

# West Eugene Wetlands Habitat Monitoring at Greenhill, Oxbow West, and Fir Butte



2015

Report to the Bureau of Land Management,  
Eugene District

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## PREFACE

This report is the result of an agreement 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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## EXECUTIVE SUMMARY

This document summarizes habitat monitoring in the West Eugene Wetlands on land managed by the BLM Eugene District. In 2015, we monitored Fir Butte SE, and new areas at Oxbow West (NW), and Greenhill (N) to assess whether they were within the habitat targets for Threatened and Endangered species or offer potential habitat for nearby rare species.

- At Fir Butte SE, we noted an increase of cover of both native and introduced species, with introduced grasses dominating the site. While native species cover increased slightly since 2012, it still remained low in comparison to introduced species cover. The increase in native species cover was most associated with an increase of Kincaid's lupine at the site.
- Greenhill N was established in 2015 as a new area to monitor at Greenhill. We noted higher cover of introduced species than natives at the site, however native species cover was quite high relative to species composition in other sites. The site hosted a diverse mix of grasses and forbs.
- Oxbow West NW was established in 2015 as a new area to monitor at the site. At Oxbow West NW, we found higher cover of introduced species overall, however native species had relatively high cover. Introduced forbs were common when compared to native forbs. Native grasses had higher cover than introduced grasses at the site.
- Cover of invasive species exceeded the thresholds for management (maximum 50% cover for invasive species) at all sites. Introduced species cover was extremely high at Fir Butte SE due to the high cover of introduced grasses present.
- Cover of litter/thatch exceeded the thresholds for management (maximum 20% cover for litter) at all of the sites, most likely due to the high grass cover at all sites.

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# Habitat monitoring at Greenhill, Oxbow West, Fir Butte

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. 0R090-0503, Alternative D, pages 58-61). In addition, many of these sites provide 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 to assess whether they



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

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were within the habitat targets for Threatened and Endangered species (including Kincaid's lupine, Figure 1). In 2015, we monitored three sites: Greenhill N, Oxbow West NW, and Fir Butte SE (Table 1). At Greenhill and Oxbow West, new areas for monitoring were identified which occurred outside of areas with known rare plant populations, but in close proximity. Fir Butte SE was previously monitored in 2012 and the area will be treated in fall 2015 with herbicide, so pre-treatment monitoring is essential. Sites have been on a monitoring rotation of either spring (May) or summer (July) monitoring; given high temperatures and an early growing season experienced in 2015, we monitored the summer plots in late June rather than July.



Table 1. Monitoring schedule for West Eugene Wetlands T and E sites from 2007 through 2015. If no month is listed, then the site was not monitored through this project.

| Site          | Plot            | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013          | 2014 | 2015      |
|---------------|-----------------|------|------|------|------|------|------|---------------|------|-----------|
| Balboa        | 1 and 3         |      |      | July |      |      | May  |               |      |           |
| Fir Butte     | NE and SW       | July |      |      | July |      |      | May (NE only) |      |           |
| Fir Butte     | SE              |      |      | July |      |      | May  |               |      | Late June |
| Greenhill     | 1 and 2         |      |      |      | July |      | May  |               |      |           |
| Greenhill     | N               |      |      |      |      |      |      |               |      | Late June |
| Hansen Meadow |                 |      | July |      |      | May  |      |               |      |           |
| Hansen Woods  |                 |      | July |      |      | May  |      |               |      |           |
| Long Tom      |                 |      | July |      |      | May  |      |               | May  |           |
| North Taylor  |                 |      | July |      |      | May  |      |               |      |           |
| Oxbow West    | ERDE (wetland)  | July |      |      | July |      |      | May           |      |           |
| Oxbow West    | LUOR (upland)   |      |      | July |      |      |      |               | May  |           |
| Oxbow West    | NW              |      |      |      |      |      |      |               |      | Late June |
| Speedway      |                 |      | July |      |      | May  |      |               | May  |           |
| Turtle Swale  |                 |      | July |      |      | May  |      |               |      |           |
| Vinci         | Upland          |      |      | July |      |      | May  |               |      |           |
| Vinci         | Wetland 1 and 2 | July |      |      | July |      |      | May           | May  |           |

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## **Fir Butte SE**

Fir Butte is an 18 acre prairie remnant owned by the Eugene District BLM (Figure 4). This site has been heavily invaded by many exotic weeds including *Rubus armeniacus*, *Agrostis stolonifera*, *Cytisus scoparius*, *Centaurea pratensis*, and *Arrhenatherum elatius*. Despite the relatively poor habitat quality, one of the largest known extant populations of *Lupinus oreganus* (Kincaid's lupine) occurs here. This site also supports a relatively large population of the endangered Fender's blue butterfly (*Icaricia icarioides fenderi*). *Lupinus oreganus* 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. Restoration activities at the site have been ongoing and have included burning, mowing, and use of solarization. Monitoring in the northeast and southwest occurred in 2007, 2010, and 2013 (in the NE only). Monitoring in the southeast occurred in 2009, 2012, and 2015 (Figure 4). Monitoring in the southeast portion of the site will document pre-treatment conditions in 2015 for experimental herbicide application which will occur this fall.

