State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION

EVALUATION OF THE PETITION FROM THE XERCES SOCIETY, DEFENDERS OF WILDLIFE, AND THE CENTER FOR FOOD SAFETY TO LIST FOUR SPECIES OF BUMBLE BEES AS ENDANGERED UNDER THE CALIFORNIA ENDANGERED SPECIES ACT

Prepared by
California Department of Fish and Wildlife

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I. Executive Summary

The Xerces Society, Defenders of Wildlife, and the Center for Food Safety (Petitioners) submitted a petition (Petition) to the Fish and Game Commission (Commission) to list four bumble bee species – Crotch bumble bee, Franklin bumble bee, Western bumble bee, and Suckley cuckoo bumble bee (*Bombus crotchii, B. franklini, B. occidentalis occidentalis,* and *B. suckleyi*, respectively) – as endangered pursuant to the California Endangered Species Act (CESA), Fish and Game Code Section 2050 *et seq*.

The Commission referred the Petition to the Department of Fish and Wildlife (Department) in accordance with Fish and Game Code Section 2073. (Cal. Reg. Notice Register 2018, No. 45-Z, p. 1986.) Pursuant to Fish and Game Code Section 2073.5 and Section 670.1 of Title 14 of the California Code of Regulations, the Department has prepared this evaluation report (Petition Evaluation) for the Petition. The Petition Evaluation assesses the scientific information discussed and cited in the Petition in relation to other relevant and available scientific information possessed or received by the Department during the evaluation period. The Department's recommendation as to whether to make any of the four bumble bee species a candidate for listing under CESA is based on an assessment of whether the scientific information in the Petition is sufficient under criteria prescribed by CESA to consider listing the species as endangered or threatened.

After reviewing the Petition and other relevant information, the Department finds:

A. Crotch bumble bee

The Crotch bumble bee is nearly endemic to California, and historically occupied grasslands and shrublands in southern to central California, with occasional records in the northern portion of the state. Like all bumble bees, the species requires floral resources, and undisturbed nest sites and overwintering sites.

The Crotch bumble bee's abundance relative to other bumble bee species has declined significantly in recent decades, and it is no longer found in a significant portion of its historical range: the Central Valley. Habitat loss and degradation, toxins, disease, competition, and climate change appear to threaten this species, and no known management efforts specifically designed to conserve or recover the species exist.

In completing its Petition Evaluation, the Department has determined the Petition provides sufficient scientific information to indicate the petitioned action may be warranted. Therefore, the Department recommends the Commission accept the Petition for further consideration under CESA.

B. Franklin bumble bee

The Franklin bumble bee has the smallest range of any bumble bee in North America. It is only found in the Klamath Mountains of northwest California and southwest Oregon. The species inhabits prairies and meadows and requires floral resources, and undisturbed nest sites and overwintering sites.

Surveys in California and the rest of its range in adjacent Oregon suggest Franklin bumble bee distribution and abundance are in steep decline. The species has not been detected in California surveys since 1998 or in Oregon surveys since 2006, although given the amount of remote unsurveyed area, the variability of insect populations in general, and the variability of Franklin bumble bee populations in particular, there is not yet reason to believe the species is extinct. Habitat loss or degradation, disease, competition, toxins, and climate change may threaten the Franklin bumble bee, and no known management efforts specifically designed to conserve or recover the species exist.

In completing its Petition Evaluation, the Department has determined the Petition provides sufficient scientific information to indicate the petitioned action may be warranted. Therefore, the Department recommends the Commission accept the Petition for further consideration under CESA.

C. Western bumble bee

Formerly found in much of California, the Western bumble bee is now much reduced in abundance and mostly restricted to high meadows or coastal environments. Population declines throughout the western U.S. have been documented since the mid to late 1990s, perhaps coincident with a disease outbreak in commercial colonies of the species. The species requires floral resources, and undisturbed nest sites and overwintering sites. Disease, toxins, habitat loss or degradation, competition, and climate change appear to threaten the Western bumble bee, and no known management efforts specifically designed to conserve or recover the species exist.

In completing its Petition Evaluation, the Department has determined the Petition provides sufficient scientific information to indicate that the petitioned action may be warranted. Therefore, the Department recommends the Commission accept the Petition for further consideration under CESA.

D. Suckley cuckoo bumble bee

The Suckley cuckoo bumble bee is known in California only from a few records in the Klamath Mountains region. Its reproductive success appears to be dependent on its host species, the Western bumble bee, another species petitioned for listing due to an apparent decline. The Suckley cuckoo bumble bee's range, distribution, and abundance in California are not well known due to the rarity of observations of the species in the state. There is evidence the species is in decline in other parts of its range, along with evidence its host, the Western bumble bee, is in decline. The Suckley cuckoo bumble bee requires floral resources, the presence of its host in sufficient abundance, and overwintering sites to reproduce and survive. The decline of its host, the Western bumble bee, may be the primary threat to continued survival of the species. However, the factors—diseases , toxins, habitat loss or degradation, competition, and climate change—that indirectly affect the Suckley cuckoo bumble bee through their impacts on its host may also directly affect the Suckley cuckoo bumble bee.

In completing its Petition Evaluation, the Department has determined the Petition provides sufficient scientific information to indicate that the petitioned action may be warranted. Therefore, the Department recommends the Commission accept the Petition for further consideration under CESA.

II. Introduction

A. Candidacy Evaluation

The Commission has the authority to list certain "species" or "subspecies" as threatened or endangered under CESA. (Fish & G. Code, §§ 2062, 2067, 2070.) The listing process is the same for species and subspecies. (Fish & G. Code, §§ 2070-2079.1.)

CESA sets forth a two-step process for listing a species as threatened or endangered. First, the Commission determines whether to designate a species as a candidate for listing by evaluating whether the petition provides "sufficient information to indicate that the petitioned action may be warranted." (Fish & G. Code, § 2074.2, subd. (e)(2).) If the petition is accepted for consideration, the second step first requires the Department to produce, within 12 months of the Commission's acceptance of the petition, a peer reviewed report based upon the best scientific information available that advises the Commission whether the petitioned action is warranted. (Fish & G. Code, § 2074.6.) Finally, the Commission, based on that report and other information in the administrative record, then determines whether or not the petitioned action to list the species as threatened or endangered is warranted. (Fish & G. Code, § 2075.5.)

A petition to list a species under CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant." (Fish & G. Code, § 2072.3; see also Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1).) The range of a species for the Department's petition evaluation and recommendation is the species' California range. (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal. App. 4th 1535, 1551.)

Within ten days of receipt of a petition, the Commission must refer the petition to the Department for evaluation. (Fish & G. Code, § 2073.) The Commission must also publish notice of receipt of the petition in the California Regulatory Notice Register. (Fish & G. Code, § 2073.3.) Within 90 days of receipt of the petition (or 120 days if the Commission grants an extension), the Department must evaluate the petition on its face and in relation to other relevant information and submit to the Commission a written evaluation report with one of the following recommendations:

- Based upon the information contained in the petition, there is not sufficient information to indicate that the petitioned action may be warranted, and the petition should be rejected; or
- Based upon the information contained in the petition, there is sufficient information to indicate that the petitioned action may be warranted, and the petition should be accepted and considered.

(Fish & G. Code, § 2073.5, subds. (a)-(b).) The Department's candidacy recommendation to the Commission is based on an evaluation of whether the petition provides sufficient scientific information relevant to the petition components set forth in Fish and Game Code Section 2072.3 and the California Code of Regulations, Title 14, Section 670.1, subdivision (d)(1).

In *Center for Biological Diversity v. California Fish and Game Commission* (2008) 166 Cal.App.4th 597, the California Court of Appeals addressed the parameters of the Commission's determination of whether a petitioned action should be accepted for consideration pursuant to Fish and Game Code Section 2074.2, subdivision (e), resulting in the species being listed as a candidate species. The court began its discussion by describing the standard for accepting a petition for consideration previously set forth in *Natural Resources Defense Council v. California Fish and Game Commission* (1994) 28 Cal.App.4th 1104:

> As we explained in *Natural Resources Defense Council*, "the term 'sufficient information' in section 2074.2 means that amount of information, when considered with the Department's written report and the comments received, that would lead a reasonable person to conclude the petitioned action may be warranted." The phrase "may be warranted" "is appropriately characterized as a 'substantial possibility that listing could occur.'" "Substantial possibility," in turn, means something more than the one-sided "reasonable possibility" test for an environmental impact report but does not require that listing be more likely than not.

(*Center for Biological Diversity*, *supra*, 166 Cal.App.4th at pp. 609-10 [internal citations omitted].) The court acknowledged, "the Commission is the finder of fact in the first instance in evaluating the information in the record." (*Id.* at p. 611.) However, the court clarified:

> [T]he standard, at this threshold in the listing process, requires only that a substantial possibility of listing could be found by an objective, reasonable person. The Commission is not free to choose between conflicting inferences on subordinate issues and thereafter rely upon those choices in assessing how a reasonable person would view the listing decision. Its decision turns not on rationally based doubt about listing, but on the absence of any substantial possibility that the species could be listed after the requisite review of the status of the species by the Department under [Fish and Game Code] section 2074.6.

(*Ibid*.)

