West Eugene Wetlands Augmentation of Threatened and Endangered Plant Species: 2017 Annual Report- Web version

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Report for the Bureau of Land Management, Agreement #L14AC00314-009, 0018

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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.

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Cover photographs: Kincaid's lupine inflorescences bagged for seed collection at Hansen on August 10, 2017. Photo by Andrew Esterson.

SUGGESTED CITATION

Esterson, A. 2018. West Eugene Wetlands Augmentation of Threatened and Endangered Plant Species: 2017 Annual Report. Unpublished report for the Bureau of Land Management, Northwest Oregon District. Institute for Applied Ecology, Corvallis, OR.

SPECIAL NOTE

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

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1. EXECUTIVE SUMMARY

In 2017, the Institute for Applied Ecology (IAE) continued to support the Bureau of Land Management, Northwest Oregon District (BLM) by providing technical assistance with the establishment and maintenance of populations of threatened and endangered species at the West Eugene Wetlands (WEW). Specifically, IAE helped plant 1,358 Kincaid's lupine (*Lupinus oreganus*) at two WEW sites (Hansen and Turtle Swale), 1,607 Willamette daisy (*Erigeron decumbens*) at Greenhill and 320 shaggy horkelia (*Horkelia congesta* spp. *congesta*) at Speedway. In addition, 157 grams of Kincaid's lupine seed was collected from the augmented population at Hansen. IAE began to develop infrastructure at their farm to support seed production for Kincaid's lupine and shaggy horkelia, and provided commercial grower partners with plant materials to develop seed production beds of Bradshaw's lomatium (*Lomatium bradshawii*) and Willamette daisy. Overall, actions completed by IAE in 2017 helped the BLM move closer to meeting recovery goals of threatened and endangered species at the WEW.

2. INTRODUCTION

IAE has been collaborating with the BLM to introduce and augment threatened, endangered, and bureau-sensitive plant populations in BLM-managed sites within the WEW in Eugene, Oregon, since 2011. The WEW currently hosts populations of three federally endangered species: Willamette daisy, Bradshaw's lomatium and Fender's blue butterfly (*Icaricia icarioides fenderi*). This area also supports populations of the federally threatened Kincaid's lupine and numerous bureau sensitive species, including white-topped aster (*Sericocarpus rigidus*), shaggy horkelia, thin-leaved peavine (*Lathyrus holochlorus*), and three rare moss species. In addition, the federally threatened golden paintbrush (*Castilleja levisecta*) is scheduled to be introduced to the WEW in the upcoming years.

Nine WEW sites (Balboa, Fir Butte, Greenhill, Hansen, Isabelle, Oak Hill, Speedway, Turtle Swale and Vinci) have had at least one of the aforementioned species (except Oak Hill) introduced or augmented, or have had management actions completed to prepare the site for introduction (Figure 1). According to the Final Environmental Impact Statement "…it is not likely that recovery of these [listed] species can be achieved in this recovery zone without the BLM-administered lands in the WEW" (USDI 2014). Therefore, this multi-year project is expected to continue through 2018 and beyond.

Figure 1. Map removed from web version

3. GOALS AND OBJECTIVES

The goals of this project are to contribute to the recovery of sensitive prairie species and prevent the need for listing of rare prairie species through seed and plug production, population augmentation and introduction, maintenance of prairie habitat, population status and trend assessment and adaptive management. Specific objectives are based on recovery targets within the Eugene West Recovery Zone identified in the Recovery Plan (USDI 2010) and are as follows:

- 15,000 Willamette daisy individuals; at least three populations (or metapopulations with patches located within two miles of each other) must have a minimum of 2,000 individuals
- 15,000 Bradshaw's lomatium individuals; at least three populations (or metapopulations with patches located within two miles of each other) must have a minimum of 2,000 individuals
- 7500 m^2 cover of Kincaid's lupine; three populations (or metapopulations with patches located within two miles of each other) must have a minimum of 1,000 m^2 of cover
- 1,000 individuals of golden paintbrush at one population
- 15,000 individuals of shaggy horkelia distributed between three populations
- 7500 m^2 cover of white-topped aster distributed between three populations
- 1000 individuals of thin-leaved peavine at one population

In 2017, efforts by IAE primarily focused on four species: Kincaid's lupine, Willamette daisy, shaggy horkelia and Bradshaw's lomatium (Figure 2). 2017 work completed by IAE at Fir butte, which hosts large populations of Kincaid's lupine and Fender's blue butterfly, and a small population of white-topped aster, is not discussed in this report, but can be found in the Fir Butte 2017 annual report (Esterson 2018).

