Introduction of the thin-leaved peavine (Lathyrus holochlorus): 2020 annual report

11/23/2021

Report for the Bureau of Land Management (Agreement # L20AC00035)

Report prepared by Jessica Celis and Rebecca Currin

Institute for Applied Ecology

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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ACKNOWLEDGMENTS

Funding for this project was provided by the Northwest Oregon District of the Bureau of Land Management (BLM). We thank retired BLM botanist Cheshire Mayrsohn for the opportunity to assist in the conservation of this rare species. We also thank John Klock and Sally Villegas-Moore, also with the BLM, and Wes Messinger, with the U.S. Army Corps of Engineers, for supporting plant introductions in the West Eugene Wetlands and at Bake Stewart Park. Thank you also to botanist John Klock with the Upper Willamette Field Office for his continued support of this project and for helping coordinate the acquisition of shrubs for the enhancement of outplanted plots. Photographs were taken by IAE staff unless otherwise stated.

Cover photograph: *Lathyrus holochlorus*. Photo by BLM staff, West Eugene Wetlands.

SUGGESTED CITATION

J. Celis and R. Currin. 2021. Introduction of the thin-leaved peavine (*Lathyrus holochlorus*): 2020 annual report. Unpublished report prepared for the Northwest Oregon District of the Bureau of Land Management, agreement #L20AC00035. Institute for Applied Ecology, Corvallis, Oregon. 25 pp. plus appendices.

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1. EXECUTIVE SUMMARY

This report describes restoration actions taken in 2020 for the implementation of Phase 4 of a multi-phase project designed to help prevent the federal listing of *Lathyrus holochlorus* (thin-leaved peavine), a Bureau of Land Management (BLM) sensitive species. Phase 4 (FY 2016-20) focuses on amplifying seed for reintroduction, monitoring populations, and maintaining *L. holochlorus* plantings at introduction sites. In 2020, herbivory by deer was observed in seed-increase beds, resulting in poor plant survival and seed set. Based on those results, seed-increase beds were protected with electric fencing and weeded regularly. Introduction plots (planted in 2016 and 2018) were monitored for survival, number of stems, and vigor of *L. holochlorus* plants. In addition, seed plots established in 2019 were monitored for seedling emergence. Habitat enhancement in the form of tree removal and mowing was conducted at Dorena.

Survival of *L. holochlorus* planted in 2016 decreased 80% from 2016 to 2020. In terms of habitat quality, observations suggest that sites with higher average shrub and lower exotic perennial grass cover may have higher rates of survival. This information could help land managers and ecologists make strategic choices about where to conduct future *L. holochlorus* introductions and prioritize restoration efforts at those sites currently occupied by *L. holochlorus*.

It is recommended that, in 2021, the seed-increase bed continue to be maintained, wild seed is collected, and the 2019 seed plots be monitored for seedling establishment.

2. INTRODUCTION

Lathyrus holochlorus (thin-leaved peavine) is a rare member of the pea family (Fabaceae). It is a Bureau of Land Management (BLM) sensitive species, a U.S. Fish and Wildlife (USFWS) species of concern and an Oregon Biodiversity Information Center (ORBIC) List 1 species. It is found throughout the Willamette Valley and south toward Roseburg in Oregon. A few small populations are also found in Lewis County, Washington. Most of the remaining populations exist along roadsides and unmowed fencerows, where they are commonly associated with Oregon white oak (*Quercus garryana*), common snowberry (*Symphoricarpos albus*), various species of rose (*Rosa* spp.), and poison oak (*Toxicodendron diversilobum*). Many populations are threatened by weed-management practices that utilize mowing and herbicides during the growing and reproductive season.

Lathyrus holochlorus is a rhizomatous perennial forb. Small populations are likely composed of a single, self-incompatible genetic clone that typically does not produce viable seed. In a 2012-2014 range-wide inventory performed by the Institute for Applied Ecology (IAE) and volunteers from the Native Plant Society of Oregon (NPSO), 31% (37) of the 90 known populations appeared to be extirpated. Of the remaining 53 populations, 17 had 10 or less stems, 23 had 100 or less stems, and 13 had greater than 100 stems (Ottombrino-Haworth et al. 2018).

In Phase 2 of this project, four sites were chosen for introduction of *L. holochlorus*: Bake Stewart Park, Dorena Prairie, Hansen, and South Taylor (Figure 1; Appendices B and C). Bake Stewart Park is public land managed by the U.S. Army Corps of Engineers (ACOE) and all other sites are on public lands managed by the BLM. Two plots were established at both Dorena and Bake Stewart to assess the efficacy of planting *L. holochlorus* with and without existing shrubs in the plots. At Dorena, the west plot is virtually shrub-free, while the east plot is colonized with snowberry (Table 3). At Bake Stewart Park, the east plot is virtually shrub-free, while the west plot is colonized by snowberry and poison oak. In 2018, IAE staff chose and prepared three additional sites for outplanting: another plot was established near the existing outplanted plot at Hansen (Hansen RAC), two plots were established at the Greenbelt Land Trust Bald Hill site in Corvallis (Bald Hill Big Plot and Bald Hill Small Plot), and two plots were established at Herbert Farm and Natural Area (Herbert Farm Big Plot and Herbert Farm Small Plot) (Figure 1). Plots installed in 2018 were not monitored in 2020.

This report describes the actions taken as part of Phase 4 of a four-phase project. Phase 4 objectives are to maintain *L. holochlorus* seed-increase beds, monitor establishment of outplanted plugs, and improve habitat quality at reintroduction sites to enhance outplanting and establishment success.

