

**MONITORING MALHEUR PRINCE'S PLUME
(*STANLEYA CONFERTIFLORA*) ON
BUREAU OF LAND MANAGEMENT LANDS
IN SOUTHWESTERN IDAHO:
BASELINE RESULTS, 2005**



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ABSTRACT

Malheur prince's plume (*Stanleya confertiflora*) is a showy biennial forb in the mustard family (Brassicaceae) endemic to eastern Oregon and adjacent southwestern Idaho. It is a Type 2 Idaho Bureau of Land Management (BLM) special status plant species, and on the Oregon BLM sensitive species plant list as well. In 2005, the Boise District BLM contracted the Idaho Department of Fish and Game's Idaho Conservation Data Center to establish a monitoring program for the five Malheur prince's plume occurrences located on Idaho BLM land. The objective of the monitoring program is to collect occurrence scale plant abundance, habitat, and disturbance trend information to assist resource managers in conservation efforts for Malheur prince's plume. The 2005 results found Malheur prince's plume abundance to vary greatly between occurrences, and that in a given year, different sites can be characterized by nearly all reproductive plants, all rosette plants, or a mix of the two life stages. Most transects had no or minimal amounts of cattle, wildlife, or off-road vehicle surface disturbance. All transects had one or more introduced annual weed species, but total weed cover was <10%. However, introduced grass species dominated Malheur prince's plume habitat at one of the Coal Mine Basin plots. A substantial amount of motorcycle use was found to be taking place within and around occupied Malheur prince's plume habitat at the Rye Patch North occurrence. The extent and abundance of this disturbance makes this occurrence the one most in need of immediate management attention. Regular monitoring is recommended to ensure managers are kept apprised of plant abundance and habitat trends, the status of disturbances and threats, and to evaluate whether directed management actions are effective. The 2005 monitoring dataset serves as a baseline to compare and evaluate future Malheur prince's plume monitoring results.

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INTRODUCTION

Malheur prince's plume (*Stanleya confertiflora*) is a biennial forb in the mustard family (Brassicaceae) 2-10 dm (8-39 in) tall with a showy, dense, elongated raceme of yellow (Figure 1) or cream-colored flowers (Figure 2). Plants are further distinguished by their glabrous, glaucous, nearly succulent foliage, sessile basal leaves, and clasping stem leaves. It is endemic to eastern Oregon and adjacent southwestern Idaho, with widely scattered occurrences (Element Occurrences) distributed over an approximately 385 km (240 mi) long x 160 km (100 mi) wide area. Extant occurrences are infrequent, local in extent, and typically contain a low number of plants (Mancuso 1997, Geertson 1999). In Idaho, Malheur prince's plume is known from a total of eight occurrences, located in Gooding, Owyhee, and Washington counties (Figure 3; Idaho Conservation Data Center 2005). Five of the Idaho occurrences are located on Bureau of Land Management (BLM) land. The others are on private land in close proximity to BLM property.

In Idaho, Malheur prince's plume tends to occur on open, relatively sparsely vegetated, flat to steep northerly-facing exposures of clay soil within the shrub-steppe ecosystem. Monitoring and research in Oregon has begun to shed light on the life history and ecology of Malheur prince's plume (Gisler and Meinke 2002, Meinke 2005). It is clear the species is a biennial and that above-ground numbers fluctuate between years. It also appears there are years where populations consist mostly of flowering, reproductive individuals, and alternate years where most plants are non-reproductive rosettes (Meinke 2005).

All Idaho occurrences of Malheur prince's plume are vulnerable to one or more threat factors. Habitat decline associated with weed invasion is probably the most widespread threat. Off-road-vehicle (ORV) use, livestock grazing disturbances, and mining activity have all been identified as existing or potential threats at one or more occurrences (Mancuso 1997). In addition, several occurrences are located in patches of native habitat fragmented by surrounding agricultural lands. Malheur prince's plume is a priority conservation concern for the BLM in both Idaho and Oregon because of its rarity and vulnerability to existing or potential threats. It is a Type 2 Idaho BLM special status plant species, and on the Oregon BLM sensitive species plant list. Malheur prince's plume has a NatureServe global conservation rank of G1, implying the species is critically imperiled rangewide because of rarity or some factor of its biology making it especially vulnerable to extinction (NatureServe 2005).

In 2005, the Boise District BLM contracted the Idaho Department of Fish and Game's Idaho Conservation Data Center (IDCDC) to establish a monitoring program for Malheur prince's plume occurrences on BLM land in southwestern Idaho. Monitoring is an essential component of an effective species management program (Owen and Rosentreter 1992). It provides a way to measure the effects of management actions and assess whether the response of target species and communities are consistent with conservation objectives (Menges and Gordon 1996). The objective of the Malheur prince's plume monitoring program is to collect occurrence scale population, habitat, and disturbance factor trend information. This information will assist BLM resource managers in their efforts to ensure the long-term conservation of Malheur prince's plume on lands they administer. Transects were established at all five Malheur prince's plume occurrences located on Idaho BLM land and this report summarizes the monitoring protocol and results for baseline data collected in 2005.

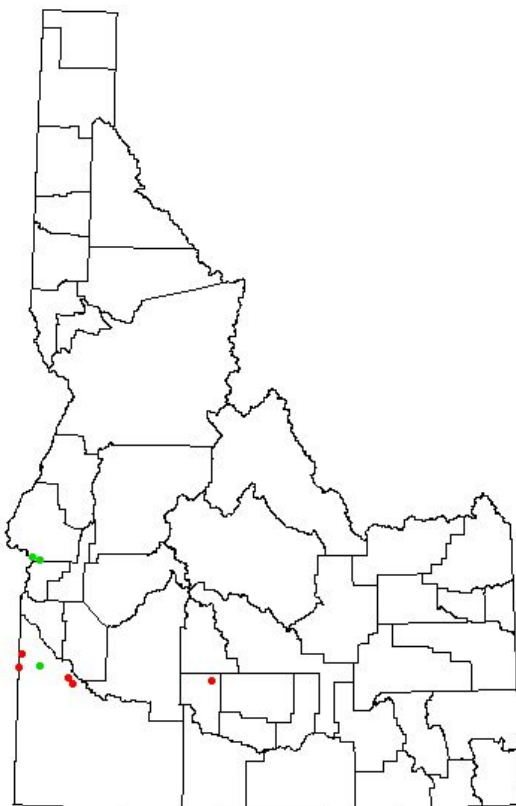
Figure 1. Malheur prince's plume with inflorescence of yellow flowers. Photo taken at the East of Little City of Rock occurrence



Figure 2. Malheur prince's plume with inflorescence of cream-colored flowers. Photo taken at the Coal Mine Basin occurrence.



Figure 3. Distribution of Malheur prince's plume in Idaho. Red occurrences included in the monitoring program. Green occurrences not included in the monitoring program.



METHODS

The monitoring protocol consisted of five main components: (1) the collection of Malheur prince's plume census information using distance or macroplot sampling techniques, (2) a reconnaissance to assess overall disturbances and threats to the occurrence or subpopulation, (3) a belt transect to collect and quantify disturbance factor information, (4) a belt transect to collect and quantify plant community information, and (5) photo point photographs to help document transect and surrounding landscape features. The Malheur prince's plume census macroplot area and the two belt transects collectively made up the monitoring plot.

Information and maps contained in the IDCDC Element Occurrence Record (EO Record) database were used to help relocate occurrences in the field (Idaho Conservation Data Center 2005). A reconnaissance was conducted at each occurrence to determine the distribution of Malheur prince's plume in the general area. Monitoring transects were subjectively located in areas where Malheur prince's plume plants were relatively abundant to ensure adequate sampling. The protocol design attempts to minimize researcher disturbance to habitat occupied by Malheur prince's plume. The census part of the protocol takes advantage of the plant's showiness and the relatively limited, localized extent of most occurrences or subpopulations. Portions of the protocol are similar to methods used to monitor Mulford's milkvetch (*Astragalus mulfordiae*), another BLM special status plant species occurring in southwestern Idaho (Mancuso and Miller 2004). Protocols for each component of the monitoring program are outlined below.

