Upper Oak Basin Kincaid's lupine and Hitchcock's blue-eyed grass monitoring and restoration: 2024 annual report

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Report to the Bureau of Land Management, Upper Willamette Resource Area: Northwest Oregon District, L21AC10456, L23AC00134, L23AC00272, L23AS00441, and L21AC10117

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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: Kincaid's Lupine (*Lupinus oreganus*) in spring, 2024. Photo by Tyler Roberts.

SUGGESTED CITATION

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EXECUTIVE SUMMARY

This report documents habitat restoration and vegetation monitoring activities conducted by the Institute for Applied Ecology (IAE) in partnership with the Bureau of Land Management's (BLM) Upper Willamette Field Office (UWFO), Northwest Oregon District, at Oak Basin ACEC (Oak Basin), a complex of upland meadows. Oak Basin is home to Kincaid's lupine (*Lupinus oreganus*), a federally threatened species; Hitchcock's blue-eyed grass (*Sisyrinchium hitchcockii*), a federal species of concern and state-listed as endangered; and wayside aster (*Eucephalus vialis*), a federal species of concern and state-listed as threatened. Kincaid's lupine serves as the primary larval host plant for the threatened Fender's blue butterfly (*Icaricia icarioides fenderi*). The small population of Fender's blue butterfly at Oak Basin has been at risk of extirpation since 2015, and only 19 individuals were documented in 2024 at Oak Basin on BLM-administered land.

Management treatments

Restoration activities conducted in 2024 included mowing to reduce thatch and shrub cover; removal and limbing of conifers to increase meadow connectivity and reduce woody encroachment; hand-pulling invasive plants including Italian plumeless thistle (*Carduus pycnocephalus*) and false brome (*Brachypodium sylvaticum*); chemical treatments of Himalayan (*Rubus bifrons* syn. *Rubus armeniacus*) and evergreen blackberry (*Rubus laciniatus*); chemical treatments of non-native grasses; installing solarization fabric in Meadow D; broadcasting native forb and grass seed to prepared and disturbed ground; planting native prairie plants; seeding and planting Kincaid's lupine; and continuing seed amplification beds for dwarf checkermallow (*Sidalcea malviflora ssp. virgata*), toughleaf iris (*Iris tenax*), shooting star (*Primula sect. Dodecatheon sp.*), Lemmon's needlegrass (*Achnatherum lemmonii*), whitetop aster (*Sericocarpus rigidus*), and naked buckwheat (*Eriogonum nudum*).

Kincaid's lupine

In 2024, total Kincaid's lupine foliar cover at Oak Basin was 463.6m^2, continuing the generally positive trend that started in 2016 coincident with more active management of the site. The count of racemes in 2024 was 9,646 nearly double the count in 2023 of 5,238. Since the initiation of more active management practices in 2016, all meadows have shown a positive trend in foliar cover and count of mature racemes. Increases in 2024 are in part related to outplanting efforts in Meadow A.

Lupine on the adjacent private property was mapped and measured and these patches add an additional 150m^2 of lupine foliar cover and 1,809 mature racemes in 2024.

Hitchcock's blue-eyed grass

The number of Hitchcock's blue-eyed grass individuals and reproductive stems at Oak Basin's Meadow C has generally decreased since monitoring began in 2012. In 2024, 42 total plants were observed. Of

particular concern was that no plants have been observed in the small patch peripheral to the main population since 2021.

Wayside aster

In 2024, IAE staff located an existing population of wayside aster in the forest edge to the east of Meadow C. These plants are small and non-flowering due to resource competition from woody encroachment and dense canopy cover. Habitat management including limbing and small tree thinning could improve habitat quality for all species of concern in Meadow C.

Recommendations

Building on this year's efforts, we recommend ongoing control of non-native plants in the meadows and corridors. Utilize a combination of chemical, thermal, mechanical, and manual treatments as appropriate. Following treatment, seed and plant these areas with native Fender's blue butterfly host and nectar species and perennial grasses to promote habitat recovery..

To support the small populations of Hitchcock's blue-eyed grass and wayside aster in Meadow C, we recommend targeted habitat management. Actions should include controlling introduced graminoids to reduce competition, seeding native prairie species to expand suitable habitat, and decreasing canopy cover to increase light availability in the understory for wayside aster.

Continue efforts to convert two acres of low-quality habitat in Meadow D into resource-rich habitat for Fender's blue butterfly. This fall, glyphosate was applied after Kincaid's lupine senescence to control dominant grasses. We recommend repeat treatments and seeding to achieve long-term control of these grasses.

Collaborate with adjacent landowners to align management actions and improve habitat connectivity for Kincaid's lupine and Fender's blue butterfly populations within the meadow complex irrespective of land ownership.

Degraded roads have made accessing the site at optimal times challenging. Improving access to the meadows is essential for continuing restoration and monitoring efforts. Current road conditions restrict vehicle access to the dry season, which slows progress and limits management options. In 2024, IAE submitted a proposal for Title 2 funding to The Western Oregon Resource Advisory Council to support this effort and to increase restoration and monitoring on the adjacent private land.

1. INTRODUCTION

This report documents habitat restoration and rare plant and community monitoring activities conducted by the Institute for Applied Ecology (IAE) at Oak Basin ACEC (Oak basin) in 2024. Oak Basin, managed by the Northwest Oregon BLM (Bureau of Land Management) District's Upper Willamette Field Office, is about six miles southeast of Brownsville, Oregon (Figure 1). The site includes upland prairie and oak (*Quercus garryana*), maple (*Acer macrophyllum*), and Douglas-fir (*Pseudotsuga menziesii*) woodlands. Oak Basin supports the largest known population of Kincaid's lupine (*Lupinus oreganus*; Figure 2) in the Upper Willamette Field Office's management area and is home to a population of the threatened Fender's blue butterfly (*Icaricia icarioides fenderi*; Figure 2). The Oak Basin Fender's blue butterfly population is relatively small, with an estimated population of 19 butterflies in 2024 and remains vulnerable to extirpation (Diaz and Harris 2023).

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Figure 1. The location of Oak Basin within the Willamette Valley and a close-up of the project area.

Vegetation monitoring by IAE at Oak Basin is focused on documenting the size and reproduction of the Kincaid's lupine population and assessing habitat quality. This information is used to determine the effectiveness of restoration treatments and to document long-term population trends in support of meeting recovery goals as outlined in the Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington (U.S. Fish and Wildlife Service, 2010). In addition to monitoring Kincaid's lupine, IAE monitors a small population of the rare Hitchcock's blue-eyed grass (*Sisyrinchium hitchcockii*).

Figure 2. Fender's blue butterfly (*Icaricia icarioides fenderi*) and Kincaid's lupine (*Lupinus oreganus*). Photos taken on May 5, 2021 in Meadow B.

1.1. Plant species status and information

Kincaid's lupine is a member of the legume family (Fabaceae). It is an herbaceous perennial that reproduces by seed. Plants form clumps of basal leaves and eventually produce one or more flowering stems. The species also spreads vegetatively, though it is unknown to what extent vegetative growth may result in the formation of physiologically distinct clones (Severns et al. 2011). Kincaid's lupine requires insects for successful fertilization and seed formation (Kaye 1999). It is found in native prairie remnants in the Willamette Valley and southwestern Washington and in forest openings in Douglas County, Oregon. Because Kincaid's lupine serves as the larval host for the federally threatened Fender's blue butterfly (Oregon Biodiversity Information Center 2016), conservation of Kincaid's lupine populations is the primary goal for the protection of both species. Kincaid's lupine is listed by the Oregon Department of Agriculture and the U.S. Fish and Wildlife Service (USFWS) as a threatened species (Oregon Biodiversity Information Center 2016).

The site contributes to the recovery of Kincaid's lupine since the population currently meets the minimum foliar cover of 100 m^2 needed for the site to count towards recovery. Additionally, large patches of Kincaid's lupine occur on the adjacent, privately owned Oak Basin Tree Farm that is currently being

restored through a cooperative agreement between private landowners, Greenbelt Land Trust, Oregon Department of Fish and Wildlife, and U.S. Fish and Wildlife's Partners for Fish and Wildlife Program.

Hitchcock's blue-eyed grass is a rhizomatous perennial forb in the Iris family (Iridaceae; Figure 3). The species reproduces by seed and by clonal vegetative growth. It is listed as a federal Species of Concern by the U.S. Fish and Wildlife Service (Oregon Biodiversity Information Center 2016) and is a Bureau Sensitive Species for the BLM.

Figure 3. Hitchcock's blue-eyed grass (*Sisyrinchium hitchcockii*): (a) long and narrow leaves with parallel veins that are mostly basal; (b) 3-chambered capsules up to 6 mm long containing black seeds; and (c) flowers with blue to bluish-purple tepals with a faint (or absent) yellow "eye" in the center.

Wayside aster (*Eucephalus vialis*) is a perennial forb in the aster family, it does not have ray flowers (Figure 4). Wayside aster reproduces sexually by seed and vegetatively over short distances (<20 cm) with rhizomes. It grows in gaps and openings along the edges of Douglas-fir forests and is threatened by woody encroachment and the suppression of fire to maintain open forest and edge habitats. Flowering usually occurs from mid-July to September. Previous work by IAE in partnership with BLM has shown that targeted forest canopy thinning through tree removal or limbing in existing habitat can stimulate flowering and plant vigor in populations suppressed by canopy cover (Giles-Johnson 2013).

Figure 4. Wayside aster (*Eucephalus vialis)* is a rayless aster. Each capitula is ~1cm long with plants flowering in July-September. Healthy plants may grow over a meter tall producing up to 150 flowers. In areas where plants are suppressed, very few if any flowers are produced, and seed viability is low.

1.2. Fender's blue butterfly

Fender's blue butterflies become mature adults in May and June at which time they fly, consume nectar, and mate. The females oviposit their eggs on the underside of Kincaid's lupine leaves. Eggs are identifiable as small (0.5–1.0 mm) white spheres. The eggs hatch in a few weeks; hatched eggs resemble unhatched eggs except that they are burst in the center, making them look like little white "donuts." The larvae subsequently feed on Kincaid's lupine leaves until late June or early July, at which time they crawl under nearby vegetation and plant litter and enter diapause. They remain in a dormant state until February or early March when they then begin feeding again on the newly emerging Kincaid's lupine leaves. Near the end of April, they pupate and reemerge as butterflies (Schultz and Crone 1998).

2. GOALS AND OBJECTIVES

2.1. Monitoring

The goals of monitoring are to track the size and reproductive status of the Kincaid's lupine population at Oak Basin and examine overall Kincaid's lupine and Fender's blue butterfly habitat quality over time. Specifically, we aim to link these data with habitat restoration activities occurring on-site, conducted and facilitated by IAE, and to document population size and trends to ensure that the population remains stable or increases, with area of foliar cover being maintained at or above the minimum targets as laid out in the Recovery Plan (U.S. Fish and Wildlife Service 2010). Secondary goals are to assess the status of the Hitchcock's blue-eyed grass and wayside aster populations and to help guide restoration activities at the site.

2.2. Habitat restoration

Habitat restoration goals are to maintain or improve prairie habitat in support of Kincaid's lupine and its associated Fender's blue butterfly populations, and to increase and distribution of Hitchcock's blue-eyed grass and wayside aster.

This project has four primary objectives:

1) Maintain and improve quality prairie habitat by removing non-native invasive plants;
2) Prevent encroachment of woody species into the prairie;
3) Increase diversity and the areal extent of the native plant community; and
4) Improve connectivity between meadows.

3. METHODS

3.1. Monitoring methods

Habitat quality

In 2024, we continued habitat monitoring efforts that begun in 2020 and are directly applicable to the habitat quality criteria as outlined in the Recovery Plan (U.S. Fish and Wildlife Service 2010). Standard relevé plots (5m x 5m) were established in each meadow, two in Meadow A and one each in Meadows B and C. Within each plot, we estimated percent cover by species and then calculated species richness and cover by plant functional group.

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Figure 5. Experimental plot and Kincaid's lupine (*Lupinus oreganus*) patch locations at Oak Basin.

Kincaid's lupine

Monitoring Kincaid's lupine at Oak Basin is considered to be a complete census of the population. In 2006, Meadows A, B, and C were surveyed for the presence of Kincaid's lupine. Plots were then installed around Kincaid's lupine patches. Additional plots have been added as new patches have been located, and all plots are sampled annually. Larger plots are rectangular and marked with fiberglass posts, rebar, or conduit at all four corners. Smaller patches are monitored in either circle or belt transects. Circular plots were marked in the center and all plants were included by setting an appropriate radius. Belt transects were marked on opposite ends, a tape was stretched between the posts, and all the Kincaid's lupine on either side of the tape were recorded. Each plot origin was tagged with a pre-numbered aluminum tag. Plot notes can be found on the plot maps in Appendix F. When plants are found outside of existing plots, plot boundaries are either modified or new plots added to accommodate these plants in the census.