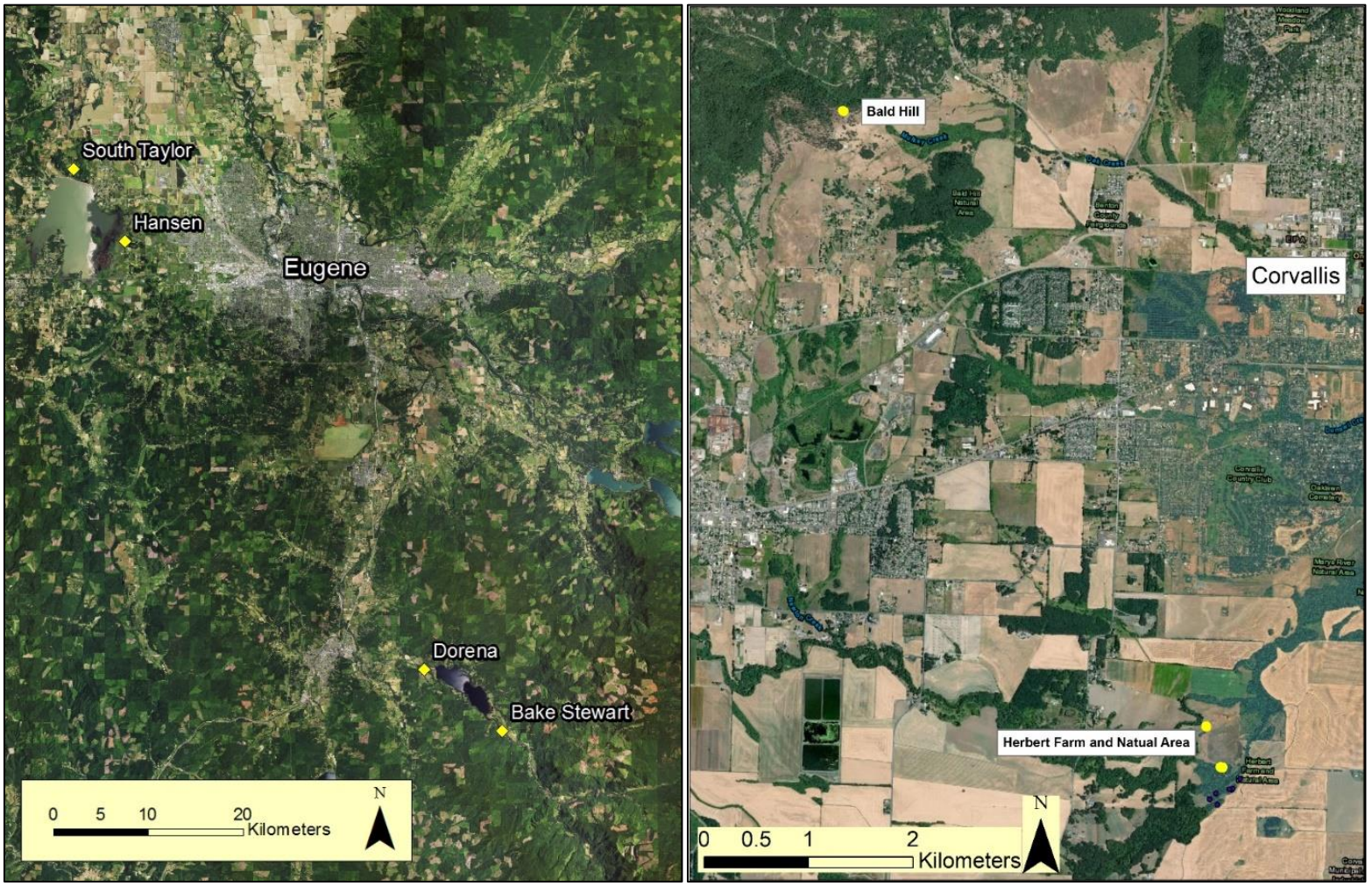

Figure 1. Locations of *Lathyrus holochlorus* outplanting sites (yellow points on both maps). In 2018, a second plot was added at Hansen and four plots were established at two sites in Corvallis (right).

3. 2020 RESTORATION ACTIVITIES

In 2020, restoration and enhancement activities included maintenance of seed-increase beds; monitoring of outplanted and seeded plots; collection, cleaning, sowing of seed from wild populations; maintenance of selected outplanted sites; and planting of native shrubs (Table 1; Appendix A).

Table 1. Monitoring and management activities conducted in 2020.

Date	Personnel	Management Activity/Observations
6/11/2020	IAE	Monitored plug survival and seed emergence in outplanted and seeded plots at Bake Stewart East, Bake Stewart West, and Dorena East.
6/19/2020	IAE	Monitored plug survival and seed emergence in outplanted and seeded plots at Dorena West and Hansen.
6/24/2020	IAE	Monitored plug survival and seed emergence in outplanted and seeded plots at South Taylor.
7/22/2020	IAE	Collected *Lathyrus holochlorus* seed from four sites: • Cutler Lane: 21.33 grams • Riverside Road: 8.86 grams • Linn-Benton Community College: 4.46 grams • Herbert Farm: 14.9 grams
7/28/2020	IAE	Collected *L. holochlorus* seed from one site: • Coyote Spencer: 16.5 grams
9/20/2020	IAE	Cleaned wild-collected *L. holochlorus* seed.
10/27/2020	IAE	Mowed introduction plots at Dorena diagonally in strips. Mowed about half of the vegetation to reduce shrubs.
11/18/2020	IAE	Plant material program personnel sowed 66.05 grams of *L. holochlorus* into 20 plug trays for an approximate total of 1,700 plugs to be used for establishment of new seed production field.
11/23/2020	IAE and AmeriCorps Blue 4 Team	Cut down three oaks that fell in *L. holochlorus* plots; bucked boles and piled logs in woods; added small branches to existing burn piles at Dorena.