Malheur prince's plume census

Distance sampling method: A distance sampling method (Buckland et al. 2001) is used to collect Malheur prince's plume census (abundance and life stage) information at occurrences located on steep clay-ash slopes to minimize researcher disturbance on these erosive sites. A baseline transect tape that provides a good visual overview of the occurrence or subpopulation is established along the base of (below), the rim of (above), or through (center) the area to be sampled. Baseline length is a minimum of 20 m, but varies depending on the size of the area occupied by Malheur prince's plume. A red-painted rebar stake "permanently" marks the location and starting point for the transect. A large metal spike references the end point.

The protocol requires two people. The person observing Malheur prince's plume walks along the baseline tape starting from the transect's 0 m mark and holds the 0 m end of a second measuring tape. The second person walks a parallel path outside occupied habitat above or below the Malheur prince's plume outcrop holding the far end of the second measuring tape. Life stage information is recorded for each individual or cluster of Malheur prince's plume observed by the person walking the baseline. Plants are assigned to either the reproductive or rosette life stage class. Plants with flowers or fruits are reproductive, while those consisting of a set of basal leaves and no inflorescence are rosettes. The distance (to the nearest 0.1 m) from the baseline tape to each Malheur prince's plume individual or cluster is also recorded. This measurement is acquired using the second tape positioned perpendicular to the baseline. If needed, binoculars are used to help read the tape measurement. A "cluster" is defined as two or more Malheur prince's plume plants of the same life stage located within 0.5 m of each other. The mid-point of the cluster is the distance recorded. Life stage and distance information is recorded separately for reproductive and rosette plants occurring <0.5 m from each other. The size of the macroplot sample area is acquired using either GPS (a polygon can be generated by taking a series of readings around the perimeter of the sample area), or by simply measuring the length and width the sample area using the tapes.

Macroplot method: The macroplot method is used to collect census information at occurrences where tallying Malheur prince's plume plants in a defined sample area can be accomplished without substantial researcher disturbance. Macroplots have a rectangular shape with a baseline along one edge "permanently" marked by a red-painted rebar stake. A large metal spike references the other end of the baseline. The other two corners are temporarily marked with flagging. Every Malheur prince's plume individual within the macroplot is tallied and assigned to the reproductive or rosette life stage class.

Disturbances and threats

Completion of the "*Stanleya confertiflora* general disturbance information" data sheet provides an assessment and summary of ORV, livestock, and other disturbance and management concerns for the entire occurrence (or subpopulation) area. The form is filled out after a reconnaissance of the area. This information supplements the quantified ground disturbance information collected along the baseline transect.

Ground disturbance

The Malheur prince's plume census baseline tape serves as the belt transect for monitoring ground disturbances such as ORV tracks, livestock prints and feces, wildlife tracks, and animal burrows. Disturbance information is sampled within 20 1 m²-microplots. The microplots are sampled at each meter tic, starting at the 1 m mark, for a total of 20 microplots. The microplot frame is placed on the inside edge of the tape (the edge within the census plot). The ground cover of each surface disturbance is estimated and assigned to one of eight modified

Daubenmire method cover classes. The cover of each introduced weed species rooted within the microplot is also estimated and assigned to one of the cover classes. Total ground disturbance and total weed cover class values are also assigned for each microplot. The modified Daubenmire method cover classes are:

1 = <1% cover; 2 = 1 - 4.9% cover; 3 = 5 - 9.9% cover; 4 = 10 – 24.9% cover; 5 = 25 – 49.9% cover; 6 = 50 – 74.9%; 7 = 75 – 94.9%; 8 = 95 – 100%.

Plant community

Plant community information is collected along a 20 m long transect using the rebar marker stake as the start point. The transect azimuth is randomly selected (the only caveat is that the transect does not pass into an area that would result in researcher disturbance of occupied Malheur prince's plume habitat). Shrub cover by species is measured using the line intercept method (Bonham 1989). The distance (cm) each shrub intercepts above or below the tic side of the transect line is recorded. Using a plumb improves sampling consistency and accuracy. Herbaceous cover by species is measured using a 20 x 50-cm Daubenmire microplot, with the 20 cm side aligned flush against the tic side of the tape. Ten microplots are sampled, starting at the 2 m mark and ending at 20 m. The cover class of each herbaceous species rooted within the microplot is estimated and assigned one of the Daubenmire cover class values. Ground cover values are also assigned for bare ground, litter, microbotic crust, rock/gravel, and wood.

Photo points

Photo point photographs provide a visual, time-lapse record of the vegetation and other habitat characteristics for each monitoring site. Repeat photo monitoring is useful to document site-specific change or lack of change to landscape features of interest (Hall 2001). Photographs are taken using a digital camera set to wide angle. The transect rebar marker stake serves as the reference point (the photo point) for taking the photos. The photo point series is comprised of a minimum of six photographs, including two photos of the transect and four others providing a panorama of the surrounding landscape. One transect photo is taken along the transect azimuth while standing 3 m behind the rebar marker stake. The other transect photo is taken along the back azimuth standing 3 m behind the end stake. Photos taken at 0⁰, 90⁰, 180⁰, and 270⁰ azimuths provide a panoramic overview of the surrounding landscape. Including the skyline makes it easier to compare photos taken different years. Additional photos to show the rebar marker stake, disturbances, or landmark landscape features are optional.

Transect azimuth, any deviations from the protocol, and other sampling information are summarized in Appendix 1. UTM coordinates obtained with a navigation grade (Garmin 12XL) GPS unit at each transect marker stake are also listed in Appendix 1. The map location for each transect is in Appendix 2. Appendix 3 includes directions, sketch map, landmarks, and other information to help relocate transects in the future. Each transect is labeled and identified using its EO Record number. A declination of 16⁰ was used for all protocol azimuths.

RESULTS

Monitoring was conducted May 27 – June 16, 2005, with plots established at each of the five known Malheur prince's plume occurrences located on Idaho BLM land. A total of seven plots were established, including two occurrences with two plots. Table 1 lists the occurrences included in the monitoring program. Reconnaissance and collection of GPS reading portions of the monitoring protocol provided an opportunity to verify, or in several cases adjust and improve the accuracy of the map location for each occurrence and to update habitat and other general information. Updated EO Records for the five Malheur prince's plume occurrences included in

the monitoring program are in Appendix 4, with maps showing the location of each occurrence in Appendix 5.

Table 1. Malheur prince's plume occurrences included in the monitoring program, 2005.

EO #	Occurrence name	USGS quadrangle	Legal description
3	Rye Patch North	Sinker Butte	T3S R1E S30 T3S R1W S25
4	Dead Horse Creek	Piute Butte	T1S R5W S18
6	East of Little City of Rocks	McHan Reservoir	T3S R15E S28
7	Rye Patch South	Oreana	T4S R1E S7
8	Coal Mine Basin	Sheaville	T2S R6W S35

Malheur prince's plume census – A total of 728 Malheur prince's plume were tallied at the 7 monitoring plots. One Coal Mine Basin plot accounted for slightly more than half (51%) of all plants tallied. The number of plants/plot ranged from 7 to 369. More than two-thirds (68%) of the plants were reproductive. Plots tended to be dominated by one life stage class, but a mix of both reproductive stems and non-reproductive rosettes was observed at two plots.

The macroplot method was used to tally Malheur prince's plume abundance and life stage information at four plots. Plants were tallied by walking in a small drainage pathway at the base (along the baseline) and a parallel route at the top of the slope for plot 3-1. Plants were tallied by walking along the baseline in a small drainage pathway that bisected plot 7-1. Plants were tallied by walking through occupied habitat for plots 6-1 and 8-1. Malheur prince's plume census information for the other three plots was collected using distance sampling methods to minimize researcher disturbance on erosive slopes. Distance data were analyzed using Distance Version 4.1 Release 2 to estimate the abundance of Malheur prince's plume (Thomas et al. 2003). Transect length was halved for analysis purposes for plots 4-1 and 8-2 because distance sampling measurements were taken from only one side of the baseline tape. Probability curves for detecting Malheur prince's plume at each of the three plots are in Figure 4 (page 13). Census data for 2005 are summarized in Table 2. Table 3 summarizes distance analysis data results. Copies of 2005 census information field data sheets are in Appendix 6.

