concern purposefully left out many of the weeds that have been designated as Noxious by the State of Idaho. State law regulates their transport, introduction and management. The noxious weeds included in the list of species of concern are either currently growing in the project area or near it.

Twenty-seven invasive plant species were commonly encountered in the study area:

Bachelor's button
Blackgrass
Bur chervil
Canada thistle
Chamomile/pineapple weed complex
Cluster tarweed / coastal tarweed
Downy brome "cheatgrass"
Field bindweed
Interrupted windgrass
Japanese brome
Jointed goatgrass
Meadow brome
Prickly lettuce
Quackgrass
Reed canarygrass
Smooth brome
Soft brome
St John's wort
Sulfur cinquefoil
Tall oatgrass
Tumble mustard
Ventenata
White bryony
Yellow starthistle

Species Profiles (species of concern for project area)

Bachelor's button / *Centaurea cyanus* L.

Introduction

Bachelor's button or cornflower is the national flower of Estonia, symbolizing daily bread. It is grown throughout Europe and has been used as a symbol of royalty and political power. Once weedy in Europe, plants are now listed as endangered in many areas of Europe because of the use of herbicides to provide control in croplands and increased natural seed feeding insects and disease. It first appeared in Oregon in 1880, but was not found in Latah County until 1927 near Moscow although it had been in Whitman County since 1914. Bachelor's button is still a popular garden flower.

Identification

Bachelor's button is an annual plant ranging in height from 2 to 3 feet. Plants have grey-green branching with lanceolate leaves about 1 inch long, but lower leaves may be toothed. Flower heads have long stalks and are topped with showy blue, purple, pink, and white flowers measuring at least 1 inch in diameter.

Biology, Ecology and Habitat

In Latah County, bachelor's button flowers between May and July with seed maturing in late August. A few seeds on the soil surface will germinate in the fall but most germinate in the early spring. Buried seeds may remain viable for many years (80 plus). Fall germinating plants are susceptible to extreme cold and molds. Bachelor's button seems to thrive along field edges and roadsides of the Clearwater River Canyon Breaks. It grows well in the deep loam soils of the Palouse.

Impacts

Bachelor's button is an escaped ornamental often found in native areas, along roadsides, and in waste lands. Heavy infestations are known along Highway 95, but these are usually easy targets for roadside herbicide application crews because of showy summer flowers. Insects released as biocontrol agents for other weedy Centaurea species will cross-feed on Bachelor's button seed.

Mitigation Measures

Although bachelor's button presents a contamination problem in native grasslands, aggressive management focused on control may be unnecessary. Insects, rodents, snow mould and climate will often successfully suppress heavy infestations. Curtail, Milestone, Tordon, dicamba, or 2,4-D will control bachelor's button.

Additional Resources

Centaurea cyanus (cornflower)
http://www.arkive.org/species/ARK/plants_and_algae/Centaurea_cyanus/more_info.html

Knoke, D. 2006 Centaurea cyanus (cornflower)
http://biology.burke.washington.edu/herbarium/imagecollection.php?Genus=Centaurea&Species=cyanus

Blackgrass / *Alopecurus myosuroides* Huds.

Introduction

Blackgrass is a winter annual from Europe and Asia recently spreading to Latah County from Whitman County. The seed head appears dark red to black – green in the early spring. It is often identified as one of the first grasses to produce seed heads in the county. It is commonly found in wetter sites of winter cropland, pasture, and along roadsides. Blackgrass, also called slender foxtail, has become a major weed problem in western Oregon and eastern Washington and is ranked as one of the most important grass weeds in Europe.

Identification

Blackgrass plants typically grow to 2 to 3 feet tall. The leaves are narrow and hairless, ranging from 1/8 to 1/4 inches wide with long papery ligules and no auricles. The panicle is 1 to 4 inches long and is a tapered spike. Each seed head can produce 100 to 200 seeds and most plants will have 10 to 30 seed heads. The lemma has a bent awn and is about the same length as the glumes. The glumes are three nerved with whitish points.

Biology, Ecology and Habitat

In Latah County, blackgrass generally germinates in the fall when temperatures are between 48 and 77ºF but may germinate year round. The seed has after-ripening dormancy lasting about 2 months and is viable for about 7 years when buried. Seedling plants can tolerate temperatures of -13ºF.

Blackgrass prefers moist soils and is most abundant in low areas of fields with heavy soils and high winter water tables. It is not limited to these areas and likes seasonly water-saturated soils of the Palouse. The plant has usually completed seed production before the soils begin to dry in July.

Impacts

Blackgrass is a major weed problem of Europe in winter wheat production areas. It has spread into hay meadows and along roadsides in Latah County and in our winter

cropping lands. Cattle tend to avoid or delay grazing blackgrass when other forage is available.

Mitigation Measures

Partial or periodic control allows for seed production and rapid spread so cultural management plans need to include both chemical and mechanical control measures. Reduced tillage systems create an ideal seedbed for blackgrass. Blackgrass seedlings have difficulty competing with existing vegetation so focus control measures where competition is least. Repeated mowing reduces seed, but single mowing allows secondary tillers to avoid being cut off. Delayed mowing for hay allows the seed to ripen and drop to the ground while being baled and redistributed in the bale.

Chemical control was possible with several grass herbicides, but blackgrass has developed resistance to several grass herbicides (amides and urea based, dinitroanilines, and ALS and ACCase inhibitors) that were used for repeated control in winter wheat and broadleaf crops. Glyphosate will provide excellent control when used at label doses when applied at the pre-flower stage (see PNW Weed Management Handbook http://pnwpest.org/pnw/weeds).

Additional Resources

Aldrich-Markham, S. 1992. Blackgrass. University of Oregon Extension Service. http://extension.oregonstate.edu/catalog/html/pnw/pnw377/

Heap, I. 2006. Herbicide Resistance Blackgrass Globally. Weed Science Society of America.
http://www.weedscience.org/Summary/USpeciesCountry.asp?lstWeedID=6&FmCommonName=Go

Bur chervil / *Anthriscus caucalis* Bieb

Introduction

Bur chervil is a cultivated plant of European gardens introduced into the U.S. in the 1800's. It was first collected in Bingen, Washington in 1927. Idaho records it's first collection in 1964 from a spring on the old Lewiston grade. Plants could be found in shady areas along streams and creeks above Lapwai and Culdesac, Idaho along Lapwai Creek and south of the Lewiston Fairgrounds. More recently, bur chervil has spread to open rangeland and pastures in Latah County and is found from Genesee to Potlatch along Highway 95.

Identification

Bur Chervil is an aromatic plant that averages about 2 feet high but may range between 6 inches and 3 feet. The smell is about as bad a poison hemlock and often confused with hemlock at the seedling stage. The stems are hollow and do not have red-purple spots

characteristic of hemlock. The leaves are finely divided in a lacy pattern and arranged alternately on the stem. Younger leaves have hairs but tend to become glabrous as the plant matures. Flowers are small white and borne in compound umbel arrangement. Plants start to flower in late April in Latah County. Seeds are produce in June. The fruit is about 1/8 to 1/4 inch long and covered with small hooked bristles that attach easily to clothing and fur.

Biology, Ecology and Habitat

In Latah, bur chervil is commonly found near old building and in farmyards. It was considered a weed of most open area along stream banks, but in the past 10 years has moved into pastures with a weedy annual grass problem. It has become a dominate species in the Clearwater River Canyon and the Lewiston Grade.

Plants are considered to be winter annuals but a few can germinate in the spring and some have been reported to live three years. In Latah County, plants will flower in April to June in the second year of growth. The plants have thick tuberous lateral roots that form lateral buds and a tap root that can extend over 6 feet deep.

Impacts

Bur Chervil is an aggressive competitor for light, water and nutrients and will shade surrounding vegetation. Seeds are easily attached to passing animals and equipment and can be transported long distances. Bur chervil is a host for a virus disease that infects carrots, celery and parsnips. Cattle and wildlife avoid area infested with this weed.

Mitigation Measures

The aromatic nature of this plant prevents large scale hand pulling to be useful for control. Just writing this brings the memory of the bur chervil aroma back and need to avoid handling this plant. There are no biological control agents for bur chervil. Chemical control is the best option using Milestone or Transline (see PNW Weed Management Handbook http://pnwpest.org/pnw/weeds). Plants may also be controlled with Telar or Escort.

Additional Resources

Bur chervil
http://kaweahoaks.com/html/burchervil.html

California wildflowers
http://www.calacademy.org/RESEARCH/botany/wildflow/wildflowers.asp?w_id=2

Canada Thistle / *Cirsium arvense* (L.) Scop.

Introduction

Canada thistle is an invader from Eurasia. It was introduced to Canada probably as a crop seed contaminant before 1800. It is an aggressive weed that spreads by both seed and an extensive root system. The deep roots grow horizontally and send up shoots along their length, forming dense colonies. Even seedlings develop an extensive creeping root system within 2 to 4 months after emergence. Canada thistle plants have either male flowers or female flowers, and the flower difference may lead to confusion in identification. It is one of Idaho's most widespread noxious weeds.

Identification

Canada thistle, also called creeping thistle, is a perennial plant that can grow up to 5 feet tall. Early rosette leaves have an egg to rounded spatula shape that may have wavy margins. The petiole is winged and the wing tapers toward the base. The petiole is at least two times longer than cotyledons. The teeth on the leaf margin end in a weak prickle. Several leaves above the cotyledons resemble the first leaves but they are larger. Upper leaf surfaces are covered with stiff hairs. Seedlings initially develop a deep taproot. Creeping roots develop in about 2 to 4 months. Seedlings sometimes initiate stems early and have poorly developed rosettes. Leaves have wavy or lobed margins, up to 6 inches long, and are armed with yellowish spines. Stems are single, branched near the top, ridged, and hollow. Flower heads develop in midsummer, 1/2 inch in diameter, and are not particularly spiny. Flowers are purple to lavender, occasionally white, with male and female flowers borne on separate plants. Seeds are slender, tan, 1/8 inch long, and bear fine plumes.

Biology, Ecology, and Habitat

Canada thistle is an erect perennial forb with extensive creeping roots. Horizontal roots may extend up to 15 feet, and may extend 6-15 feet deep in soil. It reproduces vegetatively from horizontal creeping roots or from seeds. Canada thistle spreads primarily by vegetative means, and secondarily by seed. Roots have the ability to regenerate from small root pieces. Root fragments can grow into plants. Reproduction from root system contributes to localized spread, while seeds contribute to spread over longer distances. A single plant produces an average of 1500 seeds, and up to 5200 seeds. Canada thistle seeds have been found to remain viable up to 21 years. However, length of survival depends on depth of burial. Seeds are dispersed by wind, contaminated crop seed, feed, manure, packing straw, and irrigation water. Seeds mature July-September. Seeds germinate most readily in mid-spring, do not tolerate drought stress or moist, poorly aerated soils. Flowering begins early July and continues into September. Canada thistle is usually dioecious, with male and female flowers produced on separate plants. Female flowers can be distinguished from male flowers by the absence of pollen and presence of a distinct vanilla-like odor, as well as by shorter corolla lobes.

Impacts

After 110 years since the introduction to Idaho, the weed is still causing economic losses in wheat production areas by reducing yield and grain quality. Farmers often destroy pea and lentil crops in rotational years while spot spraying visible Canada thistle patches. It has become a weed of field borders along roadside rights-of-ways and often sprayed by highway spray crews. Wetland sites are susceptible to large infestations.

Mitigation Measures

Management by mechanical methods tends to stimulate root development and will suppress seed development but not provide control. Herbicides with Milestone (aminopyralid), Transline or Curtail (clopyralid) as active ingredients are most effective for control (see PNW Weed Management Handbook http://pnwpest.org/pnw/weeds for a complete listing of herbicides). There are two biological control agents. The stem weevil (Ceutorhynchus litura) causes damage to the plant when the larvae feed in the stem and crown. The Gall fly (Urophora cardui) larvae burrow into the stem causing a gall to form. The gall disrupts translocation of sugars to the roots and moisture to the flowers. Infected plants have less root biomass and seed production. Repeated mowing with the establishment of competitive grasses and alfalfa may be as effective as introducing a biological control agent.

Additional Resources

Nechols, J. R., L. A. Andres, J W. Beardsley, R. D. Goeden, and C. G. Jackson (eds.). 1995. Biological Control in the Western United States: Accomplishments and Benefits of Regional Project W-84, 1964-1989. Division of Agriculture and Natural Resources, Publication 3361, University of California, Oakland, California.

Prather, T. S., S. S. Robins, D. W. Morishita, L. W. Lass, R. H. Callihan, and T. W. Miller. 2002. Idaho's Noxious Weeds. University of Idaho Bull. 816, Moscow, ID. 76 p.

Chamomile/pineapple weed complex
Mayweed chamomile / *Anthemis cotula* L.
Pineapple-weed / *Matricaria matricarioies* (Less.) C. L. Porter
Scentless chamomile / *Anthemis arvensis* L

Introduction

This chamomile/pineapple weed complex will be a common weed along the new section of Highway 95 between Lewiston and Moscow. These weeds are major problems in agricultural fields and visible in edible legume crops where herbicide options are often limited. The chamomiles are native to Europe and came to the U.S. as a garden flower or seed contaminant in about 1890 to 1900 era, and pineapple weed is a native to North America that has become weedy. Mayweed chamomile was identified in Latah County

in 1907 although it had been found near Kellogg, Idaho in 1895. Scentless chamomile was first found in 1949 in Latah County just to the east of Moscow, but had been in the region since 1911. Pineapple weed was first reported in Nez Perce County in 1884. All three of these invasive weeds can adapt to many growing conditions and are commonly found in waste areas, barnyards, cultivated fields, and overgrazed pastures.

Identification

Mayweed chamomile is a fowl smelling annual / winter annual plant having a miniature daisy flower, ranging in height from 6 inches to 2 feet. Leaves are alternate in arrangement on stem and pinnately dissected, appearing almost carrot like. Flowers are about 3/4 inch in diameter with 12 white ray and yellow disk flowers. In Latah County, flowers are produced in the leaf axils from May to September.

Scentless chamomile is a winter or summer annual, but may also be biennial to short lived perennial that is odor free and looks like Mayweed with reddish stems and a little larger growth form than mayweed chamomile.

Pineapple weed has a wonderful pineapple smell when leaves are crushed. The annual plant looks similar to the chamomiles with pinnately dissected leaves, but can easily be identified at flower by the absence of the white ray flowers and with slightly cone-shaped yellow-green flower heads. Plants are generally about half the size of the chamomiles and range from 3 inches to 1 foot.

Biology, Ecology and Habitat

In Latah County, these plants grow well in disturbed sites. Pineapple weed tends to favor compacted sites along roadsides, footpaths and bike trails. Mayweed chamomile favors rich clay loam soils and is adapted to wetter sites where crop competition may not be present. Scentless chamomile prefers areas of low competition where there is abundant moisture in the early spring and a lot of light.

All three species have similar biology where the plant reproduction is solely by seeds. These weeds germinate throughout the growing season when the temperature is above 60ºF and the soil is moist. They can persist as a winter, summer annual, biennial and scentless chamomile is capable of being a short-lived perennial. Spring seedlings will generally flower in the summer from late May to September. Over-wintering plants begin flowering a month earlier than spring germinating plants. Robust plants may produce 750 to 20,000 seeds and may remain viable in the soil 5 to 10 years.

Impacts

Mayweed chamomile can cause skin rashes and mouth blistering in grazing animals and has been attributed as a cause of death in miniature horses by WSU Equine Veterinarians. It will produce an off flavor in milk products of dairy cattle. Scentless chamomile may reduce yield of editable legume crops by 20 to 60% if not managed with herbicides.