3.1. *Lathyrus holochlorus* monitoring

In 2020, survival, vigor, and stem count of *L. holochlorus* plugs as well as a census of seedlings in the seeded plots (established in fall 2019; Figure 2) were monitored between June 11 and June 24 (Table 1). If a plant was visible within a plot, it was given a measure of vigor between 0 and 4 (0 indicating a dead plant, 4 indicating a healthy and hearty plant, and 1-3 indicating variability between 0 and 4). For "live" plants, the number of stems were also counted. Additionally, if the plant was flowering or fruiting, an "FL" or "FR" was noted, respectively.

In addition, a census of seedlings in the seeded plots (established in fall 2019) was conducted. Seeded plots were relocated (see Figure 2 for a diagram of seeded plots) and any *L. holochlorus* seedlings or suspected seedlings were tallied.

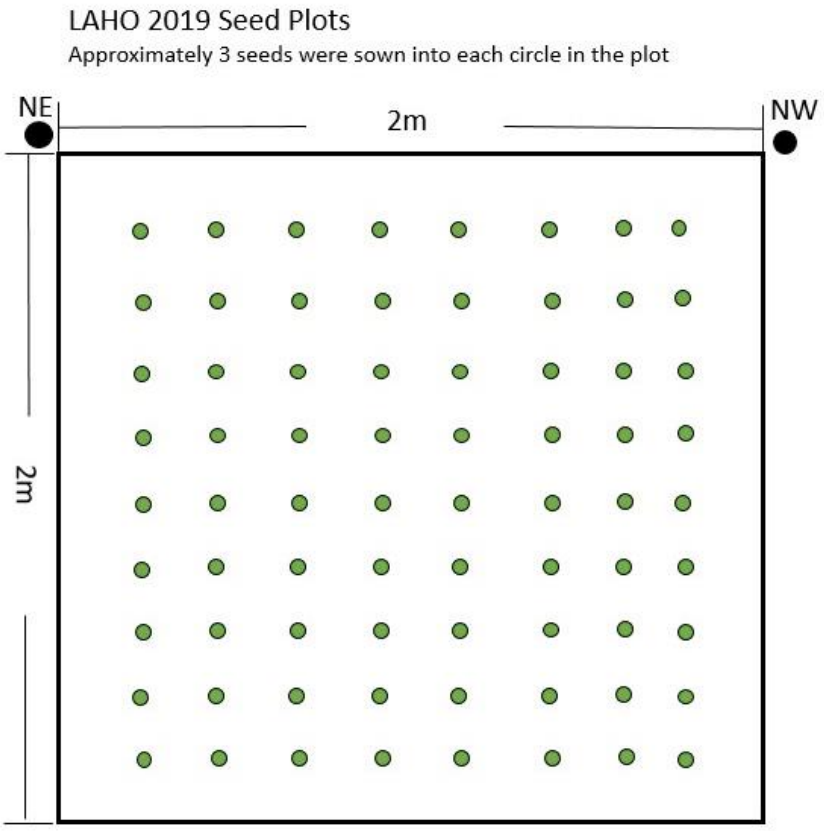

Figure 2. 2019 *Lathyrus holochlorus* (LAHO) seed plot diagram. Approximately three seeds were sown in each green circle. Seed plots were established at four sites (Dorena West, Bake Stewart East, Hansen, and South Taylor).

3.2. Wild seed collection

In 2020, IAE collected approximately 66 g of *L. holochlorus* seed from five sites: Cutler Lane, Riverside Road, Linn-Benton Community College, Herbert Farm and Coyote Spencer (Table 2).

Table 2. *Lathyrus holochlorus* seed collected in the wild in 2020.

Date collected	Collection site	Cleaned weight (g)
7/22/2020	Cutler Lane	21.33
7/22/2020	Riverside Road	8.86
7/22/2020	Linn-Benton Community College	4.46
7/22/2020	Herbert Farm	14.9
7/28/2020	Coyote Spencer	16.5
Total		**66.05**

3.3. Seed production

In March 2016, two raised beds (480 ft^2 total) were planted with nursery-grown plugs; since then these beds have failed to produce seed. In 2020, a decision was made to decommission the raised beds and establish a new seed production field at the IAE farm. Approximately 20 trays (~1700 plugs) were seeded with seed that was either collected by IAE or donated by the NRCS Plant Materials Center. These plugs will be used to establish the new seed- amplification bed in 2021. *Lathyrus holochlorus* plants will be planted with snowberry shrubs in the new field in order to test if the presence of shrubs will encourage plant growth and seed production.

3.4. Habitat enchancement

Snowberry (*Symphoriocarpus albus*) and other shrubs were extremely dense at the Dorena plots. In 2020, IAE mowed diagonal strips within these plots, resulting in ~50% of competing vegetation being mowed. In addition, IAE and a volunteer AmeriCorps team removed three oak trees that fell into *L. holochlorus* plots at Dorena the previous winter. Logs were piled in the adjacent woods and small branches were added to existing burn piles.

4. RESULTS

4.1. *Lathyrus holochlorus* transplant monitoring

Survival

In 2020, the estimated mean survival of *L. holochlorus* transplants differed between the 6 outplanted plots (Table 3; Appendix B). The average percent survival across all 6 plots (year 4 after planting) was 12%.

Table 3. Number and percent survival of *Lathyrus holochlorus* transplants from 2016-2020.

Introduction Site	Year Planted	Number Planted	Survival 2016 No. (%)	Survival 2017 No. (%)	Survival 2018 No. (%)	Survival 2019 No. (%)	Survival 2020 No. (%)
Bake Stewart E	2016	200	142 (71)	27 (14)	19 (10)	18 (9)	17 (9)
Bake Stewart W	2016	200	146 (73)	39 (20)	43 (22)	38 (19)	47 (24)
Dorena E	2016	100	61 (61)	22 (22)	24 (24)	24 (24)	6 (6)
Dorena W	2016	100	36 (36)	8 (8)	5 (5)	5 (5)	0
Hansen	2016	200	131 (66)	76 (38)	58 (29)	59 (30)	55 (28)
South Taylor	2016	200	108 (54)	59 (30)	32 (16)	20 (10)	10 (5)
Average across all sites			**104 (60)**	**39 (22)**	**30 (18)**	**27 (16)**	**23 (12)**

Vigor

In 2020, the average *L. holochlorus* transplant vigor across all sites was 2.2 (with 0 being not present and 4 being healthy and vigorous), with the range extending from 2.3 to 3.5 (Table 4; Appendix B).

