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

2009 Report

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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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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The West Eugene Wetlands (WEW) Project is a cooperative venture by the Bureau of Land Management, 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 (USDI 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. 0R090-0503, Alternative D, pages 58-61).

The purpose of this project was to conduct monitoring at five sites, Balboa 1, Balboa 3, Fir Butte, Oxbow West, and Vinci, to assess whether they were within the habitat guidelines.

Sites

Balboa

Balboa encompasses 74.1 acres and includes populations of the Bureau Sensitive and USFWS listed species *Sericocarpus rigidus* (= *Aster curtus*), *Erigeron decumbens, Lomatium bradshawii* and *Horkelia congesta* ssp. *congesta*. 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.

Fir Butte

Fir Butte is an 18 acre prairie remnant owned by the Eugene District BLM. 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 sulphureus* ssp. *kincaidii* occurs here. This site also supports a relatively large population of the endangered Fender's blue butterfly (*Icaricia icarioides fenderi*). *Lupinus sulphureus ssp. kincaidii* serves as the obligate host plant for *Icaricia 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.

Oxbow West

The overall habitat quality of the remnant prairie at Oxbow West is good, and ongoing management efforts have helped reduce encroachment by woody species including *Pyrus communis*, *Fraxinus latifolia*, *Populus trichocarpa*, and other shrubs. Efforts are also being made to eradicate *Phalaris arundinacea,* an invasive graminoid that is expanding into the prairie from adjacent wet areas. Oxbow West supports a number of rare species, including *Erigeron decumbens*, *Lupinus sulphureus* ssp. *kincaidii*, *Cicendia quadrangularis*, and *Sidalcea cusickii*. The habitat has also been noted as having high potential for reintroduction of *Lomatium bradshawii*. The federally endangered *Erigeron decumbens* is the most abundant rare plant at Oxbow West, occupying approximately five acres. Maintaining and improving the prairie habitat is the main objective for management at Oxbow West. Management treatments have included mowing (initiated in 2002) and burning (treated in September 2005).

Vinci

Vinci is a relatively large parcel containing both wet prairie and vernal pool habitats. 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*.

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 July 2009, five sites were sampled to estimate vegetation cover in the West Eugene Wetlands; Fir Butte, Oxbow West, and Vinci each contained one site and Balboa contained two sites (Figure 1). Plot dimensions varied by site and were based on established infrastructure (e.g. conduit or other permanent markers). 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 1). The origin was placed in the southeast corner of each plot (Figure 2). In all plots, the first transect running perpendicular to the baseline was randomly located between 0m and 5m. Subsequent transects were placed every 2m (Oxbow West), 3m (Balboa 3), 4m (Balboa 1, Vinci), or 7m (Fir Butte) along the baseline. The first sample point along each transect was randomly located between 0m and 2m. Sampling points were then systematically located every 2m (Balboa 3) or 3m (Balboa 1, Fir Butte, Oxbow West, Vinci).

We used a monopod that utilized a laser light (Synergy Resource Solutions, Inc.) to sample the vegetation at each point. We were able to adjust 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).

Species nomenclature, habit, and native status 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. The timing of our surveys (July) meant that we missed many early-season species, including some of those that are listed threatened and endangered. In order to document all species at a site, surveys should take place at multiple times throughout the growing season.

Table 1. Characteristics of the habitat sampling plots.

Site	Plot origin (Lat/Longs, WGS 84)	Plot dimensions	# samples
Balboa			
Site 1	44.053450, 123.181431	60m x 37m	204
Site 3	44.051556, 123.180491	51m x 22m	207
Fir Butte	44.077712, 123.230943	82m x 50m	204
Oxbow West	44.054518, 123.187915	39m x 30m	211
Vinci	44.053138, 123.198425	64m x 37m	207

