Population status of Kincaid's lupine (*Lupinus oreganus*) in the BLM Roseburg District: 2023 annual report

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Report for the Bureau of Land Management, Roseburg District

Report prepared by J. Christina Mitchell and Scott Harris

Institute for Applied Ecology

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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.

Questions regarding this report or IAE should be directed to:

Thomas Kaye (Executive Director)
Institute for Applied Ecology
4950 SW Hout St.
Corvallis, OR 97333

phone: 541-753-3099
fax: 541-753-3098
email: info@appliedeco.org

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Cover photograph: Kincaid's lupine (*Lupinus oreganus*) raceme beginning to flower at Stout's Creek. All photographs by J. Christina Mitchell unless documented otherwise.

SUGGESTED CITATION

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EXECUTIVE SUMMARY

Only a few remnant populations of Kincaid's lupine (*Lupinus oreganus*) exist in Douglas County, forming the southern edge of this threatened species' range. The Institute for Applied Ecology (IAE) has been monitoring Kincaid's lupine on the Bureau of Land Management (BLM) Roseburg District since 2003. We monitor the status of Kincaid's lupine populations by assessing foliar (leaf) cover and counting racemes at multiple sites on the Roseburg District.

Based on this long-term dataset, we conclude that Kincaid's lupine is in steep decline on the Roseburg District. In 2022, cover of Kincaid's lupine at the sites we monitored was the lowest observed since 2003, with only a slight recovery in 2023.

In 2023, we assessed populations at the Callahan Meadows, China Ditch, Dickerson Heights, Letitia Creek, and Stout's Creek. Compared to averages from the previous three years of data (between 2019 and 2022 based on data availability), foliar cover declined at every site monitored by IAE (and by half or more in four out of five sites). No monitored site had greater than 20 m^2 foliar cover of Kincaid's lupine, and one site had only 0.6 m^2 Kincaid's lupine cover. However, Kincaid's lupine foliar cover increased at three monitored sites between 2022 and 2023. The number of total racemes in 2023 was greater than those counted in 2022 at three out of five monitored sites. The number of aborted racemes was greater than those counted in 2022 at four out of five monitored sites. With a recovery goal of 5,000 m^2 of occupied Kincaid's lupine habitat in at least two meta-populations in Douglas County, the Douglas County recovery zone does not meet these goals at this time and continued monitoring and management are recommended.

The most substantial and consistent increase in Kincaid's lupine cover occurred following canopy thinning in 2009 and 2010. While we cannot attribute causation to the thinning (because we didn't conduct an manipulative experiment), we recommend population-wide thinning in order to arrest the steep decline in Kincaid's lupine in the Roseburg District.

1. INTRODUCTION

Kincaid's lupine (*Lupinus oreganus*), a member of the legume family (Fabaceae), is an herbaceous perennial that forms clumps of basal leaves which subsequently produce one or more flowering stems. Kincaid's lupine is listed as a threatened species by the Oregon Department of Agriculture and the U.S. Fish and Wildlife Service. This species is a host plant for larvae of the Fender's blue butterfly (*Icaricia icarioides fender*; Figure 1), also listed as a threatened species (recently downgraded from endangered; U.S. Fish and Wildlife Service 2023). Kincaid's lupine reproduces by seed, a process dependent on insects for successful fertilization and seed formation (Kaye 1999), and spreads vegetatively, though it is unknown to what extent genetic diversity occurs with vegetative growth. To date, Fender's blue does not occur in Douglas County and there are no historical records of Fender's and Kincaid's lupine co-occurring in this area.

Kincaid's lupine is found in native prairie remnants in the Willamette Valley and forest openings in Douglas County, Oregon, and southwestern Washington. Few remnant populations of Kincaid's lupine exist in Douglas County; seven extant populations are located on BLM land, four are found on private land, and one population is managed by the U.S. Forest Service (Mouallem and Giles 2020).

Figure 1. Fender's blue butterfly (*Icaricia icarioides fenderi*) on Kincaid's lupine (*Lupinus oreganus*) at Baskett Slough National Wildlife Refuge. Photograph by Soledad Diaz.

