

Habitat Restoration and Monitoring of Shaggy Horkelia at Twin Prairie: 2020 Annual Report



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Report prepared by Jessica Celis, Andrew
Esterson and Rebecca Currin

Institute for Applied Ecology



PREFACE

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



Questions regarding this report or IAE should be directed to:

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

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

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Cover photographs: Shaggy Horkelia (*Horkelia congesta* ssp. *congesta*) flower. Photo taken on June 4, 2020 by IAE staff.

SUGGESTED CITATION

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Habitat Restoration and Monitoring of Shaggy Horkelia at Twin Prairie: 2020 Annual Report

1. EXECUTIVE SUMMARY

Twin Prairie is a mid-elevation meadow owned and managed by the Bureau of Land Management, Northwest Oregon District (BLM), and located in southern Lane County, Oregon, south of Cottage Grove. The meadow supports a population of shaggy horkelia (*Horkelia congesta* ssp. *congesta*), a rare species endemic to Oregon. The goals of restoration actions at Twin Prairie are to maintain and improve rare upland prairie habitat in support of the shaggy horkelia population. In 2020, restoration actions consisted of monitoring the shaggy horkelia population, pulling Scotch broom (*Cytisus scoparius*), removing encroaching trees, and establishing experimental plots to determine the efficacy of seeding and planting shaggy horkelia.

During the shaggy horkelia census we observed 1,603 individuals, of which 661 (41%) were seedlings; 71% of the 942 mature plants were reproductive and 29% were vegetative. 1,618 reproductive stems were counted, and of those 25% were browsed. From 2019 to 2020, there was a 9% increase in the total number of plants, reproductive individuals and number of stems. However, the most surprising and encouraging result was the 1,844% increase in seedlings from 2019 (34) to 2020 (661).

2. INTRODUCTION

Twin Prairie is a mid-elevation prairie owned and managed by the Bureau of Land Management, Northwest Oregon District (BLM), and located in southern Lane County, Oregon, south of Cottage Grove (**Error! Reference source not found.**). The prairie supports a population of the Oregon endemic, BLM Sensitive and State of Oregon Candidate (Oregon Department of Agriculture 2017) species shaggy horkelia (*Horkelia congesta* ssp. *congesta*). The Oregon Biodiversity Information Center (ORBIC) designates shaggy horkelia as a “List 1” species that “contains taxa which are endangered or threatened throughout their range or which are presumed extinct” (ORBIC 2016). Management that protects or bolsters shaggy horkelia populations is necessary to prevent the listing of this species under the Federal Endangered Species Act.

The Institute for Applied Ecology (IAE) and the BLM have partnered since 2013 to perform restoration work at Twin Prairie. This report describes restoration activities performed in 2020.

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FIGURE 1. LOCATION OF TWIN PRAIRIE IN THE CONTEXT OF THE GREATER WILLAMETTE VALLEY. MAP INSET SHOWS THE BOUNDARIES OF TWIN PRAIRIE (YELLOW) AND PART OF THE WILLAMETTE VALLEY PRAIRIE OAK AND PINE AREA OF CRITICAL ENVIRONMENTAL CONCERN (ORANGE; ACEC).

3. GOALS AND OBJECTIVES

The goals of habitat restoration at Twin Prairie are to maintain and improve rare upland prairie habitat in support of the shaggy horkelia population that exists at the site. The four primary objectives of this project are to:

1. Decrease the abundance of non-native invasive plant populations;
2. Prevent encroachment of woody species into the prairie;
3. Increase diversity and abundance of the native plant community; and
4. Improve connectivity between meadows at Twin Prairie.

4. 2020 RESTORATION ACTIONS

In 2020, restoration actions consisted of monitoring the shaggy horkelia population, pulling Scotch broom (*Cytisus scoparius*), removing trees around oaks and between the large and small meadows, and establishing three experimental plots to test the efficacy of augmenting shaggy horkelia with seeds and plugs (Table 1 and **Error! Reference source not found.**). See Appendix A for a list of all restoration activities conducted at Twin Prairie from 2013 to 2020.

Table 1. Summary of 2020 restoration actions at Twin Prairie.