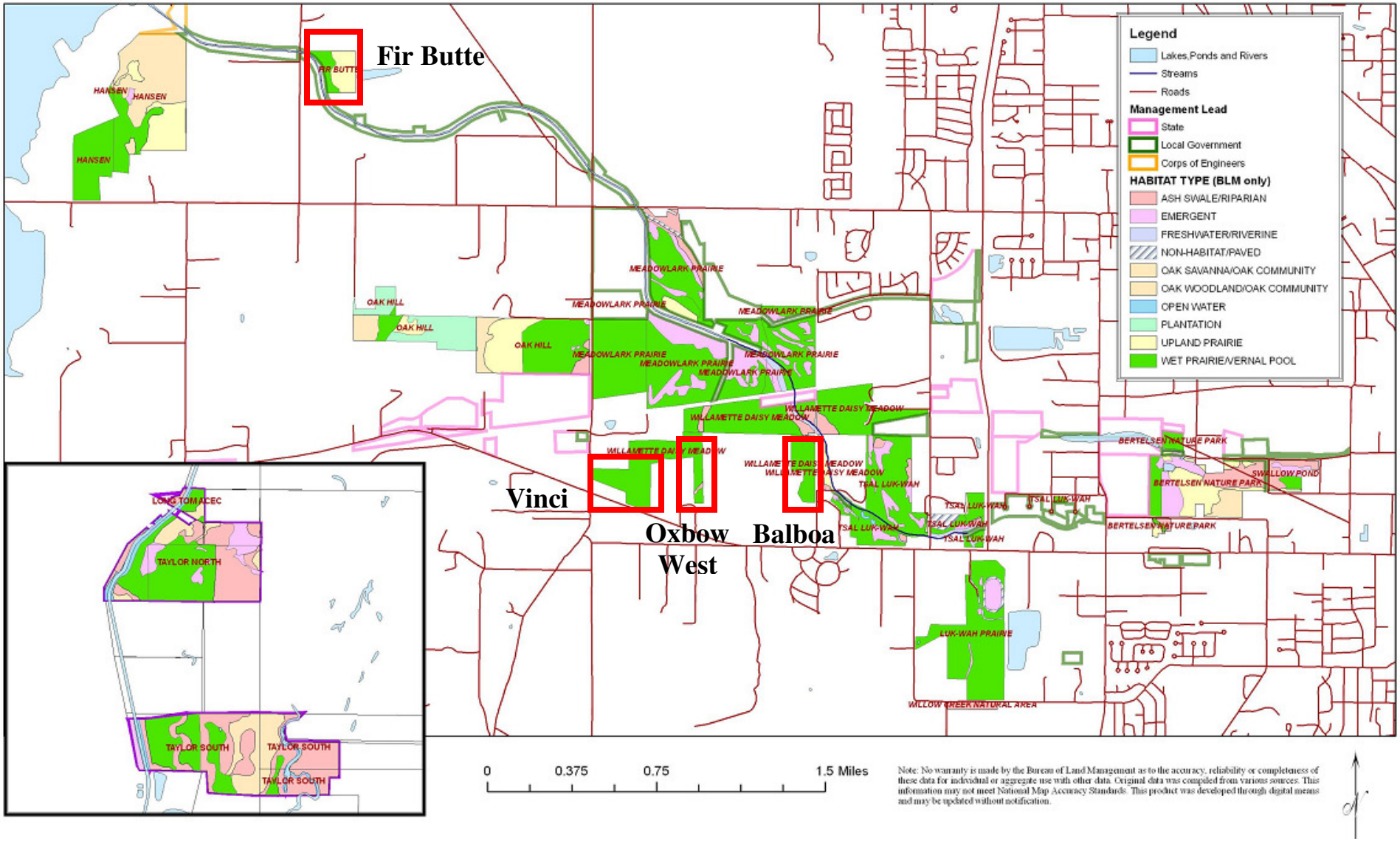

Figure 1. Monitoring sites described in this project (Balboa, Fir Butte, Oxbow West, and Vinci). Sites are labeled and outlined. Map describes plant communities at these and other sites in the West Eugene Wetlands (USDI BLM 2005).

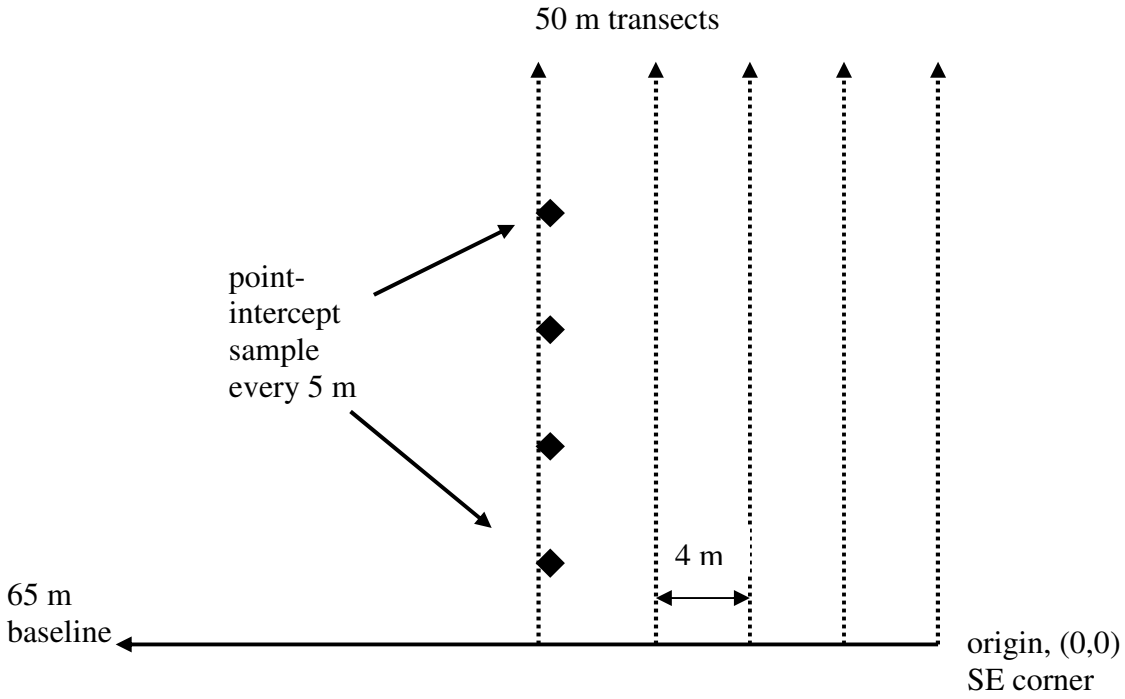

Figure 2. Example design of a sampling plot.

RESULTS AND DISCUSSION

Sites

Balboa

The vegetation at Balboa 1 was dominated by the cover of introduced species. Introduced species were more abundant in terms of cover and richness in the forb and graminoid vegetation classes, while native shrub and tree species richness and cover was greater and equal, respectively (Figure 3). The introduced species with the highest cover included the forbs *Hypochaeris radicata* (17%), *Leucanthemum vulgare* (14%), and *Galium parisiense* (5%), the graminoids *Anthoxanthum odoratum* (20%), *Aira caryophyllea* (17%), and *Festuca arundinacea* (5%), and the shrub *Rubus armeniacus* (4%). The covers of each of the other introduced species were under 2%. The native species with the highest cover included the forbs *Aster hallii* (6%), *Prunella vulgaris* var. *lanceolata* (6%), and *Grindelia integrifolia* (4%), the graminoids *Deschampsia cespitosa* (31%), *Danthonia californica* (9%), and *Juncus tenuis* (4%), and the shrub *Rosa gymnocarpa* (7%). All of the other native species present had less than 4% cover each (Appendix A).

Balboa 3 was also dominated by introduced species in terms of overall cover and species richness, though native shrubs had slightly higher cover than introduced species (Figure 4). No tree species were present. The introduced species with the highest cover included the forbs *Leucanthemum vulgare* (12%), *Galium parisiense* (11%), and *Daucus carota* (8%) and the graminoids *Anthoxanthum odoratum* (20%), *Agrostis capillaris* (15%), and *Festuca arundinacea* (13%). All of the other introduced species each had covers less than 5%. The native species with the highest cover included the forb *Grindelia integrifolia* (4%), the graminoids *Deschampsia cespitosa* (28%), *Danthonia californica* (11%), and *Carex obnupta* (9%), and the shrub *Rosa gymnocarpa* (5%). All other native species had less than 3% cover each (Appendix A).

