Habitat sampling at Hanson, Long Tom, North Taylor, Speedway, and Turtle Swale

2008 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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Cover photographs: Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*) at Turtle Swale and Turtle Swale. Photos by Burl Martin.

REFERENCE

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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 of 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 Schedule (hereafter the EA), outlines targets for habitat conditions and provides guidance on the priority of work for the 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, Hansen, Long Tom, North Taylor, Speedway, and Turtle Swale in order to provide data to assess whether these sites were within their habitat targets.

Sites[1]

Hansen

Hansen is 143.37 acre site with a small population of the threatened plant, *Lupinus sulphureus* ssp. *kincaidii* (Kincaid's lupine). *Lupinus sulphureus ssp. kincaidii* is the primary host plant for larvae of the endangered *Icaricia icarioides fenderi*. Invasive forage grasses dominate this site. *Lupinus sulphureus ssp. kincaidii* research plots were accidentally seeded with *Festuca rubra* (red fescue), which was mistaken for the native *Festuca roemeri* (Roemer's fescue) when seed was collected for the project. *Festuca rubra* has taken over most of the native species in plots where it was originally seeded and has spread outside of the plots. This site has also been invaded by *Cirsium arvense* (Canada thistle) and *Rubus* spp. (blackberry).

Long Tom and North Taylor

Combined, the Long Tom and North Taylor sites are eight acres in size. These high quality prairies host a population of the endangered *Lomatium bradshawii* (Bradshaw's desert-parsley). Threats to these the prairies include invasion by *Cirsium vulgare*, encroachment by *F. latifolia, Quercus garryana* var. *garryana* (Oregon white oak), and *Quercus kelloggii* (California black oak), and thatch build-up.

[1] All site descriptions are from *USDA FWS 2005.*

Speedway

Speedway is a 50 acre site with populations of the *Erigeron decumbens* ssp. *decumbens* (Willamette daisy) and *L. bradshawii*, both federally endangered species. This site has been impacted intensively, having previously served as a racing drag strip. Remnant wet prairie is in poor to good condition depending of level of disturbance. Severe erosion is occurring along channelized portions of Willow Creek and associated swales. Threats to this site include the invasive species *Cytisus scoparius* (Scots broom), *Cirsium arvense*, *Cirsium vulgare* (bull thistle), and *Rubus* spp.; encroachment by woody native species, including *Fraxinus latifolia* (Oregon ash) and *Crataegus douglasii* (Douglas' hawthorn); dog walkers; and transient campers.

Turtle Swale

Turtle Swale is 60.5 acre, high quality prairie remnant. Both *L. s. kincaidii* the *I. i. fenderi* are present at this site. Threats to Turtle Swale include invasive by *Rubus* spp. and non-native grasses.

Monitoring Approach

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 species with less than 0.5% cover are likely to have been missed using this method, it provides a consistent manner in which to efficiently sample a large area.

METHODS

In July 2008 five sites in the West Eugene Wetlands, Hansen, Long Tom, North Taylor, Speedway, and Turtle Swale (Figure 1) were sampled for percent vegetation estimates. Plot dimensions varied by site and were 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 for each plot was placed in the south corner of each plot (Figure 2). In all plots, the first transect running perpendicular to the baseline was randomly located between 0m and 2m. Subsequent transects were placed every 2m (Long Tom, North Taylor), 3m (Hansen), or 4m (Speedway, Turtle Swale) along the baseline. The first sample point along each transect was randomly located between 0m and 2m. Sampling points were then systematically located every 1m (North Taylor), 2m (Hansen, Long Tom), or 3m (Speedway, Turtle Swale). Due to the small size of the meadow, only 100 points were sampled at North Taylor.

We used a laser point sampler (Synergy Resource Solutions, Inc.) to sample each point. At most site, we were able to adjust the height of the monopod so that it was above the canopy of the vegetation. As the monopod used a laser pointer to sample vegetation, it could also be flipped upside down over each point to sample tall shrubs and/or trees. At each point, we recorded every species intercepted by the laser, the habitat type (wetland, upland, vernal pool or emergent), and if the substrate was bare ground, litter or moss.