Table 2. Malheur prince's plume census monitoring data, 2005.

Occurrence	Plot #	Type of sampling	Area (m ²)	# of plants	# plants by stage class (%)	
					Reproductive	Rosette
Rye Patch North	3-1	macroplot	1000	37	1 (3)	36 (97)
Rye Patch North	3-2	distance	640	115	37 (32)	78 (68)
Dead Horse Creek	4-1	distance	250	55	29 (53)	26 (47)
E Little City Rocks	6-1	macroplot	735	49	49 (100)	0
Rye Patch South	7-1	macroplot	1000	96	1 (1)	95 (99)
Coal Mine Basin	8-1	macroplot	450	7	7 (100)	0
Coal Mine Basin	8-2	distance	1500	369	369 (100)	0
Total				728	493 (68)	235 (32)

Table 3. Estimated abundance of Malheur prince's plume using distance sampling method, 2005.

Plot	Life stage	N ¹	AIC ²	ESW ³ (m)	LCL (95%) ⁴	UCL (95%) ⁵	Traditional count ⁶
Rye Patch North (3-2)	Repro.	30	131	8.7	19	56	37
Rye Patch North (3-2)	Rosette	43	175.8	7.7	48	127	78
Dead Horse Creek (4-1)	Repro.	19	95.4	11.6	15	60	29
Dead Horse Creek (4-1)	Rosette	14	71.6	12.0	11	60	26
Coal Mine Basin (8-2)	Repro.	167	1080	27.4	156	389	369

N¹ = number of observations

AIC² = Akaike Information Criterion (used to select model with best fit)

ESW³ = effective strip width

LCL⁴ = lower confidence limit

UCL⁵ = upper confidence limit

Traditional count⁶ = number of Malheur prince's plume plants counted in plot

Disturbance factor transect – Two of the seven transects had no ground disturbance. Minor amounts (<1% or 1-4.9%) of animal or cattle tracks were recorded at four transects. The highest disturbance cover class was due to researcher footprint disturbance at one transect. ORV or other recreation-related disturbances were not recorded on any transects. All transects had one or more introduced annual weed species present. Cheatgrass (*Bromus tectorum*) was the only weed species recorded at every transect. Introduced grasses had higher cover than introduced forb species, but total introduced weed cover was <10% for all transects. Table 4 summarizes baseline ground disturbance and introduced weed cover information collected in 2005. Cover of disturbance factors and introduced weed species in the table were calculated by summing the cover class mid-points recorded at the 20 microplots comprising each transect, divided by the total number of microplots (20). Appendix 7 has copies of the disturbance factor field data sheets, and a summary tabular spreadsheet.

Table 4. Percent cover of ground disturbances and introduced weed species on Malheur prince's plume monitoring transects, 2005.

EO#	Disturbance factor			¹ Introduced weed species							
	animal tracks	cattle tracks	researcher footprints	Brojap	Brotec	Halglo	Lacser	Lepper	Poabul	Sisalt	Total weed cover
3-1	0.1				0.2	0.1					0.4
3-2			5.1		0.9	0.2	0.03				0.9
4-1					1.0			0.6	0.05		1.1
6-1				5.3	1.0					0.03	6.1
7-1	0.4				0.8	0.2		0.1			0.8
8-1	0.7				2.8						2.8
8-2		0.5		3.3	0.8						3.9

¹Weed species: Brojap = *Bromus japonicus*, Brotec = *Bromus tectorum*, Halglo = *Halogeton glomerata*, Lacser = *Lactuca serriola*, Lepper = *Lepidium perfoliatum*, Poabul = *Poa bulbosa*, Sisalt = *Sisymbrium altissimum*

General disturbance and threat information – Cattle were loafing <100 m from one of the Coal Mine Basin plots (8-2) at the time of sampling. This was the only plot with evidence of recent cattle use. Old cattle feces were present outside the enclosure fence near the other Coal Mine

Basin plot (8-1). Scattered older cattle feces were also observed at or adjacent to all other monitoring plots except for East of Little City of Rocks. In all cases, the amount of feces was indicative of light cattle use within or adjacent to habitat occupied by Malheur prince's plume. Water for livestock is seasonally available from Coal Mine Basin Creek approximately 100 m from one of the monitoring plots (8-2). A stock pond is located roughly 0.7 km from both Coal Mine Basin plots. The nearest water source was estimated to be at least 2 km away for all other occurrences. Livestock salt stations were not observed in the vicinity of any occurrences.

Motorcycle and 4x4 ORV tracks occurred at one of the North of Rye Patch monitoring plots (3-1). Tracks were present in habitat occupied by Malheur prince's plume, but were more prevalent outside of occupied habitat. A frequently used ORV pathway was noted on the gentle, sparsely vegetated slope immediately upslope from the plot (see Appendix 11, photos 9, 10, 18). Motorcycle tracks were also seen <100 m from the second Rye Patch North plot (3-2). A few motorcycle tracks were observed on the barren ash beds and adjacent vegetated hills at the Rye Patch South occurrence, although none were in the monitoring plot (7-1). Mining claim markers were posted within 500 m of the Dead Horse Creek (4-1) and Coal Mine Basin monitoring plots (8-1 and 8-2); however, evidence of recent mining activity was not observed at either occurrence. All of the monitoring plots were within habitat that has not burned in recent years. Burn patches were observed within approximately 1 km of the Coal Mine Basin monitoring plots (8-1 and 8-2). Copies of the general disturbance and threat assessment data sheets are in Appendix 8.

Plant community transect – Plant community data were collected at six monitoring plots (all except Coal Mine Basin plot 8-2). In Idaho, Malheur prince's plume tends to occur on clayey exposures having open, relatively sparse vegetation. Sagebrush-steppe dominates on adjacent zonal soil sites. In most cases, plant community transects were not located directly in habitat occupied by Malheur prince's plume to minimize researcher disturbance to the habitat. Transect sample areas often had higher shrub cover, greater plant diversity, and lower bare ground cover than the adjacent habitat occupied by Malheur prince's plume. A total of 47 vascular plant species were recorded on the plant community transects, including 7 shrubs, 30 forbs, and 10 grasses. Ten of the 40 (25%) herbaceous species are introduced annual weeds. Twenty (50%) of the herbaceous species are annuals, 19 (48%) are perennials, and one (2%), Malheur prince's plume, is a biennial.

Shrub cover ranged from 4% to 20%, with one to three shrub species/transect. Low sagebrush (*Artemisia arbuscula*) and shadscale (*Atriplex confertifolia*) were the only shrubs present on >2 transects. Shrub cover information for each transect is summarized in Table 5. The number of herbaceous species/transect ranged from 2 to 20, with an average of 9. Forbs outnumbered grasses on all transects, and had higher cover on all except one transect. Most herbaceous species (82%) always occurred at <1% cover. Cheatgrass (*Bromus tectorum*) was recorded on 5 transects, the most of any species. Only five other species occurred on 50% or more of the transects. Table 6 summarizes herbaceous plant community sampling information for each transect. Copies of plant community field data sheets are in Appendix 9. Nomenclature for most plant names follows Intermountain Flora (Cronquist et al. 1977, 1984, 1989, 1994, 1997, Holmgren et al. 2003). Common plant names are listed in Appendix 10.

Photo points - Photo point photographs were taken for all plots. A total of 51 digital images were put onto a CD and submitted to the BLM as part of this report. Reproductions of the digital images are in Appendix 11.

Table 5. Shrub cover (%) at Malheur prince's plume monitoring plots, 2005.
Data are based on line intercept method (# of cm intercepted/2000 cm).

