

Twin Prairie restoration: 2022 annual report



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PREFACE

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



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Cover photographs: Looking west at Twin Prairie Unit 2 corridor creation area from Unit 3, October 24th, 2022. Photo by Rolando Beorchia.

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Twin Prairie restoration: 2022 annual report

EXECUTIVE SUMMARY

The Institute for Applied Ecology (IAE) has partnered with the Bureau of Land Management (BLM) Upper Willamette Field Office, Northwest Oregon District, to restore Twin Prairie since 2013. In 2022, restoration activities focused on removing Douglas-fir (*Pseudotsuga menziesii*) to increase meadow connectivity, seeding native plants to increase community diversity and abundance, and monitoring both the remnant shaggy horkelia (*Horkelia congesta* spp. *congesta*) population and the experimental plots testing efficacy of seeding and planting Willamette Valley and mid-elevation seed sources.

During the shaggy horkelia census we counted 847 individuals, of those 53% were flowering and 47% were vegetative; 29 seedlings were also counted. 1,050 reproductive stems were counted, and of those 21% were browsed. In the experimental plots with Willamette Valley seed 0, 2, and 25 plants were observed in the West, Central and East plots, respectively. In the Willamette Valley plug plots 122, 124 and 135 plants were observed in the West, Central and East plots, respectively. In the mid-elevation seed plots 115, 90 and 84 plants were observed in the West, Central and East plots, respectively.

1. INTRODUCTION

Twin Prairie is a mid-elevation (1600-1800ft) 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 (Figure 1). The meadow 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 2016) 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 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 2022.

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Figure 1. Twin Prairie ACEC boundary, management units, and location within the Willamette Valley.

2. GOALS AND OBJECTIVES

The purpose of this project is to assist the BLM with maintaining and improving regionally rare mid-elevation prairie habitat in support of the native plant community and shaggy horkelia population at Twin Prairie.

There are five primary objectives of this project:

1. Decrease the abundance of non-native invasive plant populations
2. Reduce encroachment of woody species into the prairie
3. Release Oregon white oaks from conifer encroachment
4. Increase diversity and abundance of the native plant community
5. Improve meadow connectivity

3. 2022 RESTORATION ACTIONS

In 2022, restoration actions consisted of removing conifers, broadcasting native seed and monitoring shaggy horkelia (see section 4 for monitoring results). Restoration actions were completed by IAE and BLM staff, and the Northwest Youth Corps (NYC).

Conifer removal

Conifers were removed to increase meadow connectivity, release Oregon white oak, and create future shaggy horkelia habitat. Douglas-fir were removed in unit 3 from the meadows northern edge to reduce shading shaggy horkelia. Limbs and logs were scattered in the forest to the north of unit 3. Douglas-fir were removed in units 1 and 2 for Oregon white oak release and the creation of two corridors for future shaggy horkelia habitat. Logs were moved into long piles and

covered with limbs to allow for long term natural decay, provide wildlife habitat, and minimize meadow surface area coverage. Additionally, conifers were removed from within the meadow to reduce future encroachment and material was scattered in the nearest forest edge. Ground that was disturbed from tree removal actions was seeded with a native seed mix (see Seeding section).

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Figure 2. Tree removal plans for the week of October 24, 2023 (top image) and Institute for Applied Ecology staff orienting the Northwest Youth Corps to Twin Prairie (lower photo).

Seeding

A native seed mix was broadcast within units 1, 2, and 3 to areas disturbed from tree removal. Units 1, 2, and 3 each received seed to promote prairie habitat (Table 1). Seed was sourced from mid-elevation locations and was hand broadcast to disturbed ground and to existing meadow habitat on October 27th (Table 2).