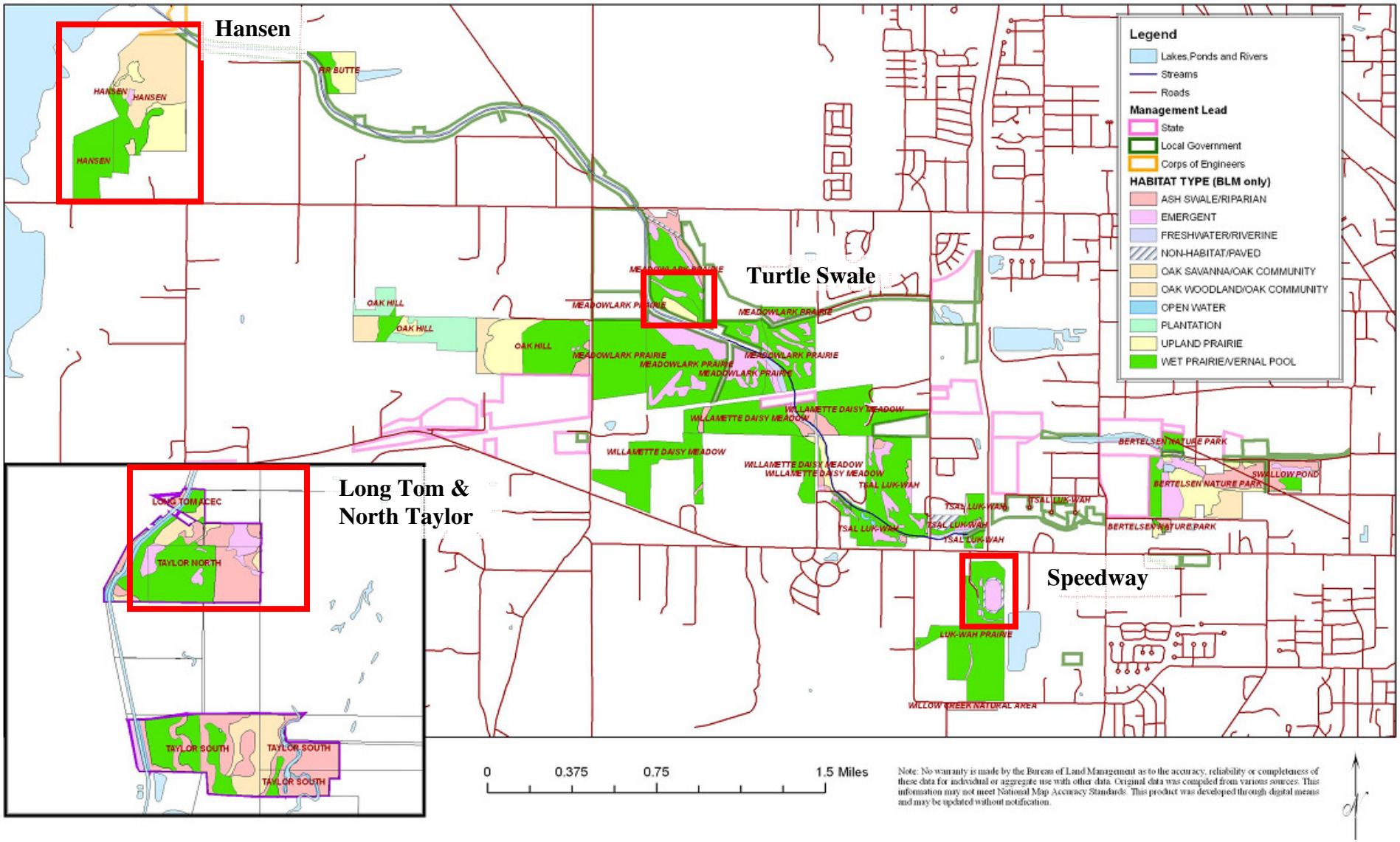

Figure 1. Monitoring sites described in this project, Hansen, Long Tom, North Taylor, Speedway, and Turtle Swale. Sites are labeled and outlined. Map describes plant communities at these and other sites in the West Eugene Wetlands. (Map from USDI BLM 2005)

Species nomencalture, habit, and natality 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 cover type), dividing by the total number of sampling points per plot, and multiplying by 100.

Table 1. Habitat sampling plot characteristics.

Site	Plot origin (UTM)	Plot dimensions	# samples
Hansen			
Meadow (treated 2007)	10T 0480167, 4880232	40m x 30m	200
Woods (untreated)	10T 0476265, 4887315	40m x 30m	200
Long Tom	10T 0476412, 4887473	40m x 20m	208
North Taylor	10T 0476315, 4887383	20m x 10m	100
Speedway	10T 0486220, 4876905	50m x 50m	204
Turtle Swale	10T 0483998, 4878754	50m x 50m	204

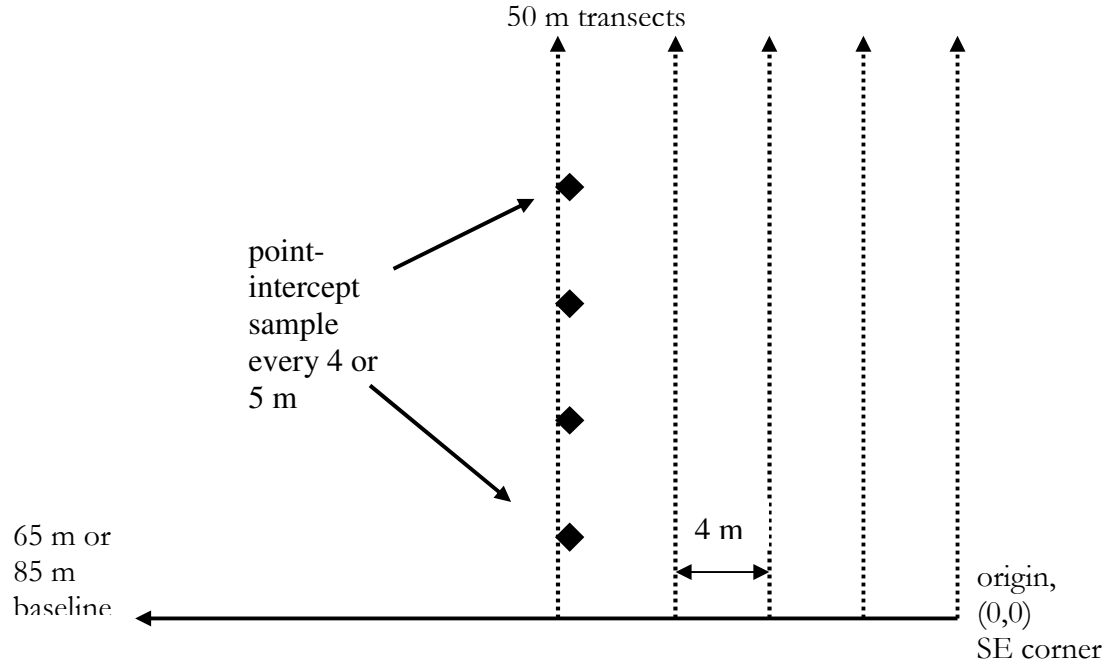

Figure 2. Example of plot sampling design.

RESULTS AND DISCUSSION

Sites

Hansen

In the treated area at Hansen (Hansen Meadow), there were 18 native and 28 introduced species. Introduced species were more abundant than native species in all vegetation classes except trees (Figure 3). The most abundant introduced species were the forbs *Vicia hirsute* (22%) and *Trifolium dubium* (7.5%), gramoindoids *Agrostis stolonifera* (5.5%) and *Anthoxanthum oderatum* (5%), and the shrub *Rubus armeniacus* (10.5%). The cover of all other introduced species under 5% (each).

In the untreated areas at Hansen (Hansen Woods), there were 19 native and 4 introduced species. The most dominant introduced species were the shrub *Rubus armendiacus* (8.5%) and tree *Prunus avium* (19.5%). No invasive forbs and graminoids were present, but there were also very few native forbs and graminoids. Although treating the meadow in 2007 released native forbs and graminoids, it also appeared to release introduced forbs and graminoids (15 and 10 greater, respectively, than the untreated area). Very few native forb and graminoid species typical of meadows were present in the untreated area to respond to canopy treatments. If more shrubs and trees are removed from the area, we recommend an aggressive seeding and weed control program.

Both areas had over 50% cover of woody species. In the treated area, the majority of woody species cover was by the native *Quercus kelloggii* (58% cover) in the overstory. The native shrub *Amelancier alnifolia* (16.5%) and trees *Cornus nuttallii* (19%), *Corylus cornuta* (27%), *Quercu garryana* var. *garryana* (12%), and *Quercus kelloggii* (46.5%) were dominant in the untreated area.