Species name	Shrub cover (%)					
	3-1	3-2	4-1	6-1	7-1	8-1
<i>Artemisia arbuscula</i>			2	7		13
<i>Artemisia arbuscula</i> (dead)			1			
<i>Artemisia spinescens</i>		<1				
<i>Artemisia spinescens</i> (dead)		2				
<i>Artemisia tridentata vaseyana</i>			1			<1
<i>Atriplex confertifolia</i>	3	4			16	
<i>Atriplex confertifolia</i> (dead)					4	
<i>Chrysothamnus nauseosus</i>			4			7
<i>Gutierrezia sarothrae</i>	6					
<i>Tetradymia glabrata</i>	11					
Total (live)	20	4	8	7	16	20

DISCUSSION

The monitoring program initiated in 2005 is designed to document long-term trends in Malheur prince's plume persistence and abundance, habitat condition, and disturbances such as cattle use, ORV traffic, and weed invasion. The 2005 baseline results indicate Malheur prince's plume abundance varies greatly between occurrences, and that in a given year, occurrences can have nearly all reproductive plants, all rosette plants, or a mix of the two life stages. Detection probability curves suggest distance sampling is an appropriate sampling technique for Malheur prince's plume plots at Rye Patch South (3-2) and Coal Mine Basin (8-2), but not for Dead Horse Creek (4-1). The detection curve for Dead Horse Creek fails to show a decreasing probability of detecting target plants proceeding further from the baseline. Future census sampling at Dead Horse Creek should use the macroplot method, tallying Malheur prince's plume while walking the baseline and perhaps also a parallel route along the top of the macroplot looking down at the clay-ash exposure. In all cases, the traditional count of Malheur prince's plume plants was captured within the 95% lower and upper confidence limit intervals generated by the distance analysis. An advantage of distance sampling is the acquisition of lower and upper confidence intervals to allow comparisons from different monitoring years to be statistically evaluated.

Introduced weed cover was low at most disturbance factor transects. One exception was at East of Little City of Rocks, where Japanese brome (*Bromus japonicus*) was locally common, although total introduced weed cover did not exceed 10% for the entire transect. The other exception was at one of the Coal Mine Basin plots (8-2), where the transect was not representative of most of the habitat occupied by Malheur prince's plume. The transect area had relatively low introduced weed cover; however, most occupied habitat had high introduced annual grass cover, likely averaging close to 25%, or higher in places. Overall, it was the most weedy of all the monitoring plots, but it also had the largest number of Malheur prince's plume plants. It seems a reasonable assumption that high introduced weed cover can adversely affect the establishment and persistence of Malheur prince's plume. At what level of invasion this may be manifested is not known.

Table 6. Percent cover class average by species for Malheur prince's plume plant community monitoring transects, 2005. Averages calculated by summing the cover class mid-points recorded for each of the 10 transect microplots, divided by the number of microplots (10).

¹ Life form	² Habit	³ Origin	Species name	Plot					
				3-1	3-2	4-1	6-1	7-1	8-1
G	P	N	<i>Agropyron spicatum</i>						0.6
F	P	N	<i>Allium acuminatum</i>						0.15
F	P	N	<i>Allium</i> sp.			0.45			0.1
F	P	N	<i>Antennaria dimorpha</i>			0.3			
F	P	N	<i>Astragalus iodanthus</i>			8.05			
F	A	N	<i>Blepharipappus scaber</i>			0.7			0.1
G	A	I	<i>Bromus japonicus</i>				5.05		0.8
G	A	I	<i>Bromus tectorum</i>	0.35	0.1	0.4	3.9		3.7
F	A	N	<i>Chaenactis macrantha</i>	0.4	0.3				
F	P	N	<i>Cirsium utahense</i>				0.3		
F	A	N	<i>Collinsia parviflora</i>				0.15		0.25
F	A	N	<i>Cryptantha</i> sp.		0.05				
F	A	N	<i>Descurainia incana</i>	0.1	0.35			0.1	
F	A	N	<i>Draba verna</i>			0.15			0.2
G	P	N	<i>Elymus cinereus</i>				0.3		
F	A	N	<i>Epilobium brachycarpum</i>			0.1	0.1		0.2
F	P	N	<i>Erigeron chrysopsidis</i>			0.6			
S	P	N	<i>Eriogonum microthecum</i>			0.3			
F	A	N	<i>Eriogonum salicornoides</i>		0.35				
G	P	N	<i>Festuca idahoensis</i>						8.55
F	A	I	<i>Halogeton glomerata</i>	0.4	7.2				
F	A	I	<i>Holosteum umbellatum</i>			0.05			
F	A	I	<i>Lepidium perfoliatum</i>			0.45			
F	P	N	<i>Lomatium cous</i>			0.45			
F	P	N	<i>Lomatium</i> sp.						0.6
F	P	N	<i>Lomatium triternatum</i>			0.3			
F	A	N	<i>Mentzelia albicaulis</i>	0.7	0.1		0.05	0.9	
F	P	N	<i>Microseris troximoides</i>			0.1	0.05		
F	A	N	<i>Microsteris gracilis</i>				0.05		
F	A	N	<i>Montia linearis</i>			0.15			
F	P	N	<i>Phlox longifolia</i>				16.3		
G	P	I	<i>Poa bulbosa</i>			0.05			
G	P	N	<i>Poa secunda</i>		1.65	4.65			6.5
F	A	I	<i>Ranunculus testiculatis</i>			0.05			
F	A	I	<i>Salsola iberica</i>	0.05					
G	P	N	<i>Sitanion hystrix</i>	0.05		0.3	0.05		0.15
F	B	N	<i>Stanleya confertiflora</i>				0.3		
G	A	I	<i>Vulpia bromoides</i>			1.3			
G	A	I	<i>Vulpia microstachys</i>						0.05
F	P	N	<i>Zigadenus venenosus</i>						
			Bare ground	4.8	54.35	43.5	50.05	77.75	44.35
			Litter	4.9	0.95	2.25	23.65	7.6	13.25
			Microbiotic crust	73.5	34.25	13.7		1.6	23.85
			Rock/gravel	13.15	2.25	24	5.7	0.35	0.15
			Wood	1.65	0.7		1.9	0.1	0.5

¹Life form: G = grass; F = forb ²Habit: A = annual; P = perennial ³Origin: I = introduced; N = native

Disturbance factor transect results indicate no or minimal amounts of surface disturbance by cattle, wildlife, or ORVs. The highest level of ground disturbance was from researcher footprints at one of the Rye Patch North plots (plot 3-2). This was unavoidable while conducting distance sampling along the baseline established in 2005. Placement of this baseline should be re-evaluated during the next monitoring visit to the plot. Using the macroplot method with a baseline along the small gully along the east edge of subpopulation may provide a way to collect census information with less disturbance to occupied habitat.

Reconnaissance information for the general plot vicinity that was collected in addition to the disturbance factor transect data provided a larger scale perspective concerning disturbances and possible threats. General plot disturbance information verified the lack of anthropogenic disturbances or threats at the East of Little City of Rock occurrence. In contrast, general plot disturbance information revealed ORV (motorcycle and some 4x4 ORV) use occurring within and around occupied Malheur prince's plume habitat at the Rye Patch North occurrence. This is a widespread and serious disturbance in the general area that was not recorded on the disturbance factor transects. General plot disturbance reconnaissance also identified a limited amount of ORV use at the Rye Patch South occurrence. Mining claim markers were noted in the vicinity of two occurrences as well. All of this disturbance information should be helpful to BLM resource managers involved with the conservation of Malheur prince's plume. The extent and abundance of ORV disturbance make Rye Patch North the occurrence most in need of immediate management attention. Uncontrolled ORV use will likely lead to greater weed invasion within Malheur prince's plume habitat and the direct destruction of plants crushed under wheel. ORV use has become more widespread since it was initially identified to be impacting portions of the Rye Patch North occurrence (Mancuso 1997).

