Champoeg Prairie Restoration 2019 Annual Report

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Report for Oregon Parks and Recreation Department

Report prepared by Andy Neill

Institute for Applied Ecology

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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 photograph: Tall camas (*Camassia leichtlinii*) flowering from a bulb that was planted in fall 2018 with Jeremy Ojua (CTGR) hand weeding in the background in the Cultural Harvest Area at Champoeg Prairie on May 1, 2019. (Photo: Andy Neill)

Photo credits: All photos in this report are by Andy Neill unless otherwise noted.

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1. EXECUTIVE SUMMARY

The Institute for Applied Ecology (IAE) has been involved in restoration of Champoeg Prairie, a 45-acre former agricultural field at Champoeg State Heritage Area, since 2013. In 2014, IAE developed and began implementation of the Champoeg Prairie Restoration Plan (IAE 2014) for Oregon Parks and Recreation Department (OPRD). The goal of restoration at Champoeg Prairie is to create upland and wet prairie habitats with diverse plant communities that attract pollinators, birds and other wildlife. Restoration objectives include controlling high priority invasive species, improving forb diversity, increasing abundance of culturally significant species, and implementing periodic prescribed burns. This report summarizes prairie conditions and restoration actions in 2019. Weed management included mowing, hand weeding, and broadcast and spot spray herbicide applications. Some of the treated or disturbed areas of the prairie were planted with native trees, shrub, and forbs. In particular, a 2.8-acre area in the central part of the prairie that has been difficult to establish natives from seed was planted with shrubs and trees in winter 2019. Native prairie species, including culturally important food plants, were planted in a portion of Champoeg Prairie for a second consecutive year. It is hoped that this portion of Champoeg Prairie will be a place for tribal members to harvest traditional food and fiber plants in the future. The planting was completed through the combined efforts of IAE, OPRD, and Confederated Tribes of the Grand Ronde (CTGR) Natural Resources Department employees, students and teachers from Newberg High School, and other dedicated volunteers.

2. INTRODUCTION

Champoeg State Heritage Area (Champoeg) is a popular recreational destination in the mid-Willamette Valley, noted for its historical importance and natural resource values. It is owned, operated and managed by the Oregon Parks and Recreation Department (OPRD). The 622-acre park consists of a variety of habitat types including creeks, oak woodlands, ash-forested wetlands, wet meadows, upland forest, riparian forest and active agricultural fields. Camping, biking, walking, disc golf and bird watching are some of the more popular recreational activities at the park. The park is located near Newberg, Oregon and is situated along the southern bank of the Willamette River in Marion County (Figure 1) and much of the park is located within the Champoeg Conservation Opportunity Area (COA), as indicated on the Willamette Valley Synthesis Map (TNC 2014).

Historically, the park was an important trade, gathering, and food harvesting location for local tribes. The word Champoeg likely derives from a Kalapuyan word for the native prairie species yampa (*Perideridia oregana*), which was an important edible root for local tribes in the area. Other food and fiber plants that were likely gathered at Champoeg include two species of camas (*Camassia quamash* and C. *leichtlinii*), soft rush (*Juncus effusus*), and hazelnut (*Corylus cornuta*). In addition to being an important harvest location, the prairie was a known location for trading among tribes because of the

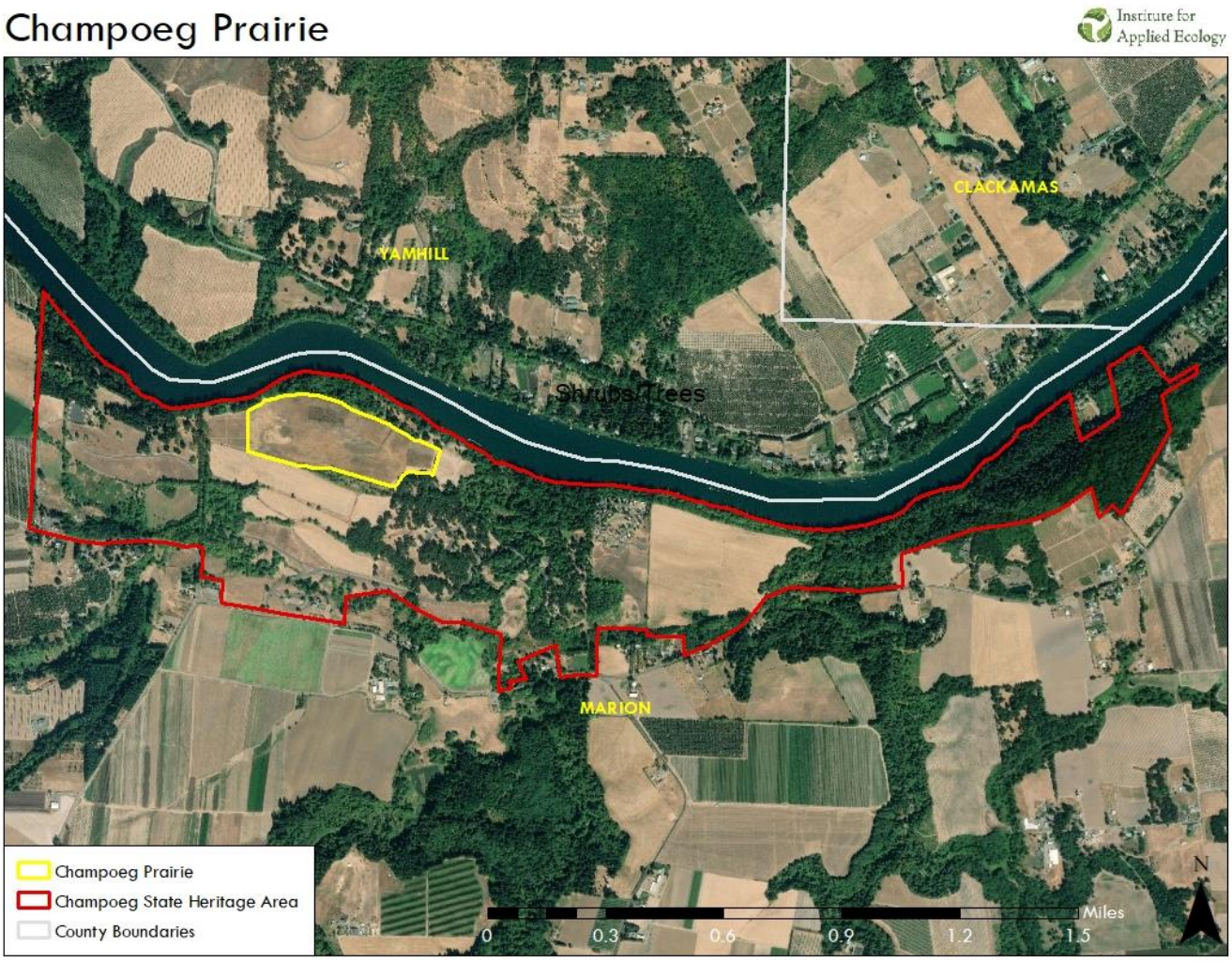

Figure 1. Champoeg State Heritage Area (outlined in red) with the location of Champoeg Prairie restoration project area (outlined in yellow).

open prairie and river access and crossing (Hussey 1967). During pioneer settlement, the Champoeg Prairie, in particular, was noted as the first place upstream from Willamette Falls where travelers could access the Willamette River easily due to the prairie extending almost all the way to the river's edge. This was also the location of the historic town of Champoeg, which was destroyed in the flood of 1861. Today, Champoeg is an important site for cultural and historic resource protection.

