

Habitat restoration at Fir Butte: 2017 annual report-Web version



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Northwest Oregon District, Agreement #
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Report prepared by Andrew Esterson
Institute for Applied Ecology



PREFACE

IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. IAE provides services to public and private agencies and individuals through development and communication of information on ecosystems, species, and effective management strategies. Restoration of habitats, with a concentration on rare and invasive species, is a primary focus. IAE conducts its work through partnerships with a diverse group of agencies, organizations and the private sector. IAE aims to link its community with native habitats through education and outreach.



Questions regarding this report or IAE should be directed to:

Thomas Kaye (Executive Director)
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, Oregon 97333

phone: 541-753-3099
fax: 541-753-3098
email: info@appliedeco.org

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Cover photographs: Nectar island at Fir Butte. Photo taken by Matt Shultz.

SUGGESTED CITATION

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SPECIAL NOTE

This report has been modified from its original format by removing maps/ and or appendices that include information on the location of rare and sensitive species.

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1. EXECUTIVE SUMMARY

Fir Butte is an 18-acre site located in Eugene, Oregon that is owned and managed by the Bureau of Land Management, Northwest Oregon District (BLM). Fir Butte hosts a large population of the federally endangered Fender's blue butterfly (*Icaricia icarioides fenderi*) and its host plant, the federally threatened Kincaid's lupine (*Lupinus oregonus*), along with other Bureau sensitive species. To conserve and bolster populations of critical species at Fir Butte, the BLM has partnered with the Institute for Applied Ecology (IAE) since 2012. Since then, IAE has performed numerous management actions including weed abatement, native seeding and nectar island creation at Fir Butte.

In 2017, IAE helped plan and implement a variety of activities to support restoration and conservation efforts. Activities included weed control, nectar island creation, native species planting, support for a prescribed burn and an ongoing experiment evaluating the non-target impacts of a grass specific herbicide on prairies supporting Fender's blue butterfly. IAE will continue to perform habitat restoration in 2018 and the foreseeable future.

2. INTRODUCTION

Fir Butte is an 18-acre site owned and managed by the BLM and located in Lane County, Oregon, in the West Eugene Wetlands. Fir Butte is part of a network of sites in the Eugene West Recovery Zone within the Willamette Valley that supports large source populations of the federally endangered Fender's blue butterfly and the federally threatened Kincaid's lupine. Bureau sensitive species including white topped aster (*Sericocarpus rigidus*) and three bryophyte species have been observed at Fir Butte as well. Populations of rare species at Fir Butte are used to meet U.S. Fish and Wildlife Service (USFWS) delisting goals referenced in the 2010 Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington (USDI 2010; Recovery Plan).

The BLM has partnered with IAE since 2012 to perform habitat restoration at Fir Butte. Listed species have benefited from restoration actions. Since restoration actions begun, the Fender's blue butterfly population has remained stable and the Kincaid's lupine population has steadily increased in the past three years (Petix and Bahm 2017). Management actions have kept meadow knapweed, bull thistle, tansy ragwort and Scotch broom populations sparse, although control of non-native blackberry at the site remains an ongoing challenge. In general, the habitat restoration work conducted by IAE and the BLM over the past five years has improved habitat conditions at Fir Butte and while the site does not yet meet habitat quality, rare species population size and trend benchmarks identified in the Recovery Plan, this partnership is moving it in the right direction.

3. GOALS AND OBJECTIVES

The goals of this project are to improve habitat quality such that the Kincaid's lupine and Fender's blue butterfly populations contribute to USFWS delisting goals, decrease the abundance of non-native species, and increase the abundance and diversity of native plant species. Specific project objectives include:

- Annually observe a minimum of 200 Fender's blue butterflies between May and June
- Maintain or increase the area of Kincaid's lupine foliar cover
- Reduce blackberry to below 5% absolute cover
- Remove all meadow knapweed and Scotch broom
- Increase native species relative cover to 50% or greater

4. 2017 PLANT COMMUNITY

In general, the flora at Fir Butte continues to be dominated by non-native species. Colonial bentgrass (*Agrostis capillaris*), tall oatgrass (*Arrhenatherum elatius*), sweet vernal grass (*Anthoxanthum odoratum*), wild carrot (*Daucus carota*), wall bedstraw (*Galium parisiense*) and Armenian blackberry (*Rubus armeniacus*) were among the most abundant non-native species (Petix and Bahm 2017). Although isolated to the south eastern portion of Fir Butte, the bracken fern (*Pteridium aquilinum*) population continues to be dense and problematic in respect to native species recruitment.

