

State of California  
Natural Resources Agency  
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION  
STATUS REVIEW OF LASSICS LUPINE (*Lupinus constancei*)

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Lassics lupine, CDFW photo by Jeb McKay Bjerke

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## LIST OF ABBREVIATIONS, ACRONYMS, AND TERMS

CEQA – California Environmental Quality Act  
CESA – California Endangered Species Act  
CNDDDB – California Natural Diversity Database  
Commission – California Fish and Game Commission  
Department – California Department of Fish and Wildlife  
Occurrence – CNDDDB Element Occurrence  
et al. – “and others”  
Evaluation – Initial Evaluation of Petition to List Lassics Lupine (*Lupinus constancei*) as Endangered under the California Endangered Species Act  
Id. – “the same”  
NEPA – National Environmental Policy Act  
Petition - Petition from Mr. Dave Imper and Ms. Cynthia Elkins from the Center for Biological Diversity to list Lassics lupine as an endangered species pursuant to CESA  
ssp. – Subspecies  
var. – Variety



## EXECUTIVE SUMMARY

This Status Review of Lassics lupine (*Lupinus constancei* T. W. Nelson and J. P. Nelson) (Status Review) has been prepared by the California Department of Fish and Wildlife (Department) for the California Fish and Game Commission (Commission) pursuant to the requirements of the California Endangered Species Act (CESA). This Status Review has been independently reviewed by scientific peers, and is based upon the best scientific information available to the Department.

Lassics lupine is an herbaceous perennial plant of the legume family (Fabaceae) that was described as a new species in 1983. Lassics lupine is only found near the summits of remote mountains in northern California called the Lassics, which have unique serpentine-influenced soils. The Lassics are located in Humboldt and Trinity counties within the Six Rivers National Forest. There are two known populations of Lassics lupine, occupying a combined area of approximately 1.6 hectares (4 acres). The smaller of the two Lassics lupine populations is found on a southwest-facing slope of a mountain called Red Lassic. The larger Lassics lupine population is located entirely within Mt. Lassic Wilderness on adjoining peaks of Mt. Lassic.

Results of extensive surveys of the Lassics suggest that Lassics lupine has always been restricted to small areas of suitable habitat. Anecdotal observations of severe population declines and of the absence of Lassics lupine plants in previously occupied areas led to the beginning of annual quantitative monitoring in 2001. The habitat requirements and life history of the species have been relatively well studied. Lassics lupine populations experienced a significant decline in 2015 due to negligible winter snowpack in the Lassics during the winters of 2013-2014 and 2014-2015, historic drought, and the 2015 Lassics Fire. The number of adult Lassics lupine plants remained low in 2016 as the drought continued. In 2017, the number of adult plants increased after heavy precipitation in the fall, winter, and spring of 2016-2017.

The most immediate threat to the existence of Lassics lupine is from predation of Lassics lupine seeds prior to dispersal (while still attached to the plant) by small mammals such as deer mice and chipmunks. In response to the observed seed predation, researchers and the U.S. Forest Service began using wire cages to exclude seed predators from reproductive Lassics lupine plants in 2003, and this practice is still in use. Lassics lupine is also sensitive to climate extremes such as high summer temperatures, low summer precipitation, and early snowmelt. As a result of climate change, the Lassics are expected to experience less snowpack and higher summer temperatures. Climate change is considered to be a significant ongoing threat to the continued existence of the species. Lassics lupine also faces significant threats from vegetation encroachment and related fire suppression, small population sizes, the aftermath of the 2015 Lassics Fire, consumption of vegetation and flowers by animals (herbivory), and relatively minor threats from illegal off road vehicle use and trampling from recreational use. Because of the rarity of Lassics lupine, the loss of all or a significant portion of either Lassics lupine population would represent the loss of a significant portion of Lassics lupine's total range.

The scientific information available to the Department indicates that Lassics lupine is in serious danger of becoming extinct in all or a significant portion of its range due to one or more causes, including seed predation and herbivory, climate change, the vulnerability of small populations, vegetation encroachment, and impacts from wildfire. The Department recommends that the Commission find that the petitioned action to list Lassics lupine as an endangered species is warranted, and further recommends implementation of the management recommendations and recovery measures described in this Status Review.

## **INTRODUCTION**

This Status Review addresses Lassics lupine (*Lupinus constancei* T. W. Nelson and J. P. Nelson).

### **Petition History**

On July 19, 2016, the Commission received a petition (Petition) from Mr. Dave Imper and Ms. Cynthia Elkins from the Center for Biological Diversity to list Lassics lupine as an endangered species pursuant to CESA (Fish & G. Code, § 2050 *et seq.*).

On July 29, 2016, the Commission referred the Petition to the Department for evaluation.

On August 12, 2016, as required by Fish and Game Code section 2073.3, the Commission published notice of receipt of the Petition in the California Regulatory Notice Register (Cal. Reg. Notice Register 2016, No. 33-Z, p. 1463).

On September 14, 2016, the Department requested a 30-day extension of time to complete its evaluation report, pursuant to Fish and Game Code section 2073.5. The Commission granted the Department's request on October 20, 2016.

On December 8, 2016, the Commission received a report from the Department titled, "Evaluation of the Petition from Mr. David Imper and Ms. Cynthia Elkins to List Lassics Lupine (*Lupinus constancei*) as an Endangered Species under the California Endangered Species Act" (Evaluation). Based upon the information contained in the Petition, the Department concluded, pursuant to Fish and Game Code section 2073.5, subdivision (a), that sufficient information exists to indicate that the petitioned action may be warranted, and recommended to the Commission that the Petition should be accepted and considered.

On February 8, 2017, at its scheduled public meeting in Rohnert Park, California, the Commission considered the Petition, the Department's Evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration.

Subsequently, on February 24, 2017, the Commission published its Notice of Findings for Lassics lupine in the California Regulatory Notice Register, designating Lassics lupine as a candidate species (Cal. Reg. Notice Register 2017, No. 8-Z, p. 258).

### **Department Review**

Following the Commission's action to designate Lassics lupine as a candidate species, the Department notified affected and interested parties and solicited data and comments on the petitioned action pursuant to Fish and Game Code section 2074.4 (see also Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)). All comments received are included in Appendix A to this report. The Department promptly commenced its review of the status of the species as required by Fish and Game Code section 2074.6, which has now concluded with this Status Review.

The Department sought independent and competent peer review on its draft Status Review by persons of the scientific/academic community commonly acknowledged to be experts on the Lassics lupine and possessing the knowledge and expertise to critique the scientific validity of the draft Status Review. Appendix B contains the specific input provided to the Department by

the individual peer reviewers, the Department's written response to the input and any amendments made to the draft Status Review (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)). This Status Review was prepared by Mr. Jeb McKay Bjerke, in the Department's Habitat Conservation Planning Branch, Native Plant Program.

## **BIOLOGY**

### **Species Description**

The information below is paraphrased from the original species description of Lassics lupine (Nelson and Nelson 1983), the Jepson Manual, 2<sup>nd</sup> Edition (Sholars 2012), and other sources.

Lassics lupine is an herbaceous plant of the legume family (Fabaceae) that grows to a height of less than 15 centimeters (six inches) from an erect short woody stem (Figure 1, Photo 1). Plants produce a tap root that reaches relatively deep into soil to extract persistent moisture. Lassics lupine is covered with relatively long, shaggy hairs, and is cespitose, which means that it grows close to the ground. Reproductive plants may reach a diameter of approximately 30 centimeters (12 inches), but have an average diameter of 18 centimeters (7 inches) (Six Rivers National Forest 2015; S. Carothers pers. comm. 2017 in Appendix B). The leaves are palmate compound, which is typical for plants in the genus *Lupinus* (lupines). Leaves are clustered near the base of the plant. The leaves have six to seven leaf segments, called leaflets, which are each 10 to 20 millimeters ( $\frac{3}{8}$  to  $\frac{3}{4}$  inch) long and approximately 8 to 10 millimeters ( $\frac{3}{8}$  inch) wide and spoon-shaped. The leaf stalks can be 4 to 14 centimeters (1.5 to 5.5 inches) long, and there are two appendages at the base of each leaf stalk called stipules that are each less than 6 millimeters ( $\frac{1}{4}$  inch) long. The first leaves to appear on Lassics lupine seedlings are called cotyledons (Figure 1, Photo 2).

Like most plants in the legume family, the flowers of Lassics lupine are pea-like, which means that they have a large upper petal called a banner, two smaller side petals called wings, and two fused lower petals called a keel. The petals of Lassics lupine flowers are pink, with parts of the banner and keel a darker rose color. The keel of Lassics lupine flowers is hairless. The flower structure of fused sepals below the petals has two lips and is called a calyx. There are 10 male reproductive structures in the flower called stamens, and they are all partially fused together. There is one female reproductive structure in the flower called a pistil. Lassics lupine flowers are densely arranged together in a structure called a raceme inflorescence, which means the flowers grow on short stalks called pedicels along a central axis, and the flowers at the bottom of the inflorescence tend to open and mature before the flowers at the top. The inflorescence of Lassics lupine is relatively short and thick. Mature plants growing under the best conditions may produce up to 20 or more clusters of flowers, but they typically produce fewer.

Lassics lupine flowers can develop into a 1.5 to 2.5 centimeter ( $\frac{3}{8}$  to 1 inch) long fruit called a legume that splits into two halves that may remain jointed at the base. Lassics lupine fruits are hairy and produce one to five multicolored seeds, with an average of two seeds per pod (Kurkjian 2012b; S. Carothers pers. comm. 2017 in Appendix B).

### **Taxonomy**

A type specimen is the specimen, or group of specimens, of an organism used to describe and name that organism. The type specimen of Lassics lupine was collected by Thomas W. Nelson and Jane Nelson on July 9, 1982, from "Mt. Lassic (Signal Peak) and saddle to E" (Nelson and



Photo 1: Reproductive Lassics lupine plant with flowers and maturing fruit



Photo 2: Lassics lupine seedling showing red cotyledons

Figure 1. Photographs of Lassics Lupine (*Lupinus constancei*)

Nelson 1982). Lassics lupine was first described by Nelson and Nelson in 1983, but the earliest collection of the species recorded within the Consortium of California Herbaria database is a 1972 collection by D. E. Anderson, Thomas W. Nelson, and S. Dowty (Anderson et al. 1972, CCH 2017). Lassics lupine was reduced to a variety of *Lupinus lepidus* for a short time, but was maintained as *Lupinus constancei* in the 2012 Jepson Manual (Isely 1998, Sholars 2012). Lassics lupine (*L. constancei*) is named for Dr. Lincoln Constance, a botanist and administrator at the University of California, Berkeley (Nelson and Nelson 1982).

Analysis of the genetic differentiation between the two Lassics lupine populations at Mt. Lassic and Red Lassic found the overall genetic diversity within the species to be very low, and differentiation between the two populations to be a small component of the total variation within the species (Wilson and Hipkins 2004).

### **Range and Distribution**

Range is the general geographical area in which an organism occurs. For purposes of CESA and this Status Review, the range is the species' California range (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal.App.4th 1535, 1551). Distribution is the actual sites where individuals and populations of the species occur within the species' range.

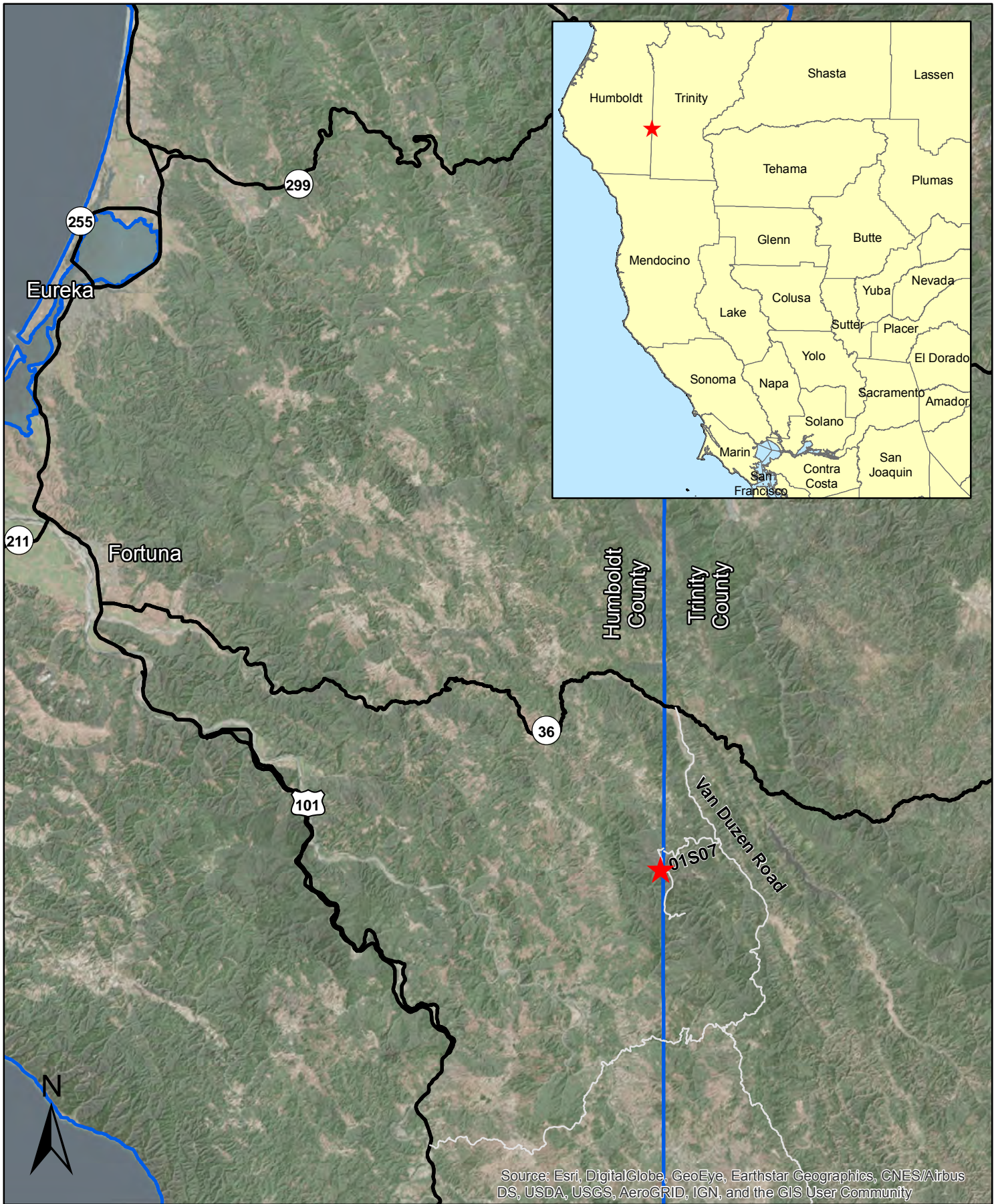
Lassics lupine occurs only in California. All known populations of Lassics lupine are restricted to the Lassics mountain range which is situated near the boundary of Humboldt and Trinity counties, approximately 130 kilometers (80 miles) southeast of Eureka (Figure 2) (CNDDDB 2017). The Lassics mountain range is within the Mad River Ranger District of Six Rivers National Forest, and is partially within Mt. Lassic Wilderness, which was designated in 2006. The range of Lassics lupine is also entirely within the 1,473 hectare (3,640 acre) Lassics Botanical and Geologic Special Interest Area, a designation by the Six Rivers National Forest. The three principal mountains of the Lassics mountain range are Mt. Lassic, Red Lassic, and Black Lassic. Lassics lupine is only known to occur on Mt. Lassic and Red Lassic at elevations between 1,590 and 1,740 meters (5,200 and 5,700 feet), near the top of the Little Van Duzen River watershed. The Little Van Duzen River watershed drains into the Van Duzen River, then the Eel River, and ultimately into the Pacific Ocean. The Van Duzen River is approximately four miles east of the Lassics, and the Little Van Duzen River is approximately six miles to the west.

The distribution of Lassics lupine is documented within the California Natural Diversity Database (CNDDDB). Plant taxa, animal taxa, and natural communities that are documented within the CNDDDB are of conservation concern within California and are referred to as "elements." An "element occurrence" (occurrence) is a location record for a site which contains an individual, population, nest site, den, or stand of a special status element. Populations, individuals, or colonies that are located within 0.40 kilometer (1/4 mile) of each other generally constitute a single occurrence, sometimes with multiple "parts" (Bittman 2001).

The Department updated the CNDDDB occurrences for Lassics lupine in September 2016 in conjunction with initial preparation for this Status Review. This update involved entering all information on Lassics lupine that had been submitted to the Department, correcting erroneous information, and checking for additional information from online resources such as the Consortium of California Herbaria, Calflora.org, and CalPhotos.Berkeley.edu.

There are currently two known populations of Lassics lupine (Figure 3). One of the populations is on Mt. Lassic (Mt. Lassic Population), and the other, smaller population is approximately 0.8

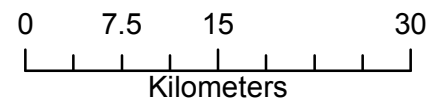




Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

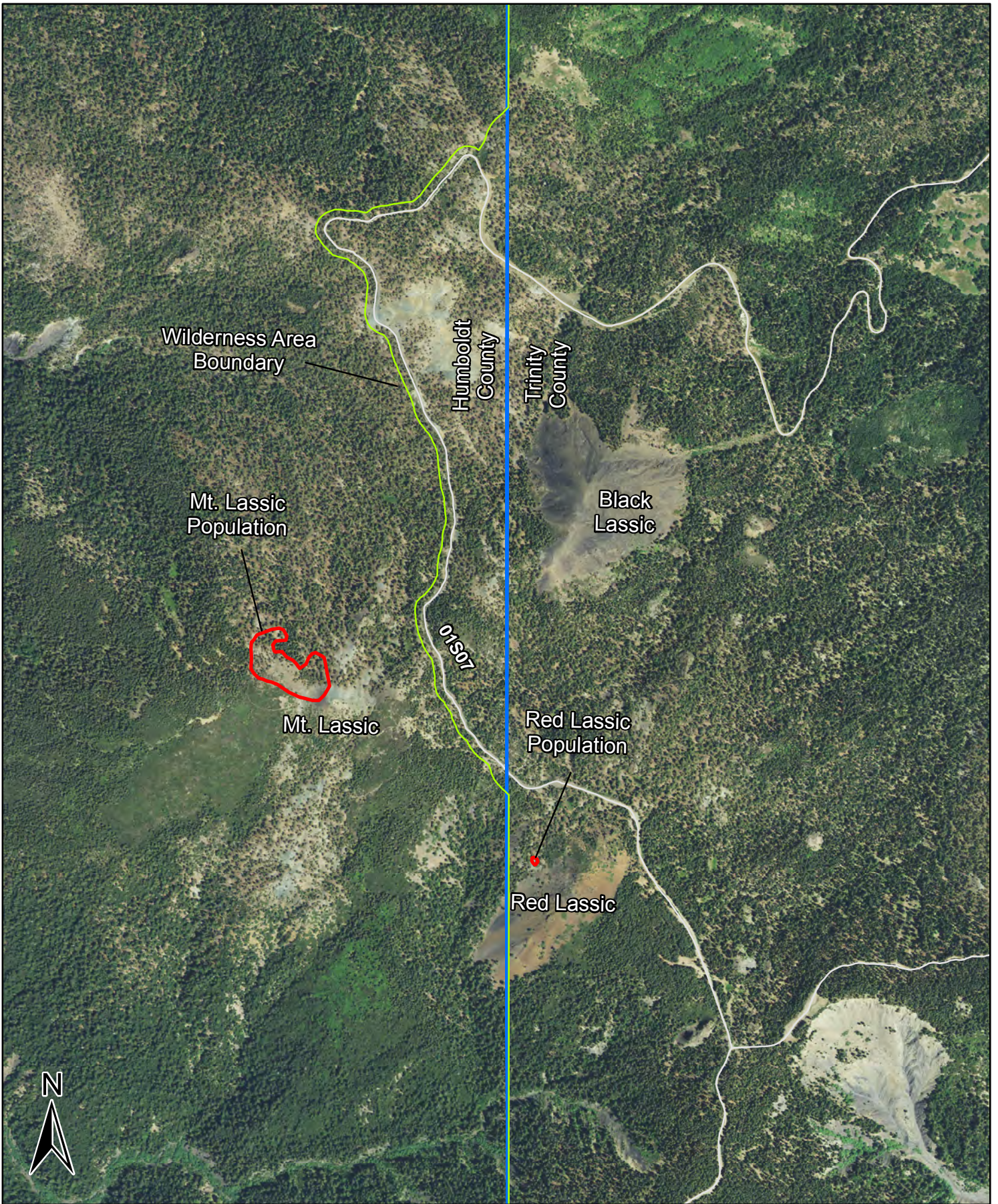
Species Occurrence Data Source: California Natural Diversity Database July 2017

Figure 2. Regional Vicinity of Lassics Lupine ★ = Lassics Lupine Populations



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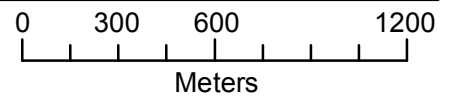




Species Occurrence Data Source: California Natural Diversity Database July 2017

Figure 3. Lassic Lupine Populations  = Lassic Lupine Populations

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 Status Review of Lassic lupine (*Lupinus constancei*)





kilometer (0.5 mile) to the southeast on Red Lassic (Red Lassic Population) (Table 1). Lassics lupine was reported to occupy a total area of approximately 1.6 hectares (4 acres) in 2014 (Imper and Elkins 2016).

Table 1. Lassics Lupine Populations

Occurrence Number*	Population Name	Approximate Area
Occurrence 1	Mt. Lassic Population	1.6 hectares (4 acres)
Occurrence 3	Red Lassic Population	0.02 hectare (0.06 acre)

\*Another occurrence (Occurrence 2) was based on an herbarium collection (Anderson et al. 1972), but the location was mapped erroneously and the record was removed in 2003.

Occurrence 1: Mt. Lassic Population. The largest population of Lassics lupine occurs on Mt. Lassic. Mt. Lassic consists of three peaks arranged in an east to west row (Figure 4, Photo 3). Peak 1 is the easternmost peak and Peak 2 is the middle peak. Peak 3 is the tallest and westernmost peak and is commonly referred to as Signal Peak. Lassics lupine currently occurs near the top of Peak 3, and on the saddle between Peaks 2 and 3. Several Lassics lupine plants occurred at the top of Peak 2 between 2005 and 2012 but are no longer present (Imper and Elkins 2016). A voucher specimen of Lassics lupine that was collected in 1972 was cited in the original species description and includes a location description of “Mt. Lassic and two smaller peaks to immediate E” (Anderson et al. 1972, Nelson and Nelson 1982). It is reasonable to assume that “Mt. Lassic” refers to Peak 3, and the “two smaller peaks to immediate E” are Peaks 1 and 2. If this is true, Lassics Lupine may have also previously occurred on Peak 1. There are no other observations of Lassics lupine on Peak 1 despite years of targeted surveys. The Mt. Lassic Population is within Mt. Lassic Wilderness, and is approximately 0.4 kilometer (0.25 mile) west of Forest Route 1S01. The Mt. Lassic Population occupied an area of approximately 1.6 hectares (4 acres) in 2014 (Imper and Elkins 2016).

Occurrence 3: Red Lassic Population. The Red Lassic Population is approximately 0.8 kilometer (0.5 mile) southeast of the Mt. Lassic Population. The Red Lassic Population is approximately 160 meters (530 feet) west of the summit of Red Lassic at an elevation approximately 100 meters (325 feet) lower than the summit. The Red Lassic Population is approximately 100 meters (325 feet) east of Mt. Lassic Wilderness. The Red Lassic Population occupies an area of approximately 0.02 hectare (0.06 acre) (Figure 4, Photo 4).

Various targeted surveys of potential Lassics lupine habitat since 1991 have not identified any additional populations. Furthermore, few sites have been found that meet the Lassics lupine’s soil requirements, suggesting that it is unlikely the species was much more widespread in the recent past than described above (Imper 2012).

