

Habitat Sampling at Balboa, Fir Butte, Greenhill, and Vinci



2012

Report to the Bureau of Land Management,
Eugene District

Report prepared by Erin Gray

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PREFACE

This report is the result of a cooperative Challenge Cost Share project between the Institute for Applied Ecology (IAE) and a federal agency. IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. Our aim is to provide a service to public and private agencies and individuals by developing and communicating information on ecosystems, species, and effective management strategies and by conducting research, monitoring, and experiments. IAE offers educational opportunities through 3-4 month internships.



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Cover photograph: Habitat monitoring at Fir Butte

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EXECUTIVE SUMMARY

This document summarizes habitat monitoring in the West Eugene Wetlands on land managed by the BLM Eugene District. In 2012, we monitored Balboa, Fir Butte, Greenhill, and Vinci to assess whether they were within the habitat targets for Threatened and Endangered species.

- Monitoring in 2012 occurred in May, which was earlier than in previous years at the sites. All sites had less total cover than they did previously, likely due to a difference in monitoring times.
- The plots at Balboa 1 and Greenhill 2 were native dominated while the others had greater cover of introduced species.
- The southeast portion of Fir Butte continued to have extremely high percentages of introduced species when compared to natives.
- Cover of invasive species and litter exceeded thresholds for management in habitat for *Lupinus oreganus*, *Erigeron decumbens*, and *Lomatium bradshawii*.
- Thresholds for woody vegetation were not exceeded at any of the sites.

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Habitat sampling at Balboa, Fir Butte, Greenhill, Oxbow West, and Vinci

REPORT TO THE BUREAU OF LAND MANAGEMENT, EUGENE DISTRICT

INTRODUCTION

The West Eugene Wetlands (WEW) Project is a cooperative venture by the Bureau of Land Management (BLM), Eugene District, and others to protect and restore wetland ecosystems in the southern Willamette Valley of Oregon. This unique program involves a partnership between federal, state, and local agencies and organizations to manage lands and resources in an urban area for multiple public benefits. In 2005, the BLM developed a long term (10 year) land management implementation schedule for its parcels within the West Eugene Wetlands project area. This 10 year Environmental Assessment (EA) schedule outlines targets for habitat conditions and provides guidance on the priority of work for maintenance, enhancement, and restoration projects (BLM 2005). Within the EA, each parcel will be monitored to meet four habitat management targets. In general, these habitat targets include the following: (1) prevent woody vegetation encroachment, (2) prevent invasive plant spread, (3) prevent litter and thatch build up, and (4) maintain existing levels of native plant species diversity. When monitoring indicates that these targets are not being met based on the established thresholds, management actions may be triggered (further outlined in the EA NO. OR090-0503, Alternative D, pages 58-61). In addition, many of these sites provide



Figure 1. *Lupinus oregonus* (Kincaid's lupine)

habitat for species listed in Recovery Plan for Threatened and Endangered Species in Western Oregon and Southwest Washington (USFWS 2010).

The purpose of this project was to conduct monitoring at several sites in the West Eugene Wetlands (Table 1) to assess whether they were within the habitat targets for Threatened and Endangered species (Figure 1). In 2012, we monitored four sites: Balboa (2 plots), Fir Butte (1 plot), Greenhill (2 plots), and Vinci (1 plot). With the exception of Greenhill, monitoring previously occurred at these sites in 2009.

Table 1. Monitoring schedule for West Eugene Wetlands T and E sites from 2007 through 2012. If no month is listed, then the site was not monitored through this project.

Site	Plot	2007	2008	2009	2010	2011	2012
Balboa	1 and 3			July			May
Fir Butte	NE and SW	July			July		
Fir Butte	SE			July			May
Greenhill	1(S) and 2 (N)				July		May
Hansen Meadow			July			May	
Hansen Woods			July			May	
Long Tom			July			May	
North Taylor			July			May	
Oxbow West	ERDE	July			July		
Oxbow West	LUOR			July			
Speedway			July			May	
Turtle Swale			July			May	
Vinci	Upland			July			May
Vinci	Wetland 1 and 2	July			July		

Sites

Balboa

Balboa encompasses 74.1 acres and includes populations of the Bureau Sensitive and USFWS listed species *Sericocarpus rigidus* (nee *Aster curtus*), *Erigeron decumbens*, *Lomatium bradshawii*, and *Horkelia congesta* ssp. *congesta* (Appendix B). This site is broken up into two monitoring plots encompassing habitat occupied by these rare species. The vegetation cover is dominated by invasive forbs and graminoids, though native forbs do contribute to the overall cover and the cover by native graminoids approaches that of introduced graminoids. Habitat enhancement at this site began in 2000 and included the reduction of native and non-native woody vegetation; prior to this time, fire suppression permitted significant woody encroachment into the prairie. Without continual reduction of the woody species, this site will revert to ash forest. Balboa was monitored in 2009 and again in 2012.

Fir Butte

Fir Butte is an 18 acre prairie remnant owned by the Eugene District BLM (Appendix B). This site has been heavily invaded by many exotic weeds including *Rubus armeniacus*, *Cytisus scoparius*, *Centaurea pratensis*, and *Arrhenatherum elatius*. Despite the relatively poor habitat quality, one of the largest known extant populations of *Lupinus oregonus* (Kincaid's lupine) occurs here. This site also supports a relatively large population of the endangered Fender's blue butterfly (*Icaricia icarioides fenderi*). *Lupinus oregonus* serves as the obligate host plant for *I. icarioides fenderi*. Since 1999, BLM crews have made substantial efforts to control *C. pratensis* and *C. scoparius*, and selected areas have been repeatedly mowed to reduce the invasion of *R. armeniacus*. Since 2001, experimental treatment plots at the site have been mowed and/or burned. Monitoring in the northeast and southwest occurred in 2007 and 2010. Monitoring in the southeast occurred in 2009 and was repeated in 2012.

Greenhill

Greenhill is a mix of high quality remnant wet prairie, ash swale, upland prairie and oak woodland (Appendix B). Monitoring occurred in the remnant wet prairie with a population of *Lomatium bradshawii* (Bradshaw's lomatium). The area has variable microtopography, and supports species adapted to living across the hydrological range of seasonally flooded lowlands to dry uplands. The remnant prairie is adjacent to a restored area that has had reintroductions of *Horkelia congesta*, *Sericocarpus rigidus*, *Erigeron decumbens*, and *Lomatium bradshawii*. Monitoring occurs in two plots that encompass habitat associated with these rare species. These sites were last monitored in 2010 and were prioritized for monitoring in 2012 because they had only been monitored once since 2007 (Table 1). In 2012, plot setup in Greenhill 2 (N) was modified because only one corner of the macroplot was found (Table 2).