The Champoeg Prairie restoration unit is a 45-acre former agricultural field situated along the southern bank of the Willamette River (Figure 1). Restoration of this prairie is important because of the rarity of prairie habitats and associated plants and animals in the Willamette Valley Ecoregion. Much of the wet and upland prairie habitat has been lost due to conversion to agriculture, urban expansion, and encroachment by trees and shrubs. Prior to European settlement in the Willamette Valley, open prairie habitats were maintained by periodic fires, including those intentionally set by native tribes that had long lived in the area. Farming began at Champoeg in the 1850s, or possibly earlier (Hussey 1967).

Habitat restoration efforts began at Champoeg Prairie in 2005, when OPRD ended the farming lease and began converting the 45-acre field to native wet and upland prairie. The field was kept in chemical fallow during 2005 and 2006, and in 2007 it was seeded using a no-till drill with five native grasses: tufted hairgrass (*Deschampsia cespitosa*), blue wildrye (*Elymus glaucus*), Roemer's fescue (*Festuca roemeri*), California brome (*Bromus carinatus*), and California oatgrass (*Danthonia californica*). By 2013, Champoeg Prairie was dominated by tufted hairgrass with minor components of blue wildrye, Roemer's fescue, and California brome (Figure 2).

Figure 2. Tufted hairgrass (*Deschampsia cespitosa*) dominating the field in October 2013 (Photo: Peter Moore).

In 2013, the Institute for Applied Ecology (IAE) became involved with work at the site and worked with OPRD to develop a plan to guide restoration (IAE 2014). Since then, IAE has received funding and support from OPRD to implement the restoration plan. Other grants have also contributed to the restoration efforts at the site. For example, a collaboration between IAE, OPRD and CTGR as part of two consecutive Plants for People grants (funded by the Oregon Watershed Enhancement Board [OWEB]) included Champoeg Prairie as a project site (Moore and Neill 2017).

Since 2014 IAE has worked to increase forb diversity in the prairie by planting thousands of native bulbs, plugs and bareroot plants and seeding native seed across most of the prairie (Figure 3 and Appendices). Successful establishment and flowering of many of these species has led to increased diversity and abundance of pollinators and other animals that use the site. The techniques, tools, and schedule outlined in the restoration plan have been refined over time to reflect changing conditions and effectively create prairie habitats with a diversity of native forbs and grasses. For a full schedule of restoration actions at Champoeg Prairie completed since 2014, see Appendix A.

In 2017 and 2018, IAE worked with the Champoeg park manager and OPRD archaeologist to ensure cultural compliance with State Historical Preservation Office (SHPO) prior to performing a prescribed burn and installing of native plants. The approval from SHPO to perform ground-disturbing activities established boundaries for restoration activities that disturb the soil, including planting, hand weeding, and use of a no-till seed drill (Figure 4). The prescribed burn of Champoeg Prairie completed in fall 2017 by a fire crew from the CTGR was a significant achievement, and it is hoped that the cooperative efforts of these partners will enable implementation of future prescribed burns at Champoeg Prairie every 3-5 years.

Figure 3. Overview of the 45-acre Champoeg Prairie restoration project area and plant establishment areas.

Figure 4. Plant establishment areas and methods approved by the State Historical Preservation Office for Champoeg Prairie.

As part of the OWEB funded work at Champoeg, a two-acre area of Champoeg Prairie was designated at a future traditional harvest area, with a focus on culturally significant plants when selecting species for planting and seeding (Table 1). Once established, the goal is to make these traditionally important species available for harvesting by local tribes. In order to harvest cultural foods within the proposed Harvest Area (Figure 4), use of herbicides in this area was phased out in 2018. Moving forward, weed control in this area will be done by hand and chemical herbicides will not be used. Although culturally significant plants have already been planted and seeded across much of the prairie, the planting of these species specifically for future harvest within the Harvest Area began in 2018. A harvest plan has been drafted in consultation with OPRD and CTGR that will provide partners with a working plan to facilitate future sustainable harvests of food and fiber plants at Champoeg (Celis et al. In progress).

Table 1. List of traditional food and fiber plants that have been planted at Champoeg Prairie since 2014.

Scientific Name	Common Name	Cultural Use
Allium acuminatum	tapertip onion	food
Allium amplectens	narrowleaf onion	food
Brodiaea elegans	elegant brodiaea	food
Calochortus tolmiei	cats-ear lily	food

Scientific Name	Common Name	Cultural Use
Camassia leichtlinii	tall camas	food
Camassia quamash	small camas	food
Dichelostemma congestum	forktooth ookow	food
Fragaria virginiana	strawberry	food
Iris tenax	Oregon iris	cordage
Juncus effusus	common rush	cordage
Lomatium nudicaule	barestem biscuitroot	food, medicine, ceremony
Madia sp.	tarweed	food
Perideridia gairdneri	Gairdner's yampah	food
Triteleia hyacinthina	white brodiaea	food

3. GOALS AND OBJECTIVES

The goal of this project is to create diverse wet and upland prairie habitat in the 45-acre prairie at Champoeg State Heritage Area.

Restoration objectives include:

1) Control high priority invasive species such as mullein, thistles, and non-native grasses;
2) Improve forb diversity at Champoeg Prairie by seeding and planting appropriate native species;
3) Increase abundance of culturally significant species; and
4) Implement periodic prescribed burns as part of prairie management.

4. 2019 RESTORATION ACTIVITIES

Restoration activities in 2019 focused on reduction of priority weeds, preparing the west end of the prairie for eventual broadcast seeding, establishing shrubs and trees in 2.8 acres in the central part of the prairie, and continued establishment of native plants, including culturally significant food and fiber plants (Table 1) in the proposed Harvest Area (Figure 4). In 2019, IAE staff began drafting a harvest plan that will provide partners with a working plan to facilitate future sustainable harvests of food and fiber plants at Champoeg. The plan will be completed with input from OPRD and CTGR staff and is intended to be a "living" document that can be adapted as conditions change. Development of the cultural harvest plan was funded through the OWEB funded Plants for People project.

A complete list of activities completed at Champoeg Prairie in 2019 is listed in Table 2.

Table 2. 2019 restoration activities at Champoeg Prairie.

Date	Activity	Note
Jan-2019	Site visit and plant material harvest	Mapped and marked out a 2.8-acre shrub and tree planting area. Harvested Pacific ninebark (300) and Pacific willow (~250) live stakes from the Corvallis Plant Material Center (PMC). Live stakes were stored in buckets with water for later planting.