Both sampling sites at Balboa had high cover of litter. At Balboa 1, organic materials covered 82% and bare ground (mineral soil) covered 18% of the ground surface. Balboa 3 had 93% litter cover and 6% bare ground. The third ground cover category, moss, comprised only 1% or less of the ground cover at the Balboa sites.

Table 2. Cover of bare ground, litter, and moss at study sites in the West Eugene Wetlands.

	Site				
	Balboa 1	**Balboa 3**	**Fir Butte**	**Oxbow West**	**Vinci**
Bare ground	17.6	6.3	8.8	3.3	12.6
Litter	81.9	92.8	90.7	94.3	87.4
Moss	1.0	0.5	0.0	2.4	0.0

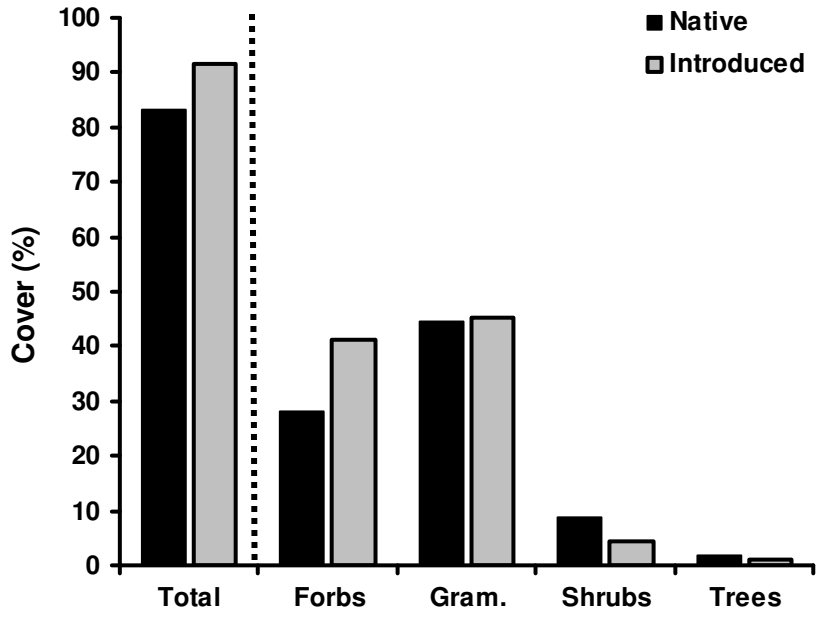

Figure 3. Percent cover of native and introduced species divided into growth habits at **Balboa 1** in the West Eugene Wetlands. The total cover of all of the growth habits is left of the dotted line, while each part is to the right. "Gram." is an abbreviation for graminoids.

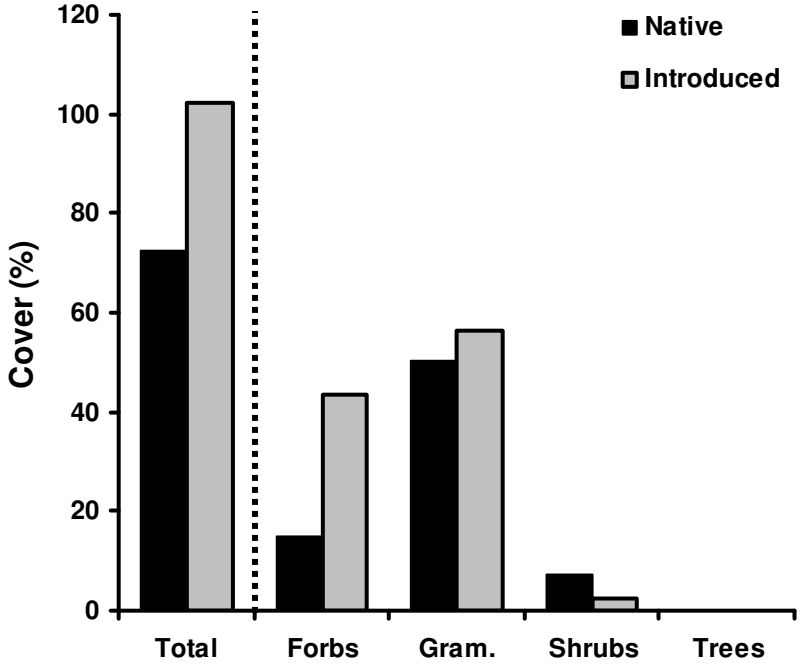

Figure 4. Percent cover of native and introduced species divided into growth habits at **Balboa 3** in the West Eugene Wetlands. The total cover of all of the growth habits is left of the dotted line, while each part is to the right. "Gram." is an abbreviation for graminoids. No tree species were present at this site.

Fir Butte

The meadow habitat at Fir Butte was overrun with introduced species. Of the 25 species present in the sample plot, 20 were introduced and 5 were native. All of the native species were forbs, while the introduced species were forbs (8 species), graminoids (11 species), and shrubs (1 species). The combined cover of the introduced species was more than 15x the combined cover of the native species (Figure 5). The most abundant native species were the forbs *Pteridium aquilinum* (6%) and *Lupinus sulphureus* ssp. *kincaidii* (3%). The other three native forbs present had less than 1% cover each. The most abundant introduced species included the forbs *Vicia sativa* (30%), *Galium parisiense* (16%), and *Daucus carota* (13%), the graminoids *Agrostis capillaris* (82%), *Vulpia bromoides* (7%), and *Holcus lanatus* (4%), and the shrub *Rubus armeniacus* (16%). The cover values of all of the other introduced species were less than 4%. While *Pteridium aquilinum* is considered a native forb in this study, it often acts as a weedy species in historically disturbed meadows such as Fir Butte, in part because the site characteristics and historical disturbance regime promote its rhizomatous habit.

Both the shrub cover (16%) and the litter cover (91%) at Fir Butte exceeded the thresholds for upland prairie habitats (see Summary below & Table 2). If the *Rubus armeniacus* cover is not controlled, it may quickly overgrow the meadow. The thick layer of litter may inhibit seed germination and establishment of native species, especially *Lupinus sulphureus* ssp. *kincaidii*.