Figure 2. Rare species that were the focus of introduction and augmentation efforts in 2017. From upper-left in clockwise fashion: Bradshaw's lomatium (*Lomatium bradshawii*, endangered), Kincaid's lupine (*Lupinus oreganus*, threatened), Willamette daisy (*Erigeron decumbens*, endangered), and shaggy horkelia (*Horkelia congesta* ssp. *congesta,* Bureau sensitive).

4. 2017 RECOVERY ACTIONS

The following recovery activities were implemented in 2017: seed collection, seed and plug production, outplanting, plot maintenance, monitoring and site preparation.

4.1. Seed collection

4.1.1. Kincaid's lupine

In 2017 Kincaid's lupine seed collection was limited to one introduced population at Hansen. IAE and BLM staff placed seed collection bags on 201 inflorescences in June and July (cover page). On August 10th all bags were collected and seed was processed by IAE staff; 157 grams of Kincaid's lupine seed was collected and is currently stored at IAE's temperature-and-moisture controlled seed cooler.

4.2. Seed production

4.2.1. Kincaid's lupine

Establishment of a Eugene West seed production field has been challenging. Originally started at Heritage Seedlings, Inc. (Heritage) in 2014, at the request of Heritage, plants from this field were transplanted to a different grower, the Natural Resource Conservation Service's (NRCS) Corvallis Plant Materials Center, or PMC) in 2015. In 2016, the NRCS discontinued native seed growout partnerships with IAE and federal partners, and the transplanted field was discontinued. In the fall of 2016, IAE established new production beds of Eugene West Kincaid's lupine at our native plant farm. We planted Kincaid's lupine plugs and seeds (Eugene West seed source) into six raised beds at this site. We expect our first seed harvest from these beds to be in 2019.

Although IAE attempted to transplant all Kincaid's lupine plants from Heritage in 2015, apparently some plants were missed, and in 2016 the remaining plants emerged, flowered and set seed (Heritage had not plowed the field under). Heritage allowed IAE staff to bag and harvest seed from this remnant field, and in 2017, IAE harvested 4.98 lbs of Eugene West Kincaid's lupine seed from Heritage. IAE expects to be able to harvest from this remnant field again in 2018, after which the field will be plowed under.

Finally, in 2017 IAE provided the Dorena Genetic Resource Center (DGRC) with Kincaid's lupine seed that will be used for a seed production bed.

4.2.2. Willamette daisy

In 2011, a Willamette daisy seed production field was established at the PMC. This field was discontinued in 2016. In 2017, IAE begin growing ~600 Willamette daisy (Eugene West seed source) plugs which will be used to establish a seed production field at Heritage Seedlings in 2018.

4.2.3. Shaggy horkelia

IAE planned to establish a shaggy horkelia seed production field in 2017. Unfortunately, shaggy horkelia seed that was sown into plugs containers and put into cold stratification in 2016 (to be used to establish a seed production field in 2017) by the Oregon Department of Corrections was removed from cold stratification to early, resulting in almost no shaggy horkelia germination. IAE restarted the growing process in 2017 and has the seed in cold stratification at a local commercial blueberry facility. IAE will establish the shaggy horkelia production field at our native plant farm in the fall of 2018.

4.2.4. Bradshaw's lomatium

In the fall of 2017, IAE provided Heritage Seedlings with G1 Bradshaw's lomatium seed (harvested from the PMC seed production field, now discontinued). This seed will be used to establish a seed production field in 2018.

4.3. Plug production

4.3.1. Willamette daisy

In the fall of 2017, IAE began growing 1500 Willamette daisy plugs (Eugene West seed source) for outplanting at Balboa and Greenhill in the spring of 2018.