Date	Activity	Note
Feb-2019	Plant material harvest	IAE staff harvested approximately 970 live stakes including red osier dogwood (~140), Pacific willow (~150), Hooker's willow (~400), and Sitka willow (~280) from the PMC.
Feb-2019	Planting	IAE staff coordinated a contractor crew to plant of over 5,600 bare root and live stake shrubs and trees in the planting area funded by a grant from the Marion Soil and Water Conservation District (MSWCD).
Mar-2019	Site visit and photopoints	Met with Dr. Paige Parry and her ecology class from George Fox University to talk about prairie ecology and restoration at Champoeg. Took photos at standard photo points and assessed planting and seeding success.
May-2019	Hand weeding	IAE staff, AmeriCorps NCCC Blue 4 team, Jeremy Ojua (CTGR) and staff from the Marion County Food Share hand weeded the Harvest Area and other parts of the prairie. Workers targeted mullein, thistles, and tiny vetch (*Vicia hirsuta*).
May-2019	Watering	Two days watering shrubs and trees (planted in February) using a portable tank and hose.
May-2019	Weed treatment	Two days spot spraying weeds with glyphosate in and around the shrub and tree planting area. Mullein, thistles and other priority weeds were targeted.
Jun-2019	Site visit	IAE and OPRD staff (Andrea Berkley and Noel Bacheller) met to assess Champoeg Prairie, to exchange restoration ideas and identify sickle keeled lupine (*Lupinus albicaulis*) flowering in the old Champoeg townsite west of Champoeg Prairie.
Jun-2019	Site visit	Project completion review with Meredith Hoffman from MSWCD to assess success of shrub and tree planting that was funded by a grant from MSWCD.
Jun-2019	Mowing	IAE staff used a brush mower to mow between the shrub and tree planting rows. A string trimmer was used to mow between plants in the first five rows at the north end of the planting area.
Jul-2019	Site visit and seed collection	Assessed seeding and planting success and took photos at standard photo points. Collected camas seed from other areas of the park for eventual broadcast over Champoeg Prairie in fall 2020 after the next prescribed burn. Additional seed will be collected in June, 2020.
Aug-2019	Mowing	OPRD staff mowed a path to and around the shrub and tree planting area to reduce fire risk and improve access for watering.
Aug-2019	Watering	IAE staff used hoses and water tank borrowed from OPRD to water shrubs and trees over three days in August.
Aug-2019	Mowing	IAE staff used a brush cutter to mow between planted shrubs and trees.
Sep-2019	Weed treatment	IAE staff hand-pulled marestail (*Conyza canadensis*) and flagged areas to be mowed and sprayed in October.
Sep-2019	Weed treatment	IAE staff spot sprayed common mullein and hand-pulled marestail in shrub and tree planting area.

Date	Activity	Note
Oct-2019	Mowing	Contractor mowed ~2 acres of the Harvest Area for fall planting and ~12 acres at the west end of the prairie to prepare for a fall broadcast herbicide application.
Oct-2019	Weed treatment	Contractor broadcast sprayed a mix of Plateau (Imazapic), Rodeo (aquatic glyphosate) and MSO surfactant on ~9 acres at the west end of the prairie. The contractor also spot sprayed with a similar mix of Plateau, Rodeo, and MSO surfactant along the rows in the shrub and tree planting area.
Nov-2019	Planting	IAE, OPRD, and CTGR staff, students from Newberg High School and other volunteers planted 4600 plants in the Harvest Area.

Figure 5. Jeremy Ojua from Confederated Tribes of the Grand Ronde Natural Resources Department (left) and nine members of the AmeriCorps Blue 4 team after a day of pulling weeds from the Harvest Area and other parts of Champoeg Prairie.

High priority weeds were spot sprayed by IAE staff and contractors during the 2019 growing season (Table 2). IAE staff spent two days in May spot spraying herbicide to kill common mullein (*Verbascum thapsus*), Canada and bull thistles (*Cirsium arvense* and C. *vulgare*), oxeye daisy (*Leucanthemum vulgare*) and velvet grass (*Holcus lanatus*). Additional spot spray applications were completed in September. In May, flowering stems of common mullein were pulled by hand, bagged and removed from the prairie. Weed control in the Harvest Area was completed by hand pulling target species. In May, nine members of the AmeriCorps National Civilian Community Corps (NCCC) Blue 4 team and staff from IAE, CTGR and Marion Polk Food Share (Figure 5) worked to remove tiny vetch (*Vicia hirsuta*), common mullein, English plantain (*Plantago lanceolata*) and non-native thistles (Figure 6). Hand weeding began in the two-acre Harvest Area then expanded to other areas of Champoeg Prairie. Plants that had flowers or ripening seed were bagged and removed from the prairie. Plants that had not yet flowered were pulled and left on the ground with roots exposed (Figure 6). In July, oxeye daisy and other priority weeds flowering in the east end of the prairie, including within Forb Diversity Block D (Figure 3), were pulled by hand and removed from the prairie.

Figure 6. Jeremy Ojua (Confederated Tribes of Grand Ronde) and AmeriCorps Blue 4 pulling weeds, such as Canada thistle (*Cirsium arvense*), in May 2019.

In 2018, multiple weed treatments in the center of Champoeg Prairie prepared a 2.8-acre area for planting of shrubs and trees. This has been a difficult area to establish native plants or control weeds, so it is hoped that shrubs and trees will create sufficient cover to suppress the weeds. In February 2019, over 5,700 live stakes and bareroot shrubs and trees were planted in rows five and a half feet apart to create a target density of 2,000 stems per acre (Table 3). The live stakes were harvested by IAE staff from shrubs growing at the Natural Resource Conservation Service's Corvallis Plant Materials Center (PMC). Live stakes of redosier dogwood (*Cornus sericea*), Pacific ninebark (*Physocarpus capitatus*), Pacific willow (*Salix llucida* ssp. *lasiandra*) and Scouler's willow (*S. scouleriana*) were cut to two to three feet segments and stored in plastic garbage cans with their rooting tips in water for 1-2 weeks (Figure 7) until they were planted (Figure 8). Two or three live stakes were planted in each location to increase establishment rates.

Figure 7. Live stakes of redosier dogwood (left), Hooker's willow (center) and Pacific willow (right) soaking in water before being planted at Champoeg Prairie in February, 2019. (Photo: Anna Ramthun)

Figure 8. Contractor crew planting shrubs and trees at Champoeg Prairie in February, 2019. (Photo: Anna Ramthun)

Table 3. Shrubs and trees planted at Champoeg Prairie on February 15, 2019.

Scientific Name	Species	Growth form	Bareroot	Live stakes	Stems/ acre	Total stems
Acer macrophyllum	bigleaf maple	Tree	162	-	58	162
Amelanchier alnifolia	western serviceberry	Shrub	420	-	150	420
Cornus sericea	redosier dogwood	Shrub	420	140	200	560
Fraxinus latifolia	Oregon ash	Tree	200	-	71	200
Holodiscus discolor	oceanspray	Shrub	420	-	150	420
Mahonia aquifolium	Oregon grape	Shrub	420	-	150	420
Oemleria cerasiformis	ososberry	Shrub	420	-	150	420
Physocarpus capitatus	Pacific ninebark	Shrub	340	280	221	620
Populus trichocarpa	black cottonwood	Tree	420	-	150	420
Quercus garryana	Oregon white oak	Tree	280	-	100	280
Rhamnus purshiana	cascara	Shrub	280	-	100	280
Salix lucida ssp. *lasiandra*	Pacific willow	Shrub	140	400	193	540
Salix hookeriana	Hooker's willow	shrub	-	400	143	400
Salix scouleriana	Scouler's willow	Shrub	140	-	50	140
Salix sitchensis	Sitka willow	Shrub	140	280	150	420
		Totals:	**4,202**	**1,500**	**2,036**	**5,702**

Spot spray herbicide applications in 2019 within the shrub and tree planting area targeted weeds including mullein, oxeye daisy, velvet grass, and marestail (*Conyza canadensis*). Marestail, false dandelion (*Hypochaeris radicata*), and rattail fescue (*Vulpia myuros*) continue to be abundant but the fall application of Plateau (imazapic) should reduce their cover.