Oxbow West

While there were more introduced species (17) than native species (13) at Oxbow West, the cover of native species was 160% that of introduced species and higher in every growth habit category (excluding trees, of which there were none; Figure 6). The most abundant native species were the forbs *Fragaria virginiana* (57%) and *Lotus purshianus* (4%), the graminoids *Deschampsia cespitosa* (37%) and *Dichanthelium acuminatum* (11%), and the shrub *Amelanchier alnifolia* (7%). The cover of all other native species was less than 3% each. The most abundant introduced species were the forbs *Daucus carota* (17%), *Cirsium* sp. (7%), and *Hypochaeris radicata* (4%), the graminoids *Anthoxanthum odoratum* (15%) and *Bromus hordeaceus* ssp. *hordeaceus* (13%), and the shrub *Cytisus scoparius* (5%). No other introduced species had a cover value greater than 3% (Appendix A).

Both litter cover and cover by woody species exceeded the thresholds for this habitat type (see Summary below). Total cover by woody species at Oxbow West was 16%. Litter cover was higher than in any other site sampled in 2009 (94%), while only marginal amounts of bare ground cover (3%) and moss cover (2%) were present (Table 2).

Vinci

Both total cover and richness of introduced species were higher than that of native species at Vinci. Although the cover of introduced species (111%) was more than 2.5x the cover of native species (39%), the cover of native forbs (37%) was slightly higher than the cover of introduced forbs (31%; Figure 7). The imbalance between total cover values is a manifestation of the absence of native graminoid and tree species. The most abundant introduced species were the forbs *Geranium dissectum* (16%), *Cirsium vulgare*

(7%), and *Leontodon taraxacoides* (5%), the graminoids *Bromus sterilis* (34%), *Briza minor* (9%), and *Cynosurus echinatus* (5%), the shrub *Cytisus scoparius* (6%), and the tree *Pyrus communis* (13%). All other introduced species had covers less than 4% each. The most abundant native species included the forbs *Aster hallii* (12%), *Eriophyllum lanatum* var. *lanatum* (5%), and *Epilobium* species (5%). No other native species exceeded 4% in cover, and no native tree species were present (Appendix A).

Both the cover of woody species and the litter cover exceeded recommended threshold values at Vinci. The total woody cover was 20% and dominated by the invasive species *Cytisus scoparius* and *Pyrus communis.* Litter at the site composed 87% of the non-vegetated ground cover while bare ground comprised the remaining 13% (Table 2).

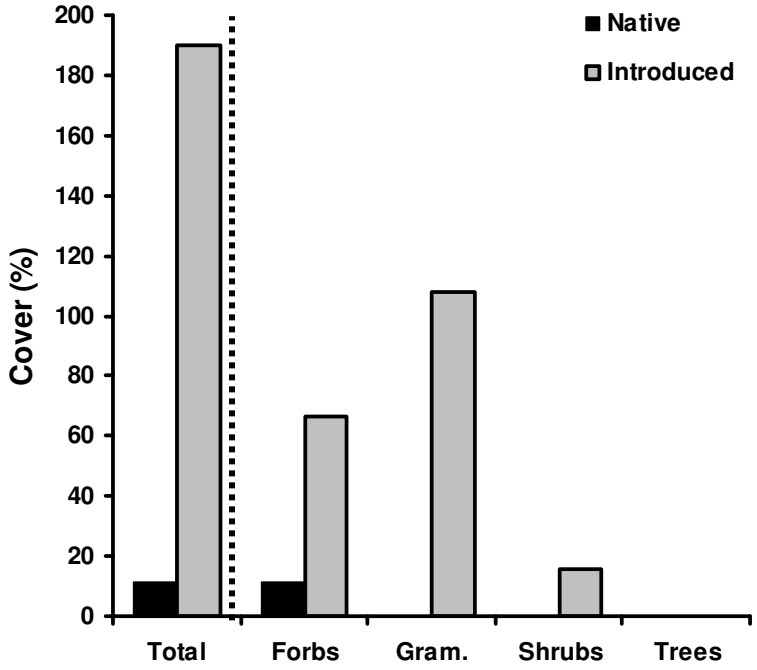

Figure 5. Percent cover of native and introduced species divided into growth habits at **Fir Butte** in the West Eugene Wetlands. The total cover of all of the growth habits is left of the dotted line, while each part is to the right. "Gram." is an abbreviation for graminoids. No tree species or native graminoids and shrubs were present at this site.

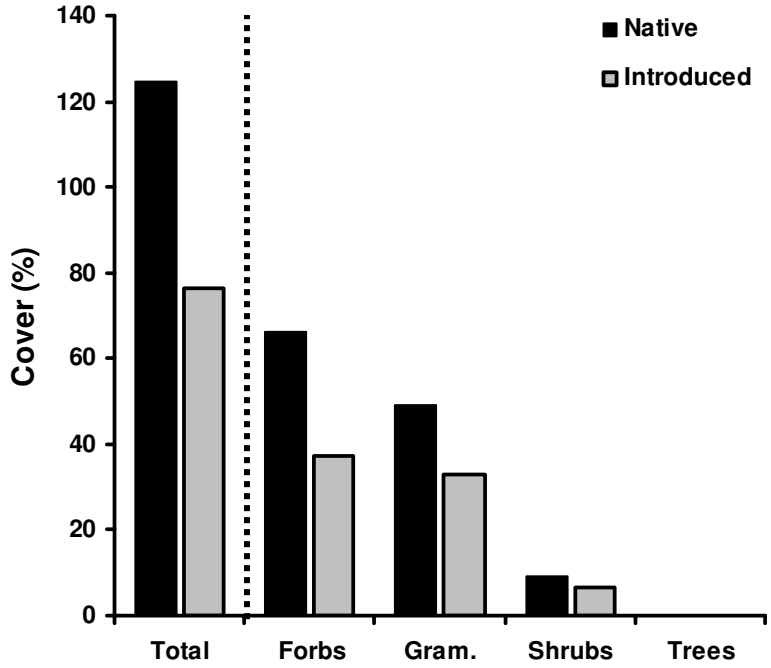

Figure 6. Percent cover of native and introduced species divided into growth habits at **Oxbow West** in the West Eugene Wetlands. The total cover of all of the growth habits is left of the dotted line, while each part is to the right. "Gram." is an abbreviation for graminoids. No tree species were present at this site.