Native species are present throughout the site, but are typically sparse and make up a fraction of the percent cover compared to non-native species. Kincaid's lupine is the most abundant native species, while scant amounts of Oregon sunshine (*Eriophyllum lanatum*), checkermallow (*Sidalcea sp.*), common yarrow (*Achillea millefolium*) and self-heal (*Prunella vulgaris*) are present (other native species are present but with relatively small populations compared to the aforementioned native species). In the wet prairie, tufted hairgrass (*Deschampsia cespitosa*) is the most abundant species.

5. 2017 RESTORATION ACTIONS

In 2017, IAE helped plan and implement a variety of activities to support restoration and conservation efforts at Fir Butte. Activities included nectar island creation, non-native species control, preparation for a prescribed burn, native and nectar species planting, and support for an on-going experiment evaluating the non-target impacts of a grass specific herbicide on prairies supporting Fender's blue butterfly (Table 1).

Table 1. Management actions completed at Fir Butte in 2017

Date	Action	Who	Description
3/23/2017	Herbicide application	Habitat Restoration LLC	Applied Fusilade herbicide to four experimental plots to test non-target impacts of using Fusilade to manage prairie harboring Fender's blue butterfly
5/1/2017 – 7/31/2017	Survey for Fender's blue butterfly	BLM	Distance sampling for Fender's blue butterfly
7/13/2017	Weed removal	BLM and Looking Glass	Removed meadow knapweed inflorescences
6/6/2017	Hand mow tall oatgrass	IAE and BLM	Hand mowed tall oatgrass at 6" throughout site. Where growing concurrently with Kincaid's lupine, mowed above top of raceme. Did not mow Cheryl Schultz's research plots in the SW corner
9/13/2017	Nectar Island preparation	IAE and BLM	Cleared and prepared shade cloth for nectar species planting
9/13/2017	Fire break preparation	IAE and BLM	Delineated burn zone with pin flags
9/14/2017	Fire break preparation	Contractor	Mowed fire brake around burn zone
9/14/2017	Mow	Contractor	Mowed entire site except 2017 burn unit
10/5/2017	Prescribed burn	Inter-Agency burn crew	Burned 4 acres in north section which contain both upland and wet prairies
10/19/2017 & 10/26/2017	Nectar Island prep	IAE and BLM	Burned 1710 holes in shadecloth and seeded with native mix
10/24/2017	Seeding	IAE and BLM	Seeded wet prairie with native mix
10/26/2017	Seeding	IAE and BLM	Seeded upland with native mix
11/14/2017	Planting	BLM and Looking Glass	Planted approximately 1200 <i>Fragaria virginiana</i> runners
11/15/2017	Planting	IAE, BLM and Looking Glass	Planted approximately 1600 <i>Triteleia hyacinthine</i> bulbs
11/20/2017	Planting	IAE	Planted 50 <i>Eriophyllum lanatum</i> plugs and 50 <i>Sidalcea malviflora</i> in the upland area of the burn zone
11/20/2017	Nectar Island prep	IAE and BLM	Burned holes in weed barrier
11/21/2017	Planting	IAE and BLM	Planted 200 <i>Eriophyllum lanatum</i> , 300 <i>Sidalcea malviflora</i> pots, ~300 <i>Camassia leichtlinii</i> and ~300 <i>Allium amplexens</i> bulbs and a native seed mix in the nectar island

5.1. Nectar Islands

Nectar islands were first created at Fir Butte in 2014. The primary objective was to establish small 'islands' of nectar resources for pollinators, mainly Fender's blue butterflies. Established nectar islands would also provide seed to the surrounding prairie, helping to increase the diversity and abundance of native species. Nectar islands were established by covering five 8m x 10m blocks (Figure 1) with weed barrier for a year, after one-year the weed barrier was removed, and blocks were seeded and/or plugs were planted with native species.



Figure 1. Nectar island and experimental plot locations at Fir Butte.

Unfortunately, nectar islands are slowly transforming into non-native grass patches (Figure 2), and without the use of herbicides, maintaining nectar islands by hand weeding is not possible with the resources available. To mitigate future nectar island transformations, IAE and BLM staff created a new nectar

island in 2017 using a different design. Rather than removing the weed barrier prior to planting, we left the barrier in place and planted native seed (Table 2), plugs and bulbs (Table 3) directly into holes burned into the weed barrier (Figure 3). This should reduce the amount of manual weeding needed to maintain the nectar island and allow nectar islands to persist over time. Once herbicide is permitted, the weed barrier will be removed in the fall after plants have senesced and herbicides (along with hand weeding) will be used to manage non-native species.