Date	Personnel*	Task
4/14/21	IAE	Site visit and felled approximately 12 conifer trees (primarily Douglas-fir (<i>Pseudotsuga menziesii</i>)) less than 20" in diameter from around four Oregon white oaks (<i>Quercus garryana</i>) using chain saws.
6/3/21-6/4/21	IAE	Monitored shaggy horkelia (<i>Horkelia congesta</i> ssp. <i>congesta</i>) population.
7/1/21	IAE	Hand-pulled Scotch broom (<i>Cytisus scoparius</i>) in the western most prairie, cut a corridor between the meadows by removing approximately 15 Douglas-fir between 4 and 8 inches DBH and cut back Himalayan blackberry (<i>Rubus bifrons</i>).
10/20/21	IAE	- Set up three plots to test the efficacy of augmenting shaggy horkelia using seed or plugs. - Approximately one acre of non-native annual grasses and perennial weeds were spot sprayed with a mix of Rodeo (62719-34: 1.25 oz./gallon), Nufilm IR (a surfactant: 0.33 oz./gallon), and blue Hilight dye.
11/3/21	IAE, AmeriCorps	- Handpulled approximately 50 Scotch broom from the Twin Prairie access road using weed wrenches, shovels, and poleasks. - Experimental plots were flame weeded and the west end of each plot was seeded with Willamette Valley origin shaggy horkelia seed (0.75lbs total seeded). BLM fire duty officer, Sean Sheldon authorized the activity.

Date	Personnel*	Task
12/3/21	IAE, AmeriCorps	• Hand-pulled approximately 100 Scotch broom from the Twin Prairie access road using weed wrenches, shovels, and poleaskis • Approximately 25 conifer trees between 1-4 and 11-20 inches DBH were cut around Oregon white oaks. The woody material was piled in the open or hauled and scattered into the adjacent forests. Approximately seven oaks that were being crowded by conifers were released.
12/4/21	IAE, AmeriCorps	• Approximately 40 conifer trees between one and 20 inches DBH were cut from around Oregon white oaks and along the forest/meadow edge. The woody material was piled in the open or hauled and scattered into the adjacent forests. Approximately seven oaks that were being crowded by conifers were released.

*Institute for Applied Ecology (IAE); 10 person AmeriCorps Blue 4 Team (AmeriCorps)

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5. SHAGGY HORKELIA MONITORING

5.1. Background and methods

Shaggy horkelia monitoring began in 2013. Geographically unique clusters of shaggy horkelia were designated as “patches” and mapped (**Error! Reference source not found.**). Since then, patches have either been added or consolidated as new patches were found or as patches grew together and became indistinguishable from one another. Initially, every reproductive stem in each patch was counted. Since 2014, additional data has been collected, including the total number of individuals, reproductive status (vegetative or flowering) and the number of browsed stems. Beginning in 2016, mature individuals were distinguished from seedlings to document evidence of reproduction. A description of the monitoring protocol can be found in Appendix B.

5.2. Results

In 2020, 22 patches of shaggy horkelia were monitored and 1603 shaggy horkelia individuals were recorded; of those, 41% were flowering, 17% were vegetative (but not seedlings) and 41% were seedlings (total does not equal 100% due to rounding). 1,618 reproductive stems were counted and of those 25% of were browsed. Between 2019 and 2020, there was a 9% increase in the total number of plants, reproductive individuals and number of stems. However, the most surprising and encouraging result was the 661 seedlings recorded. The highest previous seedling count was in 2016 with 128 seedlings (**Error! Reference source not found.**,

Table 2, and Table 3).