Vinci

Vinci is a relatively large parcel containing both wet prairie and vernal pool habitats (Appendix B). Although the quality of the site is relatively high, it has been invaded by woody species such as *Pyrus communis*, *Fraxinus latifolia*, *Populus trichocarpa* and exotic herbaceous species including *Phalaris arundinacea* and *Dipsacus fullonum*. Vinci supports a number of rare species, including *Erigeron decumbens*, *Sericocarpus rigidus*, and *Horkelia congesta* ssp. *congesta*. Monitoring of the wet prairie habitat occurred in 2007 and 2010. Upland prairie habitat was monitored in 2009 was repeated in 2012.

METHODS

The point-intercept sampling method was selected for this project because it provides an unbiased quantitative description of plant communities in an efficient manner (City of Eugene 1997). Although some species with less than 0.5% cover were likely missed, this method provides a consistent manner in which to efficiently sample a large area.

In May 2012, six plots were sampled to estimate vegetation cover in the West Eugene Wetlands. Balboa and Greenhill both contained two plots and Vinci and Fir Butte each had one (Figure 2). Oxbow West was not monitored because no management treatments had occurred there since it was last monitored. Plot dimensions varied by site and were based on established infrastructure (e.g. conduit or other permanent markers, Table 2). The sampling scheme at each site was selected so that (1) the maximum amount of habitat would be sampled, and (2) there would be at least 200 points per plot (Table 2). The origin was placed in the southeast corner of each plot (Figure 3). For Vinci, the first transect running perpendicular to the baseline was randomly located between 0m and 4m. Subsequent transects were placed every 3m along the baseline. For Fir Butte, the first sample point along each transect was randomly located between 0m and 4m, and systematically located every 5m. For Balboa 1, the first transect perpendicular to the baseline was randomly located between 0m and 3m and then was continued every 3m, while at Balboa 3 the first sample was randomly started between 0m and 5m and was continued every 2m. For Greenhill 1(S), the first transect perpendicular to the baseline was randomly located between 0m and 3m, with transects placed every 3m thereafter. For Greenhill 2 (N), the first transect perpendicular to the baseline started randomly between 0m and 5m, and continued every 5m thereafter.

We used a monopod that utilized a laser light (Synergy Resource Solutions, Inc.) to sample the vegetation at each point. We adjusted the height of the monopod so that it was above the vegetation canopy at every site. At each point, we recorded every species intercepted by the laser light and the nature of the substrate (bare ground, litter, or moss). Cover can exceed 100% due to multiple species intercepting the laser light.

Species nomenclature, growth habit, and provenance were obtained from the USDA Plants Database (<http://plants.usda.gov>). We calculated the percent cover within each plot by totaling the “hits” for each component (each species, growth habit group, and cover type), dividing by the total number of sampling points per plot, and multiplying by 100. We timed our surveys (May) early to document early-season species, including some of those that are listed threatened and endangered, however we may have missed some later-season species. In order to document all species at a site, surveys should take place at multiple times throughout the growing season.

Table 2. Characteristics of habitat sampling plots

Site	Plot origin (Lat/Long, WGS 84)	Plot dimensions	# samples
Balboa			
Plot 1	44.053450, -123.181431	60m x 37m	211
Plot 3	44.051556, -123.180491	51m x 22m	233
Fir Butte			
Plot 1(SE)	44.077712, -123.230943	82m x 50m	206
Greenhill			
Plot 1 (S)	483331E, 4878454N	60m x 50m	228
Plot 2 (N)	483384E, 4878331N	30m x 40m	203
Vinci			
Plot 3 (upland)	44.053138, -123.198425	64m x 37m	213