The treated area at Hansen had a heavy cover of litter (87%; Table 2). This litter could inhibit germination and/or establishment of seedlings. In contrast, there was only 10% litter in the untreated area. Moss cover was approximately 6% at both sites.

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

	Site					
	Hansen treated '07	**Hansen untreated**	**Long Tom**	**North Taylor**	**Speedway**	**Turtle Swale**
Bare	7	86	18	6	12	2
Litter	87	10	81	93	87	97
Moss	7	6	1	1	1	1

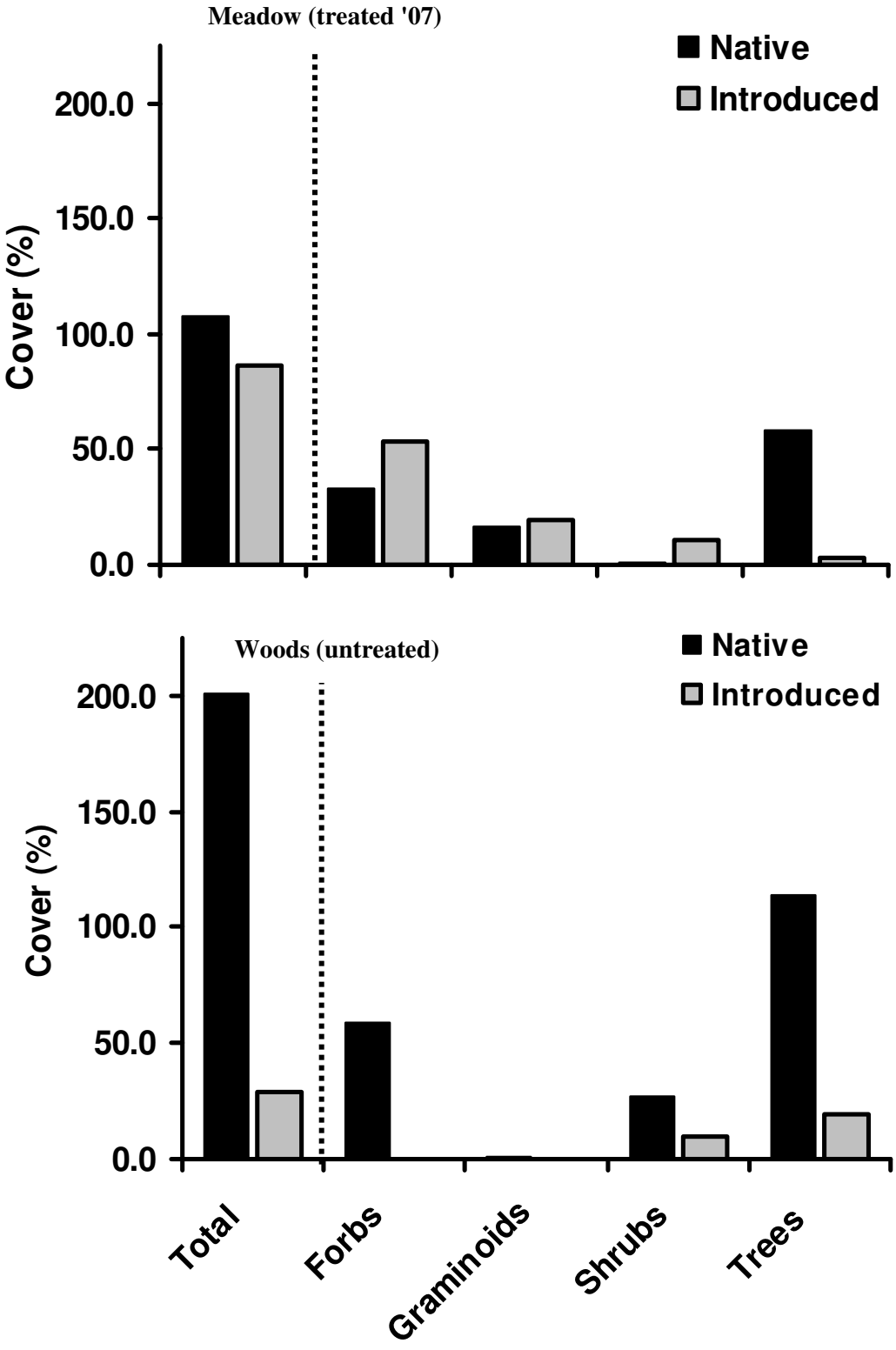

Figure 3. Cover (%) of native and introduced species divided into growth habits at **Hansen** in the West Eugene Wetlands.