Pineapple weed has many useful medicinal properties such as a tea to calm nerves and stomach and the crushed plant can reduce itching and sooth sores. In Latah County, pineapple weed may reduce lentil yields by 60% to 100%

Mitigation Measures

In Latah County, mayweed chamomile may be resistance to ALS inhibitors (b/2) herbicides such as chlorosulfuron and metsulfuron. Some tolerance to 2-4, D and dicamba has been found in mayweed populations near the current Highway 95 construction site between Genesee and Moscow.

Hand weeding of the chamomiles and pineapple weed when seedlings are small is an option but mature plants tend to break off and will regenerate and produce seed without further pulling. Mowing will reduce seed production but plants produce secondary branches that still produce seed. Continuous season long germination requires repeated visits to an infestation if control is to be achieved by hand weeding or mowing.

Herbicides for control of the chamomiles and pineapple weed offer season long control. Products containing Transline (clopyralid) and Milestone (aminopyralid) offer excellent control without injury to desirable grasses.

Additional Resources

North Dakota Department of Agriculture. 2006. Scentless Chamomile (Anthemis arvensis)
http://www.agdepartment.com/noxiousweeds/pdf/Scentlesschamomile.pdf#search='scentless%20chamomile'

Alaska Heritage Program. 2005. Mayweed chamomile Anthemis cotula L. Non-native Plant Species of Alaska
http://akweeds.uaa.alaska.edu/pdfs/species_bios_pdfs/Species_bios_ANCO_mlc_edits.pdf#search='mayweed%20chamomile'

Cluster tarweed / *Madia glomerata* Hook.
and Coast tarweed / *Madia sativa* Molina

Introduction

Cluster tarweed is a native plant in the sunflower family that establishes on disturbed sites in forest openings and grasslands. Found in Western North America, it has recently transitioned to establish along roadways and heavily grazed pasture and rangeland. Tarweed is avoided by grazing animals due to its odor, and will increase on pastures where over utilization occurs.

Coast tarweed is an introduced invasive from South America that is also found in Latah County. It also is found along roadsides, on disturbed areas, and overgrazed pastures.

Identification

Cluster tarweed is a glandular (tar-scented) and hairy plant averaging about a foot in height but may range from 6 inches to 3 feet. Leaves are linear and about 1/8 to 1/4 inch wide and 1 to 2 inches long. The flowers of cluster tarweed are considered rayless or have only 1 to 3 ray flowers that are inconspicuous.

Coast tarweed looks a lot like cluster tarweed except it has 5 to 13 showy yellow ray flowers ranging in length of 1/8 to 1/3 inch.

Biology, Ecology and Habitat

In Latah County, both cluster and coast tarweeds are common along roadside and can usually be found in the gravel adjacent to the road shoulder and other disturbed sites. Plants are common in areas where grazing has selectively removed desirable species. Cluster and coast tarweeds are annuals germinating in the late spring. Flowers are produced in late July to early August and seeds are dispersed in September. Seeds are easily caught by clothing and animal fur. Little is known about seed longevity, but may be as short as 18 months.

Impacts

Cluster and coast tarweeds are indicators of disturbed soils and overgrazed pastures. Plants form dense stands displacing seedling grasses and making new plantings difficult to establish.

Mitigation Measures

Mowed plants will often produce secondary flower stems and still produce seeds. Repeated mowing will reduce populations if seed production can be prevented. Herbicides containing 2,4-D and dicamba work best for control (see PNW Weed Management Handbook http://pnwpest.org/pnw/weeds)

Additional Resources

British Columbia Ministry of Agriculture and Food. Stinking Tarweed-a.k.a. Cluster Tarweed. http://www.agf.gov.bc.ca/cropprot/tarweed.pdf#search='tarweed%20cluster'

Whitson, T. D., L. C. Burrill, S. A. Dewey, D. W. Cudney, B. E. Nelson, R. D. Lee, and R. Parker. 1996. Weeds of the West p. 160-161.

Downy Brome /*Bromus tectorum* L.

Introduction

Downy brome, also known as cheatgrass and Junegrass, was introduced from the Mediterranean region in packing material sent to Denver, Colorado in 1881. The plant is described as a winter annual but also germinates year round. It has been a weed problem in croplands, pastures, roadsides and forests in Latah County for about 75 years. In Western States, downy brome has replaced most native shrub-grass communities because of repeated fire and human disturbance. Downy brome matures in late June and is the major fuel for many of Idaho's large rangeland fires.

Identification

Seedling downy brome plants are identified by numerous soft hairs on the leaves with membranous ligules about 1/8 inch long and missing auricles. Mature plants retain the soft hairs and will reach a height of 3 to 24 inches. The leaves are flat and range from 2 to 7 inches long and less than 1/3 inch wide. The inflorescence is 3 to 9 inches long and usually appears drooping. Spikelets are 1/2 to 1 inch long and nodding with awns about 1/2 to 1 inch long. At maturity the seeds and awns are usually purplish and easily attach to socks and other clothing.

Biology, Ecology and Habitat

In Latah County, the common habitats of downy brome include drier sites of overgrazed range, abandoned farmlands, around farm and ranch buildings, railroads, roadsides, and cropland. Under moist conditions, most of the seed will germinated within the first year after production. A few seeds remain viable in the soil for 2 to 5 years. Germination is highest when soil temperature fluctuations between day and night are the greatest in the fall and spring and seeds are near the soil surface. Little or no emergence occurs if seeds are buried below 7 inches.

Impacts

Downy brome is a serious weed on rangelands and in several agricultural systems where spring tillage is not applicable.

Winter wheat, alfalfa, and grass seed fields are crops where downy brome has become of particular concern. A study conducted over a 3 year period showed downy brome reduced winter wheat biomass up to 59% and seed yield up to 68%. The presence of downy brome appeared to have a larger impact than the weed density. Other research confirms this, where downy brome caused a 2- to 5-fold greater yield loss when it emerged within 3 weeks after winter wheat than when it emerged 6 weeks after wheat or in early spring. Only at densities of 200 to 400 plants/yd2 did late-emerging downy brome cause significant wheat yield or biomass losses.

Mitigation Measures

Control with herbicides is possible in non-grass crops and prior to planting grass crops, but options in emerged grass crops are limited. Prevention strategies focused on clean equipment, and seed should also include inspection of ground mulches and seed movement by survey teams and other human traffic. Mowing and burning will not control downy brome and their use may increase weed density in subsequent years. Several herbicide options have been developed for downy brome control in alfalfa, perennial grasses grown for seeds, and for some rangeland plants (consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds). In winter wheat options are limited because of similar growth habits and susceptibility to herbicides. The herbicides that control downy brome include atrazine, bromacil, cyanazine, chloropropham, diclofop, glyphosate, metribuzin, paraquat (with or without selected triazines), pronamide, propham, simazine, terbacil, and trifluralin.

Roundup has shown to be the most effective herbicide for downy brome control after fall rains have stimulated germination, but prior to planting a desirable cover. Roundup provides a more consistent control method than tillage because tillage will not kill downy brome if the conditions remain wet.

Additional Resources

Blackshaw, Robert E. 1991. Control of Downy brome (Bromus tectorum) in conservation fallow systems. Weed Technology. 5:557-562.

Finnerty, D.W. and D. L. Klingman. 1961. Life cycles and control studies of some weed bromegrass. Weeds 10: 40-47.

Hulbert, L.C. 1955. Ecological studies of Bromus tectorum and other annual bromegrasses. Ecol. Monogr. 25:181-213.

Maun, M.A. 1977. Response of seeds to dry heat. Can. J. Plant Sci. 57:305-307.

Pepper, T.F. 1984. Chemical and biological control of downy brome (Bromus tectorum) in wheat and alfalfa in North America. Weed Sci. 32: 18-25.

Richardson, J.M., D.R. Gealy, L.A. Morrow. July 1989. Influence of moisture deficits on the reproductive ability of downy brome (Bromus tectorum). Weed Science. 37 (4): 525-530.

Upadhyaya, Mahesh K., Roy Turkington, and Douglas McIlvride. July 1986. The Biology of Canadian Weeds. Bromus tectorum L. Can. J. Plant Sci. 66:689-709.

Wicks, G.A., O.C. Burnside, and C.R. Fenster. 1971. Influence of soil type and depth of planting on downy brome seed. Weed Sci. 19: 82-86.

Wicks, G.A. 1984. Integrated systems for control and management of downy brome (Bromus tectorum) in cropland. Weed Sci. 32: 26-31.

Originally written by Meghan Trainor, Extension Weed Associate, MSU and Alvin J. Bussan, Cropland Weed Specialist, MSU and modified for this EIS.

Field Bindweed /*Convolvulus arvensis* L.

Introduction

Field bindweed is included in the "world's most undesirable agricultural weeds" list and found throughout the world except Antarctica. Field bindweed originates from Mediterranean Europe and was introduced in wheat seed to Pennsylvania in 1812. It was collected in Latah County in 1906, although it had been in Oregon since 1866 and the Midwest in 1877. In 1955, every county in Idaho reported having field bindweed.

Identification

Field bindweed is identified by short herbaceous vines that climb on anything and whitish-pink trumpet-like flowers. The leaf edge is entire and in alternate arrangement along the stem that may grow to 4 feet. Leaves may be slightly hairy when young and tend to be arrow-shaped, 0.4 to 4 inches long and 0.4 to 1.6 inches wide when mature. Flowers are white to pink or white with modeled pink to purple edges and are typically about 1 inch across when fully expanded. The flowers are solitary and usually have small bracts at the base. The seeds are dark brown and roundish, about 0.1 to 0.2 inches long. They are found in a small capsule 0.2 to 0.3 inches long. The plant grows from a taproot, which can grow into the soil 21.7 feet with rhizomes growing up to 8.5 feet.

Biology, Ecology and Habitat

Field bindweed uses both seed and rhizomes to invade disturbed sites, such as roadsides, railroads, and fields. Flowers are produced between June and September and pollinated by insects such as moths, honeybees, and butterflies. The flowers open in the morning when exposed to full sun and survive only one day. Each flower produces one to four and sometimes up to 10 seeds in the capsule 30 days after fertilization. Seeds generally fall close to the parent plant, but may be transported by birds and small animals. Seeds buried for 50 years will have 65% germination and surprisingly a few 100 year old seeds will still germinate. The seeds generally germinate when soil temperatures reaches 50°F but may germinate in temperatures up to 104°F. Early seedling development focuses on establishing deep roots into the soil. The above ground parts of the plant are susceptible to frost; however, the deep taproot escapes these killing temperatures and will re-grow new plants once temperatures reach 68°F. Frost, water stress and low light conditions cause the roots to become dormant and once dormant, the roots survive to temperatures as cold as -76°F. During periods when dormant the starchy taproot and lateral roots provide nutrients for the plant.

The lateral root is a key mechanism for spread. Roots are found near the soil surface and buds can form anywhere along the lateral roots. Most lateral roots form a secondary taproot and continue to form laterals when roots extend 3 to 6 feet from the main taproot. Cutting and dragging the root help spread field bindweed into new areas. Root pieces as short as 2 inches survive and form new plants.

Impacts

In Latah County, field bindweed will shade seedling plants as it twines around standing vegetation, and in small grain crops will cause the plants to lodge (lay on the ground) making harvest difficult. Field bindweed is a toxic plant and will cause cattle, sheep, and goats to become ill when the diet contains more than 5%. Losses in crop production can be 100% in dry years and in small grains a 20% average loss is expected when field bindweed is present. If field bindweed is present during grass establishment there is a high probability the grasses will fail to establish.

Mitigation Measures

Prevention is the best management option because once established, control requires regular treatment and monitoring and may never totally eradicate the problem. Methods for preventing field bindweed include cleaning off machinery and vehicles after tilling or driving through bindweed, purchasing weed-free seeds, and quarantine of livestock that have grazed bindweed.

Herbicides have been effectively used to control above ground and partially control roots for the past 50 years (see PNW Weed Management Handbook http://pnwpest.org/pnw/weeds). Most popular treatments include products with 2,4-D and dicamba applied to actively growing plants to ensure maximum translocation of the chemical to roots, shoots and leaves. New plants will emerge in treated areas about one month after treatment from seed or roots not killed by initial treatment. Follow-up monitoring and additional treatments are required to successfully reduce the impact of field bindweed.

Mechanical tillage with a cultivator that cuts more than 6 inches deep applied when new field bindweed plants emerge will reduce root development and prove some measure of control. Field burning just stimulates growth of field bindweed by scarifying the seeds and stimulating new buds from the deep roots. Grazing is also not a very viable option for field bindweed control because of potential toxicity.

Biological control has not been very effective in Idaho. *Tyta luctuosa*, a European moth whose larvae eat the leaves of field bindweed in the later part of the year, failed to become established after 8 years. *Aceria malherbae* forms galls on the leaves of field bindweed and is successfully established in dry semi-arid conditions. The Argus tortoise beetle (*Chelymorpha cassidea* Fabr.) is native to the eastern United States and attacks many of the species in the Convolvulaceae family, but has not adapted to the West.

More promising are the fungi that attack field bindweed. *Phomus convolvulus* and *Phoma proboscis* both are very successful in moist areas. Alternaria and Fuarium have also been used to control bindweed (Lyons 2003).

The best method of management once established is still with long term herbicide treatment and repeated monitoring.

Additional Resources

Callihan, R.H., C.V. Eberlein, J.P. McCaffrey, and D.C. Thill. 1990. Field bindweed: Biology and Management, Bull. 719, University of Idaho, Cooperative Extension System, College of Agriculture, Moscow, ID.

EIS 2003. Index of Species Information
http://www.fs.fed.us.database/feis/plants/forb/conarv/index.html .

Lyons, K.E. Element Stewardship Abstract for Convolvulus arvensis L. Field Bindweed.
http://tncweeds.ucdavis.edu/esadocs/documnts/convarv.html

Swan, D.G. 1980. Field bindweed, Convolvulus arvensis L., Bull. 888, Washington State University, College of Agriculture Research Center, Pullman, WA.

Originally written by Marika E. Kearsley and modified for this EIS
http://www.cnr.uidaho.edu/range454/2003%20Pet%20weeds/field_bindweed.html

Interrupted windgrass / *Apera interrupta* (L.) P. Beauv.

Introduction

Interrupted windgrass is a serious weed of winter wheat and spring crops in low lying areas where abundant moisture kills fall planted winter wheat and spring tillage is impossible. Interrupted windgrass was first introduced from Europe to the United States in the late 1800's. First found in Idaho and Lemhi Counties in 1927, it was not found in Latah County until 1941. In 1950, it was found on the eastern peak Moscow Mountain. Interrupted windgrass has spread to crop production fields in the Palouse and is a major problem weed for winter wheat production since 1980. In Latah County, interrupted windgrass is found extensively in cultivated fields and is present on most roadside including in urban areas. Populations are commonly found along the gravel between the asphalt and the ditch but scattered plants (2 to 3 plants per 100 feet) were always found during roadside surveys conducted in the mid-1980's by the University of Idaho. This survey also found many of the perennial pastures in Latah County were infested with interrupted windgrass. It is now common in ditch banks along roadsides and in waste areas with standing water in the spring.

Identification

Members of the Apera family have also been placed in the bentgrass (Agrostis) family because some specialized characteristics of the Apera family are not sufficiently different from bentgrass. In the vegetative phase, interrupted windgrass looks like a carpet of green bentgrass that is soft to the touch, therefore the other common name for this plant is dense silky bentgrass. Interrupted windgrass has a compact and dense panicle. The lower branches of the panicle are less than 1 inch. The lower panicle rachis has irregularly spaced branches giving it interrupted appearance. Members of the Apera family have three nerves on the second glume and the panicle rachis extends beyond the last floret and members of the bentgrass family will not. Plants range in height from 7 inches to 3 feet (avg. 20 inches) and panicles appear slightly drooping.