### Life History

Like many plants in the legume family, Lassics lupine exhibits physical seed dormancy, which means there is a physical barrier (seed coat) that prevents moisture from entering seeds (Baskin and Baskin 1998, Guerrant 2007). This seed coat prevents seed germination, even if other environmental factors such as moisture and temperature are favorable, and allows Lassics lupine to form a persistent seed bank. The seed coat for Lassics lupine appears to be relatively robust (Guerrant 2007). Some Lassics lupine seeds can remain viable in the soil for at least five years. In one study, buried seed survival was about 25 percent after three years in the soil (Kurkjian 2012b, Carothers 2013b, Kurkjian et al. 2016). It is unknown how long Lassics lupine seeds can ultimately survive in the soil. In a germination experiment conducted in a germination chamber, about 95 percent of Lassics lupine seeds required scarification



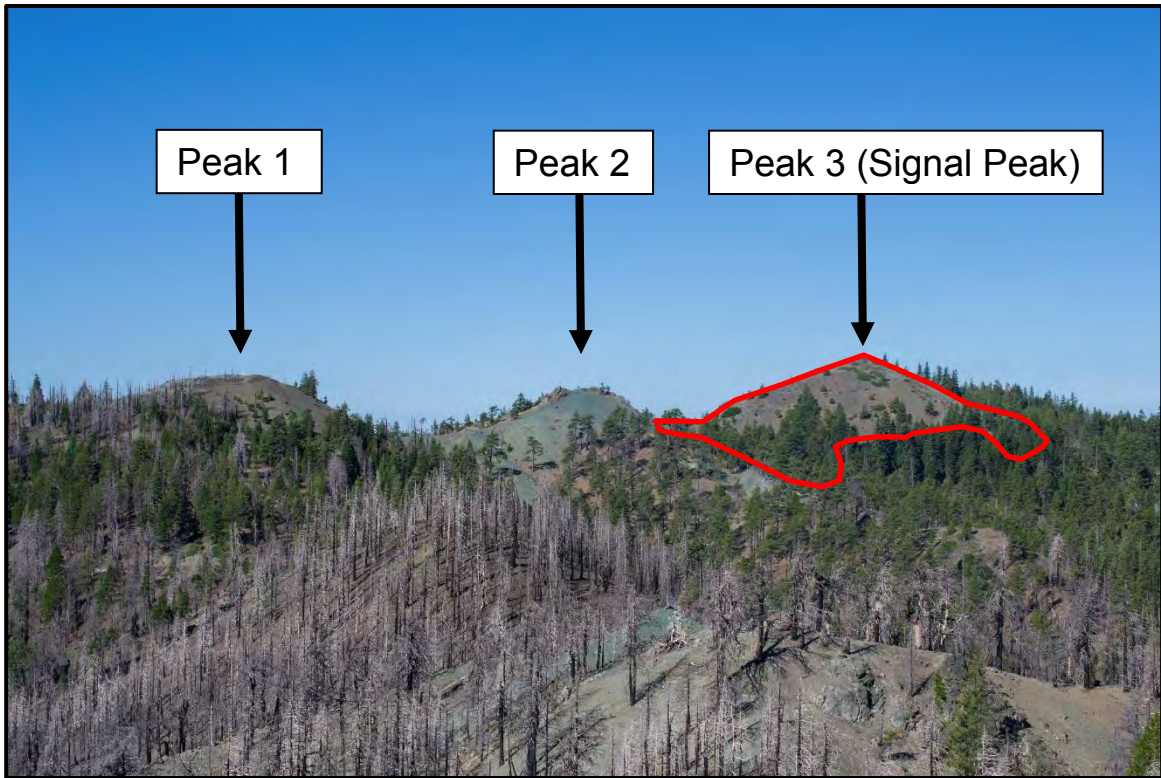


Photo 3: Looking south at Mt. Lassic Peaks 1, 2, and 3, with Mt. Lassic Population Outlined in Red



Photo 4: Approximate Location of Red Lassic Population, Outlined in Red

Figure 4. Photographs of Mt. Lassic Peaks and Lassics Lupine (*Lupinus constancei*) Population at Red Lassic

(intentionally damaging the seed coat) before water would enter the seed and initiate germination (Guerrant 2007). Once seeds had taken up water, all 64 seeds used in the experiment germinated, showing that a well-formed seed is relatively easy to germinate with scarification, although several seeds required multiple attempts to penetrate the seed coat before germination would occur.

Lassics lupine seeds likely germinate after snow has melted and soil temperatures have begun to rise. Beginning in 2005, temperature dataloggers have been used to record above and below ground climate conditions at four locations within Lassics lupine populations (Imper 2012). During this time, the snowmelt date has been somewhat variable, occurring sometime between March and June; however, snow was almost completely absent from the Lassics in the winters of 2013-2014 and 2014-2015, and only covered the ground for less than two weeks.

In-situ germination trials using unscarified seeds have resulted in low germination and low early survival (Carothers 2013a, Imper and Elkins 2016). During the very early stages of Lassics lupine growth, plant size appears to be most influenced by seed size, with larger seeds producing larger plants (Guerrant 2007). Although not directly observed, naturally-occurring microorganisms (fungi and bacteria) appear to be present in native Lassics lupine soil and are beneficial to the growth and development of Lassics lupine. After Lassics lupine plants have become established and have produced 12-15 regular leaves, plants exposed to unsterilized native soil presumed to contain beneficial microorganisms become consistently and significantly larger than plants exposed to sterilized native soil in which such microorganisms would be dead (Guerrant 2007).

After germination, Lassics lupine plants typically take several years to reproduce for the first time (Kurkjian 2012a, Kurkjian et al. 2016). An in-situ seed germination experiment that involved sowing 435 seeds in native habitat in 2005 did not result in any reproductive individuals until 2008 (Carothers 2013a). Of 64 Lassics lupine seeds germinated and grown in a controlled environment, only one individual plant flowered and produced seeds within the timeframe of the experiment (approximately eight months). Of the Lassics lupine plants that germinated from seed at the Red Lassic Population in 2016 after the 2015 Lassics Fire, 73 percent reproduced in the 2017 growing season showing that Lassics lupine is capable of reproducing in the wild in its second year if conditions are favorable (S. Carothers pers. comm. 2017 in Appendix B). Several Lassics lupine plants that germinated from seed at the Mt. Lassic Population in 2016 also reproduced during the 2017 growing season (D. Barton pers. comm. 2017 in Appendix B). Lassics lupine typically blooms in July, but flowers may appear as early as late May (Kurkjian 2012a, Sholars 2012, Kurkjian et al. 2016, CNPS 2017). Reproductive individuals typically bear 1 to 15 inflorescences with 10-60 flowers per inflorescence (Kurkjian 2012a, Kurkjian et al. 2016).

Lassics lupine is primarily pollinated by three species of bees, and the rate of pollinator visits per flower is relatively high (Crawford and Ross 2003). The majority of visits are made by the yellow-faced bumblebee (*Bombus vosnesenskii*) and the black-tailed bumblebee (*Bombus melanopygus*) with some visits by a species of mason bee (*Osmia* sp.) towards the end of the flowering season. These three species of bees appear to be effective pollinators, because they are large enough to trigger the mechanism that releases pollen and presents the tip of the female reproductive structure, which is called a stigma. Lassics lupine flowers may be capable of self-pollination because some fruit development has been observed in flowers that were self-pollinated by hand, and in flowers that pollinators could not visit due to pollinator exclusion (Crawford and Ross 2003).

Lassics lupine fruits can produce one to five seeds by July or August, and each inflorescence contributes an average of 14.6 mature seeds to a plant's total production (Kurkjian 2012b, Kurkjian et al. 2016). Mature Lassics lupine legumes split along sutures and seeds can fall to the ground nearby, or can be projected up to four meters (13 feet) away if the legumes split open suddenly (Kurkjian 2012a). Small mammals are known to consume Lassics lupine fruits and seeds (Crawford and Ross 2003; Kurkjian 2011, 2012a; Cate 2016). It is possible that seed-caching small mammals such as chipmunks are a vector in dispersing Lassics lupine seeds; however, this has not been observed (Carothers 2008).

Lassics lupine plants can live for several years and produce seeds over several growing seasons before dying. Individual Lassics lupine plants have been observed to live up to 12 years (Imper and Elkins 2016).

### **Similar-looking Plants**

Lassics lupine is reported to most closely resemble the more widespread *Lupinus lepidus* var. *sellulus* (formerly *Lupinus sellulus* var. *ursinus*) from the Yolla Bolly Mountains, but the two taxa are visually distinct. Furthermore, *Lupinus lepidus* var. *sellulus* is limited to higher elevations of the Yolla Bolly-Middle Eel Wilderness area and tends to grow on barren shale and greywacke sandstone above 2,070 meters (6,800 feet) in elevation. Habitat for *Lupinus lepidus* var. *sellulus* is similar to that of Lassics lupine, but is about 300 meters (1,000 feet) higher in elevation. Due to this higher elevation, snow persists longer into the summer and seed germination tends to occur later in the spring than it does for Lassics lupine. Lassics lupine can be distinguished from other lupines that grow close to the ground by its short erect stem, short thick inflorescence, bicolored flowers, glabrous keel, basal and prostrate leaves, long petioles, and large spoon-shaped leaflets (Nelson and Nelson 1983). Species of lupine that may be confused with Lassics lupine do not occur in the vicinity of the Lassics.

### **Habitat that may be Essential to the Continued Existence of the Species**

Lassics lupine is found on barren slopes and near edges of Jeffrey pine (*Pinus jeffreyi*) forest on and within the vicinity of serpentine soils. Lassics lupine habitat at the Red Lassic Population is somewhat different than habitat at the Mt. Lassic Population in terms of aspect and vegetation cover, but the two populations share similar soil characteristics. Lassics lupine is found in three different ecological settings at the Mt. Lassic Population, and one ecological setting at the Red Lassic Population. The four different ecological settings where Lassics lupine is found are described below and presented in Figure 5, followed by information on the vegetation communities, geology, soils, climate, and hydrology associated with Lassics lupine. A map with the approximate locations of the ecological settings at Mt. Lassic is presented in Figure 6.

Red Lassic Population:

1. **Southwest-facing Forest Crest:** The small Red Lassic Population is on a midslope crest of the southwest-facing slope of Red Lassic. It has an overstory of Jeffrey pine that protects the population from excessive solar radiation that leads to high soil temperatures in late summer. Most of the Jeffrey pine that protects the Red Lassic Population was killed or injured by the 2015 Lassics Fire. A depression adjacent to the crest collects snow in the winter, and while the snow melts relatively early compared



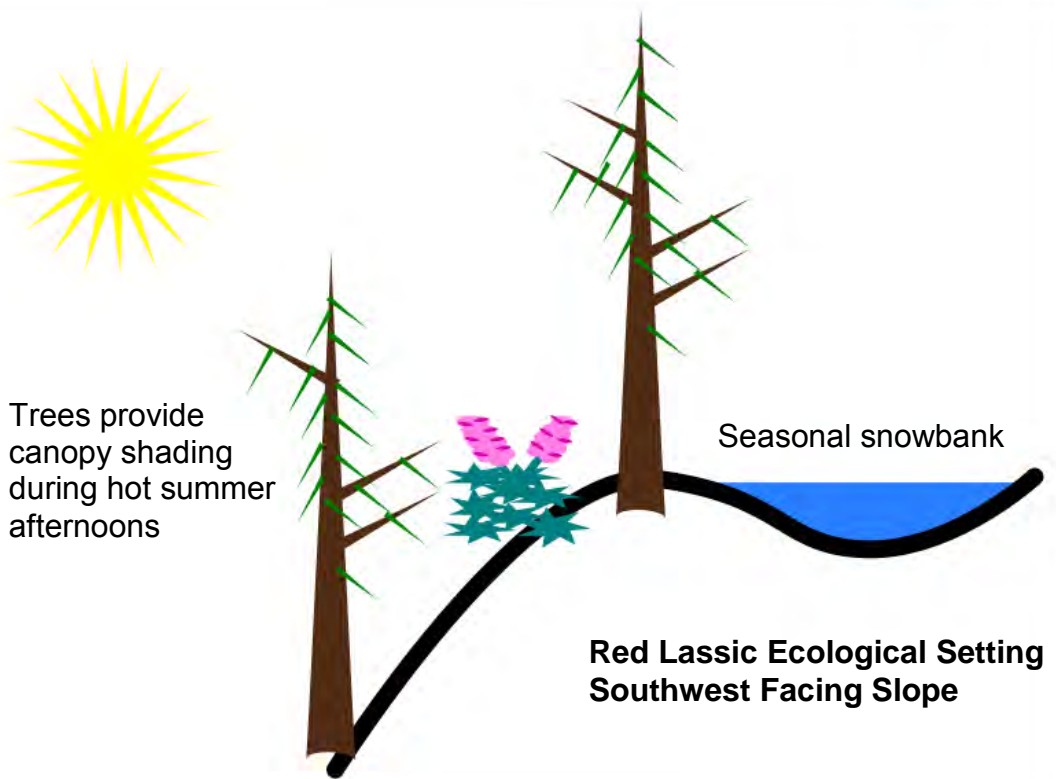
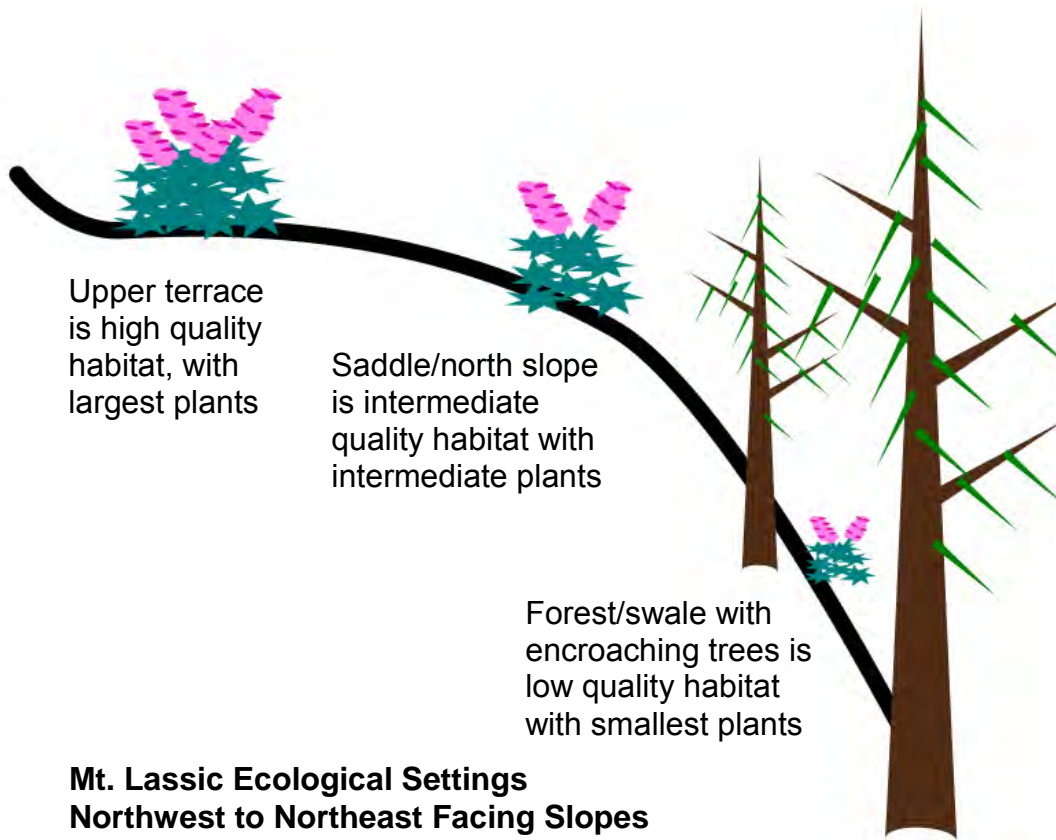


Figure 5. Ecological Settings of Lassics Lupine (*Lupinus constancei*) at Mt. Lassic and Red Lassic

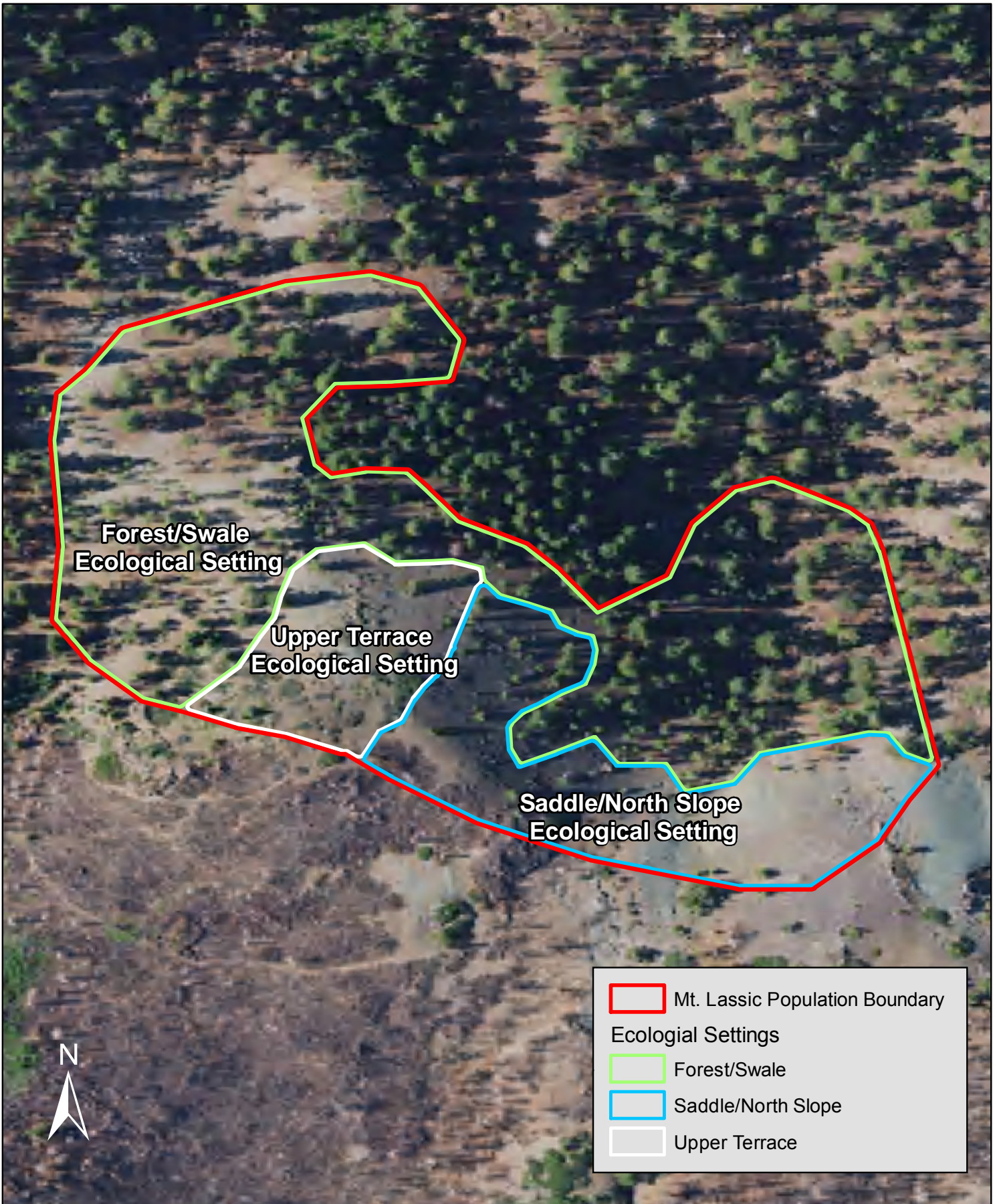
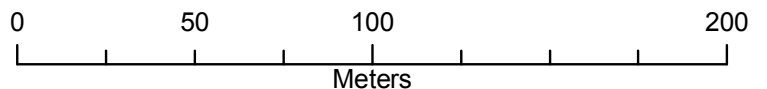


Image Source: NAIP 2016

**Figure 6. Approximate Locations of Lassics Lupine Ecological Settings at Mt. Lassic**

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with some areas at the Mt. Lassic Population, the depression retains a relatively high amount of soil moisture into the summer which drains downslope and likely provides summer moisture for the Red Lassic Population. There is a medium to high amount of leaf (needle) litter on the ground at the Red Lassic Population. Leaf litter at the Red Lassic Population since 2015 primarily consists of dead needles from dead or dying Jeffrey pines. Prior to the 2015 Lassics Fire, litter primarily consisted of piles of cone scales under trees from cones dismantled by squirrels collecting pine seed.

Mt. Lassic Population:

2. **Upper Terrace:** Optimum habitat for Lassics lupine currently appears to be areas with flat to moderate slopes that have little to no tree overstory, but are shaded by nearby topography. This habitat receives a high amount of light, has no leaf litter on the ground, and has relatively high soil temperatures in comparison to other Lassics lupine habitats. Snow tends to melt later and soils tend to retain moisture later in this habitat compared to other Lassics lupine habitats. Lassics lupine populations in these areas grow more densely, and plants tend to be more robust with respect to size and reproductive vigor.
3. **Saddle/North Slope:** Although this habitat is less optimal than the upper terrace, the majority of Lassics lupine plants grow in areas of moderate to steep north- or west-facing slopes with bare soil that has a large proportion of gravel or cobble at the surface. These areas have no tree overstory and receive high direct sunlight compared to other Lassics lupine habitats, but not as high as the upper terrace. In this habitat, snow tends to melt earlier, particularly on west-facing slopes, and soil tends to dry out earlier than the upper terrace. The Lassics lupine population grows less densely in this habitat, and plants tend to have moderate growth and reproductive vigor compared to plants in other habitats.
4. **Forest/Swale:** Lassics lupine also grows below the upper terrace and saddle/north slope habitats described above, at the edges of and within Jeffrey pine-incense cedar (*Calocedrus decurrens*) forest. This habitat retains snow for a long time, and has a high amount of leaf litter on the ground. These areas receive less direct sunlight, have lower soil temperatures, and have low soil moisture levels in comparison to other Lassics lupine habitats. Forest and forest edges are the least favorable habitat for Lassics lupine from the standpoint of reproductive vigor and growth rate, consistent with apparent intolerance of shade, litter cover and low soil moisture.

### Vegetation Communities

The Department uses A Manual of California of Vegetation Second Edition (Sawyer et al. 2009) to classify natural communities within California. However, the vegetation of the Lassics has not been classified using A Manual of California Vegetation, Second Edition. Alexander et al. (2007) describes the area as being characterized by Jeffrey pine-incense cedar woodland, chaparral vegetation, largely unvegetated serpentine barrens, and seasonal wetland habitats. The predominant cover on the serpentine soils of the Lassics is open Jeffrey pine-incense cedar forest. This vegetation would be correctly called *Pinus jeffreyi* alliance in Sawyer et al. (2009), and is primarily represented by the *Pinus jeffreyi-Calocedrus decurrens/Ceanothus cuneatus* association, described in Jimerson et al. (1995) with data from plots in the Lassics. White fir (*Abies concolor*) is prevalent on nonserpentine forest soils of the Lassics (Alexander et al. 2007). Montane chaparral composed of pinemat manzanita (*Arctostaphylos nevadensis*),

mountain whitethorn (*Ceanothus cordulatus*), buckbrush (*Ceanothus cuneatus*) and other shrubs is common on south facing slopes. Six vegetation plots were established in 2016 near Mt. Lassic to monitor changes in vegetation over time, and these plots may be revisited every 5-10 years (Hutchinson 2017).

Lassics lupine predominately occurs on patches of serpentine barrens, surrounded by Jeffrey pine-incense cedar forest. Common shrub and tree species found within and near Lassics lupine populations include manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), pinemat manzanita, incense cedar, mountain whitethorn, buckbrush, oceanspray (*Holodiscus discolor*), Jeffrey pine, canyon live oak (*Quercus chrysolepis*), gummy gooseberry (*Ribes lobbii*), and Sierran gooseberry (*Ribes roezlii*) (Nelson and Nelson 1982, Carothers 2008, Six Rivers National Forest 2015, Cate 2016, Imper and Elkins 2016). Other plants associated with Lassics lupine habitats include scytheleaf onion (*Allium falcifolium*), beegum onion (*Allium hoffmanii*), Brandegees's spring beauty (*Claytonia saxosa*), Tracy's collomia (*Collomia tracyi*), naked buckwheat (*Eriogonum nudum*), Siskiyou fritillaria (*Fritillaria glauca*), Scarlet fritillary (*Fritillaria recurva*), Gray's bedstraw (*Galium grayanum* var. *grayanum*), Lassics sandwort (*Minuartia decumbens*), Nuttall's sandwort (*Minuartia nuttallii* var. *gregaria*), naked broomrape (*Orobanche uniflora*), serpentine scorpionweed (*Phacelia corymbosa*), white-veined wintergreen (*Pyrola picta*), pale yellow stonecrop (*Sedum laxum* ssp. *flavidum*), mountain jewelflower (*Streptanthus tortuosus*), and mountain violet (*Viola purpurea*).