Figure 2. Nectar islands planted between 2014 and 2016. This picture illustrates the transformation from newly planted native nectar species to a dominant non-native grass patch. The 2016 nectar island has high native diversity and abundance; the 2015 nectar island is primarily Roemer's fescue and the oldest nectar island is overwhelmingly covered with Colonial bentgrass.

Table 2. 2017 Fir Butte nectar island seed mix.

Species	Common name	Pounds/Acre
<i>Achillea millefolium</i>	yarrow	0.2
<i>Camassia leichtlinii</i> var. <i>suksdorfii</i>	Suksdorf's large camas	1.59
<i>Clarkia purpurea</i>	purple clarkia	0.06
<i>Epilobium densiflorum</i>	denseflower willowherb	0.09
<i>Eriophyllum lanatum</i> var. <i>lanatum</i>	wooly sunflower	0.17
<i>Festuca roemerii</i>	Roemer's fescue	0.84
<i>Linanthus bicolor</i>	true babystar	0.02
<i>Lomatium nudicaule</i>	barestem biscuitroot	0.2
<i>Microseris laciniata</i>	cutleaf silverpuffs	0.17
<i>Nemophila menziesii</i> var. <i>atomaria</i>	baby blue eyes	0.11
<i>Plectritis congesta</i>	shortspur seablush	0.21
<i>Potentilla gracilis</i> var. <i>gracilis</i>	slender cinquefoil	0.07
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	self-heal	0.31
<i>Sidalcea malviflora</i> ssp. <i>virgata</i>	dwarf checkerbloom	0.83
<i>Wyethia angustifolia</i>	California compassplant	0.48

Table 3. Plugs and bulbs planted in the nectar island at Fir Butte during 2017

Species	Common name	Quantity
<i>Allium amplexans</i>	Narrowleaf onion	Approximately 300
<i>Camassia leichtlinii</i>	Suksdorf's large camas	Approximately 300
<i>Eriophyllum lanatum</i> var. <i>lanatum</i>	wooly sunflower	250 band pots
<i>Sidalcea malviflora</i> ssp. <i>virgata</i>	Rose checkermallow	350 band pots



Figure 3. Newly established nectar island in 2017 (approximately 322m²). Holes were burned into the weed cloth with a pencil tip torch and native seed, plugs and bulbs were planted into each hole.

5.2. Non-native species management

Non-native species management actions primarily targeted tall oatgrass, meadow knapweed (*Centaurea pratensis*) and non-native grasses. IAE and BLM staff used string trimmers to mow tall oatgrass on June 6th prior to seed set (Figure 4), the Looking Glass youth crew removed and bagged meadow knapweed inflorescences on July 13th, and the entire site (with the exception of the burn unit) was mowed on September 14th.

5.3. Prescribed burn

Prescribed burns have been an important component to habitat management at Fir Butte. The site was burned in 2008, 2009, 2012, 2014, 2016 and 2017. All burns have been in compliance with guidelines described in the Biological Opinion (USDI 2014; standards 9 and 36). Standard 36 requires that no more than 1/3 of Fender's blue butterfly habitat is burned in a given year if more than 100 Fender's blue butterflies occupy the site, therefore, burn units are typically less than 5-acres unless they contain unsuitable habitat for Fender's blue butterfly (e.g. wet prairie). Burn units are rotated annually and not burned again for at least three years. In 2017, the burn unit was approximately 7.8-acres and contained both wet prairie and upland habitats (Figure 5).



Figure 4. Colin Sayre of the BLM assisting IAE staff with tall oatgrass removal on June 6th. This species is mowed annually to prevent seed set.