The late-winter and spring months were unusually dry in 2019. These conditions, combined with warm weather, necessitated watering the newly planted shrubs and trees. To facilitate access and reduce fire danger, OPRD staff mowed a path to and around the planting area in May. Over a two-day period that same month, IAE staff used a tank mounted on an ATV and a hose from a large, OPRD-owned tank pulled behind a truck to deliver water to the shrubs and trees. The shrubs and trees were watered again over a three-day period at the beginning of August using hoses and the large tank borrowed from OPRD. In June, IAE staff used a walk-behind brush mower to mow between the rows and a string trimmer to mow between the planted shrubs and trees. Species that were mowed included marestail and rattail fescue. Mowing did not kill the marestail and many of the surviving plants continued to grow and were pulled by hand in September by IAE staff.

On October 16, a contractor mowed the two-acre Harvest Area with a skid steer mower to reduce thatch and facilitate fall planting (Figure 9). The contractor also mowed approximately 11 acres at the west end of the prairie to facilitate herbicide applications in the fall and spring (Figure 9). On October 28, a contractor spot sprayed around the planted shrubs and trees and between the rows using Rodeo (glyphosate) and Plateau (imazapic). Plateau is a broad-spectrum herbicide with residual effects in the soil that will kill germinating seeds for several months after the application. This is intended to reduce competition while the shrubs and trees become established. That same day, the contractor also broadcast sprayed the same combination of herbicides on the nine acres at the west end of the prairie that was

mowed earlier the same month. The goal of this treatment was to kill existing weeds and prevent germination of weed seeds for several months after the application.

Figure 9. The west end of the prairie before (left) and after (right) mowing with a skid steer mower on October 16, 2019.

Planting at Champoeg Prairie in 2019 was confined to the Harvest Area. Nearly all of the species were cultural food or fiber plants (Table 4). On November 8, staff from IAE and OPRD, as well as 10 staff from the CTGR Natural Resources Department and 45 volunteers from around the valley, including 29 Newberg High School students and two staff, planted 4,600 plants in the Harvest Area (Figure 10). The same day these workers also planted 100 Oregon white oak (*Quercus garryana*) in the nearby Oak Grove area of Champoeg. The oak planting project was organized and funded by OPRD.

Table 4. Native forbs planted at Champoeg Prairie in November, 2019.

Scientific Name	Common Name	Propagule	Count
Allium amplectens	narrowleaf onion	Bulb	450
Brodiaea elegans	elegant brodiaea	Bulb	500
Calochortus tolmiei	cats-ear lily	Bulb	500
Camassia leichtlinii	tall camas	Bulb	500
Fragaria virginiana	Virginia strawberry	Bareroot	1,000
Geranium oreganum	Oregon geranium	Bareroot	200
Iris tenax	toughleaf iris	Bareroot	500
Lomatium nudicaule	barestem biscuitroot	Bareroot	300
Triteleia hyacinthina	hyacinth brodiaea	Bulb	400
Wyethia angustifolia	narrowleaf mule's ears	Bareroot	250
		Total:	**4,600**

Figure 10. Planting in the Harvest Area at Champoeg Prairie on November 8, 2019.

5. DISCUSSION

5.1 Weed treatments

Until 2018, weed treatments have varied based on the specific needs of three distinct areas within the Champoeg Prairie. These areas include 1) sandy areas at the west end and center of the prairie, 2) the four forb diversity blocks, and 3) the rest of the prairie that is dominated by native grasses. Priority weeds targeted with broadcast and spot spray herbicide applications in all areas include mullein, tansy ragwort (*Senecio jacobaea*, Figure 11), Canada and bull thistles, Himalayan blackberry (*Rubus bifrons*), rattail fescue, velvetgrass, and reed canarygrass (*Phalaris arundinacea*). However, in 2017 following the prescribed burn and adequate control of non-native forbs, native forb seed was broadcast to additional areas outside of the original four forb diversity blocks, making broadcast herbicide treatments to control broadleaf weeds less feasible (Figure 3). Instead, multiple spot spray treatments throughout this area and most of the prairie were completed in 2018 and 2019 to control priority weeds.

Figure 11. Tansy ragwort (*Senecio jacobaea*) flowering with cinnabar moth (*Tyria jacobaeae*) caterpillar at Champoeg prairie on July 16, 2018.

In 2019, multiple spot spray treatments targeting mullein, thistles, tall oatgrass (*Arrhenatherum elatius*) and tansy ragwort were effective. However, several areas disturbed by the shrub and tree planting in February had an increase in mullein following that disturbance. This is likely due to exposure and germination of mullein seed in the seed bank. The abundance of marestail, a native agricultural weed, has increased over the past two years primarily at the west end and in the shrub and tree planting area of the prairie (Figure 12). These are both areas that have had ongoing weed problems and native plant establishment has been difficult. Hand pulling, mowing, and the fall herbicide application of the Plateau-glyphosate combination should kill living plants and prevent germination for several months. The residual effects of the herbicide should diminish enough for successful broadcast seeding of native prairie grass species, which is planned for fall 2020 if weed control appears to be sufficient.

Figure 12. Marestail (*Conyza canadensis*) and other weeds growing in the 2.8-acre shrub and tree planting area in the central part of Champoeg Prairie in September, 2019.

Figure 13. Marestail (*Conyza canadensis*) in a mowed and un-mowed area at the west end of Champoeg Prairie.

OPRD staff was able to mow a few acres at the west of the prairie in June. Although this did not kill the marestail in this area, it did significantly limit its growth and seed production (Figure 13). Although the plan was for park staff to mow an additional 12 acres at the west end of the prairie later in the summer, just before flowering of the marestail, limited resources prevented this from happening. The area was eventually mowed in October by a contractor with a skid steer, but unfortunately, the timing was too late to reduce growth and prevent seed production of marestail. Mowing of these areas twice a year starting in June is recommended to reduce thatch and prevent seed production of unwanted species, facilitating weed control and preparing the area for eventual broadcast seeding of natives.

Hand weeding of the two-acre portion of Champoeg Prairie designated as a harvest area (Neill 2019) removed live plants but some of the species have rhizomes or taproots that are difficult to remove by hand. For example, Canada thistle will likely require multiple years of hand weeding since rhizomes are deeply rooted and plants can regenerate from small pieces of rhizomes left in the ground. Similarly, if the taproot of mullein is not removed, the plant will resprout. Multiple visits to remove plants and flowering heads will be required to keep these and other similar weeds under control in the Harvest Area.

Figure 14. Tansy ragwort burning as part of the prescribed burn on September 27, 2017.

Tansy ragwort is a common agricultural weed throughout the Willamette Valley (Figure 11). The prescribed burn in 2017 (Figure 14) and targeted herbicide spot and broadcast spray applications in 2018 and 2019 appear to have reduced the abundance of tansy ragwort after an unexpected outbreak in 2017 (Neill 2017). Although currently there are no large patches of this species present at the site, the prairie should be monitored periodically, especially in disturbed areas such as the archaeological building site, to identify and treat any future outbreaks.

Sandy areas of the prairie have been dominated by non-native grasses and broadleaf weeds since the areas were sprayed and left fallow prior to IAE's involvement in the project. The fall 2018 broadcast application of Plateau to inhibit germination of annual grasses to the ~11 acres at the west end of the prairie was only partially successful, and it appears that the concentration of the imazapic broadcast application was too low or the soil porosity was too great to maintain a high enough concentration to affect the germinating annual grasses or other weeds. The application of Plateau and glyphosate in fall 2019 was done at a higher concentration with the hope of having a longer residual effect to control weeds and annual grasses in the area. It is likely that this treatment will also kill the native grasses that were seeded in fall 2017, but since the weed abundance in this area remained high and inhibited establishment of natives from seed, reseeding was already going to be necessary. Good weed control in this area is necessary because broadcast seeding of natives, which usually requires better site preparation to be successful, is the only option for establishing natives and increasing diversity in this area (Figure 4).