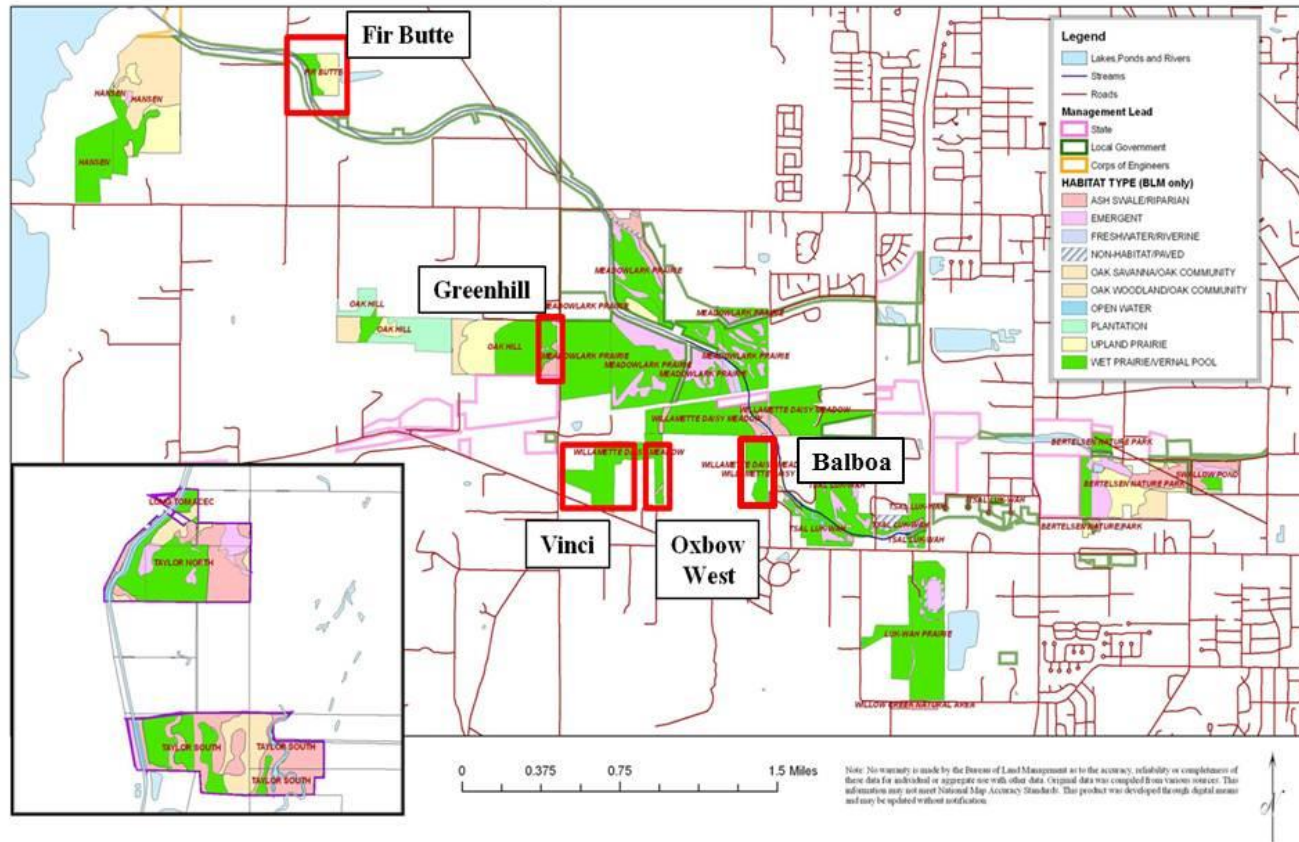


Figure 2. Monitoring sites described in this project: Fir Butte, Greenhill, Balboa and Vinci (Oxbow West was not monitored in 2012). Sites are outlined in red and labeled.

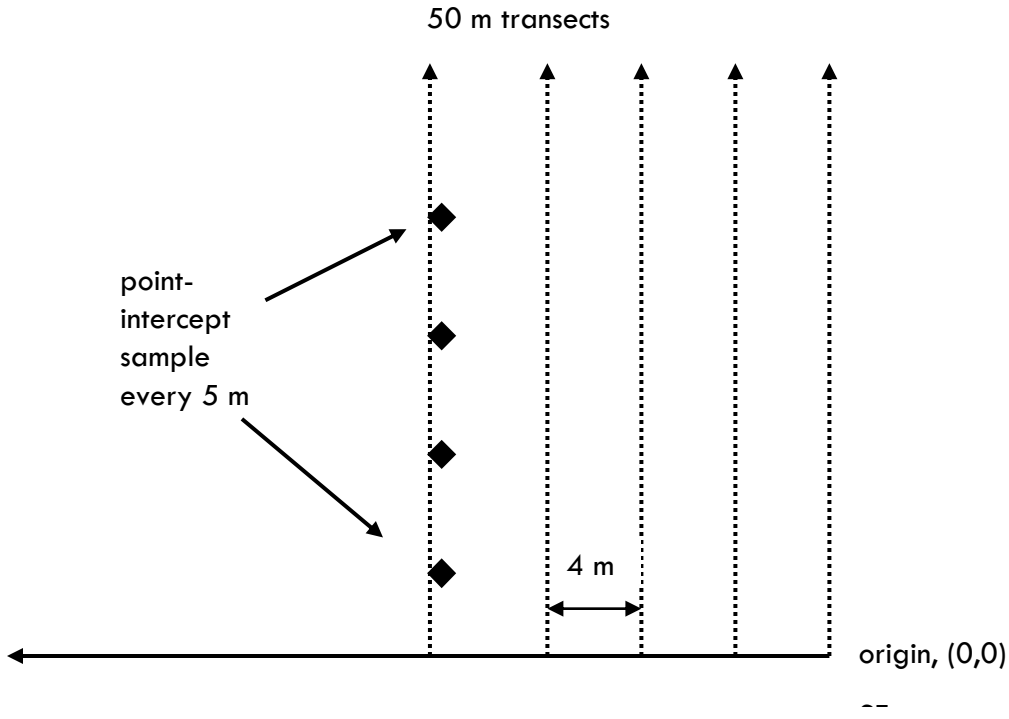


Figure 3. Example design of a sampling plot.

RESULTS AND DISCUSSION

Sites

Table 3. Cover of bare ground, litter and moss at study sites in the West Eugene Wetlands in 2012

	Site					
	Balboa 1	Balboa 3	Fir Butte	Greenhill 1(S)	Greenhill 2 (N)	Vinci 3
Bare ground	32.7	15.5	0.5	42.1	15.3	37.6
Litter	87.7	93.1	95.6	72.8	92.6	85.0
Moss	5.2	24.9	8.3	7.9	12.8	1.4

Balboa

Balboa 1

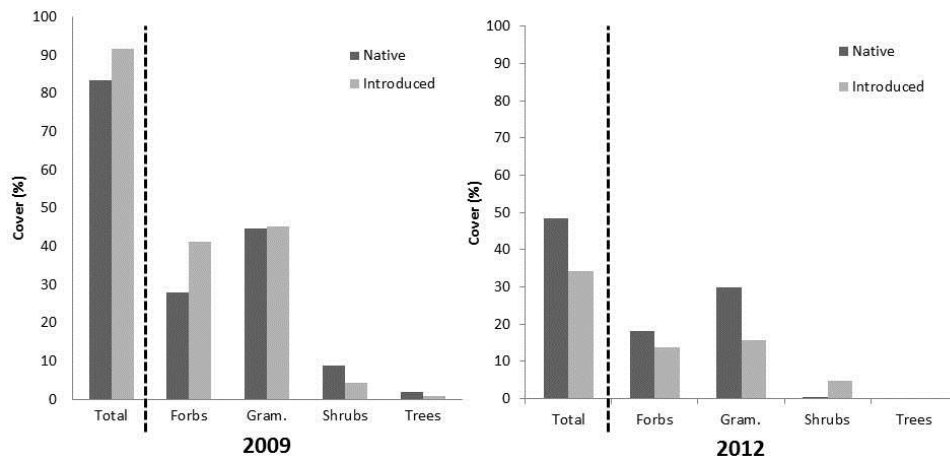


Figure 4. Percent cover of native and introduced species, by growth habit, at Balboa 1 in 2009 and 2012.

The vegetation at Balboa 1 was dominated by native species in 2012, which was an increase since the site was last monitored in 2009 (Figure 4). Native species were more abundant in the forb and graminoid vegetation classes, while introduced shrub cover was more abundant than natives (Figure 3). The native species with the highest cover included the forbs *Symphotrichum hallii* (6%), *Brodiaea* sp. (4%),

and the graminoids *Deschampsia cespitosa* (21%) and *Danthonia californica* (7%; Appendix A). The introduced species with the highest cover included the forbs *Hypochaeris radicata* (6%) and *Leucanthemum vulgare* (3%), and the graminoid *Anthoxanthum odoratum* (13%). Total cover was less in 2012 than in 2009. Differences in cover reflected in the different monitoring events could be accounted for by the difference in timing of sampling. In 2012 monitoring occurred in May when more native forb species are present as compared to July (2009) which is a time when late-season invasive species are present.