Lassics lupine habitat at the Mt. Lassic Population is generally open, with scattered buckbrush and mountain whitethorn shrubs, stunted Jeffrey pine trees, incense cedar trees, and a variety of herbs and geophytes (plants that survive underground for a part of the year). This habitat corresponds with the upper terrace and saddle/north slope ecological settings described above. Lassics lupine is also found at the edge of or within relatively more closed-canopy Jeffrey pine-incense cedar forest with mats of prostrate buckbrush down the north slopes of Mt. Lassic, to the northwest and northeast of Peak 3 (Signal Peak). This forested habitat is the forest/swale ecological setting described above and is the least favorable habitat for Lassics lupine, from the standpoint of reproductive vigor and growth rate, perhaps due to reduced light and water availability and the presence of leaf litter (Carothers 2008, Imper 2012). Lassics lupine habitat at the Red Lassic Population is a recently burned area with an overstory of relatively large Jeffrey pine trees that provide partial shelter from the south and southeast, and pinemat manzanita, Nuttall's sandwort, white-veined wintergreen and other plant species in the understory (Carothers 2004).

Jeffrey pine and incense cedar have expanded their distribution up the north slope of Mt. Lassic, in some areas on the order of 90 to 120 meters (300 to 400 feet) or more since the 1930s (Carothers 2008). The majority of the encroachment is from Jeffrey pine trees ranging from 13-38 centimeters (5-15 inches) diameter at breast height and 3-15 meters (10-50 feet) tall, and relatively even-aged at about 45 years old (Imper 2012). Incense cedar is scattered in the understory, and is up to about 8 centimeters (3 inches) diameter at breast height, and 5 meters (15 feet) tall (Imper 2012).

In August 2015, Mt. Lassic and the surrounding area was subject to an approximately 7,490-hectare (18,200-acre) lightning-caused fire called the Lassics Fire. The effects of the Lassics Fire on vegetation are discussed in the Vegetation Encroachment and Fire sections of this Status Review, below.

## Geology and Soils

The Lassics are in the central Franciscan Belt of the California Coast Ranges (Bailey et al. 1964), and the geology of the area is somewhat complex. The Lassics are a mountainous area with moderately steep to very steep slopes. There are three primary assemblages of rocks in the area around the Lassics: (1) the Franciscan Complex, (2) Coast Range Ophiolite, and (3) the Great Valley Sequence (Kaplan 1984, Krueger 1990). The Franciscan Complex underlies and completely surrounds the Coast Range Ophiolite and Great Valley Sequence rocks in the area. The Coast Range Ophiolite is the source of the ultramafic (serpentine) rocks in the area, and originated from oceanic crusts and underlying mantle that were brought to the surface by geologic forces. The serpentine rocks in the area are from an outlier of Coast Range Ophiolite that has been highly disrupted by folding and faulting (Alexander et al. 2007). Rocks from the Great Valley Sequence were also thrust into the area over the Coast Ranges fault, which is now about 75 kilometers (47 miles) to the east. Red Lassic and Mt. Lassic consist of serpentine and other rocks from the Coast Range Ophiolite intermixed with rocks from the surrounding Franciscan Complex. The summit of Red Lassic is almost completely composed of well-developed pillow basalt. Black Lassic, which does not support any Lassics lupine plants, primarily consists of sedimentary rocks from the Great Valley Sequence, with some contact with volcanic rocks on its north and west sides (Kaplan 1984).

Both erosion caused by water flow and mass wastings such as slope failures and rock slides have been important processes in forming the parent materials of the Lassics area, and these processes have contributed to the complex geology of the Lassics.

Lassics lupine populations occur on several soil units related to serpentine and/or clastic sedimentary rocks that are described in detail in a 2008 report by Alexander. Serpentine soils are characteristically rich in magnesium and iron, while relatively low in calcium, nitrogen, potassium, and phosphorus compared to nonserpentine soils (Kruckeberg 1984, Alexander et al. 2007, Alexander 2011). Clastic rocks are those composed of broken pieces of older rocks. The Alexander report describes soil map units in detail over the approximately 2.5 square kilometers (1 square mile) of serpentine soils that are within 15 square kilometers (6 square miles) enclosing the Lassics. The soil map units from the 2008 Alexander report that relate to Lassics lupine populations are described below. The majority of the Lassics lupine population is in "Entisols/clastic metasedimentary rock colluvium over serpentine (CS)" soils, which are limited to a portion of the north slope of Mt. Lassic. Approximately 20 percent of the Lassics lupine population is mapped in "Entisols/clastic sedimentary rocks (CM)" which is also limited to a portion of the north slope of Mt. Lassic. The Lassics lupine population also extends to a much lesser degree into "Entisols, Inceptisols and Mollisols/serpentinite (ST)", the widespread "Hyampom variant and Hungry family complex/serpentinite (SD)" and "nonserpentine (N)" soils. The Red Lassic Population is within an area mapped as "Hungry family/serpentinite colluvium (SL)" soil. Alexander noted that Lassics lupine populations are only found on shallow soils, and although they occur predominately on serpentine soils, plants can also be found on nonserpentine soils (Alexander 2008).

Additional mineralogical and physical analysis by Imper (2012) revealed that soils supporting Lassics lupine generally have similar sand content (ranging from 81 to 91 percent), and generally similar concentrations of phosphorus, potassium, calcium, copper, iron, zinc, total carbon, total nitrogen and extractable aluminum when compared with other soils nearby. Lassics lupine always appears to occur in soils exhibiting some influence from clastic sedimentary material, and usually also exhibiting an obvious influence from serpentine rock, either mixed with or underneath clastic sedimentary material. The totally barren, green-gray



serpentine soils typical of much of Mt. Lassic are similar in many respects to the soils that support Lassics lupine, but have higher sand content and pH, and also lower lead levels (Imper 2012). Few sites that meet Lassics lupine soil requirements are unoccupied by Lassics lupine, which suggests that it is unlikely the species was significantly more widespread in the recent past than it is now (Imper 2012).

### Climate and Hydrology

The climate at the Lassics consists of hot dry summers and snow cover in the winter. There are no weather stations on the Lassics, and the closest formal weather station is Zenia, which is approximately 15 kilometers (9.5 miles) southeast of the Lassics and about 460-520 meters (1,500-1,700 feet) lower in elevation. Using PRISM (2017) weather data from 1981 to 2010, the average November to April minimum temperatures in the vicinity of the Lassics are modeled to be 0.1°C (32.2 °F), and the average maximum temperatures from June to September are modeled to be 23.9 °C (75.1 °F). The modeled average annual precipitation is 225 centimeters (88.7 inches), with less than 10 centimeters (3.7 inches) falling in June, July, August and September (PRISM 2017).

Lassics lupine occurs near the top of the Little Van Duzen River watershed. The Little Van Duzen River watershed drains into the Van Duzen River, then the Eel River, and ultimately into the Pacific Ocean. Lassics lupine depends on snowmelt, rainfall, and groundwater as its primary sources of water.

Imper (2012) collected extensive soil and climate data from several locations within Lassics lupine populations. A chronological description of typical climate and hydrological conditions of a year in Lassics lupine habitat is presented in the following paragraphs. As described below, snowmelt date, summer precipitation, and late summer temperatures all appear to be critical factors affecting Lassics lupine distribution, mortality, reproduction and recruitment (Imper 2012).

Soil in Lassics lupine habitat is typically close to freezing and covered in snow, with high moisture content in the winter months, and may be covered in snow for up to eight months of the year, although snow cover may be intermittent in some years. Data from weather stations and soil temperature dataloggers installed in the Lassics have shown soil temperatures to be a good indicator of when snow has melted (Imper 2012). Weather data recorded at the Zenia weather station were also found to be typically good indicators of spring conditions in Lassics lupine habitat, particularly the date of average snowmelt (Imper 2012). From 2005 to 2011, the average snowmelt date of all dataloggers was May 8, with an average of 5.5 months of snow cover per year at the north saddle. Between 2005 and 2011, the latest snowmelt date recorded within Lassics lupine populations was June 22, 2011, at the north part of the saddle on Mt. Lassic, and the earliest snowmelt date recorded was March 13, 2007, at the south part of the saddle on Mt. Lassic. Winter snowpack was negligible in the Lassics during the winters of 2013-2014 and 2014-2015, coinciding with a historic drought in California. Demographic data suggest that snow melting early in the year tends to have a negative effect on the survival of Lassics lupine plants in that year, particularly if it is not followed by summer rain (Imper 2012). Snow may melt earlier in the year if more winter precipitation falls as rain instead of snow, or the snowpack is small. Potential benefits of greater snow cover include reduced desiccation of overwintering Lassics lupine plants and greater water infiltration into soils, compared with precipitation as rainfall.

Soil temperatures typically rise rapidly after winter snow has melted and the growing season for Lassics lupine begins. Soil moisture levels remain high or spike even higher in the weeks following initial snowmelt. Soil moisture in Lassics lupine habitat then typically decreases gradually after all snow has melted, although it may spike with precipitation events. Soil temperature typically increases gradually into August. Optimum Lassics lupine habitat has both high light levels and high available soil moisture in August when compared to unsuitable or less suitable habitat for Lassics lupine nearby. Areas with excessively low soil moisture and excessively high soil temperatures in late summer appear to be unsuitable for Lassics lupine survival. Areas with lower light levels, such as those near trees, likely experience less late summer stress from high soil temperature, but appear to be less suitable for Lassics lupine from the standpoint of reproductive vigor and growth rate. Despite more cover, forested areas experience a more rapid decrease in soil moisture after snow has melted than other areas of Lassics lupine habitat, likely due to the soil water demands of trees (Imper 2012).

Summer rainfall, when it occurs, appears to be the climate factor that is the most beneficial for Lassics lupine survival, and mortality tends to be lower in years with more late spring and summer rainfall (Imper 2012). Information also suggests that Lassics lupine cannot survive if soil temperatures become too high, particularly in late summer after soils have dried out. High photosynthetically active radiation (light) levels have been correlated with higher soil temperatures, and therefore shading from trees and topography are important factors in the kind of habitat necessary for Lassics lupine survival (Imper 2012). Erosion from rills and deposition of sediment or gravel may contribute to mortality of Lassics lupine plants during significant rainstorms, particularly if Lassics lupine habitat is not protected by snow cover.

To summarize, available information suggests that Lassics lupine mortality appears to be highest when summer rainfall is low and summer temperatures are high, and the effects of these conditions are exacerbated by early snowmelt.

## **POPULATION TRENDS**

Lassics lupine was first described in 1983 and the results of extensive surveys of the Lassics suggest that Lassics lupine has always been restricted to small areas of suitable habitat. Anecdotal observations of severe population declines and of the absence of Lassics lupine plants in previously occupied areas led to the beginning of annual quantitative monitoring in 2001 (Carothers 2005, Kurkjian et al. 2016). Monitoring is conducted jointly by the U.S. Forest Service, California Native Plant Society and U.S. Fish and Wildlife Service. There are currently four Lassics lupine monitoring transects, identified as Red, Saddle, Forest, and Terrace (S. Carothers pers. comm. 2017). The Red monitoring transect was established in 2001 and includes all plants at the Red Lassics Population. The Saddle transect was established in 2002 and includes most plants in the saddle between Peaks 2 and 3 of Mt. Lassics. The Forest transect was established in 2005 and includes all of the plants on the lower forested north slope of Mt. Lassics. The Red, Saddle, and Forest transects were positioned to capture as much of the population as possible, and include approximately half of the entire Lassics lupine population. The Terrace monitoring transect was established in 2016 and is located on the upper terrace of Mt. Lassics Peak 3. Population counts and demographic information is collected within the monitoring transects in the summer. Information collected includes location of the plant, life stage, plant size, number of inflorescences, number of fruits, evidence of herbivory and/or seed predation, predation intensity, and whether the plant is caged. In addition, Lassics lupine plants outside of the monitoring transects are counted to the extent possible, and binoculars are used to count plants on steep erodible slopes. Counts of plants outside of monitoring transects have

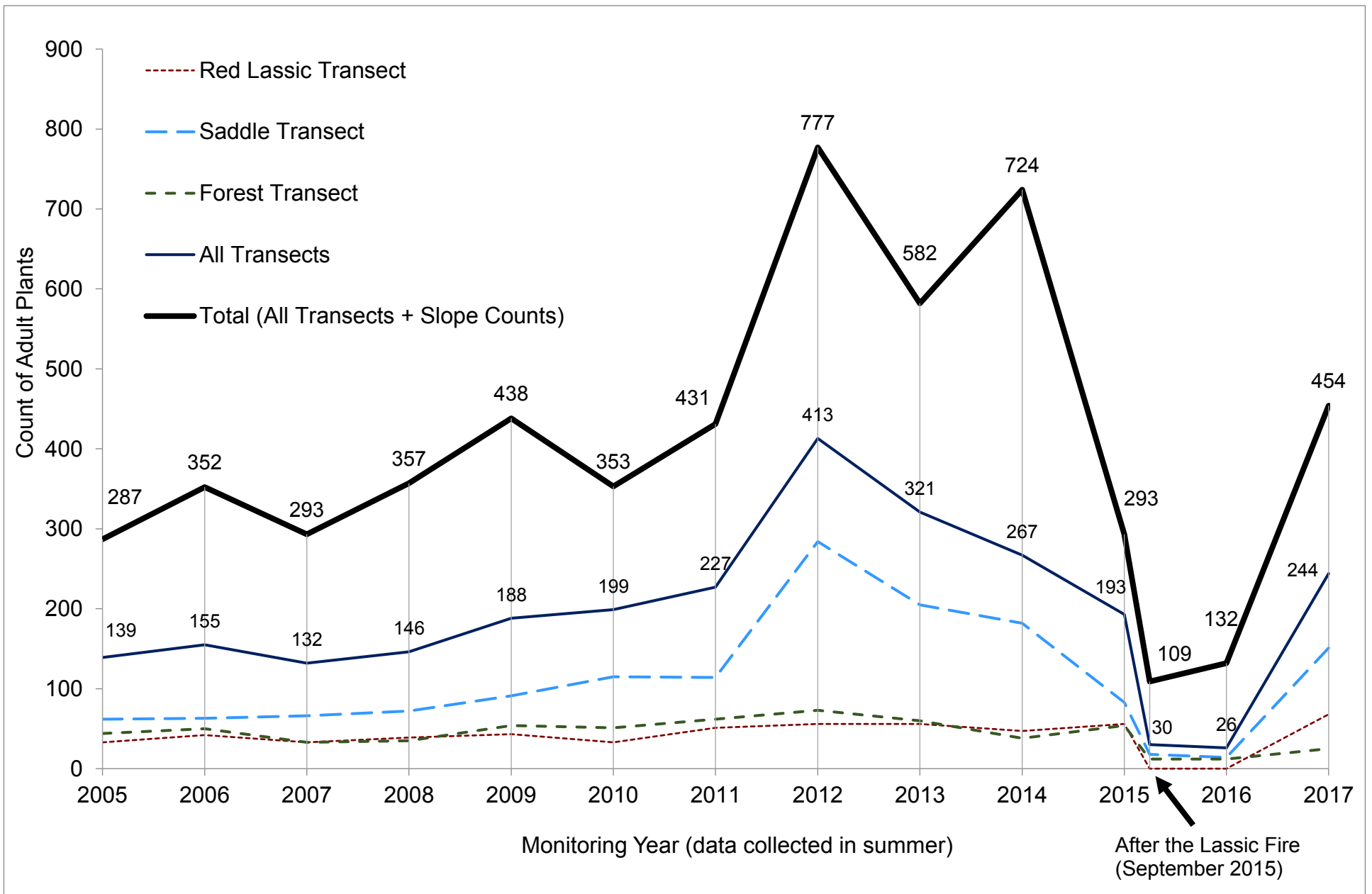
varied in completeness from year to year, and the overall population size is likely underestimated to some small degree in most years (S. Carothers pers. comm. 2017).

The population trends of adult Lassics lupine plants from 2005 to 2017 are presented in Figure 7. Adult Lassics lupine plants are those plants that have survived one growing season after germination, and are no longer seedlings. The number of adult Lassics lupine plants increased gradually from 2005 to 2011, and reached highs of over 700 adult plants in 2012 and 2014, likely due to efforts to protect reproductive plants with wire cages. This caging began in 2003 and reduced the effects of small mammal seed predation on Lassics lupine populations (Kurkjian et al. 2016). Lassics lupine populations suffered a significant decline in 2015 due to negligible winter snowpack in the Lassics during the winters of 2013-14 and 2014-15, historic drought, and the 2015 Lassics Fire. The number of adult Lassics lupine plants remained low in 2016 as the drought continued. In 2017, the number of adult plants increased significantly after approximately 340 centimeters (134 inches) of precipitation fell in the Lassics area in the fall, winter and spring of 2016-2017, which is the most precipitation between monitoring visits since the monitoring began (PRISM 2017).

A significant contraction of the area occupied by Lassics lupine plants was documented at the south end of the Saddle transect between 2002 and 2015, with a significant contraction coinciding with the drought conditions of 2014 and 2015 (Imper and Elkins 2016). The area occupied by Lassics lupine at the south end of the Saddle transect expanded after high precipitation in the Lassics area in the fall, winter and spring of 2016-2017.

A population viability analysis for Lassics lupine was conducted using the demographic data described above from the Red, Saddle, and Forest transects, and information from seed experiments (Kurkjian 2011, 2012a, 2012b; Kurkjian et al. 2016). The population viability analysis estimated that, without protecting any reproductive plants from seed predation, the probability of quasi-extinction of Lassics lupine (defined as 10 or less adult plants remaining) in the next 50 years is between 68.4 and 100 percent. If approximately 30 percent of reproductive Lassics lupine plants are protected from seed predation by caging, the probability of quasi-extinction in the next 50 years is reduced to between 0.7 and 31.5 percent. If all reproductive Lassics lupine plants are caged, the probability of quasi-extinction in the next 50 years is reduced to between 0 and 1.8 percent. Of the three transects studied, the Saddle transect has the best chance of persisting over the next 50 years if the current practice of caging approximately 30 percent of reproductive individuals is continued. The population viability analysis model was most sensitive to changes in survival and growth rates of the reproductive class, yet despite this, reductions in predispersal seed predation from caging had a major positive effect on stochastic growth rate and population viability. These results show that current efforts to cage reproductive plants are critical for preventing the extinction of Lassics lupine.

The population viability analysis did not attempt to model predicted changes due to climate change, and did not account for impacts to Lassics lupine populations from reduced snowpack, drought, or the 2015 Lassics Fire. In fact, the population of adult Lassics lupine plants suffered a significant decline in 2015 despite the ongoing caging of reproductive plants (Kurkjian et al. 2016). The starting population sizes are now smaller than the population sizes used for the population viability analysis, which will likely reduce the modeled viability of the population. The 2015 Lassics Fire may have also altered vital rates in ways that will affect the viability of the population.



Source: S. Carothers Unpublished Data 2017

Figure 7. Lassics Lupine (*Lupinus constancei*) Population Trends

## FACTORS AFFECTING THE ABILITY TO SURVIVE AND REPRODUCE

### Predation and Herbivory

Pre-dispersal seed predation by rodents has the potential to drive Lassics lupine to extinction (Kurkjian 2012a, Kurkjian et al. 2016).

Extreme pre-dispersal seed predation (removal of seeds while they are still attached to the plant) of Lassics lupine fruits was first observed by Crawford and Ross in 2003 during the course of a Lassics lupine pollination study. They found that approximately 72 percent of the 67 inflorescences observed suffered from heavy seed predation, with the greatest predation occurring early in fruit development. Plants with the greatest number of inflorescences were subject to particularly severe seed predation. Significant Lassics lupine seed predation has been subsequently observed in most years. Seventy-two uncaged plants were observed during the 2010 growing season, and all of them sustained some level of seed predation while the fruits developed on reproductive plants, and before seeds had matured and dispersed, with all developing fruits removed from most plants (Kurkjian 2011). Pre-dispersal seed predation often results in mortality of the seed, and can therefore have serious effects on populations of rare plant species (Dangremond et al. 2010, Kurkjian et al. 2016). There is no evidence indicating that seeds and fruits removed by seed predators are cached or otherwise survive.

Several animal species, particularly rodents, have been identified as consumers of Lassics lupine seeds, flowers, and vegetation (Six Rivers National Forest 2015). Cameras placed near Lassics lupine plants have captured images of deer mice (*Peromyscus* spp.), chipmunks (*Tamias* spp.), mountain quail (*Oreortyx pictus*), and California ground squirrel (*Otospermophilus beecheyi*) preying upon Lassics lupine seeds and/or flowers (Figure 8, Photo 5), and black-tailed jackrabbit (*Lepus californicus*) has been observed consuming an entire Lassics lupine individual (Cate 2016, D. Barton pers. comm. 2017). Herbivory of Lassics lupine flowers and vegetation is also frequently observed during demographic monitoring, in some cases resulting in excavation of the root crown and death of the plant.

Other animals in the vicinity of Lassics lupine populations may also consume Lassics lupine seeds or vegetation. Monitoring of small mammals via live trapping has been conducted since 2005, and small mammals known to occur within and near Lassics lupine habitat include three species of deer mice (*Peromyscus boylii*, *P. maniculatus*, and *P. truei*), two species of chipmunks (*Tamias sonomae* and *T. senex*), and two species of woodrats (*Neotoma fuscipes* and *N. cinereus*) (Cate 2016, G. Falxa unpublished data). Based on live trapping and camera trap detection, deer mice appear to have the highest relative abundance in areas near the Mt. Lassic Population of Lassics lupine, followed by California ground squirrels, chipmunks, black-tailed jackrabbit, mule deer (*Odocoileus hemionus*), woodrats, and fox sparrows (*Passerella iliaca*) (Cate 2016, G. Falxa unpublished data).

A surrogate seed predation experiment using cameras directed at sugar snap pea pods placed in different habitats at Mt. Lassic captured deer mice, black-tailed jackrabbits, and California ground squirrels all removing the snap peas (Cate 2016). All snap peas placed in the chaparral habitat were removed within 70 hours, and almost all of the snap peas placed in the more exposed upper terrace and saddle areas of the experiment were also removed within 70 hours. Approximately half of the snap peas placed in the forest habitat were removed within 70 hours. Because snap peas in the forest survived at a higher rate than other habitats, Lassics lupine in the forest may be at a lower risk of seed predation than plants in other habitats; however, Cate (2016) did not find strong experimental support for this conclusion. This experiment was





Photo 5: California ground squirrel (*Otospermophilus beecheyi*) eating Lassics lupine (*Lupinus constancei*) flowers (D. Barton pers. comm. 2017)



Photo 6: Wire cage used to protect Lassics lupine fruits from seed predation

Figure 8. Photographs of a Seed Predator and Protective Wire Cage

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conducted in 2015 prior to the Lassics Fire and repeated after the fire in 2016, with similar results suggesting that the 2015 Lassics Fire did not alter the spatial patterns of pre-dispersal seed predation risk at Mt. Lassic (D. Barton pers. comm. 2017).

Preliminary studies suggest that herbivory does not have a particularly large effect on the survival of Lassics lupine seedlings (D. Barton pers. comm. 2017).

Based on data from 18 years of monitoring small mammals using live traps, small mammals in the vicinity of Lassics lupine populations are generally most abundant in chaparral habitat, followed by barren serpentine habitat, with lowest abundance in forest habitat (G. Falxa pers. comm. 2017 in Appendix B). An analysis of the movements of small mammals near the Mt. Lassics population was conducted using live trapping, marking and recapturing, and passive remote detection technology (Cate 2016). Chipmunks were found to move between habitats (chaparral, forest, and serpentine) at a higher rate than deer mice. Models also suggest that the probability for small mammal movement between the chaparral and serpentine habitats is highest, the probability for movement between forest and chaparral is lowest, and the probability for movement between forest and serpentine is intermediate (Cate 2016). Although most animals tended to remain within the same habitat, animals did move between habitats, and therefore seed predators from adjacent communities have the potential to influence Lassics lupine populations (Cate 2016). Furthermore, high amounts of movement into and out of the barren serpentine habitat suggests that forest and chaparral habitats act as refuges for seed predators. Lassics lupine plants that are closer to the cover provided by chaparral habitat are therefore likely to be at a greater risk of pre-dispersal seed predation than plants farther from refuge habitat (Kurkjian 2011, Cate 2016). Indeed, for a variety of plant species, the risk of seed predation by seed predators has been demonstrated to be higher in areas that are closer to vegetation that provides refuge to seed predators (Myster and Pickett 1993, Notman et al. 1996, McCormick and Meiners 2000, Wenny 2000, Dangremond et al. 2010).