Biology, Ecology and Habitat

In the Palouse, plants emerge in the late fall after consistent rainfall has moistened the soil. Seedlings grow to 1 inch and have 4 to 6 leaves and a couple of tillers by January. In April and May plants begin to grow rapidly with panicles emerging in June. Plants reach final height in late June and the panicle will usually reach 7 inches above the crop canopy. Final plant height may be 3 to 4 feet in some wheat fields but only 20 inches in open areas. Taller interrupted windgrass plants often rely on the crop canopy to provide support and will topple if the crop is not present. Shorter plants do not need support but will bend easily in the wind. Seeds mature in late July and many drop to the ground but a few are caught by harvest equipment and moved to new locations. Interrupted windgrass will occasionally germinate during warm periods of February and March and still set seed in the fall.

Impacts

In Latah County, interrupted windgrass forms large dense patches in wet spots. Mature stems tend to be tough and difficult to cut with mowers and harvest equipment.

Mitigation Measures

Prevention is the best management solution. Clean equipment prior to entering an un-infested area and use certified seed. There are no biological control agents.

Chemical management options are available for wheat and barley, but control in pasture and rangeland with herbicides is limited to total control of all vegetation and starting over with more competitive grass. In bluegrass seed production fields, dicamba has successfully suppressed interrupted windgrass and glyfosinate has been used to control windgrass in conifer and hardwood plantings.

Additional Resources

Northam, F. E. and R. H. Callihan. 1992. The windgrasses (Apera Adans., Poaceae) in North America. Weed Technology 6(2):445-450.

Northam, F.E. and R.H. Callihan. 1992. Morphology and phenology of interrupted windgrass in northern Idaho. J. Idaho Acad. Sci. 28:15-19.

Japanese Brome / *Bromus japonicus* Thunb.

Introduction

USDA Agricultural Research Service Researchers claim there is little chance that land managers will rid grasslands of the weedy annual called Japanese brome (*Bromus japonicus*) once established. This weedy winter/spring annual has invaded the mixed-grass prairies of Montana, the Dakotas and Wyoming. In Latah County, this invader is found in pastures, rangeland and roadsides. Japanese brome has increasingly become a problem in wheat and grass production fields. Originally from Eurasian, Japanese brome was introduced to Prosser, Washington in about 1900 as a seed contaminant. In 1939, Latah County reported the first infestation south east of Moscow on a roadside. Japanese brome is now common in most dry disturbed sites in Western North America and tends to favor alkaline soils.

Identification

This winter annual brome or annual brome can reach a height of 12 to 30 inches. Stems and leaves are covered with soft hairs. The leaf sheath is very hairy and the auricles are absent. Leaf blades unroll to form a flat blade about 1/8 to 1/4 inch wide. The inflorescence is slightly nodding and about10 inches long resembling miniature oats with an open loose panicle. Each spikelet is about 3/4 inch long and has 5 to 9 flowers. The lemmas are about 1/8 inch long and have an awn also about 1/8 inch long that is twisted at maturity. Flowers are capable of self-fertilization.

Biology, Ecology and Habitat

In Latah County, Japanese brome is a winter annual requiring vernalization to produce seeds. Seeds from fall production are dormant and must after-ripen before they can germinate. Seeds of the previous years production will germinate after fall rains and temperatures are between 5º and 105º F but ideally 76º F. Long-term seed viability is unknown, but 70% of the seeds will germinate the second year. These seedlings start growing in early spring and take advantage of warm south and southwest facing aspects. Plants flower in April and seeds ripen in July and disperse in October to March.

Impacts

Japanese brome is an early invader of disturbed sites and provides competition for desirable plants, but establishment of competitive vegetation ultimately reduce Japanese brome densities to tolerable levels.

Japanese brome is susceptible to a grass infecting wheat bunt fungi and head smut.

Mitigation Measures

Establishment of competitive vegetation has not successfully controlled Japanese brome because limiting factors such as water and nutrients are abundant prior to seed ripening. Increased litter from competitive plants increases seedling survival of Japanese brome.

Herbicides offer the best suppression but applications need to be made to control three germination cycles because of seed dormancy.

Additional Resources

Silzer, T. 2005. *Bromus japonicus* Thunb.
http://www.usask.ca/agriculture/plantsci/classes/range/bromusjaponicus.html

Jointed Goatgrass / *Aegilops cylindrical* Host

Introduction

Jointed goatgrass is a winter annual weed of winter wheat production areas of the United States and Canada. Jointed goatgrass and winter wheat share some genetic similarities and is a native to southern Europe that was introduced as a winter wheat contaminate with several entry points. One entry was in Kansas, brought by Russian immigrants in the late 1800's from seed originating from Turkey. It is believed that the weed was introduced into North America as a contaminant in winter wheat seed. Some speculate that it was transported into Kansas in the late 1800's in contaminated winter wheat seed from Turkey. The Turkish wheat seed was brought from Russia by Mennonite settlers. The earliest herbarium specimen of jointed goatgrass in North America was collected in 1870 in central Delaware. Jointed goatgrass made its first officially recorded appearance in the Pacific Northwest in 1917, where it was found in eastern Washington. Management strategies for jointed goatgrass control must include knowledge of growth habitats, reproductive strategies and possible control methods to be effective.

Identification

Jointed goatgrass is vegetatively similar to winter wheat in the seedling stage, and is often described as hairy wheat growing outside the planter row. Leaves are about 1/8 to 1/4 inch wide and have evenly spaced hairs along the leaf edges and down the sheath opening. The plant develops erect stems or tillers reaching 15 to 30 inches tall. The rachis has 2 to 12 spikelets that appear to connect together with "joints". The spikes appear reddish to yellow in July and August, and the glumes are ribbed with a keel on one side which extends into a single awn or beard. At maturity the spike breaks off intact at the "joints" and contains one to three viable seeds. Plants with adequate moisture tend to tiller and may produce 200 seeds per plant in some wheat fields, but have produced as many as 3,000 seeds or more per plant.

Biology, Ecology and Habitat

Jointed goatgrass is established in most areas where winter wheat is grown in Latah County. Typically, it is redistributed by harvest equipment and will appear along the edge of a field near the road access. It has spread from wheat fields, and is common along roadsides, in waste areas, fence lines, pastures and rangeland. Current distribution estimates suggest 7.5 million acres in the United States are infested, and it is spreading at a rate of 50,000 acres per year.

Jointed goatgrass requires winter vernalization to produce seeds so seed producing plants germinate in the fall when temperatures range between 40º to 80° F. Plants are often found in vehicle tracks (highly compacted soil) or tend to germinated within the top 2 inches of the soil surface. Half the seed of each joint will usually germinate in the fall after maturing and the other half may persist for up to five years in the soil.

Impacts

Jointed goatgrass impacts winter wheat production in Latah County by reducing yield 20% to 50% and grain value by $0.25 to $1.00 per bushel. Fields infested with jointed goatgrass may not be eligible for certified grass seed production. Many producers grow low value crops or low yielding spring wheat in order to help decrease the density of jointed goatgrass. Typically, the field must go a five year rotation of crops before winter wheat can be planted again, due to the longevity of jointed goatgrass seeds in the soil.

Jointed goatgrass does not have many impacts on other plant communities, but has been found to be a reservoir of seeds for vehicles to move back into wheat fields. Animal communities have not been shown to be impacted by jointed goatgrass infestations, but digested seed show high vitality and survival rates.

Mitigation Measures

Until recently, basic prevention was the best method of jointed goatgrass control and may still be the most economically viable of all management options. Prevention strategies include using certified wheat seed, cleaning equipment, and isolating infested fields into continuous spring crops for a period of five years.

Mechanical and chemical strategies may help reduce seed production once infestations have established. Burning stubble after wheat harvest reduced the number of viable seeds on the soil surface by 90%, but populations were not eradicated. Mowing young jointed goatgrass spikes will reduce seed production, but new tillers may be formed and viable seed produced. Plants mowed in the soft dough stage will produce viable seed. Deep tillage buries jointed goatgrass seed below ideal germination depth and will reduce population densities.

Chemical control alternatives offer management methods for new winter wheat varieties and management during non-wheat production. Glyphosate will control actively growing plants before the boot stage at a rate of 0.38 to 0.75 lbs/acre. Sulfometuron applied early in fall or winter to seedling plants at a rate of 1.3 to 2 oz/acre will also provide good control. A new winter wheat variety (Clearfield) having tolerance to imazamox, a herbicide that controls grasses, offers the option of controlling jointed goatgrass in the winter wheat cropping year. For more options for chemical control consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds.

There are currently no biological control agents for jointed goatgrass management.

Additional Resources

Lyon, D., R. Klein, and G. Wicks. 2002. Controlling Jointed Goatgrass. University of Nebraska Lincoln. NebGuide. < http://ianrpubs.unl.edu/weeds/index.htm> Accessed 2005 April 11.

National Jointed Goatgrass Research Program. 2005. Jointed Goatgrass Ecology. <http://www.jointedgoatgrass.org> Accessed 2005 Feb. 14.

Ogg, A, P. Westra, and S. Seefeldt. 1998. Relative competitiveness of commonly grown winter wheat cultivars against jointed goatgrass. National Jointed Goatgrass Research Program. Washington State University Ag Research Center.

Prather, T. and L. Wilson. 2005. Idaho's Noxiouos Weeds 2005 Control Guidelines. Univeristy of Idaho Extension. BUL 816.

Trainor, M. 2005. Jointed Goatgrass. Montana State University. <http://weeds.montana.edu/crop/jgg.htm> Accessed 2005 Feb. 14.

Young, F., S. Seefeldt, D. Ball, D. Thill, and D. Young. 1998. Integrated management of jointed goatgrass in PNW dryland cropping systems. In: National Jointed Goatgrass Research Program. Progress Reports, Final Reports. Published by: Ag Research Center, Washington State University.

Originally written by Krystle Wengreen
From http://www.cnr.uidaho.edu/range454/2005%20pet%20weeds/jointedgoat.htm

Meadow Brome / *Bromus biebersteinii* Roemer & J.A. Schultes

Introduction

Meadow brome was introduced by the USDA Aberdeen Experiment Station in Idaho in 1966 as the perfect grazing and pasture grass for Idaho. It tolerates low moisture conditions, grows in a variety of locations from sagebrush to Douglas fir communities, is fast growing in the spring taking advantage of moisture, and deep roots allows summer long growth and regrowth following grazing or haying. Many of the primary characteristics used to select meadow brome as desirable characteristics for grazing and haying also make it an undesirable weed for native prairies.

Identification

Meadow brome is a tufted perennial about 1 to 4 feet tall. Leaf sheaths are without hairs and leaves are about 3/8 inch wide and 2 to 7 inches long. Plants have an erect appearance and will often have a reddish yellow cast to lower stems and leaves. Spikelets lengths range from 7 to 10 inches. Seeds are about 3/4 inch long and have a short awn. Alternative names for *Bromus biebersteinii* are *B. erectus* or *B. riparius*.

Biology, Ecology and Habitat

Meadow brome was selected for tolerance to warm dry summers and the cool growing season found throughout most of Idaho. Deep roots utilize moisture below the zone used by many native bunchgrasses. Rapid regrowth following mowing and grazing often allows a second hay cutting or late summer grazing. The regrowth provides meadow brome a competitive edge when introduced to native prairies. Meadow brome has been planted throughout the United States and is often used for roadside vegetation.

Impacts

In Latah County, meadow brome will degrade native prairies with late summer competitive vegetation that displaces native plants. Meadow brome may be a bridge crop for Silvertop and head smut when alternative crops are grown to break the disease cycle.

Mitigation Measures

There are no biological controls being promoted for meadow brome control. Silvertop and head smut are common problems causing reduced seed viability. There are no herbicides labeled for selective control of meadow brome in native prairies. Spot treatment with glyphosate will reduce stand density, but in many cases plants return the next year. Selective herbicides are available for perennial brome control in grass seed and small grain production fields. For more options for chemical control consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds.

Additional Resources

USDA NRCS Plant Guide. Meadow Brome *Bromus biebersteinii* Roemer & J.A. Schultes http://plants.usda.gov/plantguide/pdf/pg_brbi2.pdf

Prickly lettuce / Lactuca serriola L.

Introduction

Prickly lettuce is a common field and wasteland weed that came from Europe through southern Canada in about 1860. It is found in all fifty states but generally grows in counties with cropland. It was first found in Latah County in 1897, but had been in Whitman County near Wawawai for about 3 years prior to the Latah discovery and in Montana since 1881. It is widespread along Highway 95 and is present in all new roadside plantings along Highway 95 in Latah County. Other common names are China lettuce, wild lettuce and compass plant.

Identification

This plant is easily identified by white milky juice. Lower leaves, typically the irregular lobed ones, have prickles along the edge and midrib. Seedling plants will not have prickles and lobed leaves may not have developed making identification difficult. Seedlings typically are a flat rosette consisting of 5 to 10 fleshy light green leaves. The leaves of mature plants are arranged alternately on the stem and may be 6 to 12 inches long. Plants range in height between 2 to 7 feet with stiff hollow stems and a deep taproot. Plants are often covered with wax and pants will often have a whitish appearance. Yellow flowers about 1/3 inch across with 15 to 20 ray flowers are borne singly on terminal branches in clusters. Seeds are oblong with a slender beak with a pappus.

Biology, Ecology and Habitat

Prickly lettuce is a biennial or winter annual that flowers from July to frost. Plants may produce 250 to 5000 flowers and each seed head may contain 15 to 22 seeds per flower

head. Seeds sown on the surface of the soil have a 50% to 86% germination rate, but seeds buried 1/2 to 1 inch will still have 14% to 23 % germinating. The best germination temperature is about 70º F with 97% of the sown seeds germinating in 3 days. Cooling the temperature to 50º F did not signification reduce the rate of germination.

True to its common name of "compass plant", leaves have a unique characteristic of a north-south orientation to allow maximum sun light capture. The deep tap root allows prickly lettuce to avoid dry summer conditions of the Palouse. In Latah County, plants are common in disturbed sites and found at most construction sites in the Palouse.

Impact

Prickly lettuce is a serious weed in disturbed soil of irrigated crops and orchards. Plants are common along roadsides and small gardens. Deer, elk and moose often utilize prickly lettuce as forage and it is a contributing factor to many road kill deaths. Fall re-growth has caused poisoning in cattle, but mature and dried plants appear to be harmless. The white latex has been investigated as an alternative source of natural rubber and for energy production. The juice has been reported to have narcotic properties and is used as a natural medicine for sunburn.

Mitigation Measures

Prickly lettuce has developed resistance to Group II herbicides (ALS inhibitors). The weed may be hand pulled, but mowed plants will recover and produce seeds. Sheep and goats are excellent biocontrol agents and will devour whole fields of prickly lettuce. Most broadleaf herbicides are effective but plants are difficult to control when flowering. Pre-emergence applications of atrazine and metribuzin will usually control germinating seedlings. Post-emergence herbicides providing excellent control include 2,4-D, aminopyralid, dicamba, clopyralid, and metribuzin. For more options for chemical control consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds.

Additional Resources

Alcocer-Ruthling M., D. C. Thill, B. Shafii. 1992. Seed biology of sulfonylurea-resistant and -susceptible biotypes of prickly lettuce (Lactuca serriola). Weed Technol. 6:858–864.