Kincaid's lupine is monitored by measuring the area of foliar cover (m^2) and counting mature and aborted racemes in each plot. Specifically, Kincaid's lupine foliar cover is measured by taking the approximate length (cm) and width (cm) of area occupied by Kincaid's lupine using standard rulers and meter poles.

Foliar cover of Kincaid's lupine (as opposed to counting 'individual' plants of this rhizomatous species) is the standard metric for Kincaid's lupine monitoring in the Recovery Plan (U.S. Fish and Wildlife Service 2010). The percentage of aborted racemes is calculated by dividing the number of aborted racemes by the sum of all mature and aborted racemes and multiplying by 100.

In 2024 we refined mapping and measured foliar cover and raceme count of Kincaid's lupine on the adjacent Merzenich property (Appendix F). We monitored using similar protocols quantifying foliar cover and raceme counts in patches on the adjacent private property. Areas with Kincaid's lupine were mapped using FieldMaps. In addition, most areas are already marked with fiberglass poles near the center of each lupine patch.

In 2024, three relevé plots were established in Doghead meadow (Figure 1), at Lower Oak Basin before restoration actions were initiated. These plots will be continually monitored through the restoration phase to assess treatment efficacy and monitor plant community changes.

Hitchcock's blue-eyed grass

Two permanent plots were established in 2012 to monitor the small population of Hitchcock's blue-eyed grass in Meadow C. These same plots were monitored in 2023. The first is a 15m long x 8m wide belt transect with rebar marking both ends. The plot was monitored in 1m sections on the east and west sides of the tape. The origin of the transect is on the south end, tagged with an aluminum tag with #185 stamped on it. The second plot is a 2m radius circular plot with the rebar placed in the center and tagged with #186; plants in this plot are measured in four quadrants. There is a small patch of Kincaid's lupine in this same area, and the circular plot #186 serves as a marker for both the Kincaid's lupine and the Hitchcock's blue-eyed grass. Western blue-eyed grass (*Sisyrinchium bellum*) is also present in the area; for this reason, monitoring occurs at the time of flowering (late June/early July) to ensure proper identification of each species.

Due to the rhizomatous growth of Hitchcock's blue-eyed grass, plants greater than 20cm apart were counted as distinct individuals unless there was clear evidence otherwise (e.g., exposed rhizomes;

Groberg et al. 2013). Plants were noted to be either vegetative (V) or reproductive (R). Those that were reproductive were also given a number to represent the number of flowering stems of each plant (e.g., R1 has one flowering stem; R2 has two flowering stems, etc.); individual stems may have more than one flower. In addition, a reproductive plant is likely to have multiple vegetative stems as well.

Wayside aster

In the summer of 2024 IAE located a population of wayside aster on the periphery of Meadow C at Oak Basin (Figure 6). Historic location data for this population was not precise and the exact location of the population had been unknown; thus IAE staff (Denise Giles) performed an intuitively controlled survey of Meadow C and the corridor between Meadows B and C to locate wayside aster individuals.

Figure 6. Wayside aster (*Eucephalus vialis*) at Oak Basin in 2024. Plants are suppressed and grazed by deer (left). Plants were found along a game trail at the edge of a forest opening (right – marked by pin flags).

4. HABITAT RESTORATION ACTIONS

In 2024, IAE restored habitat on both BLM and private land to meet the goals outlined in in Section 2.2. Restoration activities included manual treatments, mowing, solarization, spot herbicide applications targeting Himalayan blackberry (*Rubus bifrons*) and non-native grasses, tree removal, planting, and seed broadcasting. The adjacent private landowner, collaborating with IAE and BLM, dedicated time and resources to restore habitat for Kincaid's lupine and Fender's blue butterfly on their property (not detailed in this report). Restoration at Lower Oak Basin began in 2024 with the establishment of relevé plots in the spring. See Appendix A for a summary of restoration actions completed at Oak Basin over the past decade.

Table 1. Habitat restoration actions completed in 2024.

Date	Personnel	Tasks	Where
24-Jan	IAE	Solarization fabric check.	Meadow D
30-Jan	IAE	Bucked remainder of large tree near solarization fabric and distributed cookies on fabric. Repaired fabric where it pulled up on the west side of the meadow.	Meadow D
28-Feb	IAE	Mowed dead blackberry patches in Meadow D. Repaired solarization fabric. Felled and bucked two small Douglas-fir trees. Girdled a small Douglas-fir to release an oak.	Meadow D
27-Mar	IAE	Planted 78 Kincaid's lupine plugs across 6 existing patches in Merzenich meadow.	Merzenich Meadow and Meadow D
9-Apr	IAE, BLM, GLT, Private landowner	Site visit with partners to coordinate efforts and discuss 2024 restoration and monitoring plans. Pulled Italian thistle in Meadow B.	All Meadows
12-Apr	IAE	Repaired solarization fabric in meadow D.	Meadow D
29-Apr	IAE	Pulled Italian thistle in meadows A, B and D. Also pulled Canada thistle in Meadow B.	Meadows A, B, D, And Merzenich Meadow
1-May	IAE	Established and collected data for three relevé plots at Lower Oak Basin. Pulled Italian thistle in the center of the meadow. Cut and removed small conifers under three feet in height.	Lower Oak Basin
7-May	IAE, BLM, Dana Ross, Private landowner	Site visit with partners. Broadcast seed that was purchased in 2023 to burned areas in Merzenich Meadow and A-B corridor.	All Meadows
31-May	IAE	Collected photo points. Pulled oxeye daisy in Merzenich meadow around Kincaid's lupine patches.	All Meadows
13-Jun	IAE, Private landowner	Led a tour for small woodlands group highlighting restoration efforts and value of partner collaboration.	Meadow A and Merzenich Meadow
2-Jul	IAE	Mowed Meadow D to prepare for solarization fabric. Pulled oxeye in Kincaid lupine patches.	Meadow D and Merzenich Meadow
18-Jul	IAE, AmeriCorps	Pulled oxeye daisy.	Meadow D and Merzenich Meadow
15-Aug	IAE	Located wayside aster population and cut back encroaching ocean spray to increase light penetration.	Meadow D and Meadow C
12-Sep	IAE	Sprayed Himalayan blackberry with Garlon 3A.	All Meadows
24-Sep	IAE	Mowed to prepare for fabric installation.	Meadow D
26-Sep	IAE	Moved solarization fabric in meadow D.	Meadow D

Date	Personnel	Tasks	Where
25-Oct	IAE	Seeded solarization fallow with a native seed mix via dewdrop and broadcast. Broadcast total of 1.5 lbs Kincaid's lupine to the fallow in strips, receiving 0.125 lbs of seed per strip. The strips are also bisected with a 15 foot east-west access road that was not broadcast with lupine. The Kincaid's lupine strips alternate seed source (Eugene West and SW/CW sources) beginning with Eugene West on the east most strip.	Meadow D
7-Nov	IAE, Private landowner	Planted 300 dwarf checkermallow, 100 narrowleaf mules ears, 75 deltoid balsamroot, 50 death camas. All plants were split between Private and BLM land. Broadcast native seed mix to ground prepared by private landowner.	Meadow D and Merzenich Meadow
26-Nov	IAE	Felled and bucked two Douglas-fir trees to reduce encroachment and use as additional weight for solarization fabric.	Meadow D
27-Nov	IAE, AmeriCorps	Felled and bucked three Douglas-fir trees to reduce encroachment and create additional weights for solarization fabric. AmeriCorps team distributed rounds and branches to solarization fabric.	Meadow D
9-Dec	IAE	Sprayed glyphosate to kill grass in lupine patches. Broadcast native seed over sprayed areas and Kincaid's lupine seed to the still bare ground burned section of the A-B corridor.	All Meadows

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Figure 7. Restoration actions completed at Oak Basin in 2024.

4.1. Invasive plant treatments

Manual treatments

Manual treatments included hand pulling weeds, mowing to reduce thatch and speed up decomposition, and removing woody debris from meadow habitat (Figure 8). Priority weeds pulled in 2024 include Italian plumeless thistle (*Carduus pycnocephalus*), oxeye daisy (*Leucanthemum vulgare*), and a small patch of false brome (*Brachypodium sylvaticum*). Contrary to 2023, a large amount of Italian plumeless thistle emerged this year, part of a trend seen more broadly across the BLM mid-elevation sites in 2024 and likely due to the mild winter conditions facilitating germination of this winter annual. IAE mowed the east side of Meadow D and dead Himalayan blackberry canes to prepare for solarization fabric, increase decomposition, and improve accessibility for future treatments and seeding.

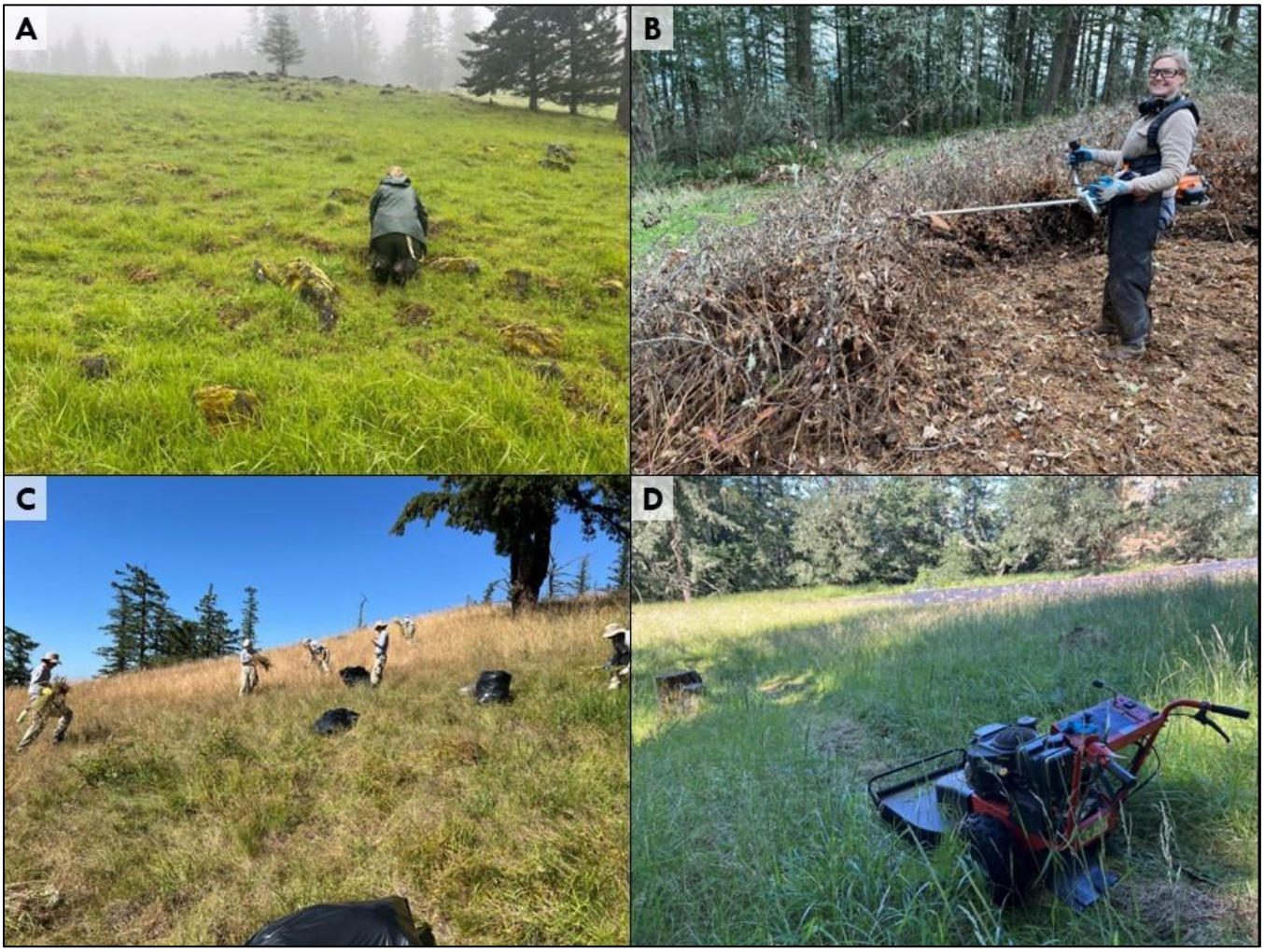

Figure 8. Manual treatments at Oak Basin in 2024. **A.** Pulling Italian plumeless thistle (*Carduus pycnocephalus*), **B.** Mowing Himalayan blackberry (*Rubus bifrons*), **C.** AmeriCorps team members hand pulling oxeye (*Leucanthemum vulgare*) daisy from sensitive habitat, **D.** Mowing down tall grasses to prepare for solarization fabric.