Previous work by IAE in the BLM Roseburg District consisted of population surveys beginning in 2003 at six sites (Giles-Johnson et al. 2011) and population augmentation efforts from 2016 to 2017 using Kincaid's lupine collected from BLM populations (Giles and Bahm 2017, Mouallem and Giles 2020). The BLM Roseburg District partnered with IAE in 2021 to conduct a three-year long project to continue long-term monitoring of Kincaid's lupine populations and the effects of management on five known populations within areas managed by the BLM Roseburg District. Populations of Kincaid's lupine are censused at Callahan Meadows, Dickerson Heights, and Letitia Creek, while populations at China Ditch and Stout's Creek are too large for censusing and therefore sub-sampled. In 2023, we visited areas of Kincaid's lupine, outplanted in 2017 and last monitored in 2020, at Callahan Meadows and Stout's Creek to assess survival and reproductive status.

2. GOALS AND OBJECTIVES

The goal of this project is to continue long-term monitoring of Kincaid's lupine populations within areas managed by the BLM Roseburg District (the southernmost portion of this species' range). These efforts help conserve genetic diversity to benefit the long-term survival of this species.

Specific objectives include:

1) Continue long-term monitoring of Kincaid's lupine populations at Callahan Meadows, China Ditch, Dickerson Heights, Letitia Creek, and Stout's Creek;

2) Assess survival and reproductive status of outplanted Kincaid's lupine at Callahan Meadows and Stout's Creek; and

3) Determine potential threats to Kincaid's lupine populations at all sites and suggest management actions for population enhancement.

3. METHODS

3.1. Site Description

Layouts of monitoring plots varied based on the different characteristics of the population or subpopulations at each site. Brief site descriptions are included below; please refer to previous reports for further details (Mouallem and Giles 2020). Monitoring plots were designated by relocatable units or transect segments to facilitate long-term detection and to consistently track Kincaid's lupine population densities. Kincaid's lupine populations at Callahan Meadows, Dickerson Heights, and Letitia Creek were censused, and populations at China Ditch and Stout's Creek were sub-sampled. Foliar cover was estimated, mature racemes were counted, and aborted racemes were counted within monitoring areas at each site.

Callahan Meadows – Census; two subpopulations

Callahan Meadows is located near Tiller, OR, and monitoring began in 2003. This is the only known Kincaid's lupine site in the Roseburg District that could potentially support Fender's blue butterfly because the surrounding plant communities provide adequate nectar resources, and the site is not alongside a road. This Kincaid's lupine population is also polyploidy, suggesting it is genetically distinct from other Kincaid's lupine populations (Severns 2008). About 1900 Kincaid's lupine plugs were planted near the naturally-occurring population in 2017 and remonitored in 2023.

China Ditch – Sub-sample; three subpopulations

China Ditch is located near the China Ditch Historic Site northeast of Myrtle Creek, OR, and monitoring began in 2004. As a subsample, transect layout is intended to represent the variability in Kincaid's lupine cover across the site and represents a consistently-sampled portion of the China Ditch population. Vegetation thinning occurred in 2009 and current vegetation, comprised of shrubs and vast amount of poison oak (*Toxicodendron diversilobum*), is heavily overgrown.

Dickerson Heights – Census; one population

Dickerson Heights is located about nine miles southwest of Winston, OR, and monitoring began in 2005. Thinning of small trees and shrubs occurred on site in 2009 and 2010 and monitoring plots expanded in subsequent years to accommodate the growing Kincaid's lupine population.

Letitia Creek – Census; two subpopulations

Letitia Creek is located about 11 miles east of Myrtle Creek, OR, and monitoring began in 2003. There are two populations on public land, but most plants in this area are on private property and not monitored by IAE. Thinning of small trees and shrubs occurred on site in 2009 and 2010, and current vegetation is overgrown.

Stout's Creek – Sub-sample; two subpopulations

Stout's Creek is located about three miles south of Milo, OR, and monitoring began in 2005. This Kincaid's lupine population extends across BLM and private land; and as a consistently-sampled subsample, monitoring plots represent a portion of Stout's Creek's population. Similar to Callahan Meadows, Stout's Creek populations also have evidence of polyploidy genes and may be distinct from other Kincaid's lupine populations (Severns 2008). Thinning of small trees and shrubs occurred on site in 2009 and 2010, and current vegetation is overgrown (Figure 2). About 750 Kincaid's lupine plugs were planted around the cutbank near the naturally-occurring population (subpopulation 2) in 2017 and remonitored in 2023.

