

# THE INTERDEPENDENCE OF NATIVE PLANTS AND FENDER'S BLUE BUTTERFLY

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**Abstract.** The rare Fender's blue butterfly (*Icaricia icarioides fenderi*) survives only in what remains of the Willamette Valley's upland prairies. The Fender's blue depends on specific native plants for adult and larval food sources. Adults collect nectar mostly from a range of native forbs, especially *Allium amplexans* and *Sidalcea virgata*. Larvae feed on three native lupines, most commonly on the rare Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*). While the Fender's blue depends on native plants for its survival, native prairie plants depend in another way on the Fender's blue for their survival. The butterfly is currently being considered for listing under the federal Endangered Species Act, and most conservation efforts for native upland prairies in western Oregon stem directly from efforts to protect the Fender's blue. This interconnection—the butterfly depends biologically on native plants and the native plants depend politically on the butterfly—shows the importance of an ecosystem approach to conservation.

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## INTRODUCTION

Low elevation native grasslands once covered the Willamette Valley and Puget Sound areas, but are now perhaps the most endangered habitat in western Oregon and Washington. More than 99 percent of the presettlement grasslands have been destroyed (Johannessen et al., 1971; Towle, 1982), leading to the decline of many native prairie plants and animals. Prairie habitat destruction has particularly been particularly injurious to the now-rare Fender's blue butterfly (*Icaricia icarioides fenderi*). This paper describes the close associations—both ecological and political—between native plants and the Fender's blue butterfly.

## LARVAL HOST PLANTS

Fender's blue butterfly (*Icaricia icarioides fenderi* (Macy)) was first described by R. W. Macy based on a collection by K. P. Fender from a hillside 6 miles southwest of McMinnville in Yamhill County, Oregon (Macy, 1931). The type specimens for the Fender's blue butterfly were collected at this site on May 25, 1929. Additional specimens were collected in and around Corvallis,

Benton County, Oregon until 1935. The butterfly was last seen at Wren in Benton County on May 23, 1937. No further observations were made until 1989, when one of us (P. Hammond) discovered a surviving population in and near McDonald Forest, Benton County, in an area we now call Butterfly Meadows.

Macy noted that the butterfly associated with an isolated patch of an unknown *Lupinus* species. For many years, butterfly enthusiasts had been searching patches of common perennial lupines in the Willamette Valley with the hope of finding the Fender's blue. We now know that these searches were doomed because the Fender's blue butterfly associates, not with common lupines, but with the very rare Kincaid's lupine (*L. sulphureus* Douglas ssp. *kincaidii* (Smith) Phillips) with the locally rare spur lupine (*L. arbustus* Douglas ex Lindley), and occasionally with sickle-keeled lupine (*L. albicaulis*) (Hammond and Wilson, 1993). (Plant nomenclature is after Hitchcock and Cronquist [1973] unless otherwise notes.) This association arises because these three native lupines are apparently the sole food source for Fender's blue butterfly larvae. We come to this conclusion from the following observations of butterfly behavior, similarities in habitat distributions between these lupines and the Fender's blue butterfly, and relationships between lupine abundance and butterfly abundance.

Our observations of all stages of the Fender's blue confirm a tight relationship between the host-plant lupines and the butterfly. Adult Fender's blue butterflies emerge from pupation in May. Immediately, females begin to lay eggs on the underside of lupine leaves. We have observed oviposition on Kincaid's lupine, spur lupine, and sickle-keeled lupine, but on no other lupines. In June the eggs hatch and larvae begin eating lupine leaves. They remain on the plant until they enter diapause in late June or early July. Larvae emerge from diapause in March the following year and begin eating young lupine leaves. We have seen several dozen larvae on host-plants in early spring and none on other species of lupines. Larvae pupate in mid-April, emerging as adults in May.

