



Habitat of the Threatened Fender's Blue Butterfly (*Icaricia icarioides fenderi*) in Western Oregon: A Photo-Point Comparison

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Abstract

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The Fender's blue butterfly (*Icaricia icarioides fenderi*) is a federally listed threatened species occurring in the Willamette Valley, Oregon. The species depends on intact, native prairie environments with plants used for nectar sources and egg-laying. This report provides photos of selected locations with the species presence and provides views of conditions and changes under seasonal and management activities, particularly focused on conditions providing suitable habitat.

KEYWORDS:

Fender's blue butterfly
Habitat management
Invertebrate conservation
Threatened species

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Introduction

The Fender's blue butterfly (*Icaricia icarioides fenderi*, family Lycaenidae) is a federally listed threatened² subspecies of the Boisduval's blue butterfly (*Icaricia icarioides*). The distribution of the Fender's blue butterfly is limited to the Willamette Valley, Oregon, disjunct from the broader range of its widespread parent species (fig. 1). It was initially listed as endangered in 2000, but since then, the Fender's blue butterfly has rebounded to "nearly thirty thousand individuals" prompting downlisting to threatened status in early 2023 (Schultz and Collins 2024), in large part because of habitat conservation and restoration activities (fig. 2).

The Fender's blue butterfly is one of five species included in a recovery plan for threatened and endangered species of the Willamette Valley (USDI FWS 2010). Much of the original native prairie in this region has been converted to other uses, and the upland prairies of western Oregon used by the butterfly are considered one of the most imperiled ecosystems in the United States (Noss et al. 1995). Recovery criteria for downlisting and delisting pertain to ensuring functioning population networks and habitat connections.

Several key vegetation conditions are required for Fender's blue butterfly habitat: (1) patches of lupine—principally Kincaid's lupine (*Lupinus oregonus* A. Heller var. *kincaidii* C.P. Sm., previously *L. sulphureus* Douglas ex Hook. ssp. *kincaidii* (C.P. Sm.) L. Phillips), a federally listed threatened and rare subspecies of sulphur lupine (*L. sulphureus* Douglas ex Hook.); sicklekeel lupine (*L. albicaulis* Douglas); or longspur lupine (*L. arbustus* Douglas ex Lindl.); (2) sunny, open, short-stature vegetation conditions, including grass-forb prairie and relatively open oak savannah; and (3) a diversity of nectar resources (Thomas and Schultz 2016). The butterfly uses lupines for ovipositing (egg-laying) and prairies, often containing Roemer's fescue (*Festuca idahoensis* Elmer ssp. *roemerii* (Pavlick) S. Aiken), for nectaring and dispersing. Larvae of the Fender's blue butterfly feed exclusively on the leaves of these three species of lupine. Other cover types include open and dense woodland, through which the butterfly may disperse, and fallow agricultural and pasture lands, which, in some instances, might provide limited nectaring and dispersal environments for adults. The presence of nonnative tall grasses, woody shrubs, or other invasives, such as tall oatgrass (*Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl & C. Presl), Scotch broom (*Cytisus scoparius* (L.) Link), or Himalayan blackberry (*Rubus armeniacus* Focke), degrades the quality of Fender's blue butterfly habitat by smothering and shading out the nectar and lupine resources required by the butterfly.

The Fender's blue butterfly associates mostly with Kincaid's lupine and longspur lupine, and occasionally with sicklekeel lupine (Wilson et al. 1997). Genetic evidence at Baskett Slough National Wildlife Refuge suggests some hybridization between Kincaid's and longspur lupines (Liston et al. 1995). The Fender's blue butterfly nectars on a variety of native forbs in lupine and prairie patches, including lupine itself. Some forbs of greater nectar value include narrowleaf onion (*Allium amplexans* Hook.) and Tolmie star-tulip (*Calochortus tolmiei* Hook. & Arn.) (Wilson et al. 1997).³ The butterfly may be limited in distribution, in part, from the scarcity of lupine and nectar plants (Schultz and Dlugosch 1999).

²Fender's blue butterfly had been federally declared as endangered but was reclassified as threatened in 2023 (USDI FWS 2023).

³Also listed is garden vetch (*Vicia sativa* L.), but this is not considered in the recovery plan as a nectar species that contributes to the total amount of nectar because it is not a native species.