Figure 2. One example of Kincaid's lupine (*Lupinus oreganus*) plants being obscured by dense ground layer and understory vegetation at Stout's Creek.

3.2. Population Estimates: Vegetation Sampling

In 2023, we estimated percent foliar cover of Kincaid's lupine within 1-m^2 quadrats and calculated total area in m^2 (Ottombrino-Haworth et al. 2016). In all monitoring plots, Kincaid's lupine racemes were counted and determined as mature (Figure 3a) or aborted (Figure 3b). Mature racemes had a typically-developed flowering stem with flowers or developing seed. Aborted racemes often had stunted flowering stems or ended in what looked like a grey tassel, and were without flowers or flower scars. At each site, we used Samsung Galaxy tablets and Bad Elf GNSS Surveyors (which provide 1-meter accuracy) to mark monitoring plots, reducing future time spent looking for missing or overgrown markers.

Figure 3. Examples of Kincaid's lupine (*Lupinus oreganus*) plants with (a) mature racemes, indicated with red ovals encircling developing seeds, and an (b) aborted raceme, indicated with a red rectangle.

3.3 Data Analyses

For each site monitored in 2023, we compared the most recent surveys of foliar cover, total racemes, and aborted racemes to a 3-year average of prior surveys (2019 or 2020, 2020 or 2021, and 2022 depending on data availability). The 3-year average represents an estimate of recent Kincaid's lupine populations, provides a relevant comparison to our current data, and allows us to detect potential trends.

4. RESULTS

Foliar cover of Kincaid's lupine declined at every site monitored by IAE, compared to previous three-year averages, and by half or more in four out of five sites. The smallest monitored population was less than 0.6 m^2 cover (Letitia Creek) and no monitored site had greater than 20 m^2 cover. However, Kincaid's

lupine foliar cover increased at three monitored sites between 2022 and 2023. The number of total racemes in 2023 was greater than those counted in 2022 at three out of five monitored sites. The number of aborted racemes was greater than those counted in 2022 at four out of five monitored sites.

4.1. Callahan Meadows

The previous three-year average at Callahan Meadows was 19.7 m^2 foliar cover, 485 total racemes, and 32 aborted racemes. Foliar cover was 8.8 m^2 in 2023, slightly greater than 2022 foliar cover (Figure 4, Table A1). The number of total racemes counted in 2023 was consistent with trends going back to about 2007 (Figure 5, Table A2). The number of aborted racemes was greater in 2023 than any year since monitoring began (Figure 6, Table A3).

An estimated 1900 Kincaid's lupine plants were outplanted in 2017 and no plants were found when monitored in 2020 (Giles and Bahm 2017). We monitored the planted area again in 2023 and confirmed that no outplanted plants remain.

4.2. China Ditch

The previous three-year average at China Ditch was 27.0 m^2 foliar cover, 261 total racemes, and 153 aborted racemes. Foliar cover was 20.0 m^2 in 2023, an increase from 2022 foliar cover (Figure 4, Table A1). The number of total racemes was 501 in 2023, more than double the previous two years (Figure 5, Table A2). The number of aborted racemes was 79, more than double the previous two years (Figure 6, Table A3).