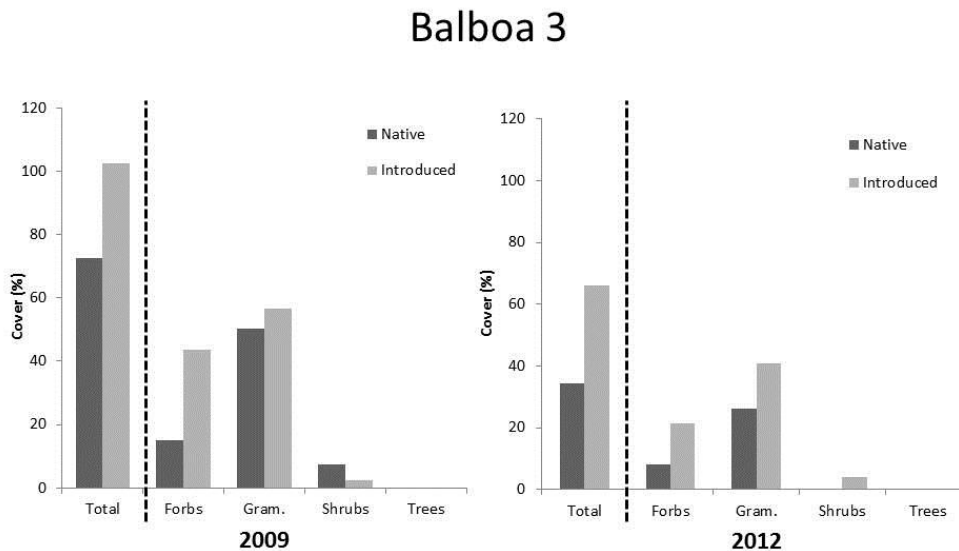


Figure 5. Percent cover of native and introduced species, by growth habit, at Balboa 3 in 2009 and 2012.

While total cover was less in 2012, relative differences in native and introduced cover were similar between 2009 and 2012 at Balboa 3. Balboa 3 was dominated by introduced species in all growth habits (Figure 5). No tree species were present. The introduced species with the highest cover included the forbs *Leucanthemum vulgare* (4%), *Galium parisiense* (5%), and graminoids *Anthoxanthum odoratum* (12%), *Agrostis stolonifera* (10%), and *Schedonorus phoenix* (17%). All of the other introduced species each had covers less than 5% (Appendix A). The native species with the highest cover included the forb *Symphotrichum hallii* (3%), and the graminoids *Deschampsia cespitosa* (13%), *Danthonia californica* (5%), and *Carex obnupta* (6%). All other native species had less than 3% cover each. Both plots at Balboa had high litter cover (Table 3). At Balboa 1, litter cover was 88%, bare ground (mineral soil) cover was 33% and moss covered 5%. Balboa 3 had 93% litter cover and 16% bare ground. Moss was abundant at Balboa 3 covering 24%.

Fir Butte

Fir Butte 3(SE) was likewise dominated by introduced species. Of the twenty-four species that were found in this plot, five were native and 19 introduced (Appendix A). All the native species were forbs, and of those, cover did not exceed 3%. Introduced species had representatives in forbs, graminoids, and shrubs. There were no trees in this plot. Introduced species cover combined was approximately eight times that of native species (Figure 6). *Agrostis stolonifera* dominated the plot with 68% cover. Other abundant invasive graminoids included *Anthoxanthum odoratum* (5%), *Dactylis glomerata* (3%), and *Schedonorus phoenix* (8%). The remaining invasive graminoids had less than 1% cover (Appendix A). Introduced forbs included *Galium pariense* (4%), *Myosotis discolor* (4%), *Vicia sativa* (8%), and *Rubus armeniacus* (5%). The remaining nonnative forbs combined for less than 3% cover. Native forb species did not exceed 3% cover, including the federally threatened *Lupinus oreganus* (1%). Litter cover at this site was very high at over 85%, perhaps due to the abundance of introduced grass species. Moss cover was relatively low (8%; Table 3) and bare ground was less than 1%. Though this site was last monitored in July 2009, in May 2012 we found very similar abundances in native and invasive species, but the total cover was less in 2012, likely due to the earlier-season sampling.

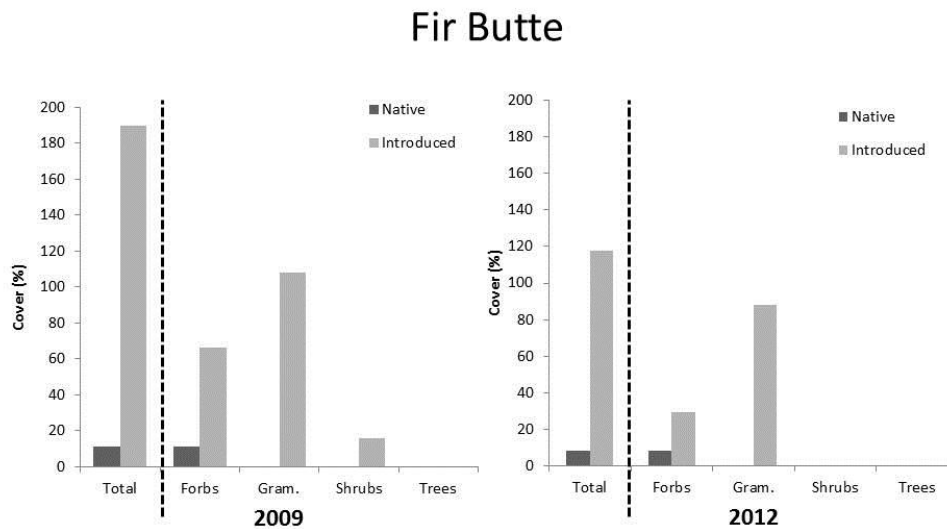


Figure 6. Percent cover of native and introduced species, by growth habit, at Fir Butte 3(SE) in 2009 and 2012.