The long-term conservation of Malheur prince's plume on Idaho BLM land is not guaranteed. All occurrences or associated subpopulations are small in size. Habitat conditions vary, but all occurrence have at least a low level of introduced weed establishment. Habitat disturbances associated with ORVs, cattle, or mining threaten, or potentially threaten several occurrences. Regular monitoring is recommended to ensure managers are kept apprised of population and habitat trends, the status of disturbances and threats, and to evaluate whether directed management actions such as the exclosure fence at the Coal Mine Basin ACEC or perhaps ORV restrictions at Rye Patch North, are having the intended effect. The 2005 monitoring dataset serves as a baseline to compare and evaluate future monitoring results.

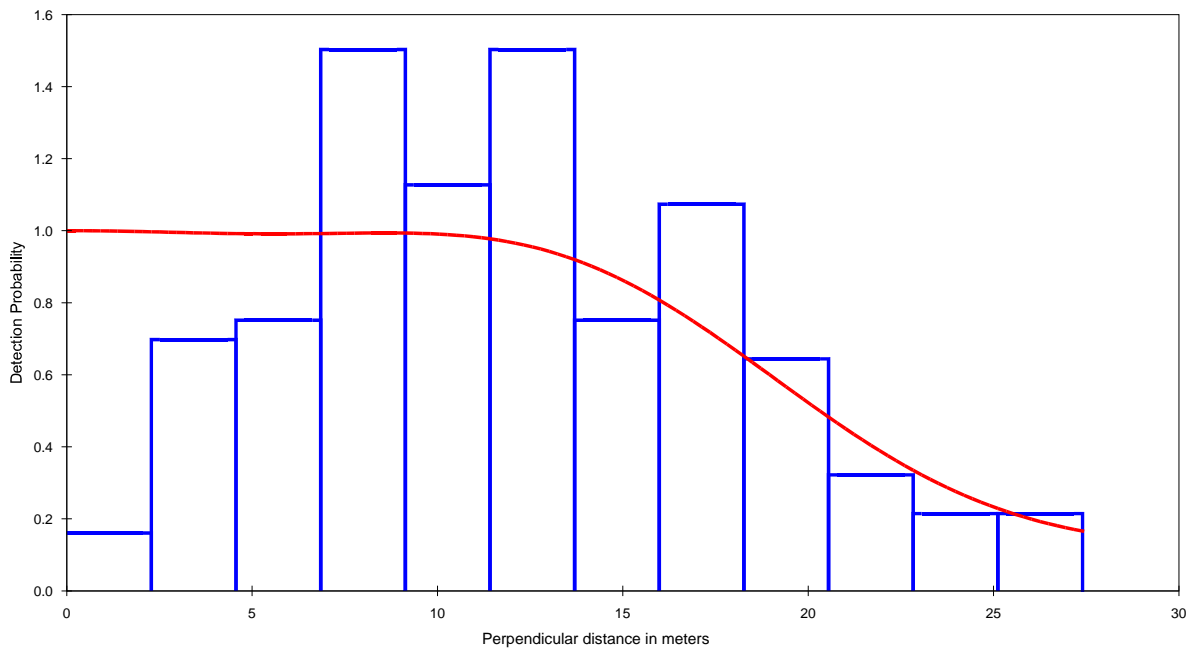
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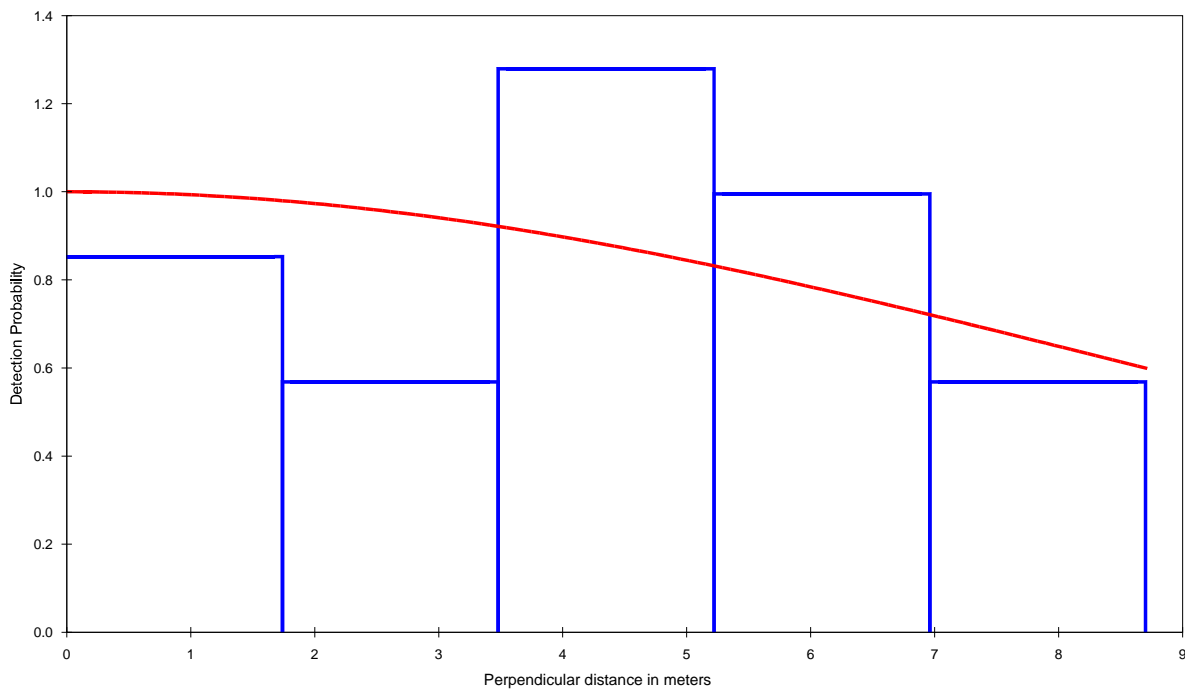
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Figure 4. Probability curves for detecting Malheur prince's plume at increasing distance from baseline transect.

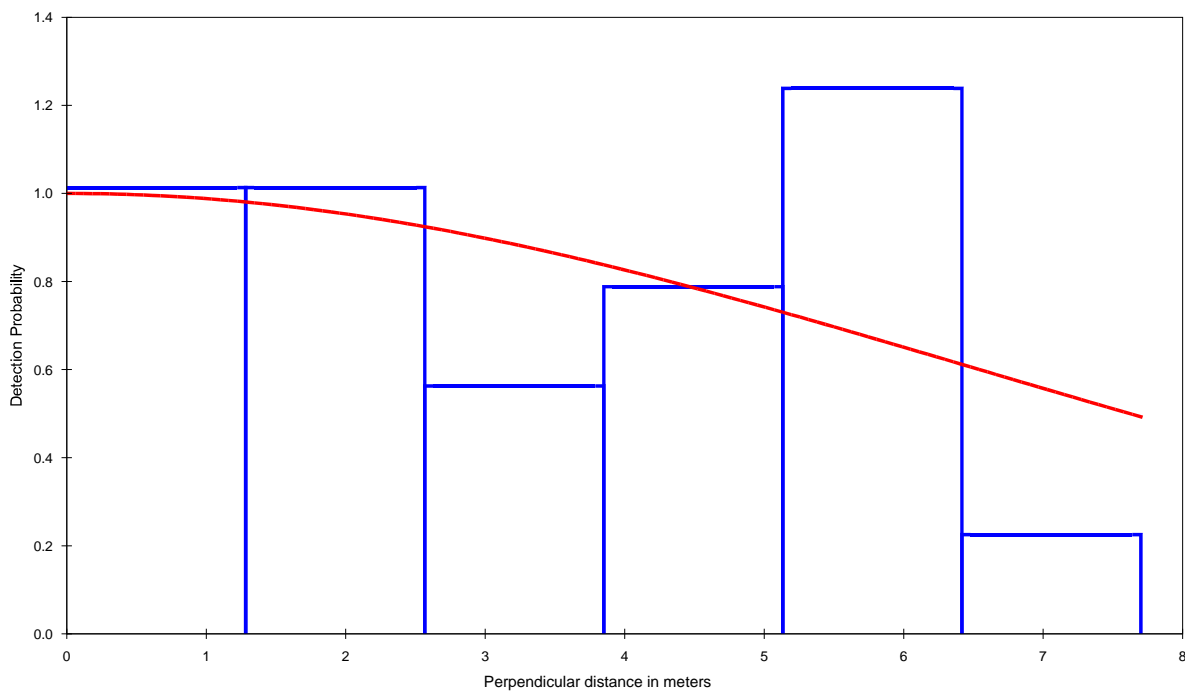


Plot 8-2 Reproductive plants

Figure 4 (continued)