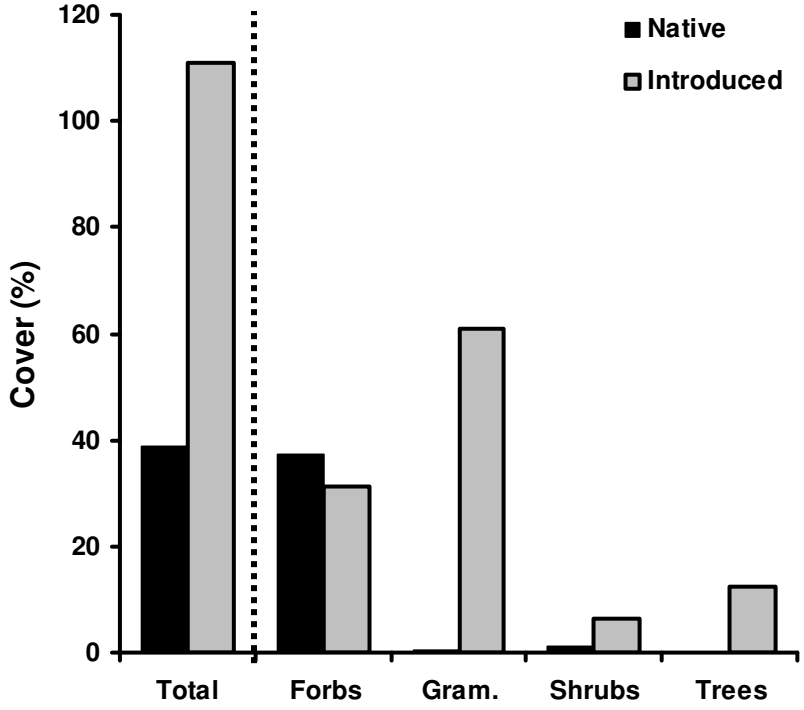

Figure 7. Percent cover of native and introduced species divided into growth habits at **Vinci** in the West Eugene Wetlands. The total cover of all of the growth habits is left of the dotted line, while each part is to the right. "Gram." is an abbreviation for graminoids. No native tree species were present at this site.

SUMMARY

The Draft Recovery objectives from the Western Oregon and Southwestern Oregon Prairie Species Recovery Plan (USFWS 2006) specify that within habitat for *Lupinus sulphureus* ssp. *kincaidii*, *Erigeron decumbens* var. *decumbens*, and *Lomatium bradshawii*, there is to be ≥50% relative cover of non-woody natives at 70% of local populations, ≤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 the EA, 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
Woody vegetation	Balboa 1	16% cover of woody species
	Balboa 3	10% cover of woody species
	Fir Butte	16% cover of woody species
	Oxbow West	16% cover of woody species
	Vinci	20% cover of woody species
Invasive species	Balboa 1	92% cover of introduced species
	Balboa 3	102% cover of introduced species
	Fir Butte	190% cover of introduced species
	Oxbow West	77% cover of introduced species
	Vinci	111% cover of introduced species
Thatch	Balboa 1	82% cover of litter
	Balboa 3	93% cover of litter
	Fir Butte	91% cover of litter
	Oxbow West	94% cover of litter
	Vinci	87% cover of litter

The cover of invasive species, woody vegetation, and the litter layer exceeded the threshold values for management at every site. Although we did not document detrimental impacts on native forbs, it is likely that the litter is inhibiting their germination and establishment. However, this litter layer may also 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. Finally, non-woody native species compose ≥50% relative cover only at one site, Oxbow West.

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APPENDIX A. SPECIES FOUND IN SAMPLED PLOTS, 2009.

Abbreviations: "Intro." = Introduced; "Gram." = Gram.

Species	Native Status	Growth Habit	Family	% Cover (lower-upper 90% C.I.)				
				Balboa 1	Balboa 3	Fir Butte	Oxbow West	Vinci
Agoseris species	Native	Forb	Asteraceae	0.5 (0.03-2.3)	0	0	0	0
Agrostis capillaris	Intro.	Gram.	Poaceae	1.5 (0.4-3.8)	15.0 (11.1-19.7)	81.9 (76.8-86.2)	11.8 (8.4-16.2)	0.5 (0.03-2.3)
Aira caryophyllea	Intro.	Gram.	Poaceae	17.2 (13.0-22.1)	3.4 (1.6-6.3)	2.5 (1.0-5.1)	10.9 (7.6-15.1)	7.2 (4.5-10.9)
Allium species	Native	Forb	Liliaceae	0	0.5 (0.03-2.3)	0	0	0
Alopecurus pratensis	Intro.	Gram.	Poaceae	0	0.5 (0.03-2.3)	0	0	0
Amelanchier alnifolia	Native	Shrub	Rosaceae	0.5 (0.03-2.3)	0	0	0	0
Anthoxanthum odoratum	Intro.	Gram.	Poaceae	20.1 (15.6-25.3)	20.3 (15.8-25.4)	2.0 (0.7-4.4)	0	16.4 (12.3-21.3)
Arrhenatherum elatius	Intro.	Gram.	Poaceae	0	0	3.4 (1.6-6.3)	0	0
Aster curtus	Native	Forb	Asteraceae	0.5 (0.03-2.3)	0	0	0	1.0 (0.2-3.0)
Aster hallii	Native	Forb	Asteraceae	6.4 (3.8-9.9)	2.4 (1.0-5.0)	0	0	4.8 (2.6-8.1)
Avena fatua	Intro.	Gram.	Poaceae	0	0	1.5 (0.4-3.8)	0	0
Briza minor	Intro.	Gram.	Poaceae	0	3.9 (1.9-6.9)	0.5 (0.03-2.3)	0	1.4 (0.4-3.7)
Bromus hordeaceus ssp. *hordeaceus*	Intro.	Gram.	Poaceae	0	0	1.5 (0.4-3.8)	0	0
Bromus sterilis	Intro.	Gram.	Poaceae	0	0	2.9 (1.3-5.7)	0	0
Carex obnupta	Native	Gram.	Cyperaceae	0	8.7 (5.7-12.6)	0	0	0
Centaurium erythraea	Intro.	Forb	Gentianaceae	0.5 (0.03-2.3)	1.0 (0.2-3.0)	0	0	0
Cirsium species	Intro.	Forb	Asteraceae	0.5 (0.03-2.3)	0	0	0	0
Cirsium vulgare	Intro.	Forb	Asteraceae	0	0.5 (0.03-2.3)	0	0	0
Clarkia species	Native	Forb	Onagraceae	0	0	0.5 (0.03-2.3)	0	0
Crataegus douglasii	Native	Shrub	Rosaceae	0.5 (0.03-2.3)	2.4 (1.0-5.0)	0	0	2.9 (1.3-5.6)
Crataegus monogyna	Intro.	Shrub	Rosaceae	0	0.5 (0.03-2.3)	0	0	0.5 (0.03-2.3)
Cynosurus echinatus	Intro.	Gram.	Poaceae	0	0	0.5 (0.03-2.3)	0.5 (0.03-2.2)	0
Cytisus scoparius	Intro.	Shrub	Fabaceae	0	0	0	0.9 (0.2-3.0)	0
Dactylis glomerata	Intro.	Gram.	Poaceae	0.5 (0.03-2.3)	0	0	0	0