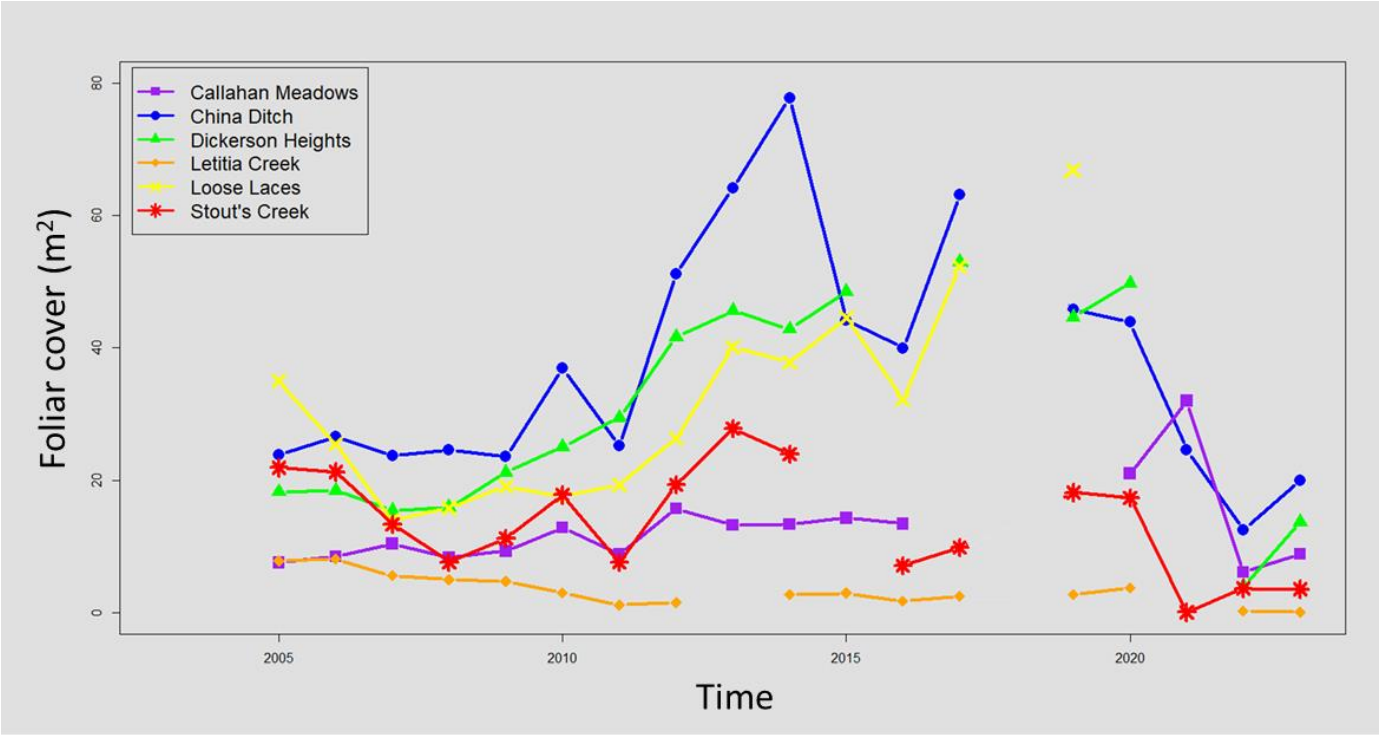

Figure 4. Trends in total amount of Kincaid's lupine foliar cover from 2003 to 2023; gaps indicate years without monitoring data. Sites are color coded: Callahan Meadows (purple), China Ditch (blue), Dickerson Heights (green), Letitia Creek (orange), Loose Laces (yellow), and Stout's Creek (red).

4.3. Dickerson Heights

The previous three-year average at Dickerson Heights was 32.8 m^2 foliar cover, 514 total racemes, and 298 aborted racemes. Foliar cover was 13.7 m^2 in 2023, more than three times greater than 2022 foliar cover (Figure 4, Table A1). Raceme counts were similar to 2022; the number of total racemes was 584 (Figure 5, Table A2) and the number of aborted racemes was 100 in 2023 (Figure 6, Table A3).

4.4. Letitia Creek

The previous three-year average at Letitia Creek was 2.2 m^2 foliar cover, 16 total racemes, and 11 aborted racemes. Foliar cover was less than 0.1 m^2 in 2023, reduced by more than half compared to 2022 foliar cover (Figure 4, Table A1). The number of total racemes was 3 (Figure 5, Table A2) and the number of aborted racemes was 1 in 2023 (Figure 6, Table A3).

