

The 2021 Surveys of Fender's Blue Butterfly and Kincaid's Lupine Sites in Benton, Polk, and  
Yamhill Counties, Oregon

by

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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 2021 at known sites of Fender's blue butterfly (*Icaricia icarioides fenderi*) and Kincaid's lupine (*Lupinus oregonus*) 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 2015-2021 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).

All sites were surveyed at the peak of the lupine blooming period, and at the peak of the adult butterfly flight season. The field season in 2021 was early for the adult butterflies after an extended period of particularly hot weather during April, but this did not affect the blooming phenology of the lupine. Thus, the peak of butterfly emergence took place this year during early to mid-May about 1-2 weeks before the peak of lupine blooming in mid to late May. In contrast to the 2020 field season, relatively little rainfall took place in 2021 during April and May, and lupine flowering was over at most sites by early June. Also, the adult Fender's blue flight season was not extended very far into June this year in contrast to the long, extended flight season in 2020.

A conservative population estimate of Fender's blue butterflies for each of the metapopulation areas described below in 2021 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. For most populations, this is probably a very conservative estimate, particularly for large populations that are dispersed over large geographic areas where many butterflies were probably missed during the surveys. 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 native 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. The primary management problems at present are spreading exotic tall oat-grass (*Arrhenatherum elatius*) and braken fern. This site was surveyed twice in 2021 at the peak of the male flight season with the following results.

May 5            65 males, 16 females

May 10          64 males

Peak butterfly counts and population estimates for the Watkins property over the past eight 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

The peak count in 2020 was based on females since the peak male flight was missed last 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 three years has successfully eliminated the brush problem. This work combined with favorable weather conditions during 2020-2021 have resulted in good lupine growth and major expansion of the lupine. In turn, butterfly numbers have greatly increased over these past two 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 over two days in 2021 with the following results.

May 5            2 males

May 10          1 male

This site was previously occupied by Fender's blue butterflies with 18 males counted in these lupine patches during the 2009 field season. Unfortunately, this colony appears to have become extinct over the 2014-2016 field seasons. An old worn male was seen on this site in 2015, and a fresh male was seen in 2017. In 2020, a female was seen at the east end of the road, and a male was present at the west end near the Picht property. In 2021, the above males were also seen at the west end near the Picht property. Kincaid's lupine was growing very well this year along the roadsides, so more butterflies might be expected next year.

## 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, but only a single male butterfly was present in the largest patch during 2020. This site was surveyed over two days in 2021 with the following results.

May 5            0

May 10          0

About 8 males were found on the Picht property in 2018, but only a single male and female were seen during 2019. Based upon the amount of lupine present, butterfly numbers should be similar to those on the Watkins property. In 2020, only a single resident male was present over a two week period and no females were seen. Perhaps genetic augmentation of this site would increase butterfly numbers by introducing some females from another site such as from the Wren population. At present, a viable colony of Fender's blue butterflies does not appear to be present on the Picht property despite the apparent habitat suitability of this site.

#### 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 2021, the lupine was still very abundant at this site, but no butterflies were seen. Specific observations are as follows.

May 11	0
May 26	0
May 31	0
June 6	0
June 12	0

#### 5. 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. Five years later in 2021, the habitat had degraded further and was mostly covered with tall oat-grass. Nevertheless, a few butterflies were still present this year. Specific observations are as follows.

May 11	0
May 26	2 males, 2 females

May 31	1 female
June 6	0

#### 6. 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 of the 2016 field season, the butterfly appeared to be extinct at this site (Hammond, 2016). However, a few males appeared in 2021, 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 are as follows.

May 11	0
May 26	0
May 31	2 males
June 6	0

I did meet with the ODOT site manager and gave him a tour of the site. I suggested to him that a grass-specific herbicide spray in March and April would greatly help to control the tall oat-grass problem.

#### 7. Yamhill Co. – Beaver Creek Road

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 2021 at the peak of lupine blooming as shown below, but no Fender's blue butterflies were present.

May 13	0
May 16	0
May 28	0
May 31	0
June 9	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 2017-2021 field seasons that had been previously shaded by trees and brush during 2015-2016. As of 2021, young trees and brush were starting to grow back, indicating that brush cutting will probably be needed again within one or two years.

⑧ 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 also surveyed five times in 2021 with the following results.

May 13	2 males
May 16	2 males, 1 female
May 28	0
May 31	1 male, 1 female
June 9	1 female

No Fender's blue butterflies were present at this site during 2017-2018, but one male and one female were seen in 2019. In 2020-2021, 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 2017-2021, and

habitat conditions throughout the site were excellent in 2021. This habitat improvement has resulted in the successful establishment of a butterfly colony at this site as of 2020-2021. 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.