Solarization

IAE performed routine maintenance throughout the wet season to repair fabric that tore or pulled free of the ground. As dryer conditions increased through the spring, the fabric required less maintenance. In September, two growing seasons after its installation, the fabric was lifted from the first acre of meadow-D and installed on a second acre by IAE staff. All hardware and wood rounds were also collected and reused on the solarization fabric. The fabric condition is moderate to fair with some weathering and small punctures but mostly intact. The fallow soil underneath appeared well denuded and visually comparable to a chemical fallow with only a small amount of Canada thistle surviving around the margins of the fabric. This fabric will be maintained for at least two growing seasons with plans to lift it and seed the second acre in the fall of 2026 (Figure 9).

Figure 9. Maintenance, preparation, removal, and installation of solarization fabric. **A.** Routine winter maintenance to keep fabric down, **B.** Before and after mowing preparation for installing the fabric, **C.** Lifting and moving fabric to the new section, **D.** Installing the fabric after moving, **E.** Moving cut rounds to add weight to the fabric, **F.** Installed fabric with wood rounds and branches to add weight.

Herbicide

In 2024, herbicide applications on BLM lands and BLM-funded projects were suspended until approval of the Pesticide Use Proposal (PUP). This delay disrupted ground preparation plans and halted any herbicide applications during the spring-summer growing season. When the PUP was approved and signed in August, IAE treated several acres of blackberry across the project area with Garlon 3A. To control persistent and germinating weeds before seeding, IAE broadcast Roundup Custom on the recently uncovered solarized area. In late fall, after Kincaid's lupine senesced, IAE applied Roundup Custom to Kincaid's lupine patches in Meadows A and B to control non-native grasses in 2025. (Figure 10).

Figure 10. Canada thistle (*Cirsium vulgare)* and germinating weeds where solarization fabric was recently removed.

Tree removal

In 2024, IAE felled seven Douglas-fir trees and girdled one to expand meadow habitat, increase connectivity between meadows and reduce competition on Oregon white oak (*Quercus garryana*) (Figure 11). AmeriCorps consolidated branches and woody debris into decomposition piles under the forest canopy and out of meadow habitat. Larger tree trunks were cut into rounds and distributed across the solarization fabric. Continuing corridor creation efforts, private landowners removed woody debris by burning piles on their land which IAE later broadcast native prairie seed into.

Figure 11. Tree removal and brush control. **A.** IAE girdled a Douglas-fir (*Pseudotsuga menziesii*) tree crowding out an Oregon white oak (*Quercus garryana*), **B.** A previously girdled tree dying back next to an Oregon white oak (*Quercus garryana*), **C.** AmeriCorps team hauling branches and woody material **D.** A cut back ocean spray (*Holodiscus discolor*) bush increases light penetration through the canopy to wayside aster (*Eucephalus vialis*) nearby.

4.2. Revegetation actions

In 2024, IAE completed significant planting and seeding efforts in areas disturbed by restoration actions with a focus on key Fender's blue butterfly nectar species, native restoration plants, and Kincaid's lupine (Figure 12). Additionally, IAE staff located, mapped, and began restoration to support a small remnant population of wayside aster to the east of Meadow C.

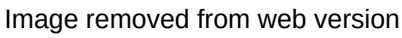

Figure 12. Revegetation actions at Oak Basin in 2024.

In the spring, the private landowner burned woody debris piles in the Merzenich meadows and the A-B corridor, resulting in large sections of bare and burned ground (Figure 13). To mitigate invasive species competition in these areas, IAE broadcast remaining seed from 2023 (Table 2).

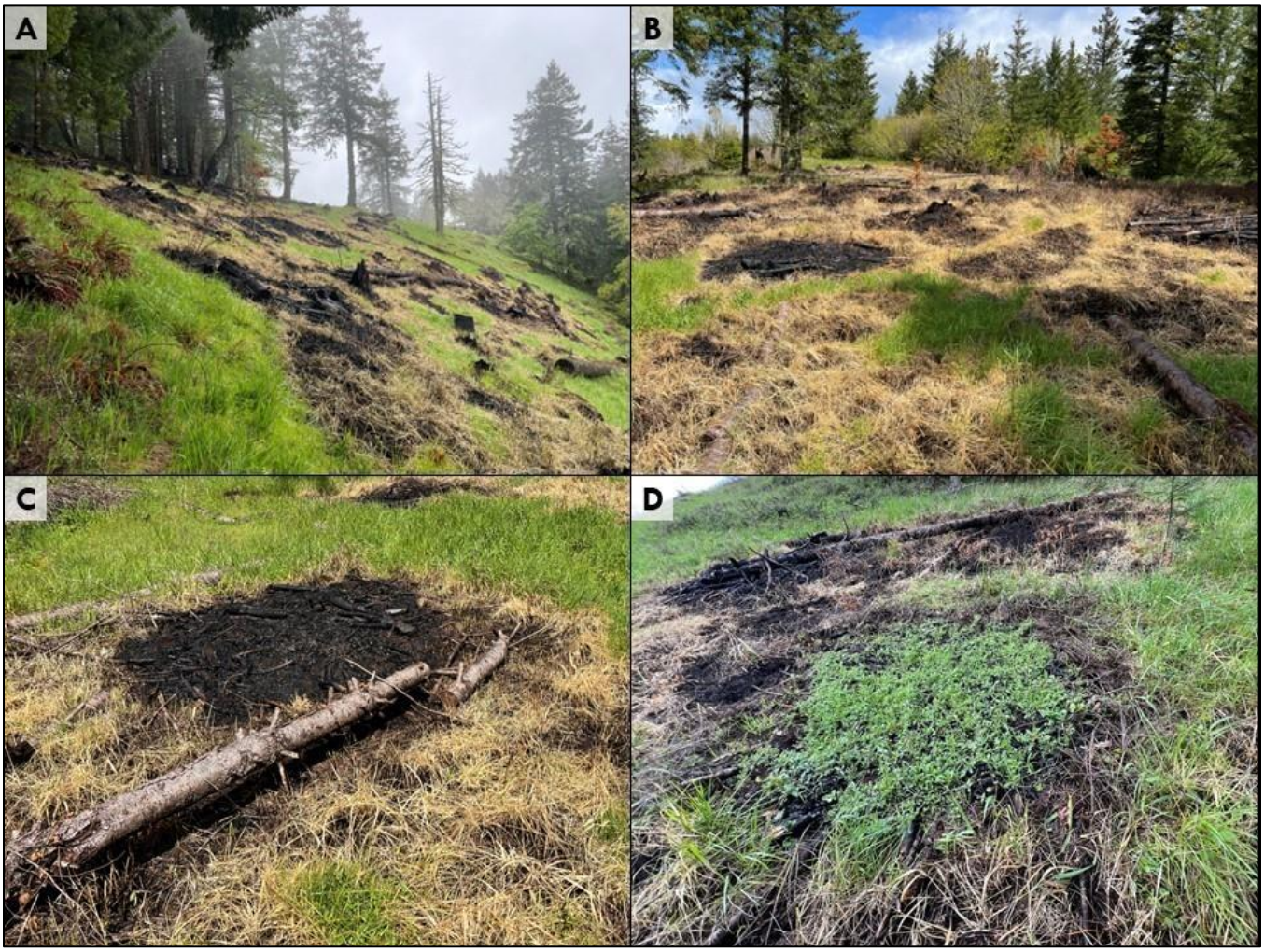

Figure 13. Piles burned at Oak Basin prepare ground for seeding. **A.** Burned piles and ground in the A-B corridor, **B.** Burned piles and vegetation in the Merzenich Meadow, **C.** A burned pile that was not seeded remained bare ground long after, **D.** A burn pile that was seeded fills quickly with native vegetation.

Table 2. Seed purchased in 2023 and broadcast to burned project areas in spring 2024.

Scientific Name	Common Name	Total lbs
Achillea millefolium	common yarrow	0.74
Aquilegia formosa	red columbine	0.03
Brodiaea coronaria	Crown brodiaea	0.02
Bromus vulgaris	Columbia brome	0.86
Carex tumulicola	splitawn sedge	0.37
Clarkia amoena ssp. lindleyi	farewell-to-spring	0.16
Collinsia grandiflora	large-flowered blue-eyed Mary	0.11
Collomia grandiflora	large-flowered collomia	0.51
Danthonia californica	California oatgrass	1.14
Elymus glaucus	blue wildrye	0.50
Eriophyllum lanatum	woolly sunflower	0.09
Festuca roemeri	Roemer's fescue	4.11
Gilia capitata	bluehead gilia	0.77
Koeleria macrantha	prairie Junegrass	0.04

Scientific Name	Common Name	Total lbs
Madia gracilis	grassy tarweed	0.21
Plectritis congesta	shortspur seablush	0.15
Prunella vulgaris var. lanceolata	common selfheal	0.25
Sidalcea malviflora ssp. virgata	dwarf checkermallow	0.60
	Total:	**10.66**
	acres	1.25
	Seeding rate (lbs/acre):	8.53

All seed purchased in 2023 was sourced from Willamette Valley commercial nurseries.

Additionally, the private landowner donated and helped plant 300 dwarf checkermallow (*Sidalcea malviflora*), 100 narrowleaf mule's ears (*Wyethia angustifolia*), 75 Deltoid balsamroot (*Balsamorhiza deltoidea*), and 50 death camas (*Toxicoscordion venenosum*) in Meadow D and the Merzenich meadow, further enhancing species diversity across the meadows (Figure 12, Figure 14).

In the fall, IAE developed, purchased, and sowed six native seed mixes across areas impacted by restoration actions on BLM and private lands (Figure 12, Table 2, Table 3). IAE applied various seeding techniques, including dewdrop drilling, broadcasting on fallow ground, overseeding sparse vegetation, and selectively hand broadcasting to match specific site conditions.

Table 3. Seed procured and amounts (lbs) broadcast to the project area in fall 2024.

Scientific Name	Common Name	Merzenich meadows	Meadow D fallow	Lupine patches	Meadow B and Burn	Blackberry treatment	**Total**
Achillea millefolium [1]	common yarrow	0.15	0.10	0.10	0.82		1.20
Acmispon americanus [1]	American bird's-foot trefoil	1.21	2.20	0.77	7.53		12.00
Aquilegia formosa [1]	red columbine		0.50		0.20		0.70
Brodiaea coronaria [1]	Crown brodiaea		0.19				0.19
Bromus vulgaris [1]	Columbia brome				0.30	1.00	1.30
Calochortus tolmiei [1]	Tolmie's star-tulip, cat's ear lily				0.40		0.40
Carex tumulicola [1]	splitawn sedge	0.15	0.10	0.10	0.32		0.70
Clarkia amoena ssp. lindleyi [1]	farewell-to-spring	0.60	0.40	0.38	3.46		5.00
Clarkia purpurea ssp. Quadrivulnera [1]	winecup clarkia				0.30		0.30
Collinsia grandiflora [1]	large-flowered blue-eyed Mary	1.36	1.00	0.86	4.14		7.70
Collomia grandiflora [1]	large-flowered collomia	1.71	2.00	1.08	10.48		15.70
Danthonia californica [2]	California oatgrass					24.30	24.30
Elymus glaucus [1]	blue wildrye				0.15		2.10
Epilobium densiflorum [1]	denseflower willowherb	0.40		0.26	0.04		0.80
Eriophyllum lanatum [1]	woolly sunflower	0.25	0.50	0.16	1.13		2.10
Erythranthe (Mimulus) guttatus [1]	common monkeyflower		0.01	0.01	0.01		0.03
Festuca roemeri [1]	Roemer's fescue	0.05		0.03	0.16	0.40	1.20
Festuca roemeri [2]	Roemer's fescue					2.88	2.88
Koeleria macrantha [1]	prairie Junegrass				0.11	0.10	0.40
Koeleria macrantha [2]	prairie Junegrass					10.10	10.10
Lomatium dissectum [1]	fern-leaved biscuitroot		3.00		0.45	1.50	9.50
Lomatium nudicaule [1]	barestem biscuitroot		0.50		0.12	0.80	2.60
Lomatium utriculatum [1]	spring gold		0.70		0.20	1.70	3.60
Lupinus bicolor [1]	bi-colored lupine	2.86		1.82	3.30		8.70
Microsteris gracilis [1]	slender phlox	0.40		0.26	0.04		0.80
Phacelia nemoralis var. oregonensis [1]	Shade phacelia				0.10		0.10
Plectritis congesta [1]	shortspur seablush	0.45	2.90	0.29	2.04		5.80
Prunella vulgaris var. lanceolata [1]	common selfheal	0.40	0.50	0.26	2.24		3.50
Sidalcea malviflora ssp. virgata [1]	dwarf checkermallow		1.30		1.50		2.80
Wyethia angustifolia [1]	Narrowleaf mules ears		4.00				4.00
	Total:	**10.00**	**19.90**	**6.35**	**39.54**	**42.78**	**118.58**
	acres	0.6	0.75	0.6	1.8	1.3	5.05
	Seeding rate (lbs/acre):	*16.67*	*26.53*	*10.59*	*21.97*	*32.91*	23.48

[1] *Willamette Valley sourced species purchased from commercial nurseries in 2024.*

[2] *Mid-Elevation sourced species.*

Figure 14. Planting and seeding methods in 2024. **A.** Planting Kincaid's lupine (*Lupinus oreganus*) plugs, **B.** Kincaid's lupine seed from Eugene West Recovery Zone was broadcast by hand, **C.** Dewdrop drill filled with a forb dominant seed mix, **D.** Private landowner, Jim Merzenich donated and helped plant native plugs throughout his property and the BLM meadows.