The link between the Fender's blue butterfly and its host lupines manifests itself in similarities in habitat distributions. One of us (P. Hammond) has conducted extensive searches of known and possible populations of Kincaid's lupine, spur lupine, and sickle-keeled lupine. These direct searches followed leads suggested by herbarium records and by colleagues at The Nature Conservancy, the Native Plant Society of Oregon, the Army Corps of Engineers, and the Bureau of Land Management. We examined more than 80 candidate sites since 1989, in Benton, Douglas, Lane, Linn, Marion, Polk, Washington, and Yamhill counties, Oregon, and Lewis County, Washington. These searches uncovered 13 populations of the Fender's blue butterfly, together supporting about 3500 adults (Hammond and Wilson, 1993; Hammond, 1995; Schultz, 1995). The entire range of populations is within the Willamette Valley. Kincaid's lupine is present at all 13 populations, although spur lupine is the prime host lupine at Baskett Butte and Coburg Ridge, two of the major sites. Sickle-keeled lupine, a species often associated with weedy habitats, supports very weak butterfly populations at best, possibly because nectar flowers are usually scarce in disturbed areas. Twenty-three sites containing host lupines do not support

the Fender's blue butterfly (Hammond and Wilson, 1993). Thirteen sites containing other lupine species, but not host lupines, also do not support the Fender's blue butterfly. These results (Table 1) show an apparently obligate requirement of the Fender's blue butterfly for suitable host lupine species ( $\chi^2 = 6.4$  for the test of independence,  $P < 0.025$ ). These results also show that the presence of host lupines by itself is not sufficient to maintain a population of the Fender's blue butterfly.

Not only does the presence of Fender's blue butterfly depend on the presence of host lupines, but their abundances within a site may be positively related. In 1990, we recorded the number of Fender's blue butterflies, the cover of Kincaid's lupine cover in three height classes, and the number of Kincaid's lupine inflorescences at the Butterfly Meadows site. Measurements were separately recorded within 7 adjacent subpopulations of Fender's blue butterfly covering approximately 5 ha of prairie. Fender's blue butterfly abundance was highly correlated with lupine cover ( $r = 0.89-0.94$ ,  $P < 0.01$ ) and flowering ( $r = 0.90$ ,  $P < 0.01$ ; Figure 1). It is convenient that the measure of abundance easiest to record in the field—number of inflorescences—accounts for nearly all the variability in Fender's blue butterfly abundance.

These results suggest that, at least within single sites, lupine abundance would be a good indicator of Fender's blue butterfly abundance. However, this relationship does not explain the variation in butterfly population sizes among sites. In 1994, for example, the Willow Creek site held about 8,000 Kincaid's lupine inflorescences, supporting about 450 Fender's blue butterflies. In contrast, the Fir Butte site in Lane County in the same year held almost 10,000 Kincaid's lupine inflorescences but only 20 butterflies. Other factors, such as the abundance of nectar sources for adults, must influence Fender's blue butterfly abundance.

## NECTAR SOURCES

Although Fender's blue butterfly larvae feed on leaves from only a few species of host lupine leaves, adults feed on nectar from a variety of forb species. In one survey, adults visited mostly flowers of native plant species (Table 2; Hammond and Wilson, 1993). The same pattern holds at the Willow Creek site, where native species contributed only 6 percent of the number of flowers on site, yet attracted 77 percent of the adult visits (Table 3). Fender's blue butterfly adults also selected plant species at this site at a rate unrelated to their relative flower abundance (Table 3): the Spearman rank correlation of flower abundance to visitation was only 0.31 ( $P > 0.10$ ).

Measurements of dispersal distances show that, during the flight season, adults rarely traveled farther than 100 m from host lupines (Schultz, 1994). Thus, Fender's blue butterfly survival requires habitat with both host lupines for larval food plants and an abundance of native flowers for adult nectar sources.

## HABITAT

### **Habitat Quality**

Development of farms and cities has destroyed most of the Willamette Valley native prairies (Habeck, 1961; Johannessen et al., 1971; Towle, 1982). Woody plants or tall, non-native grasses dominate much of the prairie that remains. These degraded prairies are poor habitat for the Fender's blue butterfly in several ways. Tall foliage shades most native species, including the host-plant lupines and nectar sources, and the extensive root systems of these pest plants are believed to out-compete native species for nutrients and water. Thus, as pest plants increase, plants required by the Fender's blue butterfly decline. Tall foliage also shades the habitat, slowing the butterfly's activities and probably lowering its feeding and reproductive rates.