As described in the Population Trends section of this Status Review, a population viability analysis has shown that seed predation has the potential to drive Lassics lupine to extinction (Kurkjian 2012a, Kurkjian et al. 2016). The population viability analysis estimated that, without protecting any reproductive plants from seed predation, the probability of quasi-extinction of Lassics lupine (defined as 10 or less adult plants remaining) in the next 50 years is between 68.4 and 100 percent, but if all reproductive Lassics lupine plants are caged, preventing seed predation, the probability of quasi-extinction in the next 50 years is reduced to between 0 and 1.8 percent (Kurkjian 2012a, Kurkjian et al. 2016). These results demonstrate that protecting reproductive Lassics lupine plants from seed predation is critical for preventing the extinction of Lassics lupine.

After dispersal, Lassics lupine seeds can also remain exposed on the ground for several months before becoming covered with snow. Small mammals find and remove Lassics lupine seeds from the ground following dispersal from mature fruits. In an experiment, Kurkjian (2011) found that approximately 10 percent of Lassics lupine seeds placed on the ground surface within Lassics lupine habitat had been removed within five days, representing a considerable level of post-dispersal seed foraging.

Other animals may also consume Lassics lupine. Arthropods may prey on Lassics lupine plants, and evidence of insect herbivory is recorded during annual demographic monitoring. Unidentified grasshoppers were observed consuming small portions of a Lassics lupine fruit in camera trap photos taken one time in 2014 and one time in 2015 (D. Barton pers. comm. 2017 in Appendix B). Two arthropods were found on many Lassics lupine plants in 2003; a small

unidentified, grey beetle was observed opening the keel and eating pollen, and a red mite was found in flowers and on other parts of the plant (Crawford and Ross 2003). Historically, the Lassics were within two range allotments, and feral cattle may still be present and could consume Lassics lupine if they encountered a population, although there is no evidence that this has occurred.

Predation and herbivory, particularly by small mammals, are significant threats to Lassics lupine's ability to survive and reproduce.

## **Climate Change**

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia (IPCC 2014). Experimental and empirical evidence indicates that climate change is impacting wildlife species and natural systems across the globe (Parmesan and Yohe 2003, Parmesan 2006). According to the California Global Warming Solutions Act of 2006, climate change is now considered one of the greatest threats to California's ecosystems, and over the current century, climate change will alter the fundamental character, production, and distribution of the ecosystems in California (Snyder et al. 2002, Snyder and Sloan 2005, California Energy Commission 2009b). Climate change is a major challenge to the conservation of California's natural resources, and it will amplify existing risks and create new risks to natural systems.

Numerous studies indicate that by the end of the century California's climate will be considerably warmer than today's, more winter precipitation will fall as rain instead of snow, snowpack will be substantially diminished, and snowpack will melt much earlier in the year (Kim et al. 2002; Knowles and Cayan 2002; Snyder et al. 2002; Miller et al. 2003; Hayhoe et al. 2004; Leung et al. 2004; Vanrheenen et al. 2004; California Energy Commission 2009a, 2009b; Melillo et al. 2014). California is also more vulnerable to climate fluctuations relative to the rest of the U.S. because it derives a disproportionate percentage of its water supply from only a small number of winter storms, typically in the form of "atmospheric rivers" (Dettinger 2011, Dettinger et al. 2011). Mountaintop species face a particularly high threat from climate change because as the climate system warms, potentially suitable habitat for many species is expected to shift upwards in elevation, and suitable habitat for mountaintop species may disappear (Parmesan 2006, Cochrane 2011). Furthermore, the topographic isolation and harsh abiotic environments often found on mountaintops correspond with high levels of adaptation and isolation, and specialist species utilizing these environments may not be able to compete with generalist species as habitats change and species move (Xu et al. 2009).

Department staff conducted an assessment of the vulnerability of Lassics lupine to climate change using the NatureServe Climate Change Vulnerability Index Version 3.02 (CDFW 2017, NatureServe 2017). Based upon the Department's assessment, Lassics lupine has a climate change vulnerability index value of Highly Vulnerable (HV), indicating that abundance and/or range extent within the geographical area of the species is likely to decrease significantly by the year 2050. The confidence in this vulnerability index score is very high based on the results of a Monte Carlo simulation (Young et al. 2015).

As described in the Climate and Hydrology section of this report, available information suggests that Lassics lupine mortality appears to be highest when summer rainfall is low and summer temperatures are high, and the effects of these conditions are exacerbated by early snowmelt. Climate change scenarios for northern California in the vicinity of the Lassics generally include similar annual precipitation levels, higher temperatures, and less snow pack (Cayan et al. 2009,



Girvetz et al. 2009). Based upon available evidence discussed in the Climate and Hydrology section of this Status Review, Lassics lupine is sensitive to climate extremes, and the higher summer temperatures and diminished winter snowpack in the future are expected to increase Lassics lupine mortality and reduce the amount of suitable habitat.

Climate change may have also contributed to the observed encroachment of Jeffrey pine and incense cedar forest into Lassics lupine habitat on Mt. Lassic, and may have also contributed to chaparral succession on Mt. Lassic's south slope (Rochefort et al. 1994, Carothers 2008). Climate change is predicted to increase the rate and intensity of disturbance events, such as drought, exotic species invasions, insect and pathogen outbreaks, and wildfire. The fire hazard severity rating over the majority of North America is predicted to increase as a result of climate change (Dale et al. 2001).

All of these changes have the potential to change the distribution of vegetation in the Lassics, and consequently alter the abundance and movement of animal species, including consumers of Lassics lupine seeds, flowers, and vegetation.

Climate change is a significant threat to Lassics lupine's ability to survive and reproduce.

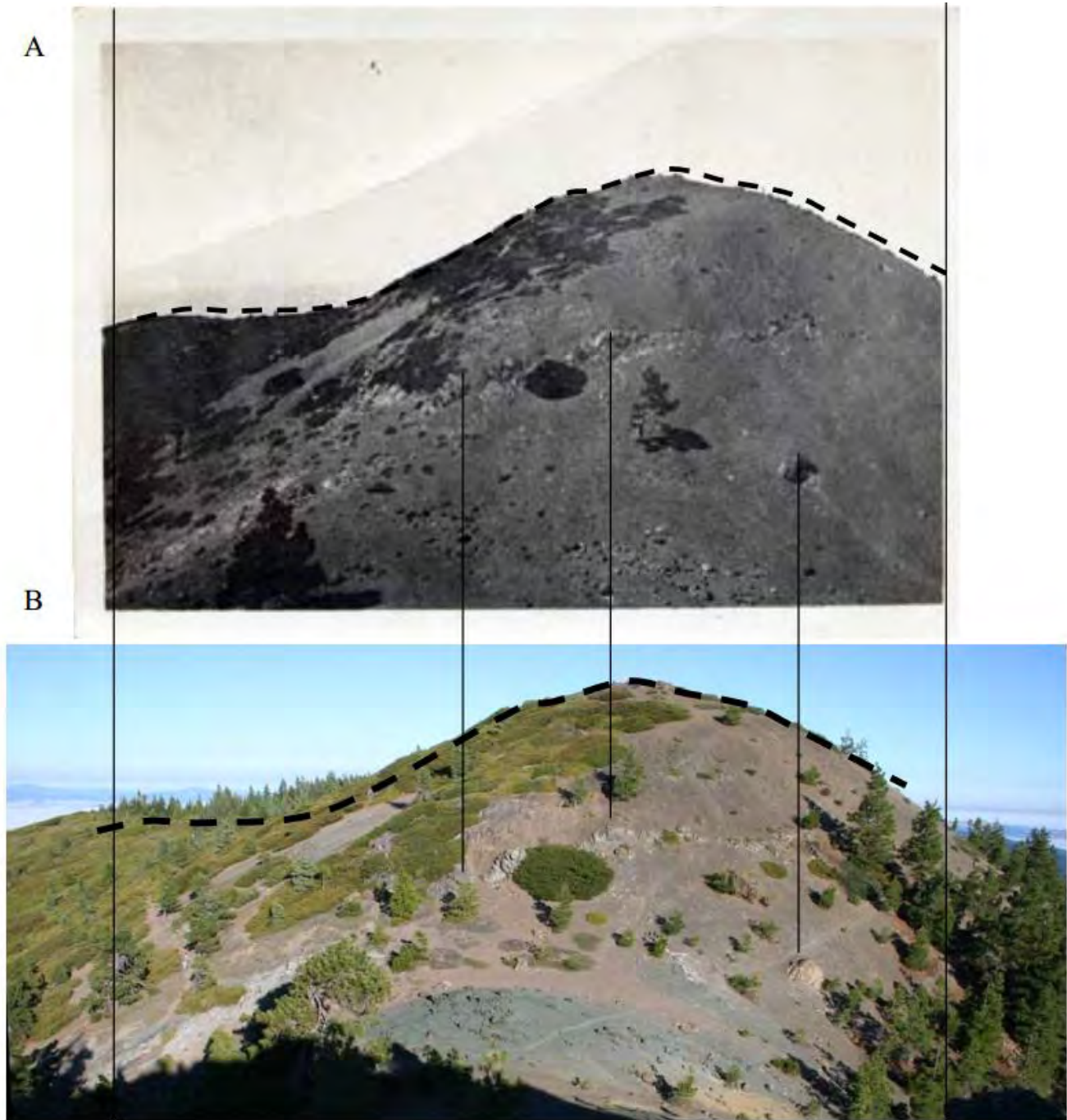
### **Vegetation Encroachment**

A vegetation study prepared by Carothers (2008) involving analysis of historic photographs and aerial imagery clearly shows that forest and chaparral have become more dense and have expanded their distribution up the slopes of Mt. Lassic since the 1930s (Figure 9). Jeffrey pine-incense cedar forest has spread into the Lassics lupine population on Mt. Lassic's north slope, and the chaparral community on the south side of Mt. Lassic has also matured and become denser (Carothers 2008). Approximately 0.8 to 1.2 hectares (2 to 3 acres) of suitable habitat has been encroached upon by forest. This area may have supported Lassics lupine in the past, when forest was absent or less dense. Furthermore, a dense layer of leaf litter accumulates under forest trees which may suppress germination of Lassics lupine and other seeds.

Fire suppression has contributed to the encroachment of vegetation on Mt. Lassic over the past 80 years (Carothers 2017). Jeffrey pine seedlings also establish most successfully on bare mineral soil (Jenkinson 1990), and chipmunks tend to cache Jeffrey pine seeds in bare mineral soil away from existing trees (Vander Wall 1993). Chipmunks have therefore likely contributed to the migration of Jeffrey pine forest into Lassics lupine habitat. Climate change and resulting shifts in species' ranges may have also contributed to the vegetation encroachment (Carothers 2008). Based upon the trend since the 1930s, forest encroachment is expected to continue into the future.

In August 2015, Mt. Lassic and the surrounding area was subject to an approximately 7,490-hectare (18,200-acre) lightning-caused fire called the Lassics Fire. The effects of the Lassics Fire on vegetation encroachment are discussed in this section, and the Lassics Fire is also discussed in the Fire section of this Status Review.

As described below, the Mt. Lassic Population is threatened by encroaching vegetation in two primary ways: (1) encroaching vegetation provides cover for consumers of Lassics lupine seeds, flowers, and vegetation (Kurkjian 2011, Cate 2016), and (2) the encroaching forest is less suitable for Lassics lupine survival and reproduction than the treeless upper terrace and north slope ecological settings (Carothers 2008, Imper 2012).



Photos 7 and 8: Looking west from Mt. Lassic Peak 2 to the vegetation on the northeast slope of Mt. Lassic Peak 3: (A) in 1930s (Photo by V. Coleman); and (B) in 2008 (Photo by D. Imper). Lines reference landmarks present at both time periods. Source: Carothers 2008.

Figure 9. Mt. Lassic Peak 3 (Signal Peak) Photograph Comparison

### Cover Vegetation for Small Mammals Consuming Lassics Lupine Seeds

As described in the Predation section of this Status Review, without protection from wire cages, seed predation is projected to drive Lassics lupine to extinction. This seed predation was presumably not as severe in the past because Lassics lupine populations have persisted until now. The cause of this recent intensification of seed predation on Lassics lupine is therefore likely due to changes in habitat conditions at the Lassics, and vegetation encroachment is the likely cause. Predators that consume small mammals likely have less impact on small mammal populations when there is more cover for small mammals to utilize. A relationship between distance to cover vegetation and risk of seed predation has been demonstrated in a variety of plant species (Myster and Pickett 1993, Notman et al. 1996, McCormick and Meiners 2000, Wenny 2000, Dangremond et al. 2010), and seed predation experiments conducted in 2010 and 2015 also suggest that Lassics lupine plants closer to vegetation, particularly chaparral vegetation, are at greater risk from seed predation (Kurkjian 2011, Cate 2016).

The August 2015 Lassics Fire may have altered the amount of refuge available for seed predators, their abundance, or their movements in a way that could reduce the impact of seed predation on Lassics lupine; however, studies show that the abundance of small mammals could go up, down, or stay the same after fire (Lawrence 1966; Masters et al. 1998; Converse et al. 2006a, 2006b; Amacher et al. 2008; Zwolak et al. 2010). Recolonization of burned areas by small mammals may be dependent upon the density of the regenerating vegetation (Monamy and Fox 2000).

The Lassics Fire burned the chaparral on the south side of Mt. Lassic with high intensity. Cate (2016) ran an exploratory analysis of the small mammal community after the Lassics Fire with one trapping session performed in October 2015; however, the post-fire data was limited to only one night of trapping and 12 animal captures, which may not provide a strong basis to draw conclusions. Seven of the 12 animals caught were recaptures from before the fire, demonstrating that a significant number of small mammals survived the fire.

In August 2017, D. Barton reported preliminary results of small mammal trapping investigations at the Mt. Lassic Population. Deer mice remain very abundant on the upper terrace and in unburned shrub cover, moderately abundant in the now-resprouting chaparral and the barren saddle, and at low abundance in the forest. This pattern has remained relatively consistent after the Lassics Fire. Chipmunks have remained unusually rare, and 2017 had the lowest abundance of chipmunks since small mammal monitoring began. The abundance of small mammals is generally lower in the forest and chaparral than it was prior to the 2015 Lassics Fire (D. Barton pers. comm. 2017). Despite the lower small mammal abundance, seed predation and herbivory of Lassics lupine by a California ground squirrel was observed in 2017, and a small systematic sample of caged and uncaged plants that bore fruit in 2017 suggests that pre-dispersal seed predation risk remains high, and that caging mitigates this risk (D. Barton pers. comm. 2017).

### Habitat Suitability for Lassics Lupine

Areas that have been encroached upon by forest have a lower density of Lassics lupine plants, and the Lassics lupine plants that are present in the forest are smaller and have lower reproductive vigor than Lassics lupine plants in open habitat (Carothers 2008, Imper 2012) (see Figure 5). Forest may be less suitable for Lassics lupine due to tree leaf litter and competition with forest trees for light and moisture. The forest also retains snow later into the year, which may also have an effect on Lassics lupine. Open habitats that represent the most suitable

habitat for Lassics lupine from the standpoint of plant density and reproductive vigor are relatively barren of leaf litter. The litter layer in the forest likely inhibits the germination of Lassics lupine seeds unless it is removed by fire or other means. The forest also provides more canopy cover, and less solar radiation, which likely also contribute to reduced Lassics lupine density and reproductive vigor (Imper 2012). Finally, soil moisture dries down rapidly in the forest after snowmelt, likely due to the water needs of the forest trees, and this may also contribute to the reduced plant density and reproductive vigor of Lassics lupine in the forest (Imper 2012).

The August 2015 Lassics Fire was not adequate to kill a significant number of trees or completely remove the litter layer in the encroaching forest on Mt. Lassic. Despite the fire, the encroaching forest habitat has not been reduced.

Vegetation encroachment is a significant threat to Lassics lupine's ability to survive and reproduce, particularly at the Mt. Lassic Population.

### **Vulnerability of Small Populations**

Lassics lupine has a narrow distribution and the only two populations occupy relatively small areas. Approximately 454 adult Lassics lupine plants were observed during 2017 demographic monitoring. The Department recognizes that species with small numbers of populations and small population sizes are highly vulnerable to extinction due to stochastic (chance), demographic, environmental, and genetic events (Shaffer 1981, 1987; Primack 2006; Groom et al. 2006). Chance events, such as landslide, drought, or fire could result in the loss of all or a significant portion of a Lassics lupine population. A landslide at the Red Lassic Population, for instance, could result in the loss of the entire population. Chance environmental conditions that result in excessive seed germination without subsequent growth and reproduction could also deplete the soil seed bank and threaten the long-term persistence of Lassics lupine.

Impacts to a species that have already taken place may also lead to an "extinction debt," where species that appear abundant disappear over time (Tilman et al. 1994, Kuussaari et al. 2009). Extinction processes often occur with a time delay and populations living close to their extinction threshold might survive for long periods of time before they go extinct (Hanski and Ovaskainen 2002, Lindborg and Eriksson 2004, Helm et al. 2006, Vellend et al. 2006). Habitat specialist species, such as Lassics lupine, may also be more sensitive to changes in habitat and thus more prone to local extinction than generalist species (Helm et al. 2006, Krauss et al. 2010, Cousins and Vanhoenacker 2011, Guardiola et al. 2013).

Species with small numbers of populations or small populations may also be subject to increased genetic drift and inbreeding (Menges 1991, Ellstrand and Elam 1993). There are two geographically distinct populations of Lassics lupine left; however, they are genetically very similar (Wilson and Hipkins 2004). Cross planting between the two surviving populations could improve the survival probability of the populations, if necessary, by boosting the number of plants in the populations and by introducing new genes that might overcome any inbreeding depression (Wilson and Hipkins 2004).

Due to the small number of Lassics lupine individuals and the presence of only two small Lassics lupine populations, the loss of any portion of either population would represent the loss of a significant portion of Lassics lupine's total range.

Small population size and small number of populations is a significant factor influencing Lassics lupine's ability to survive and reproduce.

## Fire

Little information is available regarding the fire history in the Lassics prior to the early 1900s. Prior to 1865, local tribes regularly used fire to keep their territory free of underbrush and immature trees, although prehistoric human use of fire in the Lassics is undocumented (Keter 1987 rev. 2015, Carothers 2017). Based on a study of fire-scarred stumps, the mean fire-free interval in the centuries prior to fire suppression in Mad River Ranger District of Six Rivers National Forest was approximately 12.7 years (Carothers 2017). The mean fire return interval for Jeffrey pine forest across its range is approximately 20 years, but may be longer for relatively open stands with low understory fuels, such as those on serpentine substrates (Munnecke 2005).

Fire suppression records date back to 1910 on Six Rivers National Forest, but aggressive fire suppression did not begin until after World War II (Stuart and Salazar 2000). Three relatively small fires were caused by lightning in the Lassics in August 1953, burning 0.4 hectare (1 acre) near Red Lassic, 17 hectares (42 acres) of primarily chaparral southwest of Mt. Lassic, and 32 hectares (78 acres) about 1.6 kilometers (1 mile) north of Black Lassic (Carothers 2017, Six Rivers National Forest 2015). These fires were attacked by crews of four to eight people using hand tools. Three other relatively small fires were recorded within 1.6 kilometers (1 mile) of Mt. Lassic in the following years. An approximately 2.4 hectare (6 acre) fire was caused by lightning in 1969, an approximately 0.04 hectare (0.1 acre) fire was caused by an incendiary device in 1987, and an approximately 0.2 hectare (0.5 acre) fire with an uncertain cause was recorded in 2003 (Six Rivers National Forest 2015). A total of 18 fires were recorded within the 1,473 hectare (3,640 acre) Lassics Botanical and Geologic Special Interest Area between 1940 and 2014, and 71 percent were under 2 hectares (5 acres) in size (Carothers 2017).

An extensive analysis of historic and current fire regimes on U.S. Forest Service and National Parks lands in California found that fire frequency in northwestern California since 1908 has been “less to much less” than during pre-settlement conditions (Stafford and Van de Water 2014). Furthermore, estimates indicate that the fire return interval within the Lassics Botanical and Geologic Special Interest Area is now 70 to 80 percent less frequent than before fire suppression policies were implemented, except in chaparral where the fire return interval is now 24 percent less frequent (Carothers 2017). These findings suggest that fire is likely less frequent within and near Lassics lupine habitat than it was prior to fire suppression activities.

In August 2015, the Lassics were subject to an approximately 7,490-hectare (18,200-acre) lightning-caused fire called the Lassics Fire. The chaparral on the southern slope of Mt. Lassic and the Red Lassic Population and surrounding area burned at high severity. The forest on the north side of Mt. Lassic burned at mixed severity (see photos from D. Barton pers. comm. in Appendix B). The top of Signal Peak (Peak 3), the highest point on Mt. Lassic, burned patchily at low severity.

Many Lassics lupine plants were killed by the Lassics Fire (see Figure 7). All of the Lassics lupine plants at the Red Lassic Population were killed and many plants at the Mt. Lassic Population were killed as well, particularly in the forest. Despite the Lassics lupine plants killed in 2015, there was an exponential increase in the number of seedlings in 2016 after a relatively wet winter, which resulted in the large numbers of adults in 2017. Most of the adult plants in 2017 were from 2016 seedlings at the Mt. Lassic Population. All of the adults at the Red Lassic Population in 2017 were from 2016 seedlings from the seed bank. The explosion of seedlings in 2016 and their high survival rate may be attributable to precipitation, snowpack from the winter of 2016-2017 (although it was relatively brief), and nutrient flush from the Lassics Fire.

As described in the Climate and Hydrology section of this Status Review, information provided by Imper (2012) suggests that Lassics lupine cannot survive if soil temperatures become too high. The Lassics Fire burned very hot at the Red Lassic Population, eliminating leaf litter and burning up into the Jeffrey pine and incense cedar trees in the area. Many trees in the vicinity of the Red Lassic Population were killed, including some of the large trees that provide canopy shading for the Red Lassic Population during hot summer afternoons. These trees appear to be critical for the suitability of habitat at the Red Lassic Population for Lassics lupine because of the shade that they provide (Imper 2012). The dead trees are still standing, so their trunks and branches continue to provide some protection from solar radiation; however, the trees no longer have leaves, and are at a greater risk of falling over. Without the canopy shade from these trees, habitat at the Red Lassic Population may not be able to support Lassics lupine in the future. The aftermath of the 2015 Lassics Fire is a threat to the continued existence of the Red Lassic Population.

The Lassics Fire was not adequate to kill a significant number of trees or completely remove the litter layer in the encroaching forest on Mt. Lassic, and so it did little to improve habitat for Lassics lupine in the forest. The burning of the chaparral on the south side of Mt. Lassic appears to have lowered the abundance of small mammals in the forest and chaparral; however, seed predation sampling suggests that pre-dispersal seed predation risk for Lassics lupine remains high, and that caging mitigates this risk (D. Barton pers. comm. 2017). The burned areas of chaparral have resprouted, and the vegetation is returning.

Future fires in the Lassics could have both positive and negative effects on Lassics lupine. Fires that eliminate the encroaching forest and chaparral on Mt. Lassic would likely benefit Lassics lupine; however, fires that kill adult plants could have serious population-level effects on the species, particularly during periods of drought or other unfavorable conditions. The effects of fire on population levels could be exacerbated by Lassics lupine's small population sizes, as described in the Vulnerability of Small Populations section of this Status Review.

The aftermath of the 2015 Lassics Fire is a threat to the ability of the Red Lassic Population of Lassics lupine to survive and reproduce. Future fires may also be a significant factor influencing Lassics lupine's ability to survive and reproduce.

## **Recreational Use**

Boulders were placed at access points near Forest Road 1S07 to block vehicle access to Lassics lupine populations in 2003. Off-highway vehicle use was precluded at both populations in 2004, and the area containing the Mt. Lassic Population was designated a wilderness in 2006. These efforts appear to have significantly reduced impacts to Lassics lupine from off-highway vehicle use; however, an all-terrain vehicle trespassed into Mt. Lassic Wilderness in 2016 or 2017, and illegal all-terrain vehicle trespass could occur again in the future.