Kincaid's lupine (Lupinus oreganus)

In the spring, IAE planted 78 Kincaid's lupine plugs to expand patch sizes on the private landowner's property. Due to a shortage of Kincaid's lupine seed from the Eugene East Recovery Zone USFWS and BLM approved using seed from other Recovery Zones at Oak Basin in 2024. IAE received two pounds of Kincaid's lupine seed: one pound from Eugene West Recovery Zone and one of mixed Corvallis West and Salem West Recovery Zones.

To assess establishment and productivity in the future, IAE broadcast 0.75 pounds from each source in alternating 15-foot-wide bands running north-south across Meadow D. IAE mixed and broadcast the remaining 0.5 pounds of Kincaid's lupine seed to the burned and still bare ground on private land between Meadows A and B

5. MONITORING RESULTS

5.1. Habitat quality

In each meadow, a 25 m^2 relevé plot was permanently installed in 2020 and surveyed for species richness. Observations are summarized in Table 4. A full list of observed species is provided in Appendix H. Plots are scheduled to be monitored on at least a three-year cycle to assess changes in plant community. Plots were monitored in 2020, 2023 and 2024.

5.2. Kincaid's lupine

Kincaid's lupine cover and raceme count increased in 2024.

Total Kincaid's lupine foliar cover was 463.6 m^2 up from 340.8 m^2 across all meadows (Table C-2). There were 9,646 up from 5,238 mature racemes and only 16 (<<1%) aborted racemes compared to 1,530 (22%) in 2023 (Figure 15, Figure 16, Table D- 1).

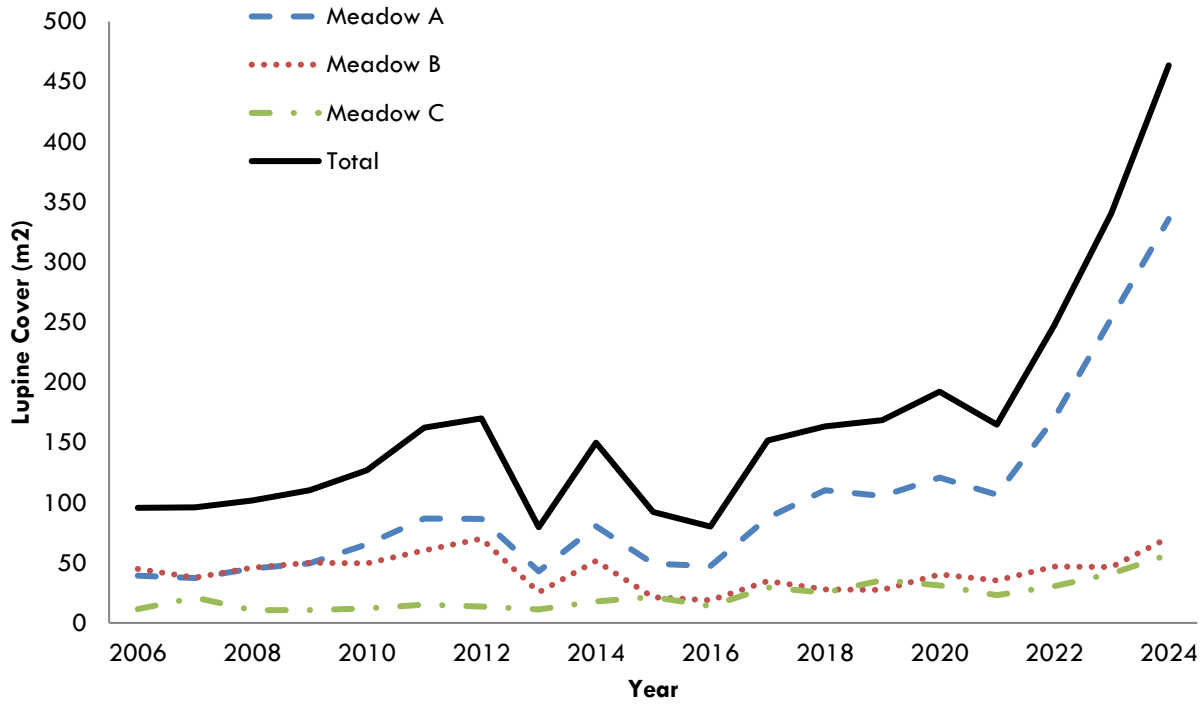

Figure 15. Foliar cover of Kincaid's lupine (*Lupinus oreganus*) from 2006-2024 at Oak Basin in Meadows A, B, C, and all meadows combined.

Table 4. Number of species observed within a 5 x 5 m plot in each meadow in 2020, 2023 and 2024, summarized by plant functional group and nativity. Plots will be monitored on at least a 3 year cycle.

	Meadow	**C (plot #696)**			**B (plot #691)**			**A (plot #690)**			**Average**		
Year		2020	2023	2024	2020	2023	2024	2020	2023	2024	2020	2023	2024
Forbs	Native	9	10	11	8	7	8	10	5	7	9	7	9
	Non-native	13	8	9	14	8	9	14	6	12	14	7	10
Graminoids	Native	6	6	5	4	3	6	6	6	6	6	4	6
	Non-native	8	3	6	9	3	7	9	3	8	9	4	7
Tree/Shrubs	Native	0	0	0	2	2	1	0	0	0	1	1	0
	Non-native	0	0	0	0	0	0	0	0	0	0	0	0
Total	Native	15	16	16	14	12	15	16	7	13	15	12	15
	Non-native	21	11	15	23	11	16	23	12	20	23	11	17

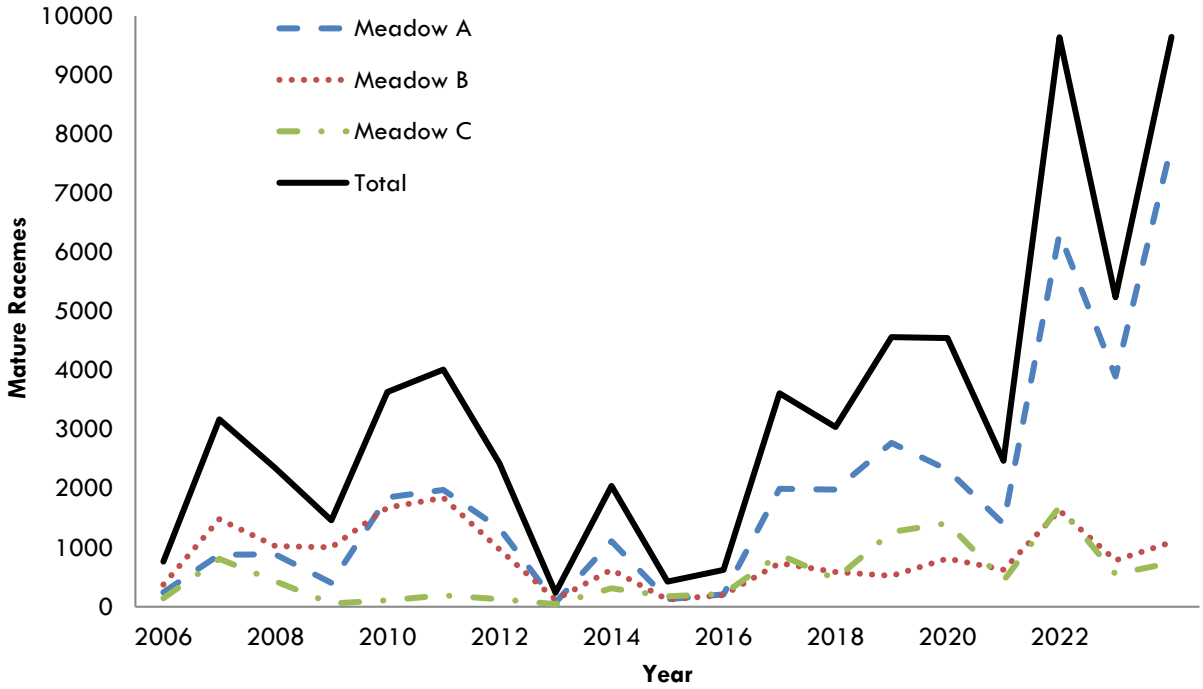

Figure 16. Count of mature Kincaid's lupine (*Lupinus oreganus*) racemes from 2006-2024 at Oak Basin in Meadows A, B, C, and all meadows combined.

5.3. Hitchcock's blue-eyed grass

In 2024, a total of 42 Hitchcock's blue-eyed grass plants were observed, with a total of 40 reproductive stems (Figure 17, Appendix E). As in previous years, most plants observed in the four-meter-wide belt transect were found within two meters of the transect tape. Plants have not been observed in the smaller plot 186 since 2021 when only four plants were noted. This population has been in apparent decline since monitoring began in 2012 (Figure 17).

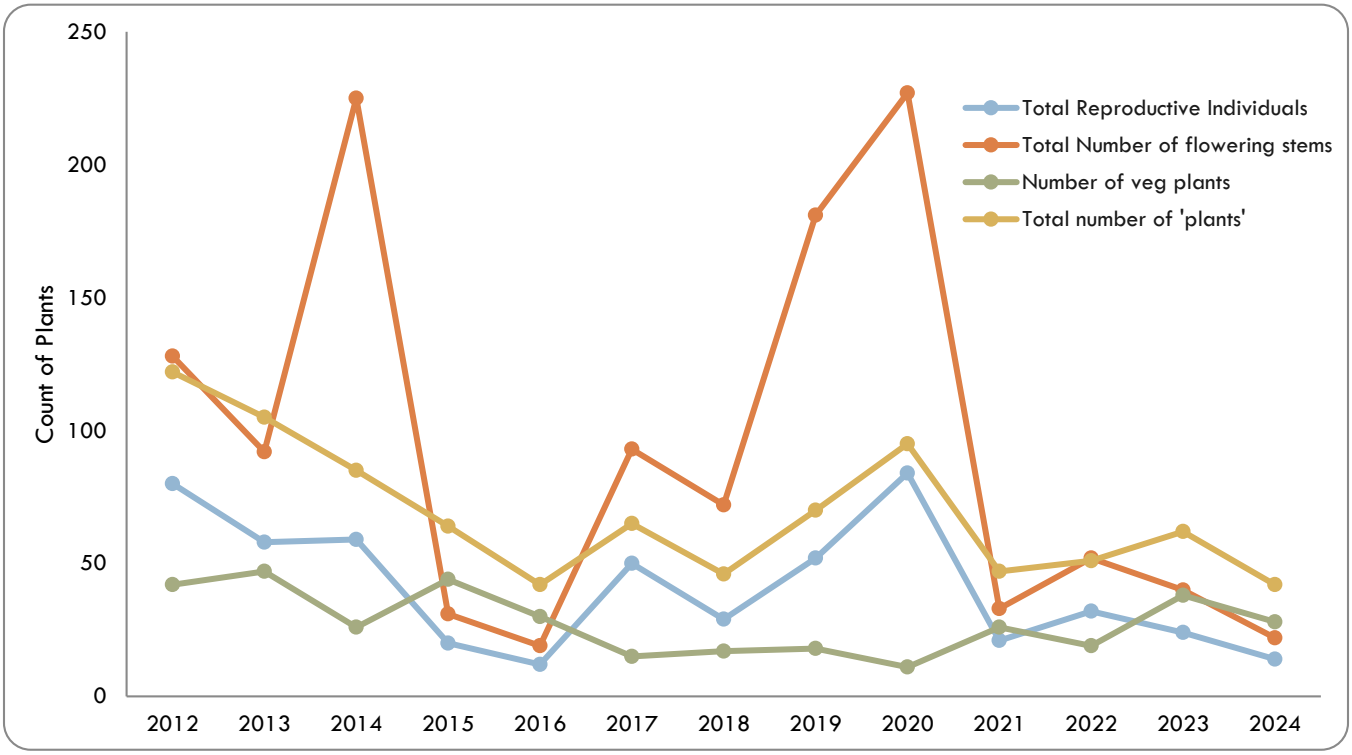

Figure 17. Count of Hitchcock's blue-eyed grass (*Sisyrinchium hitchcockii*) from 2012 - 2024 at Oak Basin, Meadow C.