As a result, the important Fender's blue butterfly populations persist in relatively high-quality prairie, often dominated by *Festuca idahoensis* Elmer var. *roemeri* Pavlick and abounding in other native species. Yet pest plants remain a problem in most Fender's blue butterfly sites. Woody plant succession threatens 12 of 13 Fender's blue butterfly sites and aggressive exotic weeds threaten 7 of 13 sites (Hammond and Wilson, 1993).

### **Vegetation**

Two Fender's blue butterfly habitats exemplify high-quality native upland prairie. The Baskett Slough National Wildlife Refuge west of Salem, Oregon supports the largest single population of the Fender's blue butterfly, approximately 1300 adults in 1994 (Hammond, 1995). We have been studying woody-plant control techniques within a small portion of the refuge. We recorded the cover of 12 key plant species within treatment plots. These 12 species together accounted for 71 percent (sd = 8 percent) of the total herbaceous plant cover. Within this sample, native plants contributed 61 percent (sd = 10 percent) of total measured cover. Although this ratio might seem low, it is probably among the highest of the remaining upland prairies in the Willamette Valley.

Butterfly Meadows is another high quality prairie supporting the Fender's blue butterfly. In 1990, we recorded cover of plant species within 44 0.25-m<sup>2</sup> quadrats within the most pristine portion of Butterfly Meadows. Of the total plant cover recorded, 87 percent (sd = 13 percent) was from native species. This is an exceptionally high proportion of native cover. Forty of the 52 species encountered in the sample were natives. The larger area (about 0.1 ha) of pristine prairie supports at least 65 species of native plants (Table 4).

The Coburg Ridge butterfly population in Lane County occurs within another extensive area of native upland prairie. Preliminary plant inventories (P. Hammond, unpublished data) show this site to be particularly rich in native plant species.

## Rare plants

Fender's blue butterfly habitats support several rare native plant species, some of which have legal protection (Table 5). The Willamette daisy (*Erigeron decumbens* var. *decumbens*), found at two Fender's blue butterfly sites, is currently a candidate species under the federal Endangered Species Act, and is listed as Endangered by the Oregon Department of Agriculture. Kincaid's lupine and *Aster curtus* are listed by the Oregon Department of Agriculture as Threatened. Although no other plant species in Fender's blue butterfly habitats has legal protection, several species are rare in the Willamette Valley. This group of species, which are often more abundant elsewhere in their range, include *Balsamorhiza deltoidea*, *Brodiaea howellii*, *Lomatium macrocarpum*, *Lupinus arbustus*, *Silene campanulata*, and *Viola sheltonii*. And, of course, habitat destruction makes the native upland prairie of the Willamette Valley itself an endangered ecosystem.

## IMPLICATIONS

Native plants have many interrelationships with the Fender's blue butterfly. From an ecological perspective, conserving the Fender's blue butterfly requires protecting the native plants and native ecosystems on which it depends. Fender's blue butterfly populations will survive only in habitats that include suitable host plants, support a range of suitable nectar sources, and are free from pest plant encroachment.

There is another, political, perspective. Conservation biologists have called for individual species with legal protection to act as umbrellas of protection for other, associated rare species (Hammond and Wilson, 1992; Launer and Murphy, 1994; New et al., 1995). We believe that the Fender's blue butterfly should act as such an umbrella species. The Fender's blue butterfly is currently a candidate for listing under the federal Endangered Species Act (Table 5). The U. S. Fish and Wildlife Service has requested that governmental agencies whose lands contain Fender's blue butterfly populations stop activities that could directly harm the butterfly until its candidacy is resolved. This temporary and informal protection extends to the 5 of the 13 populations on public lands. Federal listing of the Fender's blue butterfly as Threatened or Endangered would both formalize the legal protection and extend it to all 13 sites. Moreover, habitat restoration as part of a federal recovery plan would also increase overall prairie biodiversity (Wilson et al., 1992).