4.4. Reintroduction: plug planting

4.4.1 Kincaid's lupine

1,358 plugs of Kincaid's lupine were planted at two BLM WEW sites (Hansen and Turtle Swale) in the spring and fall of 2017.

Previously laid weed barrier cloth was left in place for site preparation. A monitoring grid was established with plugs placed approximately a half-meter apart, and a propane pencil tip torch was used to burn holes in the weed barrier cloth. Plugs produced from Heritage Seedlings, the IAE farm and the DGRC (all Eugene West seed source) were transplanted into holes at Hansen on March 28th (620 plugs), April 11th (330 plugs) and November 8th (308 plugs; Figure 3), and at Turtle Swale on April 13th (100 plugs).

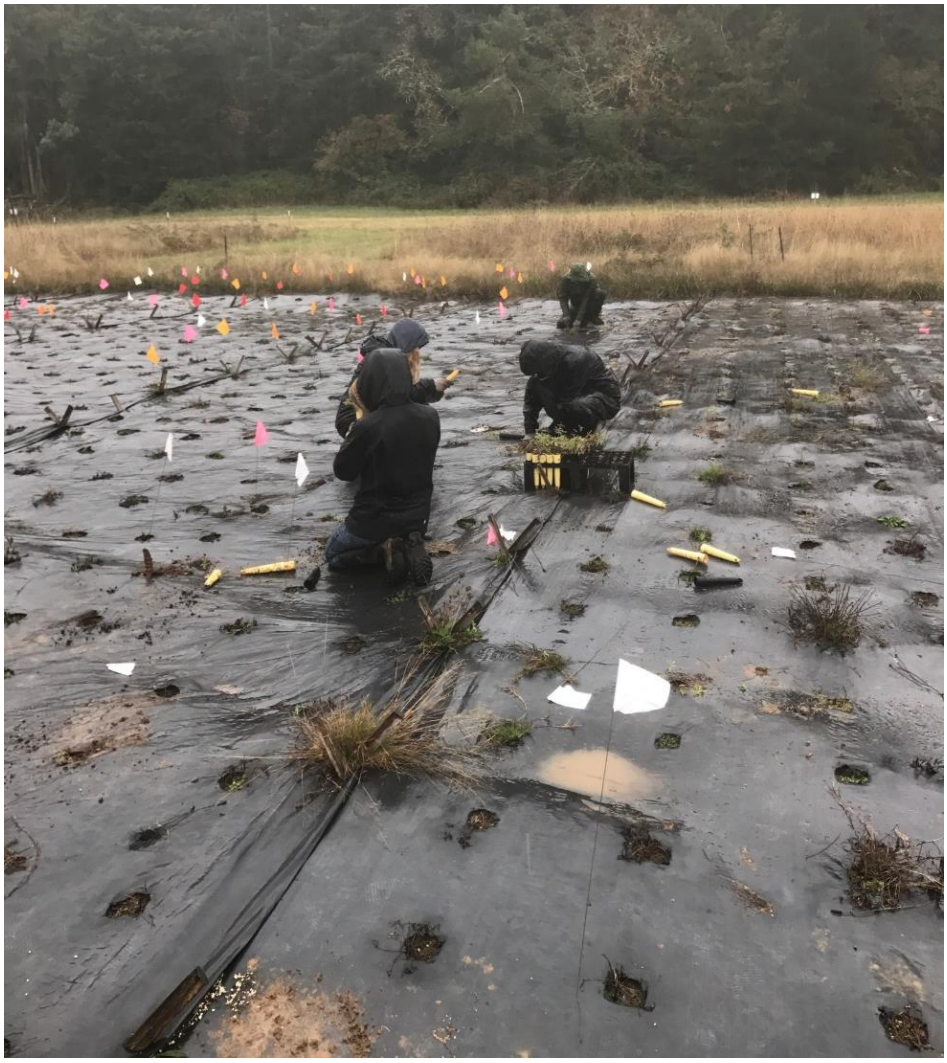

Figure 3. Looking Glass Your Crew planting Kincaid's lupine at Hansen on November 8th, 2017.