## **Greenhill N**

Greenhill is a mix of high quality remnant wet prairie, ash swale, upland prairie and oak woodland (Figure 5). Monitoring has occurred in the remnant wet prairie with a population of *Lomatium bradshawii* (Bradshaw's lomatium) in 2012 (Greenhill 1 and 2). The remnant prairie is adjacent to a restored area that has had reintroductions of *Horkelia congesta*, *Sericocarpus rigidus*, *Erigeron decumbens*, and *Lomatium bradshawii*. Monitoring in these two plots encompassed habitat associated with these rare species. In 2015, we monitored a new area of Greenhill, Greenhill N, which was located just outside of the area occupied by rare species in the northern section of the site (Figure 5). This monitoring was meant to document habitat quality of the site in areas adjacent to the rare species introductions that occurred there.

## **Oxbow West NW**

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 grass that is expanding into the prairie from adjacent wet areas. Oxbow West supports a number of rare species, including *Erigeron decumbens*, *Lupinus oreganus*, *Cicendia quadrangularis*, and *Sidalcea cusickii*. The habitat has also been noted as having high potential for reintroduction of *Lomatium bradshawii*. The federally endangered *E. 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 in the wet prairie (occupied by *E. decumbens*) have included mowing (initiated in 2002) and burning (treated in September 2005). Monitoring of the wet prairie habitat occupied by *E. decumbens* occurred in 2007, 2010 and 2013. Monitoring of the upland prairie habitat occupied by *Lupinus oreganus* occurred in 2009 and 2014. In 2015, we established a new monitoring plot in the NW portion of the site, in an area suggested by the BLM to document habitat quality in areas adjacent to the occurrences of rare plants to document potential habitat (Figure 6).

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## METHODS

In May 2015, three plots were sampled to estimate vegetation cover in the West Eugene Wetlands, each site contained one plot (Figure 2). Plot dimensions varied by site, the plot at Fir Butte SE had been monitored prior, and the plots at Oxbow West and Greenhill N were both established in 2015 (Table 2). In new plots, plot corners were marked with 9 inch nails and blue whiskers, and location information was collected with a GPS for future monitoring. 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). For Fir Butte SE, the first sample point along each transect was randomly located between 0m and 4m, and systematically located every 4m (Figure 6, Figure 3). At Greenhill N, the first sample point along each transect was randomly located between 0m and 5m, and systematically located every 5m (Table 2, Figure 4). For Oxbow West NW, the first transect running perpendicular to the baseline was randomly located between 0m and 3m (Figure 5). Subsequent transects were placed every 3m along the baseline. 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. 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 (late June) later to document late-season species, however we may have missed some early-season species. While we were originally scheduled to monitor in July, we decided to move monitoring up due to an early plant phenology and very hot temperatures noted at other sites. Surveys have been conducted at multiple times throughout the growing season to yield a greater understanding of the plant community over time (Table 1)

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Table 2. Characteristics of habitat sampling plots in 2015

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| Site          | Plot origin (Lat/Long, Nad83) | Plot dimensions | # samples |
|---------------|-------------------------------|-----------------|-----------|
| Greenhill N   | 44.062090, -123.210944        | 50 x 100m       | 215       |
| Oxbow West NW | 44.056711, -123.194980        | 30 x 100m       | 212       |
| Fir Butte SE  | 44.078163, -123.229655        | 40 x 100 m      | 211       |

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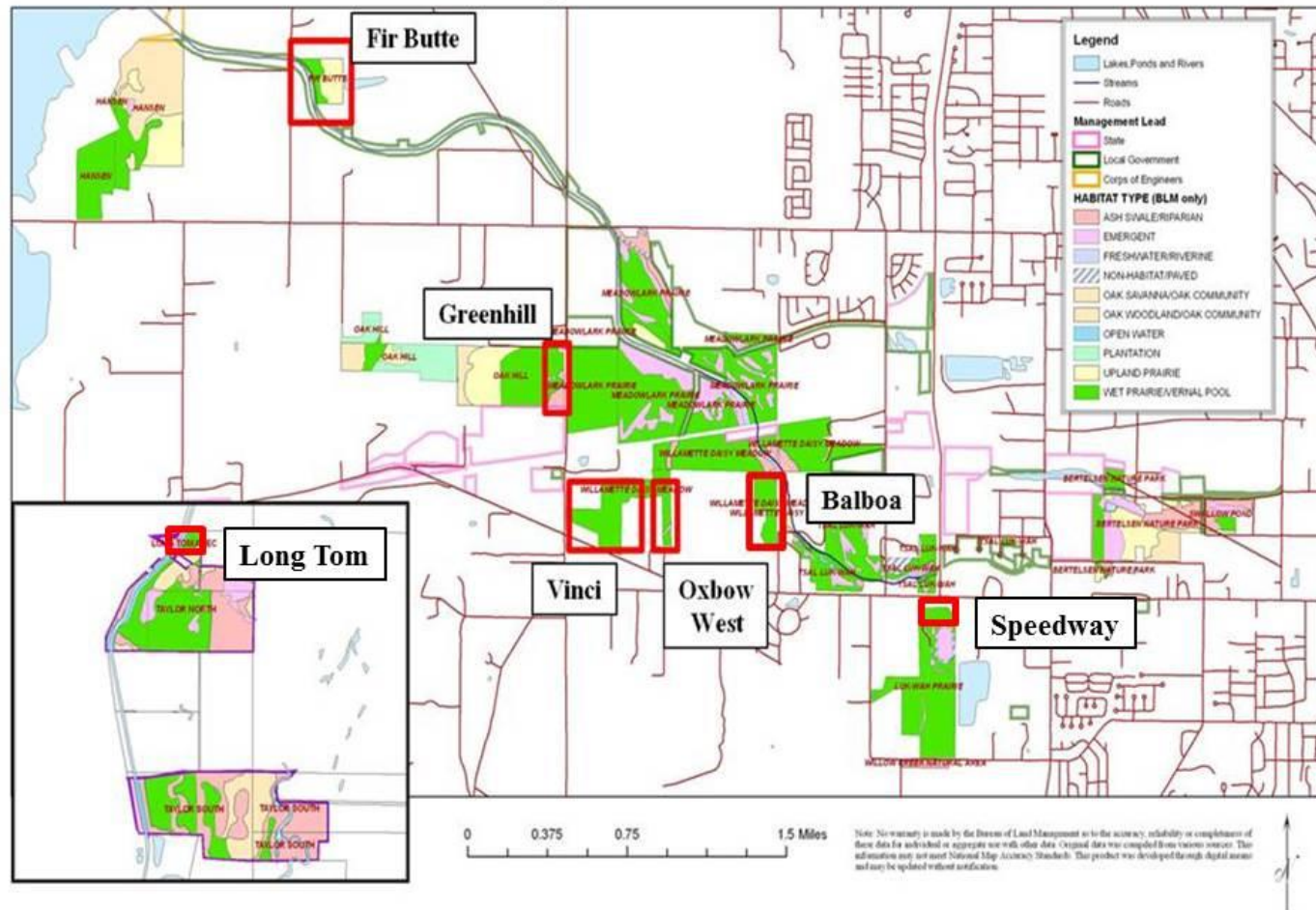