Table 4. Transplant vigor of *Lathyrus holochlorus* transplants (2016-2020). Vigor ranges from 0=not present to 4=healthy and vigorous.

Introduction site	Mean vigor of surviving plants 2016	Mean vigor of surviving plants 2017	Mean vigor of surviving plants 2018	Mean vigor of surviving plants 2019	Mean vigor of surviving plants 2020
Bake Stewart E	2.2	2.1	2.0	2.3	2.4
Bake Stewart W	2.3	2.6	2.2	2.6	2.6
Dorena E	2.2	2.7	2.9	2.9	3.5
Dorena W	1.9	2	3.1	3.1	No survivors
Hansen	2.2	2.7	2.5	2.6	2.4
South Taylor	2.3	2.4	1.8	1.6	2.3
Total	**2.2**	**2.4**	**2.3**	**2.5**	**2.2**

Stem count

Lathyrus holochlorus stem counts/plant were variable between all sites, but the average stem count remains similar for all years (Table 5, Appendix B). In 2020, the average stem count/plant for all sites was 1.3 (range 1.0 - 2.1). Stem counts refer to the number of stems per plant.

Table 5. Descriptive statistics for *Lathyrus holochlorus* stem count data for all years for the four plots monitored in 2020. Sites are ordered alphabetically.

Introduction Site	Mean Stem Count of Surviving Plants 2016	Mean Stem Count of Surviving Plants 2017	Mean Stem Count of Surviving Plants 2018	Mean Stem Count of Surviving Plants 2019	Mean Stem Count of Surviving Plants 2020
Bake Stewart East	1.5	1.3	1.5	1.8	2.1
Bake Stewart West	1.6	2.0	1.6	1.9	1.9
Dorena East	1.9	1.8	1.9	1.9	1
Dorena West	1.6	2.75	1.2	1.2	No survivors
Hansen	1.5	1.8	1.7	1.9	1.6
South Taylor	1.6	1.4	1.4	1.5	1.4
Across All Sites	**1.6**	**1.8**	**1.6**	**1.7**	**1.3**

Flowering and fruiting

In 2020, we did not observe *L. holochorus* in flower or fruit at any of the introduction sites.

5. DISCUSSION

5.1 Monitoring methods

Given the very low survival rate of outplanted *L. holochlorus* plugs at the new outplanting sites (added in 2018), it is recommended that future monitoring continue only at the original outplanted sites. Additionally, given the relatively stable survival rate at sites, it is recommended that the monitoring schedule change from annual to biennial monitoring. In addition, we recommend that monitoring is limited to documenting plant survival (number of plants present) and evaluation of recruitment (e.g. seedling counts). Additionally, a count of both mature plants and seedlings present in seeded plots should occur in 2021 (two years after direct seeding) to assess the effectiveness of outplanting using seed rather than plugs (at Bake Stewart West, Dorena East, Hansen, and South Taylor).

5.2 Monitoring results

Some die-off of transplanted plugs in the first year and subsequent years after outplanting is common with restoration projects (Vance et al. 2006). Our results in 2017 (two years after outplanting) showed a drastic decline in average survival when compared to initial survival (the first year after outplanting) (Table 3). However, although rates declined slightly in subsequent years, *L. holochlorus* survival, vigor, and stem counts remained relatively stable following the high transplant mortality observed one year after outplanting. These preliminary data could indicate that, once established, plants are likely to survive–and probably reproduce–in the future.

Outplanted plots have a wide range of percent cover for native and exotic plants of various growth forms and life histories (Table 6). Observations indicate that those plots with higher-than-average shrub cover also have a higher-than-average *L. holochlorus* survival (Figure 3). Plots with higher-than-average cover of exotic perennial grasses appear to be associated with lower-than-average *L. holochlorus* survival (Figure 5). No regression analyses were run on these data and thus these observations are preliminary.

We also observed that sites with higher levels of shrub cover and lower exotic perennial grass cover appeared to have slightly higher rates of *L. holochlorus* survival. These observations could help land managers make strategic choices about where to plant *L. holochlorus* plugs and where to focus restoration efforts at those sites currently occupied by *L. holochlorus*. For example, when choosing *L. holochlorus* reintroduction sites, land managers might choose sites with at least some shrub cover, and, at outplanting at sites without shrub cover, they might consider also planting native shrubs at the same time as planting *L. holochlorus* plugs. Additionally, land managers might target exotic perennial grasses when treating weeds around existing *L. holochlorus* populations or as a site preparation treatment before planting *L. holochlorus*.

Table 6. Seedling survival in *Lathyrus holochlorus* plots.

Site	Year seeded	# seeds sown	2020 seedling count	% seedling germination
Bake Stewart West	2019	243	2	0.8
Dorena East	2019	243	6	2.5
Hansen	2019	243	2	0.8
South Taylor	2019	243	3	1.2
Total		**972**	13	1.3

Figure 3. Photo of a *Lathyrus holochlorus* seedling in the seeded plot at South Taylor on 6/24/2020.

6. 2021 MANAGEMENT RECOMMENDATIONS

The following actions are proposed for future work on this project:

- Continue monitoring of original outplanted plots and seeded plots every other year instead of annually (unless additional site treatment or augmentation occurs and monitoring is desired to document the effects of the treatment or survival of introduced plants or seed).
- Implement habitat management actions annually when appropriate (see Table 7 for a list of recommended actions).
- Habitat-enhancement efforts should occur in the fall or winter when *L. holochlorus* is dormant and should focus on spot-spraying non-native perennial grasses and Himalayan blackberry and mowing approximately 40%-60% of the plots when shrub growth becomes too dense.
- Maintain *L. holochlorus* seed-increase beds. Harvest and clean seed as it becomes available.
- Collect wild seed of *L. holochlorus* to use for grow-out of plugs.
- Grow *L. holochlorus* plugs to (1) replace dead plants in seed increase beds and (2) augment outplanting sites that show high survivorship.

