

**Annual Compliance Report
for the Yamhill County Habitat Conservation Plan
for Fender's Blue Butterfly and Kincaid's Lupine**



October 2022

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Yamhill County Habitat Conservation Plan

2022 Annual Compliance Report

Background

Yamhill County (County) maintains the right-of-way easements along County roads for the purposes of public safety and optimum travel conditions. Some of the road maintenance activities have the potential to affect Fender's blue butterfly (*Icaricia icarioides fenderi*), Kincaid's lupine (*Lupinus oreganus*), and their habitat as defined under the Endangered Species Act (ESA, 16 U.S.C.5131-1344, 87 Stat. 887). In March 2014, the U.S. Fish and Wildlife Service (USFWS) issued an Incidental Take Permit (ITP) TE10049B-0 pursuant to Section 10 (a)(1)(B) of the ESA. The ITP includes County road and right-of-way maintenance activities. The ITP is conditional upon implementation of the Yamhill County Habitat Conservation Plan (HCP; Cardno ENTRIX 2013). The HCP provides measures to minimize the adverse effect from these essential services on Fender's blue butterfly and Kincaid's lupine.

This report records actions completed during the Fiscal Year (FY) 2021-2022 (July 1, 2021, through June 30, 2022) under the 30-year ITP issued to Yamhill County for Fender's blue butterfly on March 14, 2014 (TE10049B-0). As part of HCP implementation, the County is required to submit an annual report to USFWS documenting the following:

- A description of conservation measures initiated, continued, or completed during the previous year, and a description of conservation measures projected to be implemented during the upcoming year.
- A summary of findings, results, and conclusions of monitoring activities, and a projection of monitoring needs for subsequent years.
- A tabulation and description of funds expended during the previous year, and a projection of funds to be expended during the upcoming year.
- Other recommendations if any, such as minor modifications or amendments to the HCP document.

Conservation measures during FY 2021-2022, and projected for FY 2022-2023

Following is a description of conservation measures initiated, continued, or completed during FY 2021-2022, and a description of conservation measures projected to be implemented during FY 2022-2023:

- Director Mark Lago consulted with Parks Manager Travis Pease to recruit a new Parks committee member, and to secure Board of Commissioners' reappointment of all Habitat Conservation Plan Implementation Committee (HCPIC) members.
 - The County adhered to the measures described in the HCP for maintenance in the existing Threatened and Endangered Species Special Maintenance Zones (T&E SMZ) and in the newly created T&E SMZs around the seven Kincaid's lupine locations that were identified as being occupied by Fenders blue butterflies (during the butterfly dispersal survey). This will be continued in FY 2022-2023.
 - The County adhered to the requirements of the HCP in non-occupied sites by refraining from adverse management activities such as application of broad spectrum herbicides or early mowing that would have harmed the lupines. This will be continued in FY 2022-2023.
 - The County again contracted with Dr. Paul Hammond to perform Fender's blue butterfly surveys at sites not covered by USFWS funding within Yamhill County during June of 2022. Surveys followed USFWS protocols established for Fender's blue butterfly and the HCP monitoring plan was followed. This will be continued in FY 2022-2023.
 - The County did conduct a field visit with species experts and members of the HCPIC on May 24, 2022. This visit will continue to be used by the County to help formulate its habitat restoration plans in the T&E SMZs and Deer Creek Park as described in the HCP and ITP.
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- The County continues to clear Himalayan blackberries at Deer Creek Park and other HCP areas, which allowed for vigorous lupine growth observed at some sites by Dr. Hammond. During next fiscal year, the County will continue to spray blackberries with herbicide, and cut back blackberries and trees in the right-of-way that shade lupines. The County has also continued to mow HCP sites and will continue to spray tall oat grass in the T&E SMZs in order to expose Kincaid’s lupines to more sunlight. These management practices will continue in accordance with SMZ work plans and as recommended by Dr. Hammond.
- The County added more signage for lupines.
- This Annual Report will be reviewed by the HCPIC, and their comments will be integrated within it.

Findings, results, and conclusions of monitoring activities during FY 2021-2022 and projected for FY 2022-2023

The weather conditions were cool, cloudy, and rainy during May and June, delaying the butterfly season up to 2 weeks. Hence, butterfly numbers seemed to be down in lower and north facing areas, but normal to higher in south facing and higher elevation areas. Therefore, Dr. Hammond’s findings and conclusions after surveying in June of 2022 were a mixed bag of some successes and some need for attention. The County’s efforts at cutting dense stands of brush and small trees as well as spraying a grass specific herbicide on exotic tall oat grass, were successful habitat management efforts which increased the lupine population. However, there is still vegetation removal and management to be done to allow the Kincaid lupines to flourish in all locations. Per his recommendation, that such treatment should be conducted in other areas of suppressed lupines. The County will continue to implement this management action during the upcoming year.

The Deer Creek Park environment had some butterflies when surveyed this year. This is most likely because, under direction from Dr. Paul Hammond, the County’s efforts have resulted in the lupine population growing vigorously and expanding. The County will continue to follow Dr. Hammond’s recommendation of increased brush management to sustain these improvements.

There was a decline in butterfly population on Moores and Gopher Valley, suspected due to adverse weather conditions. Elsewhere in Yamhill County (i.e., Oak Ridge) the numbers indicate recovery is occurring.

Dr. Hammond’s 2022 survey is attached.

Funds expended during FY 2021-2022, and projected for FY 2022-2023

Below is a tabulation of funds spent during FY 2021-22 by the County on HCP activities.

Expenses	Cost
County Personnel (Vegetation Manager) and Materials for Maintenance	\$20,807
Dr. Hammond survey (\$5000)	\$6,000
Reserve for Future Obligations	\$10,000
Total HCP Expenses	\$36,807

The County Public Works Department expended over \$20,807 from the road fund in the 2021-22 fiscal year for labor (including mowing, brush-cutting, tree removal, weed spraying, etc.), equipment, and material costs in improving habitat environments.

It is estimated that \$33,262 will be expended during FY 2022-23 on continued restoration and mitigation, as required by the HCP, p. 7-12, section 7.10. Most of the FY 2022-23 expenditure will be to continue developing

and implementing restoration and mitigation plans, which include utilizing the expertise of Dr. Paul Hammond once again to survey lupines and butterflies in the Deer Creek Park mitigation site, and in other sites in accordance with the HCP's species status monitoring requirements. The County will continue to implement his suggestions for mowing, cutting, and spraying to improve the roadside habitat, and release more and invigorated lupine populations for butterfly egg laying.

Yamhill County Public Works, under Director Mark Lago, has purchased additional iPads for vegetation control staff to use for species location (GIS) and identification throughout the County. This activity includes monitoring Kincaid's lupines. The department will continue to expand and refine its management of the species as it takes on a new Vegetation Management Coordinator this year, who will assume the vacancy from Andrea Vallejo's resignation in May 2022. The department will also continue its partnership with new Parks Manager, Travis Pease.

Other recommendations

There are no recommendations for changes to the HCP at this time.