Figure 2. Monitoring sites described in this project. Sites monitored in 2015 include Greenhill, Oxbow West, and Fir Butte. Other listed sites were not monitored in 2015.

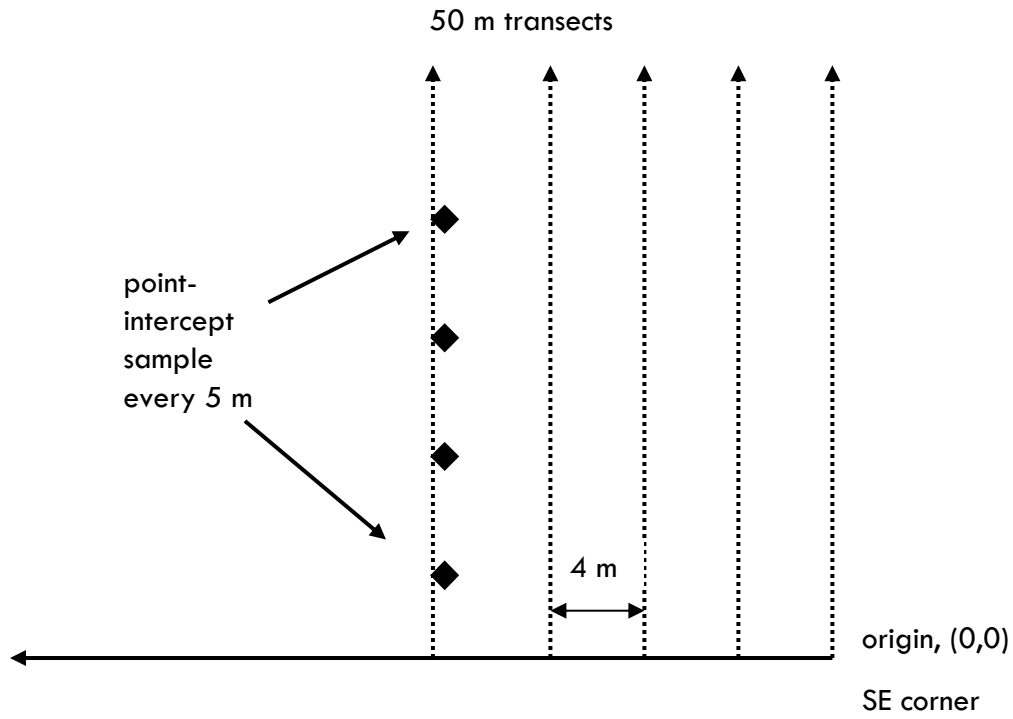


Figure 3. Example design of a sampling plot.

### High Intensity Monitoring at Greenhill 2015



Figure 4. Location of sampling plot at Greenhill N in 2015. The red box indicates the targeted area and the blue dots indicate the four corners of the plot monitored in 2015. Greenhill 1 and 2 were last monitored in 2012.

High Intensity Monitoring at Oxbow West 2015



Figure 5. Location of the sampling plot at Oxbow West NW in 2015. The red box indicates the targeted area and the blue dots indicate the four corners of the plot.