Table 1. 2022 Twin Prairie native seed mix

Scientific Name	Common Name	Total Seed (lbs)
<i>Achnatherum lemmonii</i> ssp. <i>lemmonii</i>	Lemmon's needlegrass	0.117
<i>Cirsium remotifolium</i>	Few-leaf thistle	0.02
<i>Clarkia amoena</i> ssp. <i>lindleyi</i>	farewell-to-spring	0.007
<i>Clarkia purpurea</i>	winecup clarkia	0.12
<i>Danthonia californica</i>	California oatgrass	2.0
<i>Eriophyllum lanatum</i>	woolly sunflower	2.016
<i>Festuca californica</i>	California fescue	0.68
<i>Festuca roemerii</i>	Roemer's fescue	1.8
<i>Koeleria macrantha</i>	prairie June grass	1.107
<i>Lomatium dissectum</i>	fernleaf biscuitroot	0.025
<i>Lomatium utriculatum</i>	spring gold	0.086
<i>Madia gracilis</i>	grassy tarweed	0.096
<i>Microsteris gracilis</i>	slender phlox	0.05
<i>Microseris laciniata</i>	cutleaf silver puffs	0.043
<i>Penstemon cardwellii</i>	Cardwell's penstemon	0.05
<i>Perideridia oregana</i>	Oregon yampah	0.158
<i>Potentilla gracilis</i>	slender cinquefoil	0.031
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	common selfheal	0.016
<i>Sidalcea malviflora</i> ssp. <i>virgata</i>	dwarf checkermallow	0.075
<i>Wyethia angustifolia</i>	mule ears	2.125
<i>Zigadenus venenosus</i>	mountain death camas	0.018
Totals (lbs):		10.64

Table 2. 2022 management actions at Twin Prairie

Date	Personnel*	Activity
21-25 Mar	IAE, BLM, NYC	NYC removed trees in unit 2 to create a corridor between units 1 and 3. IAE and BLM staff alternated days on site.
7-Jun	IAE, BLM	Monitored shaggy horkelia (<i>Horkelia congesta</i> ssp. <i>congesta</i>).
1-Sep	IAE	Evaluated spring tree removal and planned fall tree removal actions.
24-27 Oct	IAE, BLM, NYC	NYC removed trees in unit 2 to create a corridor between units 1 and 3. IAE and BLM staff alternated days on site. Broadcast native seed in units 1, 2, and 3.

*Institute for Applied Ecology (IAE), Bureau of Land Management (BLM), Northwest Youth Corps (NYC)

4. SHAGGY HORKELIA (*HORKELIA CONGESTA* SSP. *CONGESTA*) MONITORING.

Remnant population

In June 2022, the naturally occurring shaggy horkelia population and the experimental augmentation plots were monitored (Figure 3). For the naturally occurring population, we counted 847 individuals, and of those 53% were flowering and 47% were vegetative; 29 seedlings were also counted. 1,050 reproductive stems were counted, and of those 21% were browsed. Monitoring protocols are available in Appendix B and census data is available in Appendix D. 2022 was the lowest count of individuals at Twin Prairie to date and marks a 6% decrease from 2021 (957) and is 10% lower than the ten-year average (1029) (Figure 4).



Figure 3. Shaggy horkelia (*Horkelia congesta* spp. *congesta*) (left) monitoring on June 07, 2022 with Bureau of Land Management Botanists Ian Grinter and Jessica Celis at patch J (right).