Greenhill

At Greenhill 1(S), cover of native species was greater than that of introduced species. Total cover of all functional groups was much less in 2012 than in 2010 (Figure 7), which could be due to a difference in monitoring time (Table 1). Cover by native species at this site was the highest of all sites monitored in

2012 (Figure 10). The most abundant native species at this site were the graminoids *Deschampsia cespitosa* (12%), *Danthonia californica* (4%), and *Carex* sp. (3%). *Brodiaea* sp. and *Camassia quamash* var. *maxima* were the most abundant native forbs (6% each). The other 18 native species had less than 3% cover (Appendix A). *Vicia sativa* was the most abundant nonnative forb (6%), followed by *Hypochaeris radicata* (7%). Invasive graminoids were composed of *Agrostis stolonifera* (4%), *Holcus lanatus* (5%), *Anthoxanthum odoratum* (6%), and *Alopecurus pratensis* (8%), and the most abundant introduced grass *Schedonorus phoenix* (15%). Bare ground was very high at Greenhill 1 covering 42% which is likely due to effects of a recent prescribed fire (Table 3). Litter was very abundant at 73% and moss covered 8%.

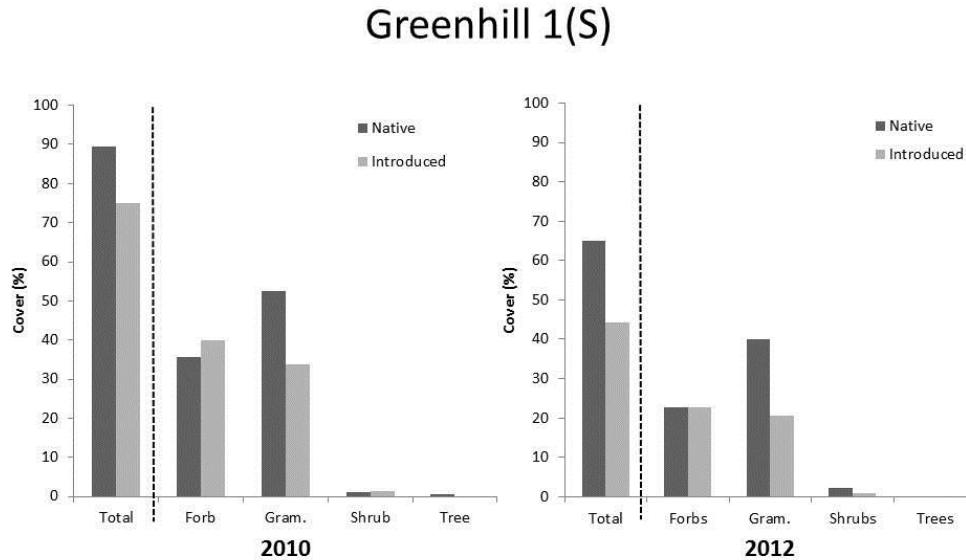


Figure 7. Percent cover of native and introduced species, by growth habit, at Greenhill 1(S) in 2010 and 2012.

The plot at Greenhill 2(N) was re-sized in 2012 due to missing plot corners (Table 2). Because of this, the total area sampled differed from that in 2010 and will not be compared. Native forbs were more abundant than introduced forbs at Greenhill 2, but introduced grass cover was greater than that of natives (Figure 8). Total cover of native and exotic species was similar. Native forbs were the most abundant and were composed of *Symphytotrichum hallii* (3%), *Saxifraga oregana* (5%), *Camassia quamash* var. *maxima* (8%), and *Brodiaea* sp. (19%; Appendix A). The most abundant native graminoids included *Deschampsia cespitosa* (8%) and *Danthonia californica* (12%). The other 11 native species had cover of less than 2%. The two most abundant introduced forbs were *Hypochaeris radicata* (4%) and *Leucanthemum vulgare* (5%). Grasses were dominated by *Schedonorus phoenix* (20%) followed by *Anthoxanthum odoratum* (7%). Also abundant was the introduced shrub *Rosa eglanteria* (8%), no native shrubs were present. Bare ground was high at Greenhill 2, but not as high as at Greenhill 1, covering 15%. The site was dominated by litter (93%), with high cover of mosses (13%). The high cover of litter is likely due to the abundance of introduced graminoids.

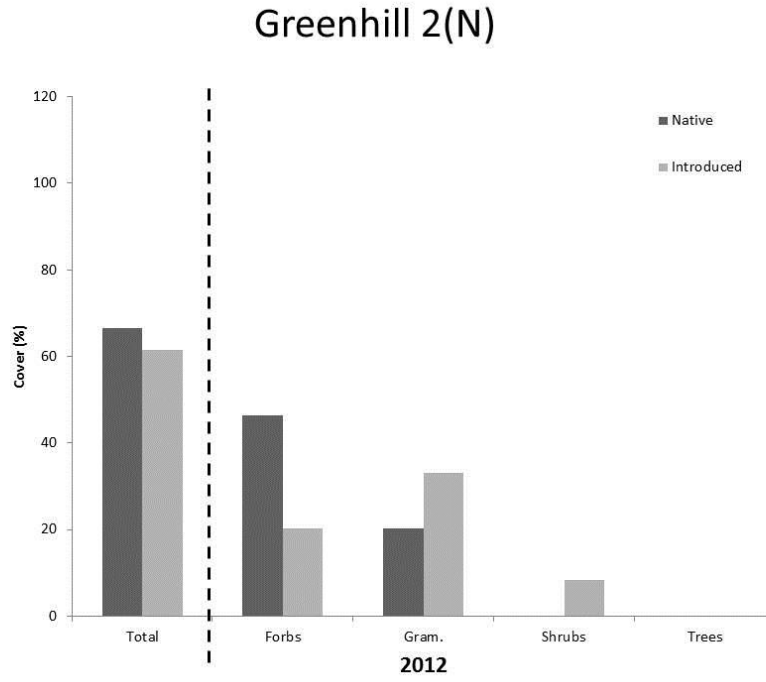


Figure 8. Percent cover of native and introduced species, by growth habit, at Greenhill 2(N) in 2012.