9. 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, most of the lupine is now shaded by the growth of young oak and conifer trees or is overgrown with tall bracken fern. Consequently, habitat conditions in this first area were very poor during the 2020-2021 field seasons, and major tree clearing and fern cutting are needed to renovate this habitat. 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 2019-2021 field seasons. These sites were surveyed six times in 2021 with the following results.

May 4	0
May 13	4 males
May 16	1 male
May 28	0
May 31	1 male
June 9	0

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

The butterflies in Area 2 covering the Yamhill Oaks Preserve were also surveyed over six days in 2021. 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. Separate male butterfly counts were made for each of the lupine habitat areas as shown below. The attached map shows the location of these habitat areas.

	<u>Roadside</u>	<u>Northwest</u>	<u>North Ravine</u>	<u>North Central</u>	<u>Northeast</u>
May 4	0	0	1	0	2
May 13	4	0	8	7	23
May 16	1	1	14	14	43
May 28	0	0	3	4	8
May 31	1	0	4	1	9
June 9	0	0	1 female	0	2 females

	<u>Pugh</u>	<u>South Central</u>	<u>South Ravine</u>	<u>Southeast</u>
May 4	7	1	0	0
May 13	22	6	10	1
May 16	28	6	16	1
May 28	2	0	11	1
May 31	1	0	9	1
June 9	0	0	1 female	0

Habitat conditions are quite variable across the Yamhill Oaks Preserve due to differences in aspect and sun exposure, with the warmest conditions along the roadside and on the Pugh site, and the coolest conditions on the Northeast and South Ravine sites. As a result, total peak counts for each of the above areas are summarized separately, and then combined together for the total peak count. Thus, the total peak count for all areas combined is 127 male butterflies in 2021. Peak counts for all areas are summarized below for 2018-2021 together with population estimates for each year.

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

The population at the Yamhill Oaks Preserve had a peak of around 170 butterflies in 2009, and has since fluctuated at around 100 butterflies each year. 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 2019-2021. 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 over 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. In addition, lupine has been rapidly spreading into new areas previously not occupied, probably resulting from long-distance seed dispersal. Specifically, the Northwest, Pugh, South Central, and Southeast areas had little or no Kincaid's lupine during the 2016-2018 time period, and lupine and butterflies have been rapidly spreading in these areas during the 2019-2021 time period. This year, about 12% of all butterflies were found in these newly created areas of lupine habitat. In addition, the lupine in the historical patches has also greatly expanded and spread into adjacent areas in the last few years.

11. 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 four days in 2021 with the following results.

May 15	0
May 26	0
May 29	0
June 5	0

Habitat conditions at this site have been 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 2019-2021.

12. 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 four days in 2021 with the following results.

May 15	0
May 26	0
May 29	0
June 5	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 2017-2021 field seasons, due in part to 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 again in 2019. As a consequence of these herbicide treatments, the lupine has responded with vigorous growth and extensive blooming in the 2019-2021 time period.

⑬ 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 2018-2021. Although the lupine was suppressed by dense stands of tall oat-grass in 2020, the grass cover was much less in 2021, perhaps because of dry weather conditions and low soil moisture levels during May of this year. These lupine patches were surveyed four times during the 2021 field season with the following results.

May 15	0
May 26	0
May 29	0
June 5	0

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.

⑭ Yamhill Co. – Area 6 Moores Valley Road – Thornton 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 four times during the 2021 field season with the following results.

May 15	0
May 26	0
May 29	0
June 5	0

During the past two 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 2021 by tall vegetation. At Site 2, the lupine also grew very poorly because of drought-like conditions on the south-facing hillside. However at the east end of Site 2, the lupine actually grew and bloomed the best because the tall oat-grass that usually suppresses these lupine patches appeared to also be suppressed by the drought and low soil moisture levels this year.

15. 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. This site was surveyed four times in 2021 with the following results.

May 15	2 males
May 26	1 male
May 29	0
June 5	0

On May 30, 2015, a total of 6 males and 2 females were counted at this site, and 3 males and 1 female were counted on May 29 of last year. Unfortunately, no females were seen this year, and the heavy livestock grazing likely resulted in the extermination of this colony in 2021.

I took Mrs. Miranda on a tour of the site and showed her the lupine. Also, she was able to see one of the male Fender's blue butterflies that were seen here in 2021. We discussed the possibility that the corner of her pasture where the lupine is located might be fenced off in future years so that livestock grazing could continue in most of the pasture without destructively impacting the lupine and butterfly.