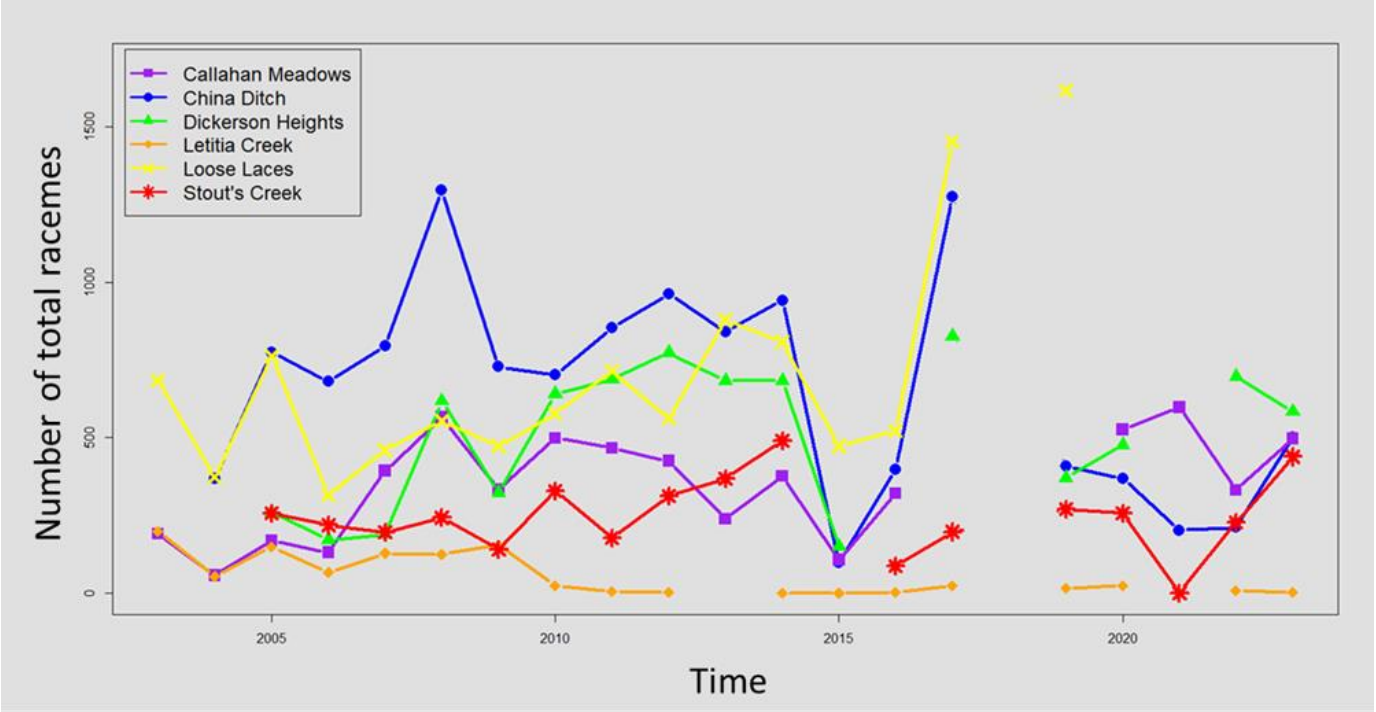

Figure 5. Trends in total number of Kincaid's lupine racemes from 2003 to 2023; gaps indicate years without monitoring data. Sites are color coded: Callahan Meadows (purple), China Ditch (blue), Dickerson Heights (green), Letitia Creek (orange), Loose Laces (yellow), and Stout's Creek (red).

4.5. Stout's Creek

The previous three-year average at Stout's Creek was 7.0 m^2 foliar cover, 252 total racemes, and 29 aborted racemes. Foliar cover was 3.5 m^2 in 2023, slightly less than 2022 foliar cover (Figure 4, Table A1). The number of total racemes was 439 (Figure 5, Table A2) and the number of aborted racemes was 42 in 2023 (Figure 6, Table A3).

An estimated 750 Kincaid's lupine plants were outplanted in 2017 and about 60 plants were found when monitored in 2022 (Giles and Bahm 2017). We monitored the planted area again in 2023 and found no remaining outplanted plants.