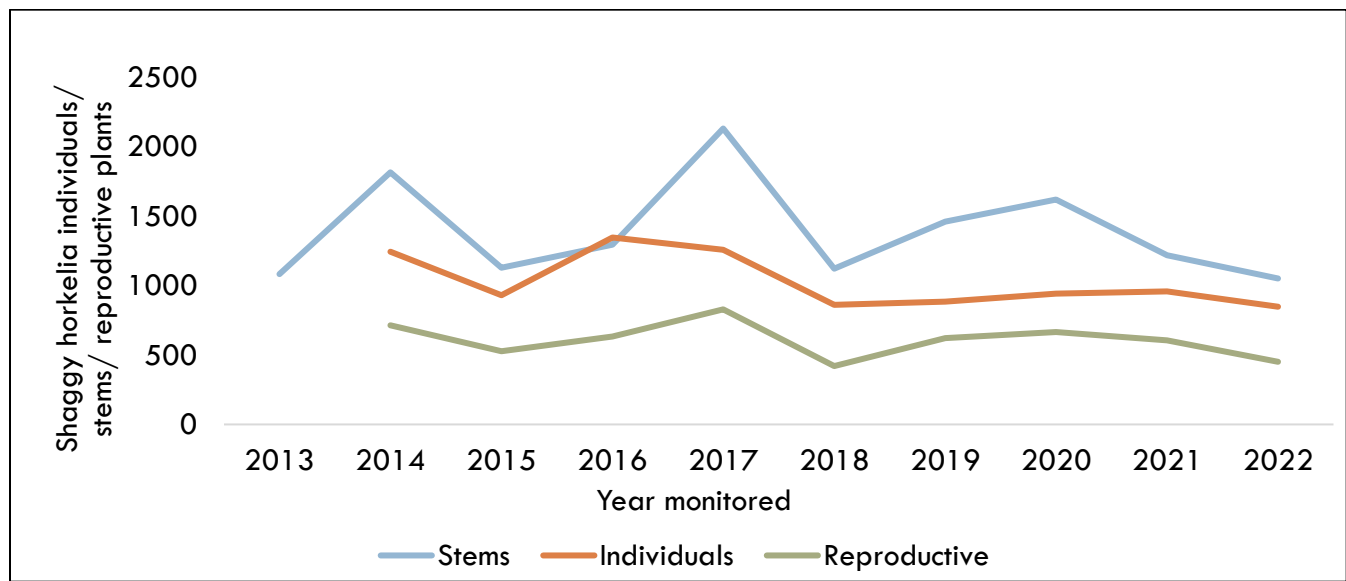


Figure 4. Shaggy horkelia (*Horkelia congesta* spp. *congesta*) individuals, stems and reproductive plants (2013-2022)

The shaggy horkelia population was first mapped in 2013 by BLM staff. In the original map individual patches were labeled by number. Over the past ten years new patches have been created as offshoots of the original patch (e.g., 7 and 7a), and at other times patches were merged due to low numbers and ease of monitoring. In 2022, multiple patches were combined and the need to revise the overall number system became necessary. To avoid confusion with the previous labeling system, the patch numbers have been replaced by letters A through J (Table 3, Figure 4). Data tables will continue to retain notes with the original numbering system and year of mergers for land manager references (Appendix D). Monitoring in 2023 will include patch boundary mapping and an updated population map should be available in the 2023 annual report.

Table 3. Shaggy horkelia (*Horkelia congesta* spp. *congesta*) patch mergers

Patch	Merger Notes
A	Patches 1 and 2 combined 2022.
B	Patches 3, 4, 5 combined 2015; plot 6 combined 2022.
C	Patches 7 and 7a combined 2021.
D	Patches 8 and 8a combined 2021
E	Patches 9, 10, 10a, and 11 combined 2022.
F	Patches 12, 12a, 12b combined 2022
G	Patches 13, 14, and 15 combined 2022.
H	Patch 16
I	Patch 18
J	Patches 17 and 19 combined 2022.

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Figure 5. Twin Prairie shaggy horkelia (*Horkelia congesta* spp. *congesta*) patches with old labeling system (numbers) and new labeling system (letters).

Seed source survivorship experiment

As described in the 2020 annual report (Celis et al. 2021), three experimental plots were established at Twin Prairie to test the efficacy of planting shaggy horkelia plugs versus sowing seeds and to determine if seed origin (Willamette Valley and mid elevation meadow) effects survival (Celis et al. 2021).

Experimental plots are referenced as east, central and west, based on their geographic location across the meadow. Each plot has concrete monuments on the corners with reference tag numbers on the NE and

NW corners (Appendix C). Plots are divided into subplots based on the seed source, Willamette Valley (WV) or mid-elevation (ME), and also the plant material type used (seed or plugs). Subplot names have been updated from the original naming system (Celis et al. 2021) in the following ways: west subplot and east subplot have now become WV plugs and WV seed, respectively. In 2020, the WV seed subplots were each seeded with 113.4g or about 110,111 seeds (971 seeds/gram). In 2021, the WV plugs subplots were each planted with 212 plugs and the ME seed subplots were each seeded with 8.65g or about 8,399 seeds (971 seeds/gram). Steep, rocky terrain at the east plot made establishment of the ME seed subplot difficult so the ME seed subplot was setup below the WV plugs subplot.