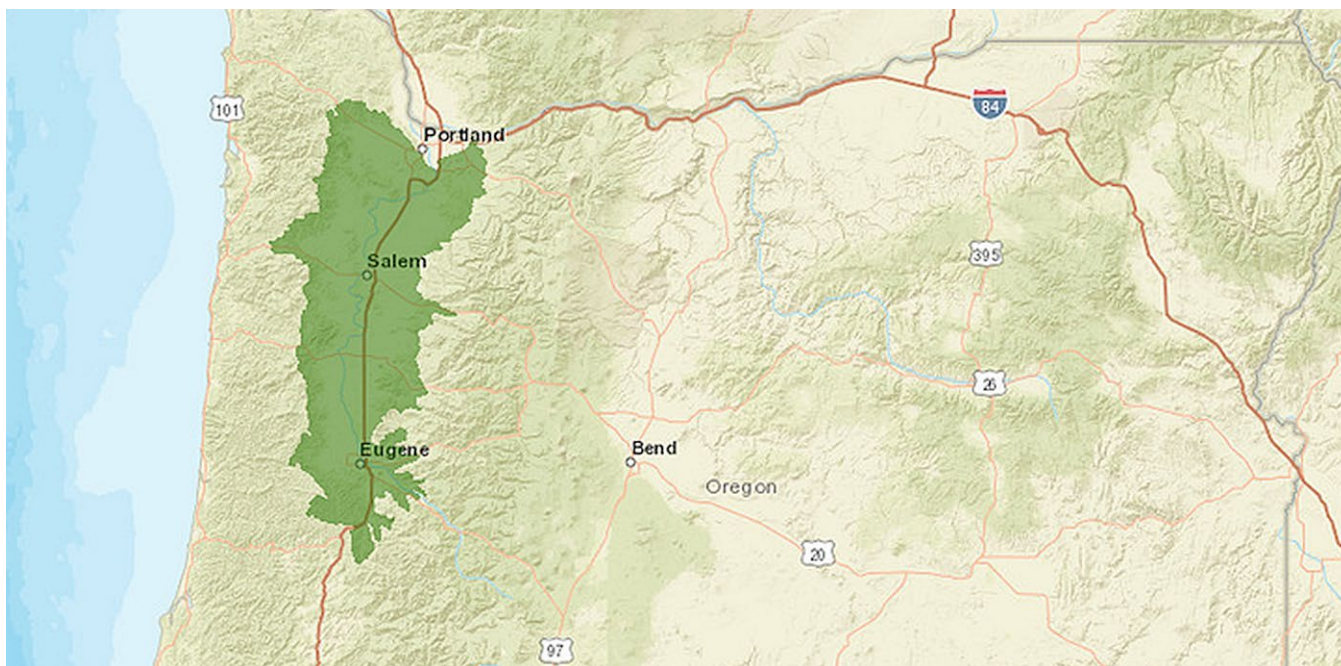


Figure 1—Extent of the Fender's blue butterfly range (green shading) in western Oregon along the Willamette Valley. Source: USDI FWS (n.d.).



Figure 2—Examples of signage at Fender's blue butterfly conservation sites. USDA Forest Service photos by Bruce G. Marcot.

Site restoration activities include protection from habitat conversion; mowing and burning to restore early seral conditions; and chemical and mechanical removal of invasive plants, particularly Scotch broom, Himalayan blackberry, Fuller's teasel (*Dipsacus fullo-num* L.), western brackenfern (*Pteridium aquilinum* (L.) Kuhn), and others. Restoration also includes seeding and planting of native nectar species and patches of lupine. Mowing, burning, and removal activities occur typically in autumn, following Fender's blue butterfly mating, egg-laying, and dispersal events. By spring green-up, the positive effects of restoration become evident.

The purpose of this compendium is to present photographic comparisons of selected sites hosting populations of Fender's blue butterfly, particularly comparing seasonal changes, and to suggest effective management actions to restore habitat. In addition, I provide information to help identify the silvery blue butterfly (*Glaucopsyche lygdamus*), a relatively common species that looks similar to, and largely overlaps in range with, the Fender's blue butterfly. I present photos of Fender's blue and silvery blue butterflies and compare the two species. To compare seasonal habitat conditions, I present pairs of photos (autumn and spring), taken at roughly the same point, at each of six sites with Fender's blue butterfly populations. I also present photos of select nectar plants and invasive plants; and photos of lupine, prairie, and woodland vegetation patches.

Sites were selected to represent a diversity of topographic, administrative, and environmental conditions and include Henry Hagg Lake and the adjacent Scoggins Bend in Washington County; Oak Ridge in Yamhill County; and Lupine Meadows, Wren, and an adjacent site in Benton County, Oregon. Noting such conditions among sites and across seasons can be useful information to help identify suitable habitat as used in modeling landscape connectivity (e.g., Schultz and Crone 2015, Schumaker 2024).

Species

Fender's Blue Butterfly

The Fender's blue butterfly is a member of the gossamer-winged butterfly family Lycaenidae. Its wingspan is about 1 inch (2.5 cm). The wings are sky-blue in males and blue-brown in females on the dorsal (back) side, and gray-brown with black spots outlined in white on the ventral (belly) side in both sexes. There is a thin, white outer edge on both sides of the wings. Excellent descriptions of the Fender's blue butterfly are presented by Hicks (n.d.) and Pyle (2002). Figures 3 through 6 are photos of Fender's blue butterfly adults, and figure 7 is of an egg.



Figure 3—Left: Ventrums of a Fender's blue butterfly, displaying characteristic bars and spots. Right: Dorsum of a male Fender's blue butterfly, showing its iridescent blue forewings and hindwings (females are brown). USDA Forest Service photos by Bruce G. Marcot.