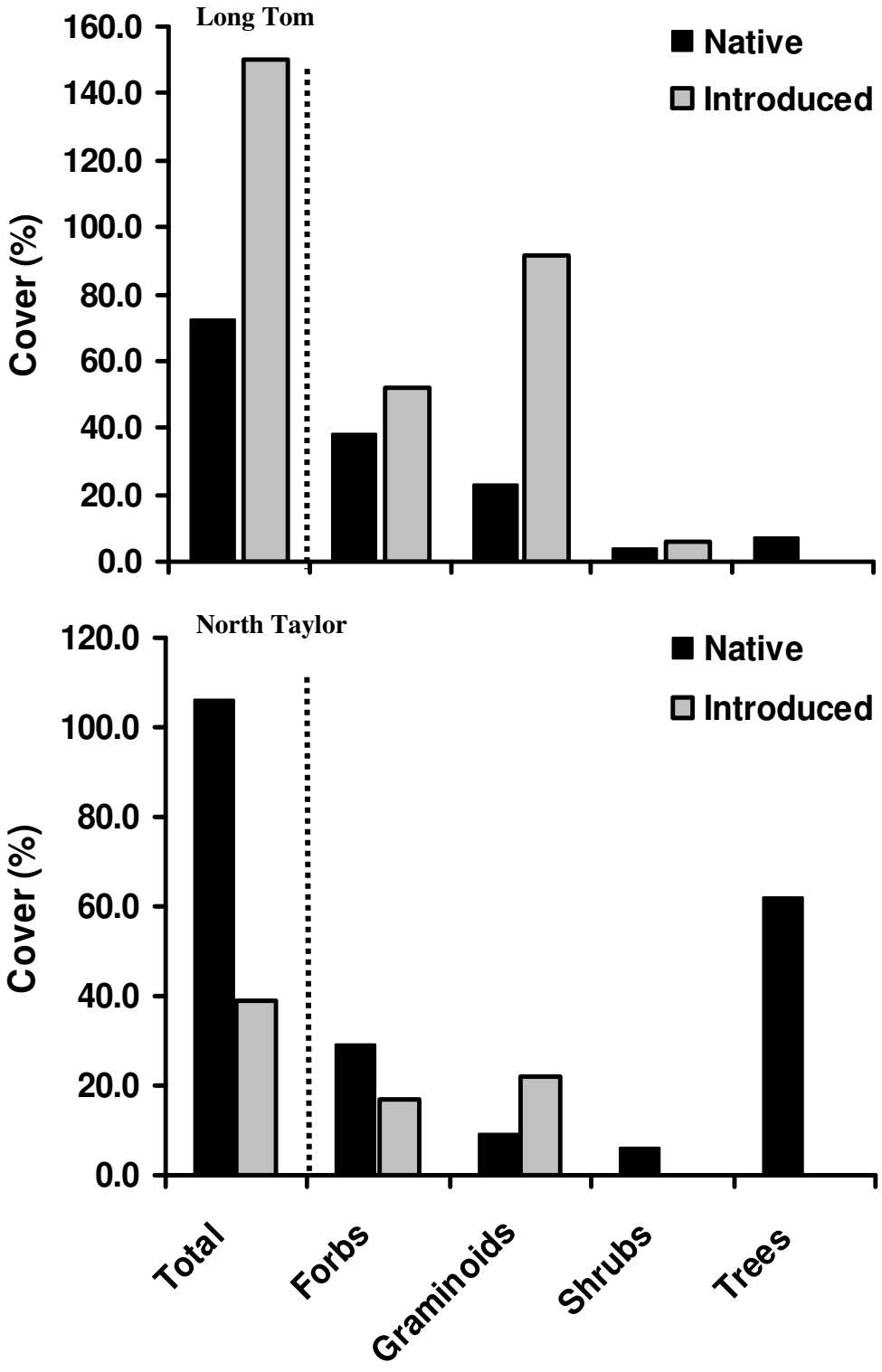

Figure 4. Cover (%) of native and introduced species divided into growth habits at **Long Tom** and **North Taylor** in the West Eugene Wetlands.

Long Tom and North Taylor

In the meadow habitat at Long Tom, there were fewer introduced species (19 introduced, 20 native), but their total cover was twice that of the native species (Figure 4). The most abundant native species were the forbs *Madia sativa* (8%) and *Symphyotrichum hallii* (13%) and graminoid *Carex obnuta* (11%). The most abundant introduced species were the forbs *Galium parisiense* (7%), *Trifolium dubium* (8%), *Vicia hirsute* (8%), and *Vicia tetrasperma* (19%); graminoids *Agrostis stolonifera* (26%), *Aira caryophyllea* (16%), *Anthoxanthum odoratum* (7%), *Briza minor* (19%), and *Festuca arundinaceae* (22%); and shrub *Rosa eglanteria* (6%). The cover values of all other species were less than 5%.

Despite their proximity, there were few similarities between Long Tom and North Taylor. At North Taylor, there was twice the number of native species (16) compared to introduced species (8) and total cover of native species was almost triple that of the introduced species (106% and 39%, respectively; **Figure 4**). The most abundant native species at North Taylor were the forbs *Fragaria virginiana* (10%) and *Symphyotrichum hallii* (11%), graminoid *Danthonia californica* (5%), shrub *Vaccinium ovalifolium* (19%), and trees *Fraxinus latifolia* (30%) and *Quercus garryana* var. *garryana* (13%). The most abundant introduced species were the forb *Hypochaeris radicata* (10%) and graminoids *Anthoxanthum odoratum* (17%).

Both Long Tom and North Taylor exceeded woody species threshold for upland prairie habitats. There was 17% cover of woody species at Long Tom and 68% cover of woody species at North Taylor. While the majority of the shrubs or trees at Long Tom were in the mid- to overstory, the majority of the *F. latifolia* at North Taylor were seedlings. If these seedlings are not controlled, they will quickly overgrow the meadow.

Litter cover was greater than 80% at both Long Tom and North Taylor (Table 2). Moss cover was 1% at both sites. The thick layer of litter may inhibit seed germination and establishment.

Speedway

While there were more native (15) than introduced (12) species at Speedway, the cover of introduced species was 130% that of native species (Figure 5). The most abundant native species were the graminoids *Danthonia californica* (9%), *Deschampsia cespitosa* (23%), and *Panicum capillare* (16%). The cover of the most abundant native forb, *Grindelia integrifolia*, was 3%. The most abundant introduced species were the forb *Hypochaeris radicata* (16%), graminoids *Agrostis stolonifera* (23%), *Anthoxantum odoratum* (18%), and *Festuca arundinaceae* (8%), and shrub *Rubus armeniacus* (5%). No other introduced species had a cover value greater than 5%.

Total cover by woody species was 11%. The most abundant woody species were the introduced shrubs *Rubus armeniacus* (5%) and *Rosa eglanteria* (4%). There was 87% cover of litter at Speedway (Table 2).