To prepare subplots for seeding, each ME seed subplot was thermally treated before hand-dispersed seeding of shaggy horkelia. An additional round of subplots will be added in fall 2023 (ME plugs) and will be planted with approximately 200 shaggy horkelia plugs using the same wild collected mid-elevation seed. Thin, rocky soils made planting 5.5 inch plugs challenging. Numerous times we were not able to dig holes deep enough for the plugs. As an alternative approach in 2023, we will grow shorter plugs that require shallower holes for planting.

In 2022, the experimental plots were monitored. The three subplots with WV seed had a total of 27 plants, the three WV plug subplots had a total of 381 plants with a first-year survivorship of 75%, and the ME seed subplots had a total of 289 plants. Data for this experiment can be found in Appendix D.

5. MANAGEMENT RECOMMENDATIONS

The overarching goal of this project is to maintain and improve regionally rare mid-elevation prairie habitat and shaggy horkelia at Twin Prairie. Moving forward, we suggest evaluating the desired target level for habitat recovery and establishing metrics for achieving these targets.

The following goals are suggested:

1. Eradicate low abundance invasive plants from within the ACEC: Scotch broom and false brome
2. Reduce high abundance invasive grasses in open prairie by implementing regular hand pulling and herbicide applications
3. Release Oregon white oaks from conifer encroachment
4. Increase meadow native plant abundance and diversity by augmenting species occurring in low abundance and introducing native mid-elevation species observed at reference meadows
5. Create one contiguous meadow by removing conifers to form corridors
6. Increase shaggy horkelia population through augmentation

With these goals in mind, we recommend the following management actions:

- Pull and/or apply herbicide to treat false brome and Himalayan blackberry along ACEC access road and Scotch broom within unit 5
- Hand pull or apply herbicide to treat non-native grasses (sponge dauber or spot spray)
- Buck and pile logs for natural decay within the unit 2 corridor
- Remove live conifers in units 4 and 5 to creating meadow continuity, leaving snags for wildlife.
- Monitor shaggy horkelia when in flower, likely between June 5th and 20th
 - Map population edges and plot polygons for future monitoring
- Seed native species in disturbed areas

To make lasting change to the abundance of shaggy horkelia at Twin Prairie, augmentation will be necessary for successful recovery. Results from the ongoing shaggy horkelia introduction experiment should be used to inform upcoming decisions. Augmentation efforts should begin using the most successful strategies identified from the experiment.

6. REFERENCES

Celis, J., A. Esterson, and R. Currin. 2021. Habitat restoration and monitoring of shaggy horkelia at Twin Prairie: 2020 annual report. Unpublished report prepared for the Bureau of Land Management, Northwest Oregon District. Institute for Applied Ecology, Corvallis, Oregon.

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APPENDIX A. COMPLETED AND PROPOSED MANAGEMENT ACTIONS: 2013-2025

2013

- Seeds of Success collection: common yarrow (*Achillea millefolium*), winecup (*Clarkia purpurea*), American wild carrot (*Daucus pusilis*), Roemer's fescue (*Festuca roemerii*), prairie June grass (*Koeleria macrantha*), nineleaf biscuitroot (*Lomatium triternatum*), showy tarweed (*Madia elegans*), grassy tarweed (*Madia gracilis*), woodland tarweed (*Madia madioides*), and short spurred seablush (*Plectritis congesta*).
- Mapped shaggy horkelia (*Horkelia congesta*), Himalayan blackberry (*Rubus bifrons*) and Scotch broom (*Cytisus scoparius*).
- Removed ~1.17 acres of Himalayan blackberry and ~0.4 acres of Scotch broom
- Monitored shaggy horkelia (only stems counted).

2014

- Mapped shaggy horkelia, Himalayan blackberry and Scotch broom populations.
- Removed ~1.2 acres of Himalayan blackberry, and ~0.5 acres of Scotch broom.
- Broadcast native seed mix on disturbed areas: common selfheal (*Prunella vulgaris*), blue wildrye (*Elymus glaucus*), Roemer's fescue and California oatgrass (*Danthonia californica*).
- Monitored shaggy horkelia (vegetative and reproductive individuals, browsed and unbrowsed stems).