Mikulka J. and D. Chodová. 2003. Germination and emergence of prickly lettuce (Lactuca serriola L.) and its susceptibility to selected herbicides. Plant Soil Environment 49 (2):89-94 http://www.cazv.cz/2003/PSE2_03/7-mikulka.pdf

Ohio Perennial and Biennial Weed Guide
http://www.oardc.ohio-state.edu/weedguide/singlerecord.asp?id=1010

Quackgrass / *Elymus repens* (L.) Gould

Introduction

Quackgrass is an invasive plant introduced from Europe to New England by colonists in about 1670 as a forage grass. It was first found in the Pacific Northwest in 1882, but was not collected in Idaho until 1901 when it was found in Bonner County. The earliest collection in Latah County came from Moscow in 1910 although it had been in Whitman County since 1901. Quackgrass grows in many soil types and at several moisture conditions. In Latah County, it is often found in wetter sites in cultivated fields, flower beds, roadsides, river banks, waste places, and abandoned fields.

Identification

Quackgrass is a sod-forming perennial grass with extensive creeping rhizomes that are straw colored and have sharp tips. Rhizomes may be 11 to 15 feet long and are typically found in the top foot of the soil. Leaf sheaths have a pair of whitish-green to reddish auricle that clasp the stem. Leaves may be up to 12 inches long with rough or slightly hairy surfaces. Leaves often have an identifiable visible constriction near the tips. Plant height ranges from 1 to 4 feet. Seeds are produced on an un-branched spike ranging in length from 3 to 10 inches. Seeds are less than 1/2 inch long and have a blunt end with a ring of hairs at the base.

Biology, Ecology and Habitat

Quackgrass spreads by both seeds and rhizomes. Broken rhizomes as small as 1/4 inch will generate new plants about 38% of the time but for best survival pieces need to be about 1 inch long. Seed production is often low and typically fewer than 25 viable seeds are produced per plant. Seed dormancy is based on depth buried in the soil with shallow placed seed having 5% dormancy and seeds buried 6 inches having 16% dormancy. Seeds loose viability within 4 years. Seeds may be dispersed long distances through the digestive tracts of horses, cows, and sheep.

Impacts

Quackgrass has been identified as a troublesome weed in over 40 countries and 32 crops. It is a vegetation bridge during crop rotations for insects and diseases of small grain. Regular cultivation of the fields spreads the broken rhizomes. The large sod-forming mats of quackgrass crowd native species out of natural areas and are a cause of concern for prairie ecologists. Quackgrass is harvested for forage hay in Latah County because it remains green throughout the growing season. Crude protein is about the same as timothy (*Phleum pretense*), but the biomass is often low.

Mitigation Measures

Mechanical control is extremely difficult since short segments of the rhizome will produce new plants. Biological controls are not available. Historically, chemical control offers the best method of management. In crops products containing Roundup (glyphosate) have been used for many years to control the above ground part of the plant and provide partial control of the roots after the crop has been harvested. Patches of quackgrass growing in non-crop sites may be spot treated but a follow-up is necessary to completely control all new plants from seed and rhizomes not affected by the herbicide. Other grass herbicides will provide selective control on roadsides, pastures, and rangelands. These include Assure II, Fusilade, Outrider, Poast, and others listed in the PNW Weed Management Guide http://pnwpest.org/pnw/weeds?33W_PROB11.dat.

Additional Resources

USFS Elymus repens.
http://www.fs.fed.us/database/feis/plants/graminoid/elyrep/all.html

OSU Biology and Management of Quackgrass in Mint
http://ippc2.orst.edu/mint/qgrassbiol.htm

Reed Canarygrass / *Phalaris arundinacea* L.

Introduction

Reed canarygrass is a hybridized native grass where the introduction of a European strain has created an aggressive and invasive strain. The new strain was promoted for "marsh hay" in wet meadows and for stream bank stabilization, but has turned into a monoculture and fire hazard nightmare.

Identification

Plants are a stout perennial that come from large rootstocks with often hollow stems up to 1/2 inch in diameter from 2 to 8 feet tall. Stems and leaves are covered with a waxy coating giving a blue-green color. Leaf blades are flat from 1/4 to 3/4 inch wide. The panicle is compact but the branches spread to about 6 inches as the plant matures. Plants generally flower in June and July.

Biology, Ecology and Habitat

In Latah County, plants are found on wet ground along streams and in marsh pastures. It is especially a problem in the bottom ground near intermittent water and areas prone to seasonal standing water.

Reed canarygrass is a perennial species that spreads by seeds and creeping rhizomes. New plants are produced at each root node when freshly cut. Each inflorescence can produce about 600 seeds. A Pennsylvania guide to establishing reed canarygrass for forage indicates seedlings are susceptible to competition and will not germinate in shady areas. This may explain why most of the spread in Latah County is attributed to creeping rhizomes. Seeds may be dispersed by animal fur and human activities, but commonly spread by floating during periods of high water.

Impacts

Reed canarygrass is still valued as a coarse forage grass but increasingly listed as an undesirable plant. Reed canarygrass forms dense single species stands that displace many wetland species offering little value for wildlife in terms of forage or cover. The stands are generally devoid of native wildlife because growth is too dense to provide good cover. The species produces large amounts of pollen when flowering which aggravates hay fever and allergies.

The dense stands of reed canarygrass fail to provide sufficient competition for many other invasive weeds like Canada thistle, leafy spurge and spotted knapweed.

Ungrazed reed canarygrass is a fire hazard in August to September and will readily burn in the spring. The quantity of fuel will support fires that easily crown into adjacent trees and shrubs.

Mitigation Measures

Control is difficult because of the persistent rhizome and the plant's ability to reproduce vegetatively and by seeds. Several control guides suggest management plans should be 10 to 20 years in duration to prevent reinvasion.

Isolated plants may be controlled by digging and removing all roots, but missed rhizomes will develop new plants. Mowing, grazing or burning appears just to stimulate more shoot from rhizomes. Tillage plus prolonged flooding has been successfully used for wetland restoration but assumes there are no other species present worth salvaging. Shade cloth, in place for a year, can eliminate reed canarygrass and may allow tree establishment to provide a more permanent shade source. There are no known biological controls agents for reed canarygrass.

Chemical controls require multiple applications to completely kill the rhizomes. Glyphosate, sethoxydim, sulfometuron and imazapyr provide some degree of control (see PNW Weed Management Handbook http://pnwpest.org/pnw/weeds). Establishing a competitive grass like red fescue will slow the reinvasion. In the all cases, reed canarygrass will return from other sources within 2 to 3 years without follow-up applications. Wick application methods should be considered for follow-up treatments to prevent damage to desirable grasses.

Additional Resources

Apfelbaum, S.I. and C.E. Sams. 1987. Ecology and control of reed canary grass (*Phalaris arundinacea* L.). Natural Areas Journal 7(2): 69-74.

Comes, R.D., V. F. Bruns and A.D. Kelley. 1978. Longevity of certain weed and crop seeds in fresh water. Weed Science 26(4): 336-344.

Dukes, T. 2000. Reed canarygrass control in the Olympic region, Washington State Dept of Transportation. Reed Canarygrass Working Group Conference, March 15, 2000, Olympia.

Hutchinson, M. 1992. Vegetation Management Guideline: Reed Canary Grass (*Phalaris arundinacea* L.). Natural Areas Journal 12(3): 159.

Kilbride, K.M. and F.L. Paveglio. 1999. Integrated pest management to control reed canarygrass in seasonal wetlands of southwestern Washington. Wildlife Society Bulletin 27(2): 292-297.

Maurer, D.A., R. Lindig-Cisneros, K. J. Werner, S. Kercher, R. Miller, and J. B. Zedler. 2003. The replacement of wetland vegetation by reed canarygrass (*Phalaris arundinacea*). Ecological Restoration 21(2): 116-119.

Moore, S., Ward, D. and B. Aldrich. 2000. Transplanting large trees for reed canarygrass control. Reed Canarygrass Working Group Conference, March 15, 2000, Olympia.

Naglich, F.G. 1994. Reed canarygrass (*Phalaris arundinacea* L.) in the Pacific Northwest: Growth parameters, economic uses, and control. M.S. Thesis, The Evergreen State College. 27 pages.

Reinhardt, C.H. and S. Galatowitsch. 2000. Best management practices for minimizing reed canarygrass prior to wetland restoration. Final Report to Minnesota Department of Natural Resources, October 20, 2000.

Smooth Brome / *Bromus inermis* Leyss.

Introduction

Smooth brome is an introduced forage grass, widely used, and has been cultivated in the United States since the early 1880's. It was brought to the Pacific Northwest by 1870's homesteaders and collected as a herbarium specimen from Yakima, WA in 1884. Smooth brome has turned into a weedy enemy of most prairie ecologists. The plant aggressively spreads by both seeds and rhizomes. The massive root system and sod forming characteristic once thought ideal for erosion control also forms dense

monocultures in native prairie sites. It has the ability to resistant to drought and tolerate extreme temperatures. The plant has become an invasive weed for natural areas.

Identification

Smooth brome is easily identified by a transverse wrinkle resembling an M in the middle of most leaves. Plants are typically 2 to 4 feet tall with leaf length ranging from 4 to 10 inches. Mature seed panicle are dark purple-brown and about 5 inches long with evenly ascending branches. Seeds are about 1/3 inch long and awnless.

Biology, Ecology and Habitat

Smooth brome is a sod forming, perennial cool season grass that spreads by seed and rhizomes. In Latah County, it was planted for erosion control along roadsides, waterways, and as a pasture grass. It grows best on well drained clay loam soils with high fertility and a pH range of 6.5 to 7.5, but is adapted to lighter textured soils. Stands are difficult to establish in high pH soils or soils with high soluble salts.

Impacts

In Latah County, smooth brome has become an invasive species growing in many natural areas. Infestations are sod forming monocultures displacing other species. Smooth brome harbors many pests and diseases impacting agricultural crops. It is a favorite food for grasshoppers.

Mitigation Measures

The easiest and probably the best management option is not to introduce smooth brome by planting seed or moving rhizomes. Biological controls are not available although some diseases will attack the plants but overall impact is slight. Grazing when plants are less than 4 inches tall will reduce stand density. Nonselective and selective herbicide control options in pastures, rangeland, and along roadside rights-of-way are available. Most effective of the nonselective contain Roundup (glyphosate) and the selective herbicides include Telar or Glean (chlorsulfuron) and Oust (sulfometuron). See the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds for a complete list.

Additional Resources

USDA NRCS Plant Guide. Smooth Brome *Bromus inermis* Leyss. http://plants.usda.gov/factsheet/pdf/fs_brin2.pdf

Soft Brome / *Bromus hordeaceus* L.

Introduction

Soft brome is common in wastelands and cultivated fields in Latah County. Soft brome began to dominate California sagebrush communities in about 1860. It was first identified in Washington in 1882, but was not reported until 1934 to be in Latah County, near Potlatch. Soft brome is introduced from the Mediterranean region of Europe and has naturalized on all continents except Antarctica. This weed is considered the replacement vegetation for many declining sagebrush communities in California, Idaho, Oregon, and Washington.

Identification

Soft brome is an annual with biennial abilities. Plant heights range from 1 to 3 feet. Leaf sheath and blades have soft hairs. Leaf blade width is about 1/4 inch wide and 3 to 5 inches long. The seed panicle has numerous compact seed heads of less than 1 inch and is covered with soft hairs. Seeds are about 1/2 inch long and have a very short awn. Other names include *Bromus mollis*, soft cheat, and soft chess.

Biology, Ecology and Habitat

Seeds will germinate in late fall when moisture is available or in early spring. Most seedlings come from seed produced during the summer with little carryover from the previous year. Seeds germinate when the temperature is between 50º and 86 º F and will go dormant when temperatures fall below 32º or are above 100º F. Seed will survive the wetting drying cycles common in the fall climate of the Pacific Northwest and there is evidence the moisture cycling will improve germination rates. Soft brome prefers sites with some mulch rather than bare soil. Soft brome populations remained less than 2% cover when mulch was mechanically removed, but increased to 37% cover in the check plots over a 3 year period.

Seeds ripen in early July and fall to the ground in early August. Fire following seed dispersal does not kill the fallen seed until temperatures reach 200 º F and most seeds are undamaged by the fast burning fires expected from grass fuels. Fire secondary effect of removing the mulch causes lower germination rates and sparse soft brome populations. Soft brome population densities increase 3 to 5 years following the fire when the mulch is again present.

Impacts

Soft brome is rated as the best of the annual brome grass for forage quality. It is nutritious and palatable at all growth stages. In the Palouse, soft brome occurs on newly disturbed sites like roadsides and cultivated fields, in fields out of cultivation like Conservation Reserve Program (CRP), and abandoned fields allowed to naturalize.

Mitigation Measures

Cultivation reduces soft brome populations about 90%. Biological control agents are not available for soft brome control. There are many herbicide choices for small grains, pastures and rangelands. For roadside vegetation management Roundup and Assure II are registered for control. Consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds for other options.

Additional Resources

Bromus hordeaceus
http://www.fs.fed.us/database/feis/plants/graminoid/brohor/all.html

St. Johnswort /*Hypericum perforatum* L.

Introduction

St. Johnswort, also called goatweed or Klamath weed, is a member of the Clusiaceae family. This Eurasian plant was introduced to Pennsylvania in 1793 as a medicinal herb or ornamental. It was transported to Oregon in the mid 1800's and spread to California in the early 1900's as a serious weed associated with poisoning of white haired livestock. In 1945, the extent of the infestation for Idaho, Oregon and Washington was estimated to cover 1.2 million acres and currently covers about 1.5 million acres. Introduced insects have reduced population densities and provide partial control but has not changed total impacted acres.

Identification

St. Johnswort is a perennial reproducing by seeds and short runners. Stems are 1-3 feet high, erect, with numerous branches, and rust-colored woody at their base. The oval leaves are covered with transparent dots and arranged opposite on the stem, not over 1 inch long. The inflorescence is an open, flat-topped, terminal clume. Flowers are 3/8 to 1 inch in diameter, bright yellow with 5 separate petals with some black dots around the edges and about twice as long as the sepals. There are numerous stamens that are arranged in groups of three that appear in early summer. The seed pods are 1/4 inch long, rust brown, 3-celled capsules with numerous seeds.

Biology, Ecology and Habitat

In Latah County, this plant is most common on disturbed sites and tends to favor sunny south and southwest slopes in degraded grasslands and forest lands. This plant grows best on sandy soils where the annual precipitation is 15-30 inches. St. Johnswort is not an aggressively competitive herb; the seedlings develop slowly and remain small. St. Johnswort seeds germinate in mid-June to late July. Seeds buried at depths greater than 0.25 inch seldom germinate. Plants rarely flower the first year and may delay flowering

for 3 to 4 years while establishing a taproot. St. Johnswort's competitive advantage comes from a long tap root for extracting water and soil nutrients unavailable to many shallow rooted native species. Mature plants often consist of several woody crowns with lateral short runners and may have 5 to 15 flowering stems in April and May. The peak flowering period is June. Seed capsules are green and sticky through the summer and mature in late fall. Each capsule contains 400 to 500 seeds and average plants have been reported to produce 15,000 to 33,000 seeds annually. The capsule pops open causing the seeds to be thrown at passing animals which move the seeds considerable distances. Seeds have a 4 to 6 month after ripening requirement and may have a red light requirement to break dormancy before germination occurs. Seed remain viable for 6 to 10 years.

Impacts

The impact of St. Johnswort has declined since the introduction of biological control agents about 50 years ago caused infestation levels to drop by as much as 99% in many areas of Latah County. In most cases the biological control agents decreased the density of infestations and the number of flower stems by half but the size of the infestation remained the same or increased. St. Johnswort is still a serious problem in degraded native grasslands and road rights-of-way.