The 2022 Surveys of Fender's Blue Butterfly and Kincaid's Lupine Sites in Benton, Polk, and
Yamhill Counties, Oregon

by

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and

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and

Yamhill County Department of Public Works

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Map of Yamhill Oaks Preserve Fender's Blue Butterfly Habitat Areas

Map of Oak Ridge Area 4 Fender's Blue Butterfly Habitat Areas

INTRODUCTION

Surveys were conducted in Benton, Polk, and Yamhill Counties, Oregon during May and June of 2022 at known sites of Fender's blue butterfly (*Icaricia icarioides fenderi*) and Kincaid's lupine (*Lupinus oreganus*) that included peak butterfly counts and an assessment of habitat conditions for the Institute for Applied Ecology, U.S. Fish and Wildlife Service, and Yamhill County Department of Public Works. This work specifically monitored the results of on-going habitat management in designated management areas, on private properties, and along Yamhill County roadsides during the 2015-2022 field seasons. These management studies included techniques for controlling several invasive plant species including bracken fern, purple vetch, and sickle-keeled lupine that threatened Kincaid's lupine and butterfly populations. This included studies of the impact using early season mowing and glyphosate herbicide applications on Kincaid's lupine. A summary of these management experiments as they affected Kincaid's lupine was included in the 2018 report (Hammond, 2018).

In sharp contrast to the 2021 field season (see Hammond, 2021), weather conditions were cool, cloudy, and rainy during much of May and June in 2022, and the butterfly field season was delayed by 1-2 weeks. As a consequence, butterfly survey work was quite challenging this year with limited opportunities of good weather for adult observations. Thus, the adult Fender's blue flight season was extended from about the middle of May to the end of June, similar to the extended flight season in 2020.

A conservative population estimate of Fender's blue butterflies for each of the metapopulation areas described below in 2022 can be made by taking the highest count of male butterflies at the peak of the flight season, and doubling that number to account for females assuming an equal sex ratio. An additional 20% of the combined male-female number is added to this sum to account for butterflies in the tail ends of the flight season that would not have been present on the peak day count. This is probably a very conservative estimate for large populations that are dispersed over large geographic areas where many butterflies were probably missed during the surveys, but is probably accurate for small populations with a more limited geographic distribution. For several large sites, separate subcounts were made for different subareas on the sites that had substantially different habitat conditions of temperature and aspect or different management histories. The peak subcount for these subareas was then used for calculating the total population estimate.

RESULTS

1. Benton Co. – Greasy Creek Area 3 – John Watkins Property (Greasy Creek Metapopulation)

The habitat on the John Watkins property consists of dry, open prairie covering about 3 acres on a south-facing hill. A rich diversity of native plants are present including large patches of Kincaid's lupine that cover about 2 acres and are actively spreading. Management problems in the past included extensive coverage by Scotch broom brush (*Cytisus scoparius*) and Himalayan blackberry, but mowing management during the fall of 2018, 2019, and 2020 removed all of the woody brush. As a consequence, the lupine has greatly increased and grew robustly throughout this habitat area during 2021 and 2022. The primary management problems at present are spreading exotic tall oat-grass (*Arrhenatherum elatius*) and bracken fern. In 2022, this site was surveyed by Greg Fritzpatrick with the following peak results.

May 25 82 males

Peak butterfly counts and population estimates for the Watkins property over the past nine years are summarized as follows.

	<u>Peak Count</u>	<u>Population Estimate</u>
2014	30 males	72
2015	51 males	122
2016	47 males	113
2017	16 males	38
2018	23 males	55
2019	12 males	29
2020	49 females	118
2021	65 males	156
2022	82 males	197

The peak count in 2020 was based on females since the peak male flight was missed that year due to cool, cloudy weather conditions. The low numbers in 2017-2019 appeared to be due to a combination of degraded habitat that had become overgrown with Scotch broom and

blackberry brush combined with poor weather conditions during those years. The fall mowing management over the past four years has successfully eliminated the brush problem. This work combined with favorable weather conditions during 2020-2022 have resulted in good lupine growth and major expansion of the lupine. In turn, butterfly numbers have greatly increased over these past three years.

2. Benton Co. – Greasy Creek Area 4 – Henkle Way (Greasy Creek Metapopulation)

The habitat along the roadside of Henkle Way and on the adjacent private property consists of native prairie with a rich diversity of native plants including large patches of Kincaid's lupine. However, much of the lupine is now being overgrown with exotic tall oat-grass. This site was surveyed by Greg Fitzpatrick in 2022 with the following results.

May 25 0

This site was previously occupied by Fender's blue butterflies with 18 males counted in these lupine patches during the 2009 field season. The colony apparently became extinct during the 2014-2016 field seasons, but a few butterflies have been seen in recent years. Total butterfly numbers are shown as follows.

2020 1 male

2021 2 males

2022 0

3. Benton Co. – Greasy Creek Area 5 – Picht Property (Greasy Creek Metapopulation)

A large amount of Kincaid's lupine covering perhaps three acres on native prairie is present on the Picht property just east of the Marys Peak Watershed for the city of Corvallis. The lupine is distributed in about seven patches that probably equal that present on the Watkins property to the north. One large patch is more isolated at the top of the hill near the house. No butterflies were found in this patch during the 2018-2021 field seasons. Six additional patches are found in a level field west of the creek adjacent to the Watershed. This site was surveyed by Greg Fitzpatrick in 2022 with the following results.

May 25 0

Butterfly numbers seen in recent years are shown as follows. For some unknown reasons, habitat conditions have not been favorable for the Fender's blue butterfly on the Picht property despite an abundance of Kincaid's lupine.

2018	8 males
2019	1 male
2020	1 male
2021	0
2022	0

4. Polk Co. – McTimmonds Valley

This historical site in western Polk County consists of roadside embankments covered with sickle-keeled lupine (*Lupinus albicaulis*). As discussed by Hammond (2011), a few Fender's blue butterflies still occupied this site in 2011 with 3 males counted on June 11. In both 2021 and 2022, the lupine was still very abundant at this site, but no butterflies were seen. Specific observations in 2022 are as follows.

June 2	0
June 14	0
June 22	0

5. Polk Co. – Monmouth Road

This historical site in western Polk County also consists of roadside embankments covered with sickle-keeled lupine. Butterflies formerly occupied this site when the lupine expanded across an adjacent old field that was being converted into a tree farm. Today, only a few scattered patches of lupine still survive along the road embankment, and no butterflies were seen this year. Specific observations in 2022 are as follows.

June 2	0
June 14	0
June 22	0

6. Polk Co. – Dallas

The Dallas population was last surveyed on May 13, 2016 (Hammond, 2016). Historically, it was located on four adjacent lots on the south side of Dallas covered with native prairie that included a high diversity of native plants, and probably consisted of perhaps 200-300 butterflies. By 2007, it had declined to an estimated 40-60 butterflies because much of the original habitat was developed for houses and an apple orchard around 1996. Invasive tall oat-grass further degraded the remaining habitat, reducing butterfly numbers to an estimated 18-25 in 2016. In 2021 and 2022, the habitat had degraded further and was mostly covered with tall oat-grass. Nevertheless, a few butterflies were still present during these past two years. Specific observations for 2022 are as follows.

June 2 1 male

June 14 0

Butterfly numbers during the past two years are shown as follows.