**Summary of the total peak number of male Fender's blue butterflies in the Moores Valley Metapopulation for 2014-2021**

2014	16
2015	14
2016	4
2017	0
2018	0
2019	2
2020	4
2021	2

**16. 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 2021 with the following results.

May 4	5 males
May 12	7 males
May 22	4 males
May 29	2 males
June 5	0

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.

By 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 2020-2021 field seasons. About half the butterflies observed this year in Area 1 were flying along the roadside rather than on the King property as a consequence.

I talked to Mr. King about management on his property. He presently needs outside assistance in clearing away the old-growth Scotch broom brush that now covers nearly all of the butterfly habitat on the north side of his property. He has recently obtained better mowing equipment, and thinks that he can maintain the habitat in the future with regular mowing if an outside agency could remove the brush. Historical peak counts of Fender's blue butterfly males on the King property are shown as follows, and indicate the potential for future butterfly increases with proper habitat management. The declining numbers in recent years are closely correlated with the spread and coverage of Scotch broom brush over the habitat.

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

17. 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 2015-2021, Mr. Goodwin did not want any additional surveys done on his property. Thus, the following surveys over five days in 2021 were limited to observations along the roadside.

May 4	10
May 12	38
May 22	39
May 29	45
June 5	9

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 2020-2021 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 2014-2021 field seasons based upon the 2014 count of butterflies in the interior of the Goodwin property. In 2021, 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	(? 40)	(? 49)
2018	24	(? 40)	(? 64)
2019	30	(? 49)	(? 79)
2020	32	(? 53)	(? 85)
2021	45	(? 73)	(? 118)

18. 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. Many Kincaid's lupine patches are located in the road right of way and on the Hebert property immediately adjacent to the road. These cover an estimated 400 square meters on the road right of way and perhaps an additional 500 square meters on the Hebert property next to the road. In particular, the lupine appears to have spread considerably on the Hebert property over the past nine 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 four years. Specific details of this management were included in the 2019 report (Hammond, 2019). Butterflies were surveyed five times in 2021 with the following results.

May 4	1
May 12	12
May 22	32
May 29	22
June 5	18

Butterflies emerged and remained at high levels in Area 3 over an extended time period during 2019-2021. Thus, butterflies flying on May 12 were probably not the same butterflies flying on June 5 when several freshly emerged males and females were still observed. Peak counts of males for 2014-2021 are shown below. Butterfly numbers have doubled over the past three years compared to 2017-2018 due in large part to the improved habitat conditions along the roadsides resulting from Yamhill County management.

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

19. 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 Kincaid's 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. Zokocs 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 five times during the 2021 field season with the number of male butterflies shown for each individual lupine patch below.

	<u>Zakocs 1</u>	<u>Zakocs 2</u>	<u>Zakocs 3</u>	<u>Zakocs 4</u>	<u>Aplin 6</u>	<u>Aplin 7</u>
May 4	2	0	2	4	0	0
May 12	46	33	12	36	31	8
May 22	39	35	14	58	52	9
May 29	26	12	10	48	56	5
June 5	10	2	5	12	36	0
Peak Count	46	35	14	58	56	9
Total Peak Count	218 males					

Thus, butterfly numbers were at peak at various times in different lupine patches between May 12 (Zakocs 1) and May 29 (Aplin 6). This is the result of variance in aspect and moisture conditions with butterflies on the Zakocs sites peaking earlier than the Aplin 6 site that has a cool, north-facing exposure. Total population size in 2021 is estimated at around 523 butterflies. Population estimates for 2013-2021 are shown below. The very high numbers in 2014-2016 were due to expanding stands of sickle-keeled lupine, which was eradicated in 2017.

2013	240
2014	690
2015	1570
2016	1258
2017	240
2018	350
2019	391
2020	545
2021	523

Thus, Area 4 continues to have the largest population of Fender's blue butterfly in Yamhill County despite the decrease over the past five years due to the elimination of the sickle-keeled lupine, with numbers gradually increasing again with the continuing spread of Kincaid's lupine patches. It is interesting to compare the production of Fender's blue butterflies over the years within each of the lupine patches with respect to variable weather conditions from year to year combined with management work. The year 2016 was particularly favorable for the butterfly in most lupine patches, 2017 was the worst weather year with a cold, wet spring, and both 2019 and 2021 had relatively warm, dry springs.