6. DISCUSSION

6.1. Monitoring trends

Kincaid's lupine and habitat quality

Foliar cover of Kincaid's lupine has increased in all Meadows in recent years. In some cases, increases are a response to outplantings (Meadow A), whereas in Meadow B and C, increases are related to habitat management actions treating weeds and creating a corridor.

Raceme counts tend to fluctuate year to year and therefore it is challenging to identify trends. However, in 2024, raceme count did increase in all meadows and the 2024 count (9,646) was the most ever recorded (Figure 16).

This was the first year of quantifying Kincaid's lupine cover on the adjacent Merzenich property and total Kincaid's lupine cover was 150.2 m^2. Monitoring on a regular basis can help measure changes in foliar cover of Kincaid's lupine in this portion of the Fender's blue butterfly habitat and track changes related to ongoing habitat management.

To assess the progress that has been made towards the Kincaid's lupine recovery goals, we have summarized data for 2024 to compare current conditions to the habitat-quality targets listed in the Recovery Plan (Table 5; USFWS 2010). The continued increase in cover of Kincaid's lupine, particularly in Meadows A and C, highlights the success of management actions at the site.

The prevalence of introduced grasses in the plant community continues to pose a challenge for the restoration of both Kincaid's lupine and Hitchcock's blue-eyed grass. Previous restoration experiments on site show that burning plus a fall treatment of broad spectrum herbicide was the most effective treatment to reduce cover of non-native species and increase bareground (Roberts et al. 2024). This treatment could be implemented in other portions of the habitat and combined with seeding and outplanting efforts over a two-year post-treatment period to increase native cover and nectar availability.

Hitchcock's blue-eyed grass

The general decline in the total count of plants (and the already small size of the population) combined with the apparent extirpation of Hitchcock's blue-eyed grass plants in the smaller plot 186 is cause for alarm. Augmentation combined with habitat maintenance is recommended to maintain this population of this state-listed plant.

Because the population remains in constant decline, it is recommended that rhizomes from at least 3-5 plants are collected early in 2026 to be propagated at IAE. These plants can then be outplanted at the site in the future. There are many vegetative ramets associated with each flowering stem; collections from a handful of these vegetative individuals could be grown in ideal conditions at an IAE Plant Materials facility with limited impact on existing plants. The resulting additional rhizomes can be returned to Oak Basin in suitable habitat. ***Without intervention this population is likely to become extirpated in the next ten years.***

Table 5. Summary of current Oak Basin prairie habitat quality compared to recovery goals. Trends summarize 15 years (2006-2024) of population and community monitoring data.

Prairie Quality and Diversity Summary*			
Criteria	**Oak Basin**	***Recovery Plan* threshold***	**Meets *Recovery Plan* objectives?**
Fender's blue butterfly population size**	BLM-administered land: 19;	Minimum population size of 200 individuals over 10 years	No
Trend of Kincaid's lupine population size (foliar cover, m^2)	Generally increasing since 2006	Increasing (+ slope) or stable (0 slope) over 15 years	Yes
Target foliar cover for Kincaid's lupine downlisting (2024)	BLM Total: 463.6m^2 Meadow A: 335.8 m^2 Meadow B: 71.0 m^2 Meadow C: 56.7 m^2 Private Land: 150.2 m^2	5,000 m^2 in Eugene East Recovery Zone; minimum of 100m^2 in each meadow to count towards recovery	Mixed
Evidence of Kincaid's lupine reproduction	7.18 g seed collected on BLM-adminstered land only in 2022	Seedset or presence of seedlings	Mixed – no seed set in some meadows, seedlings not directly observed
Native herbaceous species relative cover	15%	50% min	No (as of 2024)
Woody species cover	5%	15% max	Yes
Do any woody species of management concern exceed 5% cover?	No	5% max	Yes
Prairie diversity: Native forb richness (2024)	9	7	Yes
Prairie diversity: Native bunchgrass richness (2024)	4	1	Yes
Prairie diversity: Total native herbaceous species richness (2024)	15	>10	Yes
Sufficient abundance and diversity of nectar species ***	2 Native, 5 Non-native	5 native species	Yes

*From the *Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington* (USFWS 2010).
** Data from (Diaz and Harris 2023)
*** Nectar species abundance was measured in 2024 from other (non-BLM) funding sources.

7. CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

The following habitat management and monitoring activities are recommended at Oak Basin in 2025 and beyond:

Monitoring:

- Kincaid's lupine:
    - Monitor Kincaid's lupine populations on BLM land and at Oak Basin Tree Farm, including outplantings.
- Fender's blue butterfly:
    - Monitor Fender's blue butterfly nectar availability at least once every three years. (Conducted in 2024 and reported in Ruff and Harris 2025).
- Hitchcock's blue-eyed grass
    - Monitor Hitchcock's blue-eyed grass in Meadow C.
- Wayside aster
    - As funding permits assess population status and habitat quality.
- Management Treatments and Habitat Quality
    - Continue to monitor and assess efficacy of management treatments to reduce abundance of non-native species through appropriate weed-control measures.

Restoration:

- Initiate active restoration of Hitchcock's blue-eyed grass habitat and augment population in Meadow C by putting this species into production
    - Initiate emergency plant propagation from rhizomes of Hitchcock's blue-eyed grass in Meadow C.
- Initiate active restoration of wayside aster habitat by thinning tree and shrub cover to increase available light.
- Continue to treat non-native species using all available methods, including spot-spraying non-native perennial species with herbicide.
    - Continue treatment of non-native species between meadows, particularly in newly created corridors.
    - Annually hand-pull all Italian plumeless thistle.
    - Spot-spray Himalayan blackberry in all meadows.
    - Apply glyphosate to Kincaid's lupine patches in the fall after Kincaid's lupine senesces to control invasive grasses. This will require several years of treatment and seeding.
- Continue to address conifer encroachment on meadows, reduce competition with Oregon white oak, and to increase meadow connectivity.
- Pending authorization of the use of prescribed fire, initiate fire treatments in 2025-2026 in Meadow A.
- Continue to increase nectar availability for Fender's blue butterfly by augmenting native forbs through seeding and/or outplanting plugs.
    - Seed/plant nectar and host plant species in experimental plots.
    - Maintain mid-elevation seed-production beds.
    - Augment the Kincaid's lupine population with plugs or seed; which may now include recovery zones outside of the Eugene East Recovery Zone.

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APPENDIX A. SUMMARY OF RESTORATION ACTIONS AT OAK BASIN (2014-2023)

For management actions occurring before 2014, see the specific year's annual report.

2024 Management Actions

- Felled seven trees and girdled one on the edges of Meadow D.
- Hand-pulled *Carduus pycnocephalus* from Meadows A and B.
- Hand-pulled *Brachypodium sylvaticum* from Meadow B.
- Spot-sprayed *Rubus bifrons* and *Rubus laciniatus* with Triclopyr (Garlon 3A) in meadows A, B, C, D. and on private land.
- Sprayed glyphosate and broadcast seed over lupine patches in Meadows A and B in the fall.
- Monitored *Lupinus oreganus* and *Sisyrinchium hitchcockii (*including lupine on adjacent property).
- Located *Eucephalus vialis* population east of Meadow C.
- Collected photo points across the Oak Basin project area.
- Monitored outplanting of *Lupinus oreganus* plugs at Oak Basin Tree Farm.
- Mowed one acre in meadow D.
- Removed solarization fabric and installed it on adjacent acre in Meadow D.
- Planted 78 lupine plugs in Merzenich Meadow.
- Planted 300 *Sidalcea malviflora*, 100 *Wyethia angustifolia*, *75 Balsamorhiza deltoidea*, and *50 Toxicoscordion venenosum*
- Broadcast 129 lbs upland prairie seed to Meadow D.
- Broadcast 2 lbs of *Lupinus oreganus* to Meadow D and A-B Corridor.
- Maintained mid-elevation seed beds, including *Sidalcea malviflora ssp. virgata*, *Iris tenax*, *Primula sect. Dodecatheon sp.*, *Achnatherum lemmonii*, *Sericocarpus rigidus*, and naked buckwheat.

2023 Management Actions

- Felled 11 trees, girdled one and limbed along north border of Meadow D.
- Installed approximately one acre of solarization fabric in Meadow D.
- Swamped limbs and created decomposition piles.
- Hand-pulled *Carduus pycnocephalus* from Meadows A and B.
- Mowed all experimental plots.
- Mowed *Rubus bifrons* in meadows A and D.
- Spot-sprayed *Rubus bifrons* and *Rubus laciniatus* with Triclopyr (Garlon 3A) in meadows A, B, C, and D.
- Established seed-production beds for *Sidalcea malviflora ssp. virgata* and *Iris tenax*.
- Monitored *Lupinus oreganus* and *Sisyrinchium hitchcockii*.
- Established photo points across Oak Basin project area.
- Monitored outplanting of *Lupinus oreganus* plugs at Oak Basin Tree Farm.

- Collected wild seed from *Rupertia physodes*, *Juncus ensifolius*, *Juncus patens, Juncus effusus*, and *Sisyrinchium hitchcockii*.

2022 Management Actions

- Limbed 17 large conifers and felled one.
- Swamped limbs and created burn piles.
- Hand-pulled *Carduus pycnocephalus* from Meadows A and B; cut *Rubus bifrons* from Meadows A and D
- Mowed *Lupinus oreganus* plots in meadow C and perimeter of plots in meadow A.
- Mowed *Rubus bifrons* in meadows A and D.
- Spot-sprayed *Rubus bifrons* and *Rubus laciniatus* with Triclopyr (Garlon 3A) in meadows A, B, and D.
- Collected wild seed from *Elymus glaucus*, *Bromus vulgaris*, *Eriophyllum lanatum*, *Luzula comosa*, *Lupinus oreganus*.
- Established seed-production beds for *Sidalcea malviflora ssp. virgata* and *Iris tenax*.
- Continued Eugene East Recovery Zone seed-production beds for *Lupinus oreganus*.
- Monitored *Lupinus oreganus* and *Sisyrinchium hitchcockii*.
- Took photo points in experimental plots.
- Monitored outplanting of *Lupinus oreganus* plugs at Oak Basin Tree Farm.

2021 Management Actions

- Site inspection and partner coordination.
- Tree removal over four acres of meadow between Meadows A and B and between Meadow A and the Oak Basin Tree Farm.
- Limbed 18 large conifers.
- Piled limbs into brush piles for burning.
- Hand-pulled *Carduus pycnocephalus* and *Cirsium vulgare* from Meadows B and C; cut *Rubus bifrons* from Meadows B and D.
- Collected *Lupinus oreganus* seed.
- Mowed *Lupinus oreganus* plots in Meadows A, B, and C.
- Spot-sprayed non-native species in all experimental plots with glyphosate.
- Took photo points in experimental plots.
- Broadcast seed in experimental plots.
- Continued Eugene East Recovery Zone seed-production beds for *Lupinus oreganus*.
- Monitored *Lupinus oreganus* and *Sisyrinchium hitchcockii*.
- Planted 495 plugs at the top of Meadow A.

2020 Management Actions

- Site inspection and partner coordination.
- Tree removal between Meadows B and C.

- Hand-pulled *Carduus pycnocephalus* from Meadow B, *Cytisus scoparius* from Meadow A, and grubbed *Rubus bifrons* from Meadow C.
- Installed restoration experimental plots.
- Collected *Lupinus oreganus* seed.
- Mowed *Lupinus oreganus* plots in Meadows A, B, and C, the furthest east subplot of all 10 experimental plots and a six-foot-wide path between Meadows A and B using a weed trimmer.
- Spot-sprayed non-native species in all experimental plots with Glyphosate.
- Removed a large tree in corridor between Meadows A and B.
- Flame-weeded two patches of annual grasses (A5 and A6) and all experimental plots in Meadow A. Activity approved by BLM fire duty officer Sean Sheldon.
- Took photo points.
- Broadcast a seed mix in flame-weeded patches A5 and A6.
- Cut down approximately 35 conifers along the forest/meadow edge in Meadow C.
- Established Eugene East Recovery Zone seed-production beds for *Lupinus oreganus*.
- Monitored *Lupinus oreganus* and *Sisyrinchium hitchcockii*.