B. Petition History

On October 17, 2018, Petitioners submitted this Petition to the Commission to list the four bumble bee species as endangered under CESA. On October 26, 2018, the Commission referred the Petition to the Department for evaluation. In December 2018, the Department requested, and the Commission granted, a 30-day extension of the 90-day Petition evaluation period. The Department submitted this Petition Evaluation report to the Commission on April 4, 2019.

The Department evaluated the scientific information presented in the Petition as well as other relevant information the Department possessed at the time of review. The Commission did not receive any new information from the public during the Petition Evaluation period pursuant to Fish and Game Code Section 2073.4. Pursuant to Fish and Game Code Section 2072.3 and Section 670.1, subdivision (d)(1), of Title 14 of the California Code of Regulations, the Department evaluated whether the Petition included sufficient scientific information regarding each of the following petition components to indicate whether the petitioned action may be warranted:

- Population trend;
- Range;
- Distribution;
- Abundance;
- Life history;
- Kind of habitat necessary for survival;
- Factors affecting the ability to survive and reproduce;
- Degree and immediacy of threat;
- Impact of existing management efforts;
- Suggestions for future management;
- Availability and sources of information; and
- A detailed distribution map.

C. Overview of Bumble Bee Ecology

Bumble bee (or bumblebee, bumble-bee or humble-bee) species, genus *Bombus*, are members of the main insect family of social bees, Apidae. Bumble bees often inhabit cooler areas such as at higher elevations or latitudes, but some species are found in deserts and the tropics. Twenty-six bumble bee species have been found in California (Koch et al. 2012).

Most bumble bees are social, typically forming colonies of 50-1000 workers with a single queen. In California, bumble bees usually have an annual life cycle: reproductive females (queens) overwinter alone, establish a nest in spring and begin to rear workers to form a “colony,” the colony grows as more and more workers are produced, then the queen begins to produce males and new queens, which emerge, find mates, and the cycle repeats. The old queen, workers, and males die at the end of the breeding season (Heinrich 2004, Koch et al. 2012).

A few bumble bee species, including the petitioned Suckley Cuckoo, evolved to become “social parasites” on other, colony-forming bumble bees. Because of the parallels to the brood-parasitic birds, these species are called cuckoo bumble bees (formerly genus *Psithyrus*, now considered *Bombus*). Cuckoo bumble bee females invade and take over the nests of their host bumble bee species, killing or subduing the queen and co-opting the colony workers to raise the cuckoo bumble bee’s eggs and young. These offspring all become reproductive male and female cuckoo bumble bees. Cuckoo bumble bees tend to be larger and more heavily armored than their host queens (Heinrich 2004, Kearns and Thomson 2001), and may mimic or repel their hosts chemically (Martin et al. 2010).

Bumble bees are typically large, sturdy, hairy bees with aposematic (warning) coloration of contrasting yellow, black, or reddish bands (Thorp et al. 1983). In colony-forming bumble bees, the structure and hairs of the hind legs of queens and workers are shaped to form a pollen basket that is used to collect and return pollen to the colony. Worker bumble bees and foraging queens gather pollen – which contains protein – to feed their larvae and young workers. Queens also require the protein to produce eggs (Heinrich 2004). Cuckoo bumble bees do not have pollen baskets and are dependent on their hosts for foraging and provisioning young. Bumble bees also feed on nectar for energy and store small amounts of honey in open wax “honeypots” in the colony (Heinrich 2004).

Bumble bees have a mutualistic relationship with many plants—floral resources are vital to bumble bees and bumble bees are important pollinators. Most species visit a variety of plant species for nectar and/or pollen. They are effective pollinators for many plants, including plants like nightshades (tomatoes, peppers, eggplant) and blueberries, whose pollen is not easily released by other pollinators. Some bumble bee species are propagated commercially and marketed for pollination services such as in greenhouses (Koch et al. 2012).

Bumble bees occur in a wide variety of habitats with sufficient abundance and duration of flowers for nectar and pollen resources. Because they thermoregulate using muscle tension to generate heat (Heinrich 2004), bumble bees can initiate flight at colder temperatures and colder times of day. Because of this, they inhabit cooler places than many other bees.

Bumble bees require suitable substrate in which to nest and in which to overwinter. Most bumble bee species nest in the ground, utilizing abandoned rodent burrows or similar cavities, or aboveground, utilizing cavities in logs or similar structures. Some species may make aboveground nests in dense tufts of grass and dead vegetation including abandoned mouse and bird nests. Overwintering habitats are poorly known, but newly mated queens have been observed burying themselves in loose soil or sheltering under plant litter (Koch and Strange 2009).

D. Factors Broadly Affecting the Ability of California Bumble Bee Populations to Survive and Reproduce

The Petition outlines, on pages 37-62, a variety of factors it describes as posing a substantial threat to the survival or reproduction of all four petitioned species. The general material applying to all four petitioned species is summarized here.

Factors or threats affecting the ability of all the petitioned species to survive and reproduce fall into four main categories: 1) present or threatened modification or destruction of their habitat; 2) competition; 3) disease; and 4) other natural and human-related factors, including pesticide use, genetic factors, and climate change. The Petition also discusses overexploitation for scientific or commercial purposes (pp. 44-45) but concludes that such uses do not pose a substantial threat at this time.

1. Scientific Information in the Petition: Present or Threatened Modification or Destruction of Habitat

The Petition indicates that habitat modification and destruction pose a threat to bumble bees by reducing access to sufficient food, nesting sites, and overwintering sites (pp. 37-44). It describes how several factors, including agricultural conversion, urban development, fire suppression, invasive species, livestock grazing, and climate change, have contributed to the loss or fragmentation of bumble bee habitat. The Petition notes habitat loss as particularly pronounced in montane meadows and California's Central Valley, both of which are historical habitats for the petitioned species. It also highlights that bumble bees in fragmented habitats exhibit reduced foraging rates and altered foraging patterns, which may affect population health and limit potential for recolonizing extirpated sites. In addition, the Petition notes that bumble bees' unique method of sex determination and colonial life cycle can lead to inbreeding depression in fragmented habitat, thus exacerbating its negative effects.

2. Scientific Information in the Petition: Competition with Other Species

The Petition describes threats posed by competition with other species, particularly other bee species imported and managed to pollinate crops or produce honey (pp. 47-55). Although many of the studies cited in the petition were conducted outside California, they reasonably apply within California and indicate that competition with managed bees may pose a threat to the four petitioned species.

The Petition indicates competition with European honey bees and other managed bees poses a threat to bumble bees by reducing pollen and nectar resources, displacing native bumble bees, and transmitting disease (discussed separately in the following section). The petition specifically notes a growing body of research demonstrates competition with managed bees can lead to lower reproductive success, smaller body size, and changes to foraging behavior – notably a reduction in pollen gathering (Evans 2001; Goulson et al. 2002; Thomson 2004, 2006; Paini & Roberts 2005; Walther-Hellwig et al. 2006; Goulson & Sparrow 2009; Elbgami et al. 2014). The Petition notes European honey bee colonies and large apiaries require substantial resources to survive and can impact native bee communities by depleting available supplies of pollen and nectar (Anderson & Anderson 1989; Paton 1990, 1996; Wills et al. 1990; Dafni & Shmida 1996; Horskins & Turner 1999; Cane & Tepedino 2016). It further describes how honey bees can competitively exclude native bees from preferred floral resources, forcing them to switch to

other, less abundant and less rewarding plant species (Wratt 1968; Eickwort & Ginsberg 1980; Pleasants 1981; Ginsberg 1983; Paton 1993; 1996; Buchmann 1996; Horskins & Turner 1999; Dupont et al. 2004; Thomson 2004; Walther-Hellwig et al. 2006; Tepedino et al. 2007; Roubik 2009; Shavit et al. 2009; Hudewenz & Klein 2013; Rogers et al. 2013; but see Butz-Huryn 1997; Steffan-Dewenter & Tscharntke 2000; Minckley et al. 2003).

3. Scientific Information in the Petition: Disease

The Petition presents extensive information regarding disease threats to bumble bees (pp. 47-55). Although much of this information is from studies outside California, it reasonably applies within California as well and indicates that disease may pose a threat to the four petitioned species.

The Petition indicates that disease poses a substantial threat to bumble bees by reducing longevity and colony fitness, altering reproductive success, and affecting foraging behaviors. In particular, the Petition focuses on the potential impacts from fungal microsporidians (*Nosema bombi and N. ceranae*), protozoan gut parasites (*Crithidia bombi* and *C. expoeki*), and the tracheal mite *Locustacarus buchneri*. It cites research indicating *N. bombi* can decrease survival rates for bumble bee workers and reduce survival and reproductive rates of new queens and males (Otti and Schmid-Hempel 2007, 2008; Rutrecht and Brown 2009), and *N. ceranae* can reduce bumble bee survival by 48 percent (Graystock et al. 2013). The Petition further notes *C. bombi* can dramatically reduce bumble bee longevity and colony fitness (Brown et al. 2003; Otterstatter & Whidden 2004), interfere with learning among bumble bee foragers (Otterstatter et al. 2005), increase ovary development in workers (Shykoff & Schmid-Hempel 1991), and decrease pollen loads carried by workers (Shykoff and Schmid-Hempel 1991). Research cited in the petition also indicates *L. buchneri* is associated with reduced foraging and lethargic behavior (Husband & Shina 1970) and a significantly reduced lifespan in male bumble bees (Otterstatter & Whidden 2004).