Table 7. 2021 recommended habitat maintenance activities at *Lathyrus holochlorus* introduction sites.

Site	Habitat Maintenance Activities
Bake Stewart East	1. Manage tall oatgrass (*Arrhenantherum elatius*) inside and outside of plot by digging up plants, treating them mechanically (mowing with a string trimmer), or, if possible, spot-spraying a grass-specific herbicide. 2. Monitor orchard grass (*Dactylis glomerata*) for any increases in cover and manage if necessary.
Bake Stewart West	1. Monitor regrowth of shrubs and consider mowing if their growth is significantly outpacing that of *L. holochlorus* and appears detrimental to *L. holochlorus* establishment.
Bald Hill Small and Big Plots	1. Manage false brome (*Brachypodium sylvaticum*) population by either grubbing or spraying with herbicide. 2. Monitor for and remove conifer seedlings and saplings.
Dorena East	1. Manage tall oatgrass (only found on south side of plot) by digging up plants, mechanically treating them (mowing with a string trimmer), or, if possible, spot-spraying herbicide.
Dorena West	1. Remove oxeye daisy (*Leucanthemum vulgare*) by digging up plants, mechanically treating them (mowing with a string trimmer), or, if possible, spot-spraying herbicide. 2. Mow tall oatgrass prior to seed set and after plants have gone dormant.
Hansen and Hansen RAC	1. Grub out roots of or spot-spray Himalayan blackberry (*Rubus bifrons*). 2. Spot-spray exotic perennial grasses.
Herbert Farm Small and Big Plots	1. Monitor for and remove conifer seedlings and saplings (mostly in big plot). 2. Grub out roots of *R. bifrons*. 3. Manage *A. elatius* inside and outside of plot by spot-spraying herbicide.
South Taylor	1. There is a substantial amount of *R. bifrons* outside of the plot that could be grubbed or spot-sprayed in the fall. 2. When the plant is dormant, mow/cut approximately 40%-60% of the plot (preferably where the plants were not found in 2020).

7. REFERENCES

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APPENDIX A. PLUG INTRODUCTION PLOT LOCATIONS AND DATE OF ESTABLISHMENT.