2019 Management Actions

- Site inspection and partner coordination.
- Monitored 50 outplanted plugs of *Lupinus oreganus* on neighboring private land (Oak Basin Tree Farm); 18 survived.
- Cut seedlings and saplings from edges of Meadow A and between Meadows A and B.
- Grubbed *Rubus bifrons* in Meadows B and C.
- Pulled *Cytisus scoparius* and *Carduus pycnocephalus* in Meadows A and B.
- Flame-weeded patches for non-native annual and perennial graminoid control in all meadows, including three new flame-weeded patches and the *Sisyrinchium hitchcockii* population.
- Subcontracted the cutting of 60 trees between and along the edges of Meadows A and B ranging in size from 10 to 20 inches in diameter.
- Led an AmeriCorps Blue Five Team in the piling and moving of downed trees from the meadows and meadow corridor.
- Seeded areas disturbed by tree removal with a native forb and grass mix: *Danthonia californica* (0.87 lbs.), *Elymus glaucus* (1.10 lbs.), *Festuca roemeri* (0.34 lbs.), and *Wyethia angustifolium* (2.20 lbs.).

2018 Management Actions

- Site inspection and partner coordination.
- Monitored 38 outplanted plugs of *Lupinus oreganus* on neighboring private land (Oak Basin Tree Farm); 18 survived.
- Flame-weeded patches for *Taeniatherum caput-medusae* control and site preparation for seeding in Meadows A and B.
- Grubbed *Rubus bifrons*.

- Pulled *Cytisus scoparius, Carduus pycnocephalus*, and *Geranium lucidum* (geranium pulled near lupine patch 460 in Meadow A only).
- Cut seedlings and saplings from edges of all meadows. They were particularly concentrated in Meadow C.
- Mowed approximately one-third of *Lupinus oreganus* patches after senescence.
- Seeded flame-weeded areas (~0.67 acres) with a native forb and grass mix: *Danthonia californica* (1.87 lbs.), *Elymus glaucus* (1.45 lbs.), *Eriophyllum lanatum* (0.28 lbs.), *Koelaria micrantha* (0.09 lbs.), *Plectritis congesta* (0.46 lbs.), *Prunella vulgaris* (0.38 lbs.), and *Wyethia angustifolium* (3.27 lbs.).

2017 Management Actions

- Site inspection and partner coordination.
- Outplanted 68 plugs of *Lupinus oreganus* on neighboring private land (Oak Basin Tree Farm)
- Flame-weeded patches for *Taeniatherum caput-medusae* control and site preparation for seeding.
- Grubbed *Rubus bifrons.*
- Seeded *Danthonia californica* 2.37 lbs, *Elymus trachycaulis* 2.0 lbs, *Eriophyllum lanatum* 1.28 lbs, *Festuca roemeri* 3.41lbs, *Plectritis congesta* 1.18 lbs, *Prunella vulgaris* var. *lanceolata* 0.75 lbs, and *Sidalcea malviflora* spp. *virgata 1.0 lbs.*
- Mowed approximately one-third of *Lupinus oreganus* patches after senescence.
- Hand-mowed flame-weeded plots A3, A4, B3, and B4 in Meadows A and B.

2016 Management Actions

- Site inspection and partner coordination.
- Flame-weeded *Taeniatherum caput-medusae* control and site preparation for planting/seeding.
- Grubbed *Rubus bifrons.*
- Removed small-diameter conifers around perimeter of meadows.
- Hand-weeded *Cytisus scoparius.*
- Mowed 1/3 of all *Lupinus oreganus* patches.
- Planted plugs: 40 *Danthonia californica*, 50 *Iris tenax,* and 400 *Sidalcea malviflora* ssp. *virgata.*

2015 Management Actions

- Site inspection and partner coordination.
- Grubbed *Rubus bifrons.*
- Removed small-diameter conifers around perimeter of meadows.
- Removed, limbed, or girdled trees around edges of meadows and in corridors between meadows. Similar work also done on adjacent Merzenich property.
- Flame-weeded patches for *Taeniatherum caput-medusae* control and site preparation for planting/seeding.
- Planted native plugs: 280 *Danthonia californica*, 100 *Elymus trachycaulis*, 150 *Festuca californica*, 200 *Festuca roemeri*, 1200 *Geranium oreganum*, 2000 *Iris tenax*, 120 *Lomatium dissectum*, and 5600 *Sidalcea malviflora* ssp. *virgata.*

- Seeded 3.15 lbs *Danthonia californica*, 1.5 lbs. *Eriophyllum lanatum*, 9.40 lbs. *Festuca californica*, 6.0 *Festuca roemeri*, 3.0 lbs. *Prunella vulgaris* var. *lanceolata*, and 3.0 lbs. *Sidalcea malviflora* ssp. *virgata*.
- Mowed 1/3 of all *Lupinus oreganus* patches.

APPENDIX B. PHOTO POINTS

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Upper Oak Basin – Meadow D: photo point 01 May 31, 2024

Upper Oak Basin – Meadow D: photo point 02 May 31, 2024

NORTH

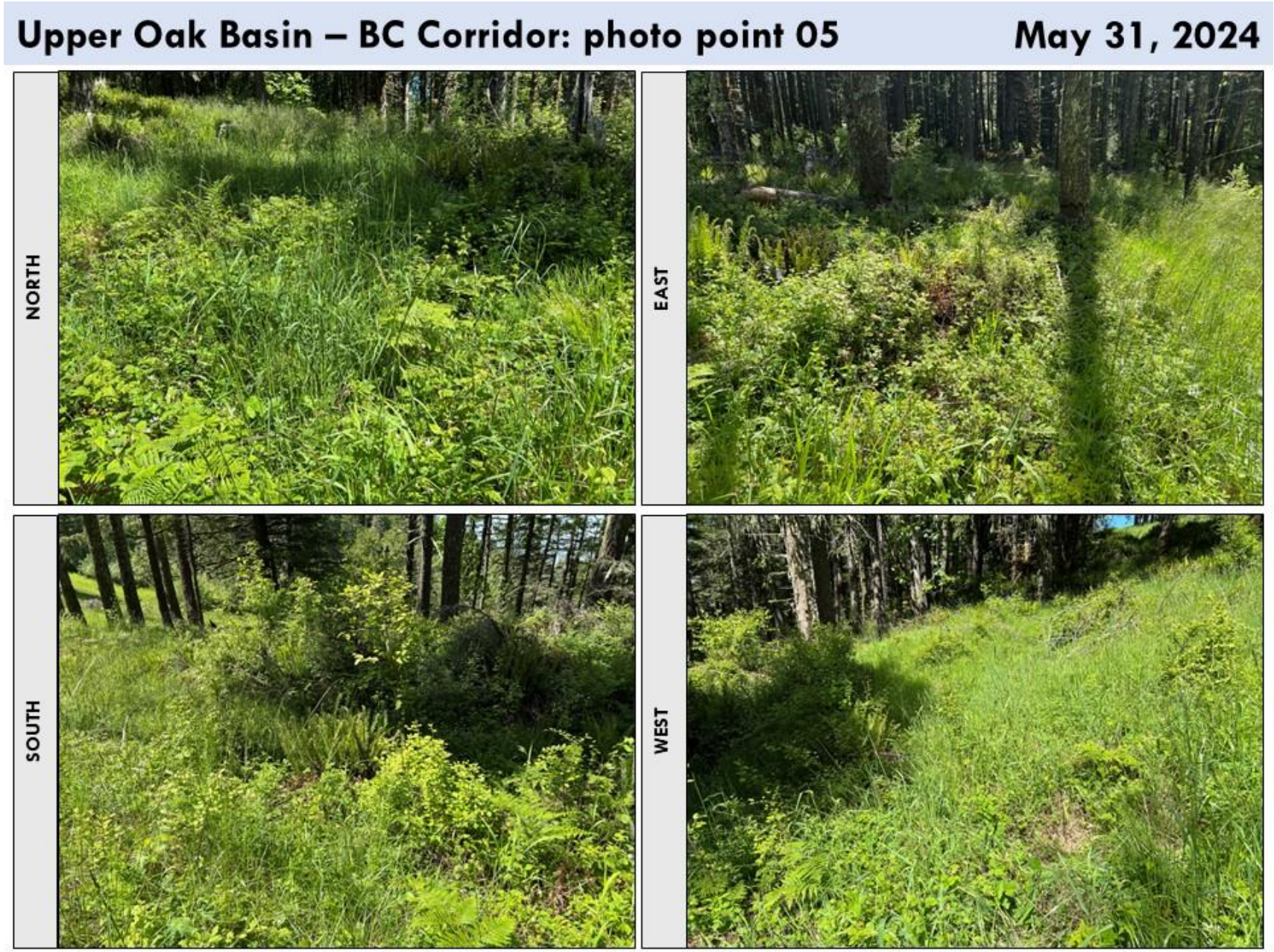
EAST

SOUTH

WEST

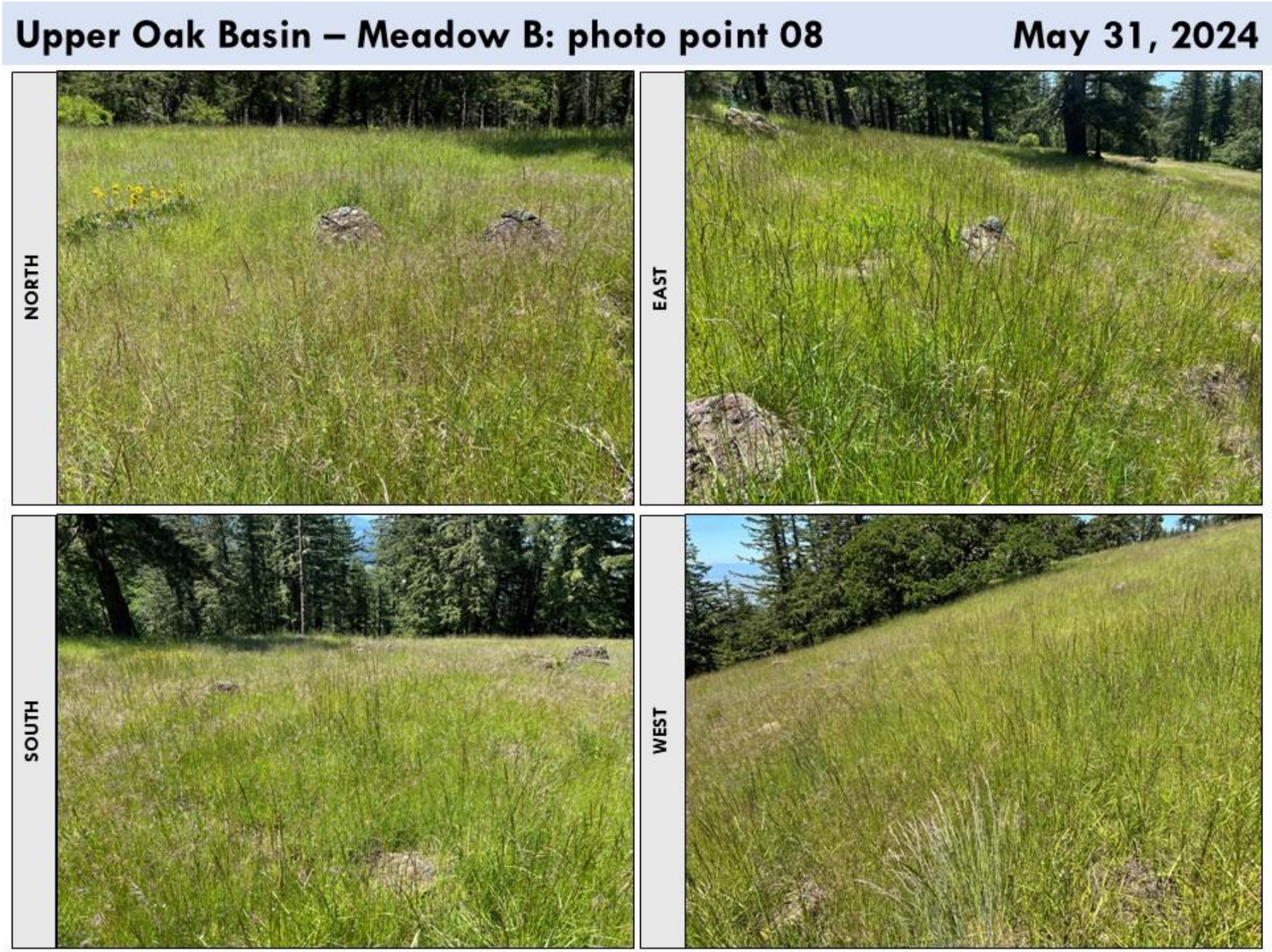
Upper Oak Basin – Meadow C: photo point 03 May 31, 2024