Options to control non-native annual grasses in the sandy areas once native perennial grasses are established in the western sandy area could include continuation of treatments with a pre-emergent herbicide such as Plateau (imazapic), Milestone (aminopyralid) or Arsenal (imazapyr). Another experimental approach to combating annual grasses that have dominated sandy soils at the site is to plant natives from seed that quickly establish and can dominate an area. For example, species in the pea (Fabaceae) family such as riverbank lupine (*Lupinus rivularis*) and American bird's-foot trefoil (*Acmispon americanus*) can temporarily dominate an area and limit resources available seed production by non-native species. This has been observed in the forb diversity blocks already. If needed, these natives could be controlled by mowing prior to flowering or seed maturation and the area subsequently seeded with a diverse mix of other desirable native species. Although the lupine or trefoil might temporarily increase nitrogen availability and soil organic matter and create conditions that could favor non-native species, it is expected that these conditions will be short lived in the sandy soil areas of Champoeg Prairie.

Figure 15. Hairy evening primrose (*Oenothera villosa*) flower (left) and basal rosette (right) that invaded the western end of Champoeg Prairie in October, 2017.

Hairy evening primrose (*Oenothera villosa*) (Figure 15) that densely occupied portions of the sandy area at the west end of the prairie has been controlled by broadcast herbicide applications in 2017 and 2018. Isolated plants and small patches can still be found in the prairie and should be monitored and treated to prevent future outbreaks. Although hairy evening primrose is native, this species can form dense patches and prevent establishment of desired native prairie species. Hairy evening primrose has not been observed in areas dominated by native species and as restoration efforts move from weed treatments to seeding and planting, the likelihood of outbreaks of evening primrose, like the one observed in 2017, should decrease.

The ~2.8-acre central sandy area has proven to be a difficult area for controlling problem weeds and establishing native grasses (Figure 3). In 2016, it was decided to implement the alternate plan of establishing native shrubs and trees in this area that was described in the Champoeg Prairie restoration plan (IAE 2014). Herbicide treatments in 2017 and 2018 prepared the area for planting in early 2019 (Neill 2017 and Neill 2018). Originally, the outplanting of the trees and shrubs was scheduled for February of 2017, but this was delayed while compliance with archaeological regulations was resolved. This delay allowed for another year of weed control in the central sandy area (Appendix A).

Despite herbicide, mowing and hand pulling treatments, weeds still persist in the sandy soil planting area. In 2019, the late-fall spot spray application of Plateau mixed with glyphosate between and around planted trees and shrubs should help control mullein, marestail, rattail fescue and other weeds, reducing direct competition to the establishing trees and shrubs. The effectiveness of this herbicide application will be assessed in early 2020. If there is good weed control in these two areas, broadcast seeding of native grasses, such as Roemer's fescue, will be recommended to increase native species diversity and inhibit weed establishment. Annual mowing combined with herbicide applications is also recommended to reduce thatch and weed competition with planted shrubs and trees and prepare the area for potential broadcast seeding and planting of natives in the future.

5.2 Planting

The forb diversity blocks (Figure 3) were established in 2014 with an initial seeding and planting, followed by an additional seeding in 2015 using belly seeders (Appendix B). Forb establishment following seeding and planting in 2014 and 2015 varies among the four forb diversity blocks. By 2019, species that have established in the forb blocks include perennials such as Oregon sunshine (*Eriophyllum lanatum*), common selfheal (*Prunella vulgaris*), common yarrow (*Achillea millefolium*), barestem biscuitroot

(*Lomatium* nudicaule), checkermallow (*Sidalcea campestris* and *S. malviflora* ssp. *virgata*), slender cinquefoil (*Potentilla gracilis*), river lupine and tall camas, as well as annuals such as farewell-to-spring (*Clarkia amoena*), American bird's-foot trefoil, denseflower willowherb (*Epilobium densiflorum*), showy tarweed (*Madia elegans,* Figure 16), and globe gilia (*Gilia capitata*). Establishment of some species continues to vary across the forb diversity blocks. For example, American bird's-foot trefoil continues to grow densely in forb diversity block D but sparsely in the other three blocks despite similar seeding rates (Appendix B). Conversely, river lupine grew in large dense patches in forb diversity block A while only a few plants established in the other blocks (Neill 2017). The robustness of river lupine plants in forb diversity block A occurred in 2015 and 2016 but this species was reduced to a few plants in 2017. In 2018, river lupine had a resurgence that was expressed as many flowering plants in 2019.

Figure 16. Showy tarweed (*Madia elegans*) flowering at Champoeg Prairie in June, 2019.

Many of the annual forbs that were broadcast seeded in fall 2017 following the prescribed burn (Appendix C) flowered in 2018 and 2019. In particular, the tarweed species were observed flowering in all the seeded areas (Figure 16).

In mid-February 2019, a contractor planted over 5,700 bareroot and live stake plants (Table 3). Originally, the planting was scheduled to occur in January, but planting of shrubs and trees at Champoeg Prairie did not receive official SHPO approval until February 5, 2019. Informal monitoring of the planted trees and shrubs throughout the summer and fall indicate lower than expected survivorship of the planted trees and shrubs, in spite of watering in May and August by IAE staff and periodic rains during the summer months. It is likely multiple factors contributed to low success, including sandy soils that do not retain soil moisture, shallow planting depths of live stakes by the contractor, direct competition for resources from weeds, and a late frost.

The frost at Champoeg occurred in April, just after young leaves had emerged. Emerging leaves of many species were damaged or died as a result of the frost, including those of Oregon white oak (*Quercus garryana,* Figure 17). Most of the planted live stakes that were harvested from the PMC did not recover from the frost and eventually died. Bareroot plants of the same species, i.e. willows and redosier dogwood, had a higher survivorship and recovered after the frost. Upon further inspections, many of the dead live stakes were inserted 6-12" into the soil, which was too shallow for root establishment as the soil continued to dry out during the growing season. This suggests that greater success could be achieved by planting the live stakes to 12-24" into the soil. Planting earlier, storing the live stakes in water longer or using a rooting hormone could have improved success by allowing for greater root development of the live stakes. A second planting of bareroot shrubs and trees is planned for early 2020 and weed treatments will continue to reduce competition.

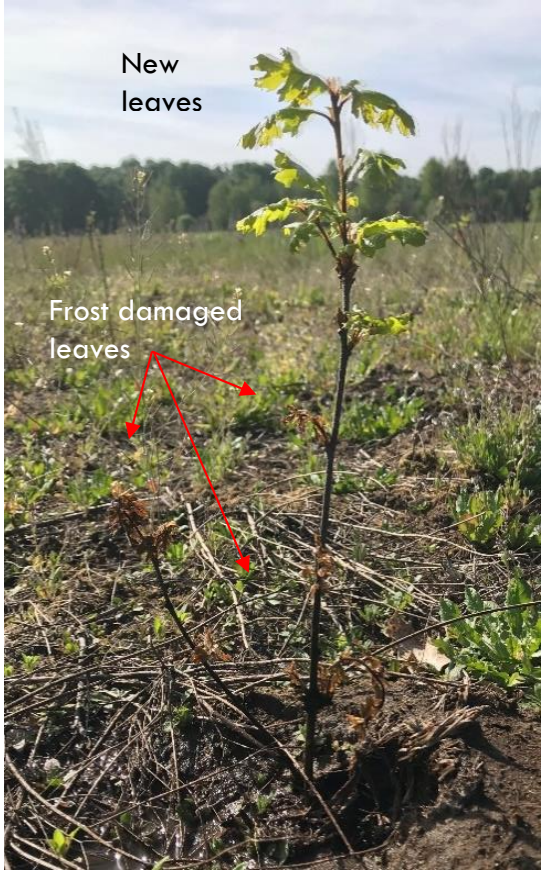

Figure 17. Planted Oregon white oak (*Quercus garryana*) recovering from a spring frost at Champoeg Prairie in May, 2019.