Appendix A (cont.): All species found in five plots sampled in the West Eugene Wetlands in 2009.
Abbreviations: "Intro." = Introduced; "Gram." = Gram.

Species	Native Status	Growth Habit	Family	% Cover (lower-upper 90% C.I.)				
				Balboa 1	Balboa 3	Fir Butte	Oxbow West	Vinci
Danthonia californica	Native	Gram.	Poaceae	9.3 (6.2-13.4)	10.6 (7.3-14.8)	0	0.9 (0.2-3.0)	9.2 (6.1-13.2)
Daucus carota	Intro.	Forb	Apiaceae	0	7.7 (4.9-11.5)	13.2 (9.5-17.8)	2.8 (1.2-5.5)	1.9 (0.7-4.4)
Deschampsia cespitosa	Native	Gram.	Poaceae	30.9 (25.6-36.6)	28.0 (22.9-33.6)	0	1.4 (0.4-3.6)	34.3 (28.8-40.1)
Dichanthelium acuminatum	Native	Gram.	Poaceae	0	0	0	0	5.3 (3.0-8.6)
Dipsacus fullonum	Intro.	Forb	Dipsacaceae	0	0.5 (0.03-2.3)	0	0	0
Elymus species	Native	Gram.	Poaceae	0	0	0	0.5 (0.03-2.2)	0
Epilobium species	Native	Forb	Onagraceae	0	0.5 (0.03-2.3)	0	0	0
Eriophyllum lanatum var. *lanatum*	Native	Forb	Asteraceae	2.0 (0.7-4.4)	0.5 (0.03-2.3)	0	0	3.4 (1.6-6.3)
Festuca arundinacea	Intro.	Gram.	Poaceae	5.4 (3.1-8.8)	12.6 (9.0-17.0)	0	66.8 (61.1-72.2)	2.4 (1.0-5.0)
Fraxinus latifolia	Native	Tree	Oleaceae	2.0 (0.7-4.4)	0	0	0	1.0 (0.2-3.0)
Fragaria virginiana	Native	Forb	Rosaceae	0	0	0	0.5 (0.03-2.2)	0.5 (0.03-2.3)
Galium parisiense	Intro.	Forb	Rubiaceae	4.9 (2.7-8.2)	10.6 (7.3-14.8)	16.2 (12.1-21.0)	10.0 (6.8-14.0)	5.8 (3.4-9.2)
Geranium dissectum	Intro.	Forb	Geraniaceae	0.5 (0.03-2.3)	1.0 (0.2-3.0)	1.0 (0.2-3.1)	0	0
Gilia capitata	Native	Forb	Polemoniaceae	0	0	1.0 (0.2-3.1)	0	0
Grindelia integrifolia	Native	Forb	Asteraceae	4.4 (2.3-7.6)	3.9 (1.9-6.9)	0	0	12.6 (9.0-17.0)
Heracleum lanatum	Native	Forb	Apiaceae	0	0	0	1.9 (0.7-4.3)	0
Holcus lanatus	Intro.	Gram.	Poaceae	0	0	4.4 (2.3-7.6)	0	0.5 (0.03-2.3)
Hypericum perforatum	Intro.	Forb	Clusiaceae	0.5 (0.03-2.3)	0	0	0	0.5 (0.03-2.3)
Hypochaeris radicata	Intro.	Forb	Asteraceae	16.7 (12.5-21.6)	3.9 (1.9-6.9)	2.5 (1.0-5.1)	1.9 (0.7-4.3)	11.6 (8.1-15.9)
Juncus tenuis	Native	Gram.	Juncaceae	4.4 (2.3-7.6)	2.9 (1.3-5.6)	0	0	1.4 (0.4-3.7)
Leontodon taraxacoides	Intro.	Forb	Asteraceae	0	0	0	0	4.8 (2.6-8.1)
Leucanthemum vulgare	Intro.	Forb	Asteraceae	13.7 (9.9-18.3)	11.6 (8.1-15.9)	0	6.2 (3.7-9.6)	5.3 (3.0-8.6)
Linum bienne	Intro.	Forb	Linaceae	2.0 (0.7-4.4)	1.0 (0.2-3.0)	0	2.4 (0.9-4.9)	2.9 (1.3-5.6)
Lotus purshianus	Native	Forb	Fabaceae	1.0 (0.2-3.1)	1.9 (0.7-4.4)	0	0	0