St. Johnswort has a toxic pigment, hypericin, produced by glands found in the stems, leaves, flowers, stamens, and fruits and will cause severe dermatitis in animals upon their exposure to intense sunlight. Animals generally avoid grazing it because all growth stages are toxic, but may ingest when it is a component of hay. A toxic dose of foliage for cattle is 4% and sheep 1% of their body weight with symptoms appearing 2-21 days following consumption. Skin cell damage leads to blistering and causes severe intensive itching such that the animals often rub infected areas raw. Animals generally lose weight, are difficult to manage, and have decreased market value. Consumption rarely causes death, but after effects such as blindness or soreness and swelling of the mouth will prevent affected animals from foraging and drinking, and contribute to death by dehydration and/or starvation. At lower doses as a tea or in tablet form it has been reported to have medicinal properties for treating depression, anxiety, healing of burns and sleep disorders, however; fair-skinned humans also suffer some side-effects related to sensitivity in intense light.

Mitigation Measures

Control is achievable with many conventional technologies and suppression with biocontrol agents is one of the early success stories for using insects to control a weed. Hand pulling or digging of young, isolated plants is effective when the lateral root buds are removed but generally pulling just stimulates growth from missed roots. Mowing is relatively ineffective as a management tool unless performed prior to seed formation. Burning may actually increase the density and vigor of St. Johnswort stands and reduces biocontrol agents. Several herbicides are effective. Consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds. Spring applications are

recommended for the suppression of the weed in pasture, rangeland, or non-cropland sites. Biological control agents for St. Johnswort were introduced in 1939 with the importation of two leaf-feeding beetles (*Chrysolina hyperici* and *C. quadrigemina*). The program was so successful, other programs followed and expanded cooperation between the U.S. and Canada. Following the initial introduction in 1950, a root-boring beetle (*Agrilus hyperici*) and a lead bud gall-forming midge (*Zeuxidiplosis giardi*) were imported from southern France to supplement the control provided by the beetles.

Additional Resources

"Plants Profile." USDA. 27 Apr. 2005 http://plants.usda.gov/.

Sheley R. L. 2003. Biology and manegement of noxious rangeland weeds. 2nd ed. Corvallis: Oregon State University Press.

"Saint Johnswort." Washington State Noxious Weed Control Board. 27 Apr. 2005 http://www.nwcb.wa.gov/weed_info/Written_findings/Hypericum_perforatum.html.

"St. Johnswort." USGS. 27 Apr. 2005 http://www.usgs.nau.edu/swepic/factsheets/hypesf_info.pdf .

Whitson, T. 2004. Weeds of the west. 9th ed. Jackson, WY: University of Wyoming.

Original information by Katlyn Peterson
From http://www.cnr.uidaho.edu/range454/2005%20pet%20weeds/St%20Johns.htm

Sulfur Cinquifoil / *Potentilla recta* L.

Introduction

Sulfur cinquefoil is an introduced aggressive perennial weed of meadows and pastures, from Eurasia. The species was new to Ontario, Canada about 110 years ago, and has been in the Pacific Northwest for about 70 years. It was first found in Latah County in 1946, but was in Bannock County as early as 1937 and Kootenai County in 1939. Plants may have been introduced as an ornamental herb but most likely came as a seed contaminant. Sulfur cinquefoil has been reported to have medicinal uses, but currently is not collected.

Identification

Sulfur cinquefoil is appropriately named for its pale sulfur yellow flowers. The alternative common name, erect cinquefoil, also describes the other unique leaf feature of the plant. Leaves appear to be erect or upright along the stem and never spread like native cinquefoils or buttercups (*Ranunculus* spp.). Leaves also have stiff short hairs and uniformly serrate (sawlike) leaf margins.

Plants and leaves are erect and typically have 1 or 2 stems reaching a height of 1 to 2 feet. The stems are terminated with a flat-topped cluster of flowers measuring from 2 to 4 inches. Each flower is about 0.5 to 1 inch in diameter and has five heart shaped petals and green sepals. Leaves are 5 to 7 palmately compound in arrangement on the stem and look a lot like miniature marijuana (*Cannabis sativa*) leaves, but have stiff hairs on the surface and stipules at the base of the leaf petiole. Seeds are beaked and have a netted purplish brown surface measuring 1/20 inch long.

Native cinquefoil species are easy to confuse with the weedy sulfur cinquefoil. It is often confused with slender cinquefoil (*Potentilla gracilis*), a species with darker flower petals and spreading leaves on the stems.

Biology, Ecology and Habitat

Sulfur cinquefoil is a perennial with a semi-woody taproot spreading by seeds. Taproots will survive about 6 years but some have been collected in Michigan showing growth ring for 20 years. Each flower may produce about 60 seeds and a typical plant in the Palouse would produce about 1,600 seeds. Seeds have been known to survive 28 months in the soil and there are reports of 3 to 4 year survival, depending on climate. Fresh mature seed are conditionally dormant and less than a third of them will germinate in the first year. During the early summer of the second year, seeds after-ripen in the warm moist soil and most are non-dormant by the fall and ready to germinate.

In Latah County, sulfur cinquefoil is often found in disturbed sites where poor plant competition has allowed early colonization and rapid dominance. It is often associated with roadsides, abandoned fields, logged areas, and pastures that are overgrazed. It can rapidly spread in bluebunch wheatgrass and Idaho fescue prairies on warmer south to south west facing slopes. It is not a serious weed of croplands, but will successfully occupy natural gaps in the forest and prairie sites.

Impacts

The ability of sulfur cinquefoil to out compete native and invasive plants with rapid dominance of infested area has been reported in many publications and visually observed, but not totally understood in the dynamics of various ecosystems. Sulfur cinquefoil tends to replace heavily managed invasive species and has become the "problem weed" following successful spotted knapweed, leafy spurge, meadow hawkweed and yellow starthistle suppression with chemicals and biological agents. Grazing animals tend to used less than 1 percent of the plant and will usually only nibble the flower petals.

Mitigation Measures

Grazing and mowing are not effective control measures. Hand pulling is an option for small patches but the taproot must be totally removed by digging and repeated survey to remove seedlings. There are currently no biological control agents for sulfur cinquefoil.

Chemical control offers a temporary method of reducing the population to a manageable level. Products containing dicamba and Transline (clopyralid) are not effective, but 2,4-D and Tordon or Grazone (picloram) applied in the spring before bolting appear to provide good control.

Additional Resources
http://www.wssa.net/photo&info/weedstoday_info/cinquefoils.htm

http://www.fs.fed.us/database/feis/plants/forb/potrec/all.html

Tall oatgrass / *Arrhenatherum elatius* (L.) Presl.

Introduction

Tall oatgrass is an introduced perennial grass native to Eurasia. It was planted as a competitive vegetation in disturbed sites and one of the few perennial grasses that will thrive and spread into a yellow starthistle infestation. In Latah County, tall oatgrass is commonly found along roadsides having deep well-drained soil.

Identification

Tall oatgrass is a perennial with stems of 3 feet up to 6 feet. Leaf blades are flat and about 3/8 inch wide with a short membranous ligule. When fully opened the panicle is ½ to 1 foot long with many short whorled branches. The spikelets are 5/8 inch long and have 2 florets with the lower floret having a bent awn resembling a ¼ sized wild oat.

Biology, Ecology and Habitat

Tall oatgrass spreads by seeds alone in a slow wave of invasion of 10 to 30 feet per year. Small rodents build extensive networks of trails to move prized seed of tall oatgrass considerable distances. The seed's awn also helps the seed disperse by attaching to passing animals. Initial seedling densities are relatively low because seed viability is low. First year plants produce a few seeds but second year plants may produce 50 to 100 seeds. Seeds tend to have higher rates of emergence if the litter is thick when compared to sites without litter.

Impacts

Tall oatgrass is an invasive perennial species in native grasslands in Latah County. Deer and elk will not use the plant for forage. Small rodents prize the seed and tend to colonize around populations because of the excellent cover provided by the tall plants. Tall oatgrass populations established along roads often require mowing to allow visibility at intersections and road access points.

Mitigation Measures

Repeated grazing and mowing will reduce population densities and over time (5 years) provides good control. Occasional mowing and summer grazing has little impact. Biological control agents are not available. Herbicides provide the best option for control, but potential lethal effects on non-target native plants limits applications to spot treatments (see PNW Weed Management Handbook http://pnwpest.org/pnw/weeds). If herbicides are used, plan on at least two follow-up treatments to find plants that escaped previous treatments.

Additional Resources

Wilson, M. V. and D. L. Clark 1998. Recommendations for control of tall oatgrass, poison oak, and rose in the Willamette Valley Upland Prairies. Oregon Natural Heritage Program and USFWS.
http://oregonstate.edu/~wilsomar/PDF/WC_Mgmt_recomm.pdf#search='Tall%20oatgrass%20control'

National Parks Service. 2001. Tall Oatgrass. NSP.GOV http://www.nps.gov/redw/tall-oat.htm

Tumble Mustard / *Sisymbium altissimum* L.

Introduction

Tumble Mustard is widely distributed throughout the U.S. and Canada (except Alabama, Florida, and Newfoundland), but rarely found in Mexico. It is found in small grain fields, rangeland, waste areas and along roadsides. It was first introduced to North America in about 1885 as a seed contaminant from Eurasia and found in Whatcom County, Washington as early as 1898. Tumble mustard was collected in 1900 near Pullman, Washington but took another 36 years before it was collected in Latah County near Viola. Other common names include Jim Hill mustard and tall tumblemustard. The name Jim Hill mustard came from Montana and Dakota pioneer farmers who were lured into settling on land unfit for farming by land advertisements of the Great Northern Railroad. James Jerome Hill was the founder of the Great Northern Railway and profited by settling the land and moving agricultural commodities to market. This mustard was one of the few plants that grew in their fields during dry years. The common name “Jim Hill mustard” is still used by many farmers on the Palouse.

Identification

Tumble mustard grows from 2 to 5 feet tall with a single stem having many branches, giving a top-heavy bush appearance. Lower leaves are coarsely lobed and appear almost as compound leaflets. Upper leaves are narrow lobed and delicate. Leaves are arranged alternately on the stem. Flowers are pale yellow with 4 petals and borne on a raceme at the terminal ends of the stems. Fruits are slender 2-valve capsules about 3 inches long. Seeds are yellow to brown oblong and very tiny with a single groove.

Biology, Ecology and Habitat

Tumble mustard is an annual that will also germinate in the fall. Mature plants may produce 1.5 million seeds and disperse long distances when the stem of the dried parent plant breaks off near the ground and tumbles in the wind. Fruits resist shattering and only a few seeds drop with each move. Wind may move the plants a few miles, but machinery can pick up the blowing branches and transport thousands of seeds great distances. Stored seed will germinate after 40 years. Seeds buried 8 inches in the soil for 2 years have 10% germination but 79% of them will germinate after 7 years and 0% germination after 17 and 22 years. The best germination temperature is 50º F but seeds will germinate when temperatures are between 32º and 68º F. Germination rate may be as high as 93% under ideal temperature and moisture conditions.

Impacts

Tumble mustard is a bee- and butterfly-pollinated plant. It may be grazed by sheep and goats but generally is avoided by cattle, elk, and deer. Plants will help stabilize fine textured soils. Leaves are edible as salad greens and tumble mustard seeds may be ground into flour for flatbread. Tumble mustard is ranked as the second worst weed of the Great Basin because of its effective seed dispersal mechanism and ability to survive any drought conditions. It is a serious crop weed infesting hay fields in Idaho. Hay and grain infested with tumble mustard seeds are not palatable to cattle and horses.

Mitigation Measures

Repeated mowing will prevent seed production, but is not a permanent solution because of the seed bank in the soil. Competitive vegetation to prevent seedling establishment will reduce populations to manageable levels. Slugs appear to be the only potential biological suppression agent when plants are in the seedling stage. Broadleaf herbicides including 2,4-D, MCPA, chlorsulfuron and metsulfuron will provide excellent season-long control.

References

Howard, Janet L. 2003. Sisymbrium altissimum. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research

Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/plants/forb/sisalt/all.html

James Jerome Hill (1838-1916) http://www.historylink.org/essays/output.cfm?file_id=7294

Ventenata /*Ventenata dubia* [Leers] Gross. & Dur.

Introduction

Ventenata, also called North Africa Grass, is a troublesome aggressive weed of roadsides spreading into less competitive grasslands and disturbed sites. It offers poor forage for livestock and wildlife. Ventenata is a native of North Africa and Eurasia. It is first reported in 1957 in Kootenia County in Idaho and may have come as a grass seed contaminant. It is now commonly found in most of the Western United States and Canada and the states of Maine, New York and Wisconsin. Interestingly, the plant is listed as a nationally rare native species in Algeria.

Identification

Ventenata is a winter annual grass with slim, erect culms from 6-27 inches tall with microscopic hairs that give the appearance of being smooth. Seedling leaves are in-rolled or lengthwise folded and appear very narrow. The inflorescence is an open panicle, appearing greenish yellow but rapidly maturing to a yellowish-tan to yellow color. The panicle branches are spreading to drooping. The twisted and bent awns (3/8 to 1 inch in length) found on the upper florets are a distinguishing characteristic of the *Avena* genus (previous named *Avena dubia*). It flowers from May to August following the pattern of many weedy winter annual grasses (Bromus spp.).

Biology, Ecology and Habitat

In Latah County, Ventenata is common along roadsides and favors west and south exposures where clay loam soils are exposed. Seeds are viable for at least three years in clay-loam soils. Plants produce 15 to 35 seeds per plant. Ventenata germinates best at moderate to high temperatures. The weed completes its lifecycle in July in most locations in Latah County and will germinate following the first fall rain. The awns cause seeds to be easily moved by humans and animals.

Impacts

Ventenata is an opportunistic grass that establishes on sites previously occupied. In many cases the prior grasses may offer open spaces for establishment, but early maturing ventenata plants are establishing in previously impervious species such as Idaho fescue and prairie junegrass (*Festuca idahoensis-Koeleria macrantha*) communities, hard and sheep fescue communities, and meadow brome production fields. Stems of ventenata

mature rapidly and are not palatable causing a dual loss in forage value of infested land where forage needs to besupplemented and replaced with quality grasses. Its spread throughout Latah County decreases yields and damages mechanical equipment.

Mitigation Measures

Control is achievable with herbicides, but mechanical and physical control options have not worked. Plants producing seed tend to bend when mowed and many escape. Some mid-June mowed seed heads also appear to continue to produce viable seed. Mowing early will reduce seed numbers but plants tend to produce a second flush of seeds following the mowing. Fire will suppress ventenata but tends to stimulate the annual weedy bromes and leave an opening for more ventenata the following year. Biological control agents have not been developed. Herbicides are effective and registered in croplands; consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds. Ventenata has shown tolerance to glyphosate (trade names Roundup, Rodeo, other names) and sethoxydim (trade names Aljaden, Vantage, other names).

Additional Resources

Northam, F.E., and Callihan, R.H. 1994. New weedy grasses associated with downy brome. General Technical Report-Intermountain Research Station, USDA Forest Service, INT-313, 211-212. Ogden, Utah.

Protected Areas Programme Algeria. 2003. http://www.unep-wcmc.org/sites/pa/1454v.htm .

Weed Alert- Ventenata dubia. 2002. http://tncweeds.ucdavis.edu/alert/alrtvent.html

Wilderman, David. 2003. Effects of wildfire on high-quality shrub-steppe vegetation, Cleveland Natural Area Preserve, south-central Washington State. The Phlox Phlyer-TheNewsletter of the Columbia Basin Chapter of the Washington Native Plant Society. 7(6): 1-2.

Zouhar, Kris. 2003. Bromus tectorum. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). http://www.fs.fed.us/database/feis/ .

Original information by Betsy Nelson
From http://www.cnr.uidaho.edu/range454/2004%20pet%20weeds/ventenata.html

White Bryony / *Bryonia alba* L.