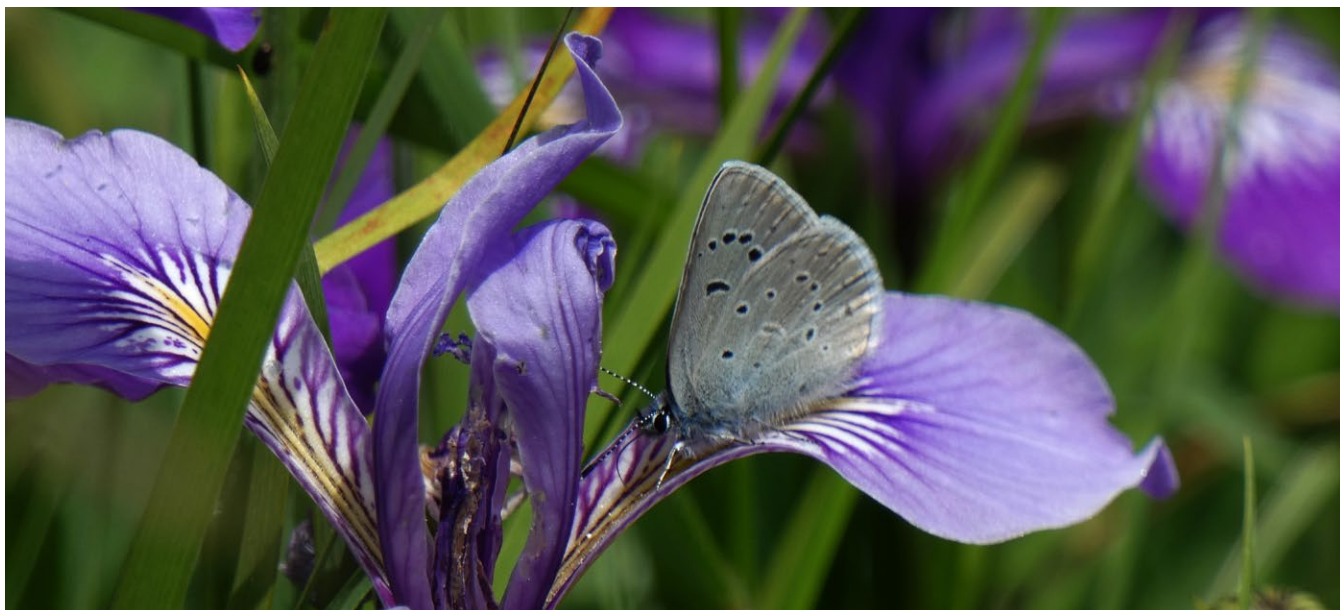


Figure 4—Fender's blue butterfly nectaring on toughleaf iris (*Iris tenax*). USDA Forest Service photo by Bruce G. Marcot.



Figure 5—Fender's blue butterfly nectaring on Kincaid's lupine (*Lupinus oreganus* var. *kincaidii*). USDA Forest Service photo by Bruce G. Marcot.



Figure 6—Mating Fender's blue butterflies. USDA Forest Service photo by Bruce G. Marcot.



Figure 7—Egg laid by a Fender's blue butterfly (tiny white dot in center of photo). Fender's blue butterflies typically lay a single egg at a time on the underside of the leaves of one of three species of lupine, up to about 350 eggs total. USDA Forest Service photo by Bruce G. Marcot.

Silvery Blue Butterfly

A look-alike species that co-occurs with the Fender's blue butterfly is the silvery blue butterfly. This species is widespread and has a broad range of host plants, including species of lupine. The subspecies of the silvery blue butterfly that overlaps the range of the Fender's blue butterfly is *Glaucopsyche lygdamus columbia*. Figures 8 through 10 are photos of the silvery blue butterfly.

When co-occurring with the Fender's blue butterfly, the silvery blue butterfly specializes on different lupine species. For inventory and monitoring, it is critical to differentiate between the two species, and distinguishing features are subtle.



Figure 8—Left: Ventrum of a silvery blue butterfly, showing spot patterns similar, but not identical, to those of the Fender's blue butterfly. Most notably, the silvery blue butterfly has only a single row of spots along the distal portion of the wings, whereas the Fender's blue butterfly has a double row. Right: Dorsum of a silvery blue butterfly, showing a light-brownish hue, which occurs with older females. USDA Forest Service photos by Bruce G. Marcot.



Figure 9—Silvery blue butterfly nectaring on small camas (*Camassia quamash*). USDA Forest Service photo by Bruce G. Marcot.



Figure 10—Silvery blue butterfly nectaring on American vetch (*Vicia americana*). USDA Forest Service photo by Bruce G. Marcot.

Species Comparison

Figure 11 shows a comparison of Fender's blue butterfly and silvery blue butterfly markings.