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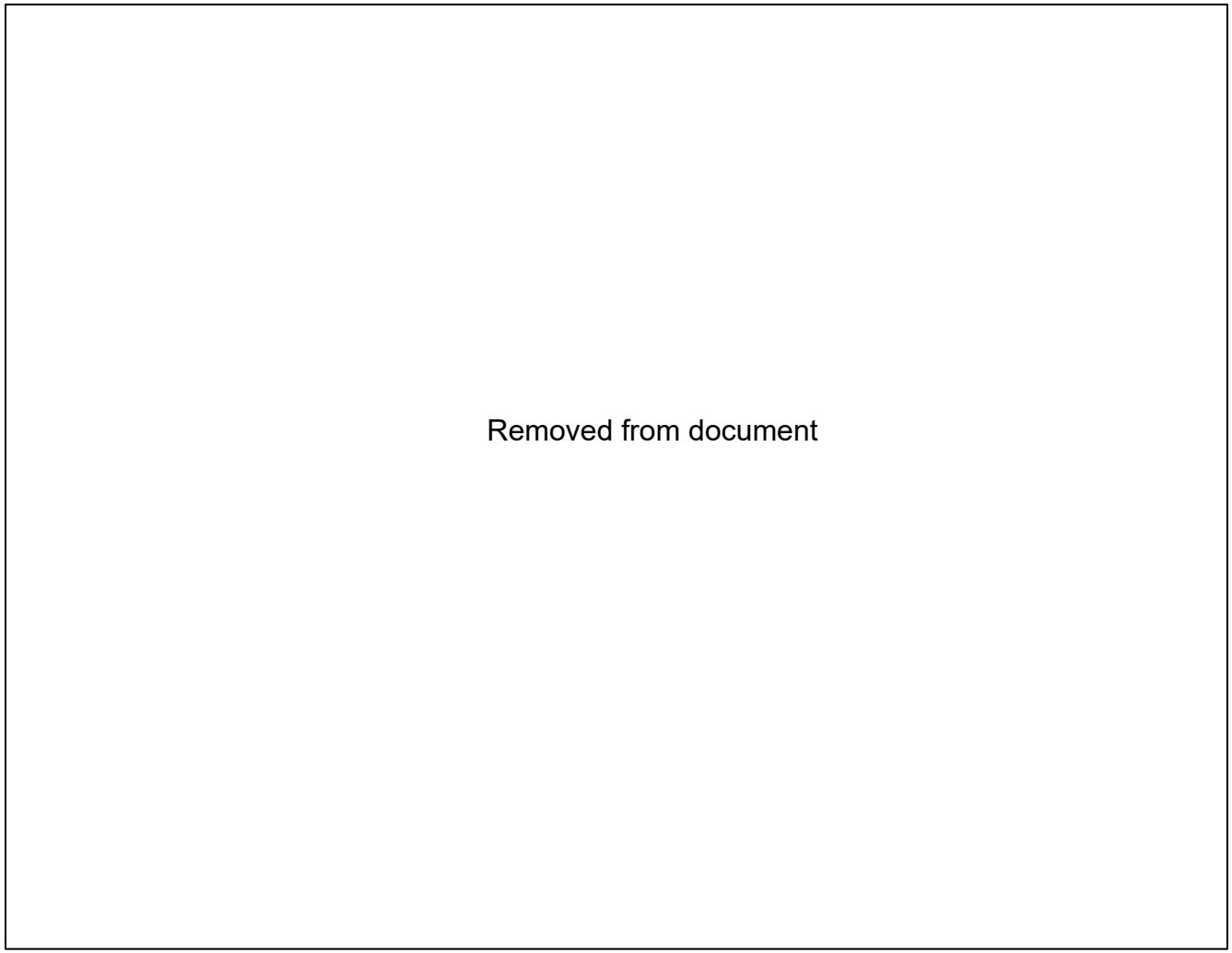
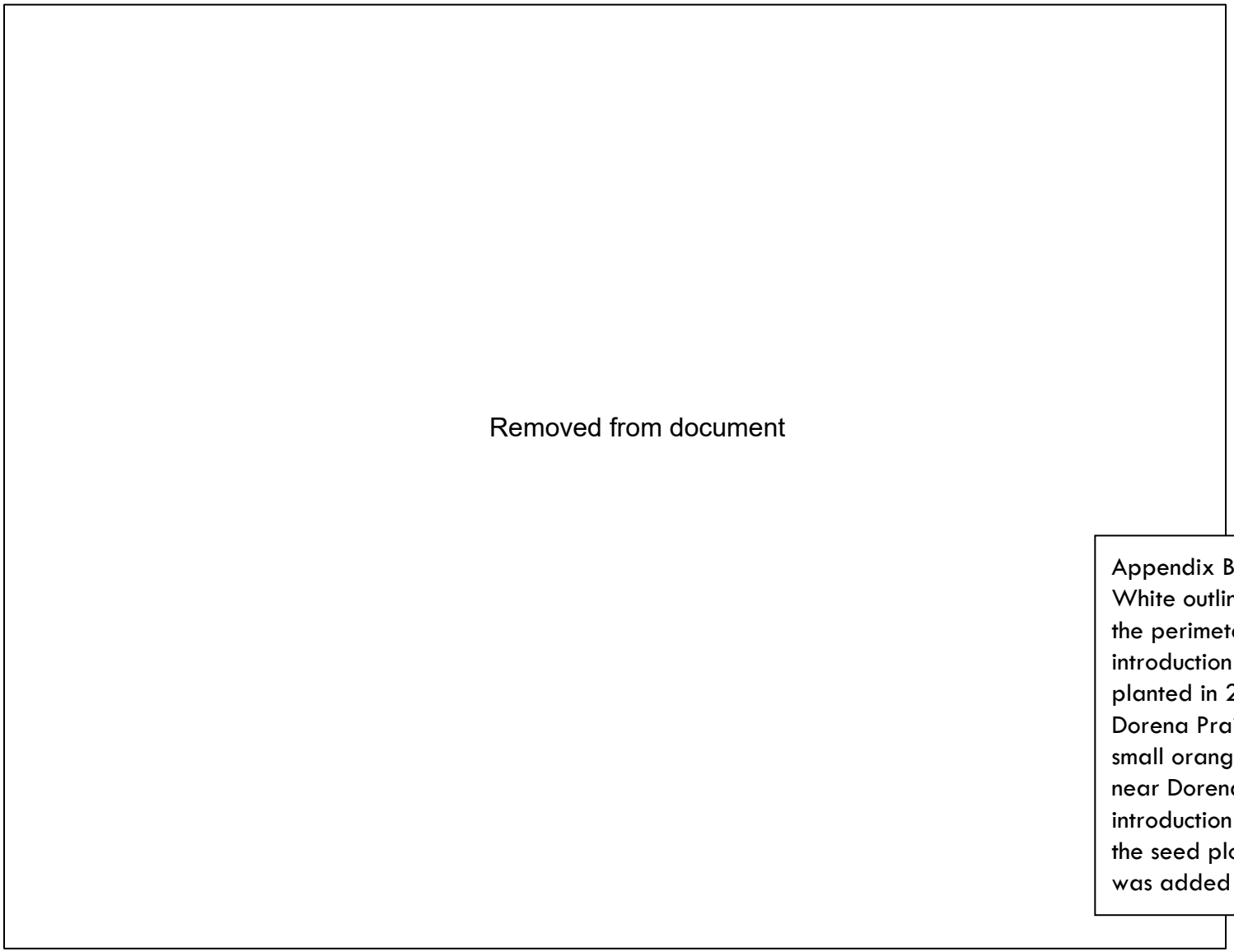
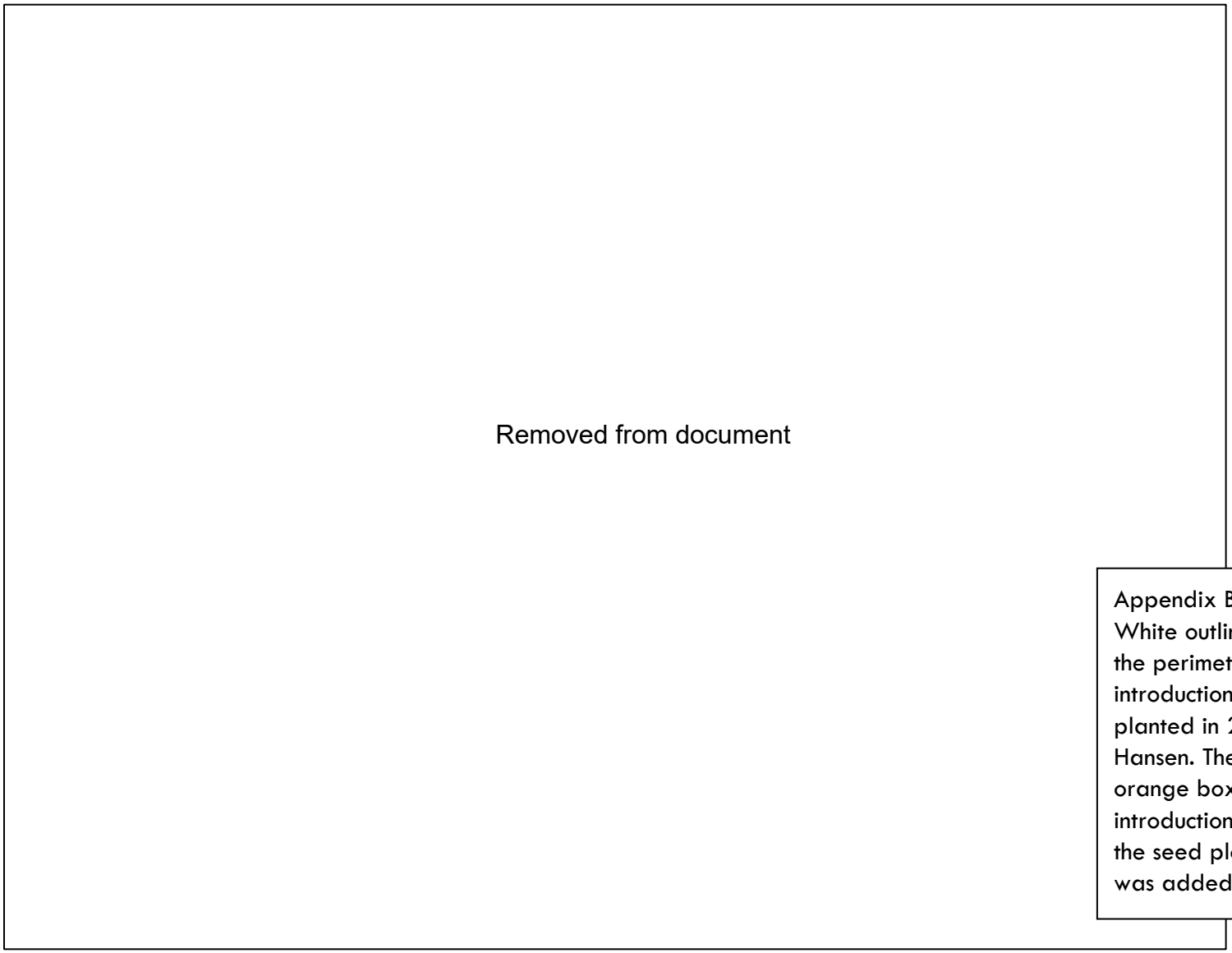
APPENDIX B. INTRODUCTION PLOT LAYOUTS