2015

- Removed Scotch broom
- Limbed or felled shrubs and trees around shaggy horkelia populations.
- Girdled large trees near shaggy horkelia plots.
- Monitored shaggy horkelia (vegetative and reproductive individuals, browsed and unbrowsed stems).
- Planted 220 shaggy horkelia plugs in two locations (110 plugs in each).

2016

- Mapped shaggy horkelia population.
- Removed Himalayan blackberry and Scotch broom.
- Limbed or felled shrubs and trees around shaggy horkelia populations.
- Girdled large trees near shaggy horkelia plots.
- Monitored shaggy horkelia (vegetative and reproductive individuals, browsed and unbrowsed stems).
- Monitored augmented shaggy horkelia population.
- Broadcast native seed mix on disturbed areas: blue wildrye, Roemer's fescue, woolly sunflower (*Eriophyllum lanatum*), and California oatgrass.

2017

- Removed Scotch broom.
- Monitored shaggy horkelia (vegetative and reproductive individuals, browsed and unbrowsed stems).
- Limbed or felled shrubs and trees around shaggy horkelia populations.

- Management plan was reviewed by IAE staff.

2018

- Removed Scotch broom.
- Monitored shaggy horkelia (vegetative and reproductive individuals, browsed and unbrowsed stems).

2019

- Removed Scotch broom.
- Monitored shaggy horkelia (vegetative and reproductive individuals, browsed and unbrowsed stems).
- Approximately 12, 14–18-inch diameter Douglas-fir (*Pseudotsuga menziesii*) were cut to open space near shaggy horkelia.

2020

- Felled numerous Douglas-fir to release Oregon white oak (*Quercus garryana*)
- Monitored shaggy horkelia.
- Hand pulled Scotch broom in western meadow.
- Setup three experimental plots to test efficacy of seeding and planting shaggy horkelia plugs.
- Applied glyphosate to approximately one acre of non-native grasses.
- Flame weeded Willamette Valley (WV) seed and WV plugs experimental subplots.
- Seeded WV seed subplots with shaggy horkelia.

2021

- Monitored shaggy horkelia.
- Removed Douglas-fir for meadow connectivity enhancement.
- Planted 600 shaggy horkelia plugs in WV plug experimental subplots.
- Flame torch treatment of mid-elevation (ME) seed experimental subplots.
- Seeded shaggy horkelia in ME seed experimental subplots.
- Seeded native mix of mid-elevation origin to disturbed areas: winecup clarkia, blue wildrye, woolly sunflower, California fescue (*Festuca californica*), Roemer's fescue, prairie June grass, showy tarweed, grassy tarweed, woodland tarweed, short spurred seablush.

2022

- Removed Douglas-fir to improve meadow connectivity
- Monitored shaggy horkelia.
- Seeded native mix of mid-elevation origin to disturbed areas: Lemmon's needlegrass (*Achnatherum lemmonii* ssp. *lemmonii*), Few-leaf thistle (*Cirsium remotifolium*), farewell-to-spring (*Clarkia amoena* ssp. *lindleyi*), winecup clarkia, California oatgrass, woolly sunflower, California fescue, Roemer's fescue, prairie June grass, fernleaf biscuitroot (*Lomatium dissectum*), spring gold (*Lomatium utriculatum*), grassy tarweed, slender phlox (*Microsteris gracilis*), cutleaf silver puffs (*Microseris laciniata*), Cardwell's penstemon (*Penstemon cardwellii*), Oregon yampah (*Perideridia oregana*), slender cinquefoil (*Potentilla gracilis*), common selfheal, dwarf checkermallow (*Sidalcea malviflora* ssp. *virgata*), mule ears (*Wyethia angustifolia*) mountain death camas (*Zigadenus venenosus*).

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 (Figure 4).
 - 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.”