2021 2 males, 2 females

2022 1 male

7. Polk Co. – Mill Creek

This site owned and managed by the Oregon Department of Transportation consists of native prairie with a high diversity of native plants and large patches of Kincaid's lupine. It has historically supported a population of around 50 Fender's blue butterflies (Hammond, 2007), but only had about 12 butterflies still surviving in 2010 (Hammond, 2010). All of the habitat has become densely overgrown with thick stands of invasive tall oat-grass that greatly suppresses the Kincaid's lupine and other native plants. The Oregon Department of Transportation has been conducting late season mowing at the site over the past few years. As a result, the lupine has actually been spreading and increasing in abundance in 2021-2022. As of the 2016 field season, the butterfly appeared to be extinct at this site (Hammond, 2016). However, a few males appeared in 2021-2022, suggesting that a re-colonization event might have taken place with long distance dispersal taking place from some unknown colony in the general area. Specific observations in 2022 are as follows.

June 2 1 male

June 14 0

Butterfly numbers during the past two years are shown as follows.

2021	2 males
2022	1 male

8. Yamhill Co. – Beaver Creek Road (Gopher Valley Metapopulation)

Very large patches of Kincaid's lupine are located on both the north and south sides of Beaver Creek Road in Gopher Valley. This site was surveyed five times in 2022 at the peak of lupine blooming as shown below, but no Fender's blue butterflies were present.

May 17	0
May 25	0
May 31	0
June 7	0
June 16	0

During 2016, young oak trees on the embankment were cut and removed, and extensive thickets of blackberry and other brush were cut along the entire length of the lupine habitat area. This work greatly improved the habitat conditions for lupine growth, and much new lupine was observed during the 2017-2022 field seasons that had been previously shaded by trees and brush during 2015-2016. As a result, large patches of lupine have been growing vigorously and blooming along this entire length of the road during 2021-2022. However, young trees and brush are starting to grow back again, particularly poison oak, blackberry, and young oak trees, indicating that brush cutting will be needed again within the near future.

9.) Yamhill Co. – Deer Creek County Park (Gopher Valley Metapopulation)

The habitat at Deer Creek County Park in Gopher Valley consists of pristine native prairie with a rich diversity of native plants. This site was surveyed six times in 2022 with the following results.

May 17	0
May 25	0
May 31	0
June 7	0
June 16	3 males
June 21	0

No Fender's blue butterflies were present at this site during 2017-2018, but one male and one female were seen in 2019. In 2020-2022, a small colony of the butterfly successfully became re-established. Yamhill County has designated Deer Creek Park as a mitigation site under its Habitat Conservation Plan for Kincaid's lupine and Fender's blue butterfly. In 2014, the site was threatened with invasive blackberry, Scotch broom brush, and small trees. Yamhill County management conducted extensive habitat renovation work during the 2015-2016 field seasons, and cleared away all of the woody vegetation. As a result of this work, the Kincaid's lupine was growing vigorously and expanding rapidly over the hill during 2017-2022, and habitat conditions throughout the site were excellent in 2021-2022. This habitat improvement has resulted in the successful establishment of a butterfly colony at this site as of 2020-2022. It is expected that the lupine will continue to increase and expand in coverage during future years, and this should result in increasing butterfly numbers as well. The peak numbers of male butterflies present over the past four years are shown below.

2019	1 male
2020	5 males
2021	2 males
2022	3 males

10. Yamhill Co. – Gopher Valley Road (Gopher Valley Metapopulation)

Large patches of Kincaid's lupine occur on the roadsides of Gopher Valley Road in two areas. Area 1 is located at the junction of Gopher Valley Road and Dupee Valley Road. Area 2 includes the roadside lupine patches on both the west and east sides of the road adjacent to the Yamhill Oaks Preserve. In Area 1, the habitat was recently renovated in 2021 by cutting young oak and conifer trees that had shaded and overgrown the lupine. In 2022, the lupine was just starting to recover from this suppression. No butterflies have been present in Area 1 over the past few years.

However, the roadsides of Area 2 were mowed and woody brush and young trees were cut by Yamhill County management in 2018-2019, uncovering considerable lupine that had been previously shaded. As a result, these lupine patches were growing quite vigorously during the 2019-2022 field seasons. These sites were surveyed four times in 2022 with the following results. For unknown reasons, no butterflies were seen along the roadsides this year, although the frequent cool, cloudy, rainy weather may have been a factor.

May 17	0
May 25	0
May 31	0
June 22	0

Peak numbers of male butterflies observed in the roadside lupine patches are shown below for the past few years. The increases in 2020-2021 appear to be the result of the recent roadside management work that greatly expanded the amount of lupine present for the butterfly, while the apparent absence of butterflies this year was likely due to the adverse weather conditions.

2016	4
2017	1
2018	2
2019	0
2020	5
2021	4
2022	0

11. Yamhill Co. – Yamhill Oaks Preserve (Gopher Valley Metapopulation)

The butterflies in Area 2 covering the Yamhill Oaks Preserve were surveyed three times during the 2022 field season with the following results. Butterflies started to emerge very late this year with a peak around the first of June, and continued to fly nearly to the first of July.

May 17	1 male
May 31	33 males
June 22	19 males

Habitat at this site consists of pristine native prairie with a high diversity of native plants. Large patches of Kincaid's lupine have been spreading in recent years over many different parts of the preserve. The attached map shows the location of these habitat areas. Separate male butterfly counts were made for each of the lupine areas as shown below.

	<u>Roadside</u>	<u>Northwest</u>	<u>North Central</u>	<u>Northeast</u>	<u>North Ravine</u>
May 17	0	0	0	1	0
May 31	0	0	1	20	3
June 22	0	0	0	12	2

	<u>South Ravine</u>	<u>South Central</u>	<u>Southwest</u>	<u>Pugh Area</u>
May 17	0	0	0	0
May 31	3	1	0	5
June 22	2	1	1	1

The following table shows the total peak count and population estimate for 2016-2022. The large drop in 2019 was the result of the prescribed fire during the fall of 2018 that burned most of the habitat, and apparently killed most of the diapausing larvae. However, the fire was highly beneficial for removing invasive woody shrubs like poison oak and young trees, and the lupine in the treated areas was greatly flourishing and spreading during 2019-2022. As a consequence, butterflies had returned to all of the previously occupied habitat areas during 2020, and the population recovered from the fire to the approximate level of 2018. However in 2021, the population doubled in size to an estimated 300 butterflies, the highest number ever seen at

Yamhill Oaks Preserve. This population explosion was likely the result of very favorable weather conditions in 2021 that resulted in particularly high survival of larvae, combined with lupine that have greatly spread within the original lupine patches during the past few years. In addition, lupine has been rapidly spreading into new areas previously not occupied, probably resulting from long-distance seed dispersal. In 2022, cool, rainy weather throughout May and June was highly favorable for lupine growth and additional spread, but these conditions apparently resulted in high mortality of the developing butterfly larvae. As a consequence, the butterfly population sharply dropped in numbers during 2022 as shown below.

	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>
Roadside	4	1	2	0	5	4	0
Northwest	0	0	0	0	1	1	0
North Central	5	6	5	0	4	14	1
Northeast	16	16	31	6	19	43	20
North Ravine	4	5	5	1	7	14	3
South Ravine	16	8	14	3	12	16	3
South Central	0	0	0	2	3	6	1
Southwest	0	0	0	1	2	1	1
Pugh Area	0	0	0	3	10	28	5
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Total Peak Count	45	36	57	16	63	127	34
Population Estimate	108	86	137	38	151	305	82

12.) Yamhill Co. – Old Moores Valley Road – Sid Freidman Property (Moores Valley Metapopulation)

This site along Old Moores Valley Road is located just south of Area 5. A small patch of Kincaid's lupine covering an estimated 41 square meters is located at the northwest corner of the Freidman property, and an additional 40 square meters of lupine is located along the adjacent county road right of way on both the west and east sides of the road within a zone of remnant native prairie. A small population of the yellow prairie violet (*Viola nuttallii*) is located at the site, and is one of the few surviving populations of this plant in Yamhill County. This site was surveyed on six days in 2022 with the following results.