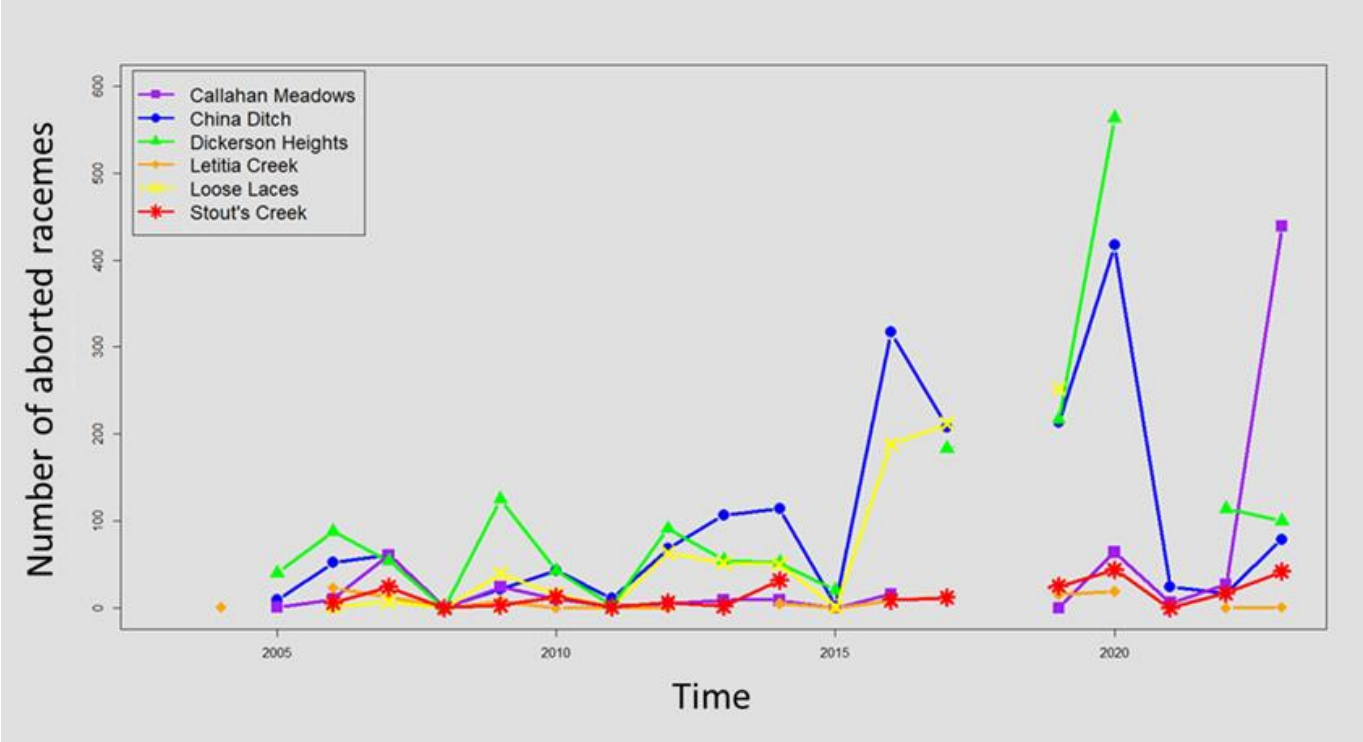

Figure 6. Trends in total number of Kincaid's lupine aborted racemes from 2003 to 2023; gaps indicate years without monitoring data. Sites are color coded: Callahan Meadows (purple), China Ditch (blue), Dickerson Heights (green), Letitia Creek (orange), Loose Laces (yellow), and Stout's Creek (red).

5. DISCUSSION

The percentage of Kincaid's lupine foliar cover increased at three sites and decreased at two sites between 2022 and 2023. Between 2023 and 2022, trends amongst raceme counts varied by site. While we did not see populations decline at every site this year, the continued trend of decline over recent years is a cause for significant concern. Foliar cover at China Ditch, Dickerson Heights, Letitia Creek, and Stout's Creek was less in 2023 than in 2005 when cover estimates began. While the Callahan Meadows population was slightly larger in 2023 compared to 2005, it was only by 1.3 m^2. The larger population at Letitia Creek was less than 1m^2 in 2023. We were unable to monitor the smaller population at Letitia Creek in 2023, but no plants were found in 2022. The Management and Recovery Plan proposes a goal of 5,000 m^2 of occupied habitat consisting of at least two meta-populations in Douglas County in order to reach recovery goals (U.S. Fish and Wildlife Service 2010). The Douglas County recovery zone does not meet these goals at this time, and continued monitoring and management are recommended.

Most sites are dense with encroaching native and nonnative woody and herbaceous vegetation, including poison oak (*Toxicodendron diversilobum*) and Himalayan blackberry (*Rubus armeniacus*). Competition from other plants can contribute to declines in Kincaid's lupine foliar cover. Trees at China Ditch, Dickerson Heights, Letitia Creek, and Stout's Creek were thinned between 2009 and 2010, and Kincaid's lupine cover exceeded pre-treatment levels for the following three years. Woody debris from vegetation removals was piled and burned on site, and germinated Kincaid's lupine seedlings were observed in 2011 and 2012. Select vegetation removals should occur every 5-10 years for ideal population management, so we recommend that the BLM Roseburg sites be considered for understory vegetation and canopy thinning as soon as possible. If possible, burning debris on site should also be considered.