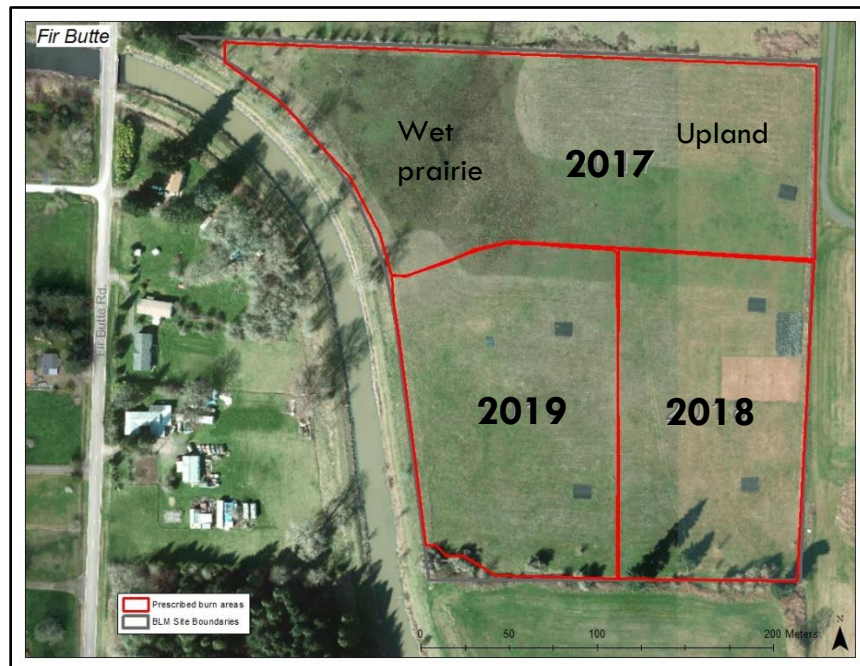


Figure 5. The red polygons delineate the Fir Butte burn units for 2017-2019.

5.4. Seeding and outplanting

Following the prescribed burn, a native seed mix was broadcast onto the wet (Table 4) and upland (Table 5) prairies within the burn unit using a belly bag on October 24th and 26th, respectively (

Figure 6). Seed was sourced from the Eugene West Recovery Zone and provided by the City of Eugene. In addition, 1,200 wild strawberry (*Fragaria virginiana*) runners, 50 Oregon sunshine and 50 dwarf checkerbloom, and hundreds of narrowleaf onion (*Allium amplexans*) and Suksdorf's large camas (*Camassia leichtlinii*) bulbs were planted in the upland prairie. 1,600 white Brodiaea (*Triteleia hyacinthina*) bulbs were planted in the wet prairie.

Table 4. 2017 Fir Butte wet prairie seed mix.

Species	Common Name	Pounds/Acre
<i>Achillea millefolium</i>	yarrow	0.13
<i>Allium amplexans</i>	narrowleaf onion	0.09
<i>Camassia quamash</i> var. <i>maxima</i>	small camas	4.41
<i>Grindelia integrifolia</i>	Puget Sound gumweed	1.32
<i>Juncus occidentalis</i>	Western rush	0.01
<i>Lomatium nudicaule</i>	barestem biscuitroot	3.67
<i>Microseris laciniata</i>	cut-leaf microseris	0.4
<i>Plagiobothrys figuratus</i>	fragrant popcorn flower	0.09
<i>Potentilla gracilis</i> var. <i>gracilis</i>	slender cinquefoil	0.26
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	self-heal	0.26

Table 5. 2017 Fir Butte upland prairie seed mix.

Species	Common name	Pounds/Acre
<i>Achillea millefolium</i>	yarrow	0.18
<i>Allium amplexans</i>	narrowleaf onion	0.72
<i>Camassia leichtlinii</i> var. <i>suksdorfii</i>	Suksdorf's large camas	0.66
<i>Clarkia purpurea</i>	purple clarkia	0.26
<i>Lomatium nudicaule</i>	pestle lomatium	0.66
<i>Luzula comosa</i>	common wood rush	0.2
<i>Microseris laciniata</i>	cutleaf silverpuffs	1.76
<i>Plectritis congesta</i>	shortspur seablush	0.88
<i>Potentilla gracilis</i> var. <i>gracilis</i>	slender cinquefoil	0.26
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	self-heal	0.18
<i>Ranunculus occidentalis</i> var. <i>occidentalis</i>	Western buttercup	0.38

<i>Sidalcea malviflora</i> ssp. <i>virgata</i>	dwarf checkerbloom	2.65
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Figure 6. Colin Sayre (BLM) and Andrew Esterson (IAE) broadcast a wet prairie seed mix after the fall prescribed burn.

5.5. Grass specific herbicide experiment

An on-going experiment evaluating long-term effects of annual application of grass specific herbicide on invasive grasses, Fender's blue butterfly and its habitat continued in 2017. IAE contracted Habitat Restoration, LLC. to apply herbicide on experimental plots. Specifically, Fusilade DX (20oz/acre) and Nu-Film (6oz/acre) were applied to four 20m x 20m plots using a boom sprayer mounted on an ATV on March 23rd (Figure 7). Experimental plots were mowed in September.