Introduction

This European – Middle Eastern herbaceous vine has been described as the Kudzu of the Northwest. It is a vigorous perennial that uses shrubs and trees for support of large dense tangled mats that shade the supportive plants. White bryony was first reported growing next to a house in Big Timber, Montana in 1953. The introduction was probably intentional since the root is reported to have medicinal value for a fertility charm, laxative and anti-rheumatic drug. Seeds are extremely toxic and 40 seeds will kill a adult human while 3 to 15 have killed children. It was collected in Latah County in 1982 although it had been in Whitman County, Washington since 1973.

Identification

The vines reach 12 feet or more with long tendrils and triangulate toothed leaves in an alternate arrangement on the stem. The leaf surfaces are covered with small white glands. The flowers arise from the leaf axis and both male and female flowers are found on the same plant. The flowers are whitish-green and about 1/2 inch across. The fruit is a black berry about the size of a large pea. The light-yellow taproot maybe a foot in diameter and grow 16 feet or more deep. The root looks like a parsnip on steroids.

Biology, Ecology and Habitat

The long-lived perennial plant climbs the tree each spring, flowers in June and produces seed in September. Birds eat the seed and fly to a new tree or fence, and a new seedling has support to climb the following year. Frost will kill the vine but seeds still remain on the vine for birds to eat all winter.

Impact

White bryony will eventually kill the support tree or shrub by totally shading it. Seeds are extremely toxic to mammals and humans.

Mitigation Measures

Small plants may be dug, but the root needs to be completely removed and protective rubber gloves are advised to prevent contact with plant juices.

A broadleaf herbicide will kill the root but usually also kills the support shrub or tree.

Additional Resources

Hall, D. 2004. Bryonia alba (white bryony, wild hops, devil's turnip) on the Palouse. Palouse Prairie Foundation. http://www.palouseprairie.org/bryonia%5Falba/

Yellow Starthistle /*Centaurea solstitialis* L.

Introduction

Yellow starthistle, an introduced Eurasian weed, presently infests nearly 3 million acres in Idaho, California, Oregon and Washington. University of Idaho field surveys show that yellow starthistle has invaded Idaho lands at the rate of about 6,000 acres per year since 1981 and now infests over 200,000 acres in northern Idaho. The largest infestations are in Clearwater, Idaho, Latah, Lewis and Nez Perce counties. It has begun invading southern Idaho at scattered locations. Yellow starthistle infestations primarily occur on semiarid rangeland and abandoned cropland. dryland grain set-aside, Conservation Reserve Program (CRP) and irrigated pastures are also susceptible to invasion.

Identification

Yellow starthistle, also called St. Barnaby's thistle or cotton tip thistle is a winter annual, maturing from 2 to 72 inches, but typically 24 inches tall. Cotyledons are about 1/4 inch long and oblanceolate. First leaves are generally without lobes but pinnately lobed in older rosette leaves. Leaf surface has cotton-like hairs on older rosette leaves. A rosette of deeply lobed leaves up to 8 inches long forms after seed germination in the fall.

Stem leaves up to 4 inches long develop in early spring, their blades forming fringe-like extensions down the side of the stem. Yellow flower heads develop at the tips of branched stems from late spring until fall. Flower head bracts bear stiff, sharp thorns that are 3/4 inch long. Seeds are tan with white and brown mottling, 1/8 inch long. Both plumed and unplumed seeds are borne in each flower head. Plumed seeds are not highly windborne, unplumed seeds not at all.

Biology, Ecology and Habitat

In Latah County, yellow starthistle is invading canyon grasslands, rangelands, southwest facing pastures dominated by annual grasses, edges of cropland, and disturbed sites. It is often found as isolated plants along highways throughout the county. Yellow starthistle is a winter-hardy annual that normally begins growth in the fall with germination and the emergence of oblong cotyledons or seed leaves. The secondary leaves are longer and narrower; later leaves are lobed. In early spring, 7 or 8 lobed leaves emerge to form a rosette as the plant continues to increase in height and diameter. Early rosette stages have from 8 to 15 leaves while later stages may be 6 to 8 inches in diameter with up to 26 leaves.

Plants bolt in late May and June, sending up a flower stalk with branches tipped with a firm flower bud. During this spring growth period, dense infestations of yellow starthistle that inhabit southern exposures of steep canyons may be identified from a distance by their characteristic blue-green color.

From mid-June to early July, each flower bud appears as a small swelling enclosed by shingle-like layers of bud scales called bracts. A yellow-green spine appears at the tip of each bract and develops with the bud to become 1/4 inch to 2 inches long after the flowers fully open.

The flowering stage can be recognized in mid-July and early August as bright dandelion-yellow flowers. One of these flower heads may look like a single flower, but it actually is a cluster of tiny flowers as in a dandelion head. At this stage, the plants may be seen easily, but they are too mature to control economically. Viable seed has been produced once 5% of the flower buds have yellow flowers visible. The small plants usually have an un-branched stem and one flower head; the large plants have a stem with many branches and can have over 100 flower heads.

In August, the leaves wither and dry, the bright yellow flowers fade, and the plants take on a straw-colored appearance. The light-colored seeds are mature and are ready to be scattered when the flower head dries to a tan color. Seeds are of two types, those with and those without a white, feathery, parachute-like plume that carries the seed in the wind or clings to clothing fur, or feathers. Seeds without a plume are dropped below the parent plant to replant the site.

Large areas of yellow starthistle-infested rangeland are easily identified during September and October. Plants continue to dry and lose leaves, becoming skeletons that are silver-grey by December. The flower head has lost most of the spines by this time. The resultant white, cottony head is a highly visible form that persists until mid-spring or until the plant disintegrates.

Yellow starthistle seeds on the soil surface begin to germinate with the onset of fall rains or spring warm-up, and the cycle is repeated.

Yellow starthistle, like many destructive weeds, can produce several hundred seeds per plant. About 95 percent of the seeds produced are viable. Many may remain alive but dormant in the soil for several years, and they will germinate and establish any time conditions are favorable. From 20 to 40 percent of the seeds may remain alive after 1 year, and 10 percent can lie dormant for more than 10 years.

The root development of yellow starthistle continues through the winter months. Yellow starthistle is therefore able to capture moisture, nutrients and solar energy before annual grasses begin to grow.

Yellow starthistle thrives at low elevations, on level ground or south-facing slopes with deep well-drained soils receiving 15 to 30 inches of precipitation annually. It also survives and forms dense infestations in shallow rocky soils with as little as 10 inches of annual precipitation. This adaptability enables it to become solidly established in Idaho agriculture's weakest spot - semiarid rangelands where control is not practical because of difficult terrain and low return on investment. From there, it persistently spreads to better land.

Impacts

Spines are a deterrent to grazing, and the plant causes "chewing disease" in horses which renders them unable to eat or drink.
Mitigation Measures

Effective control requires both weed suppression, and re-establishment of desirable species. Small infestations can be hand pulled, and disturbed sites should be reseeded with perennial grasses. Seedflies and weevils are being used and have effectively suppressed a few heavy infestations, but populations seem to recover during moist years. Cultivation effectively controls yellow starthistle. Repeated cultivation is required to control each new seed flush. Repeated mowing can also be effective, if properly timed. Waiting until the early flowering stage leads to less re-growth. Chemical control offers short-term solutions to allow competitive grasses to establish. Transline or Curtail (clopyralid), Milestone (aminopyralid) and Tordon or Grazone (picloram) are very effective in controlling yellow starthistle; consult the PNW Weed Management Handbook http://pnwpest.org/pnw/weeds. Yellow starthistle has developed resistance to some herbicides when multiple applications were applied multiple seasons to flowering plants. Therefore, it is recommended that herbicides are sprayed at labeled rates and when plants are most susceptible in the rosette stage.

Additional Resources

Yellow Starthistle Biology and Control
http://cecalaveras.ucdavis.edu/starthistle.htm

Yellow Starthistle Biology and Management
http://www.cdfa.ca.gov/phpps/ipc/weedmgtareas/MariposaMF/yst_bio-mgt.pdf#search='yellow%20starthistle%20biology'

Mitigation Measures

A competitive vegetation strip along the highway should reduce establishment of weeds from vehicles using the highway once construction is complete. Results from a grass establishment project established on Lenville Road near the Highway 95 Project site provide data on adapted species. After 17 years the following grasses have more than 50% cover: hard fescue, pubescent wheatgrass, and bluebunch wheatgrass. Grasses with less cover included crested wheatgrass, timothy, tall fescue, intermediate wheatgrass, and big bluegrass.

Species specific mitigation measures were discussed in each species profile. Herbicides used for control have the potential for controlling multiple invasive weeds with one

application. The following table is provided as a reference guide to maximize control and reduce adverse impacts caused by the treatments. Read and follow the label before making any application.

List of Herbicides approved for purchase by ITD.

2,4-D + Picloram (Tordon 101)
2,4-D Amine (Formula 40)
2,4-D Amine (Hi-Dep)
2,4-D Amine (Solution WS)
2,4-D Amine (Weedar 64)
2,4-D Aminiester (Weedone 638)
2,4-D Glyphosate (Campaign)
2,4-D, Dicamba (Veteran 720)
2,4-D, Dicamba (Weedmaster)
2,4-D, MCPP, Dicamba (Trimec Classic)
Aminopyralid (Milestone)
Borate, Chlorate, Diuron (Barespot WG)
Bromacil, Diuron (Dibro 2+2)
Bromacil, Diuron (Weed Blast 8G)
Bromacil-Diuron (Krovar I DF)
Chlorosulfuron (Telar)
Clopyralid (Transline)
Dicamba (Banvel)
Dichlobenil (Casoron 4G)
Diglycolamine (Vanquish)
Dimethylamine salt (Vengeance)
Dithiopyr (Dimension Ultra WSP)
Diuron (Direx 4L)
Diuron (Karmex DF)
Fluazifop (Ornamec)
Flumioxazin (Payload)
Fluroxypyr (Vista)
Glyphosate (Rodeo)
Imazapyr (Arsenal)
Imazapyr + Diuron (Topsite 2.5 G)
Imidazolinone (Plateau)
MCPA + 2,4-D, Dicamba (Target)
Metsulfuron (Escort)
MSMA (Bueno 6)
Pendimethalin (Pendulum WDG)
Picloram (Tordon 22K)
Sulfometuron (Oust)
Triclopyr (Garlon 4)
Triclopyr+Clopyralid (Confront or Redeem)

The list of ITD approved herbicides are focused on control of broadleaf species in grass areas and total vegetation management for maintenance yards and gravel stock-piles. Selective control of some species of concern in the project area may require adding more selective grass herbicides to the approved list.

Table 3. Herbicide effectiveness.

	Herbicide															
Common name	Spike tebuthiuron	Milestone aminopyralid	Buctril bromoxynil	Telar chlorsulfuron	Transline clopyralid	Curtail clopyralid +2,4-D	Banvel Dicamba	Overdrive Difluenzopyr+dicamba	Vista Florasypyr	Roundup glyphosate	Landmaster BW Glyphosate + 2-4D	Velpar Hexazinone	Plateau Imazapic	Journey Imazapic + glyphosate	Arsenal Imazapyr
Batchelor button	-	E	-	-	E	E	G	F	-	-	G	-	-	G	-
Blackgrass	-	-	-	-	-	-	-	-	-	P	P	-	-	P	-
Bur chervil	-	E	-	E	G	E	F	F	-	-	F	-	-	F	-
Canada thistle	F	E	F	F	G	G	F	F	-	G	G	G	G	G	G
Chamomile complex	-	E	G	G	G	E	F	G	-	F	G	P	P	G	G
Cluster tarweed	-	-	G	-	P	E	P	P	-	-	G	-	-	G	-
Downy brome or cheatgrass	G	-	-	G	-	-	-	-	-	E	E	-	G	E	E
Field bindweed	F	-	-	-	P	P	F	P	P	F	G	P	F	G	F
Interrupted windgrass	-	-	-	-	-	-	-	-	-	G	G	-	-	G	E
Japanese brome	-	-	-	-	-	-	-	-	-	G	G	-	G	G	G
Jointed goatgrass	-	-	-	-	-	-	-	-	-	G	G	-	-	G	G
Meadow brome	-	-	-	-	-	-	-	-	-	E	G	-	-	E	G
Prickly lettuce	-	E	-	P	E	E	G	G	-	F	F	-	-	F	-
Quackgrass	-	-	-	-	-	-	-	-	-	E	E	-	-	E	G
Reed Canarygrass	-	-	-	-	-	-	-	-	-	F	F	-	-	F	G
Smooth brome	-	-	-	-	-	-	-	-	-	G	G	-	-	G	G
Soft brome	-	-	-	-	-	-	-	-	-	G	G	-	G	G	G
St John's wort	-	-	-	-	F	G	F	-	-	-	-	-	-	-	-
Sulfur cinquifoil	-	-	-	-	P	P	-	-	-	G	G	-	-	-	-
Tall oatgrass	-	-	-	-	-	-	-	-	-	E	E	-	-	E	G
Tumble mustard	-	P	-	E	P	G	G	G	-	G	E	-	-	F	-
Ventenata	-	-	-	-	-	-	-	-	-	F	F	-	F	F	-
White bryony	-	-	-	-	-	G	F	-	-	-	-	-	-	-	-
Yellow starthistle	G	E	F	P	E	E	G	G	-	-	-	-	-	-	G

P = Poor; F = Fair; G = Good; and E = Excellent

Table 3. Continued

Common name	Herbicide: Gallery (isoxaben)	Snapshot (Isoxaben + trefluralin)	Lorox (Linuron)	MCPA (MCPA)	Escort (Metsulfuron)	Solicam (Norflurazon)	Surflan (Oryzalin)	Pendulum (pendimethalin)	Tordon (Picloram)	Pramitol (prometon)	Paramount (quinclorac)	Oust (sulfometuron)	Garlon (triclopyr)	Crossbow (triclopyr+2,4D)	Redeem (Triclopyr + clopyralid)	2,4-D
Batchelor button	-	-	-	-	-	-	-	-	E	-	-	-	-	-	E	G
Blackgrass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bur chervil	-	-	-	-	-	-	-	-	G	-	-	-	-	-	G	F
Canada thistle	-	-	-	F	F	-	-	-	G	-	F	G	F	F	G	F
Chamomile complex	G	G	-	-	G	-	-	-	G	-	-	G	-	F	E	F
Cluster tarweed	-	-	-	-	-	-	-	-	G	-	-	-	G	E	G	E
Downy brome or cheatgrass	-	G	-	-	-	G	G	-	-	-	-	G	-	-	-	-
Field bindweed	F	F	-	-	F	-	-	-	P	-	F	-	P	F	P	F
Interrupted windgrass	-	G	-	-	-	G	G	-	-	-	-	G	-	-	-	-
Japanese brome	-	G	-	-	-	G	G	-	-	-	-	G	-	-	-	-
Jointed goatgrass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meadow brome	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prickly lettuce	-	-	-	E	P	-	-	-	E	-	-	P	-	G	E	E
Quackgrass	-	-	-	-	-	G	-	-	-	-	-	-	-	-	-	-
Reed Canarygrass	-	-	-	-	-	-	-	-	-	-	-	G	-	-	-	-
Smooth brome	-	-	-	-	-	-	-	-	-	-	-	G	-	-	-	-
Soft brome	-	-	-	-	-	G	G	-	-	-	-	G	-	-	-	-
St John's wort	-	-	-	-	-	-	-	-	G	-	-	-	-	-	G	G
Sulfur cinquifoil	-	-	-	-	-	E	-	-	F	-	-	-	-	-	-	F
Tall oatgrass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tumble mustard	-	-	-	G	E	-	-	-	-	-	-	E	G	G	G	E
Ventenata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White bryony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	G
Yellow starthistle	-	-	-	-	-	-	-	-	E	-	-	-	-	F	E	G

P = Poor; F = Fair; G = Good; and E = Excellent

Pacific Northwest Weed Management Handbook recommendations for Non-crop and Rights-of-ways from the 2006 edition.