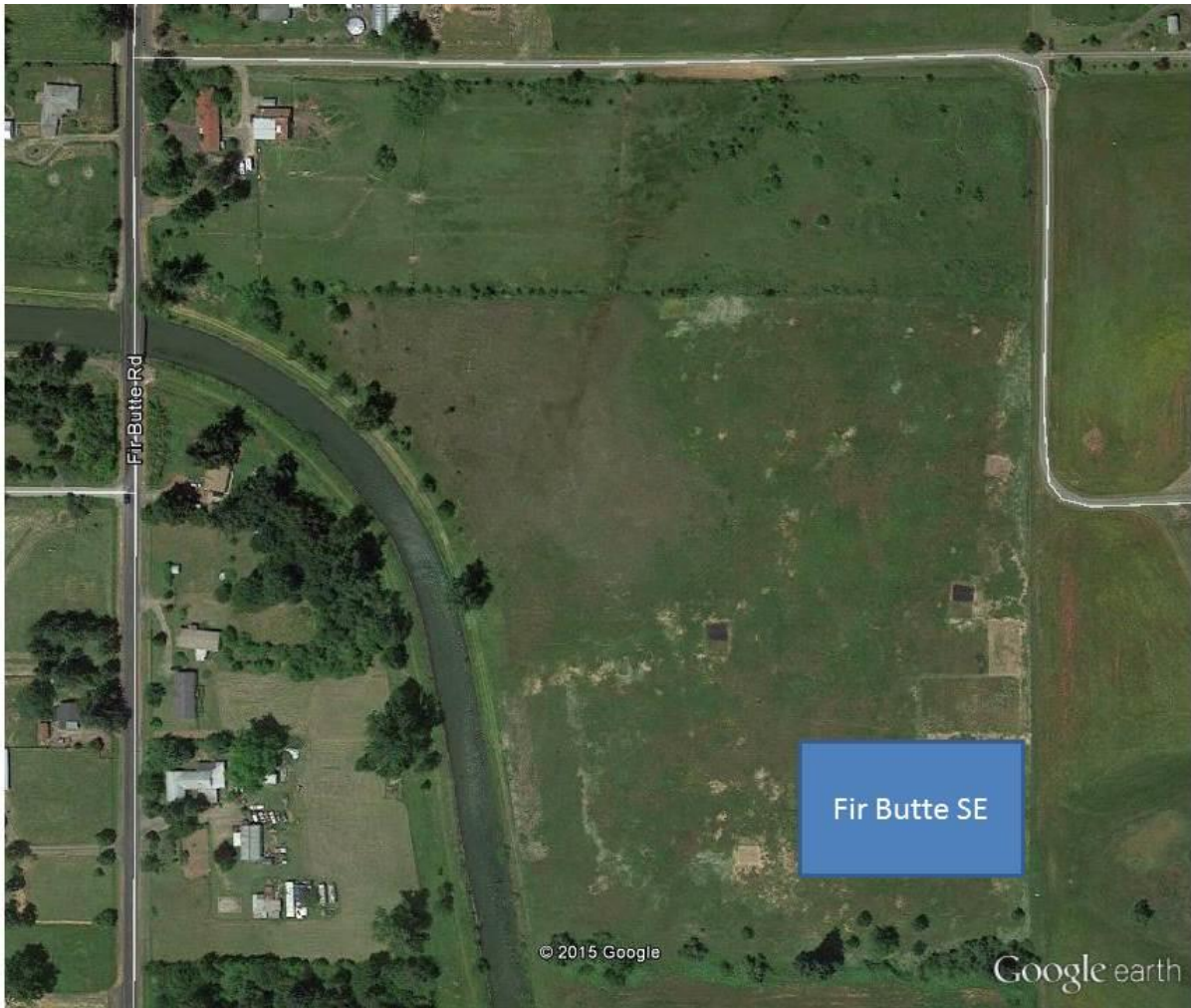


Figure 6. Location of the sampling plot at Fir Butte SE in 2015.



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## RESULTS AND DISCUSSION

### Sites

Table 3. Mean cover of substrate categories from 2015 monitoring at all sites.

|             | Fir Butte SE | Greenhill N | Oxbow West NW |
|-------------|--------------|-------------|---------------|
| Bare ground | 73.9         | 78.1        | 79.2          |
| Moss        | 3.3          | 17.7        | 11.8          |
| Litter      | 96.7         | 79.1        | 89.2          |
| Basal Veg   | 0.5          | 1.9         | 1.4           |

#### Fir Butte SE

Total cover of introduced species was greater than native species cover in 2015, and had increased from total cover in 2012 (Figure 7). Between 2012 and 2015, introduced forb cover increased from 29.6% to 47.9% and introduced grass cover increased from 87.9% to 123.22% (Figure 7). Native cover also increased slightly between 2012 and 2015; native forbs increased from 8.3% to 20.4% in 2015, and native grasses which were not present in 2012 had 1.4% cover in 2015 (Figure 7). While native species did increase slightly between 2012 and 2015, this site remained dominated by introduced species, primarily grasses. In 2015 there were 7 native species and 18 were introduced. The most dominant species at Fir Butte SE was *Agrostis stolonifera*, which was present in almost every sampling unit (90.5%). This accounted for the very high cover of introduced grasses (Appendix A). Other common introduced grasses included *Aira caryophylla* (7.1%), *Anthoxanthum odoratum* (7.6%), and *Schedonorus arundinaceus* (8.5%). Common introduced forbs included *Parentucellia viscosa* (9.9%), *Rumex acetosella* (9.5%), *Sherardia arvensis* (7.6%) and *Rubus armeniacus* (10.9%). Native forbs increased since 2012 and were composed primarily of *Pteridium aquilinum* (10.9%) and the rare *Lupinus oreganus* (7.2%). *Lupinus oreganus* has increased from roughly 1% noted in 2012. While in 2012 we picked up no native grasses in monitoring, in 2015 we noted trace amounts (<1%) of natives *Danthonia californica* and *Deschampsia cespitosa*. This site had high cover of litter (96.7%, Table 3), which was present often as a thatch layer and likely the result of the high cover of introduced grasses.