The petition describes an increased prevalence of these diseases among native bumble bees, including the petitioned species, and indicates this may be due to transmission from commercial bees, which frequently harbor high pathogen loads.

4. Scientific Information in the Petition: Other Factors – Toxins, Climate Change, Population Dynamics and Structure

The Petition presents information regarding three other factors that may threaten the four petitioned species: (1) toxins, (2) climate change, and (3) population dynamics and structure (pp. 56-62). Some of this information is from studies outside California, but it reasonably applies to the four petitioned species and their status in California.

The Petition indicates that use of herbicides and pesticides has several negative impacts on native bumble bees, including degrading habitat and removing floral resources, causing direct mortality and sublethal effects, reducing population success and survival rates, and increasing disease risk. The Petition notes the widespread use of herbicides and pesticides in the four petitioned species' ranges and describes their impacts. Herbicide use has contributed to the

loss of bumble bee habitat resulting in indirect impacts to bumble bees. It reduces floral resources for all bumble bees, nesting habitat for bumble bees that nest above ground (Smallidge & Leopold 1997), and could cause a decline in bumble bee reproductive success and/or survival rates. Pesticide use, including various types of insecticides and fungicides, could directly impact bumble bees through mortality and sublethal effects. The use of insecticides, of which neonicotinoids are addressed in detail, is most likely to directly harm bumble bees since they are broadly toxic to insects and thus could kill or otherwise harm exposed bumble bees. The Petition cites numerous studies on their potential effects, including reduced production of new queens and colony growth rates, reduced survival of hibernating queens, reduced foraging ability and increased foraging times, reduced food storage and brood production, reduced male and worker survival, and impaired learning and memory. It also notes that fungicides can lead to increased susceptibility to pathogens and parasites.

The Petition also identifies threats from climate change and indicates changes in temperature and precipitation pose a significant threat to bumble bees by decreasing the availability of floral and overwintering resources, increasing pathogen pressure, and decreasing available nesting habitat. Variability in climate can lead to phenological asynchrony between bumble bees and the plants they rely on for food and nesting (Aldridge et al. 2011; Memmott et al. 2007; Thomson 2010). While bumble bees do not require synchrony with a specific plant, asynchrony with key resources could lead to diminished resource availability at times critical to bumble bee colony success. The Petition also presents information indicating the shift in climate has altered bumble bee morphology by reducing their tongue length in response to the changed availability of food plants (Miller-Struttmann et al. 2015). This could lead to increased competition between bumble bee species due to greater niche overlap. The Petition also notes that as the climate warms in North America, the southern range of bumble bees is contracting and there is no evidence that populations are moving northward (Kerr et al., 2015), which could reduce habitat availability and further increase competition.

Bumble bee population dynamics and structure may exacerbate the threats outlined above and increase the likelihood of rapid population declines. The Petition states that reduced genetic diversity resulting from any of the described threats may be particularly concerning for bumble bees because their genetic diversity already tends to be low due to their colonial life cycle (Goulson 2010; Hatfield et al. 2012; but see Cameron et al. 2011a and Lozier et al. 2011). For species that have undergone declines in range and relative abundance, which the Petition states includes the petitioned species (Kevan 2008; Hatfield et al. 2015a, 2015c, unpublished data), genetic factors (including reduced genetic diversity, depressed survival or reproduction due to inbreeding, and the method of sex determination utilized by bumble bees) are likely among the most significant threats to their long-term survival (reviewed in Zayed 2009). The petition also describes how the loss of genetic diversity, frequently the result of reduced population size, inbreeding, or random drift, can pose a significant threat to small, isolated populations of bumble bees (Whitehorn et al. 2009), limiting their ability to adapt (Altizer et al. 2003).

III. Sufficiency of Scientific Information to Indicate the Petitioned Action May Be Warranted

The Petition components are evaluated for each of the four petitioned species separately, below, with respect to Fish and Game Code section 2072.3 and Section 670.1, subdivision (d)(1), of Title 14 of the California Code of Regulations.

III.1. Crotch bumble bee (*Bombus crotchii*)

A. Population Trend

1. Scientific Information in the Petition

The Petition discusses population trend for the Crotch bumble bee on pages 6 to 11 and cites two sources to support its conclusions, Hatfield et al. 2014 and Richardson et al. 2014. The Petition presents an approach for estimating the relative abundance of *B crotchii*. This approach analyzed the ratio of all Crotch bumble bee records to the records for all North American bumble bee species. Although this analysis included all North American records for the Crotch bumble bee, it likely approximates population decline in California because the Crotch bumble bee's range is largely confined to California. Comparing two time periods – historic (1805-2001) *versus* recent (2002-2012) - the Petition concludes the species' relative abundance has declined by 97.7 percent. The Petition also highlights the particular severity of population decline in the Central Valley, where the Crotch bumble bee was historically common but is now largely absent.

2. Other Relevant Scientific Information

One record in the Department's California Natural Diversity Data Base (CNDDB) does not appear in the Petitioners' data: an August 9, 2012 observation from McGrath State Beach, Oxnard, Ventura County. This single record is unlikely to alter Petitioner's conclusion that *B. crotchii* is in decline.

3. Conclusion

The information provided indicates Crotch bumble bee populations have significantly declined in recent decades. This trend has been particularly pronounced in the former epicenter of the bee's range, the Central Valley, where Crotch bumble bee populations are now severely depressed.

B. Range

1. Scientific Information in the Petition

Information regarding range appears on pages 6 to 10 of the Petition. The Crotch bumble bee is nearly endemic to California, historically ranging across southern California, from the coast and

coastal ranges, through the Central Valley, and to the adjacent foothills (Williams et al. 2014). It only ranges beyond California in Baja California, Mexico and southwest Nevada near the California border. The Petition indicates the Crotch bumble bee's range declined 25 percent relative to its historical range in recent years, with this decline particularly pronounced in the center of its historical range, the Central Valley.

2. Conclusion

The Petition adequately demonstrates a decline in the Crotch bumble bee's range, including a pronounced decline in the Central Valley.

C. Distribution

1. Scientific Information in the Petition

The Petition discusses distribution on pages 6 to 10. It examines Crotch bumble bee persistence or change in distribution in 50-km grid squares across the bee's historic range. The Petition reports a 79.5 percent decline in persistence in recent decades. This change is particularly pronounced in the Central Valley, where the Crotch bumble bee has not recently been reported.

2. Other Relevant Scientific Information

One recent record in the Department's CNDDB does not appear in the Petitioners' data: an August 9, 2012 observation from McGrath State Beach, Oxnard, Ventura County. This single record is unlikely to alter Petitioner's conclusions about distribution.

3. Conclusion

Although the Petition provides limited data about the Crotch bumble bee's current distribution in California, the data provided appears consistent with other information in the Petition that indicates the species' distribution is declining, particularly in the Central Valley.

D. Abundance

1. Scientific Information in the Petition

The Petition discusses abundance on pages 6 to 11. There is limited information available on the Crotch bumble bee's absolute abundance in California. The Petition presents approximately ten records in the years 2002 to 2012.

2. Other Relevant Scientific Information

One recent record in the Department's CNDDB does not appear in the Petitioners' data: an August 9, 2012 observation from McGrath State Beach, Oxnard, Ventura County. Koch et al. (2012) call the species "uncommon".

3. Conclusion

The Petition adequately addresses what little is known about the abundance of the Crotch bumble bee.

E. Life History

1. Scientific Information in the Petition

The information concerning life history appears on page 24 and pages 32 to 33. The flight period for Crotch bumble bee queens in California is from late February to late October. Their flight period peaks in early April and there is a second pulse in July. The flight period for workers and males in California is from late March through September; worker and male abundance peak in early July (Thorp et al. 1983). The Crotch bumble bee, like most other species of bumble bees, primarily nests underground (Williams et al. 2014). The size of Crotch bumble bee colonies has not been well documented. Little is known about the hibernacula, or overwintering sites, of the Crotch bumble bee, but if the behavior of queens of most other bumble bee species is indicative, it likely overwinters in soft soil (Goulson 2010) or under leaf litter or other debris (Williams et al. 2014).

2. Conclusion

The Petition presents sufficient information on what little is known about Crotch bumble bee life history.

F. Kind of Habitat Necessary for Survival

1. Scientific Information in the Petition

The Petition addresses the Crotch bumble bees' habitat requirements on pages 30 to 33. It states that in California, the Crotch bumble bee inhabits open grassland and scrub habitats. It was historically common in the Central Valley where this type of habitat was previously abundant, but it has been largely extirpated from the region because agricultural and urban expansion have modified and fragmented native grasslands.

All bumble bees, including the Crotch bumble bee, require nesting habitat, foraging resources, and overwintering habitat. The petition notes Crotch bumble bees construct their nests underground and may rely on sufficient availability of rodent and other animal burrows to provide potential nesting sites.

Crotch bumble bees are generalist foragers and have been reported visiting a wide variety of flowering plants. The Crotch bumble bee has a short tongue, and thus is best suited to forage at open flowers with short corollas. The plant families most commonly visited in California include Fabaceae, Apocynaceae, Asteraceae, Lamiaceae, Hydrophyllacae, Asclepiadaceae and Boraginaceae (Thorp et al. 1983; Richardson 2017).

Little is known about the hibernacula, or overwintering sites of the Crotch bumble bee. Generally, bumble bees overwinter in soft, disturbed soil (Goulson 2010), or under leaf litter or other debris (Williams et al. 2014).