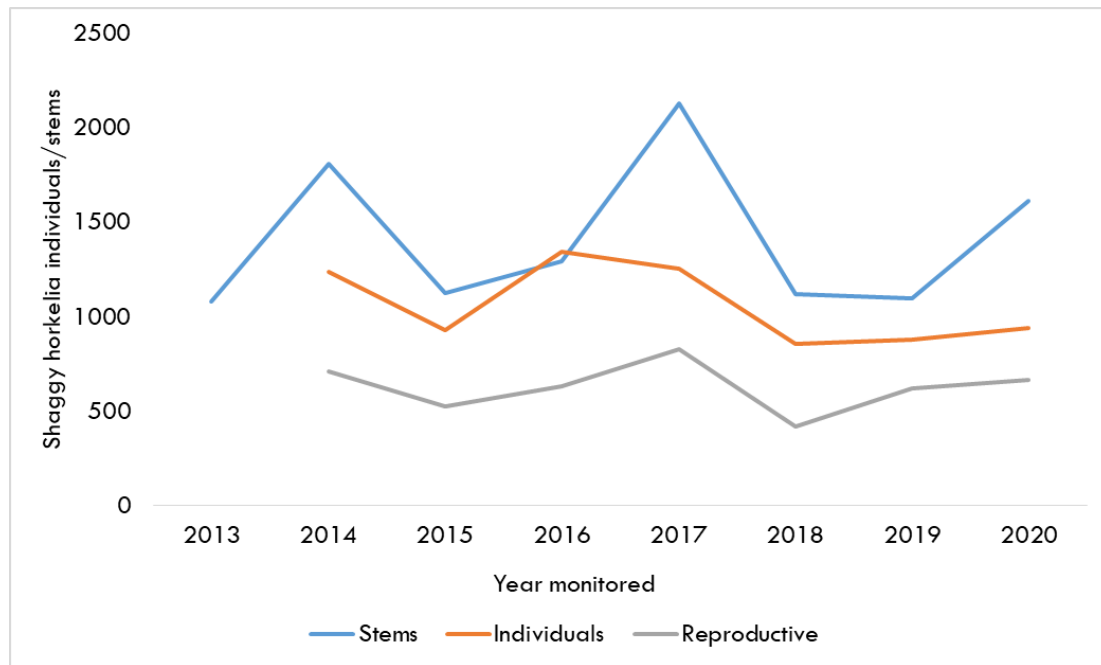


FIGURE 3. SHAGGY HORKELIA (*HORKELIA CONGESTA* SSP. *CONGESTA*) POPULATION TRENDS FROM 2013 – 2020. DATA SHOW TOTAL NUMBER OF STEMS (BROWSED AND UNBROWSED), INDIVIDUALS (VEGETATIVE AND REPRODUCTIVE, DOES NOT INCLUDE SEEDLINGS) AND REPRODUCTIVE INDIVIDUALS. IN 2013, NUMBER OF STEMS WAS THE ONLY DATA COLLECTED.

TABLE 2. RESULTS OF THE SHAGGY HORKELIA (*HORKELIA CONGESTA* SSP. *CONGESTA*) MONITORING OF TOTAL POPULATION SIZE AND TOTAL NUMBER OF REPRODUCTIVE INDIVIDUALS FROM 2014 TO 2020. COUNTS FROM 2016 TO 2020 INCLUDING SEEDLINGS.

Patch	Total # non-seedling individuals (# seedlings)							# reproductive individuals						
	2014	2015	2016	2017	2018	2019	2020	2014	2015	2016	2017	2018	2019	2020
1	12	11	17 (0)	20 (0)	0	0	0	12	9	5	15	0	0	0
2	7	5	1 (0)	9 (4)	8	15	22 (1)	7	5	1	5	8	13	19
3,4,5*	407	406	503 (0)	700 (124)	484 (45)	528 (27)	588 (60)	235	216	263	408	188	358	416
6	20	16	18 (0)	23 (0)	0	0	0	10	9	13	16	0	0	0
7	62	35	42 (0)	46 (0)	41 (15)	39 (0)	26 (0)	50	30	30	33	19	20	19
7a	1	0	0	0	0	0	1 (1)	1	0	0		0	0	1
8	68	12	58 (0)	52 (0)	68 (14)	39 (0)	30 (3)	35	12	37	41	31	35	29
8a	0	1		2 (0)	0	1 (0)	0	0	1	0	2	0	1	0
9	3	1	1 (0)	2 (0)	0	0	3 (0)	3	1	1	2	0	0	3
10	1	0		20 (0)	0	0	0	1	0	0	0	0	0	0
10a	0	1	1 (0)	1 (0)	0	0	0	0	1	1	1	0	0	0
11	5	9	11 (0)	7 (0)	8 (0)	6 (0)	3 (0)	4	8	6	6	6	6	3
12	104	67	117 (5)	50 (0)	27 (0)	42 (1)	21 (153)	64	37	56	39	22	34	18
12a	0	2	2 (0)	1 (0)	1 (0)	4 (0)	4 (39)	0	2	2	1	1	4	2
12b	0	0	0	0	3 (0)	0	1 (10)					3	0	1
13	3	6	7 (0)	2 (0)	0	2 (0)	0	3	5	5	1	0	1	0
14	1	1	2 (0)	8 (0)	2 (0)	0	0	1	1	2	6	1	0	0
15	92	80	99 (0)	84 (0)	48 (1)	40 (0)	62 (76)	45	37	43	58	38	34	44
16	355	216	303 (81)	211 (0)	122 (12)	111 (3)	130 (131)	184	116	125	159	78	82	74
17	2	2	0	0	0	0	0	2	2	0	0	0	0	0
18	76	44	104 (60)	31 (0)	31 (7)	31 (0)	26 (79)	46	24	36	27	18	25	18
19	15	14	59 (50)	8 (0)	17 (1)	20 (3)	25 (109)	10	11	7	8	7	8	18
Total	1242	929	1345 (196)	1257 (128)	860 (95)	883 (34)	942 (661)	713	527	633	828	420	621	665