May 17	0
May 25	0
May 31	0
June 7	0
June 15	0
June 21	0

Habitat conditions at this site were very poor in the past because of infestations of both tall oat-grass and braken fern. The lupine on the Freidman property was still mostly suppressed this year by the tall oat-grass. However, conditions along the roadsides were greatly improved by treating the grass with a grass-specific herbicide during the spring, and the braken fern was mostly eliminated from around the lupine by hand weed-eaters and by hand-pulling that took place in 2017-2018. As a consequence, the lupine along the roadsides was flourishing and blooming extensively during 2019-2022. However, the tall oat-grass is now starting to return to the roadsides in this area, and it is suggested that another herbicide treatment be conducted during the spring of 2023.

13.) Yamhill Co. – Area 5 Old Moores Valley Road (Moores Valley Metapopulation)

This site is limited to a strip of native prairie located in the county road right of way along Old Moores Valley Road just south of the junction with Moores Valley Road. A rich diversity of native prairie plants is found at this site, and large patches of Kincaid's lupine are located on both sides of the road. These patches were surveyed over six days in 2022 with the following results.

May 17	0
May 25	0
May 31	0
June 7	0
June 15	0
June 21	0

Butterfly numbers have dropped in this area over the past few years compared to a peak of 10 males in 2013. The population appears to have become mostly extinct during the 2017-2022 field seasons, due in part to the wet, cold weather conditions in Moores Valley during the spring development season.

In the past, very dense stands of exotic tall oat-grass have severely repressed the lupine along the roadsides of this area. The grass-specific herbicide Poast (sethoxydim) was applied to this habitat area during April in both 2015 and 2019. As a consequence of these herbicide treatments, the lupine has responded with vigorous growth and extensive blooming in the 2019-2022 time period. As of this year, the tall oat-grass is now starting to spread over the roadsides again, and it is suggested that another herbicide treatment be applied to this area during the spring of 2023.

14. Yamhill Co. – Old Moores Valley Road – Toby Van Hee Property (Moores Valley Metapopulation)

This site along Old Moores Valley Road is located north of the junction with Moores Valley Road. Patches of Kincaid's lupine were growing vigorously and expanding rapidly along both the county road right of way and also on the adjacent Van Hee property during 2018-2022. In recent years, the lupine has been suppressed to some extent by dense stands of tall oat-grass. Thus, it is suggested that a grass-specific herbicide be applied to the roadsides during the spring of 2023.

In previous years, a single male Fender's blue butterfly was seen in these lupine patches during the 2014-2016 field seasons, and also in 2019. These lupine patches were surveyed six times during the 2022 field season with the following results.

May 17	0
May 25	0
May 31	0
June 7	0
June 15	0
June 21	0

15. Yamhill Co. – Area 6 Moores Valley Road – Thorton Property (Moores Valley Metapopulation)

This area consists of two sites within the county road right of way along Moores Valley Road. The first site is located near the junction with Old Moores Valley Road very close to the main habitat portion of Area 5. The second site is located on a dry, south-facing hillside further east along the road. Lupine patches occur on both the north and south sides of the road at both sites, and some lupine also occurs on the adjacent Thorton property near the fence line. These sites were surveyed six times during the 2022 field season with the following results.

May 17	0
May 25	0
May 31	0
June 7	0
June 15	0
June 21	0

During the past three years, Kincaid's lupine has been growing very poorly along the roadsides of Moores valley Road. Some of this is due to suppression with exotic tall oat-grass at Site 1, and most lupine was severely repressed in 2022 by tall vegetation. At Site 2, the lupine also grew very poorly because of drought-like conditions on the steep, south-facing hillside. Thus, it is recommended that the tall-oat grass should be treated with a grass-specific herbicide during the spring of 2023.

16. Yamhill Co. – Sarah Miranda property (formerly Richard Blaha property) (Moores Valley Metapopulation)

This site is located along NW Fairdale Road. A large area of Kincaid's lupine covering about 600 square meters is located on a remnant area of native prairie that is dominated by Roemer's fescue bunchgrass. About two thirds of this lupine is located in a pasture that has been subject to occasional light livestock grazing, and the lupine has been actively expanding in recent years. Unfortunately, Mrs. Miranda did not know where the lupine was located, and the pasture received very heavy livestock grazing in 2021 that ate most of the lupine down to the bare ground. In 2022, the lupine in the pasture was starting to recover, although most was still stunted and not able to bloom this year. However, the lupine outside of the pasture grew and bloomed very well. This site was surveyed six times in 2022 with the following results.

May 17	0
May 25	0
May 31	0
June 7	0
June 15	0
June 21	0

Summary of the total peak number of male Fender's blue butterflies in the Moores Valley Metapopulation for 2014-2022

2014	16
2015	14
2016	4
2017	0
2018	0
2019	2
2020	4

2021	2
2022	0

Thus, butterfly numbers have been very low in the Moores Valley Metapopulation area over the past seven years, even though the lupine has been flourishing along the roadsides due to the habitat management. This may be the result of unusually cold spring weather conditions in Moores Valley. Cold air and fog from the Coast Range often settles down in Moores Valley during the spring, when the top of adjacent Oak Ridge is exposed to warm sunny weather at the same time. May and June of 2022 were particularly cold with cloudy and rainy weather, and this may have resulted in heavy mortality of developing butterfly larvae. As a result, virtually no Fender's blue butterflies were seen in Moores Valley during the 2022 field season.

(17.) Yamhill Co. – Area 1 Oak Ridge Road – Marvin King property (Oak Ridge Metapopulation)

Area 1 on Oak Ridge is located along the east and north sides of Oak Ridge Road, and is comprised of both the county road right of way and the adjacent Marvin King property. Large patches of Kincaid's lupine are present covering about 1300 square meters. This site was surveyed five times in 2022 with the following results.

May 17	6 males
May 25	12 males
May 31	14 males
June 7	14 males
June 21	2 males

Much of this habitat has been severely degraded over the past few years, and has been badly overgrown with tall oat-grass, braken fern, and Scotch broom brush that has been repressing the lupine. As a consequence, butterfly numbers have been greatly reduced during 2016-2021 compared to previous years. Nevertheless, butterflies and lupine are still persisting on the King property despite these problems. At present, all of this habitat needs to be brushed to remove the Scotch broom brush from the King property. In addition, the braken fern needs to be cut with weed-eaters during June, and a grass-specific herbicide spray during April would be highly beneficial for restoring the habitat for the lupine and butterflies.

In sharp contrast, Yamhill County management cut all of the Scotch broom brush along the county road right of way during the fall of 2019. This work resulted in exposing a large amount of lupine that had been previously suppressed by the brush, and this lupine was vigorously growing and blooming during the 2020-2022 field seasons. In turn, butterfly numbers doubled in Area 1 this year compared to previous years. While a few butterflies were present on the King property, the majority of butterflies were flying around the exposed and blooming lupine patches along the roadsides. Historical peak counts of Fender's blue butterfly males in Area 1 are shown as follows.