FBB

SBB

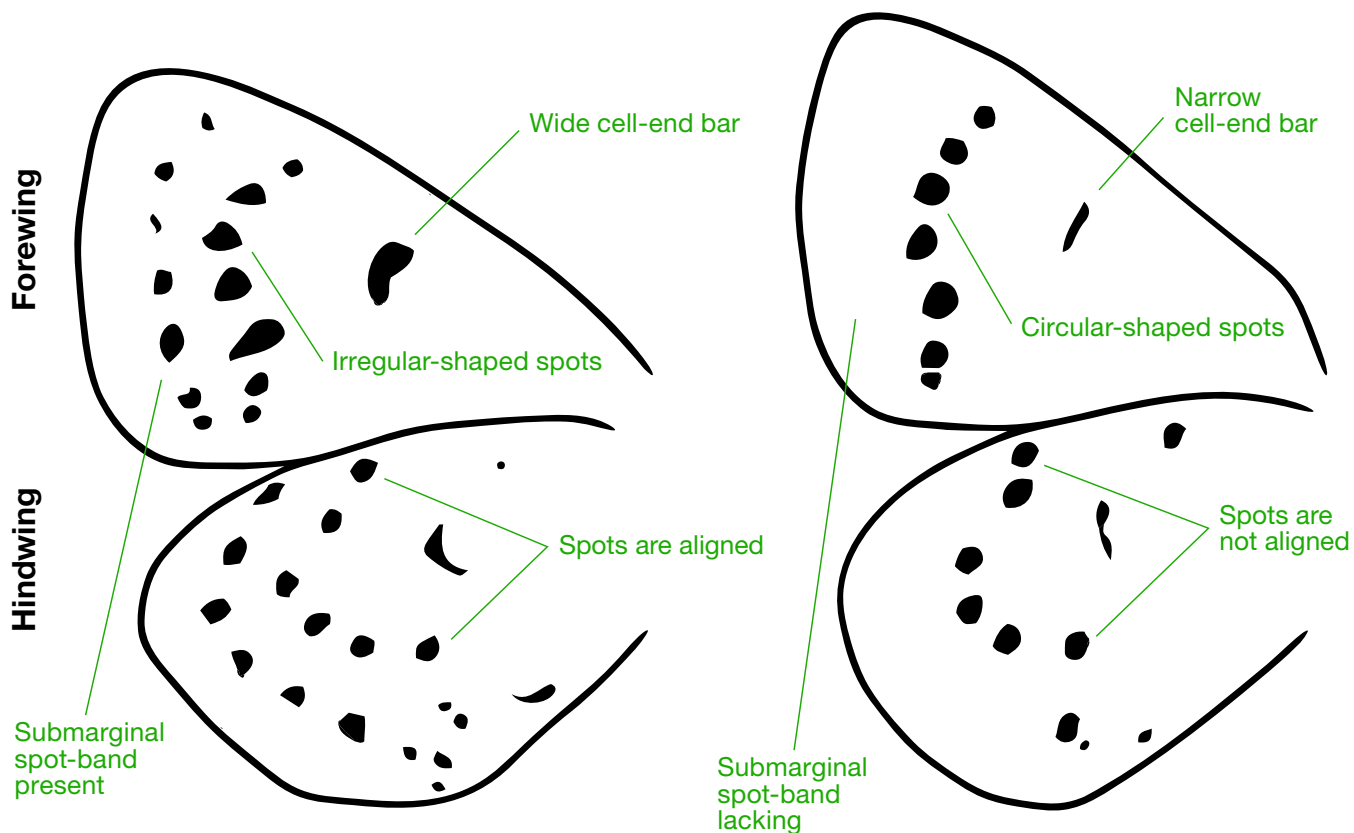


Figure 11—A comparison of ventral patterns and identification marks of the Fender's blue butterfly (FBB) and the silvery blue butterfly (SBB). Adapted from Hicks (n.d.).



Pesticide Precautionary Statement

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of these agents must be registered by appropriate state or federal agencies, or both, before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

Sites

Figures 12 through 33 compare autumn and spring conditions at a variety of sites designated for conservation and recovery of Fender's blue butterfly populations in the Willamette Valley, western Oregon. (All photos are available individually in high-resolution format upon request from the author.)

The pairs of photos below were taken in the autumn and spring as follows:

- For Henry Hagg Lake and Scoggins Bend sites (Washington County, Oregon), and the Oak Ridge site (Yamhill County), the top photo in each pair was taken on October 17, 2017, and the bottom photo was taken on May 15, 2018.
- For Lupine Meadows and Wren sites, and a site adjacent to the Wren site (Benton County, Oregon), the top photo in each pair was taken on October 13, 2017, and the bottom photo was taken on May 24, 2018.

The purpose of these photo pairs is essentially to show seasonal changes in vegetation cover and prevalence of flora; and beneficial results of various site habitat restoration or improvement management activities. The positive results of management activities demonstrated here include mowing, spraying with herbicides, mechanical removal of invasive plants, and limbing of conifers to open flightpaths for connectivity.