2. Conclusion

The Petition presents sufficient information regarding the kind of habitat necessary to the Crotch bumble bee for survival.

G. Factors Affecting the Ability to Survive and Reproduce

1. Scientific Information in the Petition

The Petition discusses factors affecting the Crotch bumble bee's ability to survive and reproduce on pages 37 to 62. As outlined in section II.D., the Petition highlights several threats to all bumble bees, including the Crotch bumble bee. These include habitat modification, herbicides, competition with managed bees, disease, pesticides, and population dynamics.

The Petition notes that the Crotch bumble bee is particularly affected by habitat modification, pesticides, and herbicides. The Crotch bumble bee was historically known throughout California's Central Valley, which once contained extensive prairies rich with wildflowers. This area has largely been converted to agricultural or urban uses, modifying and fragmenting the bee's habitat. The Petition notes this land conversion has coincided with the Crotch bumble bee's near extirpation from the Central Valley (Thorp 2014, pers. comm.; Hatfield et al. 2015a).

The Central Valley's conversion to agriculture has also led to high uses of glyphosate, the most commonly used herbicide in California (CDPR 2014). The Petition states that glyphosate application has reduced the availability of wildflowers in field margins, lowered the diversity of flowering weeds, and led to an increase in herbicide application. It asserts these factors may have a causal link to the Crotch bumble bee's decline in the Central Valley.

2. Other Relevant Scientific Information

Sleeter et al. (2012) estimate more than 70 percent of total Central Valley area was converted to agricultural use by 2000, and an additional nine percent was converted to urban/developed uses.

3. Conclusion

The Petition adequately describes factors affecting the Crotch bumble bee's ability to survive and reproduce. Crotch bumble bee populations have severely declined in the Central Valley, and available data suggests some combination of habitat modification, pesticides, and herbicides contributed to this decline. Other factors affecting bumble bee populations in agricultural settings, such as competition with managed bees and disease, may have also contributed to population declines.

H. Degree and Immediacy of Threat

1. Scientific Information in the Petition

The Petition notes the Crotch bumble bee was once common throughout the southern two-thirds of California but is now largely absent from much of that area. It has been nearly extirpated from the center of its historic range, the Central Valley, where agriculture and urban development have transformed the landscape. The Petition concludes the bee's population abundance and persistence have sharply declined over the past ten years.

2. Conclusion

The Petition presents sufficient information to suggest a sharp decline in Crotch bumble bee populations and available habitat and indicates the Crotch bumble bee may be subject to a substantial and present threat within California.

I. Impact of Existing Management Efforts

1. Scientific Information in the Petition

The Petition discusses the impact of existing management efforts on page 63. The Petition notes the Crotch bumble bee does not currently receive substantive protection under federal or California law. The Crotch bumble bee appears on the Special Animals List of the California Department of Fish and Wildlife (CDFW 2018) and is included as Endangered on the International Union for the Conservation of Nature ("IUCN") Red List (Hatfield et al. 2015a). NatureServe (a non-profit conservation organization) ranks the species with a Global Status rank of G3G4 (Vulnerable to Apparently Secure) and a state rank of S1S2 (critically imperiled or imperiled) in California (NatureServe 2018).

2. Other Relevant Scientific Information

Some factors that may result in threats to the petitioned species, including herbicides and pesticides, competition, and disease, are subject to various forms of federal and State regulatory oversight. However, these regulatory mechanisms are not specifically designed to conserve or recover Crotch bumble bee populations.

3. Conclusion

The Petition suggests a sharp population decline and provides sufficient information to raise concerns about whether existing management adequately offsets possible threats to the species. Although the species appears on the Department's Special Animals list and on other organizations' lists, these designations do not afford the species specific protections, and the Petition does not indicate any other management actions specifically designed and implemented to conserve or recover the Crotch bumble bee.

J. Suggestions for Future Management

1. Scientific Information in the Petition

The Petition provides suggestions for future management on pages 65 to 73. The Petition first outlines management actions that would benefit all bumble bees, including the petitioned species. Management actions to protect or enhance flower, nesting, and overwintering resources are expected to benefit these species. These include: practices that ameliorate or reduce the frequency of ground disturbance of nesting or overwintering habitat (Black et al. 2011, Osborne et al. 2008); restoring appropriate native flower resources throughout the flight period (Aldridge et al. 2011, Mäder et al. 2011); reducing exposure to harmful pesticides, diseases, and competitors, such as non-native honey bees and bumble bees (Cane and Tepedino 2016, Geldmann & González-Varo 2018, Mallinger et al. 2017); and preserving burrowing animal populations that provide important nesting sites for bumble bees (McFrederick and LeBuhn 2006).

Concerning the Crotch bumble bee specifically, the Petition asserts that known populations should be protected from insecticide and pesticide use, particularly in the Central Valley. Practices such as livestock grazing and other practices that may threaten essential habitat, reduce available nectar and pollen sources throughout the colony season, and/or reduce the availability of underground nest sites and hibernacula, should be minimized where this species is extant. Placement of non-native bees in areas that may be occupied by the Crotch bumble bee should be managed to reduce threats of competition or disease (*see* Hatfield et al. 2016 for more detail).

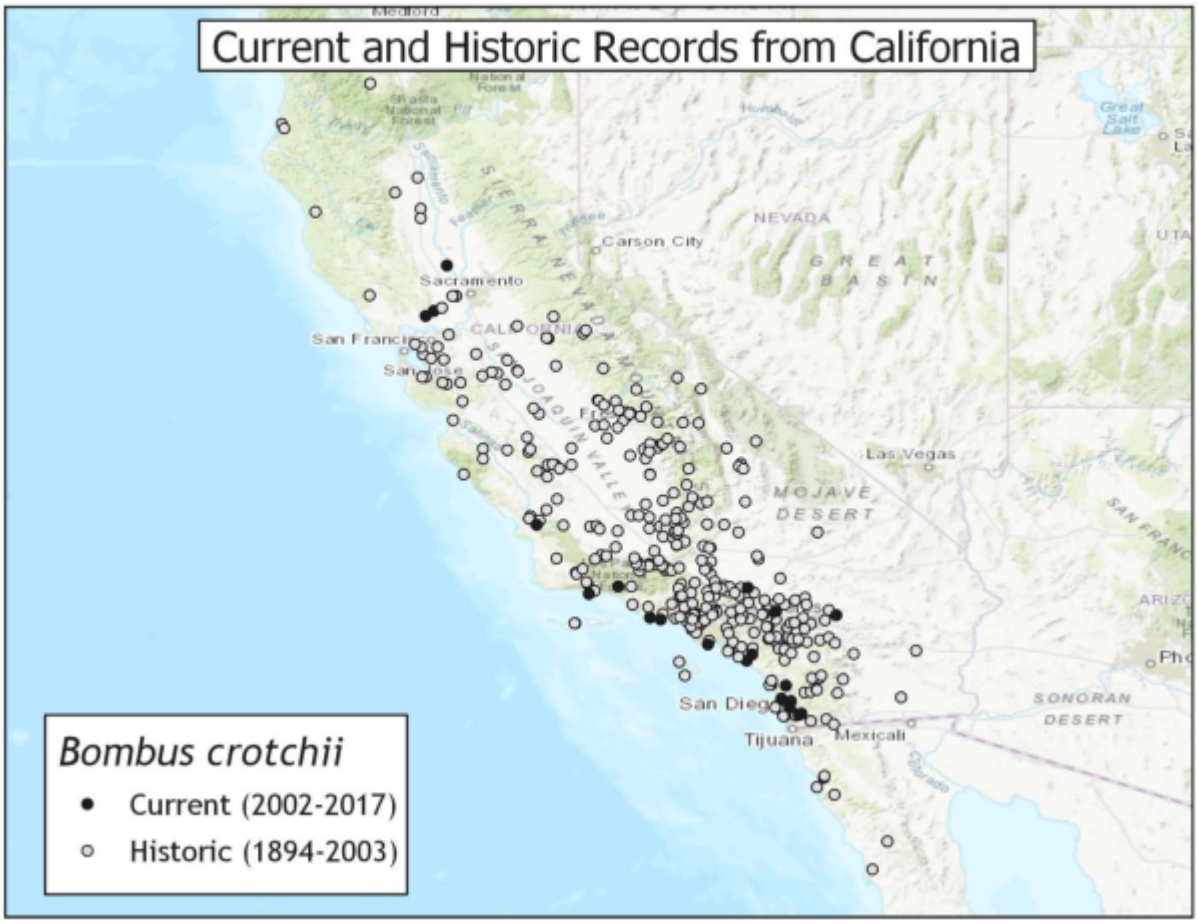
2. Conclusion

The Petition indicates additional, known management actions may aid in conserving the Crotch bumble bee in California.

K. Detailed Distribution Map

1. Scientific Information in the Petition

Crotch bumble bee (*Bombus crotchii*) Global Distribution



2. Other Relevant Scientific Information

One recent record in the Department's CNDDB does not appear in the Petitioners' data: an August 9, 2012 observation from McGrath State Beach, Oxnard, Ventura County.

3. Conclusion

The distribution map illustrates the Crotch bumble bee's historic distribution and what little is known about its current distribution.