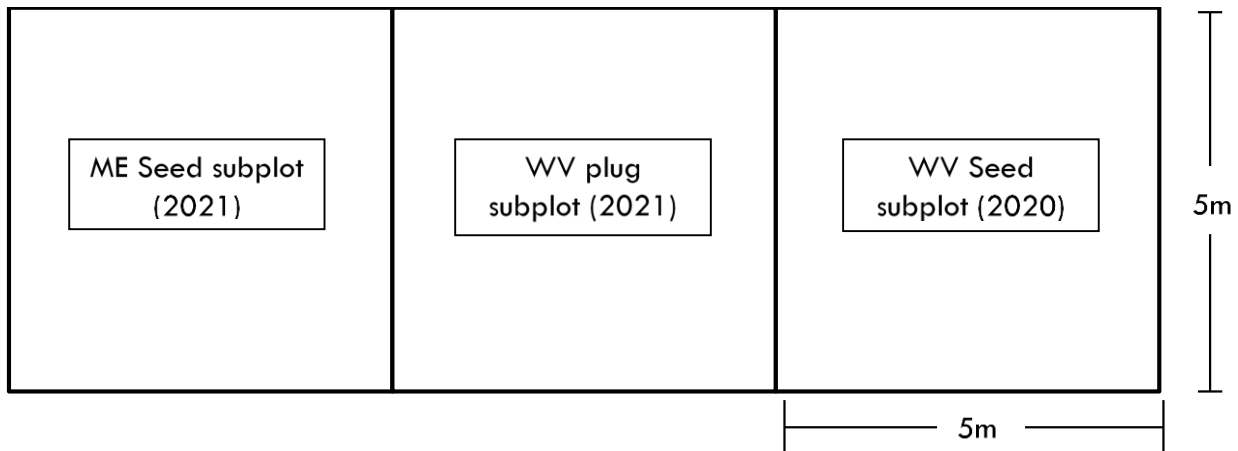


Figure 6. Average size of shaggy horkelia (*Horkelia congesta* ssp. *congesta*) seedlings found during monitoring. Photo taken by Jessica Celis on June 4, 2020.

APPENDIX C. EXPERIMENTAL PLOT LAYOUT

Table 4. Tag numbers for shaggy horkelia (*Horkelia congesta* ssp. *congesta*) experiental plots.

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

**Figure 1.** Experimental design of shaggy horkelia (*Horkelia congesta* ssp. *congesta*) seed versus plug experiment; Willamette Valley (WV) and mid-elevation (ME) seed sources.

APPENDIX D. SHAGGY HORKELIA MONITORING DATA

Table 4. Results of the shaggy horkelia (*Horkelia congesta* ssp. *congesta*) monitoring of total population and individual size from 2014 to 2021

Shaggy horkelia abundance (total individuals) from 2014-2022.										
Patch	# of total plants (# of additional seedling plants)									Notes
	2014	2015	2016	2017	2018	2019	2020	2021	2022	
A	19	16	18	29 (4)	8	15	22 (1)	32 (19)	14	Patches 1 and 2 combined 2022.
B	427	422	521	723 (124)	484 (45)	528 (27)	588 (60)	511 (261)	431 (2)	Patches 3, 4, 5 combined 2015; plot 6 combined 2022.
C	63	35	42	46	41 (15)	39	27 (1)	28 (0)	5 (0)	Patches 7 and 7a combined 2021.
D	68	13	58	54	68 (14)	40	30 (3)	21 (9)	49 (0)	Patches 8 and 8a combined 2021
E	5	9	13	30	8	6	6 (0)	5 (4)	1	Patches 9, 10, 10a, and 11 combined 2022.
F	104	69	119 (5)	51	31	46 (1)	26 (202)	66 (101)	80 (10)	Patches 12, 12a, 12b combined 2022
G	96	87	108	94	50 (1)	42	62 (76)	76 (47)	68 (5)	Patches 13, 14, and 15 combined 2022.
H	355	216	303 (81)	211	122 (12)	111 (3)	130 (131)	128 (114)	123 (6)	Patch 16
I	76	44	104 (60)	31	31 (7)	31	26 (79)	37 (17)	19 (1)	Patch 18
J	17	16	59 (50)	8	17 (1)	20 (3)	25 (109)	53 (42)	57 (5)	Patches 17 and 19 combined 2022.
Total	1242	929	1345 (196)	1257 (128)	860 (95)	883 (34)	942 (661)	957 (614)	847 (29)	