6. CONCLUSIONS

Based on this long-term dataset, we conclude that the cover of Kincaid's lupine is in steep decline on the Roseburg District. In 2022, cover of Kincaid's lupine at the sites we monitored was the lowest observed since 2003, with only a slight recovery in 2023.

Additional conclusions follow:

- The Douglas Recovery Zone for Kincaid's lupine does not meet recovery goals at this time.
- Additional years of monitoring will help to determine whether the declines seen in recent years continue, and if management actions occur, what effect they may have on populations.
- Aggressive habitat restoration to include vegetation removal, understory clearing, and canopy thinning, is needed to arrest the decline of Kincaid's lupine.

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APPENDIX A. KINCAID'S LUPINE SUBPOPULATION DATA, 2003-2023

Table A1. Estimated Kincaid's lupine (*Lupinus oreganus*) foliar cover, in m^2, for each site between the years of 2003 and 2023. NA indicates that subpopulation was not monitored that year.

Foliar Cover (m^2): 2003 - 2023																					
Site	**Sub-plots**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2019**	**2020**	**2021**	**2022**	**2023**
Callahan Meadows	1	NA	NA	6.85	8.20	10.22	8.21	9.10	12.54	8.68	15.49	12.97	13.12	14.12	13.40	NA	NA	20.98	31.98	6.11	8.83
	2	NA	NA	0.69	0.30	0.17	0.15	0.20	0.30	0.16	0.24	0.27	0.26	0.16	0.03	NA	NA	0.03	NA	0	0
China Ditch	Patch A	NA	NA	5.82	5.34	5.40	6.57	4.35	9.25	9.81	13.67	19.95	21.05	12.37	8.53	13.30	10.15	13.55	NA	2.99	10.34
	Patch B	NA	NA	9.36	10.12	9.59	9.77	8.90	16.65	9.89	25.11	27.38	36.59	17.03	20.84	32.26	22.42	16.19	14.64	3.73	4.91
	Patch C	NA	NA	8.67	11.10	8.69	8.20	10.28	11.04	5.50	12.40	16.83	20.11	14.79	10.60	17.53	13.19	14.17	9.92	5.79	4.70
Dickerson Heights	1	NA	NA	18.24	18.43	15.45	15.89	21.20	25.02	29.44	41.63	45.60	42.82	48.50	NA	52.96	44.66	49.71	NA	4.02	13.71
Letitia Creek	Public	NA	NA	0.42	0.60	0.54	0.51	0.54	0.34	0.16	0.38	NA	0.34	0.30	0.14	0	0.31	0.80	NA	0	NA
	Road	NA	NA	7.40	7.52	5.03	4.49	4.17	2.64	1.01	1.16	NA	2.39	2.63	1.60	2.50	2.45	2.94	NA	0.23	0.06
Stout's Creek	Below	NA	NA	10.00	10.19	5.08	3.11	4.21	4.76	4.58	6.74	8.01	8.38	NA	7.08	6.44	9.36	7.77	NA	1.31	1.59
	Roadside	NA	NA	7.05	8.21	6.37	3.79	6.48	12.50	2.88	12.40	19.73	15.54	NA	0	3.43	8.75	9.59	NA	2.35	1.94
	Transect A	NA	NA	0.50	0.31	0.20	0.13	0.08	0.07	0.01	0	0	0	NA	0	0	0	0	0	NA	0
	Transect B	NA	NA	1.28	0.66	0.44	0.17	0.12	0.15	0	0.08	0.02	0.02	NA	0	0	0.02	0	0.07	NA	0
	Transect C	NA	NA	1.04	0.88	0.34	0.13	0.13	0.05	0	0.02	0	0	NA	0	0	0	0	0	NA	0
	Transect D	NA	NA	2.04	1.00	0.95	0.29	0.18	0.26	0.11	0.09	0.05	0	NA	0	0	0	0	0	NA	0
Loose Laces – refer to the monitoring report for data from the last survey of this site (Giles and Gray 2019)																					

Table A2. Total number of Kincaid's lupine (*Lupinus oreganus*) racemes for each site between the years of 2003 and 2023. NA indicates that subpopulation was not monitored that year.