III.2. Franklin bumble bee (*Bombus franklini*)

A. Population Trend

1. Scientific Information in the Petition

The Petition discusses population trend for the Franklin bumble bee on pages 6 to 9 and pages 11 to 16. It indicates a significant and steady decline in population. Annual surveys conducted between 1998 and 2007 in California and adjacent Oregon documented a decline from 84 individuals observed in the early years of the survey period to a total of four individuals observed in the last five years surveyed combined. Survey efforts ranged from eight sites and 19 total visits (2007) to 31 sites and 55 or more total visits (2005). The Franklin bumble bee was last seen in California in 1998, and annual surveys since 2007 (2007-2017) have all failed to find any individuals of the species in California or Oregon. The Petition highlights these numbers are variable, but clearly trend substantially downward.

2. Conclusion

The information provided indicates Franklin bumble bee populations have significantly declined in recent years. The fact that no individuals have been observed for more than a decade in annual surveys indicates the species may be extinct. However, doubt remains, considering how difficult it is to locate species with low and variable population levels inhabiting remote terrain.

B. Range

1. Scientific Information in the Petition

Information regarding the range of Franklin bumble bee appears on pages 6 to 9 and pages 11 to 16 of the Petition. The Franklin bumble bee has the smallest range of any bumble bee in North America (Williams 1998). Since the early 20th century, it has only been found in a 190 mile by 70 mile area in the Klamath Mountain region, which extends from Siskiyou and Trinity counties in California to southern Oregon. Based on the information provided, the Franklin bumble bee was last observed in 2006.

2. Conclusion

The Petition provides sufficient information on the historic range of the Franklin bumble bee in California. The species was last observed in its range in 2006.

C. Distribution

1. Scientific Information in the Petition

The Petition discusses species distribution on pages 6 to 9 and pages 11 to 16. It notes that prior to 2003, the Franklin bumble bee was known from more than 35 localities, including six

general locations in California and three sites near the California-Oregon border. From 2003 to 2006, the species was only found at a single site in Oregon, and from 2007 onward has not been found anywhere despite expert surveys. The Petition reports that in 1998 Franklin bumble bees were detected at 75 percent of the localities known to support the species. By 2000, it dropped to 24 percent and continued dropping to 14 percent in 2002, 13 percent in 2006, and then to zero in subsequent years. The species was last observed in California in 1998.

2. Conclusion

The Petition provides sufficient information on the contracting distribution of the Franklin bumble bee. This trend is particularly pronounced in California, where the species has not been observed since 1998.

D. Abundance

1. Scientific Information in the Petition

Information regarding abundance appears on pages 6 to 9 and pages 11 to 16 of the Petition. As noted in the Population Trend section above, the total number of Franklin bumble bees observed in annual surveys from 1998-2007 in California and adjacent Oregon ranged from 94 to zero individuals, with only four individuals observed in the last five surveys combined and no observations during annual surveys from 2007-2017.

2. Conclusion

The Department concludes the Petition provides sufficient information on the historical abundance and steep decline in abundance of the Franklin bumble bee in California.

E. Life History

1. Scientific Information in the Petition

The information concerning life history appears on pages 25 to 26 and page 33 of the Petition. So far as is known, the life history of the Franklin bumble bee is similar to the life history of other bumble bees, which is described in section II.C above. The flight season of the Franklin bumble bee is from mid-May to the end of September (Thorp et al. 1983).

2. Conclusion

The Petition provides sufficient information on what little is known about the Franklin bumble bee’s life history.

F. Kind of Habitat Necessary for Survival

1. Scientific Information in the Petition

The Petition addresses the Franklin bumble bees' habitat requirements on page 33. It states that the Franklin bumble bee inhabits open coastal prairies and coast range meadows at elevations ranging from 540 feet (162 m) in the north to above 7800 feet (2340 m) in the southern part of its historical range in northwest California and southwest Oregon.

All bumble bees, including the Franklin bumble bee, require nesting habitat, foraging resources, and overwintering habitat. The Petition notes the specific nesting habits of the Franklin bumble bee are unknown, but it likely nests in abandoned rodent burrows as is typical for other members of its subgenus, *Bombus sensu stricto* (Hobbs 1968). Similarly, little is known about the Franklin bumble bee's hibernacula, or overwintering sites, but bumble bees generally overwinter in soft soil (Goulson 2010), or under leaf litter or other debris (Williams et al. 2014).

The Petition describes the Franklin bumble bee as a generalist forager because it has been reported visiting a wide variety of flowering plants. It has been observed collecting pollen from lupine (*Lupinus* spp.) and California poppy (*Eschscholzia californica*) and collecting nectar from horsemint or nettle-leaf giant hyssop (*Agastache urticifolia*) and mountain monardella (*Monardella odoratissima*) (Thorp et al. 2010). This species may also collect both pollen and nectar from vetch (*Vicia* spp.) (Thorp et al. 2010).

2. Conclusion

The Petition presents sufficient information regarding the kind of habitat necessary for survival of the Franklin bumble bee in California.

G. Factors Affecting the Ability to Survive and Reproduce

1. Scientific Information in the Petition

The Petition discusses factors affecting the Franklin bumble bee's ability to survive and reproduce on pages 37 to 62. As outlined in section II.D., the Petition highlights several threats to all bumble bees, including the Franklin bumble bee. These include habitat loss and degradation, disease, competition, toxins, climate change, and population dynamics.

The Petition notes the transmission of pathogens from commercial bumble bees has been implicated in the decline of the Franklin bumble bee (Cameron et al. 2016, Graystock et al. 2016, Otterstatter and Thomson 2008). The Petition also describes threats associated with grazing, construction-related soil excavation, and habitat loss from wildfires. In addition, it highlights that increasing aridity due to warming temperatures from climate change may be particularly detrimental for the Franklin bumble bee since it appears to have a very narrow climatic specialization compared to most bumble bees (NatureServe 2018).

2. Conclusion

The Petition adequately describes factors affecting the Franklin bumble bee's ability to survive and reproduce and indicates these factors, particularly diseases transmitted by commercial bees, habitat modification, and climate change, contribute to the species' population decline.

H. Degree and Immediacy of Threat

1. Scientific Information in the Petition

The Petition discusses the degree and immediacy of the threat to the Franklin bumble bee on pages 62 to 63. The Petition highlights that bumble bees as a whole are threatened by a number of factors, including agricultural intensification, habitat loss and degradation, pesticide use, pathogens from managed pollinators, competition with non-native bees, climate change, and genetic factors (reviewed in Goulson 2010; Williams et al. 2009; Williams and Osborne 2009; Cameron et al. 2011b; Hatfield et al. 2012; Fürst et al. 2014). It notes the magnitude of loss and rate of decline experienced by the Franklin bumble bee and that, without protective measures, the Franklin bumble bee is likely to go extinct in California.

2. Conclusion

The Petition presents sufficient information to indicate the Franklin bumble bee may be subject to a substantial and present threat within California. The Petition describes a sharp decline in Franklin bumble bee populations with no observations in California since 1998.

I. Impact of Existing Management Efforts

1. Scientific Information in the Petition

The Petition discusses the impact of existing management efforts on pages 63 to 64. Until 1996, the U.S. Fish and Wildlife Service classed Franklin bumble bee as a "Category 2" Candidate Species. In 2010, it was petitioned for endangered species status under the federal Endangered Species Act (ESA). It received a 90-day finding that federal listing may be warranted and is currently the focus of a Species Status Assessment by USFWS to determine if the species warrants ESA listing (USFWS 2011). The U.S. Forest Service and the U.S. Fish and Wildlife Service commissioned research to try to locate and assess populations of the species (e.g. Thorp 1999, 2008).

The Franklin bumble bee is on the California Department of Fish and Wildlife Special Animals List (CDFW 2018) and has been included as Critically Endangered on the IUCN Red List for more than a decade (Kevan 2008). The species has a NatureServe Global Status rank of G1 (Critically Imperiled) and a State rank of S1 (Critically Imperiled) both in California and in Oregon (NatureServe 2018). The Xerces Society (a nonprofit insect conservation group and a

petitioner) lists the species as Critically Imperiled in their Red List of Pollinator Insects of North America (Thorp 2005).

2. Other Relevant Scientific Information

Under Forest Service policy, Sensitive Species are to be managed in a way that ensures their viability and precludes trends toward endangerment. All Forest Service planned, funded, executed, or permitted programs and activities are reviewed under the National Environmental Policy Act (NEPA) for possible adverse effects on Sensitive Species. However, the Sensitive Species designation and the NEPA process only require consideration and disclosure of impacts, not necessarily avoidance, so even if it is determined that Franklin bumble bees will be harmed or killed by an action, that action may still be undertaken.

Some factors the Petition identifies as threats to the petitioned species, including herbicide and pesticide application, commercial bees, and disease, are subject to various forms of federal and State regulatory oversight. However, these regulatory mechanisms are not specifically designed to conserve or recover Franklin bumble bee populations.

3. Conclusion

The Petition suggests a sharp decline in Franklin bumble bee populations and indicates that existing management efforts are inadequate to offset possible threats to the species. Although the species is being considered for listing under the ESA and is on the Department's Special Animals List, these designations do not afford specific protections.