* Initially, patches 3, 4 and 5 were distinct, but over time they have expanded and merged, and are now counted as one patch.

TABLE 3. RESULTS OF SHAGGY HORKELIA (*HORKELIA CONGESTA* SSP. *CONGESTA*) STEM COUNTS FROM 2013 TO 2020.

Patch	# reproductive stems (#browsed stems)							
	2013	2014	2015	2016	2017	2018	2019	2020
1	12	12 (24)	27	6	56	0	0	0
2	13	10 (6)	8 (3)	1 (1)	14	21	45 (3)	37 (25)
3,4,5*	489	212 (315)	325 (168)	88 (409)	423 (634)	417 (158)	530 (288)	733 (178)
6	27	5 (25)	20	11 (17)	41	0	0	0
7	77	51 (63)	51 (11)	30 (38)	84 (7)	39	38	37 (3)
7a	0	2	0	0	0	0	0	0
8	61	39 (54)	24	44 (39)	99 (23)	62 (18)	55 (29)	69 (46)
8a	0	0	2	0	3	0	2 (1)	0
9	3	3 (1)	2	2	5	0	0	6 (6)
10	9	6	0	0	0	0	0	0
10a	0	0	1	1	1 (1)	0	0	0
11	2	8	6 (16)	1 (9)	6 (15)	17 (16)	10 (3)	7 (0)
12	17	113 (79)	54 (23)	33 (86)	80 (23)	38(5)	93	57 (5)
12a	0	0	5	6 (2)	1	5	16	5 (0)
12b	0	0	0	0	0	9(1)	0	6 (0)
13	19	2 (12)	11	2 (9)	1	0	2	0
14	6	3 (4)	1 (2)	3	14	11	0	0
15	4	43 (56)	43 (27)	42 (38)	83	59	50	80 (5)
16	229	205 (287)	111 (98)	83 (185)	239(136)	167 (9)	149 (37)	118 (93)
17	4	2	2	0	0	0	0	0
18	102	66 (68)	48 (4)	10 (85)	57(35)	40 (6)	76	29 (14)
19	7	8 (29)	35	3 (17)	15(14)	18 (5)	33	23 (36)
Unbrowsed (browsed)	N/A	790 (1023)	776 (352)	359 (935)	1222 (907)	903 (218)	1098 (362)	1,207 (411)
TOTAL Combined	1081	1813	1128	1294	2129	1121	1460	1618
Percent browsed	N/A	56%	31%	72%	42%	19%	25%	25%

* Initially, patches 3, 4 and 5 were distinct, but over time they have expanded and merged, and are now counted as one patch.

6. DISCUSSION

6.1. Habitat management

A variety of trees, including Douglas-fir, Pacific madrone (*Arbutus menziesii*), bigleaf maple (*Acer macrophyllum*) and Oregon ash (*Fraxinus latifolia*), along with shrubs such as Himalayan blackberry (*Rubus bifrons*) and Scotch broom, are the primary woody species establishing in the prairie. Limbing and/or removal of the species that encroach into shaggy horkelia habitat is a priority for restoration. In 2020, with the help of an AmeriCorps team of volunteers, we were able to remove approximately 92 conifer

trees and countless saplings from around Oregon white oaks. Additionally, Scotch broom was removed from the east prairie and along the access road, expanding rare upland prairie habitat and decreasing the ability of the Scotch broom to re-establish via the population along the road. The Scotch broom population in the east prairie has been pulled for many years and has declined as a result – currently there are only a small number of young plants. Once the Scotch broom is under control, efforts to remove Himalayan blackberry should be prioritized.

Herbicides should be used to control non-native shrubs when appropriate. All applications will be pre-approved by BLM staff and follow BLM herbicide protocols. Priority species for herbicide application includes Scotch broom and Himalayan blackberry.