The two-acre central swale of Champoeg Prairie has had little establishment of the sedges and rushes that were seeded in 2017 and 2018 (Figure 3, Appendix D). Sedges and rushes can be slow to establish and seed could still be present in the soil seedbank. Tufted hairgrass has slowly been regenerating in this area after being submerged for a majority of the wet season that lasted from fall 2015 to spring 2016. Much of the tufted hairgrass was killed during that period, but by 2019 the area had again become dominated by tufted hairgrass (Figure 18). The resurgence of tufted hairgrass, the presence of well-drained soils, and the absence of additional periodic flooding like that which occurred in 2015-2016 could all have contributed to the poor success of seeded sedges and rushes (that prefer wetter growing conditions) in this area. Common rush continues to grow in this area, but has not yet flowered since being planted as bareroot plants two years ago (Neill 2018).

Figure 18. Weeds dominating the two-acre central swale in 2016 (top) after being submerged for most of the winter and tufted hairgrass (*Deschampsia cespitosa*, bottom) that dominates the area in 2019.

5.3 Cultural Harvest Area

In October 2018, IAE, OPRD and CTGR staff partnered to host a tribal cultural event at Champoeg Prairie. The event was part of the Plants for People Project, funded by OWEB, celebrating the establishment of a harvest area at Champoeg Prairie (Moore and Neill 2017). Volunteers, tribal members, and staff from IAE, OPRD, and CTGR planted bulbs and bareroot plants, including tall camas bulbs and yampa roots, in a location where local tribes will eventually be able to collect first foods and share their traditions. Many of these species, including

narrowleaf onion, mule's ears, and barestem lomatium (Figure 19), were observed flowering in this area in 2019.

Figure 19. Many plants planted in 2018 were observed flowering in 2019, including narrowleaf onion (*Allium amplectens*, pink flowers) and hyacinth brodiaea (*Triteleia hyacinthina*) (left), cats-ear lily (*Calachortus tolmiei*, center), and barestem biscuitroot (*Lomatium nudicale*, right).

The 2019 planting of 4,600 additional plants in the Harvest Area by IAE, OPRD and CTGR staff with help from many volunteers will likely increase the density of cultural plants for future harvests (Table 4). The significant volunteer involvement in prairie restoration, primarily planting and hand weeding, in 2018 and 2019 at Champoeg has had a tremendous positive effect at Champoeg Prairie, moving the site closer to restoration goals. Mowing of the Harvest Area facilitated planting both years and should be done annually in years when there is not a prescribed burn. This will promote establishment of the seeded and planted species in Champoeg Prairie.

6. RECOMMENDATIONS

Restoration work at Champoeg Prairie has made excellent progress towards the overarching goal of creating native upland and wet prairie with a diverse mix of forbs and grasses that will attract pollinators and other wildlife that rely on these habitats.

To build on this progress, we recommend the following restoration activities in 2020 and beyond:

- Update the Champoeg Prairie Restoration Plan to include establishment and maintenance of native shrubs and trees in the central sandy areas and culturally significant species in the Harvest Area.
- Plant additional shrubs and trees in the central sandy area to fill in areas that experienced mortality after the first planting and to maintain target density of 2,000 stems per acre.

- Continue to develop the partnership between CTGR and OPRD and create opportunities for traditional harvesting of culturally significant species.
- Implement periodic prescribed burns (ideally every three years) to reduce thatch and promote native fire-adapted plant species.
- Restrict use of herbicides in the proposed Harvest Area and control weeds by hand.
- Allow for future expansion of harvest areas by phasing out the use of herbicides over a wider area of the prairie and planting a high density of food and fiber plants.
- Continue spot spray herbicide treatments to control target weed species, including mullein, tansy ragwort, Canada and bull thistles, velvet grass, tall oatgrass and rattail fescue, outside of the future harvest areas.
- Aggressively treat velvetgrass throughout meadow to prevent continued spread.
- Consider alternatives to controlling non-native annual grasses in the western sandy area.
- Augment wet and upland prairie communities with additional plantings of native forbs, sedges and rushes.
- Consider introduction of threatened and endangered species such as golden paintbrush (*Castilleja levisecta*), Kincaid's lupine (*Lupinus oreganus*), Willamette daisy (*Erigeron decumbens*), Bradshaw's lomatium (*Lomatium bradshawii*) and Nelson's checkermallow (*Sidalcea nelsoniana*) to aid in the recovery efforts of these species in Oregon.

7. REFERENCES

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APPENDICES

Appendix A. Summary of Champoeg Prairie restoration actions (2013-2018).

Date	Activity	Notes
Aug-2013	Site visit	Site assessment and prairie inventory.
Nov-2013	Weed treatment	Broadcast spray of rattail fescue with Gly-Star (glyphosate).
Feb-2014	Site visit	Site visit to assess weed abundance and determine project boundaries
Apr-2014	Weed treatment	Broadcast spray of rattail fescue, other non-native grasses and mullein with Gly-Star (glyphosate).
May-2014	Weed treatment and photopoints	Broadcast spray of strips to establish four forb diversity blocks in the prairie for planting, spot spray of reed canarygrass and thistles, collect photopoints, collect seed bank samples and assess results of previous treatments.
Nov-2014	Weed treatment	Flame weeding of rattail fescue.
Nov-2014	Planting and seeding	Planting and seeding prairie species in the four forb diversity blocks.
May-2015	Weed treatment	Broadcast spray of rattail fescue with diquat and spot spray of thistles and reed canarygrass with Gly-Star (glyphosate).
Jul-2015	Weed treatment	Spot Spray of thistle and mullein with Stinger (clopyralid).
Jul-2015	Weed treatment	Spot Spray of thistle and mullein with Stinger (clopyralid).
Dec-2015	Planting and seeding	Broadcast seeding of the forb diversity blocks with belly seeders and planted ~110 milk weed into forb diversity block D.
Mar-2016	Site visit	Site assessment with Ryan Sparks, Park Manager and Bob Woodruff to discuss weed treatments and project goals.
Apr-2016	Weed treatment	Contractor crew broadcast spray sandy areas at west end and NE corner with AquaMaster (glyphosate).
Apr-2016	Weed treatment	Spot spray thistles and mullein with AquaMaster (glyphosate) and Stinger (clopyralid) in forb diversity blocks D and western half of forb diversity blocks C and B.
May-2016	Weed treatment	Spot sprayed thistles, tansy ragwort, and velvet grass in forb diversity blocks.
Jul-2016	Weed treatment	Spot sprayed thistles and mullein in forb diversity blocks and prairie.
Aug-2016	Site visit	Site visit to assess haying of field that excluded the four forb diversity blocks, flowering forbs, and weed abundances in the prairie.