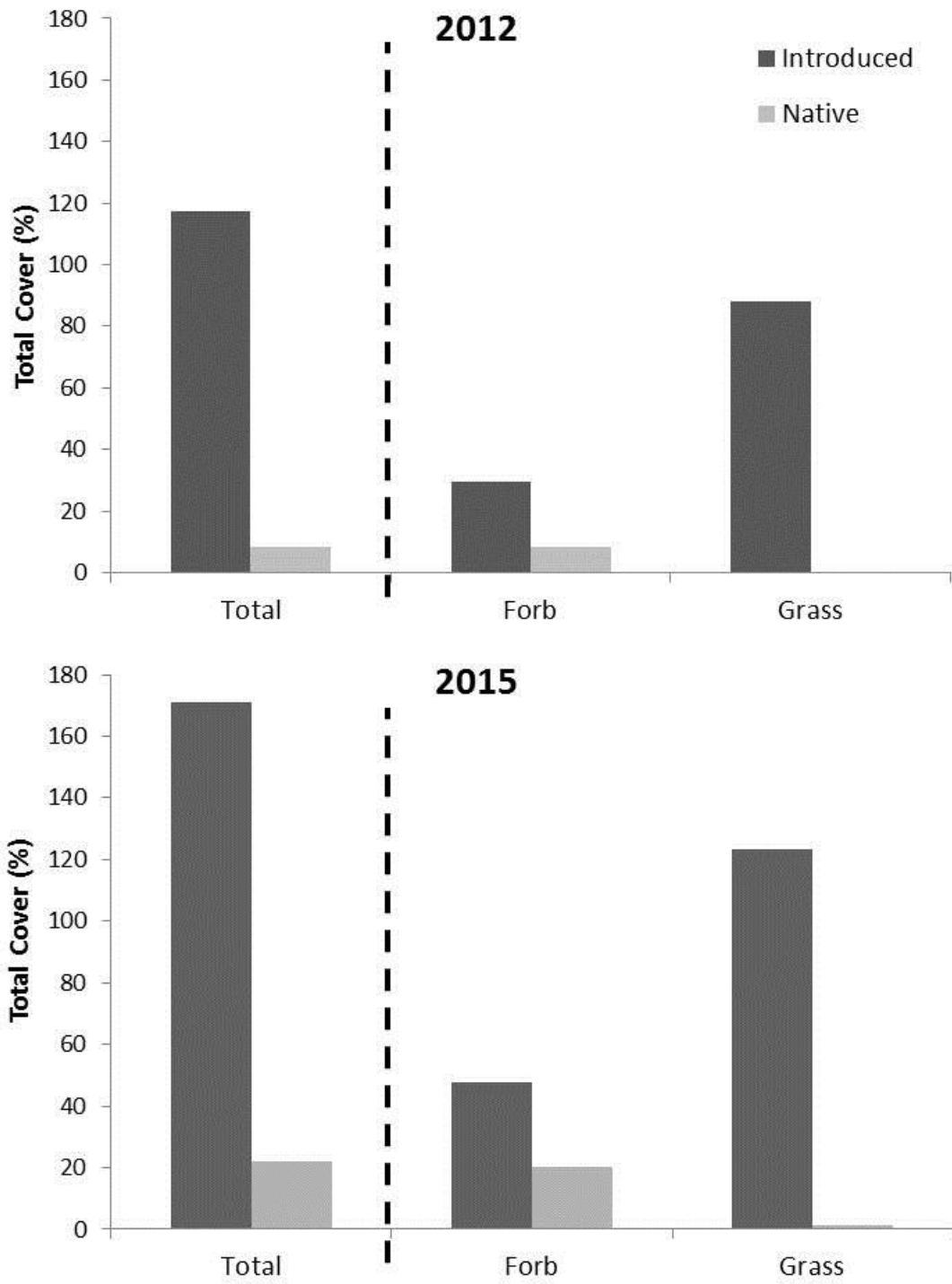


Figure 7. Percent cover of native and introduced species, by growth habit, at Fir Butte SE in 2012, and 2015. Cover can exceed 100% when multiple layers of vegetation are documented.

## Greenhill N

At Greenhill N, total introduced cover was greater than total native species cover (91% and 73%, respectively, Figure 8); despite this, native cover was relatively high for both forbs and grasses. In 2015 numbers of introduced and native species were very similar (15 and 14, respectively). Dominant native grasses included *Danthonia californica* (16.3%) and *Deschampsia cespitosa* (33.0 %); *D. cespitosa* had the highest cover of all species at Greenhill N (Appendix A). Dominant introduced grasses included *Agrostis stolonifera* (15.3%), *Aira caryophylla* (22.8%), and *Holcus lanatus* (18.6%). Native and introduced forbs were less abundant than grasses at the site (Figure 8). The most abundant introduced forbs were *Hypochaeris radicata* (13.0%) and *Sherardia arvensis* (6.5%). Native forbs were composed primarily of *Eriophyllum lanatum* (4.7%) and *Grindelia integrifolia* (4.2%). While rare species were in the surrounding vicinity, we noted none within our plots. Litter cover was high at Greenhill N, composing 78.1% of total cover, this is likely the result of the high abundance of grass canopy at the site. The area monitored in 2015 was not monitored in the past so comparisons could not be made to other parts within the site.