2002	68
2015	30
2016	13
2017	8
2018	8
2019	12
2020	8
2021	7
2022	14

18. Yamhill Co. – Area 2 Oak Ridge Road – Charles Goodwin Property (Oak Ridge Metapopulation)

The Area 2 habitat along Oak Ridge Road is comprised of both the county road right of way and the adjacent Charles Goodwin property. Large patches of Kincaid's lupine are present covering an estimated 4000 square meters. In 2014, the first comprehensive survey was conducted on the Goodwin property since 2011 with the permission and assistance of Mr. Goodwin. Over the past few years, Kincaid's lupine has greatly increased and spread over much of the Goodwin property to the west and southwest corners of the meadow. At present, both the lupine and butterfly are now widely distributed throughout the Goodwin property, and have greatly increased along the entire length of the county road right of way as well. Subcounts were made for the roadside and adjacent Goodwin property, and for the interior of the Goodwin property not observable from the road during the 2014 survey. In 2015-2022, Mr. Goodwin did not want any additional surveys done on his property. Thus, the following surveys over five days in 2022 were limited to observations along the roadside.

May 17	0
May 25	36 males
May 31	45 males
June 7	41 males
June 21	10 males

Mr. Goodwin has continued to manage his property with mowing, so it is not overgrown with Scotch broom, tall oat-grass, and braken fern like the adjacent King property in Area 1. In addition, Yamhill County management has successfully controlled tall oat-grass along the roadsides with applications of the grass-specific herbicide Poast, while infestations of exotic purple vetch (*Vicia villosa*) have been successfully controlled by mowing above the lupine plants during June. Specific details of this management work were discussed in the 2019 report (Hammond, 2019). As a consequence, the lupine was growing and blooming along the roadsides with great vigor during the 2020-2022 field seasons, and numerous female butterflies were seen ovipositing on the lupine in this managed habitat.

The following table shows the extrapolated peak counts in parenthesis for male Fender's blue butterflies in Area 2 for the 2014-2022 field seasons based upon the 2014 count of butterflies in the interior of the Goodwin property. In 2021-2022, the roadside peak count reached the highest number ever seen at this site.

	<u>Roadside</u>	<u>Interior Goodwin</u>	<u>Total</u>
2014	38	62	100
2015	34	(? 56)	(? 90)
2016	39	(? 64)	(? 103)
2017	9	(? 15)	(? 24)
2018	24	(? 40)	(? 64)
2019	30	(? 49)	(? 79)
2020	32	(? 53)	(? 85)

2021	45	(? 73)	(? 118)
2022	45	(? 73)	(? 118)

19. Yamhill Co. – Area 3 Oak Ridge Road – Carol Hebert Property (Oak Ridge Metapopulation)

The Area 3 habitat on Oak Ridge is comprised of both the county road right of way and the adjacent Carol Hebert property. Ms. Hebert has never allowed butterfly surveys to be conducted on her property, so all butterfly observations have been limited to the county roadside and what could be observed from the road on the Hebert property. Large patches of Kincaid's lupine are located in the road right of way and on the Hebert property immediately adjacent to the road. These cover an estimated 500 square meters on the road right of way and perhaps an addition 600 square meters on the Hebert property next to the road. In particular, the lupine appears to have spread considerably on the Hebert property in recent years, while the lupine on the road right of way has been released from suppression by dense stands of woody brush including poison oak, young trees, and exotic sweet pea by Yamhill County management over the past five years. Specific details of this management were included in the 2019 report (Hammond, 2019). Butterflies were surveyed five times in 2022 with the following results.

May 17	0
May 25	2 males
May 31	4 males
June 7	10 males
June 21	4 males

During the 2019-2021 field seasons, butterflies emerged and remained at high levels in Area 3 over an extended time period. Thus, butterflies flying on May 12 of last year were probably not the same butterflies flying on June 5 when several freshly emerged males and females were still observed. Butterfly numbers doubled during this time period due in large part to the improved habitat conditions along the roadsides resulting from Yamhill County management. In 2022, the cold and rainy weather conditions resulted in the adult butterfly flight season being delayed by about two weeks, with butterflies still flying on June 21 as shown above. Moreover, the population crashed in numbers to the lowest level since 2017 when poor habitat conditions suppressed numbers. Peak counts of males for 2014-2022 are shown below.

2014	36
2015	26
2016	20
2017	12
2018	14
2019	32
2020	26
2021	32
2022	10

20. Yamhill Co. – Area 4 Oak Ridge – Zakocs and Aplin Properties (Oak Ridge Metapopulation)

The habitat of Area 4 on Oak Ridge is located on the Ed Zakocs and Michael Aplin properties. There are four major patches of Kincaid's lupine on the Zakocs property covering an estimated 7000 square meters, and two major patches of lupine on the Aplin property that now cover about 2000 square meters. These lupine patches have been growing and expanding rapidly on both properties over the past few years. The locations of these lupine patches are illustrated on the attached map. Zakocs 5 lupine patch shown on the map was formerly covered with invasive sickle-keeled lupine (*Lupinus albicaulis*) that was rapidly spreading over the Zakocs property and smothering out the Kincaid's lupine. The sickle-keeled lupine was successfully eradicated with herbicide applications as discussed in the 2018 and 2019 reports (Hammond, 2018, 2019), and some isolated plants of Kincaid's lupine were becoming established within the Zakocs 5 area as of the 2020-2021 field seasons. Area 4 was surveyed during the 2022 field season by Greg Fitzpatrick with the following peak count of males compared to 2020 and 2021.

	<u>2020</u>	<u>2021</u>	<u>2022</u>
Zakocs	171	153	6
Aplin	56	65	10
Total	227	216	16

Thus, the Fender's blue butterfly population in Area 4 experienced a massive crash during 2022 that was even more extreme than what took place along the roadsides of Area 3. Apparently, the cold, rainy weather conditions along the top of Oak Ridge affected the butterfly during a critical development period, resulting in heavy mortality of the larvae during April and early May. In dramatic contrast, the habitat in Areas 1 and 2 on Oak Ridge has a warm, south-facing aspect that was particularly favorable for the butterfly this year, resulting in population increases in both areas. This parallels the apparent extinction of the butterfly in Moores Valley to the west in 2022. It also demonstrates the value of maintaining habitat for the Fender's blue butterfly in a variety of warm to cool aspects that helps to compensate for variable and unpredictable weather conditions from year to year. The 2021 report (Hammond, 2021) provided a more detailed discussion of habitat conditions and management issues in Area 4.

21. Yamhill Co. – Hacker Road (Turner Creek Metapopulation)

The Hacker Road habitat consists of a narrow strip of native prairie along the county road right of way that includes a surprisingly rich diversity of native prairie herbs and grasses. Late June observations in 2020 showed large populations of both *Brodiaea coronaria* and *Clarkia amoena*. Kincaid's lupine is abundant on the north side of the road extending for about a quarter of a mile, but also occurs on the south side of the road. In 2022, butterfly surveys were conducted over five days with the following results.

May 17	0
May 25	0
May 31	1 male
June 7	1 male
June 21	0

In recent years, only a few butterflies have occupied this habitat as shown by the peak counts below.

2015	4 males, 1 female
2016	6 males, 3 females
2017	8 males
2018	5 males, 1 female

2019	1 male, 1 female
2020	0
2021	1 male
2022	1 male

Part of the above decline may be due to a resurgence of tall-growing exotic grasses that are over-growing the lupine during the butterfly flight season, particularly tall oat-grass. Thus, it is recommended that this site be treated with a grass-specific herbicide during the spring of 2023.