Date	Activity	Notes
Mar-2017	Site visit	Met Colby Drake, CTGR Silviculture and Fire Protection Manager, and John Mullen, Park Manager to discuss burn plan for fall 2017 prescribed burn. Also met with Dr. Paige Parry and her ecology class from George Fox to talk about prairie ecology and restoration at Champoeg.
Mar-2017	Weed treatment	Contractor broadcast spray of ~11 acres in west end, central sandy, and northeast corner of meadow with Rodeo (glyphosate). Spot spray of rattail fescue, mullein and Canada and bull thistles outside targeted broadcast spray areas with Rodeo (glyphosate) and Stinger (clopyralid).
Jul-2017	Weed treatment	Spot spray of thistles and mullein with mix of Garlon 3A (triclopyr) and Gly-Star (glyphosate) and thistles with stinger (clopyralid).
Jul-2017	Weed treatment	Spot spray of thistles, tansy ragwort, and Himalayan blackberry with Garlon 3A (triclopyr).
Sep-2017	Prescribed burn	Fire crew from Confederated Tribes of the Grand Ronde (CTGR) Natural Resources Department completed prescribed burn of the 45-acre prairie.
Oct-2017	Site visit	Met with staff from Marion Soil and Water Conservation District (MSWCD) to review grant proposal to plant central sandy area with shrubs and trees.
Oct-2017	Weed treatment	Contractor broadcast spray of west end of prairie with Rodeo (glyphosate), central sandy area with Arsenal (imazapyr), and northern edge with Crossbow (2,4-D + triclopyr) to prep areas for planting and seeding.
Oct-2017	Seeding	Broadcast native forb, sedge and rush seed across 14 acres in meadow with belly seeders (2 days).
Dec-2017	Site visit	Site visit to assess burn, fall treatments, and seeding success.
Feb-2018	Site visit	Met with Nancy Nelson, OPRD Archaeologist, and John Mullen, Park Manager, to discuss State Historical Preservation Office report and future planting areas at Champoeg Prairie.
Mar-2018	Site visit	Met with Dr. Paige Parry's ecology class from George Fox University to talk about prairie ecology and restoration at Champoeg Prairie.
Mar-2018	Meeting	Meeting with Andrea Berkley, OPRD Natural Resource Specialist and John Mullen, Park Manager, to discuss restoration plans at Champoeg and other possible OPRD projects.
Apr-2018	Meeting	Meeting with OPRD and CTGR to begin planning for October 13, 2018 cultural and planting event.

Date	Activity	Notes
Apr-2018	Weed treatment	Broadcast spray of Garlon 3A (triclopyr) by contractor to ~8 acres at west end of prairie.
Apr-2018	Weed treatment	IAE staff directed contract crew to spot spray tansy ragwort, thistles and mullein across ~35 acres starting at the west end of Champoeg Prairie with Milestone (aminopyralid).
May-2018	Weed treatment	IAE staff spot sprayed tansy ragwort and thistles at east end of the prairie with Gly-Star (glyphosate).
May-2018	Weed treatment	IAE staff spot sprayed tansy ragwort and thistles at east end and central area of Champoeg Prairie with Gly-Star (glyphosate).
Jun-2018	Site visit	Site visit with IAE staff to discuss successes and challenges of prairie restoration in Champoeg Prairie.
Jun-2018	Meeting	Meeting with staff from IAE, OPRD and CTGR to discuss fall (October 13, 2018) cultural and planting event and soil sampling.
Jul-2018	Soil sampling	IAE staff collected soil samples from four pits and 6-8" deep. The four samples were mixed for a total of one quart in a Ziploc bag. The soil sample was submitted the same day to Pacific Agricultural Laboratory in Sherwood, OR. Cut tops of tansy ragwort, common mullein, St. Johnswort, and evening primrose and hauled off site.
Sep-2018	Weed treatment and Mowing	IAE staff coordinated a contractor to broadcast spray Plateau (imazapic) to 11 acres at west end of prairie. OPRD staff were mowing from the east end of meadow with a tractor pulling a mower with a six-foot wide deck.
Oct-2018	Presentation	Staff from IAE, OPRD and CTGR Natural Resources Department presented work completed at Champoeg Prairie through partnership between the three organizations to the Legislative Commission on Indian Services (LCIS) at the state capitol building in Salem.
Oct-2018	Cultural event and planting	IAE staff hosted a cultural event with CTGR to kick-off planting in a part of the Champoeg Prairie that will eventually become a harvest area for culturally important plants. In addition to cultural events provided by CTGR, attendees planted camas and yampa provided by CTGR. Many people attended the event and an estimated 40 volunteers assisted with planting during the event.
Oct-2018	Seeding	Broadcast native forbs and grasses to bare ground exposed by the OPRD mower and spot spray treatments to areas totaling about 1 acre across 15 acres at the east end of Champoeg Prairie.
Oct-2018	Planting	Twenty-four volunteers assisted IAE and CTGR staff to plant ~6,000 bareroot plants and bulbs in the Harvest Area at Champoeg Prairie.

Date	Activity	Notes
Nov-2018	Weed treatment	IAE staff broadcast spray 2.8 acres of central sandy area with Rodeo (glyphosate) to prepare the area for shrub and tree planting in January 2019. IAE staff also did a broadcast spray to the ~2-acre central swale with Garlon 3A (triclopyr) to promote sedges and rushes that were seeded in fall 2017 and 2018.

Appendix B. Native plants installed at Champoeg Prairie in 2014 and 2015

Forb diversity block seed mixes and seeding rates (2014-2015)

		Forb Diversity Block (acres) and Seeding Rates (Lbs/acre)							
		A (1.7)		B (1.4)		C (1.9)		D (1.6)	
Scientific Name	Common Name	2014	2015	2014	2015	2014	2015	2014	2015
Achillea millefolium	common yarrow	0.15	n/a	0.14	n/a	0.10	n/a	0.11	n/a
Carex unilateralis	one-sided sedge	n/a	2.99	0.14	2.99	0.10	2.99	0.11	2.99
Clarkia amoena var. *lindleyi*	farewell-to-spring	0.19	0.36	0.41	0.36	0.30	0.36	0.33	0.36
Clarkia purpurea ssp. *quadrivulnera*	winecup clarkia	0.08	n/a	n/a	n/a	n/a	n/a	0.11	n/a
Epilobium densiflorum	denseflower willowherb	n/a	2.80	0.27	2.80	0.20	2.80	0.22	2.80
Eriophyllum lanatum	Oregon sunshine	0.31	4.19	0.54	4.19	0.40	4.19	0.44	4.19
Gilia capitata	globe gilia	n/a	0.48	n/a	0.48	n/a	0.48	n/a	0.48
Grindelia integrifolia	Puget Sound gumweed	n/a	n/a	0.68	n/a	0.50	n/a	0.55	n/a
Juncus effusus	soft rush	n/a	n/a	0.001	n/a	0.001	n/a	0.001	n/a
Juncus tenuis	poverty rush	n/a	0.06	0.01	0.06	0.01	0.06	0.01	0.06
Lomatium nudicaule	barestem biscuitroot	0.76	n/a	1.36	n/a	1.00	n/a	1.09	n/a
Lomatium utriculatum	spring gold	0.11	n/a	0.20	n/a	0.15	n/a	0.16	n/a
Acmispon americanus	American bird's-foot trefoil	0.23	n/a	0.41	n/a	0.30	n/a	0.33	n/a
Lupinus latifolius	broadleaf lupine	n/a	0.72	n/a	0.72	n/a	0.72	n/a	0.72
Lupinus polyphyllus	bigleaf lupine	n/a	n/a	2.04	n/a	1.50	n/a	1.64	n/a
Lupinus rivularis	river lupine	2.29	n/a	2.04	n/a	1.50	n/a	1.64	n/a
Madia elegans	showy tarweed	0.76	n/a	1.36	n/a	1.00	n/a	1.09	n/a