Figure 12—Henry Hagg Lake (east), Oregon. Top: October 17, 2017. Most habitat treatments occur in autumn, when the native plant community has senesced. Mowing is especially important where fire cannot be used for various reasons, including not receiving approval to burn, limited control-burn resources, and a narrow time window for burning. Management here focused on removal of invasive plants. Bottom: May 15, 2018. Mowing on this site removed the tall competing vegetation, promoting the heliophylic (sun-loving) plant species. Spring conditions reveal which undesirable plants may be coming back for later treatment (e.g., here, western brackenfern (*Pteridium aquilinum*)). Treatments focus on the taller structure weeds that most limit use by the Fender's blue butterfly, where the objective is to induce a short vegetation structure. Spring is also the season for determining the need and capacity to do spot spraying, particularly for Scotch broom (*Cytisus scoparius*), which is best treated in the spring for control. Also, grass-specific treatments are determined for spraying in the spring. Spraying guidelines include not spraying more than a third of lupine habitat with herbicide in one season. USDA Forest Service photos by Bruce G. Marcot.



Figure 13—Henry Hagg Lake (west), Oregon. Top: October 17, 2017. The dense patch on the left is perennial tall oatgrass (*Arrhenatherum elatius*) and Scotch broom (*Cytisus scoparius*), yet to be mowed when the photo was taken. The restoration objective here was to remove the Scotch broom and keep a low vegetation structure to help facilitate movement of the Fender's blue butterfly. A special type of mower with a steel track was used on this site to remove a dense section of Scotch broom. Elsewhere, mowers with rubber tracks, at specific mower heights, are used in more sensitive areas to maintain existing lupine patches. Bottom: May 15, 2018. After mowing in autumn, and with spring green-up, the site shows a more continuous low, uniform vegetation height without the tall oatgrass and Scotch broom. USDA Forest Service photos by Bruce G. Marcot.



Figure 14—Henry Hagg Lake (west), Oregon. Top: October 17, 2017. The foreground has yet to be mowed, showing the problem with Scotch broom (*Cytisus scoparius*), Fuller's teasel (*Dipsacus fullonum*), Pacific poison oak (*Toxicodendron diversilobum*), and blackberry (*Rubus* spp.), which invade prairie habitat. On this site, 3 weeks prior to mowing, blackberry was sprayed with an herbicide (Garlon, active ingredient triclopyr). In addition, to reduce invasive grasses, Fusilade with Nu-Film is sometimes sprayed as a surfactant, determined to be least harmful and toxic to both Fender's blue butterflies (Schultz and Ferguson 2020) and silvery blue butterflies (Glaeser and Schultz 2014). Bottom: May 15, 2018. After spraying and mowing, a dense continuous carpet of low vegetation occupied the site. USDA Forest Service photos by Bruce G. Marcot.



Figure 15—Henry Hagg Lake (west), Oregon. Top: October 17, 2017. Often, because of seed banks, seed dispersal, and rhizomatous regrowth, weed patches such as this may need to be managed and treated on an annual basis. Bottom: May 15, 2018. Desired result of treatment. USDA Forest Service photos by Bruce G. Marcot.



Figure 16—Henry Hagg Lake (east-west boundary), Oregon. The line of trees in the photos form the east-west boundary of the site. Top: October 17, 2017. The lower boles of these conifers have been limbed to open the flightpath height of the Fender's blue butterfly, to help connect adjacent prairie patches, and to encourage the species to disperse between the two units. Bottom: May 15, 2018. Reduction of ground vegetation height also helps retain the open flightpath height and sight lines through the limbed copse, but it might be difficult to establish native prairie vegetation in the understory of this limbed copse, but it might be possible to plant bulbs for herbaceous nectar species. USDA Forest Service photos by Bruce G. Marcot.



Figure 17—Henry Hagg Lake, Oregon. This location shows little change, as the downed wood patches were not treated or removed. Left: October 17, 2017. Dense coarse woody debris along this shrub/woodland edge essentially serves to stifle the occurrence of weed patches in autumn. Right: May 15, 2018. This dense coarse woody debris also suppresses the growth of prairie vegetation and nectar-bearing plants in the spring. USDA Forest Service photos by Bruce G. Marcot.



Figure 18—Scoggins Bend (adjacent to Henry Hagg Lake), Oregon. Top: October 17, 2017. This site was just mowed with a steel track mower. Terrain is steep, and the site was overgrown with Scotch broom (*Cytisus scoparius*). Bottom: May 15, 2018. Still prevalent is a weed patch of western brackenfern (*Pteridium aquilinum*). Western brackenfern serves as a weed for the Fender's blue butterfly, as it will overshadow the lupine plants. USDA Forest Service photos by Bruce G. Marcot.



Figure 19—Scoggins Bend (adjacent to Henry Hagg Lake), Oregon. Top: October 17, 2017. The patch of western brackenfern (*Pteridium aquilinum*) was sprayed in autumn. Bottom: May 15, 2018. However, some western brackenfern resprouted in spring. Treatment will be continued for full removal. USDA Forest Service photos by Bruce G. Marcot.