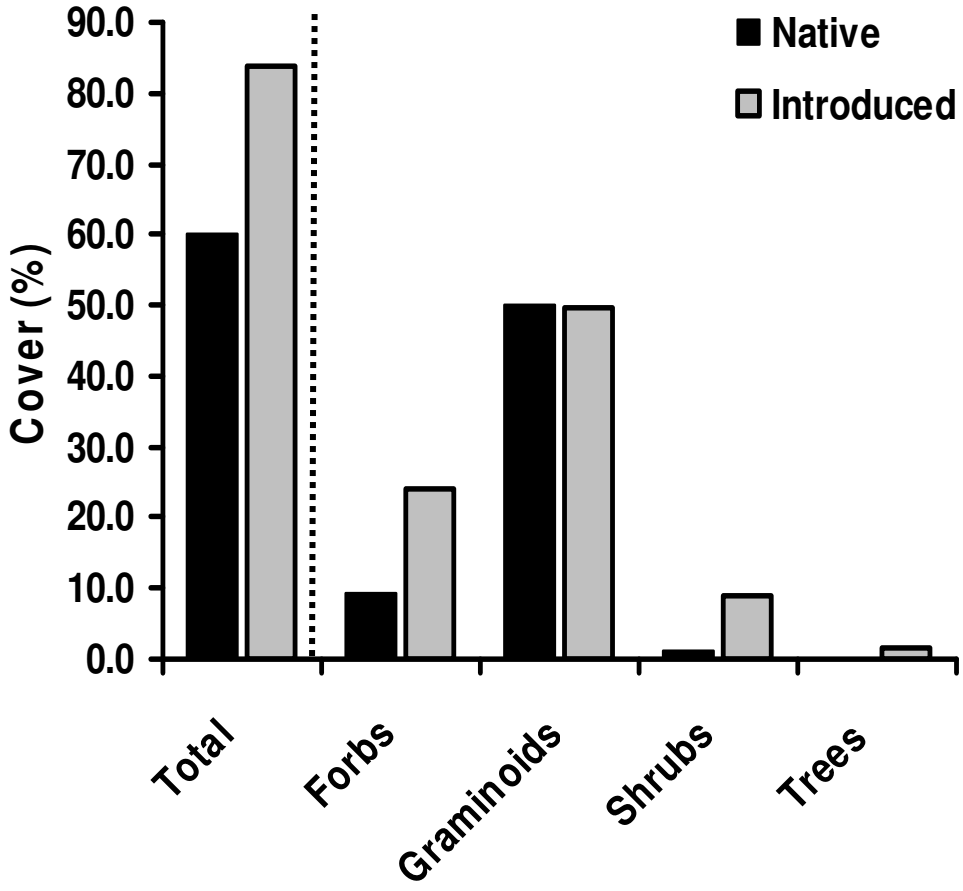

Figure 5. Cover (%) of native and introduced species divided into growth habits at **Speedway** in the West Eugene Wetlands.

Turtle Swale

Both cover and richness of introduced species were higher than that of native species at Turtle Swale (introduced species cover 187%, richness 21; native species cover 24%, richness 14; Figure 6). The most abundant introduced species were the forbs *Daucus carota* (7%), *Galium parisiense* (15%), *Leucanthemum vulgare* (13%), *Plantago lanceolata* (7%), and *Vicia hirsute* (5%), graminoids *Agrostis stolonifera* (17%), *Aira caryophyllea* (37%), *Anthoxanthumodoratum* (11%), and *Festuca arundinaceae* (57%). No native species exceeded 5% in cover. Cover of both introduced and native shrubs was less than 5% (each). There were no trees observed in our plot. There was 97% litter cover at this site (Table 2).

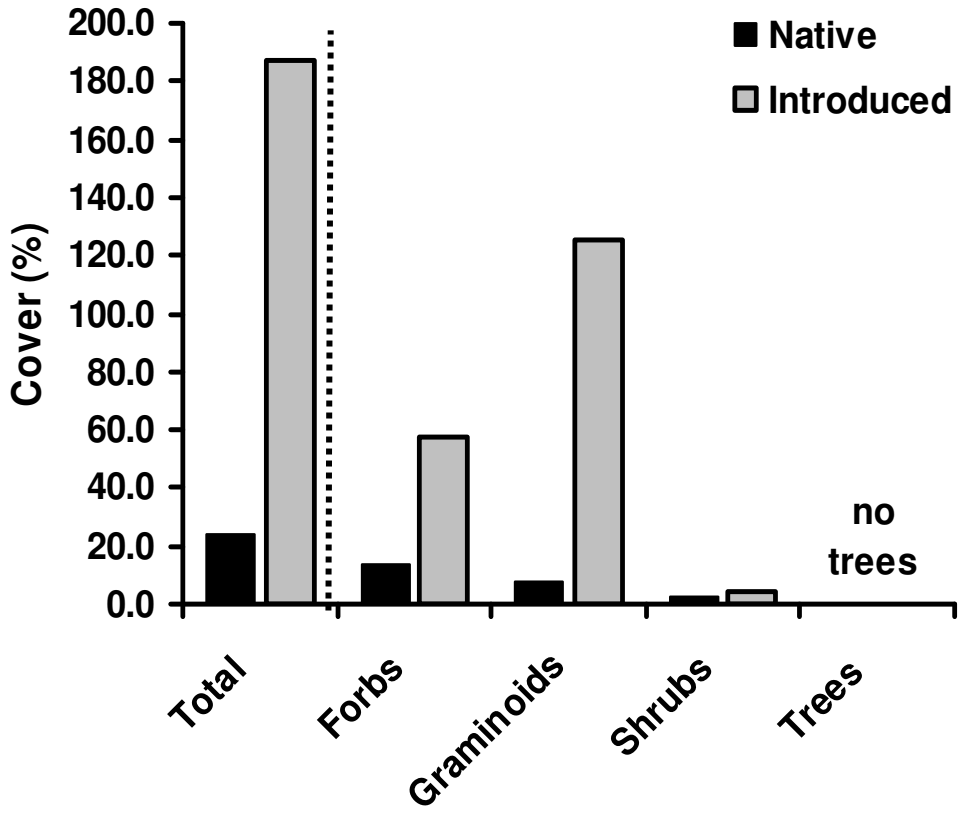

Figure 6. Cover (%) of native and introduced species divided into growth habits at **Turtle Swale** in the West Eugene Wetlands.

Monitoring Approach

The timing of our surveys (July) meant that we missed many early-season species, including the majority of the listed threatened and endangered species at these sites. In order to document all species at a site, surveys should take place both early and mid- to late in the growing season.

The point intercept method was most efficient in meadow and savannah habitats. In woodlands, it was extremely difficult to set up the large grid required to sample the entire habitat. If this method is used in savannah and woodland habitats in the future, the location of the species in the canopy should be noted (e.g. seedling, understory, overstory).

SUMMARY

The Draft Recovery objectives from the Western Oregon and Southwestern Oregon Prairie Species Recovery Plan (USFWS 2006) specify that within habitat for *L. s. kincaidii*, *E. d. decumbens*, and *L. bradshawii*, there is to be ≥50% relative cover of nonwoody 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	Hansen Meadow	73% cover of woody species
	Hansen Woods	170% cover of woody species
	Long Tom	17.3% cover of woody species
	North Taylor	68% cover of woody species
Invasive species	Hansen Meadow	87% cover of introduced species
	Long Tom	150% cover of introduced species
	North Taylor	39% cover of introduced species
	Speedway	84% cover of introduced species
	Turtle Swale	187% cover of introduced species
Thatch	Hansen Meadow	87% cover of litter
	Long Tom	81% cover of litter
	North Taylor	93% cover of litter
	Speedway	87% cover of litter
	Turtle Swale	97% cover of litter

The cover of the litter layer exceeded the threshold for management at almost every site. Although we did not document detrimental impacts on native forbs, it is likely that the litter is inhibiting 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.