Federal and state laws provide essentially no protection for listed plants off government lands (A. Robinson, pers. comm.). Thus, in a real, political sense, the conservation of many native prairies and their native plant species depends on the legal protection afforded the Fender's blue butterfly. Native plants and the Fender's blue butterfly are truly interdependent.

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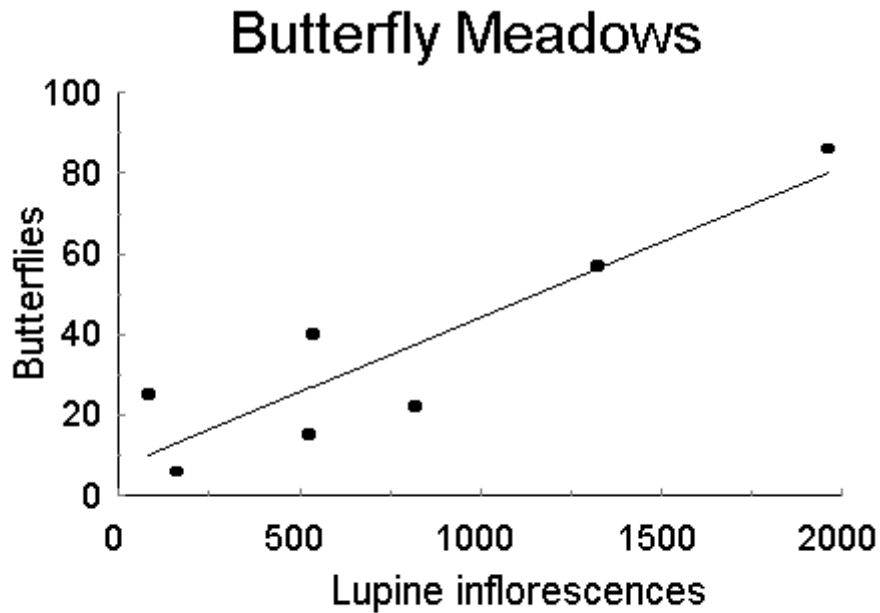


Figure 1. Abundance of the Fender's blue butterfly is directly related at Butterfly Meadows to lupine abundance, here measured by the number of flowering stalks in seven adjacent subpopulations ( $r = 0.90$ ,  $P < 0.01$ ). Data from 1990.

TABLE 1. Distribution of Fender's blue butterflies in sites with and without host lupines. Besides the 49 sites in this table, we searched more than 30 other prairie sites that turned out to have neither host lupines nor Fender's blue butterfly. The Fender's blue butterfly was found only in sites with suitable host lupines ( $\chi^2 = 6.4$  for the test of independence,  $P < 0.025$ ).

		Fender's blue butterfly	
		present	absent
Host lupines	present	13	23
	absent	0	13



TABLE 2. Flowers visited by Fender's blue butterfly adults. Observations by P. Hammond from several sites, 1990-1991. Preference was ranked subjectively based on frequency of visitation. Most visits were to flowers of native species, though exotic species were common at the site.

Species	Native/exotic	Preference
<i>Allium amplexans</i>	native	+++
<i>Brodiaea congesta</i>	native	+
<i>Calochortus tolmiei</i>	native	+++
<i>Cryptantha intermedia</i>	native	++
<i>Eriophyllum lanatum</i>	native	+
<i>Geranium oreganum</i>	native	++
<i>Lupinus sulphureus</i> ssp. <i>kincaidii</i>	native	+
<i>Sidalcea virgata</i>	native	++
<i>Vicia hirsuta</i>	exotic	++
<i>Vicia sativa</i>	exotic	+++

TABLE 3. Flowers visited by Fender's blue butterfly adults. Observations of C. Schultz from the Willow Creek Nature Conservancy Preserve, 1994. 77% of the visits were to flowers of native species, though exotic species were common at the site. Because flower density and visitation were recorded in different studies, conclusions based on their comparison must be tentative.