**Comparison of Peak Male Butterfly Numbers in Area 4 by Lupine Patch During 2013-2021**

	<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>
1. Zakocs 1	8	28	51	61	16	68	68	75	46
2. Zakocs 2	11	23	86	24	2	5	14	20	35
3. Zakocs 3	4	13	18	78	23	24	12	38	14
4. Zakocs 4	27	71	88	76	28	19	8	38	58
5. Zakocs 5	14	124	379	227	15	0	0	0	0
6. Aplin 6	37	27	31	58	15	30	41	41	56
7. Aplin 7	--	--	--	--	--	--	20	15	9
Total	101	286	653	524	99	146	163	227	218

Zakocs 1 lupine patch has been rapidly expanding each year, and has probably quadrupled in size since 2013. It includes the top of the hill that is relatively warm and dry, and a lower north-facing aspect that is cooler and moister. Butterflies start to emerge at the top of the hill beginning in early May and peak through the middle of May, but fresh butterflies continue to emerge in the north-facing area through the second week in June. Butterfly numbers have continued increasing each year since 2013 with the expanding extent of lupine coverage, declining only during the bad weather year of 2017 and the dry year of 2021.

Zakocs 2 began as a Kincaid's lupine patch in 2013, but rapidly became overgrown with sickle-keeled lupine by 2015. With the elimination of the sickle-keeled lupine and suppression of Kincaid's lupine by herbicide treatment in 2017, butterfly numbers greatly decreased in 2017-2018. However, the Kincaid's lupine recovered in 2019-2021, resulting in increasing butterfly numbers during these last three years. This site has a cool, north-facing aspect.

Zakocs 3 lupine patch is located at the top of the hill with a warm, dry south-facing aspect. It has probably tripled in size since 2013. Butterfly numbers reached the highest level during the favorable weather year of 2016, but numbers sharply declined during the dry springs of 2019 and 2021.

Zakocs 4 lupine patch is located at the bottom of the hill with a warm, dry south-facing aspect. It also has tripled in size since 2013, and reached the highest number of butterflies during 2014-2016. Numbers sharply declined during 2018-2019, but numbers greatly improved during 2021.

Zakocs 5 lupine patch on the northwest side of the hill was a sickle-keeled lupine site with virtually no Kincaid's lupine when it was eliminated with herbicides in 2017. No butterflies have been seen in this area during 2018-2021, but a few isolated Kincaid's lupine plants were just beginning to become established during the 2020 field season. In 2021, these had begun to expand into a small lupine patch. Thus, butterflies are expected to become re-established in future years as the Kincaid's lupine spreads and expands.

Aplin 6 lupine patch is located on a cool, north-facing aspect. As a consequence, butterflies fly in large numbers over an extended time period without a clear peak, and butterflies flying during the first two weeks of May are probably not the same butterflies flying during the first two weeks of June. As a consequence, the peak count numbers shown in the above table are probably not indicative of the total butterfly production levels in this lupine patch. This patch appears to be the second most productive lupine patch for butterflies in Area 4 after the Zakocs 1 patch, and this was particularly true during the dry spring of 2021.

Aplin 7 lupine patch is located higher on the hill with a warm, drier aspect. It did not exist until three years ago. A few isolated plants had become established in 2018, but the lupine has quickly spread and formed a relatively large patch as of the 2020-2021 field seasons. Over the past three years, butterflies have quickly colonized this new patch from the original Aplin 6 patch. At present, these two patches will likely continue to expand and merge together in the next few years. In sharp contrast to butterfly numbers in the Aplin 6 lupine patch during the dry spring of 2021, butterfly numbers greatly decreased in the Aplin 7 patch this year.

Over the last few years, it has become apparent that a negative type of ecological succession appears to affect very old patches of Kincaid's lupine. The plants at the edge of a newly expanding lupine patch grow with great vigor, but established old plants in the center of an old patch usually show significant decline and loss of vigor. This could result from a

depletion of important soil nutrients such as inorganic minerals. At the same time, grasses grow with great vigor in the center of old lupine patches, probably the result of increased soil nitrogen, and tend to overgrow and smother the lupine plants. This is particularly true of exotic tall oat-grass, although the shorter bentgrasses also exhibit this negative effect upon the lupine. Moreover, Fender's blue butterflies are not particularly active in the middle of old lupine patches, and females appear to conduct most of their oviposition on the vigorous lupine plants around the expanding edge of a lupine patch. As of the 2020-2021 field seasons, this lupine decline was quite significant in parts of the Zakocs 1, Zakocs 3, Zakocs 4, and Aplin 6 lupine patches. In particular, the decline of butterfly numbers within Zakocs 4 in recent years appears to be directly attributable to this lupine decline. In addition, butterfly numbers have only modestly increased within Zakocs 1 despite the massive spread of this lupine patch in recent years. Thus, ecological succession through time appears to be a significant factor in determining the size of future Fender's blue butterfly populations.