6.2. Shaggy horkelia monitoring

In 2020, the shaggy horkelia population had positive trends in total number of plants, number of reproductive individuals and number of seedlings. It is unclear what factors contribute to the positive trends, but it is likely a combination of management practices and a maturing shaggy horkelia population. IAE has limbed and/or felled conifers and removed shrubs around some shaggy horkelia patches, providing increased light and less competition for below-ground resources. As the population matures and has access to more resources, increased seed production is possible, leading to more seedlings in subsequent years. For example, there was 201 more reproductive plants in 2019 than 2018, and in 2020, there was an 1,844% increase in seedlings from 2019 (34) to 2020 (661).

Shaggy horkelia has been monitored annually since 2013; however, it may be worth altering the monitoring cycle to once every two years. This would allow more resources to be available for implementing restoration treatments in non-monitoring years. We recommend monitoring in 2021 so survivorship of 2020 seedlings can be quantified to determine the impact on the population and then consider not monitoring in 2022 and resuming the monitoring in 2023.

6.3. Shaggy horkelia augmentation

Previous augmentation efforts of shaggy horkelia in 2015 were unsuccessful. Discussion from the 2016 annual report suggested this could have been due to low vigor of outplanted plugs or a lack of moss cover at planting sites (Schultz 2016). Therefore, three experimental plots were established to test the efficacy of planting plugs versus sowing seeds (**Error! Reference source not found.**). Plugs are expensive and can be cost-prohibitive for large scale augmentation, whereas seed is relatively cheap and can be broadcast throughout the site. In addition, given the rocky substrate at Twin Prairie, planting plugs may not be a viable solution for augmentation efforts. If direct seeding proves to be an effective method for augmenting shaggy horkelia populations, this may well be a cost-effective alternative to plug growout and outplanting. However, some species do not establish well from seed, and shaggy Horkelia seed is a limited resource, so gathering more data on the efficacy of direct seeding is recommended.

EXPERIMENTAL PLOTS ARE 10M X 5M AND ARE REFERENCED AS EAST, CENTRAL AND WEST PLOTS, BASED ON THEIR GEOGRAPHIC LOCATION ACROSS THE MEADOW. PLOTS ARE DIVIDED INTO TWO SUBPLOTS, WEST SUBPLOT AND EAST SUBPLOT, AND WILL BE USED TO TEST TWO TREATMENTS: SEEDING AND PLANTING SHAGGY HORKELIA PLUGS. EACH PLOT HAS CONCRETE MONUMENTS ON THE CORNERS WITH REFERENCE TAG NUMBERS ON THE NE AND NW CORNERS (

Table 4).

TABLE 4. TAG NUMBERS FOR SHAGGY HORKELIA (*HORKELIA CONGESTA* SSP. *CONGESTA*) EXPERIMENTAL PLOTS.

Plot Location	NE Label	NW Label
East	278	279
Central	284	291
West	289	288

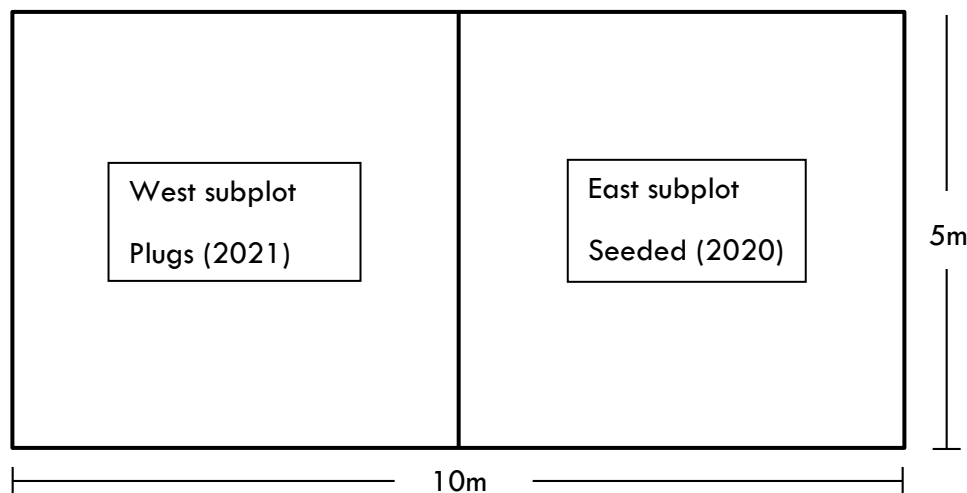


FIGURE 4. DIAGRAM OF SHAGGY HORKELIA (*HORKELIA CONGESTA* SSP. *CONGESTA*) SEED VERSUS PLUG EXPERIMENTAL PLOT.