NONCROPLAND AND RIGHT-OF-WAY—Grass Weed Control	
• amitrole Amitrol 240	**Rate** 1 to 9.9 lb ai/A, depending on product, weed species, and growth stage **Time** Apply when weeds are young and growing actively. A second treatment may be needed to control weeds not thoroughly sprayed, or weeds coming from dormant seeds or old roots. **Remarks** Controls certain annual and perennial broadleaf and grass weeds. **Caution All commercial uses were designated as restricted uses in 1985.** Do not spray or allow drift to edible crops or cropland or water for irrigation, drinking, or domestic purposes. Keep livestock off treated areas.
• borate or sodium chlorate mixtures several products	**Rate** Refer to specific labels. **Time** Apply either preemergence or postemergence. **Remarks** These two materials are combined in several different proprietary, trademarked herbicides. Most can be applied either dry or as a spray, depending on the formulation. For rates, application times, use restrictions, and precautions, consult the label of each proprietary mixture. **Caution** If used alone, sodium chlorate creates a fire hazard by increasing the flammability of any combustible material. The metallic salts of boron (borates) combined with sodium chlorate act as a fire retardant and overcome most of the fire hazards inherent in sodium chlorate. Sodium chlorate is toxic to livestock, which like its salty taste. Do not let livestock come in contact with treated areas.
• bromacil + diuron Krovar I DF	**Rate** 4.8 to 9.6 lb ai/A (6 to 12 lb product/A) **Time** Fall or late winter east of Cascades, in March or early April west of Cascades. **Remarks** Rain is necessary following application for weed control. Use higher rate where deep-rooted, hard-to-kill perennial weeds are dominant. Reduced rates may be used for maintenance retreatment as needed. **Caution** This material has a long soil residual. Do not use in areas where the roots of desirable vegetation may extend.
• dichlobenil Casoron	**Rate** 4 to 8 lb ai/A **Time** Apply during late fall or winter when rain can move the herbicide into the soil. **Remarks** Do not remove old weed growth before applying. Use the 4- to 6-lb ai rate for annual weeds and the higher rate for perennial weeds. To control yellow nutsedge, use 10 to 20 lb ai/A (250 to 500 lb product/A).

	Caution Do not apply on top of frozen soil.
• diquat Diquat or Reglone	**Rate** 0.25 to 0.5 lb ai/A for broadcast treatments, 0.5 to 1 lb ai/A for spot treatment **Time** Apply when weeds are young. **Remarks** Diquat is a contact herbicide that kills only the tops of most perennial weeds. Use 8 to 16 oz of a nonionic surfactant per 100 gal water. **Caution A moderately toxic herbicide that requires protective gear for handling and application.** Do not let spray contact skin, eyes, or clothing. Do not breathe spray mist.
• diuron Karmex DF	**Rate** 4 to 12 lb ai/A **Time** Apply in fall or late winter east of Cascades and in spring west of Cascades. **Remarks** Use higher rates for perennial weed control, lower rates for annual weed control. (Make maintenance applications on areas previously treated at 6 to 8 lb ai/A.) Does not control certain tap-rooted perennial and biennial weeds such as buckhorn plantain, wild carrot, and dandelion
• glyphosate	**Rate** 0.75 to 3.75 lb ae/A **Time** Apply to foliage of actively growing weeds and grasses at growth stage label recommends. **Remarks** Use lower rates for annual weed control, higher rates for perennial weeds. Use enough water carrier for complete coverage but not to the point of runoff. Established perennials may require retreating; glyphosate is highly translocated and has no soil activity. Can be used in wick or wiper equipment as follows: mix 1 gal Roundup in 2 gal water to prepare a 33% solution. Operate equipment no faster than 5 mph. Performance may be improved by reducing speed in areas of heavy weed infestations to ensure adequate wiper saturation. Results may be better with two applications made in opposite directions. **Caution** Rain within 12 hours after application may reduce effectiveness. Do not mow or till before treatment. Do not use glyphosate in galvanized or mild steel tanks.
• glyphosate + 2,4-D Landmaster BW	**Rate** 108 oz product/A or 1% solution for spot spraying **Time** Apply to foliage of actively growing weeds and grasses at growth stage label recommends. **Remarks** For control of labeled annual weeds and suppression of perennials on farmsteads, along fence rows, and in dry ditches. For spot spraying, thoroughly cover target weeds, but do not spray to point of runoff. **Caution** Do not allow spray to drift to desirable vegetation. Control may be reduced if treating stressed plants. Heavy dust on foliage or rain or irrigation within 6 hours after application may reduce effectiveness.
• hexazinone Velpar L or Velpar DF	**Rate** 1 to 3 lb ai/A **Time** Apply before rain to fully activate. Provides some foliar activity. **Remarks** Apply preemergence. Use low rates for annual weed control and high rates for perennial weeds. See label for susceptible weeds, use restrictions, and precautions.
• imazapic	**Rate** 0.063 to 0.188 lb ai/A

Plateau	**Time** Apply before or shortly after annual weeds emerge. For perennial weeds, follow label directions. **Remarks** To control labeled annual and perennial weeds. See label for best time for perennial weeds.
• imazapic + glyphosate Journey	**Rate** 10.7 to 32 oz product/A **Time** Apply preemergence or postemergence to weeds. See label for specific recommendations. **Remarks** Controls many annual, biennial and perennial weeds. Effective on downy brome and medusahead rye.
• imazapyr Arsenal , Contain , or Stalker	**Rate** 0.25 to 1.5 lb ai/A **Time** Apply before or soon after weeds emerge. **Remarks** For postemergence control with residual control of many annual and perennial weed species. Postemergence application to vigorously growing weeds is best in most situations. **Caution** Do not apply where chemical may contact roots of desirable trees or plants.
• isoxaben + trifluralin Snapshot 2.5 TG	**Rate** Consult respective labels. **Time** Apply before weeds germinate. **Remarks** Controls both annual grass and broadleaf weeds. Areas treated should be free of established weeds. Overhead moisture required to move herbicide into soil.
• linuron Lorox	**Rate** 1 to 3 lb ai/A **Time** Apply shortly before weed growth begins or at early seedling stage. **Remarks** For established annual weeds, add surfactant at 2 quarts/100 gal spray mixture. Apply when daily temperatures exceed 70°F and before weeds are more than 8 inches high. Best results are with rain or irrigation within 2 weeks of application. See label about soil types. **Caution** Do not enter treated area for 24 hours after applying unless wearing protective clothing.
• norflurazon Solicam DF or Predict	**Rate** 1.97 to 3.9 lb ai/A **Time** Apply in fall to early spring before weeds germinate. **Remarks** Adjust rates depending on soil texture and organic matter. Mechanically remove or control existing weeds with a suitable postemergent herbicide.
• organic arsenicals MSMA or DSMA	**Rate** See labels. **Time** See labels.

	Remarks These are broad-spectrum contact herbicides with no soil residual activity. Only the tops of most perennial weeds will be killed. Repeated retreatments are necessary. Use 0.25% of a nonionic adjuvant to enhance weed control. **Caution** Application at temperatures below 70°F usually results in poor weed control.
• oryzalin Surflan Specialty Herbicide	**Rate** 2 to 6 lb ai/A **Time** Apply before weeds germinate and when moisture can move herbicide into the soil.
	Remarks Length of control depends on rate applied. If weeds are present at time of treatment, tank-mix with an approved postemergence herbicide.
• paraquat Gramoxone Max , Gramoxone Inteon	**Rate** 0.6375 to 1 lb ai/A (1.7 to 2.7 pints/A Gramoxone Max) or 0.62 to 1 lb ai/A (2.5 to 4 pints/A Gramoxone Inteon) **Time** Apply when weeds are young and succulent.
	Remarks Paraquat is a contact herbicide that kills only the tops of most perennial weeds. Retreatments are necessary. Add a nonionic surfactant or crop oil concentrate as directed on the Gramoxone labels to spray. Use enough water to thoroughly cover weeds. **Caution A restricted-use herbicide.** Do not use around homes or other areas contacted by children or pets. Do not breathe spray mist. Do not let spray contact skin or clothing.
• pendimethalin Pendulum	**Rate** 2 to 4 lb ai/A **Time** Preemergence grass and broadleaf weed control. **Remarks** Will not control established weeds. Treatments are most effective when it rains within 30 days after application. **Caution** Toxic to fish. Do not apply directly to water or to wetlands.
• prometon Pramitol	**Rate** 10 to 15 lb ai/A **Time** Apply at weed emergence or within 2 to 3 months after spring growth begins. **Remarks** Prometon has both foliage and root action and has been one of the most effective broad-spectrum herbicides for organic and alkaline soils. Prometon is formulated as a liquid for spray application and as a granular in combination with simazine, borate, and sodium chlorate for spot application.
• sulfometuron Oust	**Rate** 1 to 6 oz ai/A (1.33 to 8 oz product/A) **Time** Apply preemergence to early postemergence to weeds for nonselective control. Rain required to activate herbicide fully.

	Remarks Controls many annual broadleaf weeds, some grasses, and certain perennial broadleaf species. Rates depend on weed species and desired duration of weed control. The 1-oz ai/A rate can be used to selectively control certain grasses. Add a nonionic surfactant at 1 quart per 100 gal spray to improve activity. **Caution** If rain is limited, Oust may not satisfactorily control hard-to-kill perennials. Do not apply during periods of intense rain or to water-saturated soils. Do not treat powdery, dry soils and light, sandy soils if it's unlikely to rain after treatment. Do not allow spray to drift to adjacent crops.

NONCROPLAND AND RIGHT-OF-WAY—Broadleaf Weed Control

• tebuthiuron Spike 80	**Rate** 1 to 4 lb ai/A **Time** Apply in fall east of Cascades and in spring west of Cascades. **Remarks** Use higher rates for perennial weed control, lower rates for annual weed control and maintenance treatments. **Caution** Spike will kill trees, shrubs, and other forms of desirable vegetation with roots extending into the treated area.
• aminopyralid Milestone	**Rate** 0.75 to 1.75 oz ae/A (3 to 7 fl oz/A Milestone) **Time** Apply to actively growing weeds. Consult label for specific weeds. **Remarks** Effective on knapweeds, biennial thistles, Canada thistle, perennial sowthistle, horseweed (marestail) and hawkweed. A nonionic surfactant at 1 to 2 quarts per 100 gal of spray will enhance control under adverse environmental conditions. Application rate depends on weed species and stage of growth. **Caution** Do not allow drift to desirable vegetation. Do not apply more than 7 fl oz/A Milestone per year.
• bromoxynil Buctril	**Rate** 0.25 to 0.5 lb ai/A **Time** Postemergent, when weeds are actively growing. **Remarks** Apply to broadleaf weeds before four-leaf stage or less than 2 inches high or 1 inch in diameter, whichever comes first. Adding surfactant or crop oil concentrate may improve broadleaf weed burndown under cool, dry conditions. **Caution** Do not allow grazing in treated areas. Do not apply through backpack or hand-held application equipment.
• chlorsulfuron Telar	**Rate** 0.75 to 2.25 oz ai/A (1 to 3 oz product/A) **Time** Apply preemergence or postemergence to weeds. For best results apply postemergence to young actively growing weeds any time except when ground is frozen. **Remarks** Adequate moisture (rain) is needed to activate herbicide. In postemergence applications, a nonionic surfactant must be added at 1 quart/100 gal spray.

	Caution Agitation is required. Do not apply to soils saturated with moisture or during periods of intense rain. Degree of control and duration of effect varies with amount of chemical applied, soil texture, soil pH, soil organic matter, weed size, rain, and other factors.
• clopyralid Transline	**Rate** 0.09 to 0.5 lb ae/A **Time** After weeds have emerged and, depending on species, up to bud stage. **Remarks** Effective on weeds in the Asteraceae (sunflower), Polygonaceae (knotweed), and legume families. Plants should be actively growing at time of treatment. Wet foliage at time of treatment may decrease control. **Caution** Do not contaminate irrigation ditches or water for irrigation or domestic use. Do not allow spray draft to contact potatoes, beans, or certain other crops.
• clopyralid + 2,4-D Curtail	**Rate** 2 to 4 quarts/A Curtail **Time** Apply after most knapweed rosettes have emerged but before flower stem elongates. Apply to Canada thistle before bud stage. **Remarks** Effective on diffuse and spotted knapweed and Canada thistle. Also controls many other weeds in the composite and legume families. **Caution** Do not contaminate irrigation ditches or water for irrigation or domestic use. Do not allow spray drift to contact potatoes, beans, or certain other crops.
• dicamba Banvel , Trooper , Vanquish , or Clarity	**Rate** 0.25 to 2 lb ai/A **Time** Apply to actively growing vegetation. **Remarks** Controls many annual and perennial broadleaf weed species as well as brush. Other herbicides often are combined and sold under a variety of trade names. Consult label for rates, times of application, use restrictions, and preparations for each of these proprietary mixtures. **Caution** Do not use in areas where roots of desirable vegetation may extend.
• difluenzopyr + dicamba Overdrive	**Rate** 0.175 to 0.35 lb ae/A (4 to 8 oz product/A) **Time** Apply to actively growing broadleaf weeds. **Remarks** Controls many annual, biennial, and perennial broadleaf weeds and vine species, including biennial thistle, Canada thistle, kochia, and marestail (horseweed). Rate depends on weed species and growth stage at time of treatment. For improved uptake, use a nonionic surfactant or a methylated seed oil on hard-to-control perennials and waxy-leaf species or when weeds are under moisture or temperature stress. **Caution** Do not plant any crop within 30 days of application. Do not apply more than 10 oz product/A per season.
• fluroxypyr Vista	**Rate** 0.125 to 0.5 lb ae/A **Time** Apply when weeds are small and/or actively growing.

	Remarks Apply in spray volume of 3 gal/A or more by air or 5 gal/A or more by ground. Do not exceed 40 gal/A total spray volume. Spot treatments may be applied with a calibrated boom or hand sprayer. Only weeds emerged at time of treatment are controlled. Control may decrease if foliage is wet at time of application. Grasses are tolerant of fluroxypyr, but larger kochia is effectively controlled. **Caution** Do not apply when weather conditions favor drift from treated areas. Do not apply more than 0.5 lb ae/A (2.67 pints product/A) per year.
• isoxaben Gallery	**Rate** 0.5 to 1 lb ai/A **Time** Apply before germination. **Remarks** Areas to be treated should be free of established weeds before application.
• MCPA several products	**Rate** 3 lb ai/A **Time** Spray to wet weeds thoroughly when in bud to early bloom and again on fall regrowth. **Remarks** Controls Canada thistle, whitetop, and meadow buttercup. **Caution** Do not cut forage or graze livestock on treated areas within 7 days of treatment.
• metsulfuron Escort	**Rate** 0.3 to 1.8 oz ai/A (0.5 to 3 oz product/A) **Time** For best results, apply postemergence to young, actively growing weeds or brush. Selective to many grasses. May combine with other products to broaden weed-control spectrum. **Remarks** For postemergence applications, include a nonionic or silicone surfactant at 0.25% by volume. Good coverage is essential for control. **Caution** Agitation required. Do not let spray drift to crops or other valuable plants or trees.
• picloram Tordon	**Rate** 0.125 to 1 lb ae/A **Time** Apply to foliage of actively growing weeds and brush. **Remarks** Picloram has soil residual activity. It is formulated in several mixtures including combinations with 2,4-D. **Caution Most formulations are restricted.** Follow all use restrictions and precautions on label.
• quinclorac Paramount	**Rate** 4 to 6 oz ai/A (5. 3 to 8 oz product/A) **Time** Apply to actively growing weeds. **Remarks** Timing and rate of application depends on weeds to be controlled. Has activity on field bindweed, leafy spurge, sowthistle, Canada thistle, and clovers. Must add methylated seed oil at 1 to 2 pints/A or crop oil concentrate at 2 pints/A. Plant uptake is through both the foliage and roots. Rain after application is important for soil uptake.