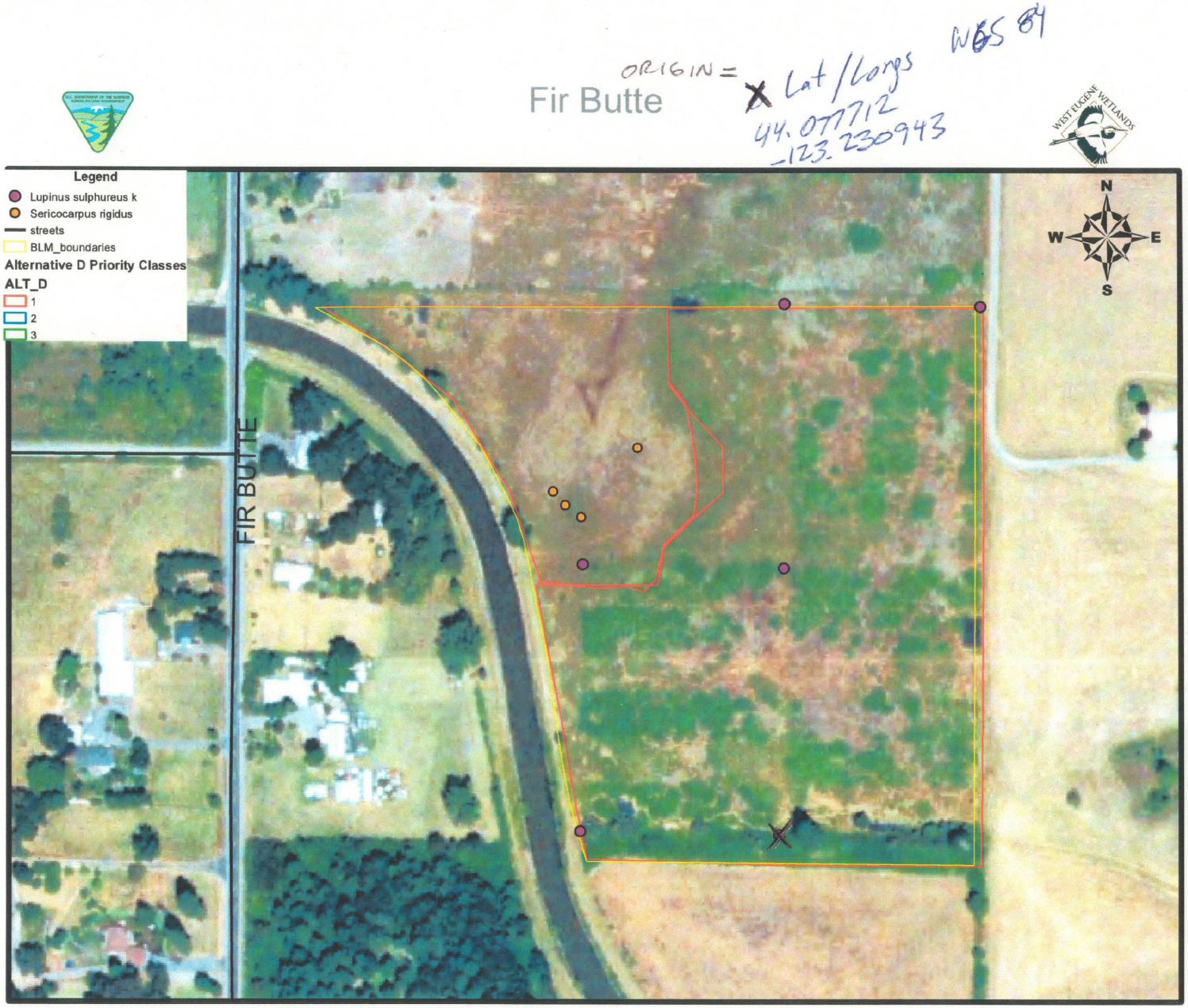
Appendix A (cont.): All species found in five plots sampled in the West Eugene Wetlands in 2009.
Abbreviations: "Intro." = Introduced; "Gram." = Gram.

Species	Native Status	Growth Habit	Family	% Cover (lower-upper 90% C.I.)				
				Balboa 1	Balboa 3	Fir Butte	Oxbow West	Vinci
Lupinus sulphureus ssp. *kincaidii*	Native	Forb	Fabaceae	0	0	2.9 (1.3-5.7)	6.6 (4.1-10.2)	0
Madia gracilis	Native	Forb	Asteraceae	3.9 (2.0-7.0)	1.4 (0.4-3.7)	0	0	0
Myosotis discolor	Intro.	Forb	Boraginaceae	0.5 (0.03-2.3)	0.5 (0.03-2.3)	1.0 (0.2-3.1)	2.8 (1.2-5.5)	0.5 (0.03-2.3)
Perideridia gairdneri	Native	Forb	Apiaceae	0	0.5 (0.03-2.3)	0	0	0
Phalaris arundinacea	Intro.	Gram.	Poaceae	0.5 (0.03-2.3)	0	0	0.9 (0.2-3.0)	0
Plantago lanceolata	Intro.	Forb	Plantaginaceae	0.5 (0.03-2.3)	0	0	0.9 (0.2-3.0)	3.9 (1.9-6.9)
Poa pratensis	Intro.	Gram.	Poaceae	0	0.5 (0.03-2.3)	0	0.5 (0.03-2.2)	0
Potentilla gracilis var. *gracilis*	Native	Forb	Rosaceae	1.5 (0.4-3.8)	0	0	6.2 (3.7-9.6)	0
Prunella vulgaris var. *lanceolata*	Native	Forb	Lamiaceae	6.4 (3.8-9.9)	1.9 (0.7-4.4)	0	0	1.0 (0.2-3.0)
Pteridium aquilinum	Native	Forb	Dennstaedtiaceae	0	0	6.4 (3.8-9.9)	0	0
Pyrus communis	Intro.	Tree	Rosaceae	1.0 (0.2-3.1)	0	0	0	0
Rosa eglanteria	Intro.	Shrub	Rosaceae	0	0	0	19.4 (15.1-24.5)	0
Rosa gymnocarpa	Native	Shrub	Rosaceae	7.4 (4.6-11.1)	4.8 (2.6-8.1)	0	0	3.9 (1.9-6.9)
Rubus armeniacus	Intro.	Shrub	Rosaceae	4.4 (2.3-7.6)	1.9 (0.7-4.4)	15.7 (11.6-20.5)	2.8 (1.2-5.5)	1.0 (0.2-3.0)
Rumex acetosella	Intro.	Forb	Polygonaceae	0	0	1.0 (0.2-3.1)	0	0.5 (0.03-2.3)
Senecio jacobaea	Intro.	Forb	Asteraceae	0.5 (0.03-2.3)	0.5 (0.03-2.3)	0	0	0
Sidalcea malviflora	Native	Forb	Malvaceae	0	0	0	0.5 (0.03-2.2)	0
Sidalcea species	Native	Forb	Malvaceae	0	0	0.5 (0.03-2.3)	0	0
Sisyrinchium species	Native	Forb	Iridaceae	1.5 (0.4-3.8)	0	0	0	0
Toxicodendron diversilobum	Native	Shrub	Anacardiaceae	0.5 (0.03-2.3)	0	0	0	0
Vicia hirsuta	Intro.	Forb	Fabaceae	0.5 (0.03-2.3)	4.8 (2.6-8.1)	1.5 (0.4-3.8)	1.4 (0.4-3.6)	1.0 (0.2-3.0)
Vicia sativa	Intro.	Forb	Fabaceae	0	0	29.9 (24.6-35.6)	0.5 (0.03-2.2)	0
Viola species	Native	Forb	Violaceae	0	0	0	0.5 (0.03-2.2)	0
Vulpia bromoides	Intro.	Gram.	Poaceae	0	0.5 (0.03-2.3)	6.9 (4.2-10.5)	0	0
Zigadenus species	Native	Forb	Liliaceae	0	1.4 (0.4-3.7)	0	0	0