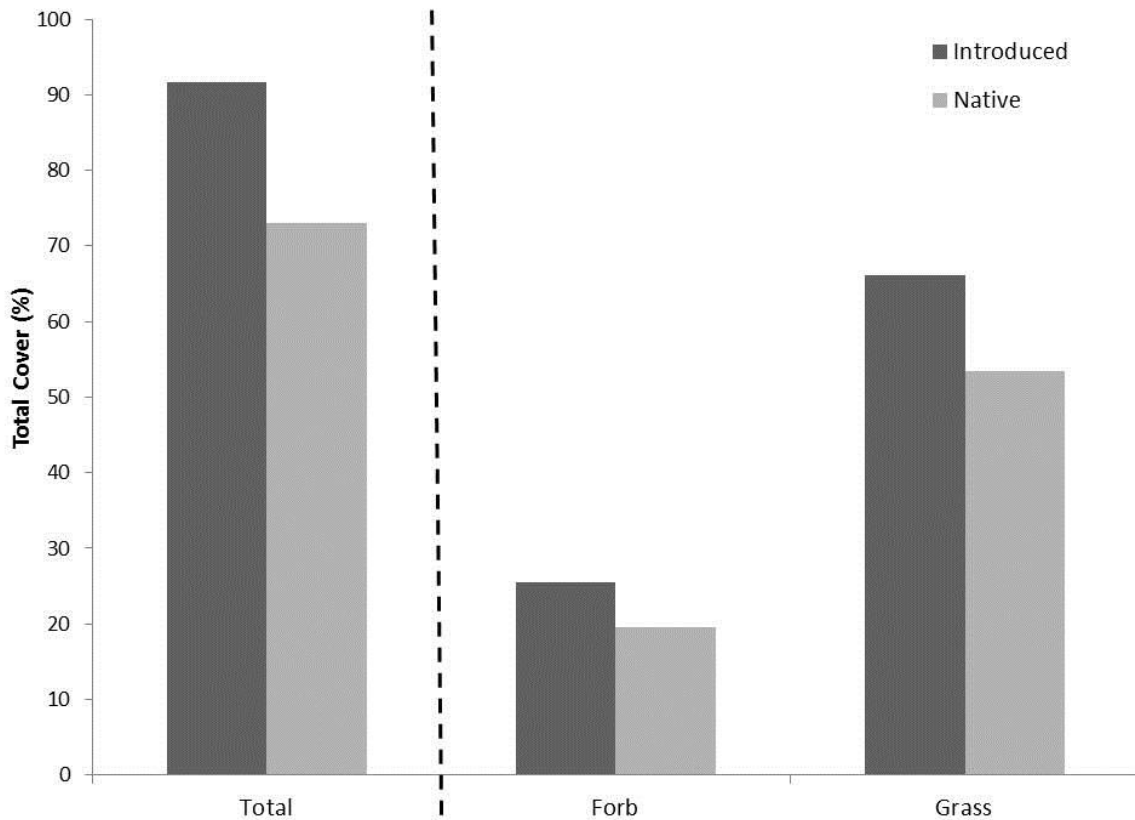


Figure 8. Percent cover of native and introduced species, by growth habit, at Greenhill N in 2015.

## Oxbow West NW

Oxbow West NW had higher cover of introduced species than native species in 2015, however native species were quite prevalent (Figure 9). Species richness at Oxbow West NW had many more introduced species than natives (17 species and 9 species, respectively), with the majority of introduced species being forbs (Figure 9). Despite there being greater number of introduced species at the site, natives still accounted for a high percentage of total cover, with native grasses having higher cover than introduced grasses (Figure 9). The most abundant native species at Oxbow West NW were the native grasses *Danthonia californica* (32%) and *Deschampsia cespitosa* (27%; Appendix A). Other prominent native species included forbs *Madia glomerata* (5%) and *Prunella vulgaris* (4.7%). The most abundant introduced species were the forbs *Sherardia arvensis* (23%), *Hypochaeris radicata* (14%), *Leucanthemum vulgare* (11%), and *Rubus armeniacus* (12%). Introduced grasses included *Anthoxanthum odoratum* (8%), *Schedonorus arundinaceus* (17%), and *Holcus lanatus* (7%). Litter/thatch cover was high in 2015 (89.2%); while there were only marginal amounts of moss and basal vegetation cover, bare ground cover was relatively high covering 79% under the dense litter mat (Table 3).