Figure 20—Scoggins Bend (adjacent to Henry Hagg Lake), Oregon. Top: October 17, 2017. This hilltop was sprayed and mowed in autumn. Bottom: May 15, 2018. Patches of western brackenfern (*Pteridium aquilinum*) returned in spring, to be subject to further treatment for eradication. USDA Forest Service photos by Bruce G. Marcot.



Figure 21—Oak Ridge, Oregon. Top: October 17, 2017; bottom: May 15, 2018. Even roadsides can have lupine patches serving as local habitat for the Fender's blue butterfly. Such narrow habitat strips can serve important functions as steppingstones between larger habitat patches. USDA Forest Service photos by Bruce G. Marcot.



Figure 22—Oak Ridge, Oregon. Top: October 17, 2017; bottom: May 15, 2018. Private landowners here worked with the local soil and water conservation district to maintain habitat for the Fender's blue butterfly by mowing in autumn and spot-spraying weeds as needed. USDA Forest Service photos by Bruce G. Marcot.



Figure 23—Oak Ridge, Oregon. Top: October 17, 2017. The local soil and water conservation district last mowed this site 3 years prior to this photograph. Bottom: May 15, 2018. The site is overgrown with Scotch broom (*Cytisus scoparius*), rendering it unusable by the Fender's blue butterfly. USDA Forest Service photos by Bruce G. Marcot.



Figure 24—Lupine Meadows, Oregon. One of the best examples of prime, native prairie habitat, although it is not particularly rich in lupine. This site has a nice diversity of native grasses and forbs; it has been managed by the Greenbelt Land Trust for several years for natural restoration and has not undergone intense treatment. The two photos here show the site at different seasons. Top: October 13, 2017. Bottom: May 24, 2018. Natural regrowth of the vegetation in spring. USDA Forest Service photos by Bruce G. Marcot.



Figure 25—Lupine Meadows, Oregon. Top: October 13, 2017; bottom: May 24, 2018. Photos show the change in structure of a prairie/forest woodland edge without intense restoration. Dense forest as shown here is more impenetrable to dispersal by the Fender's blue butterfly than open woodland. Note the seasonal changes that occurred with natural regrowth. USDA Forest Service photos by Bruce G. Marcot.



Figure 26—Wren, Oregon. Top: October 13, 2017; bottom: May 24, 2018. This site is one of the major strongholds for the Fender's blue butterfly. Benton County manages a significant portion of the habitat that supports populations of these butterflies, with management of smaller tracts also contributed by several private landholders and the Marys River Watershed Council under the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program. The council is actively seeding native nectar forbs. USDA Forest Service photos by Bruce G. Marcot.

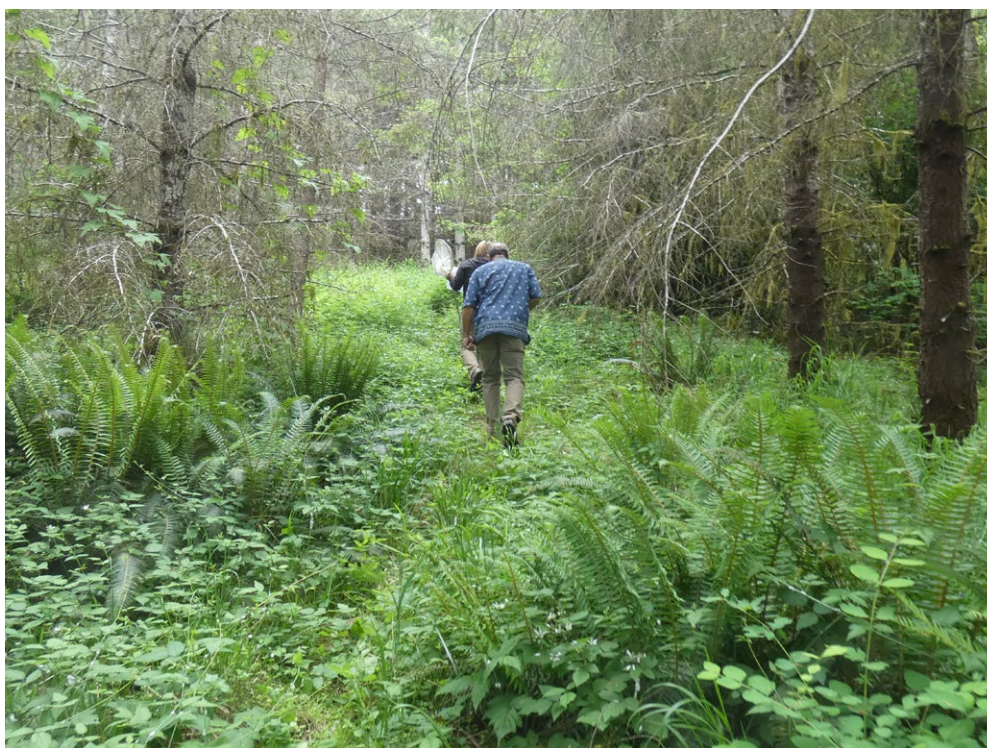


Figure 27—Wren, Oregon. Top: October 13, 2017; bottom: May 24, 2018. U.S. Fish and Wildlife Service biologists visiting dense woodland between prairie sites. Use of such dense woodlands by the Fender's blue butterfly for dispersal is limited, in part, because of the general dearth of food (nectar) sources. This woodland is now a fallow pine plantation. USDA Forest Service photos by Bruce G. Marcot.