Vinci

While in 2009 introduced species dominated total cover at Vinci, in 2012 cover of native and introduced species was relatively equal (Figure 9). In 2012, native forbs were more abundant than introduced forbs, however introduced grasses were more abundant than natives. The most abundant native forbs included *Saxifraga oregana* (3%), *Symphytotrichum hallii* (5%), and *Brodiaea* sp. (7%; Appendix A). Native graminoids were dominated by 13% cover by *Deschampsia cespitosa* and *Danthonia californica* (5%). The most abundant introduced forbs included *Myosotis discolor* (3%), *Vicia sativa* (5%), and *Hypochaeris radicata* (8%). Among nonnative graminoids, *Schedonorus phoenix* had the highest cover (8%), followed by *Alopecurus pratensis* (7%), *Anthoxanthum odoratum* (5%), and *Agrostis stolonifera* (4%). Vinci had high cover of bare ground (38%), with the remainder composed of litter (85%) and trace amounts of moss (1%).

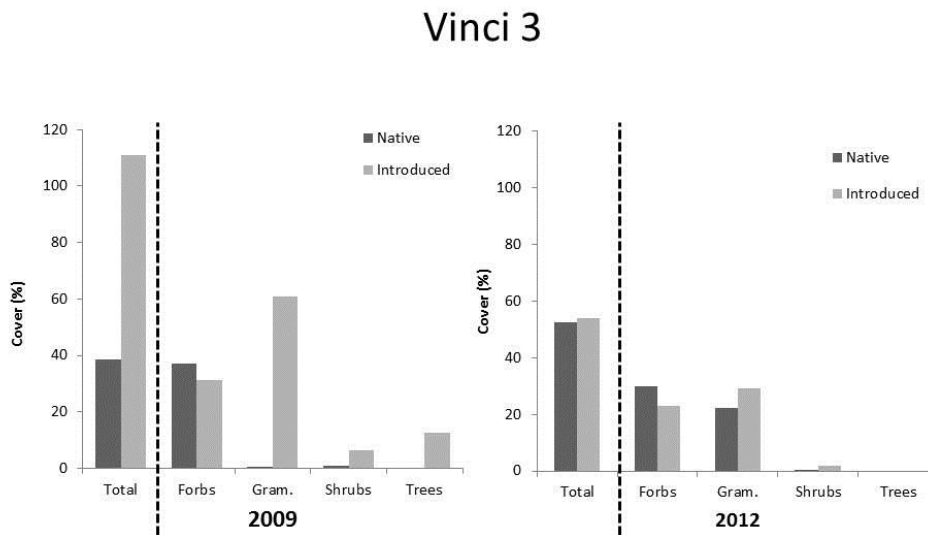


Figure 9. Percent cover of native and introduced species, by growth habit, at Vinci 3 in 2009 and 2012.

Across all sites we noticed a decrease in total plant cover which is likely due to the difference in timing of the monitoring efforts. Increases in native species found in 2012 could be due to a more-likely detection earlier in the season. Conducting monitoring at different times of the year gives a better representation of the species diversity and composition for the sites as a whole, however repeated sampling during the same time of the year would enable more concrete comparisons regarding cover of native and introduced species.

Fender's Blue Butterfly Stepping Stone Habitat

All of the sites monitored in 2012 have the potential to serve as critical habitat for Fender's blue butterfly. Critical habitat for this species includes high quality prairie or oak savannah habitat, the presence of larval host-plants (*L. oreganus*), adult nectar sources, and stepping-stone habitat

(undeveloped areas with the physical characteristics appropriate for supporting the short-stature prairie oak savannah plant community within 1.2 miles of natal lupine patches) (USFWS 2010).

In 2010, all of the sites included in this study were surveyed to meet at least one of the criteria for critical habitat for Fender's blue butterfly and were determined to be suitable stepping stone habitat (Thorpe 2010).

In 2012 monitoring, *Lupinus oreganus* was present in our plots at Fir Butte, but not in the plots at the other sites (Appendix A). We identified many nectar species including *Vicia* spp. at Balboa 3, Greenhill 1 & 2, Fir Butte, and Vinci 3. We also found *Cammassia quamash* at all sites but Fir Butte. *Eriophyllum lanatum* was present at Balboa 3, Greenhill 1, and Vinci 3, and *Sidalcea virgata* was present at Greenhill 2. Though these species were present at the sites, they constitute a low percentage of total cover and we recommend efforts to increase both the diversity and cover of nectar species at these sites.

SUMMARY

The Recovery objectives from the Western Oregon and Southwestern Oregon Prairie Species Recovery Plan (USFWS 2010) specify that within habitat for *Lupinus oreganus*, *Erigeron decumbens*, and *Lomatium bradshawii*, there is to be $\geq 50\%$ relative cover of non-woody natives at 70% of local populations, $\leq 15\%$ cover of woody species, and no single non-native species with $> 50\%$ cover. Furthermore, the monitoring indicators and corresponding thresholds for management actions from the Environmental Assessment (further outlined in USDI BLM 2005, Alternative D, pages 58-61) are:

Habitat indicator	Threshold for management
Woody vegetation	When canopy cover exceeds the level appropriate for the local habitat (5-10% for wet-prairie/vernal pool and upland prairie habitats)
Invasive species	When combined encroachment reaches 10%-35% or greater of the habitat block and/or a weed population covers $> 50\%$ of a 1m ² area, depending on site conditions and species present.
Thatch	When the litter layer exceeds 10-20% cover and litter layer is detrimentally impacting native forb plant diversity or rare plant habitat.
Native Species	When there is a loss of 5%-10% of a site's existing cover and number of native plant species.

In our surveys, we found that the thresholds for management were exceeded for the following indicators:

Habitat indicator	Site	Indicator level
Invasive species	Balboa 1	34% introduced species cover
	Balboa 2	66% introduced species cover
	Fir Butte (SE)	118% introduced species cover
	Greenhill 1	65% introduced species cover
	Greenhill 2	62% introduced species cover
	Vinci 3	54% introduced species cover
	Thatch	Balboa 1
Balboa 2		93% litter cover
Fir Butte (SE)		96% litter cover
Greenhill 1		73% litter cover
Greenhill 2		93% litter cover
Vinci 3		85% litter cover