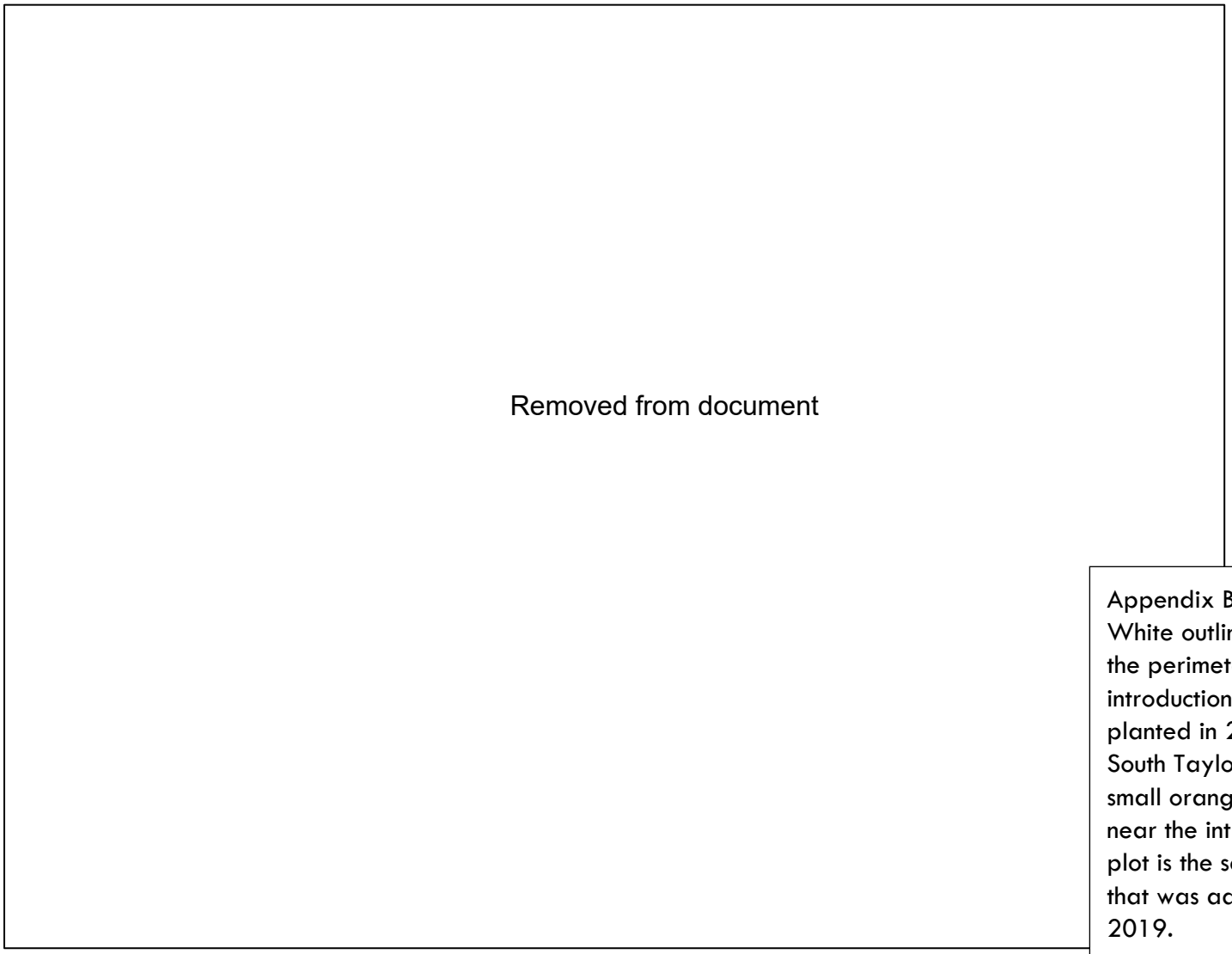
Appendix B Figure 1. White outlines show the perimeter of the introduction plots planted in 2016 at Bake Stewart Park. Small orange box near the western-most introduction plot is the seed plot that was added in 2019.