21. Yamhill Co. – Tupper Road (Turner Creek Metapopulation)

Small patches of Kincaid's lupine are distributed along the north side of Tupper Road near the junction of Turner Creek Road for about a quarter of a mile. However, this lupine has been badly overgrown with tall, dense stands of tall-oat grass in the past, including the 2018-2022 field seasons. No Fender's blue butterflies have been present during this time period. Because of the close proximity to the occupied habitat along Hacker Road and Belt Road, butterflies would probably occupy this site if the tall oat-grass was absent. Thus, it is strongly recommended that the grass should be sprayed twice with a grass-specific herbicide during March and April of 2023 to achieve better control or eradication of this pest. This site was surveyed over five days in 2022 with the following results.

May 17	0
May 25	0
May 31	0
June 7	0
June 21	0

22. Yamhill Co. – Sonja Kalbsleisch Property (former Martyn Dunn Property) (Turner Creek Metapopulation)

This site is located along the south side of Belt Road. Very large patches of Kincaid's lupine are located at the top of the hill adjacent to Belt Road covering an estimated 1000 square

meters. Much of this lupine had been overgrown with Scotch broom brush in 2013, but this brush was cleared away by the Yamhill Soil and Water Conservation District during the 2014 field season. At present, the major management problem at this site is exotic tall fescue grass (*Festuca arundinacea*) that produces thick layers of dead grass thatch, plus a large resurgence of Scotch broom and invasive Himalayan blackberry brush. Nevertheless, favorable weather conditions in 2020-2022 resulted in vigorous growth and blooming of the lupine. This site was surveyed twice during the 2022 field season with the following results.

June 7	1 female
June 15	1 female

The historical peak number of male (or female) Fender's blue butterflies at this site is shown below.

2012	2
2013	4
2014	4
2015	5
2016	2
2017	5
2018	3 females
2019	1
2020	12
2021	6
2022	1 female

The cold rainy weather conditions during the spring of 2022 appear to have had a negative effect on this local colony.

24. Yamhill Co. – Norvella Koelling Property (Turner Creek Metapopulation)

This site is located on NW Richmond Road. Before the beginning of habitat management in 2007, this site only had a small amount of Kincaid's lupine present within a dense, young tree plantation of Douglas fir, and no butterflies were present at that time. After the trees were removed and the habitat was opened up into a large contiguous meadow, the lupine began to expand into the meadow and the first Fender's blue butterfly was seen at this site in 2009. As of the 2014-2021 field seasons, many new patches of lupine have multiplied and spread in this larger meadow, and the butterfly population also grew as a consequence. Unfortunately, the cool, rainy spring of 2022 resulted in massive growth of invasive exotic vetches such as purple vetch (*Vicia villosa*), and much of the lupine became overgrown with the vetch by late May and June. This year, this site was surveyed twice with the following results.

June 7	3 males, 4 females
June 21	0

Butterfly numbers on the Koelling property have been very low over the past seven years, but numbers have remained relatively steady for most years as shown below.

2016	2 males, 2 females
2017	0 0
2018	2 males, 0
2019	1 male, 1 female
2020	2 males, 2 females
2021	3 males, 4 females
2022	3 males, 4 females

SUMMARY OF METAPOPOPULATION ESTIMATES IN RECENT YEARS

1. Benton County – Greasy Creek Metapopulation

In 2018-2022, most Fender's blue butterflies were confined to the Watkins property, but a few occurred along the roadside of Henkle Way and on the Picht property to the west. Total population estimates for 2015-2021 are shown as follows. The large increase in 2020-2022 appeared to result from the combination of favorable weather conditions and improved habitat conditions for Kincaid's lupine due to recent mowing management on the Watkins property.

2015	122
2016	113
2017	41
2018	67
2019	45
2020	122
2021	161
2022	197

2. Yamhill County – Gopher Valley Metapopulation

In 2017-2018, no butterflies were seen at Deer Creek County Park, but butterflies did occur at this site in 2019-2022. Most butterflies were seen in Area 2 along the roadside and on the Yamhill Oaks Preserve, but Area 3 west of Deer Creek was not surveyed again this year. Total population estimates for 2017-2022 are shown as follows. The large drop in butterfly numbers during 2019 appeared to result from the prescribed fire management of the habitat at Yamhill Oaks during the fall of 2018. In 2020, butterfly numbers recovered to the level seen in 2018. In 2021, butterfly numbers greatly increased due to large expansions of Kincaid's lupine within many parts of the Yamhill Oaks Preserve. Conversely, the large decrease in 2022 appeared to result from the cold, rainy weather conditions during May and June this year.

2017	106
2018	163

2019	40
2020	163
2021	310
2022	89

3. Yamhill County – Moores Valley Metapopulation

The population in Moores Valley has been greatly declining over the past few years, apparently due to bad weather conditions, and may have gone extinct during the bad weather year of 2017 and again in 2022. Total population estimates for 2015-2022 are shown as follows.

2015	31
2016	12
2017	0
2018	1 (female on Blaha property, possible stray from Oak Ridge)
2019	8
2020	10
2021	5
2022	0

4. Yamhill County – Oak Ridge Metapopulation

Total population estimates for 2013-2022 are shown as follows. The sharp drop in 2017 appears to be due to a combination of adverse management issues and adverse weather conditions during the spring larval development period. Recovery of the population appeared to be taking place during the 2018-2021 field seasons. However, the large drop in 2022 was certainly the result of the cold, rainy weather conditions during May and June of this year. Specifically, the population crashed to an estimated 62 butterflies in Areas 3 and 4 along the top of Oak Ridge, but compensation did take place by the population increases this year in Areas 1 and 2 to an estimated 317 butterflies. This emphasizes the importance of maintaining habitat within a metapopulation area with a variety of cool, moist to warm, dry aspects in order to

compensate for variable and unpredictable weather conditions from year to year. Without this diversity of habitats on Oak Ridge, this metapopulation would have crashed closed to extinction during 2022.

2013	440
2014	1066
2015	1920
2016	1584
2017	403
2018	518
2019	686
2020	830
2021	900
2022	379

5. Yamhill County – Turner Creek Metapopulation

The Turner Creek population in northern Yamhill County can not be accurately assessed at the present time because the apparent center and main concentration area of habitat on the Cruse-Weinman property could not be surveyed during the 2013-2022 field seasons. For the butterflies on the more limited habitat along Hacker Road, on the Kalbsleisch property, and on the Koelling property, the total estimated population is as follows for 2016-2022.

2016	24
2017	31
2018	22
2019	10
2020	34

2021	24
2022	14

Table 1 summarizes the historical counts of male Fender's blue butterflies within the Moores Valley, Oak Ridge, and Turner Creek habitat management areas of northern Yamhill County for the initial study in 2002 and for 2013-2022 (see previous reports for numbers from earlier years). Butterfly numbers reached a peak in 2015-2016 when sickle-keeled lupine covered much of the habitat on the Zakocs property. With removal of this lupine combined with bad weather conditions in 2017, numbers dropped sharply in all areas of northern Yamhill County with the Moores Valley metapopulation dropping to near extinction. As mentioned above, bad weather conditions again resulted in a major drop during the 2022 field season, with the exceptions of Areas 1 and 2 on Oak Ridge that actually experienced increases this year. At present, major habitat management work is needed to restore habitat overgrown with Scotch broom brush, blackberry, braken fern, or tall exotic grass and dead thatch in Area 1 (King property) and Area 10 (Kalbsleisch property) that would greatly increase butterfly numbers in these areas.