Figure 7. Fusilade application on experimental plots at Fir Butte. This treatment was applied by a contractor on March 23, 2017.

6. 2018 PROPOSED ACTIONS

In 2018, IAE will continue implementation of restoration activities similar to those conducted in 2017, including hand weeding, mowing tall oatgrass, prescribed burn preparation, site-wide mowing, and native seeding/plantings. In addition, IAE will continue coordinating Fusilade applications within the research plots managed by Dr. Cheryl Schultz. Upon approval from the BLM, IAE will begin applying targeted herbicide treatments of glyphosate on tall oatgrass, bracken fern and non-native grasses in nectar islands, triclopyr on patches of Armenian blackberry, and clopyralid on patches of meadow knapweed. IAE will continue to collaborate with the BLM to support the process leading up to herbicide implementation.

To reduce seed set from late summer flowering non-native forbs, we recommend mowing in mid-August rather than in mid-September, which is when mowing has typically taken place. Mowing with a tractor should not be conducted prior to August 15th to be in compliance with standards outlined in the Biological Opinion which governs restoration actions at this site (USDI 2014; standards 11, 27, 32). If the site is mowed using a brush mower, mowing may proceed earlier than August 15, but a 2m buffer will be maintained from all Kincaid's lupine patches.

7. REFERENCES

- Petix, M.I., and M.A. Bahm. 2017. Kincaid's lupine (*Lupinus oreganus*) and habitat monitoring at Fir Butte. Prepared by Institute for Applied Ecology for the Bureau of Land Management, Northwest Oregon District. vi+10 pp.
- USDI Bureau of Land Management, Eugene District. 2014. *Biological Opinion for the Resource Management Plan for the West Eugene Wetlands in Lane County, OR*. Ref. No. 01E0FW00-2014-0139). Eugene, Oregon, USA.

APPENDICES

Appendix A. management actions completed at fir butte between 2013-2017

Year	Date	Activity	Who	Notes
2013	17-Apr	Marking of weeds site wide	Ian Silvernail, Naomi Halpern, Guy Banner	Systematically began wandering through site and marking locations of <i>Cirsium vulgare</i> , <i>Cytisus scoparius</i> , <i>Centaurea x pratensis</i> , <i>Lepidium heterophyllum</i> , <i>Hypericum perforatum</i> , and <i>Senecio jacobaea</i> .
2013	23-Apr	Finish marking weeds	Naomi Halpern, Ian Silvernail	Systematically wandered through rest of site and marked all locations of the species listed from 4/17.
2013	25-Apr	Hand removal of weeds throughout site	Naomi Halpern	Digging/pulling of all weeds marked on 4/17/13
2013	29-Apr	Hand removal of weeds throughout site	Naomi Halpern	Digging/pulling of all weeds marked on 4/17/13
2013	1-May	Post-treatment data on shadecloth/solarization plots	Ian Silvernail	Recorded species and cover information in 10 plots per treatment area, 30 plots total. Took photograph of all points.
2013	1-May	Pre-treatment data on new shadecloth areas	Ian Silvernail, Naomi Halpern	Took pre-treatment data on shadecloth areas to be placed with youth crew the next week

Year	Date	Activity	Who	Notes
2013	10-May	Weed whacking, tilling prior to solarization	Ian Silvernail, Naomi Halpern	Weed whacked all new shade cloth plots in preparation for youth crew. Weed whacked 2m wide perimeter around all shade cloth plots. Tilled 3 of the 4 plots that are to receive solarization next week.
2013	14, 15, 22-May	Shade cloth/solarization installation	Ian Silvernail, Naomi Halpern, Looking Glass Youth Crew	
2013	19-Jun	Weed whacking tall oatgrass, hand weeding solarization plots	Ian Silvernail, NYC crew of 6	Weed whacked tall oatgrass. Started in NE corner and moved south along east boundary to SE corner. Moved west across southern border to middle. Walked north through middle whacking small patches. Did not whack big patch in SW corner nor small patches in north-middle.
2013	19-Jun	Hand weeding solarization plots	Naomi Halpern, NYC crew of 6	Hand weeded starting in SW corner of shade cloth/solarization experiment area....did not make much progress....very slow growing...attempted to be thorough but realized by end of the day that it is impractical with this density of <i>Agrostis stolonifera</i> and <i>Rumex acetosella</i> colonization
2013	10-Jul	Weeding	Naomi Halpern	Hand weeded in shade cloth/solarization experiment area. Focused largely on removing seed heads of velvet grass and sheep sorrel. 5 contractor bags full.
2013	16-Sep	Solarization removal	Ian Silvernail	Upon arrival, found that the plastic on all four solarization plots was shredded and the plots were no longer covered. Perhaps fault of heat or lack of UV stabilizer in plastic. Cleaned up 2 of the 4 plots.