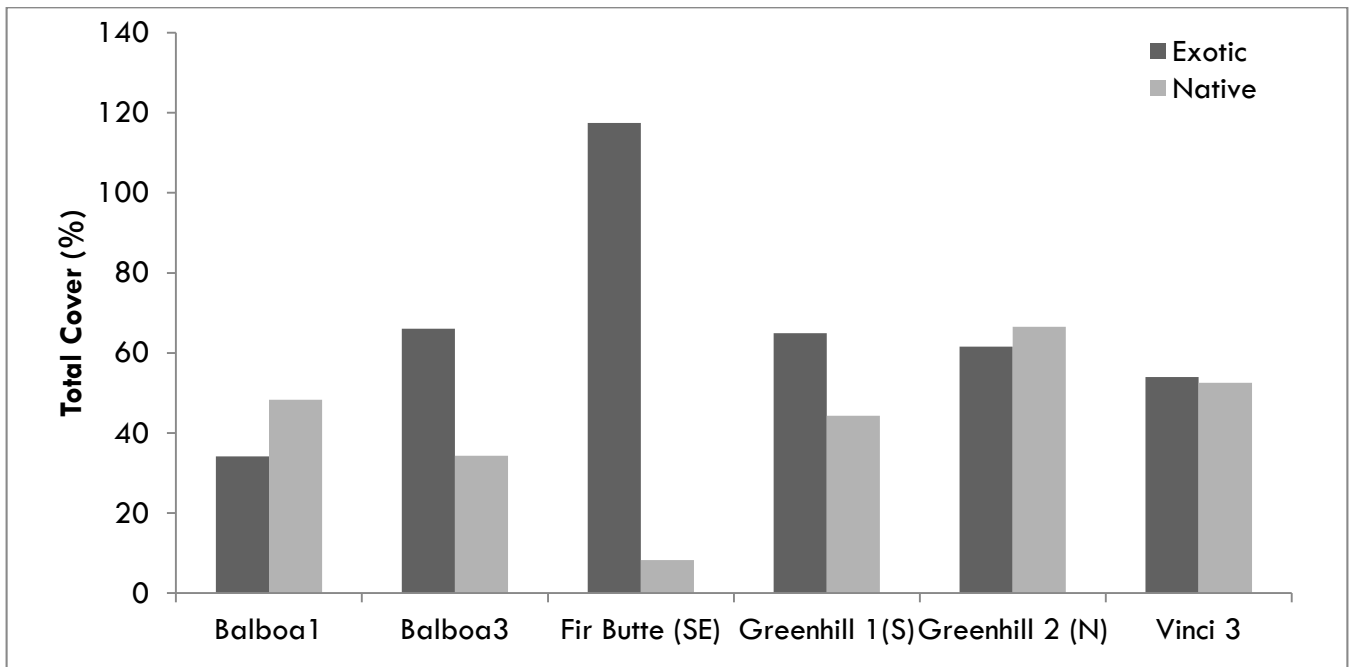


Figure 10. Total cover (%) of Introduced and native species at all sites monitored in May 2012.

Despite management efforts, the cover of invasive species and litter layer exceeded the threshold values for management at every site (Table 4, Figure 10). The threshold for woody vegetation cover was not exceeded at any site. Although we did not document detrimental impacts on native forbs, it is likely that the litter is inhibiting their germination and establishment. For example, cover of *L. oreganus* was less than 2% at Fir Butte (Appendix A), where litter cover far exceeded 50% (Table 3). While litter may inhibit native species, it could inhibit weed seed germination and establishment. Therefore, any management activities to remove litter should be followed by extensive weed control and seeding of native species. Native species composed more than 50% cover at Greenhill 2 and Vinci 3.

While monitoring in different months makes it difficult to make conclusions about changes in community composition from 2009 & 2010 to 2012, it does provide information that may be used for future management activities including the species that are present over the course of the growing season. Weed control efforts can be timed so that they are implemented when particular species are most abundant.

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APPENDIX A. SPECIES FOUND IN SAMPLED PLOTS, 2012

Nativity	Functional Group	Species						
			Balboa 1	Balboa 3	Fir Butte	Greenhill 1 (S)	Greenhill 2 (N)	Vinci 3
Exotic	Forb	<i>Vicia hirsuta</i>	0.0	0.4	2.4	0.4	0.0	0.5
Exotic	Forb	<i>Vicia sativa</i>	0.0	1.7	7.8	5.7	2.5	4.7
Exotic	Forb	<i>Vicia sp.</i>	0.0	0.0	1.5	0.4	0.0	0.0
Exotic	Forb	<i>Brassica rapa</i>	0.5	0.0	0.5	0.0	0.0	0.5
Exotic	Forb	<i>Rubus armeniacus</i>	0.0	0.0	5.3	0.0	1.5	0.5
Exotic	Forb	<i>Rubus laciniatus</i>	0.0	0.0	0.5	0.0	0.0	0.0
Exotic	Forb	<i>Cerastium glomeratum</i>	0.0	0.0	1.9	0.0	0.0	0.0
Exotic	Forb	<i>Myosotis discolor</i>	0.9	1.3	3.9	1.8	1.0	2.8
Exotic	Forb	<i>Rubus sp.</i>	0.0	0.0	0.5	0.0	0.0	0.0
Exotic	Forb	<i>Galium parisiense</i>	0.5	5.2	3.4	0.0	1.5	0.0
Exotic	Forb	<i>Plantago lanceolata</i>	0.0	1.3	1.5	0.9	1.0	0.9
Exotic	Forb	<i>Parentucellia viscosa</i>	0.0	0.9	0.5	0.0	0.0	0.5
Exotic	Forb	<i>Hypochaeris radicata</i>	5.7	3.4	0.0	6.6	3.9	8.0
Exotic	Forb	<i>Lactuca sp.</i>	0.0	0.0	0.0	0.4	0.0	0.0
Exotic	Forb	<i>Leucanthemum vulgare</i>	2.4	3.9	0.0	1.8	5.4	0.9
Exotic	Forb	<i>Centarium erythraeae</i>	1.9	3.0	0.0	0.4	2.0	0.5
Exotic	Forb	<i>Draba verna</i>	0.5	0.0	0.0	0.0	0.0	0.0
Exotic	Forb	<i>Cirsium vulgare</i>	0.5	0.0	0.0	0.0	0.0	0.0
Exotic	Forb	<i>Mentha pulegium</i>	0.9	0.0	0.0	0.4	1.0	1.9
Exotic	Forb	<i>Daucus carota</i>	0.0	0.4	0.0	3.1	0.5	0.0
Exotic	Forb	<i>Geranium dissectum</i>	0.0	0.0	0.0	0.9	0.0	1.4
Exotic	Graminoid	<i>Dactylis glomerata</i>	0.0	0.4	3.4	0.0	3.0	0.0
Exotic	Graminoid	<i>Agrostis stolonifera</i>	0.5	10.3	68.4	4.4	2.5	3.8
Exotic	Graminoid	<i>Schedonorus phoenix</i>	0.9	17.2	7.8	14.9	19.7	7.5
Exotic	Graminoid	<i>Holcus lanatus</i>	0.5	0.4	2.4	4.8	1.0	1.9
Exotic	Graminoid	<i>Agrostis exarata</i>	0.0	0.0	0.5	0.0	0.0	0.0
Exotic	Graminoid	<i>Anthoxanthum odoratum</i>	12.8	11.6	4.9	5.7	6.9	4.7