Upper Oak Basin – Meadow C: photo point 04 May 31, 2024


Upper Oak Basin – BC Corridor: photo point 05
May 31, 2024
NORTH
EAST
SOUTH
WEST

Upper Oak Basin – Meadow B: photo point 06 May 31, 2024

Upper Oak Basin – Meadow B: photo point 07 May 31, 2024


Upper Oak Basin – Meadow B: photo point 08
May 31, 2024
NORTH
EAST
SOUTH
WEST

Upper Oak Basin – Meadow B: photo point 09 May 31, 2024


Upper Oak Basin – AB Corridor: photo point 10
May 31, 2024
NORTH
EAST
SOUTH
WEST

Upper Oak Basin – Meadow A: photo point 11 May 31, 2024

NORTH

EAST

SOUTH

WEST

Upper Oak Basin – Meadow A: photo point 12 May 31, 2024

Upper Oak Basin – Meadow A: photo point 13 May 31, 2024

NORTH

EAST

SOUTH

WEST

Upper Oak Basin – Meadow A: photo point 14 May 31, 2024

Upper Oak Basin – Merzenich Meadow: photo point 15 May 31, 2024

Upper Oak Basin – Merzenich Meadow: photo point 16 May 31, 2024

NORTH

EAST

SOUTH

WEST

APPENDIX C. KINCAID'S LUPINE COVER AND RACEME COUNTS BY PLOT (2013-2024)

Table C- 1. Count of Kincaid's lupine racemes by plot from 2014-2024. Previous years data are available in previous years reports.

	Plot	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Meadow A	7	36	10	12	201	62	145	164	7	40	33	103
	8	1	-	-	4	6	9	19	-	0	0	0
	9	146	24	5	49	30	25	162	14	56	28	228
	10	18	3	-	8	3	3	29	4	0	0	0
	369					50	-	8	14	96	0	
	406	-	-	2	1	-	1	12	-	6	0	68
	450	30	21	22	29	7	93	251	111	1000	481	991
	451	4	-	-	16	-	-	-	-	5	0	2
	452	93	9	-	129	34	25	116	67	433	164	736
	454	10	-	-	36	3	27	42	15	322	59	409
	459	361	9	-	1,069	669	1,142	555	517	2968	1436	2525
	460	192	12	117	206	785	589	223	365	753	594	998
	464	118	2	-	126	23	90	83	12	315	79	818
	509	52	30	51	56	239	462	550	176	190	565	406
	510	14	4	-	1	8	14	43	15	51	19	49
	511	33	5	-	65	65	127	56	86	65	423	241
	653						23	7	-	18	16	64
	New											56
	New											72
	New											41
Meadow A Total		**1,108**	**129**	**209**	**1,996**	**1,984**	**2,775**	**2,320**	**1,403**	**6,318**	**3,897**	**7,807**
Meadow B	1	309	31	43	441	379	198	222	175	542	262	603
	2	1	1	-	3	1	-	-	-	0	0	0
	3	21	7	13	15	5	16	49	72	131	76	53
	4	23	7	-	40	2	6	-	6	28	38	3
	5	114	50	25	19	22	67	134	184	181	137	24
	6	125	24	21	51	107	36	80	71	339	136	166
	399	34		95	167	71	200	330	119	408	138	244
Meadow B Total		**627**	**120**	**197**	**736**	**587**	**523**	**815**	**627**	**1,629**	**787**	**1093**
Meadow C	184	-	-			1	3	7	13	4	10	36
	233		-		2	-	4	2	8	12	0	5
	400	1	1	3	-	-	2	7	-	222	0	0
	431	20	8	-	62	32	99	162	70	777	88	161
	432	173	86	187	408	322	741	1,010	251	596	383	390
	433	117	82	14	408	78	372	213	94	81	47	150
	594			13	1	38	44	12	6	4	26	4

	Plot	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Meadow C Total		311	177	217	881	471	1,265	1,413	442	1,692	554	746
Grand Total		2,046	426	623	3,613	3,042	4,563	4,548	2,472	9,639	5,238	9,646

Table C- 2. Kincaid's lupine foliar cover by plot from 2014-2024. (Data from previous years is available in previous years reports.)

	Plot	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Meadow A	7	2.9	1.8	1.9	2.8	1.8	2.1	4.1	0.4	2.2	2.5	2.8
	8	0.2	0.1	0.1	0.3	0.4	0.3	0.5	0	0	0.0	0.0
	9	6.4	3.2	2.2	4.7	6	4.3	7.4	1.8	7.6	8.4	8.8
	10	0.8	0.4	0.6	0.5	0.6	0.5	0.8	0.5	0.1	1.4	0.0
	369					10.9	7.8	13.8	14	21.5	21.0	28.6
	406	0.3	0	0.1	0.3	0.4	0.5	0.4	0.2	0.4	0.2	2.2
	450	11.3	7.5	3.9	6.2	7.4	15	10.5	13.5	22.4	34.7	44.5
	451	1.6	0.6	0.9	1.4	1.4	0.5	0.9	0.6	1.6	3.3	1.4
	452	10	8.5	3.8	11.1	10.4	8	8.3	12.8	20.2	34.0	38.1
	454	5.7	2.6	1.3	6.8	6.4	4.7	5.7	6.9	8.1	27.0	19.3
	459	19.3	11.9	16.8	26.3	39.3	25.1	35.2	29.9	38.2	40.4	72.5
	460	4.8	3	2.5	6.5	6.4	10.1	8.7	9.9	10.8	14.7	18.8
	464	13.8	6.4	7.9	17.4	12	14.9	9.6	7.3	20.9	36.8	52.3
	509	1.5	1.6	0.7	2.3	5	7.1	10.4	5.3	9.2	13.5	12.9
	510	1.4	1.3	0	0.1	0.8	1.6	2.2	1.3	3	6.9	2.8
	511	0.5	0.3	4.5	0.8	1.2	1.2	1.4	1.5	1.2	5.0	3.2
	653						2.1	0.9	0.6	2.4	3.5	8.0
	New											3.8
	New											9.6
	New											6.1
Meadow A Total		**80.4**	**49.2**	**47.3**	**87.5**	**110.3**	**105.5**	**120.8**	**106.6**	**169.9**	**253.3**	**335.8**
Meadow B	1	31.3	11.8	8.8	23.2	12.1	13.5	16.9	18.9	21.3	18.2	30.2
	2	0.5	0.1	0	0.1	0	0	0	0.1	0	0.0	0
	3	3.2	1.6	1.5	1.3	0.5	1	3.6	2.6	2.9	7.6	5.0
	4	2.5	0.7	0.9	1.5	0.4	1.1	0.7	0.9	0.8	1.2	1.7
	5	6.2	4.3	1.7	1.6	4.5	3.8	5.9	4.8	5.8	6.4	10.9
	6	4.6	2.9	2.3	2.5	4.3	1.9	3.8	4.2	7.2	5.9	12.8
	399	3.3	0	3.7	4.6	6.1	6.1	9.4	3.9	8.9	7.1	10.3

	Plot	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Meadow B Total		**51.6**	**21.4**	**18.9**	**34.7**	**27.9**	**27.4**	**40.3**	**35.3**	**46.9**	**46.4**	**71.0**
Meadow C	184	0	0			0.1	0.2	0.4	0.6	0	2.0	3.4
	233		0		0.1	0	0.1	0.1	0	0.2	0.1	0.2
	400	0.1	0	0	0	0.1	0.1	0.1	0	5.9	0.0	0.0
	431	2.7	3.1	1.6	3.9	2.6	4.4	6.1	4.8	14.4	9.4	15.4
	432	10.1	9.4	7.4	12.2	12.4	20.4	16.1	8.2	7	17.0	21.1
	433	4.8	9.1	4.3	12.3	8.7	9.1	6.6	7.3	3.1	9.0	11.8
	594			0.7	0.9	1.3	1.5	1.8	2.2	0	3.7	4.9
Meadow C Total		**17.8**	**21.7**	**14**	**29.5**	**25.2**	**35.6**	**31.1**	**23.1**	**30.5**	**41.1**	**56.7**
Grand Total		**149.8**	**92.3**	**80.2**	**151.7**	**163.4**	**168.6**	**192.3**	**164.9**	**247.3**	**340.8**	**463.6**

***Values with 0.0 do not show due to rounding. Some Kincaid's lupine is present. Blanks indicate that the plot was not monitored or established in that year.**

APPENDIX D. TOTAL NUMBER OF MATURE RACEMES AND PERCENT RACEMES ABORTED OF KINCAID'S LUPINE (*LUPINUS OREGANUS*) AT OAK BASIN FROM 2006 TO 2024

Table D- 1. Total number of mature racemes and percent racemes aborted of Kincaid's lupine (*Lupinus oreganus*) at Oak Basin from 2006 to 2024.

	Meadow A		Meadow B		Meadow C		Grand Total	
	Mature Racemes	Percent Aborted	Mature Racemes	Percent Aborted	Mature Racemes	Percent Aborted	Mature Racemes	Percent Aborted
2006	245	13%	375	9%	145	6%	765	10%
2007	881	28%	1,482	7%	810	4%	3,173	13%
2008	891	21%	1,027	13%	432	3%	2,350	15%
2009	415	31%	1,004	17%	55	38%	1,474	23%
2010	1,860	5%	1,678	4%	108	28%	3,646	5%
2011	1,978	3%	1,845	3%	192	6%	4,015	3%
2012	1,328	3%	969	2%	127	0%	2,424	3%
2013	71	58%	122	55%	44	46%	237	55%
2014	1,108	4%	627	1%	311	0%	2,046	2%
2015	129	46%	120	35%	177	11%	426	32%
2016	209	2%	197	3%	217	37%	623	18%
2017	1,996	2%	736	3%	881	2%	3,613	2%
2018	1,984	1%	587	2%	471	1%	3,042	1%
2019	2,775	24%	523	26%	1,265	13%	4,563	24%
2020	2,320	8%	815	10%	1,413	4%	4,548	7%
2021	1,403	12%	627	13%	442	13%	2,472	12%
2022	6,318	5%	1,629	6%	1,692	6%	9,639	5%
2023	3,897	19%	787	33%	554	29%	5,238	22%
2024	7,807	0%	1,093	0%	746	0%	9,646	0%

Table D- 2. Total Kincaid's lupine (*Lupinus oreganus*) cover and number of racemes per m^2 of Kincaid's lupine foliar cover at Oak Basin from 2006 to 2024.

	Meadow A		Meadow B		Meadow C		All Meadows	
	Cover (m^2)	Mature racemes/m^2	Cover (m^2)	Mature racemes/m^2	Cover (m^2)	Mature racemes/m^2	Cover (m^2)	Mature racemes/m^2
2006	39.3	6	44.9	8	11.5	13	95.7	8
2007	37.3	24	37.7	39	21.1	38	96.1	33
2008	45.3	20	45.9	22	10.6	41	101.8	23
2009	49.5	8	50.1	20	10.7	5	110.3	13
2010	65.3	28	49.6	34	12.0	9	126.9	29
2011	86.8	23	60.3	31	15.2	13	162.3	25
2012	86.5	15	70.0	14	13.6	9	170.1	14
2013	42.9	2	25.5	5	11.2	4	79.6	3
2014	80.4	14	51.6	12	17.8	17	149.8	14
2015	49.2	3	21.4	6	21.7	8	92.3	5
2016	47.3	4	18.9	10	14.0	15	80.2	8
2017	87.5	23	34.7	21	29.5	30	151.7	24
2018	110.3	18	27.9	21	25.2	19	163.4	19
2019	105.5	26	27.4	19	35.6	36	168.5	27
2020	120.8	19	40.0	20	31.1	45	192.3	24
2021	106.6	13	35.3	18	23.1	19	164.9	15
2022	169.9	37	46.9	35	30.5	55	247.3	39
2023	253.3	15	46.4	17	41.1	13	340.8	15
2024	335.8	25	71.0	15	56.7	13	463.6	21

APPENDIX E. *SISYRINCHIUM HITCHCOCKII* SIZE CLASS AND REPRODUCTIVE SUMMARY

Table E- 1. Count of number of Hitchcock's blue-eyed grass (*Sisyrinchium hitchcockii*) stems by size class in Meadow C at Oak Basin from 2012 to 2024. "R" numbers represent the number of inflorescences recorded per stem (R1, R2, R3, etc.).