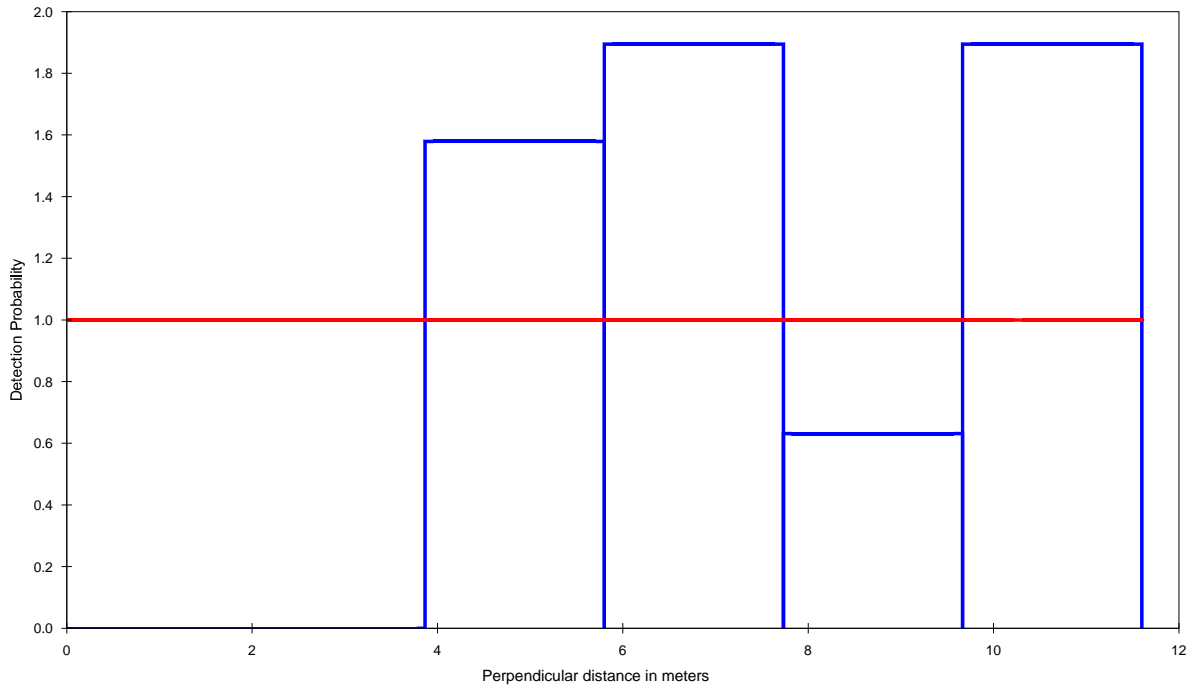


Plot 3-2 Reproductive Plants

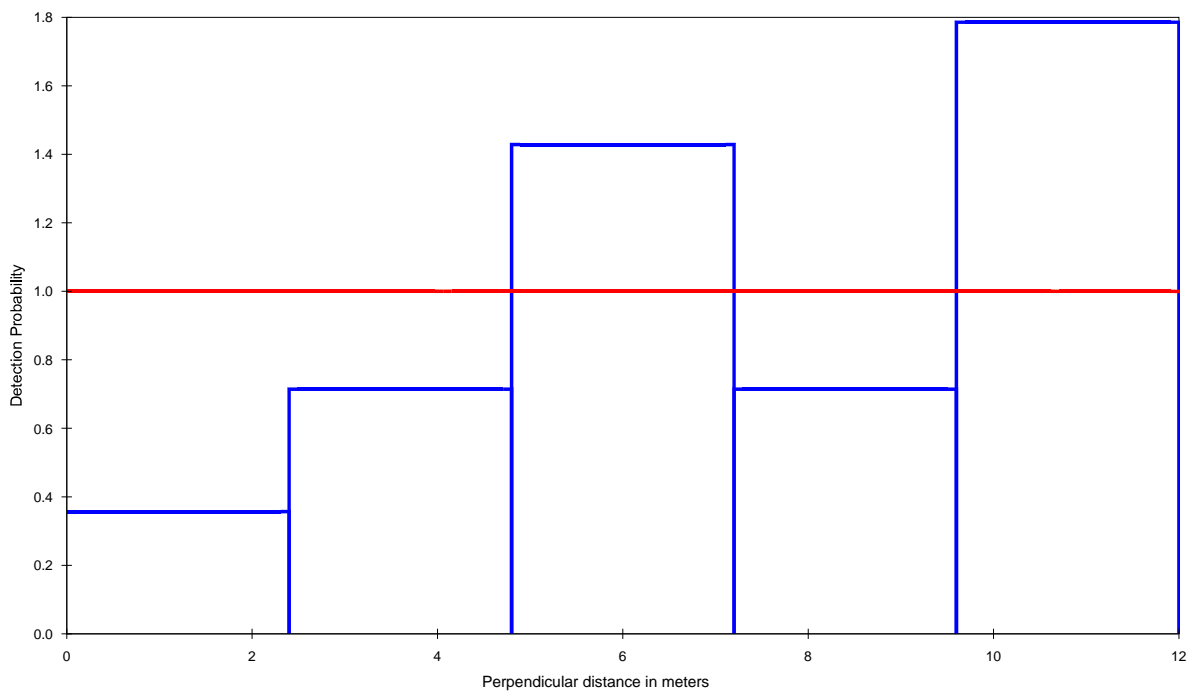


Plot 3-2 Rosettes

Figure 4 (continued)



Plot 4-1 Reproductive plants



Plot 4-1 Rosettes

Appendix 1

Malheur prince's plume monitoring plot sampling information.

All compass readings with delineation set at 16° east. All GPS coordinates are UTM zone 11, Map Datum 27.

Rye Patch North (EO 3): Plot 3-1

Plot marker rebar stake GPS = N4775027 E550639

Baseline transect length = 50 m; azimuth = 296° to 34 m point, then 345° to the 50 m point.

Disturbance factor belt transect: sampled on the uphill (south) side of the baseline transect tape.

Plant community belt transect azimuth = 126°; sampled on the north (left-hand) side of tape.

Malheur prince's plume census information was sampled in a 50 x 20 m macroplot in 2005. The 50 m baseline runs perpendicular to the slope. It is parallel to the narrow, minor drainage path at the base of the slope. From the rebar marker stake the baseline transect runs 34 m @ 296° to the 8" spike; it then "bends" and runs 16 m @ 345° to the 50 m point (which is not marked by a spike or any other reference hardware). Malheur prince's plume census information is collected by walking in the drainage path along the baseline transect. If necessary, one can also walk along the rim at the top of the slope to tally Malheur prince's plume plants located in the upper half of the macroplot. Using these areas eliminates walking through and consequently disturbing the ground surface within the macroplot area. Only Malheur prince's plume plants within the macroplot boundaries were tallied.

The macroplot is located on an approximately 12° slope, with a northeast aspect (ca 45°), and cracked, clayey soil. The vegetation is characterized by scattered desert shrubs such as *Atriplex confertifolia*, *Grayia spinosa*, *Tetradymia glabrata*, and *Sarcobatus vermiculatus*, and annual herbaceous species. In 2005, *Mentzelia albicaulis* and *Descurainia incana* were the most abundant forbs, with lesser amounts of *Halogeton glomerata* and *Phacelia lutea* var. *lutea*.