Table 1. Peak counts of male Fender's blue butterflies within the Moores Valley, Oak Ridge, and Turner Creek habitat management areas in Yamhill County during 2002 and 2013-2022.

<u>Area</u>	<u>2002</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>
1	68	29	22	30	13	8	8	12	8	7	14
2	21	42	100	90	103	49	64	79	85	118	118
3	33	11	36	26	20	12	14	32	26	32	10
4	--	101	286	653	524	99	146	163	227	218	16
5	--	10	3	5	1	0	0	2	1	0	0
6	--	5	4	2	1	0	0	0	0	0	0
7	--	7	4	4	6	8	5	1	0	1	1
8	--	5	8	4	2	0	1	1	2	3	3
9	--	1	8	6	1	0	1 F	1 F	3	2	0
10	--	4	4	5	2	5	1	1	12	6	1 F
Total	122	215	475	825	673	181	239	292	364	387	163

- Area 1 King property and county roadsides
Area 2 Goodwin property and county roadsides
Area 3 Hebert property and county roadsides
Area 4 Zakocs and Aplin properties
Area 5 Old Moores Valley Road roadsides, plus Thornton, Freidman, and Van Hee properties
Area 6 Moores Valley Road roadsides, plus Thornton property
Area 7 Hacker Road roadsides
Area 8 Koelling property
Area 9 Miranda (Blaha) property
Area 10 Kalbsleisch (Dunn) property

**COMPARISON OF DISTANCE SAMPLING WITH PEAK COUNT METHODS FOR
PRODUCING POPULATION ESTIMATES**

Since distance sampling was first introduced, there have been serious concerns that this method might be producing badly inflated and unrealistic population estimates for Fender's blue butterflies. To study this question, population estimates were generated for the Yamhill Oaks population in Yamhill County using both methods over the past five years. The results are as follows.

	<u>Peak Count Estimate</u>	<u>Distance Sampling Estimate</u>	<u>Peak Percent Difference</u>
2017	86	531	.16
2018	137	270	.51
2019	38	297	.13
2020	151	506	.30
2021	305	975	.31

In general, the distance sampling estimates have been vastly larger than the peak count estimates over these five years. The closest convergence in estimates came in 2018 with the peak count estimate about 50% of the distance sampling estimate. Otherwise, the peak count estimates were only a small fraction of the distance sampling estimates.

The peak count method is actually very simple. This estimate is generated by taking the highest count of male butterflies at the peak of the flight season, and doubling that number to account for females assuming an equal sex ratio. An additional 20% of the combined male-female number is added to this sum to account for butterflies in the tail ends of the flight season that would not have been present on the peak day count. This method is probably most accurate during years with a short flight season and a high emergence curve. It is probably less accurate in years with a long flight season and a flattened emergence curve, when more butterflies would fall into the tail ends of the flight season. Long flight seasons appear to take place during years with cold, rainy weather conditions that affect larval development in April and May, thus prolonging adult emergence through much of June.

The distance sampling method is based on a very complex and highly theoretical model that depends upon certain critical assumptions that may not be valid for many butterflies. First it assumes that butterflies are difficult to see in the field, so there must be many more butterflies present in an area than what the observer can detect. For male Fender's blue butterflies that are usually tightly confined to lupine patches while searching for females, this first assumption is probably not valid in many areas. Second, the method assumes that butterflies are randomly and evenly distributed throughout a survey area. In reality, lupine patches usually have a highly fragmented distribution and are not evenly distributed in a habitat area, so the male Fender's blue butterflies also show a highly fragmented and patchy distribution.

At the Yamhill Oaks Preserve, most of the transect lines used for distance sampling are located far outside of the lupine patches. The method appears to be generating high population estimates by assuming that large numbers of fictional butterflies must exist outside of the lupine patches. This does not appear to be a realistic assumption. By contrast, the population estimates generated by the peak count method are probably somewhat conservative, but would appear to be far more realistic than the distance sampling estimates.

It is difficult to resolve the discrepancy in population estimates between the two methods. The peak counts are thought to be highly accurate for the actual number of butterflies present at the peak of the flight season. However, the peak estimate could be more liberal if an additional 40% were added rather than 20% to account for the tail ends of the flight season. Using the 2021 data as an example, the peak population estimate of 305 using the 20% addition would be boosted to 356 using the 40% addition. Nevertheless, in order to bring the two estimate methods into alignment, the distance sampling estimate of 975 would still need to be reduced by approximately 63%.