Year	Date	Activity	Who	Notes
2013	16-Sep	Purple anther pepperweed weeding	Ian Silvernail	In large shadecloth/solarization experiment plot, dug out all visible <i>Lepidium heterophyllum</i> plants that had set seed this year. Small plants in leaf were generally not removed. Lots of dry seed on the plants.
2013	18-Sep	T-post replacement, East edge	Ian Silvernail	Replaced all T-posts near east edge of property with orange cement markers. The only T-post that had a tag on it was the one in the far SE corner; it was transferred to the new marker. T-posts appeared to be regularly spaced in southern 2/3 of property, but were sparse and irregular in northern 1/3.
2013	18-Sep	T-post replacement, middle	Ian Silvernail	Began replacing T-posts in middle of property. Started at north end and replaced all green transect T-posts. Put metal scratch tag on all new concrete markers that says 'transect'. For the red plot marker T-posts, replaced #824, 819, and 818 (transferred tags), left #826, 820 in place, and couldn't locate #825, 821-823.
2013	18-Sep	Meadow knapweed weeding	Ian Silvernail	Clipped seed heads on meadow knapweed along north border and east of big shadecloth area.
2013	18-Sep	Wooden post removal	Ian Silvernail	Removed 2 wooden posts with signs along E edge and placed on nearby shadecloth plots.
2013	18-Sep	Large shadecloth alteration	Ian Silvernail	Lifted east edge of big shadecloth and folded over so that there will be room to get mower past.
2013	18-Sep	Solarization removal	Ian Silvernail	Removed shredded plastic at the remaining 2 solarization plots.

Year	Date	Activity	Who	Notes
2013	30-Sep	Solarization raking, shadecloth removal, weed whacking around plots	Ian Silvernail, Naomi Halpern	Raked all four solarization plots to refill trenches. Weed whacked around all solarization/shadecloth plots because mower will not be able to mow close to plots/stakes. Removed shadecloth on plots 1a and on small lepidium shadecloth plot. Noticed that tall oatgrass in areas that were weed whacked on 5/10 was able to reflower much more than areas mowed on 6/19.
2013	31-Oct	Flame weeding	Ian Silvernail, Naomi Halpern	Flame weeded plots 1a-5a.
2013	1-Nov	Plant delivery	Naomi Halpern	Picked up plants at Eugene NPN and Heritage and delivered to Fir Butte
2013	4-Nov	Planting	Ian Silvernail (11.4-11.5), Naomi Halpern (11.4-11.6), Lane Metro Youth Corps (11.4-11.5), Shelby (11.5)	Planted in plots 2a, 3a, 4a, and "lepidium". See planting summary for details, Table 3 and Figure 4.
2013	6-Nov	Seeding	Naomi Halpern	Seeded over plots 2a, 3a, 4a, "lepidium", and Experiment A-C.
2013	20-Nov	Shade cloth removal	Ian Silvernail	plot 6a
2013	20-Nov	Flame weeding	Ian Silvernail	plot 6a

Year	Date	Activity	Who	Notes
2014	20-Mar	Flame weeding	Ian Silvernail, Ted Shriro	Flame weeded plots 1a, 5a, 6
2014	20-May	Flame weeding	Ian S., Ted S.	Flame weeded plots 1a, 5a, 6
2014	5, 6-Jun	Hand mow tall oatgrass	Ian S, Ted S., 4 people from Walama	Hand mowed tall oatgrass at 6" throughout site. Where growing concurrently with <i>Lupinus oreganus</i> , mowed above top of raceme. At Cheryl Schultz' request did not finish L shape patch in SW corner. (Figure 2)
2014	6-Jun	Monitoring	Ian S.	Monitored shadecloth/solarization experimental plots
2014	17, 18-Jun	Hand weeding	Deverton Cochrane, 12 from NW Youth Corps	plots 2a, 3a, 4a
2014	17, 18-Jun	Hand mow tall oatgrass	Deverton C., 12 from NYC	finished work started by Walama on 6/5 and 6/6
2014	17, 18-Jun	Hand weeding bracken fern	Deverton C., 12 from NYC	focused on area about 200 feet west of plot 2a around <i>Lupinus oreganus</i>
2014	12-Sep	Preparation for new fence construction	Ian S., Ted S.	Removed E border T-posts and barbed wire; mowed 15 foot wide blackberries and grass up against fence.
2014	12-Sep	Removed fire line	Ted S.	N edge of prescribed burn area; preparation for burn
2014	22-Sep	Fence construction	Island Fence	Fence constructed along entire east border of property
2014	29-Oct	Flame weeding	Ian S.	Flame weeded plots 1a, 5a. Did not reflame plot 6 because excessive weedy grasses had established.