Number of Total Racemes: 2003 - 2023																					
Site	**Sub-plots**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2019**	**2020**	**2021**	**2022**	**2023**
Callahan Meadows	1	191	57	168	131	394	565	330	498	464	425	239	376	107	321	NA	NA	526	598	332	497
	2	NA	0	1	NA	0	1	4	1	2	0	0	0	0	0	NA	NA	0	NA	0	0
China Ditch	Patch A	NA	95	180	95	171	305	108	183	366	211	298	369	60	57	263	147	128	NA	84	168
	Patch B	NA	147	257	302	364	546	312	292	388	499	377	373	3	231	706	197	153	115	69	207
	Patch C	NA	127	338	284	261	446	308	227	100	253	165	200	34	110	307	65	88	87	59	126
Dickerson Heights	1	NA	NA	259	171	189	618	322	641	688	773	684	684	151	NA	826	371	476	NA	696	584
Letitia Creek	Public	0	0	4	3	6	3	3	2	0	0	NA	0	0	1	NA	0	0	NA	0	NA
	Road	198	54	145	64	122	122	151	22	5	2	NA	0	0	2	24	15	24	NA	8	3
Stout's Creek	Below	NA	NA	126	89	55	127	54	41	64	55	56	91	NA	87	128	89	68	NA	127	155
	Roadside	NA	NA	96	110	118	88	84	288	114	257	131	399	NA	NA	69	181	189	NA	101	284
	Transect A	NA	NA	5	4	2	8	0	0	0	0	0	0	NA	NA	0	0	0	0	NA	0
	Transect B	NA	NA	10	0	1	6	0	0	0	NA	0	0	NA	NA	0	0	0	0	NA	0
	Transect C	NA	NA	5	5	1	2	0	0	0	NA	0	0	NA	NA	0	0	0	0	NA	0
	Transect D	NA	NA	15	11	19	12	3	0	0	NA	0	0	NA	NA	0	0	0	0	NA	0
Loose Laces – refer to the monitoring report for data from the last survey of this site (Giles and Gray 2019)																					

Table A3. Total number of Kincaid's lupine (*Lupinus oreganus*) aborted racemes for each site between the years of 2003 and 2023. NA indicates that subpopulation was not monitored that year.

Number of Aborted Racemes: 2003 - 2023																					
Site	**Sub-plots**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2019**	**2020**	**2021**	**2022**	**2023**
Callahan Meadows	1	NA	NA	1	10	61	0	24	10	2	5	9	9	0	16	NA	NA	64	6	27	439
	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	NA	0	0	NA	0	0
China Ditch	Patch A	NA	NA	3	9	7	0	3	11	4	13	33	40	0	83	54	73	121	NA	5	14
	Patch B	NA	NA	3	18	24	0	13	21	7	29	37	50	0	141	73	78	160	21	7	22
	Patch C	NA	NA	3	25	30	1	5	11	0	26	37	24	2	93	81	62	136	3	5	43
Dickerson Heights	1	NA	NA	40	88	54	0	125	43	3	91	55	52	20	NA	183	217	565	NA	114	100
Letitia Creek	Public	NA	1	NA	1	0	0	0	0	0	0	NA	0	0	0	NA	2	14	NA	0	NA
	Road	NA	NA	NA	22	13	0	8	0	0	0	NA	5	0	9	13	13	5	NA	0	1
Stout's Creek	Below	NA	NA	NA	3	15	0	3	7	1	5	2	2	NA	9	12	11	15	NA	10	27
	Roadside	NA	NA	NA	1	5	0	0	6	0	1	0	30	NA	NA	0	13	29	NA	7	15
	Transect A	NA	NA	NA	0	0	0	0	0	0	0	0	0	NA	NA	0	0	0	0	NA	0
	Transect B	NA	NA	NA	0	3	0	0	0	0	NA	0	0	NA	NA	0	1	0	0	NA	0
	Transect C	NA	NA	NA	1	0	0	0	0	0	NA	0	0	NA	NA	0	0	0	0	NA	0
	Transect D	NA	NA	NA	1	1	0	0	0	0	NA	0	0	NA	NA	0	0	0	0	NA	0

Loose Laces – refer to the monitoring report for data from the last survey of this site (Giles and Gray 2019)