Mt. Lassic is accessible to hikers, although foot traffic is relatively low. Trails were relocated away from Lassics lupine populations in 2004 to reduce pedestrian impacts to Lassics lupine. Off-trail cross country use of the area around Mt. Lassic still occurs, and Lassics lupine plants can be trampled by people in the area, particularly at the relatively flat saddle between Mt. Lassic Peaks 2 and 3.

Recreational use is considered to be a minor threat to individual Lassics lupine plants, but is not considered to be a significant threat to the ability of Lassics lupine to survive and reproduce.

## **REGULATORY AND LISTING STATUS**

### **Federal**

A petition to list Lassics lupine under the federal Endangered Species Act was received by the U.S. Fish and Wildlife Service on January 15, 2016. On September 14, 2016, the U.S. Fish and Wildlife Service found that the petition presented substantial scientific or commercial information indicating that listing Lassics lupine may be warranted, and announced plans to initiate a review of the status of Lassics lupine to determine if listing is warranted. Lassics lupine is currently under review by the U.S. Fish and Wildlife Service, but it is not listed.

Lassics lupine is designated a sensitive species by Six Rivers National Forest. As a result, management decisions by Six Rivers National Forest are not to result in a trend towards federal listing or loss of viability (USDA 1997).

### **State**

On February 24, 2017, the Commission published its Notice of Findings for Lassics lupine in the California Regulatory Notice Register, designating Lassics lupine a candidate species pursuant to CESA. The provisions of CESA apply to Lassics lupine while it is a candidate species (Fish & G. Code, § 2085). CESA prohibits the import, export, take, possession, purchase or sale of Lassics lupine, or any part or product of Lassics lupine, except in limited circumstances, such as through a permit or agreement issued by the Department under the authority of the Fish and Game Code (Fish & G. Code, § 2080). For example, the Department may issue permits that allow the incidental take of listed and candidate species if the take is minimized and fully mitigated, the activity will not jeopardize the continued existence of the species, and other conditions are met (Fish & G. Code, § 2081, subd. (b)). The Department may also authorize the take and possession of Lassics lupine for scientific, educational, or management purposes (Fish & G. Code, § 2081, subd. (a)).

### **Natural Heritage Program Ranking**

All natural heritage programs, such as the CNDDDB, use the same ranking methodology originally developed by The Nature Conservancy and now maintained by NatureServe (2012). This ranking methodology consists of a global rank describing the rank for a given taxon over its entire distribution, and a state rank describing the rank for the taxon over its state distribution. Both global and state ranks reflect a combination of rarity, threat, and trend factors. Lassics lupine has been assigned a global rank of G1 and a state rank of S1, indicating that the species is critically imperiled both within California and globally, with a very high risk of extinction due to extreme rarity (often five or fewer populations), very steep declines, or other factors.

### **California Rare Plant Rank**

Some plants in California are assigned a California Rare Plant Rank to identify them as species of conservation concern. The Department works in collaboration with the California Native Plant Society and botanical experts throughout the state to assign rare and endangered plants a California Rare Plant Rank reflective of their status. Lassics lupine has been assigned a California Rare Plant Rank of 1B.1. Plants with a California Rare Plant Rank of 1B are rare throughout their range with the majority of them endemic to California. Most of the plants that are ranked 1B have declined significantly over the last century. The threat code extension of “.1”

indicates that the species is seriously threatened in California, with over 80 percent of occurrences threatened or a high degree and immediacy of threat.

## **MANAGEMENT EFFORTS**

### **Exclusion Caging**

In response to the seed predation described in the Predation section of this Status Review, Six Rivers National Forest and the U.S. Fish and Wildlife Service began placing seed predator and herbivore exclusion cages around flowering and fruiting Lassics lupine plants in 2003 (Kurkjian 2012, Six Rivers National Forest 2015) (see Figure 8, Photo 6). Approximately 20 wire mesh cages were used at the Red Lassic Population in 2003, and caging efforts were expanded to include approximately 60 cages at the Mt. Lassic Population in 2004 (Imper and Elkins 2016). Initial cage designs proved ineffective, and cages were redesigned in 2005. When properly installed, the cages are now capable of preventing all pre-dispersal seed predation by small mammals. Cages are placed around plants in the summer, and cages are removed after seeds are released and before winter snows. Caging efforts have continued every year since 2003, often aided by researchers and volunteers. After significant Lassics lupine population declines were observed in 2015 (see Figure 7), Six Rivers National Forest and the U.S. Fish and Wildlife Service caged as many reproductive individuals as possible in the summer of 2015 as a stop-gap measure to prevent further decline due to pre-dispersal seed predation and herbivory (Cate 2016). Seedlings have also been caged, as materials have allowed, to prevent herbivory and aid in recruitment. A number of additional cages were constructed and installed in 2017.

Without continued efforts to cage Lassics lupine plants, the population is projected to have a high probability of extinction within the next 50 years (Kurkjian 2012a, Kurkjian et al. 2016). Although the caging efforts are currently critical for preventing the extinction of Lassics lupine, creating and maintaining these cages is labor-intensive, requires funding, and may not be a practical long-term solution.

Exclusion caging and other current conservation measures for Lassics lupine occur at the discretion of the U.S. Forest Service. At the end of the 2012 season, caging was temporarily halted and cages were removed from the Lassics at the direction of the Six Rivers National Forest Supervisor, who cited concerns about compatibility with wilderness and a desire to not have caging used as a long-term strategy. This decision was changed and caging was allowed to resume prior to the 2013 growing season after a Lassics Lupine Conservation Strategy was drafted by U.S. Fish and Wildlife Service and U.S. Forest Service staff.

### **Population Expansion Attempts**

Several attempts have been made to introduce Lassics lupine to new locations that are isolated from the existing populations. Locations for introduction efforts were selected based upon the results of soil analyses described in the Geology and Soils section of this Status Review. A total of 44 unscarified seeds were planted at four locations in 2005, and three of the four sites exhibited germination, but only one retained live plants after June 2007 (Imper 2012, Imper and Elkins 2016). The site that retained live plants was on the north side of Mt. Lassic Peak 1. A total of 310 unscarified seeds were planted at five locations in October 2012, and the cumulative germination rate for those sites ranged from 3-18 percent in June 2014. Of these five planting sites, the two sites that yielded the best germination and survival were the north side of Mt. Lassic Peak 1 (again), and Lower Mule Ridge, located approximately 2.9 kilometers (1.8 miles)



east of the Mt. Lassic Population. Additional seed was planted on the north side of Mt. Lassic Peak 1, and Lower Mule Ridge in November 2014. Plant survival for more than one year was negligible at all sites except for the north side of Mt. Lassic Peak 1. A colony of four reproductive plants, four juveniles, and three seedlings were present on the north side of Mt. Lassic Peak 1 in June 2014, as a result of the seeding efforts. The warm and largely snow-free winter of 2014-2015 resulted in the loss of the reproductive plants at this colony; however, the north side of Mt. Lassic Peak 1 remains the most promising location for continued attempts to establish a new population of Lassics lupine. In 2015, 60 Lassics lupine seeds were planted on Mt. Lassic at several sites, and the experiment was repeated and expanded in 2017.

Lassics lupine seeds have also been used for off-site germination and propagation experiments. A germination study undertaken in 2007 resulted in high germination. Additional propagation experiments were conducted at Leach Botanical Garden and a local greenhouse with seeds collected in 2014 and 2015 (Guerrant 2007, Six Rivers National Forest 2015). Propagation attempts at Leach Botanical Garden were largely unsuccessful. Additional seeds were scarified and sowed experimentally in a private garden by Mr. John McRae, with initial positive results. In 2017, the University of California Botanical Garden at Berkeley received 50 Lassics lupine seeds collected in 2016, and will attempt to grow Lassics lupine plants.

### **Wilderness and Special Interest Area Designations**

Both populations of Lassics lupine are within the Mad River Ranger District of Six Rivers National Forest. The Mt. Lassic Population is entirely within Mt. Lassic Wilderness, established in 2006. Both populations of Lassics lupine are also within the 1,473 hectare (3,640 acre) Lassics Botanical and Geologic Special Interest Area, a designation by Six Rivers National Forest. Special Interest Areas are established to protect unique ecological, botanical, cultural, and geologic features in national forests, and to promote public use, education, and enjoyment consistent with the values of each area (USDA 1998).

### **Conservation Seed Banking**

Lassics lupine seeds collected in 2005 are stored in a conservation seed bank at the Rae Selling Berry Seed Bank in Portland, Oregon. Additional seeds collected in 2014 and 2015 were sent to the U.S. Forest Service National Seed Bank Lab in Dry Branch, Georgia for processing. From there the seeds were sent to the National Laboratory for Genetic Resource Preservation in Fort Collins, Colorado for long term storage.

### **Monitoring and Research**

Demographic monitoring of Lassics lupine populations began in 2001 and is still being conducted. Information collected during demographic monitoring includes the number and location of plants in monitoring transects, size and stage class of plants (reproductive vegetative, seedling, or dead), number of flower clusters and seed pods, levels and sources of herbivory, and whether or not the plant has been caged. Scientific investigations into Lassics lupine genetics, pollination, population viability, soils, environmental requirements, seed predation, herbivory, fire history, vegetation communities, and nearby animal populations have also been conducted, and data are still being collected on environmental conditions, animal communities, germination, and propagation (Crawford and Ross 2003, Wilson and Hipkins 2004, Alexander 2008, Carothers 2008, Imper 2012, Kurkjian 2012a, Cate 2016, Kurkjian et al. 2016, Hutchinson 2017).

## **Draft Conservation Strategy**

A draft conservation strategy for Lassics lupine has been prepared by Six Rivers National Forest and the U.S. Fish and Wildlife Service, but the strategy has not been finalized (Six Rivers National Forest 2015). The draft conservation strategy outlines goals and objectives, studies and management activities conducted to date, key actions that should be initiated or continued, management actions, an adaptive management process, and a proposed schedule of work. Management actions proposed in the draft conservation strategy include: (1) removing small-diameter conifer trees encroaching into and degrading Lassics lupine habitat at the Mt. Lassic Population, (2) thinning chaparral on the south side of Mt. Lassic, and (3) conservation seed banking and continued attempts to grow Lassics lupine in the wild and in captivity.

## **Impacts of Existing Management Efforts**

The caging of reproductive Lassics lupine plants is a critical conservation action, and is likely responsible for preventing significant negative impacts to the Lassics lupine populations over the past 15 years and into the near future. Until a more lasting solution is implemented, continuation of the caging effort is critically important for the continued existence of the species.

Efforts to establish new populations of Lassics lupine have been largely unsuccessful, although the introduction site on the north side of Mt. Lassic Peak 1 is the most promising introduction site identified so far. Establishment of even one additional self-sustaining population of Lassics lupine would be an important step in reducing the risk of extinction. Therefore, while past efforts to establish a new population of Lassics lupine have been largely unsuccessful, they have provided important information for future introduction efforts.

The Special Interest Area designation provides a level of protection for Lassics lupine because Six Rivers National Forest is directed to manage the area with the protection of unique resources in mind. The wilderness designation protects the Mt. Lassic Population from most direct anthropogenic threats except for trampling from foot traffic and illegal off highway vehicle use, however the wilderness designation also makes it harder to implement management actions that are critical for preventing the extinction of Lassics lupine, such as removal of encroaching vegetation (Association of Fish and Wildlife Agencies 2006; Six Rivers National Forest 2012a, 2012b).

Conservation seed banking provides an emergency reservoir of genetic material and a last resort for propagation material if the species becomes extinct in the wild. The usefulness of conservation seed bank collections for preventing the extinction of plant species in the wild depends on the size and quality of the collection. Conservation seed bank collections for Lassics lupine should be from a diverse range of individuals in both populations, and collections should be stored separately along maternal lines in an appropriate facility (Guerrant et al. 2004). The collections should also be large enough to ensure that sufficient material will be available for propagation and reintroduction efforts in the future. It is unclear whether existing conservation collections of Lassics lupine seeds meet these standards.

Fortunately, Lassics lupine has been the subject of a number of scientific investigations. The ongoing Lassics lupine demographic monitoring dataset spans over 15 years, and has been the centerpiece for a number of important scientific insights regarding the species. The scientific knowledge of Lassics lupine is the foundation for conservation of the species.

The draft conservation strategy for Lassics lupine outlines measures that would help conserve the species, based on the best available science; however, it is unclear when or if the conservation strategy will be finalized or implemented.

## **SCIENTIFIC DETERMINATIONS REGARDING THE STATUS OF LASSICS LUPINE IN CALIFORNIA**

CESA directs the Department to prepare this report regarding the status of Lassics lupine based upon the best scientific information available to the Department (Fish & G. Code, § 2074.6). CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: 1. Present or threatened modification or destruction of its habitat; 2. Overexploitation; 3. Predation; 4. Competition; 5. Disease; or 6. Other natural occurrences or human-related activities." (Cal. Code Regs., tit. 14, § 670.1, subd. (i)(1)(A)).

The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific analyses. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]" (*Id.*, § 2067). A species' range for CESA purposes is the species' California range (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal.App.4th 1535, 1551).

The preceding sections of this Status Review describe the best scientific information available to the Department, with respect to the key factors identified in the regulations. This section below considers the significance of any threat to the continued existence of Lassics lupine for each of the factors.

### **Present or Threatened Modification or Destruction of Habitat**

Lassics lupine habitat is threatened by climate change and, has been impacted by the 2015 Lassics Fire (particularly at the Red Lassic Population). The Mt. Lassic Population is subject to ongoing habitat degradation and loss from forest encroachment. Lassics lupine faces a particularly severe threat from climate change because as the climate system warms, potentially suitable habitat is expected to shift upwards in elevation, and suitable habitat for Lassics lupine is expected to disappear. Many trees in the vicinity of the Red Lassic Population were killed by the 2015 Lassics Fire, including some of the large trees that provide canopy shading for the Red Lassic Population during hot summer afternoons. These trees, and the shade that they provide, appear to be critical for the Lassics lupine habitat at the Red Lassic Population. The aftermath of the 2015 Lassics Fire is therefore a serious threat to the continued existence of the Red Lassic Population. Aerial imagery clearly shows that the forest has become denser and has encroached into Lassics lupine habitat on Mt. Lassic since the 1930s, a likely result of historical fire suppression activities. Forest is less suitable for Lassics lupine survival and reproduction than the treeless upper terrace and north slope ecological settings. Approximately 0.8 to 1.2 hectares (2 to 3 acres) of habitat with soil that is suitable for Lassics lupine at the Mt. Lassic

Population has been encroached upon by forest, and forest encroachment is expected to continue into Lassics lupine habitat in the future. The Department considers degradation and loss of habitat to be a significant threat to the continued existence of Lassics lupine.

### **Overexploitation**

The Department does not have any information on overexploitation affecting Lassics lupine. The Department does not consider overexploitation to be a significant threat to the continued existence of Lassics lupine.

### **Predation**

Pre-dispersal seed predation by rodents has the potential to drive Lassics lupine to extinction, and post-dispersal seed predation and herbivory are also significant threats to the species. Deer mice, chipmunks, and California ground squirrels are the most abundant seed predators near Lassics lupine populations, and are responsible for most of the seed predation impacts on Lassics lupine. Lassics lupine plants closer to vegetation, particularly chaparral vegetation, appear to be at greatest risk from seed predation, and therefore encroaching vegetation is an important contributing factor to seed predation. The Department considers predation to be a significant threat to the continued existence of Lassics lupine.

### **Competition**

Jeffrey pine and incense cedar forest trees, saplings, and seedlings compete with Lassics lupine for light and moisture, particularly in the encroaching forest on the north slope of Mt. Lassics. The Department considers competition with encroaching trees to be a significant threat to the continued existence of Lassics lupine.

### **Disease**

The Department does not have any information on diseases or parasites affecting Lassics lupine. The Department does not consider disease or parasites to be a significant threat to the continued existence of Lassics lupine.

### **Other Natural Occurrences or Human-related Activities**

The climate of California is certain to change due to warming of the global climate system. Climate change scenarios for northern California in the vicinity of the Lassics generally include similar annual precipitation levels, higher temperatures, and less snow pack. Lassics lupine is sensitive to climate extremes, and mortality appears to be highest when summer rainfall is low and summer temperatures are high, with these effects exacerbated by early snowmelt. Furthermore, as the climate system warms, potentially suitable habitat for mountaintop species such as Lassics lupine is expected to shift upwards in elevation, and suitable habitat may be reduced or disappear. Climate change is therefore expected to increase Lassics lupine mortality, and reduce or eliminate the amount of habitat that is suitable for the species.

Lassics lupine is also a narrowly distributed plant with only two populations and very low numbers of individuals (approximately 454 adult plants during 2017 monitoring). Lassics lupine's rarity and extremely limited distribution make the species very vulnerable to stochastic (chance) events such as landslide, drought or fire, and to all other threats. The loss of all or a significant

portion of either Lassics lupine population would represent the loss of a significant portion of Lassics lupine's total range.

The 2015 Lassics Fire killed many trees in the vicinity of the Red Lassic Population, including trees that provide canopy shading that is critical for the suitability of the habitat at this location for Lassics lupine. While these trees are still standing, they are leafless and at greater risk of falling over. The aftermath of the 2015 Lassics Fire is a threat to the ability of the Red Lassic Population of Lassics lupine to survive and reproduce.

Recreational use is considered to be a minor threat to individual Lassics lupine plants, but is not considered to be a significant threat to the ability of Lassics lupine to survive and reproduce.

## **SUMMARY OF KEY FINDINGS**

Lassics lupine is a very rare species that is only known from two populations located in Six Rivers National Forest in northern California. The Mt. Lassic Population is on steep north-facing slopes and relatively flat mountaintop areas on Mt. Lassic. The very small Red Lassic Population is on a southwest-facing slope near Red Lassic, protected from excessively hot afternoon soil temperatures by the nearby tree canopy. Lassics lupine populations occur on several soil units related to serpentine and/or clastic sedimentary rocks. Approximately 454 adult Lassics lupine plants were counted during monitoring of the species in 2017.

Pre-dispersal seed predation by rodents, particularly deer mice, chipmunks, and California ground squirrels, has the potential to drive Lassics lupine to extinction and is the most immediate threat to the species. Post-dispersal seed predation and herbivory are also significant threats. An effort to put wire cages around flowering and fruiting plants to protect them from seed predation was initiated in 2003 and has continued into 2017.

Climate change scenarios for northern California in the vicinity of the Lassics generally include similar annual precipitation levels, higher temperatures, and less snow pack. Lassics lupine is sensitive to climate extremes, and mortality appears to be highest when summer rainfall is low and summer temperatures are high, with these effects exacerbated by early snowmelt. As the climate system warms, potentially suitable habitat for mountaintop species such as Lassics lupine is expected to shift upwards in elevation, and suitable habitat may be reduced or disappear. Climate change is therefore expected to increase Lassics lupine mortality, and reduce or eliminate the habitat that is suitable for the species.

Lassics lupine is also subject to ongoing habitat degradation and destruction from forest encroachment, a likely result of historical fire suppression. Encroaching forest is less suitable for Lassics lupine survival and reproduction than the treeless Lassics lupine habitat on Mt. Lassic. Approximately 0.8 to 1.2 hectares (2 to 3 acres) of habitat with soil that is suitable for Lassics lupine at the Mt. Lassic Population has been encroached upon by forest. Forest encroachment is expected to continue into Lassics lupine habitat.

The Lassics Fire in 2015 killed some of the trees providing canopy shading essential for the Red Lassic Population, but did not kill a significant number of trees in the encroaching forest on Mt. Lassic. The Lassics Fire burned chaparral that provides cover for small mammal seed predators on the south slope of Mt. Lassics. Small mammal abundance appears to have been reduced in the chaparral and forest after the 2015 Lassics Fire; however, the risk of seed predation on Lassics lupine continues to remain high. Lassics lupine's rarity and extremely limited distribution



make the species very vulnerable to stochastic (chance) events such as landslide, drought, or fire, and to all other threats. The loss of all or a significant portion of either Lassics lupine population would represent the loss of a significant portion of Lassics lupine's total range.

The information available to the Department regarding the status of Lassics lupine indicates that there are significant threats to the continued existence of the species.

## **RECOMMENDATION FOR PETITIONED ACTION**

CESA directs the Department to prepare this report regarding the status of Lassics lupine in California based upon the best scientific information available to the Department (Fish & G. Code, § 2074.6). CESA also directs the Department to indicate in this Status Review whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). The Department includes and makes its recommendation in this Status Review as submitted to the Commission in an advisory capacity based on the best available science. Based on the criteria described above, the best scientific information available to the Department indicates that Lassics lupine is in serious danger of becoming extinct in all or a significant portion of its range due to one or more causes including present or threatened degradation and loss of habitat, predation, competition, and other natural occurrences and human-related activities.

The Department recommends that the Commission find the petitioned action to list Lassics lupine as an endangered species to be warranted.

## **PROTECTION AFFORDED BY LISTING**

It is the policy of the state to conserve, protect, restore and enhance any endangered or any threatened species and its habitat (Fish & G. Code, § 2052). If listed as an endangered or threatened species, unauthorized "take" of Lassics lupine will be prohibited, making the conservation, protection, and enhancement of the species and its habitat an issue of statewide concern. Under CESA, "take" is defined as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (*Id.*, § 86). Any person violating the take prohibition would be punishable under state law. The Fish and Game Code provides the Department with related authority to authorize "take" under certain circumstances (*Id.*, §§ 2081, 2081.1, 2086, 2087, 2089.6, 2089.10 and 2835). As authorized through an incidental take permit, however, impacts of the taking on Lassics lupine caused by the activity must be minimized and fully mitigated according to state standards.

Additional protection of Lassics lupine following listing could also occur with required public agency environmental review under CEQA, and its federal counter-part, the National Environmental Policy Act (NEPA). CEQA and NEPA both require affected public agencies to analyze and disclose project-related environmental effects, including potentially significant impacts on endangered, rare, and threatened special status species. Under CEQA's "substantive mandate," for example, state and local agencies in California must avoid or substantially lessen significant environmental effects to the extent feasible. While both CEQA and NEPA would require analysis of potential impacts to Lassics lupine regardless of their listing status under CESA, the acts contain specific requirements for analyzing and mitigating impacts to listed species. In common practice, potential impacts to listed species are examined more closely in CEQA and NEPA documents than potential impacts to unlisted species. State listing,

in this respect, and required consultation with the Department during state and local agency environmental review under CEQA, may benefit the species. However, because Lassics lupine occurs entirely on land under federal jurisdiction, and only actions that require discretionary approval by a state or local agency trigger CEQA, it is unlikely that there will be CEQA environmental review related to actions affecting the species.

If Lassics lupine is listed under CESA, it may increase the likelihood that state and federal land and resource management agencies will allocate funds towards protection and recovery actions. It is the policy of the U.S. Forest Service to assist states in achieving their goals for conservation of endemic species (USDA 2005). However, funding for species recovery and management is limited, and there is a growing list of threatened and endangered species. Six Rivers National Forest has stated that it will consider pursuing partnerships with the Department and U.S. Fish and Wildlife Service if Lassics lupine becomes listed under CESA (Appendix A).

## **MANAGEMENT RECOMMENDATIONS AND RECOVERY MEASURES**

CESA directs the Department in its Status Review to include recommended management activities and other recommendations for recovery of Lassics lupine (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). Department staff generated the following list of recommended management actions and recovery measures based on considerations from federal agencies, researchers, non-profits, and interested parties. The following list is not a detailed conservation strategy for Lassics lupine; however, it outlines major components of a plan to prevent the extinction of the species. The Department recommends that the following actions be coordinated by the U.S. Forest Service as the primary land manager, in cooperation with the U.S. Fish and Wildlife Service, the Department, researchers, and other partners, consistent with the Forest Service Handbook, and California's goals of preventing the extinction of rare, threatened, and endangered species.

- Continue to cage reproductive Lassics lupine plants with wire cages to reduce seed predation.
- Finalize and implement the draft Lassics lupine conservation strategy (Six Rivers National Forest 2015).
- Continue demographic monitoring of Lassics lupine populations.
- Continue monitoring small mammal populations near Mt. Lassic.
- Continue investigations into the relationship between vegetation and seed predation.
- Conduct other research, as necessary, to inform future conservation actions.
- Ensure there is at least one high quality collection of Lassics lupine seeds maintained at a qualified plant conservation institution. Collections should represent the range of variation in the Lassics lupine populations, and there should be a sufficient number of seeds in conservation storage to be used for reintroduction and propagation efforts in the future (Guerrant et al. 2004). The plant conservation institution used should allow seeds to be withdrawn from conservation storage for propagation and reintroduction purposes, as necessary.
- Design and implement a research project to establish a self-sustaining population of Lassics lupine on the north slope of Mt. Lassic Peak 1 or other suitable habitat, including habitat previously occupied by the species. Such a project should involve propagating a large number of Lassics lupine seeds and plants off-site, and outplanting the seeds and plants over several years to establish a permanent population and soil seed bank.