4.4.2 Willamette daisy

Greenhill was the only WEW site to receive Willamette daisy plugs in 2017. No site preparation was completed prior to planting. 1,607 plugs were planted by the Looking Glass Youth Crew on April 11th and 12th.

4.4.3 Shaggy horkelia

Speedway was the only WEW site to receive shaggy horkeila plugs in 2017. Prior to planting the site was burned in the fall of 2016. 320 plugs were planted on April 13th by the Looking Glass Youth Crew.

4.5. Reintroduction: seeding

4.5.1 Nectar species

To improve habitat for Fender's blue butterfly at Turtle Swale and Isabelle, a nectar species seed mix (Table 1) was planted into unoccupied holes of weed barrier cloth. Previously, empty holes have been covered with weed barrier cloth (to minimize weed growth) until Kincaid's lupine plugs became available. However, each of these sites has Fender's blue butterfly populations, but there is relatively low diversity and abundance of nectar species in adjacent meadows. Planting nectar species will provide resources for Fender's blue butterflies, add diversity to the site and be a source of native nectar seed for neighboring meadows.

Table 1. 2017 nectar species planted at Turtle Swale and Isabelle.

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

4.6. Restoration activities

A complete list of restoration activities conducted for this project is listed in Table 2. In general, restoration activities included planting, weed control and seed collection.

Table 2. 2017 restoration activities in threatened and endangered plant augmentation sites at the West Eugene Wetlands.

Date	Site	Personnel	Activity
28-Mar	Hansen	IAE, Looking Glass Youth Crew	Kincaid's lupine planting (620 plugs)
11-Apr	Hansen	BLM	Kincaid's lupine planting (330 plugs)
11-Apr	Greenhill	IAE, Looking Glass Youth Crew	Willamette daisy planting (1607 plugs)
13-Apr	Turtle Swale	IAE, Looking Glass Youth Crew	Kincaid's lupine planting (100 plugs)
13-Apr	Speedway	IAE, Looking Glass Youth Crew	Shaggy horkelia planting (320 plugs)
8-June	Speedway	BLM, Looking Glass Youth Crew	Removed Scotch broom north of racetrack and along creek
20-Jun	Greenhill	BLM, Looking Glass Youth Crew	Removed oxeye daisy along northern boundary
28-Jun	Speedway	BLM, Looking Glass Youth Crew	Removed Scotch broom along creek
5, 6, 10, 11, 12, 17, 18-Jul	Vinci	BLM, Looking Glass Youth Crew	Removed Scotch broom
31-Jul	Hansen	BLM, Looking Glass Youth Crew	Removed meadow knapweed and weeded shade cloth
1-Aug	Isabelle	BLM, Looking Glass Youth Crew	Removed Scotch broom and tansy ragwort
1, 2, 9-Aug	Balboa	BLM, Looking Glass Youth Crew	Removed tansy ragwort, teasel, and cleared blackberry off trail
8/9	Speedway	BLM, Looking Glass Youth Crew	Removed tansy ragwort
14, 15, 16, 22-Aug	Vinci	BLM, Northwest Youth Crew	Pulled Scotch broom
21-Aug	Balboa	BLM, Northwest Youth Crew	Removed woody species from wet prairie
15-Sep	Oak Hill	Contractor	Blackberry mastication
8-Nov	Hansen	BLM, IAE, Looking Glass Youth Crew	Kincaid's lupine planting (308 plugs)

4.7. Monitoring

All BLM WEW threatened and endangered plant reintroduction sites are monitored annually for transplant survival. Individual plants are outplanted in plots and are equally spaced from each other within a given plot (except for the 2016 shaggy horkelia planting at Speedway, where a known quantity of seed was broadcast into plots). This method is used to allow easy monitoring in subsequent years after plantings and provides the BLM with accurate population data that can be used to determine if a population is meeting recovery goals. Each plot is assessed for presence/absence of a known individual. Percent survival is then calculated based on total number of individuals present compared to the total number planted in each plot.

4.8 Site preparation

In 2017, site preparation for the introduction of golden paintbrush at Oak Hill began. Approximately 29 acres of blackberry was masticated and 5.5 acres was mowed. Once herbicides are permitted, glyphosate should be used to target non-native species.