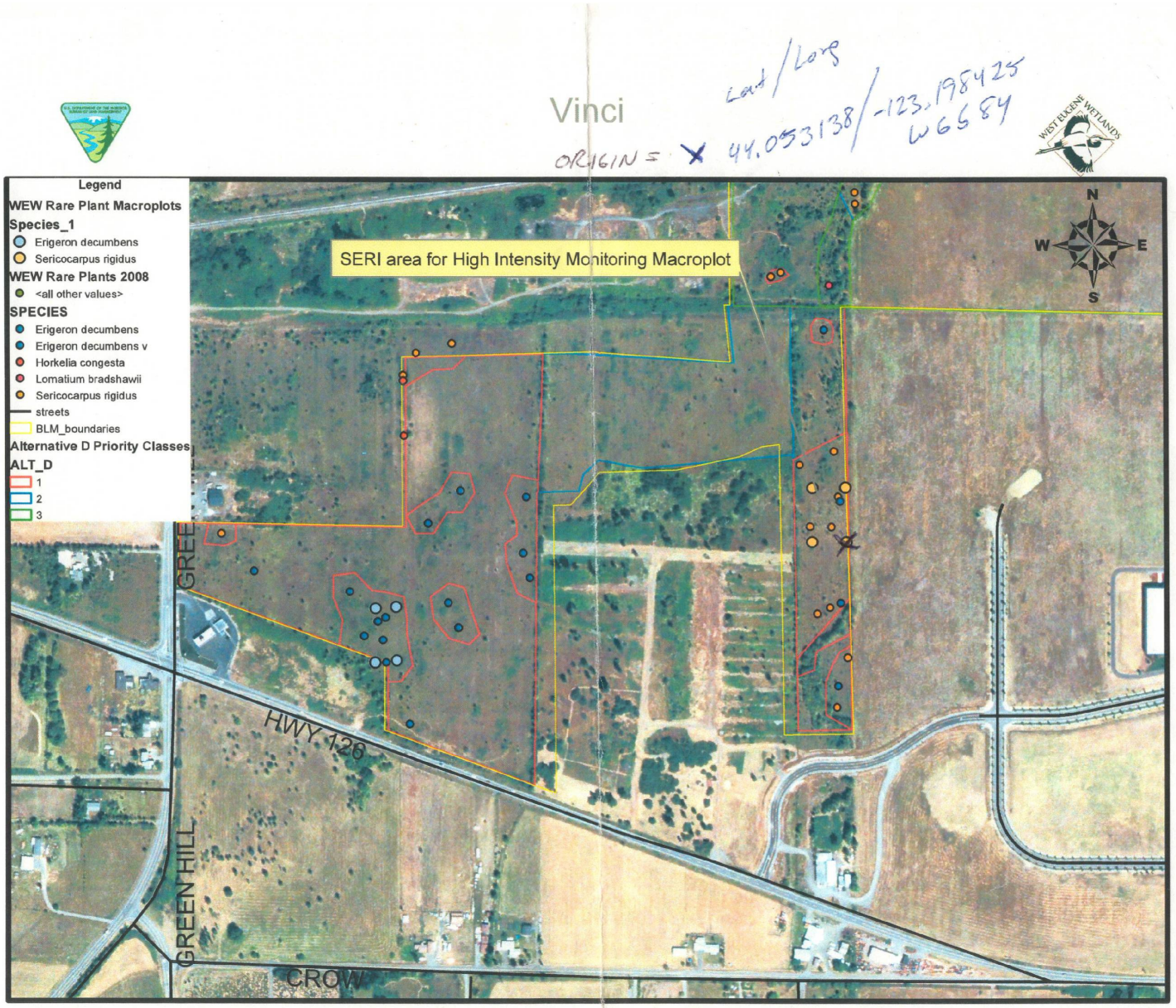
APPENDIX B. PLOT MAPS

Plot takes advantage of rebar at the 4 purple dots indicated on the map, with the origin at the "x."

Balboa 1 & 3 take advantage of the rebar associated with 2 *Erigeron decumbens* macroplots (larger light blue circles). The origin ("x") of plot 1 is the southeast corner, while the origin of plot 3 is the southwest corner (no blue circle present underneath "x").



The plot at Fir Butte takes advantage of the rebar and/or t-posts associated with the Kincaid's lupine monitoring plot (the four lower, larger purple circles). The origin ("x") is in the southeast corner of the plot.



The plot at Vinci takes advantage of rebar associated with the *Sericocarpus rigidus* marcoplot (larger light orange circles); the origin ("x") is in the southeast corner.