Appendix B Figure 2. White outlines show the perimeter of the introduction plots planted in 2016 at Dorena Praire. The small orange box near Dorena East introduction plot is the seed plot that was added in 2019.



Appendix B Figure 3. White outline shows the perimeter of the introduction plots planted in 2016 at Hansen. The small orange box near the introduction plot is the seed plot that was added in 2019.



Appendix B Figure 4. White outline shows the perimeter of the introduction plots planted in 2016 at South Taylor. The small orange box near the introduction plot is the seed plot that was added in 2019.

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APPENDIX C. *LATHYRUS HOLOCHLORUS* INTRODUCTION PLOT PHOTO POINTS

During 2016-2020, photos were taken at each corner of introduction plots, looking into the plot. Photo points below show one representative plot photo over time: plot-corner numbers listed in the captions below correspond to the plot-corner numbers in Appendix B.

Bake Stewart East

Corner 1 (Origin): from left to right 2016, 2017, 2018, and 2019.

Bake Stewart West

Corner 2: from left to right 2016, 2017, 2018, and 2019.

Dorena East

Corner 1 (Origin): from right to left 2016, 2017, 2018, and 2019.

Dorena West

Corner 2: from left to right 2016, 2017, 2018, and 2019.

Hansen

Corner 4: from right to left 2016, 2017, 2018, and 2019.

South Taylor

Corner 3: from left to right 2016, 2017, 2018, and 2019.




APPENDIX D. OVERVIEW OF MANAGEMENT ACTIONS FOR THE REINTRODUCTION OF *LATHYRUS HOLOCHLORUS* (2012-2020)

2012

- Phase I of the project was started by soliciting historic location records from ORBIC (Oregon Biodiversity Information Center) and the U.S. Fish and Wildlife Service (USFWS).
- A few small populations local to Corvallis were visited to increase IAE staff familiarity with the species' appearance, habit, and phenology.
- Site prioritization and map-making were done in the fall to prepare for field surveys in 2013.

2013

- Continued work on Phase I of the project by engaging in extensive field surveys of known locations of *L. holochlorus*.
- Efforts by IAE and Native Plant Society (NPSO) volunteer Julie Gibson resulted in a total of 62 sites visited by the end of the 2013 field season.
- IAE collected a total of 174.2 grams of seed from 12 different populations with the two largest populations yielding 73.5% of the total collected seed by weight.
- Germination testing was initiated.
- Germinated seeds were planted in the greenhouse to test the effects of different types of cultivation.

2014

- IAE and NPSO continued field surveys of known locations of *L. holochlorus* resulting in a total of 90 of the 109 sites visited in 2013 and 2014.
- A total of 126.2 grams of seed was collected from 20 different populations between July and August.
- Germination trials continued.
- Plug production continued.

2015

- A total of 47.8 grams of L. holochlorus seed was collected.
- A total of 1000 plants were grown at the NRCS Corvallis Plant Materials Center.
- One hundred second-year-old plants were grown at IAE.
- A seed-increase bed was initiated in late 2014 by direct seeding into a raised bed located at the Forestry Sciences Laboratory (FSL) at OSU.
- Visits were made to potential introduction sites. Four sites were chosen for introduction based on soils, habitat, and geographic location.

- In December 2015 and January 2016, management activities occurred at several sites in preparation for plant introduction, including mowing with a hand-held brush cutter to reduce vegetation height and to eliminate competing vegetation and the grubbing of roots of *Rubus bifrons*.

2016

- Due to poor germination in seed-increase beds at FSL, two raised beds (480 ft^2 total) were planted with nursery-grown plugs in March 2016. Both beds were weeded and fertilized twice in 2016 and irrigated regularly in early summer. None of the transplants flowered or set seed in 2016.
- 1000 plants were transplanted to four introduction sites in March 2016. Sites included Dorena East and West, Bake Stewart East and West, Hansen, and South Taylor.
- Introduction plots were monitored for survival and the associated plant community composition.
- Monitoring data were analyzed and synthesized.

2017

- The FSL seed-increase beds were weeded and dead *L. holochlorus* plants were replaced with live transplants.
- Introduction plots were monitored for survival and associated plant community composition.
- Monitoring data were analyzed and synthesized.

2018

- The FSL seed-increase beds were weeded.
- Five new introduction plots were established and planted with 1,464 *L. holochlorus* plugs under the RAC agreement # L16AC00150-0001. Sites included Herbert Big and Small Plots, Bald Hill Big and Small Plots, and Hansen RAC.
- Introduction plots were monitored for survival and associated plant community composition.
- Introduction plots and surrounding area were weeded.
- Monitoring data were analyzed and synthesized.

2019

- FSL beds were weeded and an electric fence was installed to prevent herbivory.
- Monitered outplanted plots.
- Entered and analyzed plot data.
- Collected *L. holochlorus* seed from four wild populations: Coyote Spencer Wetland, Cutler Lane, Fish Hatchery Road, and Linn Benton Community College.
- Planted 59 shrubs in 3 locations with highest potential to benefit from site enhancement.

2020

- Monitered and analyzed outplanted plot data.
- Collected *L. holochlorus* seed from large, healthy, wild populations.
- Established L. holochlorus