- Design and implement a pilot project to remove encroaching forest vegetation from the north slope of Mt. Lassic, and evaluate the effectiveness of the project.
- Design and implement a pilot project to remove chaparral vegetation from summit, and east and south slopes of Signal Peak (Mt. Lassic Peak 3), and evaluate the effectiveness of the project.
- Implement a monitoring and adaptive management plan for Lassics lupine based on the results of the vegetation removal pilot projects. This management plan should identify the scope of vegetation treatment projects, propose a long-term schedule for repeated treatments, and include a process for the ongoing evaluation of results.
- Conduct a follow-up population viability analysis with all demographic data collected thus far.

## **PUBLIC RESPONSE**

Comments were invited in response to the Petition in a Department press release dated August 3, 2017, and distributed to media outlets in the vicinity of Humboldt County, and in a letter mailed to the principal land management agency for Lassics lupine, Six Rivers National Forest, on April 27, 2017. The Department received two e-mail messages in response to the press release, and six public comments on the Department’s Facebook page, which are included in Appendix A. The Department also received a letter from Six Rivers National Forest on July 10, 2017, which is also included in Appendix A.

## **PEER REVIEW**

Independent experts familiar with the plants and animals of the Lassics were invited to review the Status Review report before submission to the Commission. All comments received are included in Appendix B. The Department’s response to the independent peer review is included in Appendix B. Independent experts that reviewed the Status Review are listed in Table 2, below.

Table 2. Status Review Peer Reviewers

Name	Affiliation
Dr. Daniel C. Barton	Humboldt State University
Ms. Sydney Carothers	independent
Dr. Gary A. Falxa	independent
Dr. Erik S. Jules	Humboldt State University
Mr. John McRae	Six Rivers National Forest

## **ACKNOWLEDGEMENTS**

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### **Personal Communication**

E-mail message from Dr. Daniel Barton regarding 2017 small mammal monitoring results. August 3, 2017.

E-mail message from Sydney Carothers regarding monitoring methodology and 2017 monitoring results. August 8, 2017.

Peer Review of Status Review of Lassics Lupine (*Lupinus constancei*) by Ms. Sydney Carothers. December 7, 2017. (Appendix B).

Peer Review of Status Review of Lassics Lupine (*Lupinus constancei*) by Dr. Daniel Barton. December 7, 2017. (Appendix B).

Peer Review of Status Review of Lassics Lupine (*Lupinus constancei*) by Dr. Gary Falxa. December 5, 2017. (Appendix B).

APPENDIX A: Comments from Affected and Interested Parties on the Petitioned Action



State of California – Natural Resources Agency  
DEPARTMENT OF FISH AND WILDLIFE  
Habitat Conservation Planning Branch  
1416 Ninth Street, 12<sup>th</sup> Floor  
Sacramento, CA 95814  
[www.wildlife.ca.gov](http://www.wildlife.ca.gov)

*EDMUND G. BROWN JR., Governor*  
*CHARLTON H. BONHAM, Director*



April 27, 2017

Mr. Merv George Jr., Forest Supervisor  
United States Department of Agriculture, Forest Service  
Six Rivers National Forest  
1330 Bayshore Way  
Eureka, California 95501

Dear Mr. George:

### **Petition to List the Lassics Lupine Under the California Endangered Species Act**

The purpose of this letter is to (1) notify the United States Department of Agriculture, Forest Service (USFS) of a petition to list the Lassics lupine (*Lupinus constancei*) pursuant to the California Endangered Species Act (CESA), (2) request any information the USFS has on Lassics lupine, and (3) provide the USFS an opportunity to submit comments on the petition.

On July 15, 2016, the State of California Fish and Game Commission (Commission) received a petition from Mr. David Imper and the Center for Biological Diversity to list the Lassics lupine as an endangered species pursuant to CESA (Fish & G. Code § 2050 *et seq.*). As required pursuant to Section 2073.5 of the Fish and Game Code, the California Department of Fish and Wildlife (CDFW) prepared and submitted an initial petition evaluation report to the Commission that recommended there was sufficient scientific information to indicate that the petitioned action may be warranted. On February 8, 2017, the Commission accepted the petition for consideration and designated the Lassics lupine a candidate species pursuant to CESA. CDFW is now in the process of preparing a peer-reviewed report on the status of the Lassics lupine that is due to the Commission by February 24, 2018.

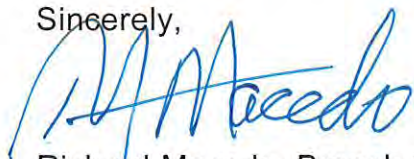
There are two known populations of the Lassics lupine, both within Six Rivers National Forest. The largest population occurs on Mt. Lassic within Mt. Lassic Wilderness. A smaller population occurs on Red Lassic, approximately 300 feet outside of Mt. Lassic Wilderness. CDFW is particularly interested in receiving comments from USFS on the petition because USFS is the principal land manager for all populations of Lassics lupine.

The petition and CDFW's initial petition evaluation report are available on the Commission's website at: <http://www.fgc.ca.gov/CESA/index.aspx#l>

Mr. Merv George Jr.  
United States Department of Agriculture, Forest Service  
April 27, 2017  
Page 2

CDFW respectfully requests to receive any comments from USFS and other additional information on the Lassics lupine by July 14, 2017. If you have any questions about the Lassics lupine or the CESA listing process, please contact Mr. Jeb Bjerke, Senior Environmental Scientist (Specialist), of CDFW's Native Plant Program at (916) 651-6594 or [jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov).

Sincerely,



Richard Macedo, Branch Chief  
Habitat Conservation Planning Branch

cc: California Department of Fish and Wildlife

Sandra Morey, Deputy Director  
Ecosystem Conservation Division  
[sandra.morey@wildlife.ca.gov](mailto:sandra.morey@wildlife.ca.gov)

Stafford Lehr, Deputy Director  
Wildlife and Fisheries Division  
[stafford.lehr@wildlife.ca.gov](mailto:stafford.lehr@wildlife.ca.gov)

William Condon, Environmental Program Manager  
Habitat Conservation Planning Branch  
[william.condon@wildlife.ca.gov](mailto:william.condon@wildlife.ca.gov)

Jeb Bjerke, Senior Environmental Scientist  
Native Plant Program  
Habitat Conservation Planning Branch  
[jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov)



*VR. Macedo*

File Code: 2670  
Date: July 5, 2017

Richard Macedo  
Branch Chief  
CDFW Habitat Conservation Planning Branch  
1416 Ninth Street, 12th Floor  
Sacramento, CA 95814

RECEIVED

JUL 10 2017

HABITAT CONSERVATION  
PLANNING BRANCH

Dear Mr. Macedo:

Thank you for notifying me of the recent petition to list the Lassics lupine pursuant to the California Endangered Species Acts and for the opportunity to review and comment. I have reviewed the findings of the initial petition evaluation report cited in your letter, specifically the Department Evaluation Report for Lassics lupine (<http://www.fgc.ca.gov/CESA/#11>). The Six Rivers National Forest recognizes the concern for the rare and endemic Lassics lupine.

The report identifies fire suppression, specifically, the absence of wildfire facilitating the succession of Jeffrey pine-incense cedar forest and chaparral vegetation into the barren habitat where Lassics lupine occurs. Wildfire history and active fire suppression in the Lassics are summarized in a recent report incorporating the fire record since 1910 (Carothers 2017). This document substantiates that fire suppression, even in a serpentine landscape, has very likely reduced the available habitat to Lassics lupine.

The forest has devoted resources over the years and developed partnerships to better understand population dynamics and causes of population decline. The effects on the Lassics lupine are cumulative—wildlife impacts, low soil moisture in the growing season due to reduced snow packs in years past, and occupancy of suitable lupine habitat by trees and shrubs influenced by fire suppression.

The majority of the Lassics lupine population is within the Mt. Lassic Wilderness which was designated in 2006. With the designation come wilderness management policy and guidance relative to the type and level of activities that can occur within the wilderness. Fundamentally, actions must demonstrate compatibility with wilderness values. The management actions raised in the petition (e.g. prescribed burning) would require forest staff to evaluate compatibility with wilderness values and conduct an environmental analysis. Currently, staff resources are directed toward high priority collaborative, community wildfire protection projects and associated environmental analyses.

The Six Rivers National Forest has assessed options to manage for the Lassics lupine and determined, with the existing forest priorities and fiscal constraints, pursuit of the management actions identified in the petition is not within the foreseeable future. Should the Lassics lupine become designated under CESA, the forest would consider pursuing partnerships with CDFW and USFWS as the lead agencies responsible for managing this species.

Thank you for the opportunity to provide feedback on the petition.

Sincerely,

MICHAEL GREEN  
Acting Forest Supervisor

cc: Jeff K. Jones, Lisa D. Hoover





## CDFW News



**ENDANGERED SPECIES, PUBLIC COMMENT PERIOD**

# CDFW Seeks Information Related to Lassics Lupine

AUGUST 3, 2017 | DANAMICHAELS2013

The California Department of Fish and Wildlife (CDFW) is seeking information relevant to a proposal to list the Lassics lupine (*Lupinus constancei*) as an endangered species.

There are two known populations of the Lassics lupine, both within Six Rivers National Forest. The largest population occurs on Mt. Lassic, within Mt. Lassic Wilderness in Humboldt County. A smaller population occurs on Red Lassic, which is in Trinity County and outside Mt. Lassic Wilderness.

In July 2016, a petition to formally list Lassics lupine as endangered under the California Endangered Species Act was submitted to the California Fish and Game Commission. The listing petition described a variety of threats to the survival of Lassics lupine, including forest encroachment, small mammal seed predation, fire, climate change and off-road vehicles. The Commission followed CDFW's recommendation and voted to advance the species to candidacy on Feb. 8, 2017. The Commission published findings

of this decision on Feb. 24, 2017, triggering a 12-month period during which CDFW will conduct a status review to inform the Commission's decision on whether to list the species.

As part of the status review process, CDFW is soliciting information from the public regarding Lassics lupine ecology, genetics, life history, distribution, abundance, habitat, the degree and immediacy of threats to reproduction or survival, adequacy of existing management and recommendations for management of the species. Comments, data and other information can be submitted in writing to:

California Department of Fish and Wildlife  
Native Plant Program  
1416 Ninth Street, 12<sup>th</sup> Floor  
Sacramento, CA 95814

Comments may also be submitted by email to [nativeplants@wildlife.ca.gov](mailto:nativeplants@wildlife.ca.gov) (mailto:nativeplants@wildlife.ca.gov). If submitting comments by email, please include "Lassics Lupine" in the subject heading.

All comments received by Sept. 8, 2017 will be evaluated prior to submission of the CDFW report to the Commission. Receipt of the report will be placed on the agenda for the next available meeting of the Commission after delivery, and the report will be made available to the public at that time. Following receipt of the CDFW report, the Commission will allow a 30-day public comment period prior to taking any action on CDFW's recommendation.

The listing petition and CDFW's petition evaluation for Lassics lupine are available at [www.fgc.ca.gov/CESA/index.aspx#ll](http://www.fgc.ca.gov/CESA/index.aspx#ll) (<http://www.fgc.ca.gov/CESA/index.aspx#ll>).

####

Lassics lupine photo by Jeb Bjerke

#### Media Contacts:

Jeb Bjerke (mailto:jeb.bjerke@wildlife.ca.gov), CDFW Native Plant Program, (916) 651-6594

Dana Michaels (mailto:Dana.Michaels@wildlife.ca.gov), CDFW Communications, (916) 322-2420

[◀ BOTANY](#)
[◀ CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE](#)
[◀ CALIFORNIA FISH AND GAME COMMISSION](#)
[◀ CANDIDATE SPECIES](#)
[◀ CDFW](#)
[◀ DEADLINE](#)
[◀ ENDANGERED](#)
[◀ HABITAT CONSERVATION](#)
[◀ HUMBOLDT COUNTY](#)
[◀ LASSICS LUPINE](#)
[◀ LISTING](#)
[◀ MT. LASSIC](#)
[◀ PUBLIC COMMENTS](#)
[◀ RARE PLANT](#)
[◀ RED LASSIC](#)
[◀ TRINITY COUNTY](#)

From: Mark Echavarria [REDACTED]  
Sent: Thursday, August 03, 2017 8:54 PM  
To: Wildlife Native Plants  
Subject: Lassics Lupine

Hello , Mark Echavarria here, just a heads up, I recognize the plant, I've seen this plant in the Mojave Dessert ca. Along with hundreds different species of cattuse.

[REDACTED]

From: [REDACTED]  
Sent: Thursday, August 03, 2017 6:52 PM  
To: Wildlife Native Plants  
Subject: Lassics Lupine

With only 2 populations of this particular Lupine, I feel very strongly that they should be listed under the ESA.  
The Red Lupine being very rare no matter what type.

Norma Campbell


[REDACTED]

Nature uses as little as possible of anything. Man on the other hand uses as much as he can. Fully knowing he will have excess which he will waste.

Humans are the most territorial and destructive species on Earth.

 Like

 Comment

 Share

   Hailey Harrell and 45 others

Chronological 


11 shares




**Michelle English** Tom Pitts

Like · Reply · August 3 at 12:01pm



**Billy Pyatt** I love the Lassics. They're fun to hike and explore. Its a zone of major metasomatism, so there are odd and rare rocks to be found. 

Like · Reply ·  1 · August 3 at 12:52pm




**Rudolf Thered** Alyssa Marquez

Like · Reply · August 3 at 1:04pm




**Alex Simmons** Adrienne

Like · Reply ·  1 · August 3 at 4:30pm



**Fred Seaman** Get it listed as endangered. Use that to take control over private land on which it grows. Forcing the owners into bankruptcy.

Been done many times already. Hasn't saved a single species.

Like · Reply ·  4 · August 3 at 7:39pm



**Richard Waldo** If it's invasive eradicate it!

Like · Reply · August 8 at 6:57pm · Edited



APPENDIX B: Comments from Peer Reviewers on the Lassics Lupine Status Review Report



State of California – Natural Resources Agency  
DEPARTMENT OF FISH AND WILDLIFE  
Habitat Conservation Planning Branch  
1416 Ninth Street, 12<sup>th</sup> Floor  
Sacramento, CA 95814  
[www.wildlife.ca.gov](http://www.wildlife.ca.gov)

EDMUND G. BROWN JR., Governor  
CHARLTON H. BONHAM, Director



November 7, 2017

Daniel C. Barton, Ph.D.  
Department of Wildlife  
Humboldt State University  
1 Harpst Street  
Arcata, California 95521  
[daniel.barton@humboldt.edu](mailto:daniel.barton@humboldt.edu)

Dear Dr. Barton:

**Status Review of Lassics Lupine (*Lupinus constancei*); California Department of Fish and Wildlife, Peer Review**

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife (Department) Status Review of Lassics lupine (*Lupinus constancei*) (Status Review). Please review the peer review draft of the Department's Status Review, dated November 9, 2017, that is included with this letter. The Department seeks your expert analysis and input regarding the scientific validity of the Status Review and its assessment of the status of Lassics lupine in California. **The Department would appreciate receiving your peer review comments on or before December 7, 2017.**

The California Fish and Game Commission (Commission) received the petition to list Lassics lupine as an endangered species under the California Endangered Species Act (CESA) on July 19, 2016. On February 24, 2017, the Commission published findings formally designating Lassics lupine a candidate for listing as threatened or endangered under CESA. Lassics lupine is currently protected under CESA in California in that capacity.

The Department seeks your scientific peer review as part of formal proceedings pending before the Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to provide a report to the Commission based on the best scientific information available indicating whether the petition to list the species is warranted and recommending actions for recovery of the species (Fish & G. Code, § 2074.6).

The peer review draft of the Department's Status Review forwarded to you today reflects the Department's effort to identify and analyze the best scientific information

available regarding the status of Lassics lupine in California. At this time, the Department believes that the best available science indicates that listing the species as endangered under CESA is warranted. We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following peer review input.


We ask you to focus your peer review on the best scientific information available regarding the status of Lassics lupine in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether the information indicates, in your opinion, that Lassics lupine is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this Status Review to you solely as part of the peer review process, and it is not yet public.

A PDF version of the Status Review is included with this letter. For ease of review, and so we may respond to your comments individually, please submit your comments in list form by page and line number. Please submit your comments electronically to Mr. Jeb Bjerke, Senior Environmental Scientist (Specialist) at [jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov). Mr. Bjerke may also be reached at (916) 651-6594. If there is anything the Department can do to facilitate your review, please let us know.

Following receipt and consideration of peer review comments, the Department will prepare and submit its final Status Review and related recommendation to the Commission. Your comments will be included in an appendix to the Department's Status Review and the Department will respond in writing to the peer review comments. After a minimum 30 day public review period and prior to making their decision, the Commission will consider: the petition to list Lassics lupine, the Department's Status Review with peer review comments, and public testimony received during a regularly scheduled Commission meeting.

Thank you again for your contribution to the Status Review effort and the important input it provides during the Commission's related proceedings.

Sincerely,



Richard Macedo, Branch Chief  
Habitat Conservation Planning Branch

Daniel C. Barton  
November 7, 2017  
Page 3

Enclosures

ec: California Department of Fish and Wildlife

Tina Bartlett, Acting Deputy Director  
Ecosystem Conservation Division  
[tina.bartlett@wildlife.ca.gov](mailto:tina.bartlett@wildlife.ca.gov)

Isabel Baer, Acting Program Manager  
Timberland Conservation and Native Plant Programs  
Habitat Conservation Planning Branch  
[isabel.baer@wildlife.ca.gov](mailto:isabel.baer@wildlife.ca.gov)

Cherilyn Burton, Senior Environmental Scientist (Specialist)  
Native Plant Program  
Habitat Conservation Planning Branch  
[cherilyn.burton@wildlife.ca.gov](mailto:cherilyn.burton@wildlife.ca.gov)

Jeb Bjerke, Senior Environmental Scientist (Specialist)  
Native Plant Program  
Habitat Conservation Planning Branch  
[jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov)

**Comments on the California Department of Fish and Wildlife's Peer Review Draft of the Status Review of Lassics Lupine, dated November 2017. Comments submitted by Daniel Barton, Humboldt State University, 12/5/2017.**

Lines 8 and 9 on p. 12 – Could be useful to clarify that drought or lack of snow in 2014 and 2015 refers to winters of 2013-14 and 2014-15.

Lines 27 and 28 on p. 13 – At least 3 individually marked plants that germinated in 2016 also bloomed in 2017 in the main (i.e. Mt. Lassic) population – directly observed because of the seedling herbivory experiment (by me).

Lines 50 and 51 on p.13 – Not sure if it's necessary given the more detailed description later, but small mammals consume fruits and pre-dispersal seeds, in addition to mature seeds.

Line 22 on p. 17 – “encroached up” is somewhat awkward use of verb, maybe “expanded distribution upslope”?

Lines 3-6 on p. 22 – I would suggest rephrasing this interpretation to clarify that in Kirkjian et al.'s population viability analysis (PVA):

- 1) Population growth was most sensitive to changes in survival and growth rates of the reproductive class, yet despite this, reductions in predispersal seed predation via the management action of caging – even though this is manipulation of a vital rate with a lower effect on population growth – had a major effect on stochastic growth rate and population viability.
- 2) This PVA was conducted with data collected before the 2015 Lassics Fire, and used starting population sizes larger than the current population sizes. The fire may have substantially reduced population viability and increased the susceptibility of the population to extinction due to environmental stochasticity, since the starting population size is simply smaller now.
- 3) The fire may have altered the vital rates of the population that were estimated from pre-fire data and used in the PVA, and it not clear how.

Line 4 on p. 24 – I think it might be useful to describe the snap pea experiment as a “surrogate” approach, to explain the use of snap peas (rather than Lassics lupine).

Line 12 on p. 24 – This experiment was conducted pre-fire (2015) and repeated post-fire (2016), with similar results (Barton pers. comm) suggesting that the 2015 Lassic Fire did not alter spatial patterns of pre-dispersal seed predation risk at Mt. Lassic.

Lines 19-20 on p. 24 – Suggest rephrasing or use of commas for clarity in this passage.

Lines 11-17 on p. 25 – Unidentified grasshoppers were observed consuming small portions of a Lassics lupine fruit in camera trap photos taken in 2014 and 2015 (once each year).

Lines 47-49 on p. 28 – It was a systematic sample but a small one. Further, two uncaged plants were observed via camera trap as the victims of folivory and/or seed predation by California Ground Squirrel in 2017.

General comments: The document is well-written, well-referenced, and accurately represents my knowledge of the status of and threats to Lassics lupine population viability and extinction risk.



2015 Photo repeats – all initial photos taken in 2014, all repeats taken 10/3/2015 post-Lassic fire on visit to Mt. Lassic by D. Barton and G. Falxa, photos by D. Barton 2014 and 2015, Canon 40D w/ 17-40 mm f/4L lens, original RAW images matched to similar exposures in processing

- 1: saddle looking west towards Signal Peak
- 2: Signal Peak looking northeast towards Black Lassic
- 3: Signal Peak looking southeast towards Red Lassic
- 4: New trail, looking downhill and southwest over chaparral patch
- 5: New trail, looking southeast towards Red Lassic over chaparral patch
- 6: Black Lassic viewed from Signal Peak
- 7: Signal Peak looking northwest over old trail towards fir stand
- 8: Signal Peak looking west over top of chaparral patch and towards fir stand































**Peer Review Comments from Dr. Daniel Barton on Lassics Lupine Status Review and California Department of Fish and Wildlife Responses**

<b>Page</b>	<b>Line</b>	<b>Reviewer Comment</b>	<b>Department Response</b>
N/A	N/A	<p>Please find attached my comments on the November 2017 CDFW Lassics Lupine Status Review. I have also attached a document that contains before (fall 2014) and after (fall 2015) photo repeats from the Mt. Lassic site, which may be useful for relating the effects of the 2015 Lassics Fire on vegetation communities at the site.</p> <p>Overall, I found the status review well-written, well-referenced, and to be an accurate representation of what I know about the current status and conservation threats of Lassics lupine. My comments in the attached document are suggestions that I hope improve the status review further.</p>	<p>Photos provided by Dr. Barton have been included in this appendix (Appendix B), and are referenced in the Fire section of the Status Review.</p>
12	8, 9	<p>Could be useful to clarify that drought or lack of snow in 2014 and 2015 refers to winters of 2013-14 and 2014-15.</p>	<p>Text updated for clarification</p>
13	27, 28	<p>At least 3 individually marked plants that germinated in 2016 also bloomed in 2017 in the main (i.e. Mt. Lassic) population – directly observed because of the seedling herbivory experiment (by me).</p>	<p>Text updated</p>
13	50, 51	<p>Not sure if it's necessary given the more detailed description later, but small mammals consume fruits and pre-dispersal seeds, in addition to mature seeds.</p>	<p>Text updated to indicate that small mammals also consume both fruits and pre dispersal seeds.</p>
17	22	<p>“encroached up” is somewhat awkward use of verb, maybe “expanded distribution upslope”?</p>	<p>Text updated</p>



Page	Line	Reviewer Comment	Department Response
22	3-6	<p>I would suggest rephrasing this interpretation to clarify that in Kirkjian et al.'s population viability analysis (PVA):</p> <p>1) Population growth was most sensitive to changes in survival and growth rates of the reproductive class, yet despite this, reductions in predispersal seed predation via the management action of caging – even though this is manipulation of a vital rate with a lower effect on population growth – had a major effect on stochastic growth rate and population viability.</p> <p>2) This PVA was conducted with data collected before the 2015 Lassics Fire, and used starting population sizes larger than the current population sizes. The fire may have substantially reduced population viability and increased the susceptibility of the population to extinction due to environmental stochasticity, since the starting population size is simply smaller now.</p> <p>3) The fire may have altered the vital rates of the population that were estimated from pre-fire data and used in the PVA, and it not clear how.</p>	<p>Paragraph rephrased and divided into two paragraphs to incorporate Dr. Barton's comment. Some of the comment language has been paraphrased.</p>
24	4	<p>I think it might be useful to describe the snap pea experiment as a "surrogate" approach, to explain the use of snap peas (rather than Lassics lupine).</p>	<p>Text updated to include the word surrogate.</p>
24	12	<p>This experiment was conducted pre-fire (2015) and repeated post-fire (2016), with similar results (Barton pers. comm) suggesting that the 2015 Lassic Fire did not alter spatial patterns of pre-dispersal seed predation risk at Mt. Lassic.</p>	<p>Text updated for clarification</p>
24	19-20	<p>Suggest rephrasing or use of commas for clarity in this passage.</p>	<p>Commas added</p>
25	11-17	<p>Unidentified grasshoppers were observed consuming small portions of a Lassics lupine fruit in camera trap photos taken in 2014 and 2015 (once each year)</p>	<p>Text updated to include observations</p>

<b>Page</b>	<b>Line</b>	<b>Reviewer Comment</b>	<b>Department Response</b>
28	47-49	It was a systematic sample but a small one. Further, two uncaged plants were observed via camera trap as the victims of folivory and/or seed predation by California Ground Squirrel in 2017	Text updated for clarification
General		The document is well-written, well-referenced, and accurately represents my knowledge of the status of and threats to Lassics lupine population viability and extinction risk.	No response needed



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DEPARTMENT OF FISH AND WILDLIFE  
Habitat Conservation Planning Branch  
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*EDMUND G. BROWN JR., Governor*  
*CHARLTON H. BONHAM, Director*



November 7, 2017

Ms. Sydney Carothers



Dear Ms. Carothers:

**Status Review of Lassics Lupine (*Lupinus constancei*); California Department of Fish and Wildlife, Peer Review**

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife (Department) Status Review of Lassics lupine (*Lupinus constancei*) (Status Review). Please review the peer review draft of the Department's Status Review, dated November 9, 2017, that is included with this letter. The Department seeks your expert analysis and input regarding the scientific validity of the Status Review and its assessment of the status of Lassics lupine in California. **The Department would appreciate receiving your peer review comments on or before December 7, 2017.**

The California Fish and Game Commission (Commission) received the petition to list Lassics lupine as an endangered species under the California Endangered Species Act (CESA) on July 19, 2016. On February 24, 2017, the Commission published findings formally designating Lassics lupine a candidate for listing as threatened or endangered under CESA. Lassics lupine is currently protected under CESA in California in that capacity.