Nativity	Functional Group	Species						Greenhill 1	Greenhill 2	Vinci 3
			Balboa 1	Balboa 3	Fir Butte	(S)	(N)			
Exotic	Graminoid	<i>Bromus</i> sp.	0.0	0.0	0.5	0.4	0.0	0.5		
Exotic	Graminoid	<i>Aira caryophylla</i>	0.5	0.4	0.0	0.0	0.0	0.5		
Exotic	Graminoid	<i>Bromus hordeaceus</i>	0.5	0.0	0.0	0.4	0.0	0.9		
Exotic	Graminoid	<i>Panicum capillera</i>	0.0	0.4	0.0	0.4	0.0	2.3		
Exotic	Graminoid	<i>Alopecurus pratensis</i>	0.0	0.0	0.0	7.5	0.0	6.6		
Exotic	Graminoid	<i>Phalaris arundinacea</i>	0.0	0.0	0.0	1.3	0.0	0.5		
Exotic	Shrub	<i>Crataegus monogyna</i>	0.5	0.0	0.0	0.0	0.0	0.0		
Exotic	Shrub	<i>Rosa eglanteria</i>	4.3	3.9	0.0	1.8	8.4	1.9		
Exotic	Shrub	<i>Pyrus communis</i>	0.0	0.0	0.0	0.4	0.0	0.0		
Native	Forb	<i>Zigadenus venenosus</i> var. <i>venenosus</i>	0.0	0.0	2.4	0.4	1.0	0.5		
Native	Forb	<i>Galium aparine</i>	0.0	0.0	1.5	0.0	0.0	0.0		
Native	Forb	<i>Brodiaea</i> sp.	4.3	0.4	1.0	5.7	19.2	7.0		
Native	Forb	<i>Lupinus oreganus</i>	0.0	0.0	1.0	0.0	0.0	0.0		
Native	Forb	<i>Pteridium aquilinum</i>	0.0	0.0	2.4	0.0	0.0	0.0		
Native	Forb	<i>Symphyotrichum hallii</i>	5.7	2.6	0.0	2.6	3.4	4.7		
Native	Forb	<i>Camassia quamash</i> var. <i>maxima</i>	3.3	2.1	0.0	5.7	8.4	2.3		
Native	Forb	<i>Potentilla gracilis</i> var. <i>gracilis</i>	0.9	0.0	0.0	0.0	1.0	1.4		
Native	Forb	<i>Lotus formosissimus</i>	0.5	0.0	0.0	0.0	1.5	0.9		
Native	Forb	<i>Prunella vulgaris</i> var. <i>lanceolata</i>	0.5	2.1	0.0	0.9	2.0	2.3		
Native	Forb	<i>Lomatium</i> sp.	0.9	0.0	0.0	0.9	0.5	1.9		
Native	Forb	<i>Microseris laciniata</i>	0.9	0.0	0.0	0.0	0.0	0.5		
Native	Forb	<i>Saxifraga oregana</i>	0.9	0.4	0.0	0.9	5.4	3.3		
Native	Forb	<i>Eriophyllum lanatum</i> var. <i>lanatum</i>	0.0	0.4	0.0	0.4	0.0	0.5		
Native	Forb	<i>Grindelia integrifolia</i>	0.0	0.0	0.0	0.4	0.0	1.4		
Native	Forb	<i>Sisyrinchium bellum</i>	0.0	0.0	0.0	0.4	0.0	0.5		
Native	Forb	<i>Cardamine oligosperma</i>	0.0	0.0	0.0	0.4	0.0	0.0		
Native	Forb	<i>Wyethia angustifolia</i>	0.0	0.0	0.0	1.3	0.0	0.9		
Native	Forb	<i>Epilobium</i> sp.	0.0	0.0	0.0	2.2	1.0	0.5		

Nativity	Functional		Balboa 1	Balboa 3	Fir Butte	Greenhill 1	Greenhill 2	Vinci 3
	Group	Species				(S)	(N)	
Native	Forb	<i>Plagiobothrys figuratus</i>	0.0	0.0	0.0	0.4	0.0	0.5
Native	Forb	<i>Epilobium brachycarpum</i>	0.0	0.0	0.0	0.0	0.0	0.5
Native	Forb	<i>Perideridia gairdneri</i> ssp. <i>borealis</i>	0.0	0.0	0.0	0.0	0.0	0.5
Native	Forb	<i>Perideridia oregna</i>	0.0	0.0	0.0	0.0	0.5	0.0
Native	Forb	<i>Sericocarpus rigidus</i>	0.0	0.0	0.0	0.0	1.0	0.0
Native	Forb	<i>Sidalcea virgata</i>	0.0	0.0	0.0	0.0	1.0	0.0
Native	Forb	<i>Achillia millifolium</i>	0.0	0.0	0.0	0.0	0.5	0.0
Native	Graminoid	<i>Deschampsia cespitosa</i>	20.9	12.9	0.0	11.8	7.4	13.1
Native	Graminoid	<i>Danthonia californica</i>	7.1	5.2	0.0	4.4	11.8	5.2
Native	Graminoid	<i>Carex unilateralis</i>	1.4	0.0	0.0	0.0	0.0	0.0
Native	Graminoid	<i>Luzula comosa</i>	0.5	0.0	0.0	0.4	1.0	0.5
Native	Graminoid	<i>Juncus tenuis</i>	0.0	1.3	0.0	0.9	0.0	0.9
Native	Graminoid	<i>Carex obnupta</i>	0.0	6.0	0.0	0.0	0.0	0.0
Native	Graminoid	<i>Carex</i> sp.	0.0	0.9	0.0	3.1	0.0	2.3
Native	Shrub	<i>Fraxinus latifolia</i>	0.5	0.0	0.0	0.4	0.0	0.0
Native	Shrub	<i>Rosa pisocarpa</i>	0.0	0.0	0.0	0.4	0.0	0.5

APPENDIX B. AERIAL PHOTOS AND IMAGES OF MONITORING SITES, 2012.







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