	Caution Do not apply more than 12 oz ai/A per calendar year. Do not allow to drift to sensitive crops. Do not apply to water or to irrigation ditches or areas that channel water entering cropland.
• triclopyr Garlon	**Rate** 1 to 8 lb ae/A **Time** Apply when woody plants and weeds are actively growing. The ester formulation may be used in the dormant season. See label for instructions. **Remarks** Controls certain perennial broadleaf weeds and woody plants. Rates depend on weed species, stage of maturity, and environmental conditions. If using lower rates on hard-to-control species, they may resprout a year later. **Caution** See label for grazing restrictions.
• triclopyr + 2,4-D Crossbow	**Rate** 1 quart to 4 gal product/A, depending on weed species **Time** Apply during warm weather when brush and weeds are actively growing. **Remarks** Controls most species of unwanted woody plants as well as annual and perennial broadleaf weeds. **Caution** Application under drought conditions may provide less than desirable results. Use low spray pressures to minimize spray drift. Avoid contacting nearby susceptible crops or other desirable plants. Avoid contaminating water for irrigation or domestic use. Do not use or store near heat or open flame.
• triclopyr + clopyralid Redeem R&P	**Rate** 1.5 to 4 pints product/A, depending on species and on target weed's size and growth stage **Time** Apply when broadleaf weeds are actively growing. **Remarks** Controls many herbaceous broadleaf weeds. Add nonionic surfactant at the surfactant manufacturer's recommended rate. Apply in at least 10 gal/A water by ground. The smaller the annual weeds, the easier they are to control. Spray biennial species in the seedling to rosette stage, before flower stalks are apparent. **Caution** Do not apply more than 4 pints product/A per year. Do not allow drift to desirable vegetation. Avoid application under completely calm conditions which may be conducive to air inversions. Do not apply to newly seeded areas until grass is well established. Injures or kills forbs and other broadleaf vegetation. Note label restrictions on overseeding or reseeding.
• 2,4-D several products	**Rate** 1 to 4 lb ae/A **Time** Apply when annual weeds are young and growing vigorously. Apply when perennial weeds are growing rapidly—generally, near the bud stage. Repeated applications may be necessary. **Remarks** Controls many annual, biennial, and perennial broadleaf weeds. **Caution** Do not apply when conditions favors drift from treated areas. Do not contaminate water for irrigation or domestic use.

PNW Weed Management Handbook is available at http://pnwpest.org/pnw/weeds.

General Prevention Measures for Mitigation

Potential general prevention measures for all weeds species moved by equipment at the construction site are outlined with specific suggestions for contractor and Idaho Department of Transportation partnerships to reduce or prevent the spread of weeds.

Early Detection and Rapid Response

Plant surveys along the highway corridor should be undertaken every 3 to 5 years in order to detect newly invading species. Lengths of road corridor adjacent to Palouse Prairie (within the 0.6 miles buffer identified in Figures 3 to 6) should be prioritized for survey. Surveys should be conducted by individuals who have botanical training and can recognize plants new to the region. Additional areas to prioritize for survey would be areas that receive periodic to frequent disturbance such as points of entry to agricultural fields that connect to the highway. Should new infestations be found they should be eradicated.

General Weed Prevention Practices for Road Construction Projects

Incorporate weed prevention and control into project layout, design, alternative evaluation, and project decisions.

Practice 1. Environmental analysis for construction projects will need to assess weed risks, analyze potential treatment of high-risk sites for weed establishment and spread, and identify prevention practices. Determine prevention and maintenance needs, to include the use of herbicides, if needed, at the onset of project planning.

Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds.

Practice 2. Before ground-disturbing activities begin, inventory and prioritize weed infestations for treatment in project operating areas and along access routes. Identify what weeds are on site, or within reasonably expected potential invasion vicinity, and do a risk assessment accordingly. Control weeds as necessary.

Practice 3. After completing "Practice 2" above, to reduce risk of spreading weed infestations, begin project operations in uninfested areas before operating in weed-infested areas.

Practice 4**.** Locate and use weed-free project staging areas. Avoid or minimize all types of travel through weed-infested areas, or restrict to those periods when spread of seed or propagules is least likely.

Practice 5**.** Determine the need for, and when appropriate, identify sites where equipment can be cleaned. Clean equipment before entering the construction site;

an ITD Inspector, in coordination with the ITD Vegetation Manager, needs to approve use of on-site cleaning locations in advance. This practice does not apply to service vehicles traveling frequently in and out of the project area that will remain on the roadway. Seeds and plant parts need to be collected when practical and taken to the landfill transfer station or incinerated. Remove mud, dirt, and plant parts from project equipment before moving it into a project area. Resources for vehicle washing can be found at http://www.fs.fed.us/eng/pubs/pdf/05511203.pdf and www.interclean.com.

Practice 6. Clean all equipment, before leaving the construction site, if operating in areas infested with weeds. Determine the need for, and when appropriate, identify sites where equipment can be cleaned. Seeds and plant parts need to be collected when practical and taken to the landfill transfer station or incinerated.

Practice 7. Workers need to inspect, remove, and properly dispose of weed seed and plant parts found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and taking them to the landfill transfer station or incinerating them.

Practice 8. Coordinate project activities with any nearby herbicide application to maximize cost effectiveness of weed treatments.

Practice 9. Evaluate options, including closure, to regulate the flow of traffic on sites where desired vegetation needs to be established. Sites could include road and trail rights-of-way, and other areas of disturbed soils.

Prevent the introduction and spread of weeds caused by moving infested sand, gravel, borrow, and fill material on the construction site, ITD and contractor.

Practice 10. Inspect material sources on site, and ensure that they are weed-free before use and transport. Treat weed-infested sources for eradication, and strip and stockpile contaminated material before any use of pit material.

Practice 11. Annually inspect and document the area where material from treated weed-infested sources is used for at least three years after project completion, to ensure that any weeds transported to the site are promptly detected and controlled.

Practice 12. Maintain stockpiled, uninfested material in a weed-free condition.

In those vegetation types with relatively closed canopies, retain shade to the extent possible to suppress weeds and prevent their establishment and growth.

Practice 13. Retain native vegetation in and around project activity to the maximum extent possible consistent with project objectives.

Avoid creating soil conditions that promote weed germination and establishment.

Practice 14. Minimize soil disturbance to the extent practical, consistent with project objectives.

Where project disturbance creates bare ground, consistent with project objectives, re-establish vegetation to prevent conditions to establish weeds.

Practice 15. Revegetate disturbed soil (except travelways on surfaced projects) in a manner that optimizes plant establishment for that specific site. Define for each project what constitutes disturbed soil and objectives for plant cover revegetation.

Practice 16. Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching as necessary. Use native material where appropriate and feasible. Use certified weed-free or weed-seed-free hay or straw where certified materials are required and/or are reasonably available. Always use certified materials in areas closed by ITD order. Where practical, stockpile weed-seed-free topsoil and replace it on disturbed areas (e.g. road embankments or landings)

Practice 17. Use local seeding guidelines to determine detailed procedures and appropriate mixes. To avoid weed-contamination, a certified seed laboratory needs to test each lot against the all-State noxious weed list to Association of Seed Technologists and Analysts (AOSTA) standards, and provide documentation of the seed inspection test. There are plant species not on State and Federal noxious weed lists that the ITD would consider non-native invasive weeds. Check State and Federal lists to see if any local weeds need to be added prior to testing. Seed lots labeled as certified weed free at time of sale may still contain some weed seed contamination. Non-certified seed should first be tested before use.

Practice 18. Inspect and document all limited term ground-disturbing operations in noxious weed infested areas for at least three (3) growing seasons following completion of the project. For on-going projects, continue to monitor until reasonable certainty is obtained that no weeds have occurred. Provide for follow-up treatments based on inspection results.

Improve effectiveness of prevention practices through weed awareness and education.

Practice 19. Provide information, training and appropriate weed identification materials to people potentially involved in weed introduction, establishment, and spread on the construction site, including project managers, employees, surveyors, inspectors, and visitors. Educate them to an appropriate level in weed identification, biology, impacts, and effective prevention measures.

Practice 20. Provide proficient weed management expertise at the construction site. Expertise means that necessary skills are available and corporate knowledge is maintained.

Practice 21. Develop incentive programs encouraging weed awareness detection, reporting, and for locating new invaders.

Set the example; maintain weed-free administrative sites.

Practice 22. Treat weeds at the construction site and use weed prevention practices to maintain sites in a weed-free condition.

Guidelines for General Weed Prevention Practices for Contractors and Equipment when establishing contracts.

CLEAN EQUIPMENT. The contractor shall ensure that prior to moving on to the construction site all off-road equipment is free of soil, seeds, vegetative matter, or other debris that could contain or hold seeds. The contractor shall certify in writing that off-road equipment is free of noxious and invasive weeds of concern prior to start-up operations and for subsequent moves of equipment to Construction Area. The certification shall indicate the measures taken to ensure that off-road equipment is free of invasive weeds. "Off-road equipment" includes dirt moving, packing and rollers, paving and construction machinery, except for service vehicles, water trucks, pickup trucks, cars, and similar vehicles. A current list of invasive weeds of concern is listed in this EIS. A current list of State Noxious weeds is posted at http://www.agri.state.id.us/Categories/PlantsInsects/NoxiousWeeds/watchlist.php .

The contractor must clean off-road equipment prior to moving between sites that are known to be infested with noxious and invasive weeds and other sites, if any, that are free of such weeds. Area Map shows areas, known by ITD prior to construction bid advertisement, that are infested with specific noxious weed species of concern.

The contractor shall employ whatever cleaning methods are necessary to ensure that off-road equipment is free of noxious and invasive weeds. Equipment shall be considered free of soil, seeds, and other such debris when a visual inspection does not disclose such material. Disassembly of equipment components or specialized inspection tools is not required.

Contractor shall notify ITD at least 5 days prior to moving each piece of off-road equipment on to the Construction Site, unless otherwise agreed. Notification will include identifying the location of the equipment's most recent operations. If the prior location of the off-road equipment cannot be identified, ITD may assume that it was infested with

noxious and invasive weed seeds. Upon request of ITD, the contractor must arrange for ITD to inspect each piece of off-road equipment prior to it being placed in service.

If the contractor desires to clean off-road equipment on the construction site land, such as at the end of a project or prior to moving to a new site that is free of noxious weeds, the contractor and ITD shall agree on methods of cleaning, locations for the cleaning, and control of off-site impacts, if any.

New infestations of noxious weeds, of concern to ITD and identified by either the contractor or ITD on the construction site, shall be promptly reported to the other party. The contractor and ITD shall agree on treatment methods to reduce or stop the spread of noxious weeds when new infestations are found. In the event of contract modification under this Subsection, the contractor shall be reimbursed for any additional protection required, provided that any work or extra protection required shall be subject to prior approval by ITD. Amount of reimbursement shall be determined by ITD and shall be in the form of a reduction final payment, unless agreed otherwise in writing.

INSTRUCTIONS: Include in all new contracts.

The ITD identifies on the area maps the known infestations of specific weeds species of concern.

The request for bid must notify prospective contractors that maps of these known locations are available from the local ITD Office or State ITD Office. A list of noxious and invasive weeds of concern to the ITD included in the Noxious Weed Program Guide) would be available for the contractor's inspection. The current Idaho Noxious Weed Program Guide, noxious and invasive weed atlas, or other data sources, as needed, will be used to determine locations of known infestation.

Significant changes in the status of invasive weed infestations on the construction site may require contract modifications to deal with changed conditions. An example might be where new noxious weed infestations are discovered after contract award, which require costly additional methods to prevent the spread of such infestations.

Conclusion

Regardless of the route selected weeds will invade the site before desirable vegetation can establish. Based on the analysis provided in this report the area of impact for direct effects will be where the soil is disturbed by construction and indirect effects and cumulative effects could extend 0.6 miles from the new highway for most weed species. Areas extending east of the road may have a slightly elevated risk of invasion by wind dispersed species like tumble mustard, prickly lettuce, and Canada thistle beyond 0.6 miles. The 0.6 miles area is identified as the zone adjacent to the highway construction and operation that has a high probability of being invaded by noxious and invasive weeds

that are present or may move to the corridor during construction and use of the new highway. Reducing the amount of disturbance and establishing competitive vegetation along the new road will be key to reducing the impact of invasive weeds on adjacent lands. Hopefully in some small measure the number of introductions and their potential spread to critical prairie remnants can be reduced by implementing prevention, monitoring and mitigation plans.

Literature Cited

Braithwaite, R.W., W. M. Lonsdale, and J. A. Estbergs. 1989. Alien vegetation and native biota in tropical Australia: the spread and impact of Mimosa pigra. Biological Conservation 48(3): 189-210.

Gelbard, J. L. And S. Harrison. 2005. Invasibility of roadless grasslands: An experimental study of yellow starthistle. Ecological applications 15:1570-1580.

Kalin M. T., C. Marticorena, O. Matthei and L. Caviers. 2000. Chapt. 16 Plant Invasions in Chile: Presen Patterns and Future Predictions. Mooney, H. A. and R. J. Hobbs (Eds.) 2000. *Invasive Species in a Changing World.* Island Press, Washington DC. p. 385-421.

Lonsdale, W.M. 1999. Global patterns of plant invasions and the concept of invisibility. Ecology 80: 1522-1536.

Noss, R. F., E. T. LaRoe, and J. M. Scott. 1995. Endangered ecosystems of the United States: a preliminary assessment of loss and degradation. US National Biological Service Biological Report 28.

Parendes, L.A., and J. A. Jones. 2000. Role of light availability and dispersal in exotic plant invasion along roads and streams in the J. J. Andrews Experimental Forest, Oregon. Conservation Biology 14: 65-75.

Rejmanek, M. And M.J. Pitcaim. 2002. When is eradication of exotic pest plants a realistic goal? In Turning the tide: the eradication of invasive species. Ed. Veitch C. R. And M. N. Clout. INCN SSC Invasive Species Specialist Group, Gland Switzerland and Cambridge, UK pp. 249-253.

Rew, L. J. and B. D. Maxwell. 2006. Stratified Random Sampling Method., In *Inventory and Survey Methods for Nonindigenous Plant Species.* Ed. Rew, L.J. and M. L. Pokorny, Montana State University, pp. 49-55.

Rew, L. J., B. D. Maxwell, and R. J. Aspinall. 2005. Predicting the occurrence of nonindigenous species using environmental and remotely sensed data. Weed Sci. 53:236-241.

Rew, L. J., B. D. Maxwell, R. J. Aspinall, and F. L. Dougher. 2006. Searching for a needle in a haystack evaluating survey methods for sessile species. Biology of Invasions 8(3):523-539.

Rew, L. J., B. D. Maxwell, R. Aspinall, T. W. Weaver, and D. G. Despain. Undated. Chapter 6: Yellow stone: An inventory Case Study: Development of a sampling methodology to create an inventory for non-native weeds within the northern range of Yellowstone National Park. Invasive Plant Management section of the CIPM online textbook. http://www.weedcenter.org/textbook/6_rew_yellowstone.html#refs

Soons, M. B., G. W. Heil, R. Nathan, G. G. Katul. 2004. Determinants of long-distance seed dispersal by wind in grasslands. Ecology 85: 3056-3068.

Tackenberg, O. 2003. Modeling long-distance dispersal of plant diasporas by wind. Ecological Monographs 73:173-189.

Weddell, B. J., and J. Lichthardt. 1998. Identification of conservation priorities for and threats to Palouse grassland and canyon grassland remnants in Idaho, Washington.