Shaggy horkelia abundance (reproductive individuals) from 2014-2022.										
	# of reproductive plants									
Patch	2014	2015	2016	2017	2018	2019	2020	2021	2022	Notes
A	19	14	6	20	8	13	19	25	13	Patches 1 and 2 combined 2022.
B	245	225	276	424	188	358	416	334	273	Patches 3, 4, 5 combined 2015; plot 6 combined 2022.
C	51	30	30	33	19	20	20	21	5	Patches 7 and 7a combined 2021.
D	35	13	37	43	31	36	29	19	25	Patches 8 and 8a combined 2021
E	8	10	8	9	6	6	6	5	1	Patches 9, 10, 10a, and 11 combined 2022.
F	64	39	58	40	26	38	21	18	13	Patches 12, 12a, 12b combined 2022
G	49	43	50	65	39	35	44	57	34	Patches 13, 14, and 15 combined 2022.
H	184	116	125	159	78	82	74	79	56	Patch 16
I	46	24	36	27	18	25	18	26	13	Patch 18
J	12	13	7	8	7	8	18	20	18	Patches 17 and 19 combined 2022.
Total	713	527	633	828	420	621	665	604	451	
Percent	57.4%	56.7%	47.1%	65.9%	48.8%	70.3%	70.6%	63.1%	53.3%	

Flowering stems (browsed) of shaggy horkelia at Twin Prairie, 2013-2022											
Patch	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Notes
A	25	22 (30)	35 (3)	7 (1)	70	21	45 (3)	37 (25)	65 (0)	24 (17)	Patches 1 and 2 combined 2022.
B	516	217 (340)	345 (168)	99 (426)	464(634)	417 (158)	530 (288)	733 (178)	306 (294)	564 (31)	Patches 3, 4, 5 combined 2015; plot 6 combined 2022.
C	77	53 (63)	51 (11)	30 (38)	84(7)	39	38	37 (3)	28 (19)	12 (0)	Patches 7 and 7a combined 2021.
D	61	39 (54)	26	44 (39)	102(23)	62 (18)	57 (30)	69 (46)	34 (26)	42 (34)	Patches 8 and 8a combined 2021
E	14	17 (1)	9 (16)	4 (9)	12 (16)	17 (16)	10 (3)	13 (6)	1 (12)	3 (0)	Patches 9, 10, 10a, and 11 combined 2022.
F	17	113 (79)	59 (23)	39 (88)	81(23)	52(6)	109	68 (5)	45 (7)	24 (8)	Patches 12, 12a, 12b combined 2022
G	29	48 (72)	55 (29)	47 (47)	98	70	52	80 (5)	81 (14)	49 (16)	Patches 13, 14, and 15 combined 2022.
H	229	205 (287)	111 (98)	83 (185)	239(136)	167 (9)	149 (37)	118 (93)	104 (61)	74 (50)	Patch 16
I	102	66 (68)	48 (4)	10 (85)	57(35)	40 (6)	76	29 (14)	59 (9)	24 (25)	Patch 18
J	11	10 (29)	37	3 (17)	15(14)	18 (5)	33	23 (36)	30 (23)	18 (35)	Patches 17 and 19 combined 2022.
TOTAL Unbrowsed + (browsed)	N/A	790 + (1023)	776 + (352)	359 + (935)	1222 + (907)	903 + (218)	1098 + (362)	1,207 + (411)	753 + (465)	834 +(216)	
TOTAL Combined	1081	1813	1128	1294	2129	1121	1,460	1,618	1,218	1,050	
Proportion of browsed stems	N/A	56%	31%	72%	43%	19%	25%	25%	38%	21%	

Table 5. Shaggy horkelia (*Horkelia congesta* ssp. *Congesta*) seed source survivorship experiment data

# of plants (# of seedlings)			
	Plot	2021	2022
WV seed	West	0 (123)	0 (0)
	Central	0 (33)	2 (0)
	East	0 (315)	0 (25)
ME seed	West	x	0 (115)
	Central	x	0 (90)
	East	x	0 (84)
WV plug	West	x	122 (0)
	Central	x	124 (0)
	East	x	135 (0)
ME plug	West	x	x
	Central	x	x
	East	x	x

Total # plants by subplot type (# of seedlings)		
	2021	2022
WV Seed	0 (471)	2 (25)
ME Seed	x	0 (289)
WV plugs	x	381 (0)
ME plugs	x	x