J. Suggestions for Future Management

1. Scientific Information in the Petition

The Petition provides suggestions for future management on pages 65 to 73. It first outlines management actions that would benefit all bumble bees, including the petitioned species. Management actions to protect or enhance flower, nesting, and overwintering resources are expected to benefit the species. These include: practices that ameliorate or reduce the frequency of ground disturbance of nesting habitat or overwintering habitat (Black et al. 2011, Osborne et al. 2008); restoring appropriate native flower resources throughout the flight period (Aldridge et al. 2011, Mäder et al. 2011); reducing exposure to harmful pesticides, diseases, and competitors such as nonnative bees (Cane and Tepedino 2016, Mallinger et al. 2017, Geldmann & González-Varo 2018); and managing land use in a manner compatible with burrowing animal populations that provide important nesting sites for bumble bees (McFrederick and LeBuhn 2006).

Concerning the Franklin bumble bee specifically, the Petition asserts that comprehensive surveys in the species' historic range need to continue along with additional research on the life history of the species and, should an extant population be discovered, factors contributing to its

decline. It also notes protection of the Franklin bumble bee's habitat and suitable nest sites should be prioritized to help conserve the species and aid its recovery.

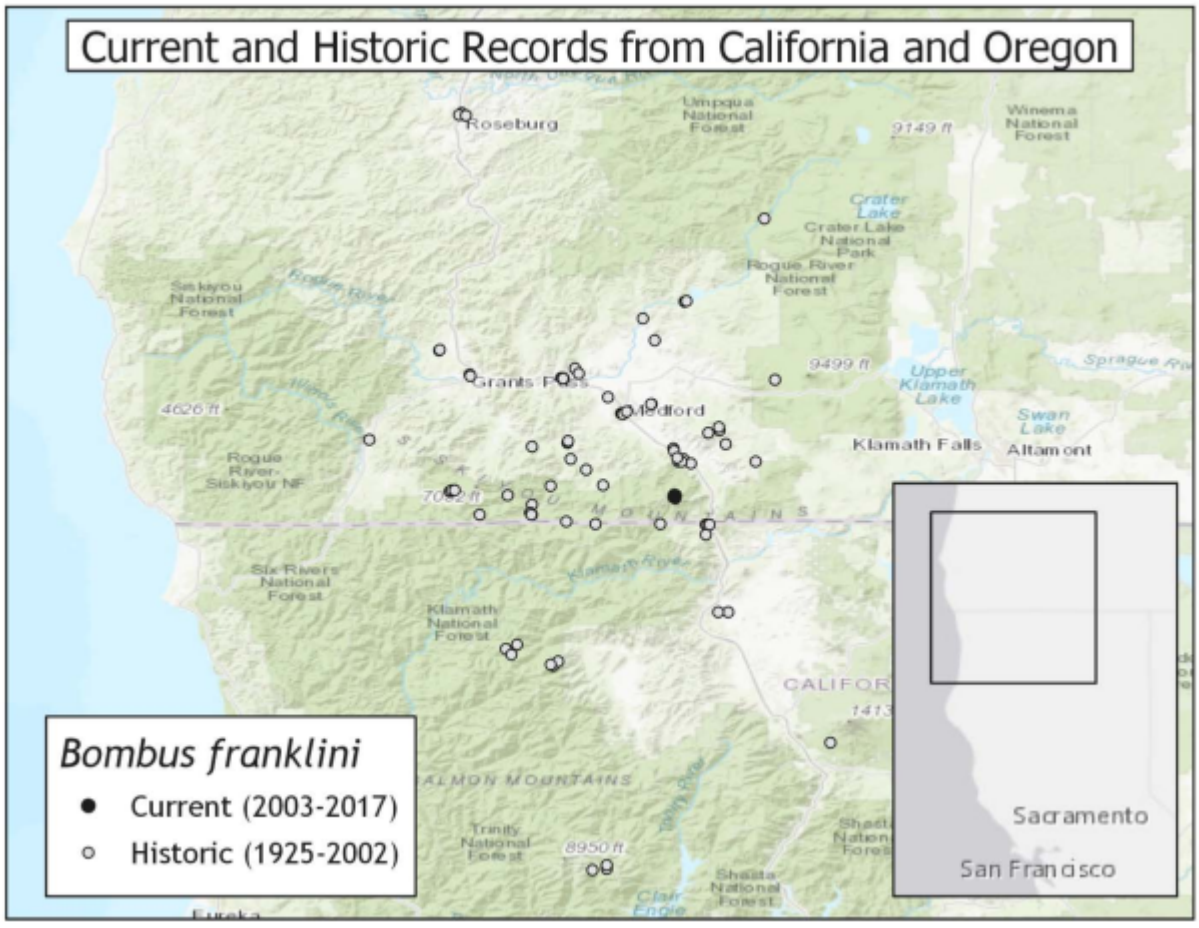
2. Conclusion

The Petition indicates additional, known management actions may aid in conserving the Franklin bumble bee in California, and additional research may help to determine where and how to best implement these measures.

K. Detailed Distribution Map

1. Scientific Information in the Petition

Franklin's bumble bee (*Bombus franklini*) Global Distribution



2. Conclusion

The distribution map illustrates the Franklin bumble bee's historic distribution and what little is known about its current distribution.

III.3. Western bumble bee (*Bombus occidentalis occidentalis*)

A. Population Trend

1. Scientific Information in the Petition

The Petition discusses population trend for the Western bumble bee on pages 6 to 9 and pages 16 to 19. The Petition notes the Western bumble bee was once very common in the western United States, but it has recently undergone a dramatic decline in abundance and distribution and is no longer present across much of its historic range. The Petition presents an approach for estimating the relative abundance of the Western bumble bee. This approach analyzed the ratio of all Western bumble bee records to the records for all North American bumble bee species. This analysis included all North American records for the Western bumble bee, so it is related, but not limited to, California. Comparing two time periods – historic (1805-2001) *versus* recent (2002-2012) – the Petition concludes the species' relative abundance has declined by 84 percent. Although the Petition does not include a California-specific relative abundance analysis, it does indicate decline is most significant at the edges of the species' range, including California (unpublished).

2. Other Relevant Scientific Information

Williams et al. (2014) state that the Western bumble bee was "[f]ormerly common throughout much of its range, but populations from central CA [California] to southern BC [British Columbia] and west of the Sierra-Cascade Ranges have declined sharply since the late 1990s."
Thorp (2008) reported a collapse of the Western bumble bee population in his Franklin bumble bee survey area (northwest California and southwest Oregon) from 12 percent of all bumble bee individuals in 1998 to none observed between 2003 and 2007.

3. Conclusion

The information provided in the Petition and other relevant scientific information indicates a significant decline in abundance, including in the California portion of its range.

B. Range

1. Scientific Information in the Petition

The Petition discusses the species' range on pages 6 to 9, pages 16 to 19, and page 116. The Petition describes the historical range of the Western bumble bee in California as stretching from the Channel Islands to the northern extent of the state, primarily in the coastal and Sierra Nevada ranges and mostly excluding the Central Valley and drier, warmer areas. It notes that Cameron et al. (2011a), comparing 2007-2009 records versus 1900-1999, estimated a 28 percent range decline in North America, and in recent years (2002-2012), the North American range of this species has declined by about half. A California-specific analysis is not included, but the Petition notes the species appears to be increasingly restricted to the Sierra-Cascades and coastal areas.

2. Conclusion

The Petition presents what limited information is available regarding the current California range of the Western bumble bee. Preliminary information suggests its range may be retracting at warmer or lower-elevation margins.

C. Distribution

1. Scientific Information in the Petition

Information concerning distribution appears on pages 6 to 9 and pages 16 to 19 of the petition. The Petition examines Western bumble bee persistence, or change in distribution, in 50-km grid squares across the bee's historic range. The Petition reports a 33 percent decline in persistence. In California, Western bumble bee populations are now largely restricted to high elevation sites in the Sierra Nevada (Xerces Society 2012) and scattered observations along the California coast (Xerces Society et al. 2017).

2. Other Relevant Scientific Information

The Department is aware of a Western bumble bee observation on October 5, 2017 in the Sierra Nevada seven miles south of Sierraville, in Sierra County, California. There are a small number of other post-2002 records in the Department's CNDDB/Rarefind/BIOS system that may not be included in the Petition.

3. Conclusion

The Petition presents sufficient information on the historical and current distribution of the Western bumble bee and indicates the distribution in California is now largely restricted to high elevation sites in the Sierra Nevada and a few scattered areas along the California coast.

D. Abundance

1. Scientific Information in the Petition

The petition discusses abundance on pages 6 to 9 and pages 16 to 19. Although the Petition only provides approximately 20 records concerning the species' current abundance and distribution in the state, it does note that in California, Western bumble bee populations are now largely restricted to high elevation sites in the Sierra Nevada (Xerces Society 2012), though there have been a few observations of this species near the coast.

2. Other Relevant Scientific Information

Williams et al. (2014) state that Western bumble bee populations, formerly common, have declined sharply since the late 1990s from central California to southern British Columbia. Koch et al. (2012) refer to a "severe population decline west of the Sierra-Cascade Crest." Thorp

(2008) reported a collapse of Western bumble bee abundance in his Franklin bumble bee survey area in northwest California and southwest Oregon from 12 percent of all bumblebee individuals in 1998 to no observation during surveys conducted from 2003 to 2007. In a study of four Sierra Nevada meadows examining 415 bumble bee individuals, a single Western bumble bee was found (Terry et al. 2018).

3. Conclusion

The information in the Petition and other relevant scientific information indicate a decline in abundance in California.