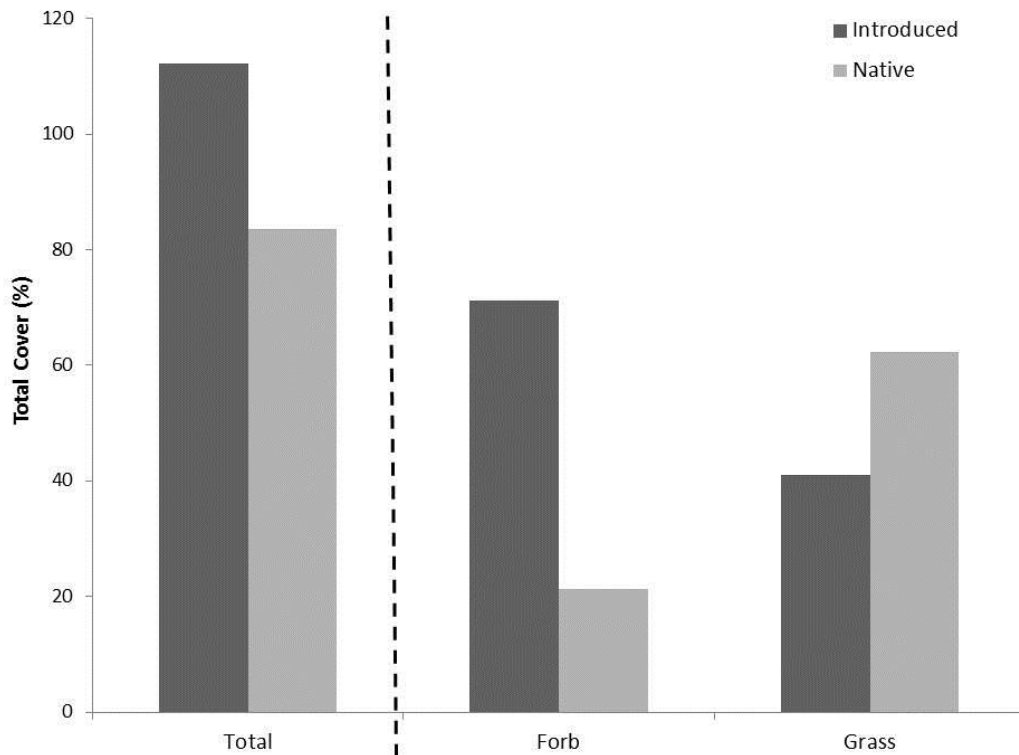


Figure 9. Percent cover of native and introduced species, by growth habit, at Oxbow West NW in 2015. Note the y-axis range (0-120).

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## Fender's blue butterfly stepping stone habitat

All of the sites monitored in 2015 show potential to serve as habitat for Fender's blue butterfly (*I. icarioides fenderi*). Appropriate 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 2015 monitoring, *Lupinus oreganus* was one of native forbs with the highest cover in our plots at Fir Butte SE (7% cover), but was not present in the plots at the other sites (Appendix A). Kincaid's lupine was present and abundant in a section of Oxbow West which was not monitored in 2015. We have not observed Kincaid's lupine at Greenhill N, however the site does host high native species composition and a number of other rare species. We identified many nectar species for Fender's blue butterfly including *Vicia* spp. at Fir Butte SE and Oxbow West NW. Another common nectar forb, *Eriophyllum lanatum*, was present and abundant at Greenhill N and present in trace amounts at Fir Butte SE. *Linum bienne* was present at Oxbow West NW. 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, particularly native forbs, at these sites.

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## 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 <sup>2</sup> 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 in 2015:

Table 4. Habitat indicators and levels at each site in 2015. Each of these indicators exceeded the thresholds in the 2005 Environmental Assessment. Cover can exceed 100% when multiple levels of vegetation are hit.

| Habitat indicator       | Site          | Indicator level               |
|-------------------------|---------------|-------------------------------|
| <b>Invasive species</b> | Fir Butte SE  | 171% introduced species cover |
|                         | Greenhill N   | 91% introduced species cover  |
|                         | Oxbow West NW | 112% introduced species cover |
| <b>Thatch</b>           | Fir Butte SE  | 97% litter cover              |
|                         | Greenhill N   | 79% litter cover              |
|                         | Oxbow West NW | 89% litter cover              |

Despite management efforts, the cover of invasive species and litter/thatch layer exceeded the threshold values for management at every site (Table 4). Litter cover was greater than 75% at all sites; litter at these sites often causes a dense layer of thatch that can be inhibitory for germination of species, both native and introduced. Any management activities to remove litter should be followed by extensive weed control and seeding of native species. High grass cover contributes greatly to the build-up of thatch.

Introduced species had greater than 50% cover at all sites (Table 4). Introduced species were particularly abundant at Fir Butte where cover was 171%, greatly exceeding 100%. This occurred because using this method, any species the laser touched was recorded as a “hit”. At Fir Butte, there were many layers of introduced grasses and there were often “hits” of many introduced species for one sample point. Oxbow West NW also had very high cover of introduced species at 112%, with Greenhill N covering 91%. These data suggest the great need for continued habitat management to reduce invasive species and decrease litter cover and push these sites closer to a condition with the potential to support more native species.

This report describes changes in plant community composition that have occurred both over time and across seasons. At all sites, monitoring from 2009-2010 occurred in July, from 2011-2014 occurred in May, and in 2015 we transitioned back to late-season, monitoring in late-June. This provides valuable information that may be used for future management activities including information on species dynamics over time and the variability between seasons. At Fir Butte SE, we noted a net increase in total cover, with very high cover of introduced species and litter. While Oxbow West and Greenhill have had monitoring in the past, it was not conducted in the same parts of the site. Data indicated that both of these sites are dominated by introduced species, but also have high native species composition. While this is promising, activities need to be targeted to shift the plant community to a native-dominated composition, which would likely decrease thatch/litter at the sites. Management activities including prescribed fire and herbicide use could greatly alter the plant community composition at these sites. Treatments like the proposed herbicide use in Fir Butte SE will enable us to see what the impact of this potential management tool on the site. Continued monitoring of these populations will be essential to

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document changes in the plant community and how these management treatments might impact the rare plant populations present.