The Department seeks your scientific peer review as part of formal proceedings pending before the Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to provide a report to the Commission based on the best scientific information available indicating whether the petition to list the species is warranted and recommending actions for recovery of the species (Fish & G. Code, § 2074.6).

The peer review draft of the Department's Status Review forwarded to you today reflects the Department's effort to identify and analyze the best scientific information available regarding the status of Lassics lupine in California. At this time, the Department believes that the best available science indicates that listing the species as

endangered under CESA is warranted. We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following peer review input.

We ask you to focus your peer review on the best scientific information available regarding the status of Lassics lupine in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether the information indicates, in your opinion, that Lassics lupine is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this Status Review to you solely as part of the peer review process, and it is not yet public.

A PDF version of the Status Review is included with this letter. For ease of review, and so we may respond to your comments individually, please submit your comments in list form by page and line number. Please submit your comments electronically to Mr. Jeb Bjerke, Senior Environmental Scientist (Specialist) at [jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov). Mr. Bjerke may also be reached at (916) 651-6594. If there is anything the Department can do to facilitate your review, please let us know.

Following receipt and consideration of peer review comments, the Department will prepare and submit its final Status Review and related recommendation to the Commission. Your comments will be included in an appendix to the Department's Status Review and the Department will respond in writing to the peer review comments. After a minimum 30 day public review period and prior to making their decision, the Commission will consider: the petition to list Lassics lupine, the Department's Status Review with peer review comments, and public testimony received during a regularly scheduled Commission meeting.

Thank you again for your contribution to the Status Review effort and the important input it provides during the Commission's related proceedings.

Sincerely,



Richard Macedo, Branch Chief  
Habitat Conservation Planning Branch

Enclosures

ec: California Department of Fish and Wildlife

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Peer Review of Status Review of Lassics Lupine (*Lupinus constancei*)Pg. (line) Comments (~~strike through~~ = suggested deletion; green highlight = suggested addition; \*= comment)

- 4 (15) on a south-facing slope ~~near~~ **of**...Red Lassic
- 4 (16) ...Mt. Lassic, and ~~in~~
- 4 (17) ...~~near the top of~~ **on** Mount Lassic and ~~nearby areas~~ **its adjoining peak**.
- 4 (19) ...suitable habitat in the Lassics **based on extensive surveys within the Lassics range**.
- 4 (20) **Anecdotal observations** ~~Quantitative monitoring of Lassics lupine populations began in 2001 after-~~  
~~anecdotal observations~~ of severe population declines and **of** the absence of plants in previously occupied areas
- 4 (21) **led to annual quantitative monitoring of Lassics lupine, initiated in 2001**. \*(While there were sites mapped elsewhere in the Lassics on old maps hand-transcribed from 15" quad maps to 7.5" quad maps, plants have never been located in modern visits to these sites; likely they were mapping errors)
- 4 (30) seeds **by small mammals such as chipmunks and field mice** and consumption of vegetation **and flowering stems by large mammals such as deer, rabbits, and ground squirrels**.
- 6 (14) **Reproductive** plants **may** reach a diameter of approximately 30 centimeters **(average 18 cm)**
- 6 (38) ~~shaggy~~-hairy and produce **1-5 multicolored** ~~tan~~ seeds **(average 2 per pod)**. \*(based on 7-year seed production study undertaken in 2010 & 2011 by Kurkjian and continued 2012-2016 by Carothers)
- 8 (46) kilometers to the southeast, ~~near~~ **on** Red Lassic.
- 13 (27) Of the Lassic lupine ~~plants~~ **seeds** that germinated ~~naturally~~ **in 2016 after a 2015 fire consumed all adults** at the
- 13 (28) Red Lassic Population ~~in 2016 reproduced~~ , **73%** reproduced in the 2017 growing season **(Carothers 2017)**, ...
- 14 (32) ...is on a crest **midslope** of a **the** southwest-facing slope of the peak **with** **It has** an overstory of Jeffrey pine...  
 \*(crest alone sounds like the top of the peak)
- 14 (33) \* in fact here Jeffrey pines were mostly killed/injured by the 2015 fire; protective value may have decreased.
- 14 (36) ...retains a relatively high amount of soil moisture ~~late~~ into the summer. \*(which drains downslope to the population and may provide summer moisture)
- 14 (38) \*Leaf (needle) litter since 2015 is primarily dead needles from dying/ailing Jeffrey pines. Prior to the fire, litter mainly consisted of piles of cone scales directly under the trees from cones dismantled by squirrels collecting pine seed, but this was (still is) a very exposed site.
- 14 (42) Optimum habitat...appears to be ~~the~~ areas with flat...
- 14 (43) moderate slopes that have **little to** no tree overstory
- 15 (Fig 5) \*The Red Lassic figure looks a little askew to me; in reality lupines are lower than the depression/pond and partially under canopy of a few large trees at northeast (upper) edge of the population.

- 16 (31) ...*Pinus jeffreyi*-*Calocedrus decurrens*/~~*Ceanothus pumilus*~~ \**C. pumilus* is not in the Lassics. Maybe *P. jeffreyi*/*Quercus vaccinifolia*?
- 16 (43) ...~~prostrate buckbrush (*Ceanothus prostratus*)~~ \*Not in Lassics. oceanspray (*Holodiscus discolor*),
- 16 (44) ... ~~sugar pine (*Pinus lambertiana*)~~ (crossed-out taxa are not IN lupine habitat)
- 16 (45) ~~Oregon oak (*Quercus garryana* var. *breweri*)~~ ...
- 16 (49) ... Tracy's collomia (*Collomia tracyi*), ~~Greene's buckwheat (*Eriogonum strictum* var. *greenii*)~~,
- 17 (1) ~~naked buckwheat (*Eriogonum nudum*)~~, Siskiyou fritillary (*Fritillaria glauca*), ~~Scarlet fritillary (*Fritillaria recurva*)~~,
- 17 (3) (*Minuartia nuttallii* var. *gregaria*), ~~naked broomrape (*Orobanche uniflora*)~~, ...white-veined
- 17 (4) wintergreen (*Pyrola picta*), pale yellow stonecrop (*Sedum laxum* ssp. *flavidum*), and ~~mountain jewelflower~~
- 17 (5) ~~(*Streptanthus tortuosus*)~~, and ~~mountain violet (*Viola purpurea*)~~.
- 20 (3) \*Only anecdotal observations from 2015 support this, but mortality on these steep slopes appeared high over winter due to rain storms causing rill erosion on the steep slopes of the saddle and Mt. Lassic north slope. Many plants that would normally have been protected by snow cover likely were washed out (we found several excavated adults) and/or buried by running water/gravels.
- 20 (7,8) \*See comments on 4 (20, 21)
- 20 (13) in 2002 and includes many ~~many~~ most plants in the saddle...
- 20 (14) ...and includes ~~some~~ all of the plants on the lower forested north slope.
- 25 (9) \*Is predation the correct term here? ~~post-dispersal foraging~~?
- 25 (44) ...Furthermore, the topographic isolation...
- 26 (34) ...and chaparral have become more dense and have encroached
- 26 (36) ...provide a strong basis to ~~make~~ draw conclusions.
- 29 (8) ...are relatively barren
- 29 (23) ...distribution and the only two populations
- 29 (26) ...due to stochastic (chance),
- 29 (45) ...genetically very ~~genetically~~ similar
- 31 (4) \*There was an exponential increase in numbers of seedlings in 2016 after a relatively wet winter, which resulted in the large numbers of adults in 2017 (most of these from 2016 seedlings on Mt. Lassic, all adults from 2016 seedlings on Red Lassic; i.e. from the seed bank). The explosion of seedlings and their high survival rate may be attributable to precipitation, winter 2016 snowpack (albeit relatively brief), and nutrient flush from the fire.
- 31 (28) \*and shrubs are resprouting
- 32 (1) \*but off-trail cross county use still occurs

32 (24-30) \*Even on federal lands?

34 (8) Lassic Peak 1 is **remains** the most promising location

34 (9-10) \*? First I've heard of it...with what results?

34 (13) A germination study ~~occurred~~ **undertaken** in 2007 resulted in high germination ~~and~~. Additional propagation...

34 (14) Garden using unscarified seeds ~~have been~~ **were** largely unsuccessful. **The local experiment using scarified seed resulted in high germination and three reproductive plants the first year (add McRae 2016).**

34 (16) ~~,and an additional 800 Lassics lupine seeds were collected in 2016 (Hutchinson 2017).~~ \*The ~800 seeds collected in 2016 were from a seed production study, not collected specifically for dissemination to experiments or seed banks. Some of these seeds were sown in 2017 at the sites from which they were collected.

34 (17) Berkeley agreed to receive 75 Lassics lupine seeds **collected in 2016**, and will attempt...

34 (21) \*To be consistent with the heading, put the Wilderness sentence first.

36 (32) ...habitat is threatened by climate change **g**

38 (14) ...The Mt. Lassic population is on **steep** north-facing

38 (25) them from ~~extreme~~ seed predation...

39-41 \*I concur.

Peer Review Comments from Ms. Sydney Carothers on Lassics Lupine Status Review and California Department of Fish and Wildlife Responses

Page	Line	Reviewer Comment	Department Response
N/A	N/A	I am attaching my comments for what they're worth. As stated at the top of the list, suggested deletions were struck through, suggested additions were highlighted green, and comments I had that may be meaningful or not are asterisked. Any questions, please ask. All in all this is an impressive document and I concur with your summary and recommendations. Thank you for the opportunity to review the report.	No response needed
4	15	on a south-facing slope near of...Red Lassic	Text updated
4	16	...Mt. Lassic, and in	Text updated
4	17	...near the top of on Mount Lassic and nearby areas its adjoining peak.	Text updated
4	19	...suitable habitat in the Lassics based on extensive surveys within the Lassics range.	Text updated
4	20-21	Anecdotal observations Quantitative monitoring of Lassics lupine populations began in 2001 after anecdotal observations of severe population declines and of the absence of plants in previously occupied areas led to annual quantitative monitoring of Lassics lupine, initiated in 2001. *(While there were sites mapped elsewhere in the Lassics on old maps hand-transcribed from 15" quad maps to 7.5"quad maps, plants have never been located in modern visits to these sites; likely they were mapping errors)	Text updated
4	30	seeds by small mammals such as chipmunks and field mice and consumption of vegetation and flowering stems by large mammals such as deer, rabbits, and ground squirrels.	Text updated to list consumption of vegetation and flowers by animals (herbivory) as a significant threat farther down in the paragraph. The list of animals contributing to herbivory of Lassics lupine was not included in the executive summary so the summary would not exceed one page in length.
6	14	Reproductive plants may reach a diameter of approximately 30 centimeters (average 18 cm)	Text updated

Page	Line	Reviewer Comment	Department Response
6	38	shaggy-hairy and produce 1-5 multicolored tan seeds (average 2 per pod). *(based on 7-year seed production study undertaken in 2010 & 2011 by Kurkjian and continued 2012-2016 by Carothers)	Text updated
8	46	kilometers to the southeast, near on Red Lassic.	Text updated
13	27	Of the Lassic lupine plants seeds that germinated naturally in 2016 after a 2015 fire consumed all adults at the	Text updated in response to this comment and comments from other peer reviewers
13	28	Red Lassic Population in 2016 reproduced, 73% reproduced in the 2017 growing season (Carothers 2017), ...	Text updated
14	32	...is on a crest midslope of a the southwest-facing slope of the peak with It has an overstory of Jeffrey pine... *(crest alone sounds like the top of the peak)	Text updated
14	33	* in fact here Jeffrey pines were mostly killed/injured by the 2015 fire; protective value may have decreased.	Sentence added to explain that most of the Jeffrey pine that protects the population was killed or injured by the 2015 Lassics Fire.
14	36	...retains a relatively high amount of soil moisture late into the summer. *(which drains downslope to the population and may provide summer moisture)	Text updated
14	38	*Leaf (needle) litter since 2015 is primarily dead needles from dying/ailing Jeffrey pines. Prior to the fire, litter mainly consisted of piles of cone scales directly under the trees from cones dismantled by squirrels collecting pine seed, but this was (still is) a very exposed site.	Text updated with a more detailed description of litter at the Red Lassic Population.
14	42	Optimum habitat...appears to be the areas with flat...	Text updated
14	43	moderate slopes that have little to no tree overstory	Text updated
15	Figure 5	*The Red Lassic figure looks a little askew to me; in reality lupines are lower than the depression/pond and partially under canopy of a few large trees at northeast (upper) edge of the population.	Figure updated to show Lassic lupine plants farther down the slope, and an illustration of a tree was added at the crest of the slope.



Page	Line	Reviewer Comment	Department Response
16	31	... <i>Pinus jeffreyi</i> - <i>Calocedrus decurrens</i> / <del><i>Ceanothus pumilus</i></del> * <i>C. pumilus</i> is not in the Lassics. Maybe <i>P. jeffreyi</i> / <i>Quercus vaccinifolia</i> ?	Text updated to remove mention of the <i>Pinus jeffreyi</i> - <i>Calocedrus decurrens</i> / <i>Ceanothus pumilus</i> association.
16	43	... <del>prostrate buckbrush (<i>Ceanothus prostratus</i>)</del> *Not in Lassics. oceanspray ( <i>Holodiscus discolor</i> ),	Text updated
16	44	... <del>sugar pine (<i>Pinus lambertiana</i>)</del> -(crossed-out taxa are not IN lupine habitat)	Text updated
16	45	<del>Oregon oak (<i>Quercus garryana</i> var. <i>breweri</i>)</del> ...	Text updated
16	49	... Tracy's collomia ( <i>Collomia tracyi</i> ), <del>Greene's buckwheat (<i>Eriogonum strictum</i> var. <i>greenei</i>)</del> ,	Text updated
17	1	<del>naked buckwheat (<i>Eriogonum nudum</i>)</del> , Siskiyou fritillary ( <i>Fritillaria glauca</i> ), <del>Scarlet fritillary (<i>Fritillaria recurva</i>)</del> ,	Text updated
17	3-5	( <i>Minuartia nuttallii</i> var <i>gregaria</i> ), <del>naked broomrape (<i>Orobanche uniflora</i>)</del> , ...white-veined wintergreen ( <i>Pyrola picta</i> ), pale yellow stonecrop ( <i>Sedum laxum</i> ssp. <i>flavidum</i> ), <del>and mountain jewelflower (<i>Streptanthus tortuosus</i>)</del> , and mountain violet ( <i>Viola purpurea</i> ).	Text updated
20	3	*Only anecdotal observations from 2015 support this, but mortality on these steep slopes appeared high over winter due to rain storms causing rill erosion on the steep slopes of the saddle and Mt. Lassic north slope. Many plants that would normally have been protected by snow cover likely were washed out (we found several excavated adults) and/or buried by running water/gravels.	Text updated to include a tentative statement about possible negative effects from rill erosion and sediment deposition.
20	7, 8	*See comments on 4 (20, 21)	Text updated
20	13	in 2002 and includes <del>many</del> <b>most</b> plants in the saddle...	Text updated
20	14	...and includes <del>some</del> <b>all</b> of the plants on the <b>lower</b> forested north slope.	Text updated
25	9	*Is predation the correct term here? <del>post-dispersal foraging?</del>	Text updated
25	44	...Furthermore, <del>the</del> topographic isolation...	Text updated

Page	Line	Reviewer Comment	Department Response
26	34	...and chaparral have become more dense and <b>have</b> encroached	Text updated
26	36	...provide a strong basis to <del>make</del> <b>draw</b> conclusions.	Text updated
29	8	...are <b>relatively</b> barren	Text updated
29	23	...distribution and <b>the</b> only two populations	Text updated
29	26	...due to stochastic (chance)	Text updated
29	45	... <b>genetically</b> very <del>genetically</del> similar	Text updated
31	4	*There was an exponential increase in numbers of seedlings in 2016 after a relatively wet winter, which resulted in the large numbers of adults in 2017 (most of these from 2016 seedlings on Mt. Lassic, all adults from 2016 seedlings on Red Lassic; i.e. from the seed bank). The explosion of seedlings and their high survival rate may be attributable to precipitation, winter 2016 snowpack (albeit relatively brief), and nutrient flush from the fire.	Text updated to incorporate suggestion
31	28	*and shrubs are resprouting	Text updated
32	1	*but off-trail cross county use still occurs	Text updated
32	24-30	*Even on federal lands?	The provisions of the California Endangered Species Act apply to the actions of individuals and other entities under the authority of California law. No change needed.
34	8	Lassic Peak 1 <del>is</del> <b>remains</b> the most promising location	Text updated
34	9-10	*? First I've heard of it...with what results?	Clarified this comment with Ms. Carothers. Text updated.
34	13	A germination study <del>occurred</del> <b>undertaken</b> in 2007 resulted in high germination <del>and</del> . Additional propagation...	Text updated
34	14	Garden using unscarified seeds <del>have been</del> <b>were</b> largely unsuccessful. <b>The local experiment using scarified seed resulted in high germination and three reproductive plants the first year (add McRae 2016).</b>	Clarified this comment with Ms. Carothers. Text updated.

Page	Line	Reviewer Comment	Department Response
34	16	,and an additional 800 Lassics lupine seeds were collected in 2016 (Hutchinson 2017). *The ~800 seeds collected in 2016 were from a seed production study, not collected specifically for dissemination to experiments or seed banks. Some of these seeds were sown in 2017 at the sites from which they were collected.	Text updated.
34	17	Berkeley agreed to receive 75 Lassics lupine seeds collected in 2016, and will attempt...	Text updated
34	21	*To be consistent with the heading, put the Wilderness sentence first.	Text updated
36	32	...habitat is threatened by climate change	Text updated
38	14	...The Mt. Lassic population is on steep north-facing	Text updated
38	25	them from extreme seed predation...	Text updated
39-41		*I concur.	No response needed



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EDMUND G. BROWN JR., Governor  
CHARLTON H. BONHAM, Director



[REDACTED]

Gary A. Falxa, Ph.D.

[REDACTED]

Dear Dr. Falxa:

**Status Review of Lassics Lupine (*Lupinus constancei*); California Department of Fish and Wildlife, Peer Review**

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The Department seeks your scientific peer review as part of formal proceedings pending before the Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to provide a report to the Commission based on the best scientific information available indicating whether the petition to list the species is warranted and recommending actions for recovery of the species (Fish & G. Code, § 2074.6).

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review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following peer review input.

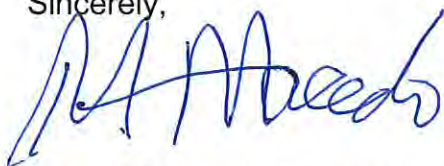
We ask you to focus your peer review on the best scientific information available regarding the status of Lassics lupine in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether the information indicates, in your opinion, that Lassics lupine is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this Status Review to you solely as part of the peer review process, and it is not yet public.

A PDF version of the Status Review is included with this letter. For ease of review, and so we may respond to your comments individually, please submit your comments in list form by page and line number. Please submit your comments electronically to Mr. Jeb Bjerke, Senior Environmental Scientist (Specialist) at [jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov). Mr. Bjerke may also be reached at (916) 651-6594. If there is anything the Department can do to facilitate your review, please let us know.

Following receipt and consideration of peer review comments, the Department will prepare and submit its final Status Review and related recommendation to the Commission. Your comments will be included in an appendix to the Department's Status Review and the Department will respond in writing to the peer review comments. After a minimum 30 day public review period and prior to making their decision, the Commission will consider: the petition to list Lassics lupine, the Department's Status Review with peer review comments, and public testimony received during a regularly scheduled Commission meeting.

Thank you again for your contribution to the Status Review effort and the important input it provides during the Commission's related proceedings.

Sincerely,



Richard Macedo, Branch Chief  
Habitat Conservation Planning Branch

Enclosures

ec: California Department of Fish and Wildlife

Tina Bartlett, Acting Deputy Director  
Ecosystem Conservation Division  
[tina.bartlett@wildlife.ca.gov](mailto:tina.bartlett@wildlife.ca.gov)

Isabel Baer, Acting Program Manager  
Timberland Conservation and Native Plant Programs  
Habitat Conservation Planning Branch  
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Jeb Bjerke, Senior Environmental Scientist (Specialist)  
Native Plant Program  
Habitat Conservation Planning Branch  
[jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov)

Gary A. Falxa, PhD

**To:** California Department of Fish and Wildlife, Habitat Conservation Planning Branch  
(Attn: Mr. Jeb Bjerke)  
**From:** Gary Falxa  
**Subject:** Peer review of Status Review of Lassics Lupine (*Lupinus constancei*)  
**Date:** 5 December, 2017

Dear Mr. Bjerke and California Department of Fish and Wildlife,

I have reviewed your Department's "Status Review of Lassics Lupine (*Lupinus constancei*)" (Status Review), provided to me in early November. Below, I provide specific detailed comments, which are relatively minor. I found the Status Review to contain and use the best available scientific information, and to represent a thorough, scientifically-valid assessment of the status of the Lassics Lupine with respect to the different population and life history categories addressed by the Status Review. I concur with the finding of the Status Review that listing the species as endangered under the California Endangered Species Act is warranted. The information provided in the review supports the finding that the species is at serious risk of becoming extinct in the foreseeable future due to multiple threats, including climate change (warming temperatures, reduced snowpack), habitat degradation associated with forest and shrub vegetation encroaching into lupine habitat, pre-dispersal seed predation by small mammals, and risks associated with small populations. The findings of the Status Review are also consistent with my own observations of the species, which are based on my work on Lassics Lupine conservation, which focused on its potential seed predators, and included multiple annual field trips since 2005 to monitor small mammal populations in and near the main lupine population on Mount Lassic.

Specific Comments:

Page 4, line 29: Suggest specifying (and defining) "pre-dispersal seed predation" (removal of seeds while still attached to the parent plant) as the most immediate threat. Also define herbivory, to clarify if herbivory as used here refers to consumption of lupine foliage or flowers, or includes pre-dispersal seed predation. Consumption of lupine foliage and flowers occurs, as it does for many plant species. However, I am not aware of information that indicates it to be a threat to the lupine at the population level, at a magnitude comparable to that posed by seed predation, or, in my opinion, by climate change. If such herbivory is included here, the limited information I am aware of suggests that mule deer, black-tailed jackrabbits, and California ground squirrels may be the primary herbivores, rather than deer mice or chipmunks.