LITERATURE CITED

City of Eugene. 1997. West Eugene Wetland Mitigation Bank Annual Report. Prepared by the Parks and Open Spaced Division of the City of Eugene, Oregon.

City of Eugene. 2007. West Eugene Wetland Mitigation Bank Annual Report. Prepared by the Parks and Open Spaced Division of the City of Eugene, Oregon.

Thorpe, A.S., and T.N. Kaye. 2007. *Erigeron decumbens* spp. *decumbens* (Willamette daisy): Population monitoring and evaluation of mowing and burning at Oxbow West (West Eugene Wetlands). Report to the Bureau of Land Management, Eugene, District. Institute for Applied Ecology, Corvallis, Oregon. 30pp.

Thorpe, A.S., and T.N. Kaye. 2007. *Lupinus sulphureous* ssp. *kincaidii* (Kincaid's lupine) and *Icaricia icarioides fenderi* (Fender's blue butterfly) in the West Eugene Wetlands: Population monitoring, reintroduction success, and an evaluation of experimental treatments. Report to the Bureau of Land Management, Eugene, District. Institute for Applied Ecology, Corvallis, Oregon. 43pp.

USDI Bureau of Land Management, Eugene District. 2005. West Eugene Wetlands Environmental Assessment No. OR090-05-03. Eugene, OR. 78 pp.

USDI Fish and Wildlife Service. 2006. Draft recovery plan for the prairie species of western Oregon and Southwestern Washington. Pacific Region, U.S. Fish and Wildlife Service, Portland, Oregon.

USDA Fish and Wildlife Service. 2005. Biological opinions and letter of concurrence on effects of implementation of the ten-year schedule of management activities to maintain, enhance and expand prairie habitats within West Eugene Wetlands, FY 2006 – 2016, on Fender's blue butterfly (*Icaricia icariodes fenderi*), Kincaid's lupine (*Lupinus sulphureus* spp. *kincaidii*), Willamette daisy (*Erigeron decumbens* ssp. *decumbens*), and Bradshaw's lomatium (*Lomatium bradshawii*), Siuslaw Resource Area, Eugene District Bureau of Land Management. FWS Reference Number 1-7-06-F-0038.

APPENDIX A. USEFUL FIELD HINTS

- Previous to arriving in the field upload data sheets with randomly assigned transect and point locations onto hand held computers.
- Although it could have been done with 2 people it was ideal to have three people working together. One person recorded the numbers on paper or a hand held computer, the second person moved the tripod (or monopod) and dropped the pin (or operated the laser pointer) while the third person watched the pin (or light) and called out which species were hit. To avoid trampling monitor on the right side of the transect tape and walk on the left side.
- On average, each plot took 1 day to survey.

APPENDIX B. ALL SPECIES FOUND IN SIX PLOTS SAMPLED IN THE WEST EUGENE WETLANDS IN 2008.

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

species	Family	US Nativity	Growth Habit	Cover % (lower-upper 90% C.I.)					
				Hansen treated '07	Hansen untreated	Long Tom	North Taylor	Speedway	Turtle Swale
Adenocaulon bicolor	Asteraceae	Native	Forb	0 (0-1.5)	5.5 (3.1-8.9)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Agrostis stolonifera	Poaceae	Intro.	Gram.	5 (2.7-8.3)	0 (0-1.5)	26 (21-31.4)	4 (1.4-8.9)	23 (18.3-28.4)	16.7 (12.5-21.6)
Aira caryophyllea	Poaceae	Intro.	Gram.	0 (0-1.5)	0 (0-1.5)	15.9 (11.8-20.6)	0 (0-3)	0 (0-1.5)	37.3 (31.6-43.2)
Allium amplectens	Liliaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)
Amelanchier alnifolia	Rosaceae	Native	Shrub	0.5 (0-2.3)	16.5 (12.3-21.4)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Anthoxanthum odoratum	Poaceae	Intro.	Gram.	5.5 (3.1-8.9)	0 (0-1.5)	6.7 (4.1-10.3)	17 (11.1-24.4)	18.1 (13.8-23.2)	11.3 (7.8-15.6)
Anthriscus caucalis	Apiaceae	Intro.	Forb	1 (0.2-3.1)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Arbutus menziesii	Ericaceae	Native	Tree	0 (0-1.5)	6.5 (3.9-10.1)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Aster spp.	Asteraceae	Intro.	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Aster hallii	Asteraceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	4.4 (2.3-7.6)
Briza minor	Poaceae	Intro.	Gram.	1 (0.2-3.1)	0 (0-1.5)	19.2 (14.8-24.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Brodiaea coronaria	Liliaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	1.4 (0.4-3.7)	3 (0.8-7.6)	2.5 (1-5.1)	0.5 (0-2.3)
Bromus spp.	Poaceae	Intro.	Gram.	0 (0-1.5)	0 (0-1.5)	0.5 (0-2.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Bromus carinatus	Poaceae	Native	Gram.	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Bromus hordeaceus ssp. *hordeaceus*	Poaceae	Intro.	Gram.	0 (0-1.5)	0 (0-1.5)	1 (0.2-3)	1 (0.1-4.7)	0 (0-1.5)	0 (0-1.5)
Bromus rigidus	Poaceae	Intro.	Gram.	1 (0.2-3.1)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Camassia quamash	Liliaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Camassia quamash var. *maxima*	Liliaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	2.9 (1.3-5.6)	0 (0-3)	1 (0.2-3.1)	2.5 (1-5.1)
Carex spp.	Cyperaceae	Native	Gram.	0 (0-1.5)	0.5 (0-2.3)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Carex obnupta	Cyperaceae	Native	Gram.	0 (0-1.5)	0 (0-1.5)	11.1 (7.7-15.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Carex rossii	Cyperaceae	Native	Gram.	0 (0-1.5)	0.5 (0-2.3)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)