Size Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Vegetative	42	47	26	44	30	15	17	18	11	26	19	38	28
R1	55	40	17	13	8	21	12	17	29	14	21	17	7
R2	14	10	9	5	2	20	10	9	19	22	7	3	6
R3	7	5	5	1	1	8	4	15	15	5	1	2	1
R4	1	1	7	0	1	1	1	3	8	0	1	1	0
R5	1	1	0	1	0	1	1	1	6	0	2	0	0
R6	1	0	12	0	0	0	0	0	3	0	0	0	0
R7	0	0	7	0	0	0	0	1	2	0	0	1	0
R8	0	1	0	0	0	0	0	0	0	0	0	0	0
R9	1	0	0	0	0	0	0	1	0	0	0	0	0
R10	0	0	0	0	0	0	0	1	1	0	0	0	0
R11	0	0	0	0	0	0	0	1	1	0	0	0	0
R12	0	0	1	0	0	0	0	1	0	0	0	0	0
R13	0	0	0	0	0	0	0	0	0	0	0	0	0
R14	0	0	1	0	0	0	0	1	0	0	0	0	0
R19	0	0	0	0	0	0	1	0	0	0	0	0	0
R21	0	0	0	0	0	0	0	1	0	0	0	0	0
Total Reproductive Individuals	**80**	**58**	**59**	**20**	**12**	**51**	**29**	**52**	**84**	**21**	**32**	**24**	**14**
Total Reproductive Stems	128	92	225	31	19	89	72	160	206	33	52	40	22
Total number of plants	**122**	**105**	**85**	**64**	**42**	**66**	**46**	**70**	**95**	**47**	**51**	**62**	**42**

APPENDIX F. LOCATION OF KINCAID'S LUPINE PLOTS BY MEADOW

Meadow A

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Figure F- 1. Map of Kincaid's lupine (*Lupinus oreganus*) monitoring plots in Meadow A.

Meadow B

Image removed from web version

Figure F- 2. Map of Kincaid's lupine (*Lupinus oreganus*) monitoring plots in Meadow B.

Meadow C

Image removed from web version

Figure F- 3. Map of Kincaid's lupine (*Lupinus oreganus*) and blue-eyed grass (*Sisyrinchium hitchcockii*) monitoring plots in Meadow C.

Private Property

Image removed from web version

Figure F- 4. Map of Kincaid's lupine (*Lupinus oreganus*) patches on private property mapped in 2023.

Lower Oak Basin

Image removed from web version

Figure F- 5. Map of Kincaid's lupine (*Lupinus oreganus*) patches at Lower Oak Basin mapped in 2023.

APPENDIX G. LOCATION, DIMENSIONS, AND MONITORING NOTES FOR PLOTS AT OAK BASIN

Table G- 1. Location, dimensions, and monitoring notes for Kincaid's lupine (*Lupinus oreganus*) and Hitchcock's blue-eyed grass (*Sisyrinchium hitchcockii*; in bold) plots at Oak Basin.

Meadow	Plot Number	Dimensions	origin (Nad27)	Notes
A	7	23m x 12m	504288 E 4906986 N	Measured in 2m increments
A	8	Circular, 2m radius	504259 E 4907001 N	Measured entire plot as one. Fallen log partially on plot.
A	9	18m x 14m	504286 E 4906960 N	Measured in 2m increments
A	10	Circular, 2m radius	504312 E 4906952 N	Measured in 4 quadrats: NW, NE, SW, and SE
A	459	13m x 12m	504246 E 4906964 N	Measured in 3m increments
A	454	20m x 13m	504210 E 4906979 N	Measured in 4m increments. 3 individuals 8m and 48° from origin.
A	464	20m x 26m	504183 E 4906999 N	Measured in 2m increments
A	450	90m x 7m	504232 E 4907030 N	Measured in 5m increments (E-W)
A	451	8m x 7m	504132 E 4906987 N	Measured in 2m increments (N-S)
A	452	25m x 35m	504156 E 4907003 N	Measured in 2m increments
A	460	22m x 16m with extension	504274 E 4906955 N	Measured in 4m increments
A	406	Circular, 2m radius	504101 E 4907056 N	Measured in 4 quadrants: NW, NE, SW, and SE
A	509	Circular, 1.5m radius	504199 E[1] 4907048N[1]	New in 2011. Measured in 4 quadrats: NW, NE, SW, and SE.
A	510	6m x 10m	503967 E[1] 4907105 N[1]	New in 2011. Measured in 1m increments N-S; 1m segment measured from E-W.
A	511	3m radius	504702 E[1] 4907160 N[1]	Changed plot to 4 quadrants (NW, NE, SW, and SE) in 2018
A	369	14m x 12m		New in 2018. Measured in 2m increments N-S.
A	653	16m x 11m	504136 E 4907160 N	New 2019, Measured in 2m segments N-S.

Meadow	Plot Number	Dimensions	origin (Nad27)	Notes
B	1	60m x 18m+	504420 E 4906668 N	Measured in 5m increments
B	2	Triangular adjacent to Plot 3	504503 E 4906649 N	Measured entire plot as 1
B	3	12m x 18m (20m)	504514 E 4906646 N	Measured in 2m increments
B	4	Circular, 3m radius	504545 E 4906630 N	Measured in 4 quadrats: NW, NE, SW, and SE
B	5	12m x 9m	504597 E 4906570 N	Measured in 2m increments, except the last, which was 3m
B	6	11m belt transect	504628 E 4906559 N	Measured in 2m increments to each side until last plant
B	399**	11m x 14m-16m plot	504326 E 4906806 N	Measured E-W in 2m increments
B	Plot 2 Tag 558	12m x 6.8m x 13.7m	504413 E[1] 4906842 N[1]	New in 2014, plot is triangular, directly adjacent to Plot 3.
C	594	12m belt	See map	New in 2017. Measured in 2m increments on each side (N&S).
C	233	1m radius	See map	New in 2017. Measured entire plot as one.
C	1(185)[2]	14m belt transect	504639 E[1] 49065659N[1]	Measured in 1m increments on each side (E&W)
C	2 (186)[2]	2m radius	504655 E[1] 4906555N[1]	Measured in 4 quadrats: NW, NE, SW, and SE
C	433	8m belt transect	504712 E 4906379 N	Measured in 2m increments on each side (N&S)
C	432	8m x 9m	504649 E 4906401 N	Measured in 2m increments
C	431	18m belt transect	504732 E 4906378 N	Measured in 1m increments on each side (E & W)
C	400	1m radius	504609 E [1] 4906553 N[1]	New in 2012; along tree line in *Rupertia physodes*

[1] Coordinates are in NAD83 instead of NAD27.
[2] Plots 1 (185) and Plot 2 (186) in Meadow C are SIHI plots.
** There is a large patch of Kincaid's lupine at the SW end of Meadow B, which is on private property. Plot 399 captures the lupine nearest the public/private boundary.

APPENDIX H. SPECIES OBSERVED IN RELEVE PLOTS IN 2020 AND 2023

Relevé plots were surveyed in 2020 and 2023. Values in bold were found in both years, values struck through indicate species present in 2020 not observed in 2023. "New" species noted in 2023 or 2024 are noted with (2023 or 2024). Plants preceded with * were noted in 2024 as well as in other years.

	Meadow (plot #)		
	A (696)	**B (691)**	**C (690)**
Non-native forbs	Cirsium vulgare (2024) Centaurium erythraea (2024) Crepis setosa (2024) ~~*Cerastium glomeratum*~~ ~~*Dianthus armeria*~~ ~~*Galium parisiense*~~ ***Hypericum perforatum*** ***Leucanthemum vulgare*** ***Linum bienne*** ~~*Myosotis discolor*~~ ***Plantago lanceolata*** ~~*Sherardia arvense*~~ ~~*Taraxacum officinale*~~ ***Torilis arvensis (2024)*** ***Tragopogon dubius*** ~~*Comandra umbellata*~~ ~~*Veronica arvensis*~~ *Vicia sativa (2023) *Vicia tetrasperma (2024)*	~~*Cerastium glomeratum*~~ ***Geranium dissectum*** ***Hypericum perforatum*** ***Leucanthemum vulgare*** *Linaria grandis (2023)* ***Linum bienne*** ~~*Medicago lupulina*~~ ~~*Plantago lanceolata*~~ ~~*Prunella vulgaris*~~ ***Rumex acetosella*** ~~*Sherardia arvense*~~ ~~*Torilis arvensis*~~ ***Tragopogon dubius*** ~~*Unk. forb 1*~~ ***Vicia sativa***	Carduus pycnocephalus (2024) ~~*Centaurium erythraea*~~ ***Dianthus armeria*** ***Geranium dissectum*** ***Hypericum perforatum*** ~~*Hypochaeris radicata*~~ ***Leucanthemum vulgare*** ***Linum bienne*** ~~*Lotus micranthus*~~ ~~*Medicago lupulina*~~ *Myosotis discolor (2023)* ***Plantago lanceolata*** ~~*Sherardia arvense*~~ *Sonchus asper (2024)* ~~*Torilis arvensis*~~ ~~*Veronica arvensis*~~ ***Vicia sativa***

Native forbs	***Achillea millefolium** ~~*Brodiaea coronaria~~ ~~Calochortus tolmiei~~ ***Clarkia amoena** ~~Clarkia purpurea~~ ***Eriophyllum lanatum** *Fragaria vesca (2023) ~~Fragaria virginiana~~ ~~*Leptosiphon bicolor~~ ***Madia gracilis**	***Achillea millefolium** Brodiaea sp. (2024) ***Clarkia amoena** Cynoglossum grande (2023) ~~Dichelostemma capitatum~~ ***Eriophyllum lanatum** ***Fragaria vesca** ~~Fragaria virginiana~~ ***Iris tenax** Madia sp (2023) Symphyotrichum hallii (2024) ~~*Viola nuttallii~~	***Achillea millefolium** Allium sp. (2023) **Balsamorhiza sagittata** *Brodiaea coronaria (2023) ~~*Calochortus tolmiei~~ Castilleja tenuis (2025) ***Clarkia amoena** ***Eriophyllum lanatum** *Fragaria vesca (2023) ~~Fragaria virginiana~~ Ligusticum apiifolium (2023) ***Madia elegans** ~~Polygonum sp.~~ ***Potentilla gracilis** ~~Ranunculus occidentalis~~ Symphyotrichum hallii (2024) Wyethia angustifolia (2024)
Non-native graminoids	~~Agrostis capillaris~~ ***Aira caryophyllea** ***Bromus hordeaceus** **Bromus japonicus (2024)** ~~Bromus sterilis~~ ***Cynosurus echinatus** ***Dactylis glomerata** ***Schedonorus arundinaceus** ~~*Vulpia bromoides~~ *Taeniatherum caput-medusae (2023)	~~Agrostis capillaris~~ ~~Aira caryophyllea~~ Alopecurus sp. (2024) ~~*Bromus hordeaceus~~ Bromus japonicus (2024) ~~Bromus sterilis~~ ***Cynosurus echinatus** ~~*Dactylis glomerata~~ ~~Phleum pratense~~ ***Schedonorus arundinaceus** ~~*Vulpia bromoides~~	~~Agrostis capillaris~~ Alopecurus sp. (2024) ~~Briza minor~~ **Bromus hordeaceus** **Bromus japonicus (2024)** ***Cynosurus echinatus** ~~Dactylis glomerata~~ ~~Holcus lanatus~~ ~~Phleum pratense~~ ***Schedonorus arundinaceus** ~~*Taeniatherum caput-medusae~~ Vulpia bromoides (2024)

Native graminoids	***Bromus carinatus** ~~*Danthonia californica~~ ~~*Elymus trachycaulus~~ ***Festuca roemeri** ~~*Koeleria macrantha~~ ~~*Luzula comosa~~	***Bromus carinatus** ~~*Danthonia californica~~ ***Elymus glaucus** ***Elymus trachycaulus (2024)** *Festuca roemeri (2023) ~~*Luzula comosa~~	***Bromus carinatus** *Carex tumulicola (2023) ~~*Danthonia californica~~ ***Elymus glaucus** ***Elymus trachycaulus** ***Festuca roemeri** ***Luzula comosa**
Shrub/tree		*Amelanchier alnifolia (2023) ~~Crataegus suksdorfii~~ ***Quercus garryana**	