20. 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 2019, butterfly numbers greatly declined to only 2 males and 1 female. In 2020, no Fender's blue butterflies were seen and the colony appeared to have become extinct last year. In 2021, a single male was seen over two weeks that could have strayed from the nearby colony on Belt Road, so re-colonization at this site is a definite possibility. The lupine was growing quite well in 2019-2021, and the habitat was generally in good condition due to roadside management by Yamhill County over the past few years. This year, butterfly surveys were made on six different days with the following results.

May 4	0
May 12	0
May 17	0
May 22	1 male
May 29	1 male
June 5	0

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 2018-2020 field seasons. No Fender's blue butterflies have been present during the 2012-2021 field seasons. 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. This site was surveyed over six days in 2021 with the following results.

May 4	0
May 12	0
May 17	0
May 22	0
May 29	0
June 5	0

In early May this year, one of the adjacent private landowners mowed the roadside and cut down much of the lupine before it could bloom. This mowing probably helped control the tall oat-grass to some extent, and the lupine plants partially grew back later in the month. However, it is strongly recommended that in 2022, the tall oat-grass should be sprayed twice with a grass-specific herbicide during next March and April to achieve better control or eradication of this pest.

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 2020-2021 resulted in vigorous growth and blooming of the lupine. This site was surveyed four times during the 2021 field season with the following results.

May 17	6 males
May 22	4 males, 1 female
May 29	3 males, 1 female
June 5	1 male

The historical peak number of male 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

Thus, small numbers of butterflies have been able to persist at this site over the past 10 years. In 2019, poor weather conditions combined with the thatch problem greatly repressed the lupine, and almost no lupine bloomed. Butterfly numbers dropped to near extinction level that year. However in 2020-2021, favorable weather conditions resulted in vigorous lupine growth and blooming, and also resulted in a mini-population explosion of butterflies last year.

I talked with Soren Kalbsleisch about management of this habitat. While they are not able to pay for the work, they would very much like outside assistance in removing the Scotch broom and blackberry brush that is presently threatening the habitat and this colony of Fender's blue butterfly. Thus, it is recommended that a fall mowing and brushing be conducted at this site to address the grass thatch problem, and to control the resurgence of broom and blackberry brush.

23. Yamhill Co. – Norvella Koelling Property (Turner Creek Metapopulation)  
(survey conducted by Amie Loop-Frison)

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. In 2021, this site was surveyed once around the peak by Amie Loop-Frison with the following results.

May 11            3 males, 4 females

Butterfly numbers on the Koelling property have been very low over the past six 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

## SUMMARY OF METAPOPOPULATION ESTIMATES IN RECENT YEARS

### 1. Benton County – Greasy Creek Metapopulation

In 2018-2021, 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 2020-2021 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

### 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 2019-2021. 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 2017-2021 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.

2017	106
2018	163
2019	40

2020	163
2021	310

### 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. The only breeding colony at present appears to be on the Miranda (former Blaha) property. Total population estimates for 2015-2021 are shown as follows.

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

### 4. Yamhill County – Oak Ridge Metapopulation

Total population estimates for 2013-2021 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.

2013	440
2014	1066
2015	1920
2016	1584

2017	403
2018	518
2019	686
2020	830
2021	900

#### 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 2013-2021 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.

2016	24
2017	31
2018	22
2019	10
2020	34
2021	24

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 2012-2021 (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. At present, major habitat management work is needed to restore habitat overgrown with Scotch broom brush, blackberry, bracken fern, or tall exotic grass and dead thatch in Area 1 (King property) and Area 10 (Kalbsleisch property) that would greatly increase 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 2012-2021.

<u>Area</u>	<u>2002</u>	<u>2012</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>
1	68	12	29	22	30	13	8	8	12	8	7
2	21	--	42	100	90	103	49	64	79	85	118
3	33	1	11	36	26	20	12	14	32	26	32
4	--	36	101	286	653	524	99	146	163	227	218
5	--	5	10	3	5	1	0	0	2	1	0
6	--	6	5	4	2	1	0	0	0	0	0
7	--	4	7	4	4	6	8	5	1	0	1
8	--	14	5	8	4	2	0	1	1	2	3
9	--	6	1	8	6	1	0	1 F	1 F	3	2
10	--	2	4	4	5	2	5	1	1	12	6
Total	122	86	215	475	825	673	181	239	292	364	387

- 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