5. RESULTS

2017 monitoring results provide survival percentage from each year's outplanting effort, as well as overall abundance of Kincaid's lupine, Willamette daisy, and shaggy horkelia at each population (Table 3).

5.1. Kincaid's lupine

Survival of Kincaid's lupine planted at Hansen and Turtle Swale between 2012 and 2015 have been less than 11%. Survival from the 2016 and 2017 plantings at Hansen was 83.7% and 82.1%, respectively, while only 29.2% of plugs planted at Turtle Swale in 2017 survived. Less than 5% of all plugs at Isabelle have survived. In total, 2,312 Kincaid's lupine have survived since introduction.

5.2. Willamette daisy

The 2017 Willamette daisy survey indicates that plug survival is low across all sites. Survival of plugs planted at Balboa in 2013, 2014 and 2015 was 29.5%, 25.5% and 6.5%, respectively. Only 15.8% of plugs planted at Vinci in 2015 were present, while 66% of plugs planted at Greenhill in 2016 survived. In total, 2,739 Willamette daisy plugs have survived since introduction.

5.3. Shaggy horkelia

Shaggy horkelia survivorship has been impressive. 91.3% of individuals planted in 2017 at Speedway survived. Of the 34g and 45g of seed broadcasted at Greenhill and Speedway, respectively, 1600 and 814 individuals were observed in 2017, respectively. In total, there were 2,706 shaggy horkelia individuals in 2017.

Table 3. 2017 introduced threatened and endangered species survival in the West Eugene Wetlands.

Site	Planting year	Species	Total # planted	# Planted in macroplot	# Survivors in macroplot	% Survival
Balboa	2013	Willamette daisy	1100	550	162	29.5%
Balboa	2014	Willamette daisy	1644	529	135	25.5%
Balboa	2015	Willamette daisy	1807	1807	118	6.5%
Vinci	2014	Willamette daisy	1398	1398	221	15.8%
Greenhill	2016	Willamette daisy	1559	1559	1032	66.2%
Greenhill	2016	shaggy horkelia	34 g. seeds		1600	N/A
Hansen	2012	Kincaid's lupine	724	496	N/A	N/A
Hansen	2013	Kincaid's lupine	600	544	N/A	N/A
Hansen	2014	Kincaid's lupine	599	599	15	2.5%
Hansen	2015	Kincaid's lupine	952	952	110	11.6%
Hansen	2016	Kincaid's lupine	1549	1549	1297	83.7%
Hansen	2017	Kincaid's lupine	950	950	780	82.1%
Isabelle	2014	Kincaid's lupine	200	200	12	4.8%
Isabelle	2016	Kincaid's lupine	50	50		
Speedway	2016	shaggy horkelia	45 g. seeds		814	N/A
Speedway	2017	shaggy horkelia	320	320	292	91.3%
Turtle Swale	2012	Kincaid's lupine	500	500	14	2.8%
Turtle Swale	2013	Kincaid's lupine	190	190	8	4.2%
Turtle Swale	2014	Kincaid's lupine	70	70		
Turtle Swale	2015	Kincaid's lupine	160	260	76	29.2%
Turtle Swale	2017	Kincaid's lupine	100	100		

*N/A indicates plots were not monitored in 2017 because no plants survived from previous years or % survival could not be calculated because the initial amount of plants is unknown.

6. DISCUSSION

6.1 Plant materials

To meet recovery goals for threatened and endangered species in the Eugene West Recovery Zone, it is critical that properly sourced plant materials are available. In 2017, the development of the IAE farm provides infrastructure that will support seed production for Kincaid's lupine and shaggy horkelia, and has the capacity to add additional species if needed. In addition, the partnership between IAE and Heritage Seedlings will provide Bradshaw's lomatium and Willamette daisy seed for the WEW.