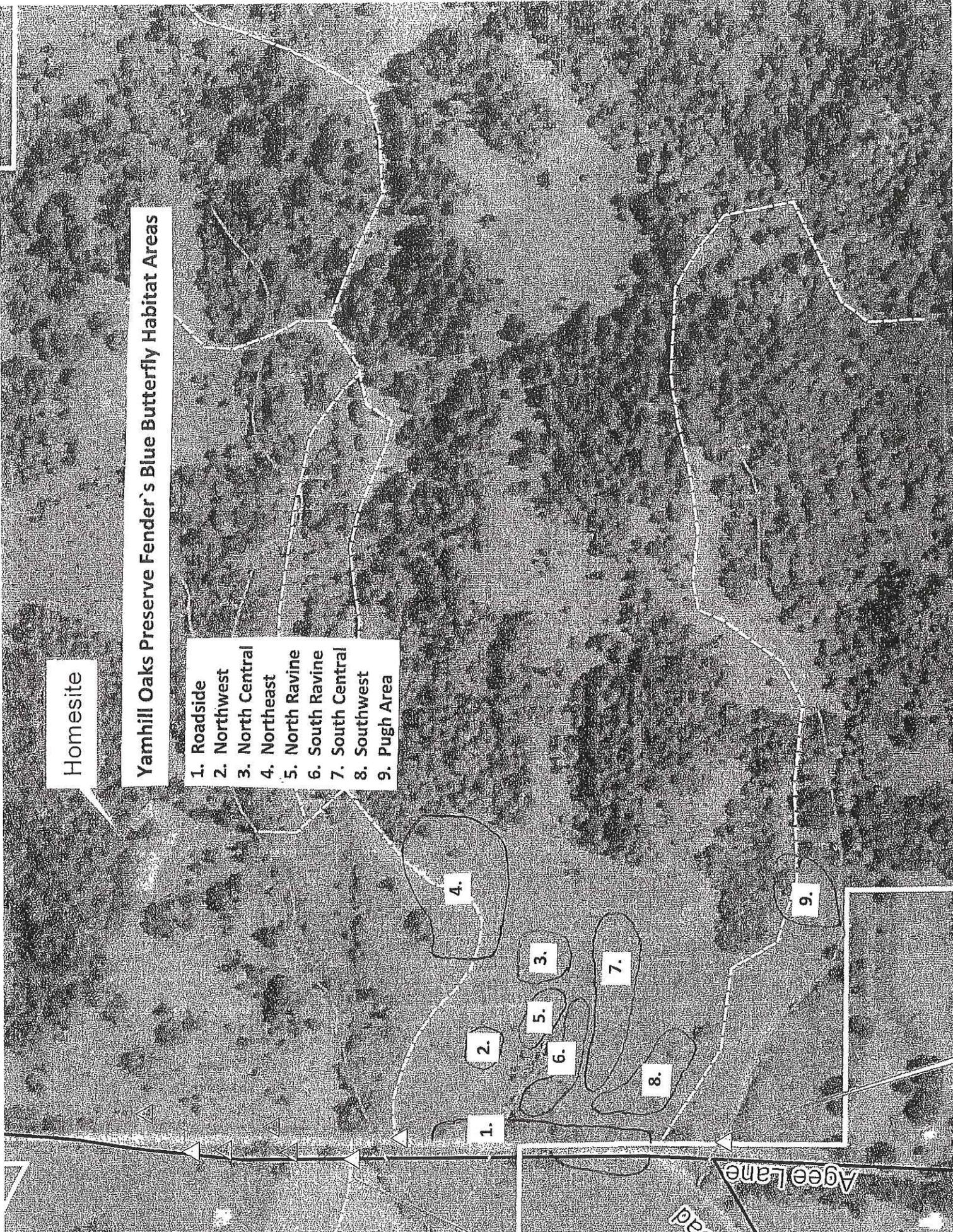
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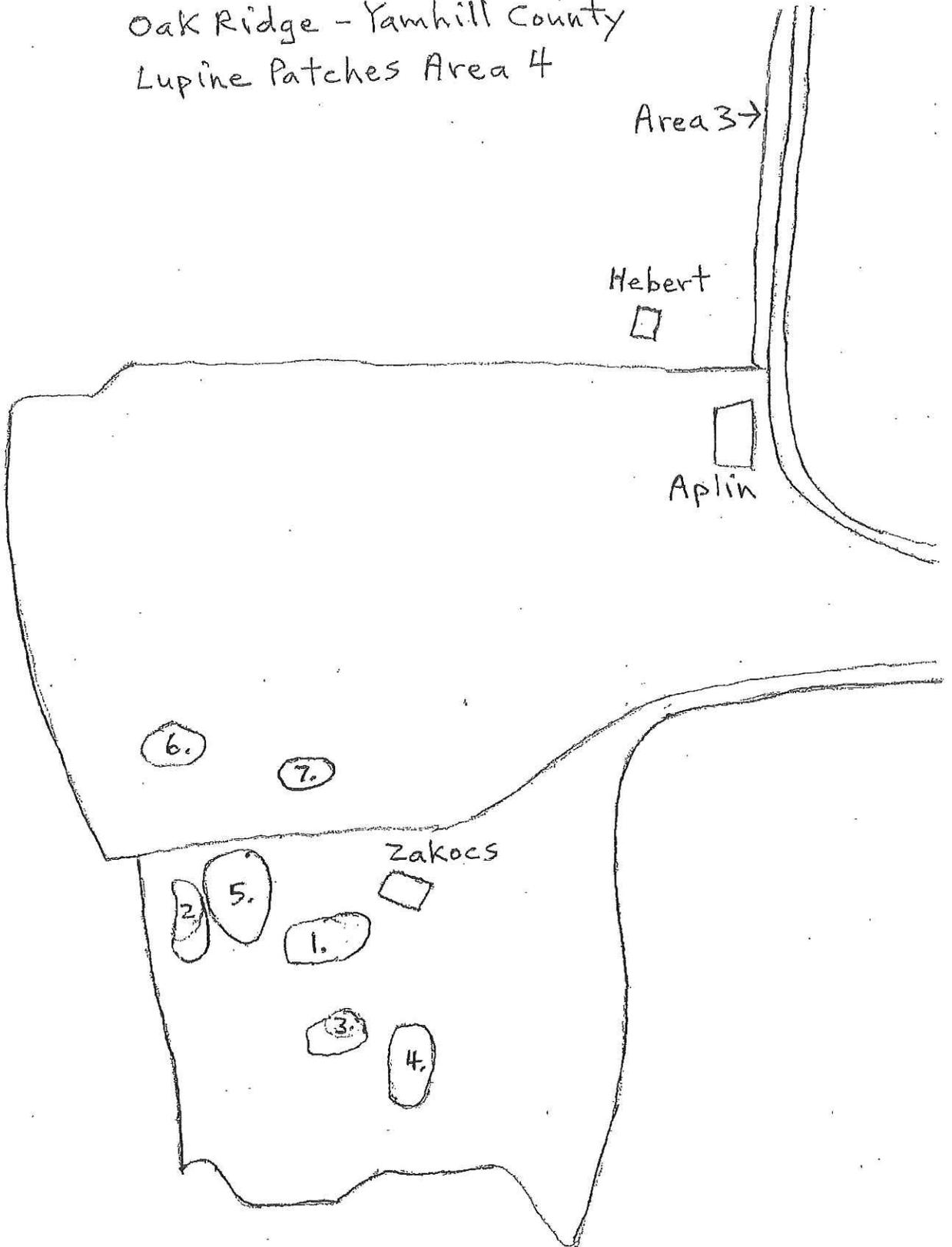
Homesite

Yamhill Oaks Preserve Fender's Blue Butterfly Habitat Areas

- 1. Roadside
- 2. Northwest
- 3. North Central
- 4. Northeast
- 5. North Ravine
- 6. South Ravine
- 7. South Central
- 8. Southwest
- 9. Pugh Area



Oak Ridge - Yamhill County
Lupine Patches Area 4



**Management Plan for Yamhill County Roadsides for Kincaid's Lupine and Fender's Blue
Butterfly in 2022-2023**

The following management recommendations for improving and maintaining roadside habitat of the Kincaid's lupine and Fender's blue butterfly in Yamhill County are suggested for the fall or winter of 2022 and the spring of 2023.

1. Beaver Creek Road in Gopher Valley

During 2016, young oak trees on the north embankment of the road were cut and removed, and extensive thickets of woody brush were cut along the entire length of the lupine habitat area. As of 2022, young trees and brush are starting to grow back again, particularly poison oak, blackberry, and young oak trees. Thus, it is suggested that brush cutting be conducted at this site during the 2022-2023 fall or winter seasons.

2. Roadsides along both Moores Valley Road and Old Moores Valley Road

During 2015 and 2019, invasive stands of exotic tall oat-grass along the roadsides were successfully treated with the grass-specific herbicide Poast (sethoxydim). This treatment released suppressed patches of Kincaid's lupine, resulting in vigorous growth and blooming of the lupine. As of 2022, the tall oat-grass is again spreading and threatening the lupine in this habitat. Thus, it is suggested that the grass again be sprayed along these roadsides with a grass-specific herbicide during the spring of 2023. Two spray treatments should be conducted, the first in March and the second in April about 2-4 weeks apart.

3. Roadside in Area 3 along Oak Ridge Road adjacent to Carol Hebert Property

As of 2022, young trees, woody brush, and exotic sweet pea are starting to grow back again over the lupine habitat along the west side of the road. Thus, it is suggested that brush cutting be conducted at this site during the 2022-2023 fall or winter seasons.

4. Roadsides along both Hacker Road and Tupper Road

As of 2022, tall oat-grass is again spreading and over-growing the lupine in the habitat along both of these roads. Thus, it is also suggested that the grass be sprayed with a grass-specific herbicide during the spring of 2023. Two spray treatments should be conducted, the first in March and the second in April about 2-4 weeks apart.

5. General Management

It is recommended that all lupine habitat areas along roadsides be mowed in late fall or early winter of 2022-2023.