Year	Date	Activity	Who	Notes
2014	3, 5-Nov	Planting	Ian S., Ted S., Lane Metro Youth Corps	planted plugs and bulbs in plots 1a, 5a, 3b
2014	24-Nov	Planting	Ian S., Guy Banner, Americorps	finished planting plugs and bulbs in plots 1a, 3b, 5a
2014	24-Nov	Weeding	Ian S.	weeded most velvet grass out of 1a
2015	14-Jan	Seeding	Ian S.	overseeded plots 1a, 3b, 5a, and burned area
2015	24-Mar	Orientation visit	Matt S., Christine	Visited site for first time, observed nectar islands and got an overview of the site from Christine
2015	23-Apr	Orientation visit; hand pull & dig weeds	Ian S., Matt S.	Removed meadow knapweed rosettes, Lepidium, thistle, tansy ragwort in northern portion of site
2015	6-May	Remove weeds	Matt S.	Removed meadow knapweed rosettes, Lepidium, thistle, tansy ragwort throughout site
2015	12-May	Monitoring	Ian S., Matt S.	Collected data from shadecloth/solarization test plots
2015	13-May	Removed weeds	Matt S.	Removed Lepidium from plot 6, weeded invasive grasses from nectar islands
2015	26, 27-May	Hand mow tall oatgrass	Matt S, 2 people from Walama Restoration	Hand mowed tall oatgrass at 6" throughout site (Figure 2). Where growing concurrently with <i>Lupinus oreganus</i> , mowed above top of raceme. Did not mow Cheryl Schultz's research plots in the SW corner.
2015	12-Jun	Nectar island weeding	Matt S.	Mowed edges of all nectar islands and Experiments A, B, and C. Weeded velvetgrass out of all nectar islands (except 6, which was excessively weedy).
2015	5-Aug	Hand weeding	Matt S.	Hand weeded and bagged meadow knapweed, mainly in the NW corner

Year	Date	Activity	Who	Notes
2015	7-Aug	Hand weeding	Matt S.	Removed blackberry from edges of nectar islands, weeded nectar islands
2015	9-Nov	Planting	Matt S., Christine, Kathryn, Looking Glass, volunteer John Koenig	Planted plugs and bulbs in plot 4b
2015	10-Nov	Planting	Matt S., Christine, Andy Looking Glass, AmeriCorps crew	Planted plugs, bulbs, and runners in plots 4b, 5b and 2b, moved shadecloth to plots 4c, 1c, 2c, and 5c,
2015	13-Nov	Planting	Matt S., Christine, Andy, 4 volunteers	Planted plugs and bulbs in plots 1b and 2b (cover photo)
2015	19-Nov	Planting	Matt S., Christine	Planted plugs and bulbs in plots 2b and 5b
2015	3-Dec	Planting, weeding	Matt S., Andy, AmeriCorps crew	Planted strawberry runners in plots 1b, 5b, and 2b weeded <i>agrostis</i> from 1a
2015	8-Dec	Seeding	Matt S.	Overseeded plots 1a, 1b, 2b, 4b, 5a, and 5b
2016	31-March	Herbicide application	IAE	Applied Fusilade herbicide to four experimental plots to test non-target impact of using Fusilade to manage prairie harboring Fender's blue butterfly