E. Life History

1. Scientific Information in the Petition

Information concerning life history appears on pages 27 to 28 and pages 33 to 35 of the Petition. The Petition states that the flight period for the Western bumble bee in California is from early February to late November, peaking in late June and late September. The flight period for workers and males in California is from early April to early November, with worker abundance peaking in early August and male abundance peaking in early September (Thorp et al. 1983). It notes Western bumble bees primarily nest in underground cavities such as old squirrel burrows or other animal nests on open west-southwest slopes bordered by trees, although a few nests have been reported in above-ground locations (Plath 1922; Hobbs 1968; Thorp et al. 1983; Macfarlane et al. 1994). Western bumble bee colonies can contain as many as 1,685 workers and produce up to 360 new queens; this colony size is considered large relative to many other species of bumble bees (Macfarlane et al. 1994). Little is known about the hibernacula, or overwintering sites, of Western bumble bees, although Hobbs (1968) reported Western bumble bee hibernacula that were two inches deep in a “steep west slope of the mound of earth.” The Petition also notes the closely related *B. terrestris* reportedly hibernates beneath trees (Sladen 1912 in Hobbs 1968).

2. Conclusion

The Petition provides sufficient scientific information about the life history of the Western bumble bee in California.

F. Kind of Habitat Necessary for Survival

1. Scientific Information in the Petition

The Petition addresses Western bumble bee habitat requirements on pages 33 to 35. It states that the Western bumble bee nests, forages, and overwinters in meadows and grasslands with abundant floral resources and may be found in some natural areas within urban environments

(Williams et al, 2014). The Petition notes that, in recent years, the species has become restricted to higher elevations and coastal habitats of this type in California.

Western bumble bees are generalist foragers that have been reported visiting a wide variety of flowering plants, but they require plants that bloom and provide adequate nectar and pollen throughout the colony's flight period from as early as February to late November. The Petition describes nesting habitat as typically underground, such as in old animal burrows, and notes that the availability of nest sites may be tied to the presence of such burrows (Evans et al. 2008). However, the Petition also notes that the species may also be able to nest aboveground such as in log cavities (Hobbs 1968, Macfarlane et al. 1994). Little is known about the hibernacula, or overwintering sites, of Western bumble bees, but they are probably in friable soil or under plant litter or debris.

2. Conclusion

The Petition provides sufficient information about the kind of habitat necessary for survival of the Western bumble bee in California.

G. Factors Affecting the Ability to Survive and Reproduce

1. Scientific Information in the Petition

The Petition discusses factors affecting the Western bumble bee's ability to survive and reproduce on pages 37 to 62. As outlined in section II.D., the Petition describes several threats to all bumble bees, including the Western bumble bee. These include habitat loss and degradation, disease, competition, toxins, and climate change.

The Petition indicates the fungal pathogen *N. bombi* has been implicated in the decline of the Western bumble bee (Colla et al. 2006; Otterstatter & Thomson 2008; Murray et al. 2013; Graystock et al. 2016; Cameron et al. 2016). This pathogen may be transmitted by commercial bees. The Petition also highlights research indicating declining Western bumble bee populations have lower genetic diversity compared to populations of co-occurring stable species (Cameron et al. 2011a; Lozier et al. 2011). Low genetic diversity can reduce evolutionary adaptability and increase developmental defects or mortality, thereby further threatening population viability.

In addition, the Petition notes the Western bumble bee's historical range overlaps marginally with the Central Valley of California, which experiences high use of glyphosate – the most commonly used pesticide within the state of California (CDPR 2014). See Section II.D.4, for a discussion of potential threats of glyphosate to bumble bees. The Petition states that agricultural and urban expansion also limit the utility of the Central Valley as habitat for the Western bumble bee.

2. Conclusion

The Petition adequately describes factors affecting the Western bumble bee's ability to survive and reproduce. It indicates that disease, habitat loss, genetic diversity, and pesticides may be contributing to the species' decline.

H. Degree and Immediacy of Threat

1. Scientific Information in the Petition

The Petition discusses the degree and immediacy of threats to the Western bumble bee on pages 16 to 17 and pages 62 to 63. The Petition highlights that bumble bees as a whole are threatened by a number of factors, including agricultural intensification, habitat loss and degradation, pesticide use, pathogens from managed pollinators, competition with non-native bees, climate change, and genetic factors (reviewed in Goulson 2010; Williams et al. 2009; Williams and Osborne 2009; Cameron et al. 2011b; Hatfield et al. 2012; Fürst et al. 2014). It notes the species is declining in California and states that current regulations and regulatory mechanisms are inadequate to protect Western bumble bees against the threats they face within California. The Petition states that, without protective measures, the Western bumble bee is likely to go extinct in California.

2. Conclusion

The Petition presents sufficient information to indicate the Western bumble bee may be subject to substantial and present threats within California. The Petition suggests a decline in Western bumble bee population and distribution within California, and that this trend may continue without action to conserve the species.

I. Impact of Existing Management Efforts

1. Scientific Information in the Petition

The Petition discusses the impact of existing management efforts on page 64. The Petition notes the Western bumble bee does not receive formal protection under federal or California law. The full species, *B. occidentalis,* has been petitioned for federal endangered species status and received a substantial 90-day finding that federal listing of the species may be warranted, and it is currently the focus of a Species Status Assessment by the U.S. Fish and Wildlife Service to determine if the species warrants ESA listing (USFWS 2016).

The Western bumble bee is on the Department's Special Animals List (CDFW 2018), which may encourage its consideration in review of projects under CEQA. The subspecies has a NatureServe Global Status rank of T1T3, its status is in the range between "Vulnerable" and "Critically Imperiled" is not secure" (NatureServe 2018). An IUCN Red List category has not yet been formally assigned for *B. o. occidentalis,* but the full species (*B. occidentalis*) is listed as

Vulnerable to extinction (Hatfield et al. 2015b). The species is listed as a “Sensitive Species” by the U.S. Forest Service in California (USFS 2013), and the Petition notes that although it does not receive formal protection, any conservation or management actions implemented on National Forests in California may provide some benefit to this species due to its “Sensitive Species” status. The Petition did not identify any known specific management actions or recovery plans in the state of California being implemented for the species.

2. Other Relevant Scientific Information

Under Forest Service policy, Sensitive Species are to be managed in a way that ensures their viability and precludes trends toward endangerment. All Forest Service planned, funded, executed, or permitted programs and activities receive review under NEPA for possible adverse effects on Sensitive Species. However, the Sensitive Species designation and the NEPA process only require that impacts to the species be considered and disclosed, not necessarily avoided, so even if it is determined that Western bumble bees will be harmed or killed by an action, that action may still be undertaken.

Some factors that may result in threats to the petitioned species, including herbicide and pesticides, competition, and disease, are subject to various forms of federal and State regulatory oversight. However, these regulatory mechanisms are not specifically designed to conserve or recover Western bumble bee populations.

3. Conclusion

The Petition suggests a steep decline in the Western bumble bee’s abundance and distribution and provides sufficient information to raise concerns about whether existing management adequately offsets possible threats to the species. Although the species is on the Department’s Special Animals List and the full species, *B. occidentalis,* is being evaluated for federal listing under the ESA, these designations do not afford the species any specific protections.

J. Suggestions for Future Management

1. Scientific Information in the Petition

The Petition provides suggestions for future management on pages 65-73. The Petition first outlines management actions that would benefit all bumble bees, including the petitioned species. Management actions to protect or enhance flower, nesting, and overwintering resources are expected to benefit the species. These include: practices that ameliorate or reduce the frequency of ground disturbance of nesting habitat or overwintering habitat (Osborne et al. 2008, Black et al. 2011); restoring appropriate native flower resources throughout the flight period (Aldridge et al. 2011, Mäder et al. 2011); reducing exposure to harmful pesticides, diseases, and competitors, such as nonnative honeybees (Cane and Tepedino 2016, Mallinger et al. 2017, Geldmann & González-Varo 2018); and managing land use in a way that is compatible with burrowing animal populations that provide nesting sites for the species (McFrederick and LeBuhn 2006).

Concerning the Western bumble bee specifically, the Petition asserts the need for additional comprehensive surveys of this species at historic and potential sites throughout its California range and the need for more research to evaluate basic life history and ecological needs. The Petition also recommends protecting known and potential sites from practices, such as livestock grazing, and other threats, such as conifer encroachment, that can interfere with the species' habitat requirements. It also states that the placement of managed bees in areas that may be occupied by Western bumble bees should be carefully considered to reduce competition and exposure to pathogens.