Kincaid's lupine seed production at Hansen in 2017 was significantly better than previous years. In 2017, 157g of seed was collected, whereas in 2016 only 10.5g was collected. The increase in seed production between 2016 and 2017 may be attributed to larger, more robust plants, increased spring precipitation, and better weed management. To continue the upwards trend in seed production at Hansen, we recommend increasing the amount of weeding and adding a slow release fertilizer to individual plants in the spring. However, if weeding does not occur frequently, we do not recommend adding fertilize because non-native species will take advantage of the extra resource and outcompete Kincaid's lupine, potentially reducing seed production.

6.2 Planting and survivorship

6.2.1. Kincaid's lupine

Between 2016 and 2017, there was a net increase of 569 Kincaid's lupine at augmented sites at the WEW (not including the November planting). We expect to see a larger increase in population size in 2018 after we monitor the survivorship of the 1,358 individuals planted in 2017. During the March planting at Hansen, soil conditions were extremely wet and there was appreciable precipitation days following the planting. Sustained saturated soils may have reduced vigor in young transplants, causing 20% to die. During the November planting, Kincaid's lupine plugs did not have robust root systems in their pots, causing the root systems to fall apart when extracting plants, and leaving a less then desirable plug for planting. At Turtle Swale, only 29% of the 2016 cohort survived to 2017. This may have been a result of weed competition and/or poor establishment conditions during the first year of growth.

To increase survivorship of Kincaid's lupine plugs we suggest:

1. Planting time should overlap with consecutive days of moist, but unsaturated soil conditions (if possible)
2. High quality plugs should be used
3. Weeding should occur more regularly, and
4. Slow release fertilizer should be distributed to each Kincaid's lupine.

6.2.2. Willamette daisy

Between 2016 and 2017, the Willamette daisy population at Vinci declined, experiencing roughly 80% mortality of individuals within this population. This was most likely caused by weeds that grew into the

planting area. Initial plugs were planted into a geotextile cloth in 2015; the geotextile cloth has since degraded and done a poor job at suppressing weeds (Figure 4). For future plantings we recommend using a plastic based weed barrier, such as polypropylene. When herbicides are permitted at the WEW, flame weeding in the fall, followed by a glyphosate application after post-fire weed seed germination, will also help reduce non-native species from planting areas.

Figure 4. Willamette daisy population planted on geotextile fabric in 2015 at Vinci (left). The same population invaded by non-native species in 2017 (right).

6.2.3 Shaggy horkelia

In 2016 and 2017, shaggy horkelia plugs and seeds were used to establish populations at Speedway and Greenhill. If future monitoring shows that shaggy horkelia establishment from seeding is similar to that of plugs, and appropriate site preparation is possible, we recommend considering the exclusive use of direct seeding for future introductions. This will reduce costs by eliminating high labor inputs needed for plug production, planting and planning.

7. 2018 RECOMMENDED MANAGEMENT ACTIONS

7.1. Seed collection

- Kincaid's lupine seed should be collected from augmented populations at Hansen, Turtle Swale and Isabelle, and from the natural population at Fir Butte, and surrounding properties managed by The Nature Conservancy, The City of Eugene and the Army Corps of Engineers

7.2. Plant material production

- Continue to maintain seed production beds of Eugene West Kincaid's lupine

- Establish shaggy horkelia seed production field at the IAE Farm using plugs currently in production
- Continue to maintain seed production fields of Willamette daisy and Bradshaw's lomatium at Heritage Seedlings, Inc.

7.3. Planting

- Plant 1,500 Willamette daisy plugs currently being grown by IAE in March/April at Balboa and Greenhill
- Plant shaggy horkelia plugs at either Greenhill or Speedway in March/April
- If any previously planted Kincaid's lupine at Hansen, Turtle Swale and Isabelle do not survive, replace them with new Kincaid's lupine plugs or nectar species plugs (filling holes in weed cloth and preventing weeds from establishing in those spaces)
- If seed is available, augment Bradshaw's lomatium populations at Speedway, North Taylor and Long Tom ACEC