Year	Date	Activity	Who	Notes
2016	19, 20-April	Hand weeding	IAE, Looking Glass crew	Hand-weeded meadow knapweed (<i>Centaurea pratensis</i>), Purpleanther field pepperweed (<i>Lepidium heterophyllum</i>), bull thistle (<i>Cirsium vulgare</i>), tansy ragwort (<i>Senecio jacobea</i>) in northern portion of site; removed hairy cat's ear (<i>Hypochaeris</i> spp.), sheep sorrel (<i>Rumex acetosella</i>), and bentgrasses (<i>agrostis</i> spp.) from nectar islands
2016	6-May	Survey for Fender's blue butterfly	IAE and BLM	Distance sampling for Fender's blue butterfly
2016	27-May	Hand mow tall oatgrass	IAE	Hand mowed tall oatgrass at 6" throughout site. Where growing concurrently with Kincaid's lupine, mowed above top of raceme. Did not mow Cheryl Schultz's research plots in the SW corner.
2016	2-Jun	Hand mow tall oatgrass	IAE	Hand mowed tall oatgrass at 6" throughout site. Where growing concurrently with Kincaid's lupine, mowed above top of raceme. Did not mow Cheryl Schultz's research plots in the SW corner.
2016	26-Jul	Hand weeding	BLM and Looking Glass crew	Hand weeded and bagged meadow knapweed, mainly in the NW corner
2016	17-Aug	Hand weeding	IAE and BLM	Removed Himalayan blackberry (<i>Rubus armeniacus</i>) from edges of nectar islands, weeded nectar islands
2016	22-Aug	Burn break prep	IAE and BLM	Mowed edges of Schultz research plots to prepare for prescribed burn.
2016	22-Aug	Shadecloth	IAE and BLM	Replaced shadecloth on nectar island 2c.
2016	2-Sep	Fire break prep	IAE	Removed tree on the edge of fire break on Schultz research plot.
2016	16-Sep	Prescribed burn	Inter-Agency burn crew	Burned 4 acres in SE corner; burned 8 research plots in SW corner.
2016	19-Oct	Seeding	BLM	Seeded burn unit with native mix

Year	Date	Activity	Who	Notes
2016	8-Nov	Planting	IAE, BLM, Looking Glass, AmeriCorps, volunteer	Planted bulbs and bareroot lomatium in plots 1c, 2c, 4c & 5c (Figure 1)
2016	21-Nov	Planting	IAE, BLM, Looking Glass, AmeriCorps, volunteer	Planted plugs and bulbs in plots 4c, 1c, 2c, and 5c, (Figure 1)
2016	29-Nov	Seeding	IAE	Overseeded plots 1a, 1b, 1c, 2a, 2b, 2c, 3a, 3b, 4a, 4b, 4c, 5a,5b, 5c (Table 3)
2017	23-Mar	Herbicide application	Habitat Restoration LLC	Applied Fusilade herbicide to four experimental plots to test non-target impact of using Fusilade to manage prairie harboring Fender's blue butterfly
2017	May-July	Survey for Fender's blue butterfly	IBLM	Distance sampling for Fender's blue butterfly
2017	13-Jul	Weed removal	BLM and Looking Glass	Removed meadow knapweed inflorescences
2017	6-Jun	Hand mow tall oatgrass	IAE and BLM	Hand mowed tall oatgrass at 6" throughout site. Where growing concurrently with Kincaid's lupine, mowed above top of raceme. Did not mow Cheryl Schultz's research plots in the SW corner
2017	13-Sep	Nectar island prep	IAE and BLM	Cleared and prepared shade cloth for nectar species planting
2017		Fire break prep	Contractor	Mowed fire brake around burn zone
2017	13-Sep	Fire break prep	IAE and BLM	Delineated burn zone with pin flags
2017	5-Oct	Prescribed burn	Inter-Agency burn crew	Burned 4 acres in north section which contain both upland and wet prairies
2017	19, 26-Oct	Nectar island prep	IAE and BLM	Burned 1710 holes in shadecloth and seeded with native mix

Year	Date	Activity	Who	Notes
2017	24-Oct	Seeding	IAE and BLM	Seeded wet prairie with native mix
2017	26-Oct	Seeding	IAE and BLM	Seeded upland with native mix
2017	8-Nov	Planting	IAE, BLM, and Looking Glass	Planted 400 Kincaid's lupine plugs at Hansen
2017	14-Nov	Planting	BLM and Looking Glass	Planted approximately 1200 <i>Fragaria virginiana</i> runners
2017	15-Nov	Planting	IAE, BLM and Looking Glass	Planted approximately 1600 <i>Triteleia hyacinthine</i> bulbs
2017	20-Nov	Planting	IAE	Planted 50 pots of <i>Eriophyllum lanatum</i> and <i>Sidalcea malviflora</i> , respectively in the upland area of the burn zone
2017	20-Nov	Nectar island prep	IAE and BLM	Burned holes in weed barrier
2017	21-Nov	Planting	IAE and BLM	Planted 200 <i>Eriophyllum lanatum</i> , 300 <i>Sidalcea malviflora</i> pots, ~300 <i>Camassia leichtlinii</i> and ~300 <i>Allium amplexans</i> bulbs and a native seed mix in the nectar island