To prepare the plots for seeding shaggy horkelia in 2020, a glyphosate spot treatment was applied to non-native species in the east plot. The central and west plots had relatively low non-native species cover and high native species cover so they were left unsprayed. Each plot was flame weeded and each east subplot was subsequently seeded using approximately 0.25 lbs. of shaggy horkelia seed (G1 seed sourced from West Eugene Wetlands populations). Plugs will be planted in the fall of 2021.

6.4. Plant materials

Using shaggy horkelia seed collected from sites other than Twin Prairie for augmentation at Twin Prairie will increase genetic diversity of the shaggy horkelia population at this site, which may contribute to its long-term viability. Ideally, if using source seed from sites other than Twin Prairie, we recommend

collecting from sites with similar thin-soiled, mid-elevation habitat. Population information collected by Kaye and Gisler in 1993 reported 20 known populations of shaggy horkelia within the Willamette Valley, Oregon. Permission should be sought to collect seed from public and private mid-elevation sites. However, if mid-elevation seed is not available, we still recommend broadening the Twin Prairie shaggy horkelia population's genetic diversity with seed from the Willamette Valley floor.

In previous years, after non-native species removal, a native seed mix was broadcast in disturbed areas. The mix consisted of Roemer's fescue (*Festuca roemerii*), Oregon sunshine (*Eriophyllum lanatum*) and California oatgrass (*Danthonia californica*). This seed was produced in partnership with the BLM and The Nature Conservancy and was provided for restoration use at no cost to the project; however, the last of this seed was broadcast in 2019. Therefore, we recommend wild-collecting native species to use for restoration at Twin Prairie and other mid-elevation meadows. Specific species to target include, but are not limited to, blue wildrye (*Elymus glaucus*), California oatgrass, California fescue (*Festuca californica*), Roemer's fescue, junegrass (*Koeleria macrantha*), and Oregon sunshine. Collected seed will be used in disturbed areas following conifer removal.

7. MANAGEMENT RECOMMENDATIONS

- **Monitor shaggy horkelia:** Monitor the extant patches of shaggy horkelia in 2021 to understand whether the seedling flush seen in 2020 results in an increase in the population. Consider a change in the monitoring cycle of shaggy horkelia from annually to biennially with the next monitoring cycle being in 2023. Monitoring in 2021 should include a census of shaggy horkelia establishment within the seed versus plug experimental plots established in 2020.
- **Shaggy horkelia augmentation experimentation:** In the fall of 2021, plant shaggy horkelia plugs into the west subplot in each of the seed versus plug experimental plots. If plots are infested with non-native species or thatch, consider treating or clearing prior to plug planting.
- **Wild-collect shaggy horkelia seed:** To increase the size and genetic diversity of the shaggy horkelia population at Twin Prairie, seed should be collected from this and other mid-elevation wild populations.
- **Remove encroaching vegetation:** Tree clearing should continue along prairie edges, especially near shaggy horkelia patches and surrounding Oregon white oaks.
- **Manage non-native shrubs:** Remove Scotch broom and Himalayan blackberry. Spot spray regrowth with herbicide following manual removal.
- **Locate and remove non-native grass and forb species:** Surveys should be conducted in spring to determine where large patches of non-native herbaceous species occur. The most aggressive species should be targeted for spot spraying with herbicide using a backpack sprayer.
- **Collect mid-elevation native seed:** Native seed (see Plant Materials, Section 6.4) should be collected from Twin Prairie and other mid-elevation sites and stored until used for future direct seeding (especially in areas where woody material has been removed), plug production and/or seed amplification.