Appendix B, cont. All species found in six plots sampled in the West Eugene Wetlands in 2008.
Abbreviations: "Intro." = Introduced; "Gram." = Graminoid

species	Family	US Nativity	Growth Habit	Cover % (lower-upper 90% C.I.)					
				Hansen treated '07	Hansen untreated	Long Tom	North Taylor	Speedway	Turtle Swale
Centaurium erythraea	Gentianaceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	1 (0.1-4.7)	0 (0-1.5)	0 (0-1.5)
Cerastium glomeratum	Caryophyllaceae	Intro.	Forb	4.5 (2.4-7.7)	0 (0-1.5)	3.8 (1.9-6.8)	0 (0-3)	0 (0-1.5)	1 (0.2-3.1)
Cirsium vulgare	Asteraceae	Intro.	Forb	1 (0.2-3.1)	0 (0-1.5)	0.5 (0-2.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Claytonia parviflora	Portulacaceae	Native	Forb	1.5 (0.4-3.8)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Cornus nuttallii	Cornaceae	Native	Tree	0 (0-1.5)	19 (14.6-24.1)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Corylus cornuta	Betulaceae	Native	Shrub	0 (0-1.5)	27 (21.9-32.6)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Crataegus spp.	Rosaceae	Intro.	Shrub	0 (0-1.5)	0.5 (0-2.3)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Crataegus douglasii	Rosaceae	Native	Shrub	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0.5 (0-2.3)	0 (0-1.5)
Cynosurus echinatus	Poaceae	Intro.	Gram.	1.5 (0.4-3.8)	0 (0-1.5)	0.5 (0-2.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Dactylis glomerata	Poaceae	Intro.	Gram.	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Danthonia californica	Poaceae	Native	Gram.	0 (0-1.5)	0 (0-1.5)	4.3 (2.3-7.4)	5 (2-10.2)	8.8 (5.8-12.8)	3.9 (2-7)
Daucus carota	Apiaceae	Intro.	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	6.9 (4.2-10.5)
Deschampsia cespitosa	Poaceae	Native	Gram.	0 (0-1.5)	0 (0-1.5)	3.8 (1.9-6.8)	0 (0-3)	23 (18.3-28.4)	1.5 (0.4-3.8)
Deschampsia danthonioides	Poaceae	Native	Gram.	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	1 (0.2-3.1)	0.5 (0-2.3)
Elymus glaucus	Poaceae	Native	Gram.	12 (8.4-16.5)	0 (0-1.5)	0.5 (0-2.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Epilobium densiflorum	Onagraceae	Native	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Eriophyllum lanatum var. *lanatum*	Asteraceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	3.8 (1.9-6.8)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)
Festuca spp.	Poaceae	Intro.	Gram.	1.5 (0.4-3.8)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Festuca arundinacea	Poaceae	Intro.	Gram.	1 (0.2-3.1)	0 (0-1.5)	22.1 (17.5-27.4)	0 (0-3)	7.8 (5-11.7)	56.9 (50.9-62.7)

Appendix B, cont. All species found in six plots sampled in the West Eugene Wetlands in 2008.
Abbreviations: "Intro." = Introduced; "Gram." = Graminoid

species	Family	US Nativity	Growth Habit	Cover % (lower-upper 90% C.I.)					
				Hansen treated '07	Hansen untreated	Long Tom	North Taylor	Speedway	Turtle Swale
Fragaria virginiana	Rosaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	10 (5.5-16.4)	0 (0-1.5)	0 (0-1.5)
Fraxinus latifolia	Oleaceae	Native	Tree	0 (0-1.5)	0 (0-1.5)	4.3 (2.3-7.4)	30 (22.5-38.4)	0 (0-1.5)	0 (0-1.5)
Galium aparine	Rubiaceae	Native	Forb	19.5 (15-24.7)	0.5 (0-2.3)	0 (0-1.4)	1 (0.1-4.7)	0 (0-1.5)	0 (0-1.5)
Galium parisiense	Rubiaceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	6.7 (4.1-10.3)	1 (0.1-4.7)	0 (0-1.5)	15.2 (11.2-20)
Geranium dissectum	Geraniaceae	Intro.	Forb	5 (2.7-8.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)
Grindelia integrifolia	Asteraceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	2.9 (1.3-5.7)	0 (0-1.5)
Holcus lanatus	Poaceae	Intro.	Gram.	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0.5 (0-2.3)	2.9 (1.3-5.7)
Hypericum perforatum	Clusiaceae	Intro.	Forb	0.5 (0-2.3)	0 (0-1.5)	0.5 (0-2.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Hypochaeris radicata	Asteraceae	Intro.	Forb	2.5 (1-5.2)	0 (0-1.5)	0 (0-1.4)	10 (5.5-16.4)	15.7 (11.6-20.5)	2.5 (1-5.1)
Ilex spp.	Aquifoliaceae	Intro.	Shrub	0.5 (0-2.3)	0.5 (0-2.3)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Juncus bufonius	Juncaceae	Native	Gram.	4 (2-7.1)	0 (0-1.5)	1.9 (0.7-4.3)	2 (0.4-6.2)	0 (0-1.5)	0 (0-1.5)
Juncus tenuis	Juncaceae	Native	Gram.	0 (0-1.5)	0 (0-1.5)	1.4 (0.4-3.7)	0 (0-3)	0.5 (0-2.3)	0 (0-1.5)
Lactuca serriola	Asteraceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)
Lathyrus angulatus	Fabaceae	Intro.	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Leucanthemum vulgare	Asteraceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	2.9 (1.3-5.7)	13.2 (9.5-17.8)
Lonicera hispidula	Caprifoliaceae	Native	Forb	3 (1.3-5.8)	7.5 (4.7-11.3)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Lotus purshianus	Fabaceae	Native	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	1 (0.1-4.7)	0 (0-1.5)	0 (0-1.5)
Lupinus sulphureus ssp. *kincaidii*	Fabaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	1 (0.2-3.1)
Luzula comosa	Juncaceae	Native	Gram.	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	2 (0.4-6.2)	0.5 (0-2.3)	2 (0.7-4.4)
Madia sativa	Asteraceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	8.2 (5.3-12)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)
Mentha ×piperita	Lamiaceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	2.5 (1-5.1)	0 (0-1.5)