The rebar marker stake is located beneath a partially dead *Tetradymia glabrata* shrub, approximately 1.5 m south of the drainage path. The drainage path is nothing more than a narrow, minor drainage bottom between opposing northerly- and southerly-facing low hills. It is 1 m wide or less in the baseline transect area. The 8" spike at the 34 m mark of the baseline transect is located at the base of an *Atriplex confertifolia* shrub. The 50 m point of the transect is not marked, but located between a mostly dead and a green *Atriplex confertifolia* shrub.

Rye Patch North (EO 3): Plot 3-2

Plot marker rebar stake GPS = N4775319 E549224

Baseline transect length = 40 m; azimuth = 354°

Disturbance factor belt transect: sampled on the uphill (west) side of the baseline transect tape.

Plant community belt transect azimuth = 246°; sampled on the uphill side of tape; with the end spike positioned at the 20 m mark.

Malheur prince's plume census information was sampled using the line-distance method along a 40 m long baseline running parallel to the slope through the middle of the subpopulation. Line-distance sampling conducted from both sides (east and west) of the baseline. The first pass

sampled the east side of the tape, with the person spotting Malheur prince's plume walking downhill along the baseline tape, and the other person walking in the nearby gully bottom and holding the end of the second measuring tape. The second pass sampled the west side of the tape, with the person spotting Malheur prince's plume again walking downhill along the baseline tape, and the second person walking along the ridge edge outside the Malheur prince's plume zone. Researcher disturbance is limited to the immediate baseline area within occupied Malheur prince's plume habitat using this method. The sample area measures 640 m² (40 m x 8 m east of baseline and 40 m x 8 m west of baseline).

The plot is located on a fairly steep (30⁰), northerly-facing (10⁰ aspect), convex-shaped slope. The vegetation was characterized by scattered *Atriplex confertifolia*, *Tetradymia glabrata*, and *Artemisia spinosa* shrubs, trace cover of the native bunchgrasses *Poa secunda*, *Sitanion hystrix*, and *Oryzopsis hymenoides*, and high cover of *Eriogonum salicornoides*, a native annual forb. *Bromus tectorum* was widespread in 2005, having low cover in the upper end of the plot and denser patches towards the downslope end. Malheur prince's plume was most abundant in the vicinity of the small gully east of the baseline, but had low density overall.

The rebar marker stake sits atop a small, low clay soil mound within the prostrate branches of a dead *Atriplex confertifolia* shrub, approximately 10 steps west of a small gully. The baseline transect end spike is at the 39.6 m point (transect length is 40 m).

Dead Horse Creek (EO 4): Plot 4-1

Plot marker rebar stake GPS = N4797943 E502501

Baseline transect length = 43 m; azimuth = initially 165⁰ from marker stake, changing to 98⁰ after the 21 m mark.

Disturbance factor belt transect: sampled on the south side of the baseline transect tape.

Plant community belt transect azimuth = 134⁰; sampled on southwest side of tape; with the end spike positioned at the 20 m mark.

Malheur prince's plume census information was sampled using the line-distance method along a 43 m long baseline positioned along the base of a steep, northerly-facing, bowl-like clay slope. From the rebar marker stake the baseline transect runs 21 m @ 165⁰ to an 8" spike; it then "bends" and runs 22 m @ 98⁰ to the 43 m point, which is marked by another 8" spike. Line-distance census information obtained by spotting Malheur prince's plume while walking along the north side of the baseline tape. The second person walks a parallel route along the top of the slope holding the far end of the second measuring tape.

The rebar marker stake is located near the north edge of the clay-ash outcrop, approximately 9 steps south of the narrow ridgecrest separating the outcrop from another clay-ash outcrop on the adjacent northwest-facing slope. In 2005, Malheur prince's plume was restricted to north and northeast aspects; none were observed on the adjacent northwest-facing slope. The majority of Malheur prince's plume plants occurred on the upper half of the bowl-like slope.

East of Little City of Rocks (EO 6): Plot 6-1

Plot marker rebar stake GPS = N4777628 E688804

Baseline transect: a true baseline not established.

Disturbance factor belt transect azimuth = 176° ; starting from rebar marker stake, with end marked by 8" spike at 20 m point. Sampled on the west side of the tape.

Plant community belt transect: uses the disturbance factor belt transect. A separate, randomly positioned transect was not established for plant community sampling. Other parts of the plant community sampling protocol were not changed.

The plot is located in a gently sloping area dotted with low, raised mounds (sometimes referred to as biscuit and swale topography – with the mounds being the “biscuits” and the intervening low, flat ground the “swales”). The mounds have deeper, less rocky soil than the adjacent flat ground. The plot is a low, raised mound measuring 32 x 23 m in size (measured across and through the middle of the mound). Malheur prince’s plume census information obtained by walking through this entire, small subpopulation area. The flat, non-erosive surface minimized any researcher ground disturbance within occupied habitat. A full, actual count of Malheur prince’s plume was made. In 2005, Malheur prince’s plume occupied a roughly 15 x 5 m segment of the mound. The 20 m long disturbance factor transect runs through the approximate middle of the subpopulation, starting from the rebar marker stake. The end of the transect is marked by an 8" spike at the 20 m mark.

The rebar marker stake is located near the north-central point of the “mound” supporting Malheur prince’s plume, approximately 1.5 m south of an *Elymus cinereus* patch and adjacent to a triangular-shaped rock embedded in the ground. In retrospect, we should have established a more precisely marked macroplot, with the rebar stake marking one of the corners and an 8" spike another corner. This would ensure that Malheur prince’s plume census information is collected within the same, precise area in future years. A macroplot 40 x 25 m in size would encompass the entire mound having Malheur prince’s plume. This should be established in a future revisit to the monitoring plot site.

Rye Patch South (EO 7): Plot 7-1

Plot marker rebar stake GPS = N4771055 E550048

GPS for 8" spike at end of transect = N4771006 E550034

Baseline transect length = 50 m; azimuth = 202°

Disturbance factor belt transect: sampled on the uphill (west) side of the baseline transect tape. The collection of disturbance factor data begins at the transect’s 10 m mark and ends at the 30 m mark (a 20 m length). To minimize researcher trampling within occupied habitat, sampling does not begin at the 1 m mark for this transect. Starting at the 10 m point allows the researcher to walk directly in the small drainage path and avoid occupied habitat.

Plant community belt transect azimuth = 318° ; sampled on the west side of tape; with the end spike positioned at the 20 m mark adjacent to an *Atriplex confertifolia* shrub.

Malheur prince's plume census information was collected within a 50 x 20 m macroplot. The baseline transect (202⁰) runs through the middle of the macroplot, so plants occurring within 10 m of either side of the baseline length were counted. The baseline transect runs adjacent and parallel to a small drainage path along most of its length. While sampling, we walked in this drainage path to minimize researcher impacts to the soft ash-clay substrate. The macroplot was located on an open, gentle (ca 10⁰), northeast-facing exposure of cracked, ash-clay substrate. In 2005, the vegetation was relatively sparse to nearly barren, with low cover of *Atriplex confertifolia* (up to ca 10% cover in places) and varying amounts of *Mentzelia albicaulis*, *Descurainia incana*, *Phacelia lutea* var. *lutea*, *Halogeton glomerata*, an unknown annual *Atriplex* species, and *Bromus tectorum*.

The rebar marker stake is positioned 1.6 m north of a small drainage path in between two *Atriplex confertifolia* shrubs. The tape crosses the drainage path at the 2 m mark; thereafter, the transect runs along the south side of the drainage path. The drainage path trends west to east, with a bend to the south approximately 9 m up-drainage from the marker stake. The end spike is located near the base of a mostly dead *Atriplex confertifolia* shrub, approximately 1 m east of the center of the small drainage path.