8. REFERENCES

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APPENDICES

Appendix A. Restoration actions at Twin Prairie (2013-2020)

2013

- Seeds of Success collection (common yarrow (*Achillea millefolium*), winecup (*Clarkia purpurea*), American wild carrot (*Daucus pusilis*), Roemer's fescue (*Festuca roemerii*), prairie Junegrass (*Koeleria macrantha*), nineleaf biscuitroot (*Lomatium triternatum*), common madia (*Madia elegans*), grassy tarweed (*Madia gracilis*), woodland madia (*Madia madioides*), and short spurred seablush (*Plectritis congesta*))
- Shaggy horkelia, Himalayan blackberry and Scotch broom populations were mapped
- ~1.17 acres of Himalayan blackberry was removed
- ~0.4 acres of Scotch broom was removed
- Shaggy horkelia was monitored (only stems counted)

2014

- Shaggy horkelia, Himalayan blackberry and Scotch broom populations were mapped
- ~1.2 acres of Himalayan blackberry were removed
- ~0.5 acres of Scotch broom was removed
- A native seed mix was broadcast over disturbed areas (common selfheal (*Prunella vulgaris*), blue wildrye (*Elymus glaucus*), Roemer's fescue and California oatgrass (*Danthonia californica*))
- Shaggy horkelia was monitored (vegetative and reproductive individuals, browsed and unbrowsed stems)

2015

- Scotch broom was removed
- Shrubs and trees around shaggy horkelia populations were limbed or felled
- Large trees near shaggy horkelia plots were girdled
- Shaggy horkelia was monitored (vegetative and reproductive individuals, browsed and unbrowsed stems)
- 220 shaggy horkelia plugs were planted in two locations (110 plugs in each)

2016

- Shaggy horkelia population was mapped
- Himalayan blackberry and Scotch broom was removed
- Shrubs and trees around shaggy horkelia populations were limbed or felled
- Large trees near shaggy horkelia plots were girdled
- Shaggy horkelia was monitored (vegetative and reproductive individuals, browsed and unbrowsed stems)

- Augmented shaggy horkelia population was monitored
- A native seed mix was broadcast over disturbed areas (blue wildrye, Roemer's fescue, common woolly sunflower, and California oatgrass)

2017

- Scotch broom was removed
- Shaggy horkelia was monitored (vegetative and reproductive individuals, browsed and unbrowsed stems)
- Shrubs and trees around shaggy horkelia populations were limbed or felled
- Management plan was reviewed by IAE staff

2018

- Scotch broom was removed
- Shaggy horkelia was monitored (vegetative and reproductive individuals, browsed and unbrowsed stems)

2019

- Scotch broom was removed
- Shaggy horkelia was monitored (vegetative and reproductive individuals, browsed and unbrowsed stems)
- Approximately 12, 14–18-inch DBH Douglas-fir (*Pseudotsuga menziesii*) trees were cut from the northern edge of the large meadow and countless saplings were cut from along the north and west edges of the meadow.

2020

- Felled numerous Douglas-fir to release Oregon white oaks
- Monitored shaggy horkelia
- Hand pulled Scotch broom in western meadow
- Set up three experimental plots to determine efficacy of seeding and planting shaggy horkelia plugs
- Applied glyphosate to approximately one acre of non-native grasses
- Flame weeded experimental plots
- Seeded west subplots with shaggy horkelia

Appendix B. Shaggy horkelia monitoring protocol

1. Designate field crew members as either plant counter (counter) or data recorder (recorder).
Generally, there are multiple counters and only one recorder.
2. Divide each shaggy horkelia patch into sections using transect tapes.
3. Count all individual shaggy horkelia encountered within each patch.
 - a. Individual plants are defined as basal rosettes not obviously connected to a single crown, usually a minimum of 1-2 inches apart (Alverson 2013).
 - b. In 2020, the monitoring crew defined a seedling as any plant less two inches in diameter; however, the crew encountered many plants that were much smaller than this (**Error! Reference source not found.**).
 - c. When a counter sees a shaggy horkelia plant they will shout whether the plant is a seedling, vegetative or reproductive. If the plant is a seedling or vegetative then no other information is needed. For example, “I have three vegetative.” The recorder will then write three tally marks under the column “vegetative” in the row indicating the patch number. However, if the counter sees a plant with any number of stems, even if browsed, they will tell the recorder that they have a “reproductive” and provide the number of browsed and unbrowsed stems present on that individual. For example, “one reproductive, four unbrowsed and three browsed stems.” The recorder will then add one tally mark to the column “flowering,” four tallies to the column “unbrowsed,” and three tallies to the column “browsed.”



FIGURE 5. SIZE OF MOST SEEDLINGS FOUND DURING 2020 MONITORING OF SHAGGY HORKELIA (*HORKELIA CONGESTA* SSP. *CONGESTA*). PHOTO TAKEN BY JESSICA CELIS ON JUNE 4, 2020.