Figure 28—Wren, Oregon. Top: October 13, 2017; bottom: May 24, 2018. Note the seasonal response of ground cover in this small opening within the dense forest. Although this is not Fender's blue butterfly habitat per se, it nonetheless shows that verdant green-up can occur even in small forest openings and might provide for connections among larger habitat areas. USDA Forest Service photos by Bruce G. Marcot.



Figure 29—Wren, Oregon. Top: October 13, 2017; bottom: May 24, 2018. This transmission line corridor supports a substantial number of Fender's blue butterflies for its small area, illustrating that even small and constrained habitat patches matter. Habitat on this site has remained intact because Bonneville Power Administration continues to manage it as a clearing under Federal Energy Regulatory Commission regulations for powerline corridors. Such management here doubly provides habitat for Fender's blue butterflies. Note the spring green-up of short vegetation with native nectar plants. Small, localized patches of lupine provide oviposition habitat for the Fender's blue butterfly. USDA Forest Service photos by Bruce G. Marcot.



Figure 30—Wren, Oregon. Top: October 13, 2017; bottom: May 24, 2018. Transmission line corridor that supports a Fender's blue butterfly population (see also fig. 29). The area had undergone some restoration for Fender's blue butterfly habitat to offset the effects of powerline maintenance. Restoration included increasing the presence and density of nectar forb species for the butterfly. Note that this powerline corridor also supports one of the few remaining populations of Taylor's checkerspot butterfly (*Euphydryas editha taylori*), which uses narrowleaf (English) plantain (*Plantago lanceolata*), an invasive plant. USDA Forest Service photos by Bruce G. Marcot.



Figure 31—Adjacent to Wren, Oregon. Top: October 13, 2017. Benton County burned this site in autumn. Bottom: May 24, 2018. Vegetation response includes an increase in oxeye daisy (*Leucanthemum vulgare*), which is a nonnative species apparently used by the Fender's blue butterfly for nectaring. This may be one example where a nonnative plant can be beneficial to the butterfly. USDA Forest Service photos by Bruce G. Marcot.



Figure 32—Adjacent to Wren, Oregon. Top: October 13, 2017; bottom: May 24, 2018. This site had been managed by a private landowner in cooperation with U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program, prior to selling the easement to Benton County. In cooperative management mode, the site maintained its habitat value to Fender's blue butterflies. USDA Forest Service photos by Bruce G. Marcot.



Figure 33—Adjacent to Wren, Oregon. Top: October 13, 2017; bottom: May 24, 2018. The local landscape includes several patches of lupine and prairie amid several private small farms and a vineyard. USDA Forest Service photos by Bruce G. Marcot.



Figure 34—Lupine patches. USDA Forest Service photo by Bruce G. Marcot.

Vegetation

Fender's blue butterfly habitat consists essentially of specific flora and vegetation conditions used for key life history stages of oviposition (egg-laying); larval development; and adult movement, feeding, and reproduction. As noted above, conditions contributing to these stages and resource uses are patches of Kincaid's, longspur, or sicklekeel lupine for oviposition and larval development, and open, sunny, low-stature prairie for movement, dispersal, nectaring, and reproduction.

In addition, there are other vegetation and landcover conditions that may support some limited movement—e.g., open and dense woodlands—or that serve as dispersal filters or barriers, as with most anthropogenic land-use conditions. It may be hypothesized, but largely unstudied, as to the degree to which agricultural croplands and livestock pasturelands might provide some degree of dispersal and nectaring use, particularly in fallow states with low vegetation lacking dominance of invasive plants, and if usable nectar plants are allowed to take root or are planted.

Figures 34 through 39 show examples of vegetation conditions.



Figure 35—Prairies. USDA Forest Service photos by Bruce G. Marcot.



Figure 36—Open woodland. USDA Forest Service photo by Bruce G. Marcot.



Figure 37—Dense woodland. USDA Forest Service photo by Bruce G. Marcot.



Figure 38—Livestock pasturelands. USDA Forest Service photos by Bruce G. Marcot.



Figure 39—Powerline corridor. USDA Forest Service photo by Bruce G. Marcot.

Management

Figures 40 through 43 show examples of the effects of management activities—creating corridors, mowing, limbing, and girdling—on vegetation conditions at various Fender's blue butterfly sites presented above.