Species	Native/exotic	Visits	Flowers (#/m <sup>2</sup> )
<i>Sidalcea virgata</i>	native	122	0.11
<i>Allium amplexans</i>	native	43	0.04
<i>Lupinus sulphureus</i> spp. <i>kincaidii</i>	native	43	0.45
<i>Camassia quamash</i>	native	31	0.05
<i>Linum angustifolium</i>	exotic	23	0.01
<i>Chrysanthemum leucanthemum</i>	exotic	18	10.6
<i>Vicia sativa</i>	exotic	11	0.01
3 other native species	native	5	0.09
5 other exotic species	exotic	19	0.54
Total		315	11.9
All native plant species		244	0.74
All exotic plant species		71	11.16

TABLE 4. Native species present in a 0.1 ha area of the relatively pristine section of Butterfly Meadows. Initial list compiled by T. N. Kaye.

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<i>Achillea millefolium</i>	<i>Koeleria cristata</i>
<i>Agoseris grandiflora</i>	<i>Lathyrus</i> sp.
<i>Apocynum androsaemifolium</i>	<i>Ligusticum apiifolium</i>
<i>Aster chilensis</i> ssp. <i>hallii</i>	<i>Lomatium triternatum</i>
<i>Balsamorhiza deltoidea</i>	<i>Lomatium utriculatum</i>
<i>Brodiaea congesta</i>	<i>Lotus micranthus</i>
<i>Brodiaea coronaria</i>	<i>Lupinus sulphureus</i> ssp. <i>kincaidii</i>
<i>Brodiaea hyacinthina</i>	<i>Luzula campestris</i>
<i>Bromus carinatus</i>	<i>Madia gracilis</i>
<i>Calochortus tolmiei</i>	<i>Marah oreganus</i>
<i>Castilleja hispida</i>	<i>Plectritis</i> sp.
<i>Cirsium callilepis</i> var. <i>oregonense</i>	<i>Potentilla gracilis</i>
<i>Clarkia amoena</i>	<i>Prunella vulgaris</i>
<i>Clarkia quadrivulnera</i>	<i>Pteridium aquilinum</i>
<i>Cryptantha intermedia</i>	<i>Pseudotsuga menziesii</i>
<i>Cynoglossum grande</i>	<i>Quercus garryana</i>
<i>Danthonia californica</i>	<i>Ranunculus occidentalis</i>
<i>Daucus pusillus</i>	<i>Rhus diversiloba</i>
<i>Delphinium menziesii</i>	<i>Rosa gymnocarpa</i>
<i>Dodecatheon hendersonii</i>	<i>Rubus ursinus</i>
<i>Elymus glaucus</i>	<i>Sanicula bipinnatifida</i>
<i>Erigeron speciosus</i>	<i>Sanicula crassicaulis</i>
<i>Eriophyllum lanatum</i>	<i>Senecio macounii</i>
<i>Erythronium oregonum</i>	<i>Sidalcea virgata</i>
<i>Festuca idahoensis</i> var. <i>roemeri</i>	<i>Silene hookeri</i>
<i>Fragaria virginiana</i>	<i>Symphoricarpos albus</i>
<i>Fritillaria lanceolata</i>	<i>Synthyris reniformis</i>
<i>Galium aparine</i>	<i>Trifolium macraei</i>
<i>Galium cymosum</i>	<i>Trifolium variegatum</i>
<i>Geranium oreganum</i>	<i>Vicia americana</i>
<i>Habenaria elegans</i>	<i>Viola nuttallii</i>
<i>Hieracium cynoglossoides</i>	<i>Wyethia angustifolia</i>
<i>Holodiscus discolor</i>	<i>Zygadenus venenosus</i>
<i>Iris tenax</i>	

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TABLE 5. Legal status of the Fender’s blue butterfly and native plant species under federal and state endangered species acts (Oregon Natural Heritage Program, 1995).

	Federal	State
<i>Icaricia icarioides fenderi</i>	Candidate	—
<i>Lupinus sulphureus</i> spp. <i>kincaidii</i>	Species of concern	Listed as Threatened
<i>Aster curtus</i>	Species of concern	Listed as Threatened
<i>Erigeron decumbens</i> . var. <i>decumbens</i>	Candidate	Listed as Endangered