		Forb Diversity Block (acres) and Seeding Rates (Lbs/acre)							
		A (1.7)		B (1.4)		C (1.9)		D (1.6)	
Scientific Name	Common Name	2014	2015	2014	2015	2014	2015	2014	2015
Perideridia oregana	Oregon yampah	n/a	n/a	0.27	n/a	0.20	n/a	0.22	n/a
Plectritis congesta	rosy plectritis	n/a	0.24	n/a	0.24	n/a	0.24	n/a	0.24
Potentilla gracilis	slender cinquefoil	0.38	n/a	0.68	n/a	0.50	n/a	0.55	n/a
Prunella vulgaris var. *lanceolata*	common selfheal	0.38	n/a	0.68	n/a	0.50	n/a	0.55	n/a
Ranunculus occidentalis	western buttercup	n/a	0.24	n/a	0.24	n/a	0.24	n/a	0.24
Ranunculus orthorhynchus	straight beaked buttercup	0.19	n/a	0.34	n/a	0.25	n/a	0.27	n/a
Sidalcea virgata	rose checkermallow	n/a	1.44	n/a	1.44	n/a	1.44	n/a	1.44
Solidago lepida var. *salebrosa*	western goldenrod	0.02	n/a	0.01	n/a	0.01	n/a	0.01	n/a

Native plants planted in the four forb diversity blocks in 2014

Scientific Name	Common Name	Propagule	Forb Diversity Block			
			A	B	C	D
Brodiaea elegans	elegant brodiaea	Bulbs	250	n/a	n/a	250
Camassia leichtlinii	large camas	Bulbs	n/a	3,766	3,766	3,468
Camassia quamash	small camas	Bulbs	n/a	2,568	2,568	2,365
Dichelostemma congestum	forktooth ookow	Bulbs	100	n/a	n/a	n/a
Sidalcea campestris/ virgata mixed	meadow and rose checkermallow	Bareroot	6,000	*2,896*	2,896	2,707
Triteleia hyacinthina	white hyacinth	Bulbs	100	150	150	n/a
Wyethia angustifolia	narrowleaf mule's ears	Plugs	150	175	175	n/a
		Totals:	**6,600**	**9,555**	**9,555**	**8,790**

Appendix C. Native seed mixes sowed at Champoeg Prairie in 2017

Native forb, sedge, and rush species broadcast on ~ 15.3 acres in October 2017

Scientific Name	Common Name	Lbs/acre
Carex unilateralis	one-sided sedge	0.22
Clarkia amoena	farewell to spring	0.10
Clarkia purpurea ssp. *quadrivulnera*	winecup clarkia	0.13
Epilobium densiflorum	denseflower willowherb	0.31
Eriophyllum lanatum	woolly sunflower	0.23
Grindelia integrifolia	Puget Sound gumweed	1.42
Juncus occidentalis	poverty rush	0.004
Madia elegans	showy tarweed	0.15
Madia glomerata	cluster tarweed	0.40
Madia gracilis	grassy tarweed	0.33
Potentilla gracilis	slender cinquefoil	0.25
Prunella vulgaris var. *lanceolata*	common selfheal	0.67
Rumex salicifolius	willow dock	0.001
Sidalcea campestris	meadow checkermallow	0.38
Solidago lepida var. *salebrosa*	western goldenrod	0.03
	Total:	**4.64**

Native sedges and rushes broadcast across 2 acres in the central swale in October 2017

Scientific Name	Common Name	Lbs/acre
Carex densa	dense sedge	0.19
Carex pachystachya	chamisso sedge	0.41
Carex scoparia	pointed-broom sedge	0.28
Carex stipata	saw-beaked sedge	0.69
Carex unilateralis	one-sided sedge	0.45
Eleocharis palustris	creeping spikerush	0.38
Juncus bufonius	toad rush	0.02
Juncus effusus	soft rush	0.02
Juncus occidentalis	poverty rush	0.02
	Total:	**2.31**

Native grasses broadcast on a portion of the western sandy area (5.2 ac) and the northeastern corner of the prairie (0.7 ac) in October 2017

Scientific Name	Common Name	Lbs/acre
Achnatherum lemmonii	Lemmon's needlegrass	2.53
Bromus carinatus (none available)	California brome	-
Danthonia californica	California oatgrass	1.86
Elymus glaucus	blue wildrye	8.39
Festuca roemeri	Roemer's fescue	5.74
	Total:	**18.52**

Appendix D. Native plants installed at Champoeg Prairie in 2018

Native forb and grass seed mix broadcast to bare ground throughout prairie (~1 acre) in October 2018

Scientific Name	Common Name	Lbs/acre
Achillea millefolium	common yarrow	0.09
Camassia leichtlinii var. *suksdorfii*	tall camas	1.83
Carex tumulicola	splitawn sedge	0.00
Collinsia grandiflora	large-flowered blue-eyed Mary	0.45
Collomia grandiflora	large-flowered collomia	1.61
Danthonia californica	California oatgrass	2.89
Eriophyllum lanatum	woolly sunflower	0.11
Festuca roemeri	Roemer's fescue	1.05
Gilia capitata	bluehead gilia	0.19
Perideridia gairdneri	Gairdner's yampa	0.15
Potentilla gracilis	slender cinquefoil	0.14
Prunella vulgaris var. *lanceolata*	common selfheal	0.49
	Total:	**9.31**

Native sedge and rush seed mix broadcast to 2.5 acres in the central swale in October 2018

Scientific Name	Common Name	Lbs/acre
Carex unilateralis	one-sided sedge	0.26
Carex densa	dense sedge	0.07
Juncus effusus	soft rush	0.02
Carex pachystachya	chamisso sedge	0.14
Carex scoparia	pointed-broom sedge	0.15
Carex stipata	saw-beaked sedge	0.17
Carex tumulicola	splitawn sedge	0.81
Carex feta	green-sheath sedge	0.18
Eleocharis ovata	ovoid spikerush	0.13
Juncus occidentalis	poverty rush	0.01
Juncus bufonius	toad rush	0.02
Scirpus microcarpus	small fruited bulrush	0.11
Schoenoplectus tabernaemontani	softstem bulrush	0.44
	Total:	**2.51**

Native grass mix broadcast to ~2 acres at the east end of the prairie October 2018

Scientific Name	Common Name	Lbs/acre
Festuca roemeri	Roemer's fescue	17.18
Hordeum brachyantherum	meadow barley	
Danthonia californica	California oatgrass	
Elymus glaucus	blue wildrye	
Deschampsia cespitosa	tufted hairgrass	

Native bulb and bareroot plants planted in the two-acre Harvest Area in October 2018

Scientific Name	Common Name	**Cultural**	Propagule	Count
Allium amplectens	narrowleaf onion	Food	Bulb	400
Calochortus tolmiei	cats-ear lily	Food	Bulb	600
Camassia leichtlinii	tall camas	Food	Bulb	1,000
Fragaria virginiana	strawberry	Food	Bareroot	1,400
Geranium oreganum	Oregon geranium	n/a	Bareroot	200
Iris tenax	toughleaf iris	Fiber	Bareroot	700
*Juncus effusus**	common rush	Fiber	Bareroot	550
Lomatium nudicaule	barestem biscuitroot	Food	Bareroot	350
Perideridia gairdneri	Gardner's yampah	Food	Bareroot	500
Triteleia hyacinthina	hyacinth brodiaea	Food	Bulb	500
Wyethia angustifolia	mule's ears	n/a	Bareroot	300
**J. effusus was planted in the central swale, just west of the Harvest Area*			**Total:**	**7,100**