Appendix B, cont. All species found in six plots sampled in the West Eugene Wetlands in 2008.
Abbreviations: "Intro." = Introduced; "Gram." = Graminoid

species	Family	US Nativity	Growth Habit	Cover % (lower-upper 90% C.I.)					
				Hansen treated '07	Hansen untreated	Long Tom	North Taylor	Speedway	Turtle Swale
Microseris laciniata	Asteraceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0.5 (0-2.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Myosotis discolor	Boraginaceae	Intro.	Forb	1.5 (0.4-3.8)	0 (0-1.5)	1.4 (0.4-3.7)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)
Osmorhiza berteroi	Apiaceae	Native	Forb	0 (0-1.5)	3.5 (1.7-6.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Osmorhiza purpurea	Apiaceae	Native	Forb	3 (1.3-5.8)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Panicum capillare	Poaceae	Native	Gram.	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	16.2 (12.1-21)	0 (0-1.5)
Parentucellia viscosa	Scrophulariaceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	1.9 (0.7-4.3)	0 (0-3)	0 (0-1.5)	1.5 (0.4-3.8)
Perideridia oregana	Apiaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	3.8 (1.9-6.8)	2 (0.4-6.2)	0 (0-1.5)	0 (0-1.5)
Plantago lanceolata	Plantaginaceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	3 (0.8-7.6)	2 (0.7-4.4)	6.9 (4.2-10.5)
Poa spp.	Poaceae	Intro.	Gram.	2 (0.7-4.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Polystichum munitum	Dryopteridaceae	Native	Forb	1.5 (0.4-3.8)	40 (34.2-46)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Potentilla gracilis var. *gracilis*	Rosaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	1.4 (0.4-3.7)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Prunella vulgaris var. *lanceolata*	Lamiaceae	Native	Forb	1.5 (0.4-3.8)	0 (0-1.5)	1 (0.2-3)	0 (0-3)	1.5 (0.4-3.8)	2 (0.7-4.4)
Prunus avium	Rosaceae	Intro.	Tree	3 (1.3-5.8)	19.5 (15-24.7)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Pseudotsuga menziesii	Pinaceae	Native	Tree	1.5 (0.4-3.8)	2.5 (1-5.2)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Pyrus communis	Rosaceae	Intro.	Tree	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	1.5 (0.4-3.8)	0 (0-1.5)
Quercus garryana var. *garryana*	Fagaceae	Native	Tree	0 (0-1.5)	12 (8.4-16.5)	2.9 (1.3-5.6)	13 (7.9-19.9)	0 (0-1.5)	0 (0-1.5)
Quercus kelloggii	Fagaceae	Native	Tree	56.5 (50.4-62.4)	46.5 (40.5-52.6)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Ranunculus occidentalis var. *occidentalis*	Ranunculaceae	Native	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Rosa eglanteria	Rosaceae	Intro.	Shrub	0 (0-1.5)	0 (0-1.5)	6.3 (3.7-9.8)	0 (0-3)	3.9 (2-7)	0 (0-1.5)

Appendix B, cont. All species found in six plots sampled in the West Eugene Wetlands in 2008.
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species	Family	US Nativity	Growth Habit	Cover % (lower-upper 90% C.I.)					
				Hansen treated '07	Hansen untreated	Long Tom	North Taylor	Speedway	Turtle Swale
Rosa nutkana var. *nutkana*	Rosaceae	Native	Shrub	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0.5 (0-2.3)	2.5 (1-5.1)
Rubus armeniacus	Rosaceae	Intro.	Shrub	10.5 (7.1-14.8)	8.5 (5.5-12.5)	0 (0-1.4)	0 (0-3)	4.9 (2.7-8.2)	4.4 (2.3-7.6)
Rubus ursinus	Rosaceae	Native	Shrub	0 (0-1.5)	2.5 (1-5.2)	0 (0-1.4)	4 (1.4-8.9)	0 (0-1.5)	0 (0-1.5)
Rumex acetosella	Polygonaceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	1 (0.2-3.1)	1.5 (0.4-3.8)
Sanicula crassicaulis	Apiaceae	Native	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Satureja douglasii	Lamiaceae	Native	Forb	0 (0-1.5)	1 (0.2-3.1)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Senecio jacobaea	Asteraceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)
Sherardia arvensis	Rubiaceae	Intro.	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Sidalcea virgata	Malvaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	2 (0.7-4.4)
Sisyrinchium idahoense	Iridaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	2.4 (1-5)	0 (0-3)	0.5 (0-2.3)	0 (0-1.5)
Spiraea douglasii	Rosaceae	Native	Shrub	0 (0-1.5)	0 (0-1.5)	3.4 (1.6-6.2)	1 (0.1-4.7)	0 (0-1.5)	0 (0-1.5)
Symphoricarpos albus	Caprifoliaceae	Native	Shrub	0 (0-1.5)	3.5 (1.7-6.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Symphyotrichum hallii	Asteraceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	13 (9.3-17.5)	11 (6.3-17.6)	0.5 (0-2.3)	0 (0-1.5)
Tellima grandiflora	Saxifragaceae	Native	Forb	0 (0-1.5)	0.5 (0-2.3)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Toxicodendron diversilobum	Anacardiaceae	Native	Shrub	0.5 (0-2.3)	5 (2.7-8.3)	0.5 (0-2.3)	1 (0.1-4.7)	0 (0-1.5)	0 (0-1.5)
Trientalis latifolia	Primulaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	1 (0.1-4.7)	0 (0-1.5)	0 (0-1.5)
Trifolium dubium	Fabaceae	Intro.	Forb	7.5 (4.7-11.3)	0 (0-1.5)	7.7 (4.9-11.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)

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				Hansen treated '07	Hansen untreated	Long Tom	North Taylor	Speedway	Turtle Swale
Trifolium subterraneum	Fabaceae	Intro.	Forb	2.5 (1-5.2)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Triteleia hyacinthina	Liliaceae	Native	Forb	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0.5 (0-2.3)	0 (0-1.5)
Vaccinium ovalifolium	Ericaceae	Native	Shrub	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	19 (12.8-26.6)	0 (0-1.5)	0 (0-1.5)
Vicia americana	Fabaceae	Native	Forb	0.5 (0-2.3)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Vicia hirsuta	Fabaceae	Intro.	Forb	22 (17.3-27.4)	0 (0-1.5)	8.2 (5.3-12)	0 (0-3)	0 (0-1.5)	5.4 (3.1-8.8)
Vicia sativa	Fabaceae	Intro.	Forb	3 (1.3-5.8)	0 (0-1.5)	1.9 (0.7-4.3)	2 (0.4-6.2)	0 (0-1.5)	1.5 (0.4-3.8)
Vicia tetrasperma	Fabaceae	Intro.	Forb	0 (0-1.5)	0 (0-1.5)	19.2 (14.8-24.3)	0 (0-3)	0 (0-1.5)	0 (0-1.5)
Vulpia bromoides	Poaceae	Intro.	Gram.	0 (0-1.5)	0 (0-1.5)	0 (0-1.4)	0 (0-3)	0 (0-1.5)	0.5 (0-2.3)