Figure 40—In this location, an opening was created in an otherwise dense conifer stand to create a grassland corridor to connect an otherwise isolated upslope prairie. USDA Forest Service photo by Bruce G. Marcot.



Figure 41—Effects of mowing are shown in photo comparisons above, such as on the Henry Hagg Lake site. The objective of mowing for improving Fender's blue butterfly habitat is to eliminate dominance of tall invasive perennial and shrub species. Note the bottom image is a striking example of a fallow field half-mowed to provide rejuvenation of lowland herb and grass cover. USDA Forest Service photos by Bruce G. Marcot.



Figure 42—In some semiclosed conifer stands, removing lower limbs (limbing) can help create some open, near-ground habitat to serve at least as movement corridors for Fender's blue butterflies. These sites had been recently limbed for this purpose. USDA Forest Service photos by Bruce G. Marcot.



Figure 43—Girdling is used for more extreme control of trees that have expanded into grassland environments. USDA Forest Service photo by Bruce G. Marcot.

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References

- Glaeser, R.M.; Schultz, C.B. 2014.** Characterizing a contentious management tool: the effects of a grass-specific herbicide on the silvery blue butterfly. *Journal of Insect Conservation*. 18: 1047–1058. <https://doi.org/10.1007/s10841-014-9714-9>.
- Hicks, T.L. [N.d.].** Fender's blue butterfly monitoring handbook. Ridgefield, WA. 18 p. https://www.polkswcd.com/uploads/5/1/7/5/1756011/fbb_monitoring_handbook_hicks.pdf. (November 7, 2024).
- Liston, A.; St. Hilaire, K.; Wilson, M.V. 1995.** Genetic diversity in populations of Kincaid's lupine, host plant of Fender's blue butterfly. *Madroño*. 42(3): 309–322.
- Noss, R.F.; LaRoe, E.T., III; Scott, J.M. 1995.** Endangered ecosystems of the United States: a preliminary assessment of loss and degradation. Biological Report 28. Washington, DC: U.S. Department of the Interior, National Biological Service. 59 p.
- Pyle, R.M. 2002.** The butterflies of Cascadia. Seattle, WA: Seattle Audubon Society. 420 p.
- Schultz, C.; Collins, M. 2024.** Fender's blue on a flight to recovery. *Wings*. 47(1): 5–10.
- Schultz, C.B.; Crone, E.E. 2015.** Using ecological theory to develop recovery criteria for an endangered butterfly. *Journal of Applied Ecology*. 52(5): 1111–1115. <https://doi.org/10.1111/1365-2664.12450>.
- Schultz, C.B.; Dlugosch, K.M. 1999.** Nectar and hostplant scarcity limit populations of an endangered Oregon butterfly. *Oecologia*. 119: 231–238. <https://doi.org/10.1007/s004420050781>.
- Schultz, C.B.; Ferguson, J.A. 2020.** Demographic costs and benefits of herbicide-based restoration to enhance habitat for an endangered butterfly and a threatened plant. *Restoration Ecology*. 28(3): 564–572. <https://doi.org/10.1111/rec.13102>.
- Schumaker, N.H. 2024.** A rapid assessment methodology for quantifying and visualizing functional landscape connectivity. *Frontiers in Conservation Science*. 5: 1412888. <https://doi.org/10.3389/fcsc.2024.1412888>.
- Thomas, R.C.; Schultz, C.B. 2016.** Resource selection in an endangered butterfly: females select native nectar species. *The Journal of Wildlife Management*. 80(1): 171–180. <https://doi.org/10.1002/jwmg.987>.
- U.S. Department of the Interior, Fish and Wildlife Service [USDI FWS]. [N.d.].** Environmental Conservation Online System. Fender's blue butterfly (*Icaricia icarioides fenderi*). <https://ecos.fws.gov/ecp/species/6659>. (November 8, 2024).
- U.S. Department of the Interior, Fish and Wildlife Service [USDI FWS]. 2010.** Recovery plan for the prairie species of western Oregon and southwestern Washington. Portland, OR. xi + 241 p. https://ecos.fws.gov/docs/recovery_plan/100629.pdf. (November 7, 2024).
- U.S. Department of the Interior, Fish and Wildlife Services [USDI FWS]. 2023.** Endangered and threatened wildlife and plants; reclassifying Fender's blue butterfly from endangered to threatened with a section 4(d) rule. 88 Fed. Reg. 2006 (January 12, 2023). <https://www.govinfo.gov/content/pkg/FR-2023-01-12/html/2023-00037.htm>. (December 20, 2024).
- Wilson, M.V.; Hammond, P.C.; Schultz, C.B. 1997.** The interdependence of native plants and Fender's blue butterfly. In: Kaye, T.N.; Liston, A.; Love, R.M.; Luomo, D.; Meinke, R.J.; Wilson, M.V., eds. *Conservation and management of native flora and fungi. Proceedings of an Oregon conference on the conservation and management of native vascular plants, bryophytes, and fungi*. Corvallis, OR: Native Plant Society of Oregon: 83–87.

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