Coal Mine Basin (EO 8): Plot 8-1

Plot marker rebar stake GPS = N4783874 E499126

Baseline transect length = 30 m; azimuth = 326⁰

Disturbance factor belt transect: sampled on west side of the baseline transect tape. The collection of disturbance factor data begins at the transect's 5 m mark and ends at the 25 m mark (20 m long). Sampling does not begin at the 1 m mark for this transect. Starting at the 5 m point limits sampling the first and last few meters of the transect, which are less suitable Malheur prince's plume habitat.

Plant community belt transect azimuth = 351⁰. The plant community transect end spike is positioned at the 19 m mark (not 20 m due to the presence of a sagebrush). For sampling, the tape is laid flat on the ground, not stretched fully taut due to the 0 m mark being on higher ground than the 20 m mark, with a concavity between the two points. The tape would wave >1 m above the surface if stretched fully tight.

Malheur prince's plume census information was collected within a 30 x 15 m macroplot. In 2005, Malheur prince's plume was restricted to a section of the macroplot having a northwest aspect. The amount of northwest aspect being limited to a roughly 15 x 5 m area, with Malheur prince's plume occupying an approximately 3 x 7 m zone. The macroplot occurs on a gentle westerly to northwest -facing slope with clayey soil and much more vegetation than the adjoining open, steep, west-facing ash-clay exposure (no Malheur prince's plume on exposure in 2005). Vegetation in the macroplot had both mountain big sagebrush and low sagebrush with an understory dominated by annual brome species. Native bunchgrasses such as *Poa secunda*, *Agropyron spicatum*, *Festuca idahoensis*, and *Stipa thurberiana* were more common outside the Malheur prince's plume macroplot zone. *Mentzelia mollis* and *Phacelia lutea* var. *calva* occurred on the west-facing ash outcrop below the macroplot.

The rebar marker stake for the plot is located on the crest of the slope above a steep, sparsely vegetated, westerly-facing, ash-clay outcrop. A strip of sagebrush runs along the crest of the slope. The stake is positioned between 3 clumps of *Stipa thurberiana*, about 1 m east of a

sagebrush shrub, just downhill from the high point of the crest. The end spike is at the 30 m mark, at the base of a *Festuca idahoensis* plant.

Coal Mine Basin (EO 8): Plot 8-2

Plot marker rebar stake GPS = N4783756 E498325

Baseline transect length = 50 m; azimuth = 178⁰.

Disturbance factor belt transect: sampled on east (downslope) side of the baseline transect tape.

Plant community belt transect: not established; no plant community data collected in 2005.

Malheur prince's plume census information was sampled using the line-distance method in 2005. The sampling macroplot was 50 x 25 m in size. The 50 m long baseline runs perpendicular to the slope along the upper edge of an east-facing, gentle to moderately steep (ca 15 -20⁰) clay-ash exposure. Census information was collected by walking on the uphill side of the baseline tape and looking downhill for Malheur prince's plume. Curvature of the convex-shaped slope prevented viewing further than approximately 25 m downslope. Annual grassland vegetation with *Bromus japonicus*, *Bromus tectorum*, and some *Elymus caput-medusea* dominated the habitat occupied by Malheur prince's plume. Other associated species included *Poa secunda*, *Elymus cinereus*, *Helianthus cusickii* (Cusick's sunflower), *Epilobium brachycarpum* (tall annual willowherb), *Lepidium perfoliatum*, *Chrysothamnus nauseosus*, and a few *Purshia tridentata* (bitterbrush). The soil and vegetation was different upslope of the transect, outside the zone occupied by Malheur prince's plume. This area contained a mix of *Artemisia arbuscula* and *A. tridentata*, with *Poa secunda*, *Agropyron spicatum*, some *Bromus tectorum*, and *Aster scopularum* as a common forb.

The rebar marker stake is located near the base of an *Artemisia arbuscula* shrub approximately 1 m south of a much larger *Artemisia tridentata*, in an upper slope position near the northern end of a ridgeline that descends to the Coal Mine Basin Creek bottoms. In 2005, the stake was in a relatively weed-free area, with annual grasses becoming abundant approximately 5 m further downslope. *A. arbuscula* was largely absent from the annual grassland zone. The end spike is at the 50 m mark, in an open, rocky area, roughly 2.5 m northeast of a relatively large sagebrush shrub. This was near what appeared to be the southern extent of Malheur prince's plume in 2005.

Appendix 2

Map locations for Malheur prince's plume monitoring plots.

Appendix 3

Malheur prince's plume monitoring plot location forms.

Appendix 4

Element Occurrence Records for Malheur prince's plume.

Appendix 5

Map locations for Malheur prince's plume Element Occurrences.

Appendix 6

Malheur prince's plume census data sheets, 2005.

Appendix 7

Transect disturbance factor data sheets, 2005.

Appendix 8

General disturbance information sheet, 2005.

Appendix 9

Plant community monitoring data sheets, 2005.

Appendix 10

List of common plant names.

Scientific Name**Common Name**

<i>Agropyron spicatum</i>	Bluebunch wheatgrass
<i>Allium acuminatum</i>	Tapertip onion
<i>Allium</i> sp.	Onion sp.
<i>Antennaria dimorpha</i>	Low pussytoes
<i>Artemisia arbuscula</i>	Low sagebrush
<i>Artemisia spinescens</i>	Bud sagebrush
<i>Artemisia tridentata vaseyana</i>	Mountain big sagebrush
<i>Astragalus iodanthus</i>	Humboldt River milkvetch
<i>Atriplex confertifolia</i>	Shadscale
<i>Blepharipappus scaber</i>	Rough eyelashweed
<i>Bromus japonicus</i>	Japanese brome
<i>Bromus tectorum</i>	Cheatgrass
<i>Chaenactis macrantha</i>	Bighead dustymaiden
<i>Chrysothamnus nauseosus</i>	Gray rabbitbrush
<i>Cirsium utahense</i>	Utah thistle
<i>Collinsia parviflora</i>	Maiden blue-eyed Mary
<i>Cryptantha</i> sp.	Cryptantha sp.
<i>Descurainia incana</i>	Mountain tansymustard
<i>Draba verna</i>	Spring whitlow-grass
<i>Elymus cinereus</i>	Basin wild rye
<i>Epilobium brachycarpum</i>	Tall annual willowherb
<i>Erigeron chrysopsidis</i>	Sagebrush fleabane
<i>Eriogonum microthecum</i>	Slender buckwheat
<i>Eriogonum salicornoides</i>	Saltwort buckwheat
<i>Festuca idahoensis</i>	Idaho fescue
<i>Gutierrezia sarothrae</i>	Broom snakeweed
<i>Halogeton glomeratus</i>	Saltlover
<i>Holosteum umbellatum</i>	Jagged chickweed
<i>Lactuca serriola</i>	Prickly lettuce
<i>Lepidium perfoliatum</i>	Clasping pepperweed
<i>Lomatium cous</i>	Cous biscuitroot
<i>Lomatium</i> sp.	Biscuitroot sp.
<i>Lomatium triternatum</i>	Nineleaf biscuitroot
<i>Mentzelia albicaulis</i>	Whitestem blazingstar
<i>Microseris troximoides</i>	Nodding microseris
<i>Microsteris gracilis</i>	Slender phlox
<i>Montia linearis</i>	narrowleaf montia
<i>Phlox longifolia</i>	Longleaf phlox
<i>Poa bulbosa</i>	Bulbous bluegrass
<i>Poa secunda</i>	Sandberg bluegrass
<i>Ranunculus testiculatis</i>	Bur buttercup
<i>Salsola iberica</i>	Russian thistle
<i>Sisymbrium altissimum</i>	Tumblemustard
<i>Sitanion hystrix</i>	Squirreltail
<i>Stanleya confertiflora</i>	Malheur prince's plume
<i>Tetradymia glabrata</i>	Littleleaf horsebrush
<i>Vulpia bromoides</i>	Brome fescue
<i>Vulpia microstachys</i>	Small fescue
<i>Zigadenus venenosus</i>	Meadow deathcamas

Appendix 11

Malheur prince's plume monitoring photo point photographs, 2005.