Page 8, line 22: Suggest stating that the Special Interest Area is a designation by the Six Rivers National Forest.

Page 14, line 42: It might be more accurate to state that the Upper Terrace currently appears to be optimal (or higher-quality) habitat. Habitat suitability at different sites appears to be changing and

dynamic. When I began field work at Mt Lassic in 2005, the Saddle and North Slope areas supported the greatest number of, and most robust, lupine plants.

Page 15, Figure 5: The figures are helpful in understanding the different ecological settings. It might be helpful to also include a map or aerial photo showing the different occupied habitats on Mt. Lassic (Upper Terrace, Saddle/North Slope, Forest/Swale).

Page 20, line 3: I wonder if reduced snowfall and snowpack may be equally important as the date of snowmelt. Potential benefits of greater snow cover include reduced desiccation of overwintering lupines and greater infiltration into soils, compared to precipitation as rainfall.

Page 20, Population Trends: I believe that David Imper has documented a substantial range contraction of lupines from the southern end of the Saddle over the past 5-plus years. If this information is available, it could be worth noting in the document, as this coincided with the multi-year drought.

Page 21, Figure 6: Suggest defining "adult" plants in the legend or text of the Status Review.

Page 22, lines 13 and 16: Suggest specifying "pre-dispersal" seed predation.

Page 24, line 17: If this statement represents the results of small mammal monitoring that others and I have conducted, I would characterize it as "Based on data from 18 years of monitoring small mammals using live traps, small mammals are generally most abundant in the chaparral habitat, followed by the open serpentine (lupine) habitat, with lowest abundance in forest habitat." I can provide supporting data, if needed.

Page 24, line 37-42: In my opinion, the support is weak for these correlative relationships representing cause and effect relationships. Also, I believe that the correlations reported by Imper in 2012 between rodent abundance and weather factors are weaker with the addition of more years of data.

Page 24, line 45: Kurkjian looked at pre-dispersal seed predation.

Page 33, line33-34: As a regulatory consideration, caging and other current conservation measures occur at the discretion of US Forest Service management. At the end of the 2012 season, caging was temporarily halted and cages (exclosures) were removed from the Lassics at the direction of the Forest Supervisor of Six Rivers National Forest, who cited concerns about compatibility with wilderness status and a desire to not have exclosures used as a long-term strategy. This decision was changed and caging allowed to resume prior to the 2013 growing season, upon drafting of a Lassics Lupine Conservation Strategy by US Fish and Wildlife Service and US Forest Service staff.

Page 36, line 32: "change" not "chang"

Page 40, line 46: There may also be value in removing chaparral vegetation from the peak and east slopes of Mount Lassic (Signal Peak), which were not burned in the 2015 fire. Chaparral in these areas remains in close proximity to occupied lupine habitat, notably the Upper Terrace.



**Peer Review Comments from Dr. Gary Falxa on Lassics Lupine Status Review and California Department of Fish and Wildlife Responses**

Page	Line	Reviewer Comment	Department Response
N/A	N/A	<p>I have reviewed your Department's "Status Review of Lassics Lupine (<i>Lupinus constancei</i>)" (Status Review), provided to me in early November. Below, I provide specific detailed comments, which are relatively minor. I found the Status Review to contain and use the best available scientific information, and to represent a thorough, scientifically-valid assessment of the status of the Lassics Lupine with respect to the different population and life history categories addressed by the Status Review. I concur with the finding of the Status Review that listing the species as endangered under the California Endangered Species Act is warranted. The information provided in the review supports the finding that the species is at serious risk of becoming extinct in the foreseeable future due to multiple threats, including climate change (warming temperatures, reduced snowpack), habitat degradation associated with forest and shrub vegetation encroaching into lupine habitat, pre-dispersal seed predation by small mammals, and risks associated with small populations. The findings of the Status Review are also consistent with my own observations of the species, which are based on my work on Lassics Lupine conservation, which focused on its potential seed predators, and included multiple annual field trips since 2005 to monitor small mammal populations in and near the main lupine population on Mount Lassic.</p>	No response needed

Page	Line	Reviewer Comment	Department Response
4	29	Suggest specifying (and defining) "pre-dispersal seed predation" (removal of seeds while still attached to the parent plant) as the most immediate threat. Also define herbivory, to clarify if herbivory as used here refers to consumption of lupine foliage or flowers, or includes predispersal seed predation. Consumption of lupine foliage and flowers occurs, as it does for many plant species. However, I am not aware of information that indicates it to be a threat to the lupine at the population level, at a magnitude comparable to that posed by seed predation, or, in my opinion, by climate change. If such herbivory is included here, the limited information I am aware of suggests that mule deer, black-tailed jackrabbits, and California ground squirrels may be the primary herbivores, rather than deer mice or chipmunks.	Added text to define pre-dispersal seed predation. Moved the text regarding herbivory to near the end of the paragraph.
8	22	Suggest stating that the Special Interest Area is a designation by the Six Rivers National Forest.	Added text stating that the Special Interest Area is a designation by the Six Rivers National Forest.
14	42	It might be more accurate to state that the Upper Terrace <u>currently</u> appears to be optimal (or higher-quality) habitat. Habitat suitability at different sites appears to be changing and dynamic. When I began field work at Mt Lassic in 2005, the Saddle and North Slope areas supported the greatest number of, and most robust, lupine plants.	Updated the text to include the word "currently".
15	Figure 5	The figures are helpful in understanding the different ecological settings. It might be helpful to also include a map or aerial photo showing the different occupied habitats on Mt. Lassic (Upper Terrace, Saddle/North Slope, Forest/Swale).	Additional figure created and added to the Status Review.
20	3	I wonder if reduced snowfall and snowpack may be equally important as the date of snowmelt. Potential benefits of greater snow cover include reduced desiccation of overwintering lupines and greater infiltration into soils, compared to precipitation as rainfall.	Added two sentences at the end of the paragraph beginning on page 19, line 14 regarding the factors that could contribute to early snow melt, and the potential benefits to Lassics lupine from greater snow cover.

Page	Line	Reviewer Comment	Department Response
20	Population Trends	I believe that David Imper has documented a substantial range contraction of lupines from the southern end of the Saddle over the past 5-plus years. If this information is available, it could be worth noting in the document, as this coincided with the multiyear drought.	A paragraph has been added to provide information on changes in the area occupied by Lassics lupine at the south end of the Saddle transect between 2002 and 2017.
21	Figure 6	Suggest defining "adult" plants in the legend or text of the Status Review.	A sentence defining adult plants was added on page 20.
22	13 and 16	Suggest specifying "pre-dispersal" seed predation.	Text updated to specify pre-dispersal
24	17	If this statement represents the results of small mammal monitoring that others and I have conducted, I would characterize it as "Based on data from 18 years of monitoring small mammals using live traps, small mammals are generally most abundant in the chaparral habitat, followed by the open serpentine (lupine) habitat, with lowest abundance in forest habitat." I can provide supporting data, if needed.	Text updated
24	37-42	In my opinion, the support is weak for these correlative relationships representing cause and effect relationships. Also, I believe that the correlations reported by Imper in 2012 between rodent abundance and weather factors are weaker with the addition of more years of data.	Paragraph removed
24	45	Kurkjian looked at pre-dispersal seed predation.	Reference to (Kurkjian 2012a, Kurkjian et al. 2016) added.
33	33-34	As a regulatory consideration, caging and other current conservation measures occur at the discretion of US Forest Service management. At the end of the 2012 season, caging was temporarily halted and cages (exclosures) were removed from the Lassics at the direction of the Forest Supervisor of Six Rivers National Forest, who cited concerns about compatibility with wilderness status and a desire to not have exclosures used as a long-term strategy. This decision was changed and caging allowed to resume prior to the 2013 growing season, upon drafting of a Lassics Lupine Conservation Strategy by US Fish and Wildlife Service and US Forest Service staff.	Paragraph added regarding the removal of Lassics lupine cages under the direction of the Six Rivers National Forest Supervisor in 2012.
36	32	"change" not "chang"	Text updated

<b>Page</b>	<b>Line</b>	<b>Reviewer Comment</b>	<b>Department Response</b>
40	46	There may also be value in removing chaparral vegetation from the peak and east slopes of Mount Lassic (Signal Peak), which were not burned in the 2015 fire. Chaparral in these areas remains in close proximity to occupied lupine habitat, notably the Upper Terrace.	Text updated





State of California – Natural Resources Agency  
DEPARTMENT OF FISH AND WILDLIFE  
Habitat Conservation Planning Branch  
1416 Ninth Street, 12<sup>th</sup> Floor  
Sacramento, CA 95814  
[www.wildlife.ca.gov](http://www.wildlife.ca.gov)

EDMUND G. BROWN JR., Governor  
CHARLTON H. BONHAM, Director



November 7, 2017

Erik S. Jules, Ph.D.  
Department of Biological Sciences  
Humboldt State University  
1 Harpst St.  
Arcata, California 95521  
[erik.jules@humboldt.edu](mailto:erik.jules@humboldt.edu)

Dear Dr. Jules:

**Status Review of Lassics Lupine (*Lupinus constancei*); California Department of Fish and Wildlife, Peer Review**

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife (Department) Status Review of Lassics lupine (*Lupinus constancei*) (Status Review). Please review the peer review draft of the Department's Status Review, dated November 9, 2017, that is included with this letter. The Department seeks your expert analysis and input regarding the scientific validity of the Status Review and its assessment of the status of Lassics lupine in California. **The Department would appreciate receiving your peer review comments on or before December 7, 2017.**

The California Fish and Game Commission (Commission) received the petition to list Lassics lupine as an endangered species under the California Endangered Species Act (CESA) on July 19, 2016. On February 24, 2017, the Commission published findings formally designating Lassics lupine a candidate for listing as threatened or endangered under CESA. Lassics lupine is currently protected under CESA in California in that capacity.

The Department seeks your scientific peer review as part of formal proceedings pending before the Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to provide a report to the Commission based on the best scientific information available indicating whether the petition to list the species is warranted and recommending actions for recovery of the species (Fish & G. Code, § 2074.6).

The peer review draft of the Department's Status Review forwarded to you today reflects the Department's effort to identify and analyze the best scientific information

available regarding the status of Lassics lupine in California. At this time, the Department believes that the best available science indicates that listing the species as endangered under CESA is warranted. We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following peer review input.

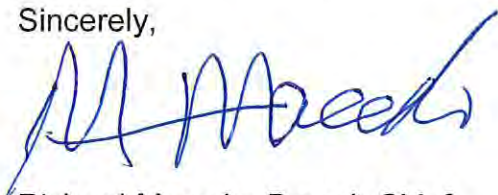
We ask you to focus your peer review on the best scientific information available regarding the status of Lassics lupine in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether the information indicates, in your opinion, that Lassics lupine is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this Status Review to you solely as part of the peer review process, and it is not yet public.

A PDF version of the Status Review is included with this letter. For ease of review, and so we may respond to your comments individually, please submit your comments in list form by page and line number. Please submit your comments electronically to Mr. Jeb Bjerke, Senior Environmental Scientist (Specialist) at [jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov). Mr. Bjerke may also be reached at (916) 651-6594. If there is anything the Department can do to facilitate your review, please let us know.

Following receipt and consideration of peer review comments, the Department will prepare and submit its final Status Review and related recommendation to the Commission. Your comments will be included in an appendix to the Department's Status Review and the Department will respond in writing to the peer review comments. After a minimum 30 day public review period and prior to making their decision, the Commission will consider: the petition to list Lassics lupine, the Department's Status Review with peer review comments, and public testimony received during a regularly scheduled Commission meeting.

Thank you again for your contribution to the Status Review effort and the important input it provides during the Commission's related proceedings.

Sincerely,



Richard Macedo, Branch Chief  
Habitat Conservation Planning Branch

Enclosures

ec: California Department of Fish and Wildlife

Tina Bartlett, Acting Deputy Director  
Ecosystem Conservation Division  
[tina.bartlett@wildlife.ca.gov](mailto:tina.bartlett@wildlife.ca.gov)

Isabel Baer, Acting Program Manager  
Timberland Conservation and Native Plant Programs  
Habitat Conservation Planning Branch  
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Jeb Bjerke, Senior Environmental Scientist (Specialist)  
Native Plant Program  
Habitat Conservation Planning Branch  
[jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov)



November 13, 2017

Jeb Bjerke  
Senior Environmental Scientist (Specialist)  
Department of Fish and Wildlife  
Habitat Conservation Planning Branch  
1416 Ninth St., 12<sup>th</sup> floor  
Sacramento, CA 95814

Dear Mr. Bjerke,

I appreciate the opportunity to read and comment on CDFW's Lassics Lupine Status Review. I have read the entire document with special focus on the sections related to life history, population trends, and the population viability analysis.

Overall, this is an incredibly thorough and well-written document. I commend you and CDFW on such a solid review of what is currently known about the Lassics lupine. The document is an exceptional review of all of the work that has been done over several decades on the lupine.

I am somewhat sheepish to write that have very few corrections to recommend, but here they are nonetheless:

- Page 23, lines 6-8: This sentence seems somewhat misleading (unintentionally I believe). It suggests that the PVA was conducted prior to (among other things) climate change. I think a better way to state this is that the PVA did not attempt to model predicted changes due to climate change.
- Page 23, line 21: Insert "of" where "Seventy-two percent of seed..."
- Page 26, lines 41-44: This sentence seems to suggest that there is empirical evidence (from Vander Wall 1993) that increased litter suppresses germination. Is that true? The actual citation doesn't seem to be about germination. What is the evidence?

Sincerely,

Erik S. Jules  
Professor  
Department of Biological Sciences  
Humboldt State University  
erik.jules@humboldt.edu



**Peer Review Comments from Dr. Erik S. Jules on Lassics Lupine Status Review and California Department of Fish and Wildlife Responses**

Page	Line	Reviewer Comment	Department Response
N/A	N/A	I appreciate the opportunity to read and comment on CDFW’s Lassics Lupine Status Review. I have read the entire document with special focus on the sections related to life history, population trends, and the population viability analysis. Overall, this is an incredibly thorough and well-written document. I commend you and CDFW on such a solid review of what is currently known about the Lassics lupine. The document is an exceptional review of all of the work that has been done over several decades on the lupine. I am somewhat sheepish to write that have very few corrections to recommend, but here they are nonetheless:	No response needed
23	6-8	This sentence seems somewhat misleading (unintentionally I believe). It suggests that the PVA was conducted prior to (among other things) climate change. I think a better way to state this is that the PVA did not attempt to model predicted changes due to climate change.	Text updated as suggested to clarify the sentence.
23	21	Insert “of” where “Seventy-two percent of seed...”	Comment unclear. There is no reference to 72 percent of seed in the Status Review, only a reference to approximately seventy-two percent of inflorescences, and 72 uncaged plants. No change was made in response to this comment, but the Crawford and Ross 2003 reference was re-checked, and some of the text on page 22 of the Status Review was revised for clarity.
26	41-44	This sentence seems to suggest that there is empirical evidence (from Vander Wall 1993) that increased litter suppresses germination. Is that true? The actual citation doesn’t seem to be about germination. What is the evidence?	The references in this paragraph were re-checked, the paragraph was split into two paragraphs, and the text was revised for clarity and to more accurately reference the appropriate citations.



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DEPARTMENT OF FISH AND WILDLIFE  
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[www.wildlife.ca.gov](http://www.wildlife.ca.gov)

*EDMUND G. BROWN JR., Governor*  
*CHARLTON H. BONHAM, Director*



November 7, 2017

Mr. John McRae  
Six Rivers National Forest  
1330 Bayshore Way  
Eureka, California 95501  
[jmcr@fs.fed.us](mailto:jmcr@fs.fed.us)

Dear Mr. McRae:

**Status Review of Lassics Lupine (*Lupinus constancei*); California Department of Fish and Wildlife, Peer Review**

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife (Department) Status Review of Lassics lupine (*Lupinus constancei*) (Status Review). Please review the peer review draft of the Department's Status Review, dated November 9, 2017, that is included with this letter. The Department seeks your expert analysis and input regarding the scientific validity of the Status Review and its assessment of the status of Lassics lupine in California. **The Department would appreciate receiving your peer review comments on or before December 7, 2017.**

The California Fish and Game Commission (Commission) received the petition to list Lassics lupine as an endangered species under the California Endangered Species Act (CESA) on July 19, 2016. On February 24, 2017, the Commission published findings formally designating Lassics lupine a candidate for listing as threatened or endangered under CESA. Lassics lupine is currently protected under CESA in California in that capacity.

The Department seeks your scientific peer review as part of formal proceedings pending before the Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to provide a report to the Commission based on the best scientific information available indicating whether the petition to list the species is warranted and recommending actions for recovery of the species (Fish & G. Code, § 2074.6).

The peer review draft of the Department's Status Review forwarded to you today reflects the Department's effort to identify and analyze the best scientific information available regarding the status of Lassics lupine in California. At this time, the

Department believes that the best available science indicates that listing the species as endangered under CESA is warranted. We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following peer review input.

We ask you to focus your peer review on the best scientific information available regarding the status of Lassics lupine in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether the information indicates, in your opinion, that Lassics lupine is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this Status Review to you solely as part of the peer review process, and it is not yet public.

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Following receipt and consideration of peer review comments, the Department will prepare and submit its final Status Review and related recommendation to the Commission. Your comments will be included in an appendix to the Department's Status Review and the Department will respond in writing to the peer review comments. After a minimum 30 day public review period and prior to making their decision, the Commission will consider: the petition to list Lassics lupine, the Department's Status Review with peer review comments, and public testimony received during a regularly scheduled Commission meeting.

Thank you again for your contribution to the Status Review effort and the important input it provides during the Commission's related proceedings.

Sincerely,



Richard Macedo, Branch Chief  
Habitat Conservation Planning Branch

Enclosures

ec: California Department of Fish and Wildlife

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Native Plant Program  
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[jeb.bjerke@wildlife.ca.gov](mailto:jeb.bjerke@wildlife.ca.gov)



From: McRae, John -FS <jmcræ@fs.fed.us>  
Sent: Tuesday, November 28, 2017 10:10 AM  
To: Bjerke, Jeb@Wildlife  
Cc: Hoover, Lisa D -FS; David Imper; Carothers, Sydney - FS  
Subject: Peer draft review of status of Lassics lupine (*Lupinus constancei*)

Jeb,

Thank you for the opportunity to comment on the status review for *Lupinus constancei*. The scientific determinations regarding the status of the Lassics lupine are well documented in the review and I have nothing to add to them. I do have a few comments to add regarding other facts presented in the document which I've outlined below.

Page 4, line 46 – 'vegetation encroachment, and impacts from wildfire'. Although the 2015 Lassics wildfire did impact the species, wildfire is a natural disturbance in the Lassics and it is highly likely that it has adapted to the presence of wildfire in the landscape. I think it is important to include wildfire suppression here. Years of wildfire suppression is partly responsible for the vegetation encroachment. Including wildfire suppression adds support to a case that can be made for reintroducing prescribed fire to the Lassics should this tool become available.

Page 8, lines 45 and 46 state that the distance between the Red Lassic population and the Mt. Lassic population is 0.8 kilometer (0.5 mile) which is different than the distance shown on page 11, line 21 and 22 where it states that the distance is 0.9 kilometer (0.6 miles)

Page 11, line 6 should state that 'The Lassics consist of three peaks. Peak 3 is Mount Lassic which is also known as Signal Peak.' Photo 3 also needs to be edited to show Peak 3 as Mount Lassic (Signal Peak).

Page 34, line 18 – The University of California Botanical Garden received 50, not 75, seed.

Page 34, line 30 – should read 'sent to the U.S. Forest Service National Seed Bank Lab in Dry Branch, Georgia for processing. From there the seed was sent to the National Laboratory for Genetic Resource Preservation in Fort Collins, Colorado for long term storage.'

Page 40, line 9 – following 'action.' State that 'It is the policy of the Forest Service to assist states in achieving their goals for conservation of endemic species. (USDA 2005). The reference for this would be;

U.S. Department of Agriculture. 2005. Forest Service Manual 2670 - Wildlife, Fish, and Sensitive Plant Habitat Management. Chapter 2670 - Threatened, Endangered and Sensitive Plants and Animals. 2670.32 – Sensitive Species.

Page 40, line 34 – should read 'Ensure there is at least one high quality collection of Lassics lupine seeds is maintained at the National Laboratory for Genetic Resource Preservation in Fort Collins, Colorado. There is not a need to impact the natural seed bank by maintaining a redundant collection especially considering the physical integrity of the facility in Fort Collins.

Page 40 – a bullet needs to be added to the bulleted list that states; ‘Continue in situ and ex situ seed propagation to investigate methods of reestablishing plants at the Lassics via direct sowing of seed and the transplanting of plants grown off site.

Thanks again for the opportunity to comment. John



John McRae  
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**Peer Review Comments from Mr. John McRae on Lassics Lupine Status Review and California Department of Fish and Wildlife Responses**

<b>Page</b>	<b>Line</b>	<b>Reviewer Comment</b>	<b>Department Response</b>
N/A	N/A	Thank you for the opportunity to comment on the status review for <i>Lupinus constancei</i> . The scientific determinations regarding the status of the Lassics lupine are well documented in the review and I have nothing to add to them. I do have a few comments to add regarding other facts presented in the document which I've outlined below.	No response needed
4	46	'vegetation encroachment, and impacts from wildfire'. Although the 2015 Lassics wildfire did impact the species, wildfire is a natural disturbance in the Lassics and it is highly likely that it has adapted to the presence of wildfire in the landscape. I think it is important to include wildfire suppression here. Years of wildfire suppression is partly responsible for the vegetation encroachment. Including wildfire suppression adds support to a case that can be made for reintroducing prescribed fire to the Lassics should this tool become available.	Text updated to include fire suppression.
8	45 and 46	lines 45 and 46 state that the distance between the Red Lassic population and the Mt. Lassic population is 0.8 kilometer (0.5 mile) which is different than the distance shown on page 11, line 21 and 22 where it states that the distance is 0.9 kilometer (0.6 miles)	Text updated to correct inconsistency
11	6	line 6 should state that 'The Lassics consist of three peaks. Peak 3 is Mount Lassic which is also known as Signal Peak.' Photo 3 also needs to be edited to show Peak 3 as Mount Lassic (Signal Peak).	As used in the Status Review, 'the Lassics' is used to refer to the three principal mountains of the Lassics mountain range collectively (Mt. Lassic, Red Lassic, and Black Lassic), or the Lassics mountain range in its entirety. 'Mt. Lassic' is used to refer to the three principal peaks of Mt. Lassic collectively (Peak 1, Peak 2, and Signal Peak (Peak 3)). Using the term 'Lassics' to refer to the three principal peaks of Mt. Lassic would therefore be inconsistent with the rest of the Status Review. No change needed.
34	18	The University of California Botanical Garden received 50, not 75, seed.	Text updated to reflect the correct number of seeds

Page	Line	Reviewer Comment	Department Response
34	30	should read 'sent to the U.S. Forest Service National Seed Bank Lab in Dry Branch, Georgia for processing. From there the seed was sent to the National Laboratory for Genetic Resource Preservation in Fort Collins, Colorado for long term storage.'	Text updated
40	9	<p>following 'action.' State that 'It is the policy of the Forest Service to assist states in achieving their goals for conservation of endemic species. (USDA 2005). The reference for this would be;</p> <p>U.S. Department of Agriculture. 2005. Forest Service Manual 2670 - Wildlife, Fish, and Sensitive Plant Habitat Management. Chapter 2670 - Threatened, Endangered and Sensitive Plants and Animals. 2670.32 – Sensitive Species.</p>	Text updated
40	34	should read 'Ensure there is at least one high quality collection of Lassics lupine seeds is maintained at the National Laboratory for Genetic Resource Preservation in Fort Collins, Colorado. There is not a need to impact the natural seed bank by maintaining a redundant collection especially considering the physical integrity of the facility in Fort Collins	Text updated to remove the recommendation for redundant collections.
40		a bullet needs to be added to the bulleted list that states; 'Continue in situ and ex situ seed propagation to investigate methods of reestablishing plants at the Lassics via direct sowing of seed and the transplanting of plants grown off site.	The text of the 8 <sup>th</sup> bullet has been revised to more clearly recommend a project to establish an additional self-sustaining Lassics lupine population via propagation and outplanting.