7.4. Management

- In April visit each site and assess management needs for the 2018 field season
- Weed threatened and endangered plant introduction sites as needed throughout the year
- Monitor weed fabric at Hansen, Isabelle and Turtle Swale and secure with six inch ground cloth staples as needed
- If herbicides are permitted, treat problematic weeds such as meadow knapweed, blackberry, thistles, and non-native grasses by spot spraying
- If herbicides are permitted, remove all weed barrier cloth in the fall after plants senesce, and follow removal with a glyphosate application once non-natives emerge
- Mow sites with threatened and endangered species in mid-August to reduce seed set of non-native species
- If there is a spring Kincaid's lupine planting at Hansen, Turtle Swale and/or Isabelle, water plugs in the summer as needed
- Continue focused habitat restoration at Oak Hill in preparation for future introduction of golden paintbrush
- Assist BLM staff with organizing prescribed burns

7.5. Monitoring

- Monitoring should occur at the appropriate time to capture survival and reproduction data for all outplanted species (typically in April-May for Bradshaw's lomatium, May-June for Kincaid's lupine and Willamette daisy, and in June for shaggy horkelia)
- Surveys should be completed before and after herbicide application to determine efficacy of herbicide treatments

8. REFERENCES

Esterson, A. 2018. Restoration of Fir Butte: 2017 Annual Report. Unpublished report for the Bureau of Land Management, Northwest Oregon District. Institute for Applied Ecology, Corvallis, OR.

USDI Bureau of Land Management, Eugene District. 2014. Final Environmental Impact Statement West Eugene Wetlands Resource Management Plan. Eugene, Oregon, USA.

APPENDICES

Appendix A. Monitoring Results for West Eugene Wetland Threatened and endangered plant Augmentation sites, 2012-2017

WEW Augmentation Summary 2012-2017					Monitoring year											
					2012		2013		2014		2015		2016		2017	
Site	Planting year	Species	Total # planted	# Planted in macroplot	# Survivors in macroplots	% Survival	# Survivors in macroplots	% Survival	# Survivors in macroplots	% Survival	# Survivors in macroplots	% Survival	# Survivors in macroplots	% Survival	# Survivors in macroplots	% Survival
Balboa	2013	ERDE	1100	550			521	94.7%	334	60.7%	268	48.7%	221	40.2%	162	29.5%
Balboa	2014	ERDE	1644	529					351	66.4%	181	34.2%	177	33.5%	135	25.5%
Balboa	2015	ERDE	1807	1807							892	49.4%	429	23.7%	118	6.5%
Vinci	2014	ERDE	1398	1398					1304	93.3%	1197	85.6%	1116	79.8%	221	15.8%
Greenhill	2016	ERDE	1559	1559									1458	93.5%	1032	66.2%
Greenhill	2017	ERDE	1607	1607											1071	66.6%
Greenhill	2016	HOCO	34 g. seeds												1600	
Hansen	2012	LUOR	724	496	301	60.7%	24	4.8%	13	2.6%	N/A	N/A	N/A	N/A	N/A	N/A
Hansen	2013	LUOR	600	544			297	54.6%	3	0.6%	N/A	N/A	N/A	N/A	N/A	N/A
Hansen	2014	LUOR	599	599					134	22.4%	39	6.5%	25	4.2%	15	2.5%
Hansen	2015	LUOR	952	952							341	35.8%	144	15.1%	110	11.6%
Hansen	2016	LUOR	1549	1549									1413	91.2%	1297	83.7%
Hansen	2017	LUOR	950	950											780	82.1%
Isabelle	2014	LUOR	200	200					62	31.0%	27	13.5%	51	20.4%	12	4.8%
Isabelle	2016	LUOR	50	50												
Speedway	2016	HOCO	45 g. seeds												814	
Speedway	2017	HOCO	320	320											292	91.3%
Turtle Swale	2012	LUOR	500	500	322	64.4%	158	31.6%	125	25.0%	108	21.6%	73	14.6%	14	2.8%
Turtle Swale	2013	LUOR	190	190			156	82.1%	57	30.0%	41	21.6%	24	12.6%	8	4.2%
Turtle Swale	2014	LUOR	70	70					0	0.0%						
Turtle Swale	2015	LUOR	160	260							44	27.5%	13	5.0%		
Turtle Swale	2017	LUOR	100												76	29.2%

*Table created by Christine Calhoun. Monitoring conducted by Christine Calhoun and Sarah Erski.