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## LITERATURE CITED

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APPENDIX A. SPECIES COMPOSITION FOR THREE SITES IN THE WEST EUGENE WETLANDS, 2015.

| Species                       | Nativity | Functional Group | % cover     |              |               |
|-------------------------------|----------|------------------|-------------|--------------|---------------|
|                               |          |                  | Greenhill N | Fir Butte SE | Oxbow West NW |
| <i>Achillea millefolium</i>   | Native   | Forb             | 0.5         | 0.5          | 0.0           |
| <i>Agrostis stolonifera</i>   | Exotic   | Grass            | 15.3        | 90.5         | 2.8           |
| <i>Aira caryophylla</i>       | Exotic   | Grass            | 22.8        | 7.1          | 6.1           |
| <i>Anthoxanthum odoratum</i>  | Exotic   | Grass            | 2.8         | 7.6          | 8.0           |
| <i>Arrhenatherum elatius</i>  | Exotic   | Grass            | 0.0         | 0.5          | 0.0           |
| <i>Aster hallii</i>           | Native   | Forb             | 1.4         | 0.0          | 2.4           |
| <i>Bromus hordeaceus</i>      | Exotic   | Grass            | 0.9         | 0.0          | 0.0           |
| <i>Briza minor</i>            | Exotic   | Grass            | 2.8         | 0.0          | 0.0           |
| <i>Centaureum erythraea</i>   | Exotic   | Forb             | 0.0         | 0.0          | 0.5           |
| <i>Convolvulus sp.</i>        | Exotic   | Forb             | 0.0         | 0.9          | 0.0           |
| <i>Daucus carota</i>          | Exotic   | Forb             | 0.0         | 0.5          | 0.0           |
| <i>Dactylis glomerata</i>     | Exotic   | Grass            | 0.0         | 2.8          | 0.0           |
| <i>Danthonia californica</i>  | Native   | Grass            | 16.3        | 0.9          | 32.1          |
| <i>Deschampsia cespitosa</i>  | Native   | Grass            | 33.0        | 0.5          | 27.4          |
| <i>Eriophyllum lanatum</i>    | Native   | Forb             | 4.7         | 0.9          | 0.0           |
| <i>Galium aparine</i>         | Native   | Forb             | 0.0         | 0.9          | 0.0           |
| <i>Geranium dissectum</i>     | Exotic   | Forb             | 0.0         | 0.0          | 1.4           |
| <i>Grindelia integrifolia</i> | Native   | Forb             | 4.2         | 0.0          | 0.0           |
| <i>Holcus lanatus</i>         | Exotic   | Grass            | 18.6        | 2.8          | 7.1           |
| <i>Hypochaeris radicata</i>   | Exotic   | Forb             | 13.0        | 0.5          | 13.7          |
| <i>Juncus tenuis</i>          | Native   | Grass            | 4.2         | 0.0          | 2.8           |
| <i>Leucanthemum vulgare</i>   | Exotic   | Forb             | 0.5         | 0.0          | 11.3          |
| <i>Linum bienne</i>           | Exotic   | Forb             | 0.0         | 0.0          | 1.4           |
| <i>Lotus formosissimus</i>    | Native   | Forb             | 0.5         | 0.0          | 0.5           |
| <i>Lotus unifoliatus</i>      | Native   | Forb             | 0.9         | 0.0          | 0.0           |
| <i>Lupinus oreganus</i>       | Native   | Forb             | 0.0         | 7.1          | 0.0           |
| <i>Madia glomerata</i>        | Native   | Forb             | 0.0         | 0.0          | 5.2           |
| <i>Mentha pulegium</i>        | Exotic   | Forb             | 1.4         | 0.0          | 2.4           |
| <i>Microseris laciniata</i>   | Native   | Forb             | 1.4         | 0.0          | 0.9           |
| <i>Parentucellia viscosa</i>  | Exotic   | Forb             | 0.5         | 10.0         | 0.5           |
| <i>Plantago lanceolata</i>    | Exotic   | Forb             | 0.0         | 1.9          | 0.9           |
| <i>Potentilla gracilis</i>    | Native   | Forb             | 1.4         | 0.0          | 0.0           |
| <i>Prunella vulgaris</i>      | Native   | Forb             | 2.3         | 0.0          | 4.7           |
| <i>Pteridium aquilinum</i>    | Native   | Forb             | 0.0         | 10.9         | 0.0           |
| <i>Rosa sp.</i>               | Native   | Forb             | 0.0         | 0.0          | 7.5           |

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|                                 |        |             |      |      |      |
|---------------------------------|--------|-------------|------|------|------|
| <i>Rumex acetosella</i>         | Exotic | Forb        | 1.9  | 9.5  | 3.8  |
| <i>Rubus armeniacus</i>         | Exotic | Forb        | 0.9  | 10.9 | 11.8 |
| <i>Schedonorus arundinaceus</i> | Exotic | Grass       | 0.0  | 8.5  | 17.0 |
| <i>Sisyrinchium sp.</i>         | Native | Forb        | 0.5  | 0.0  | 0.0  |
| <i>Vicia hirsuta</i>            | Exotic | Forb        | 0.9  | 5.7  | 0.0  |
| <i>Vicia sativa</i>             | Exotic | Forb        | 0.0  | 0.5  | 0.5  |
| <i>Vulpia bromoides</i>         | Exotic | Grass       | 2.8  | 3.3  | 0.0  |
| <i>Wyethia angustifolia</i>     | Native | Forb        | 1.9  | 0.0  | 0.0  |
|                                 |        | Bare ground | 78.1 | 73.9 | 79.2 |
|                                 |        | Moss        | 17.7 | 3.3  | 11.8 |
|                                 |        | Litter      | 79.1 | 96.7 | 89.2 |
|                                 |        | Basal Veg   | 1.9  | 0.5  | 1.4  |

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