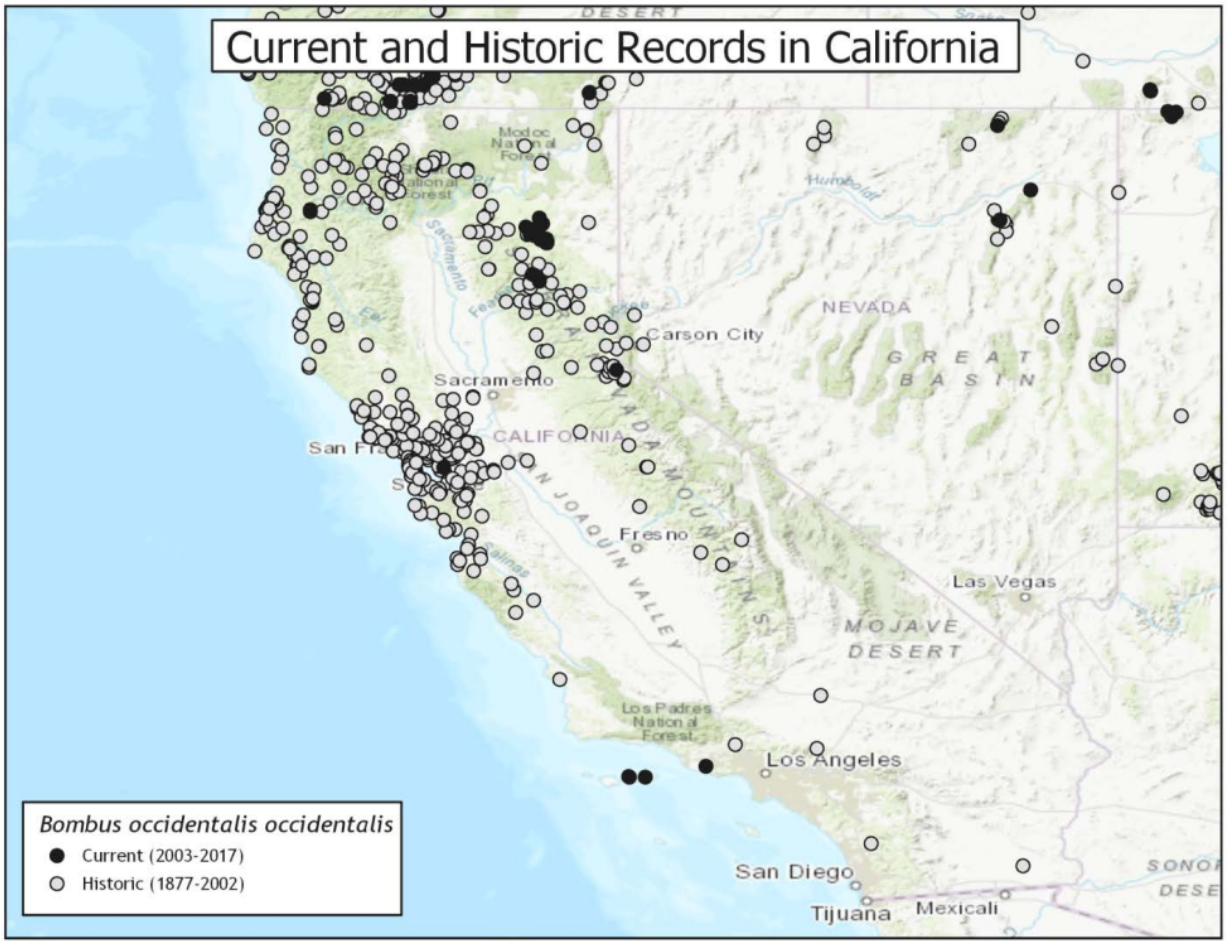
2. Conclusion

The Petition indicates there are known management actions that may aid in conserving the Western bumble bee in California.

K. Detailed Distribution Map

1. Scientific Information in the Petition

Western bumble bee (*Bombus occidentalis occidentalis*) California Distribution



2. Conclusion

The distribution map illustrates the Western bumble bee's historical and contemporary distribution in California.

III.4. Suckley cuckoo bumble bee (*Bombus suckleyi*)

A. Population Trend

1. Scientific Information in the Petition

The Petition discusses population trend for the Suckley cuckoo bumble bee on pages 6 to 9 and pages 16 to 20. The Petition presents scientific information regarding the population trend of the Suckley cuckoo bumble bee throughout its range in North America, suggesting a dramatic decline. The Petition only provides two data points concerning the Suckley cuckoo bumble bee's current range in California.

However, the Petition does provide additional indirect evidence of the Suckley cuckoo bumble bee's population trend in California. The Petition states that the Suckley cuckoo bumble bee is entirely dependent upon Western bumble bees for reproduction and therefore, Suckley cuckoo bumble bee population trends are directly linked to Western bumble bee population trends. Regarding the population trend of the host, the Petition estimates Western bumble bee abundance has declined by more than 75 percent in North America during 2002 to 2012 relative to prior records, and that roughly half as many localities are occupied. The Petition notes that the Western bumble bee's decline is most significant at the edges of its range, including California, and the host species' distribution has retracted to higher elevation sites in the Sierra Nevada and scattered locations near the coast, which would presumably limit Suckley cuckoo bumble bee distribution and abundance.

2. Conclusion

The Petition presents sufficient information on what little is known about population trend of the Suckley cuckoo bumble bee in California. Although the two California data points are insufficient direct evidence to estimate a California population trend, the Western bumble bee's trend in California indicates that the Suckley Cuckoo bumble bee may be declining in the state because of its dependence on its declining host for reproduction.

B. Range

1. Scientific Information in the Petition

Information on the range of the Suckley cuckoo bumble bee appears on pages 16 to 20 and page 118 of the Petition. The Suckley cuckoo bumble bee's historical range includes the

Klamath Mountain region in northern California, as well as portions of 11 other states and three Canadian provinces.

The Petition states that the Suckley cuckoo bumble bee's North American range has declined by roughly one-half in size, although this determination is based on the little data available about the species' current range and may not accurately capture the exact rate of decline (2002-2012). The Petition only provides two data points on the Suckley cuckoo bumble bee's current California range, making it difficult to determine if the species' range has declined in California.

2. Other Relevant Scientific Information

The Department is aware of a historical report that the Suckley cuckoo bumble bee was observed in Orleans, Humboldt County, California, but details of observations or collections were not provided (Thorp et al. 1983).

3. Conclusion

The Petition adequately addresses what little is known about the Suckley cuckoo bumble bee's California range. However, given the lack of data about the species' current range, it is difficult to know if its California range has declined or is declining.

C. Distribution

1. Scientific Information in the Petition

Information regarding distribution appears on pages 6 to 9 and 16 to 20 of the Petition. Only three or four localities with few or no repeat surveys are known in California, and the Petition does not specifically address Suckley bumble bee distribution within California.

However, the Petition describes a steep decline in occupied localities throughout the Suckley cuckoo bumble bee's North American range, including an apparent reduction in occupied range and localities within the range. The Petition adds that while the species' range has significantly declined, the exact rate of decline is difficult to determine given the lack of information available on its current range. Declining distribution of its host, the Western bumble bee, may also plausibly cause the Suckley cuckoo bumble bee's distribution to contract.

2. Other Relevant Scientific Information

The Department is aware of a historic report that the Suckley cuckoo bumble bee was observed in Orleans, Humboldt County, California, but details of observations or collections were not provided (Thorp et al. 1983).

3. Conclusion

The Petition sufficiently addresses the known scientific information on the distribution of the Suckley bumble bee in California. This information indicates a decline in distribution throughout the species' North American range. The decline in its host species, the Western bumble bee,

may be responsible or a contributing factor. It is difficult to determine if the Suckley cuckoo bumble bee's California distribution has declined considering the paucity of available data.

D. Abundance

1. Scientific Information in the Petition

The Petition discusses abundance on pages 6 to 9 and pages 16 to 20. The Petition estimates the Suckley cuckoo bumble bee's abundance has declined by approximately 90 percent throughout its range in North America, but it does not present an estimate regarding abundance within California. The Petition notes only two observations of the species reported in the state since 2002.

However, the Petition does present indirect evidence on the Suckley cuckoo bumble bee's abundance in California. Because the species is dependent on its host, the Western bumble bee, for reproduction, its abundance and distribution are also tied to its host. The Petition estimates Western bumble bee abundance has declined by more than three-quarters in North America, comparing 2002-2012 with prior years, and that roughly half as many localities are occupied. The Petition does not include an explicit discussion of Western bumble bee abundance trends within California, but it notes that in California, the host species' distribution has retracted to higher elevation sites in the Sierra Nevada and scattered locations near the coast, which would presumably limit Suckley bumble bee distribution and abundance. The Western bumble bee's current distribution map (see III.3.K) indicates the host species has not recently been observed within the Suckley cuckoo bumble bee's historic range, although there have been sightings nearby.

2. Conclusion

The Petition presents sufficient information on what little is known about the abundance of the Suckley cuckoo bumble bee in California. Although little direct evidence is available on the species' current abundance in California, data for its host species, the Western bumble bee, indicates the Suckley cuckoo bumble bee may be declining in abundance within the state.

E. Life History

1. Scientific Information in the Petition

Information concerning life history appears on pages 28 to 29 and pages 35 to 36 of the Petition. The Petition describes the Suckley cuckoo bumble bee as a social parasite that has only been documented to reproduce successfully within colonies of the Western bumble bee (Thorp et al. 1983). The Petition notes spatial and temporal co-occurrence with the host are essential. See section III.3.E for more information on the life history of the Western bumble bee.

The Petition also notes cuckoo bumble bees emerge from their hibernacula later in spring than other bumble bees. Suckley cuckoo bumble bee's flight period for females ranges from late May through October, peaking in June. Males fly July through September (Thorp et al. 1983). Upon emerging from hibernation, the female forages (visits flowers) while searching for a suitable host bumble bee nest. Upon finding a nest, she enters, kills or subdues the queen, and using pheromones or physical attacks, "enslaves" the host workers. Then she lays her own eggs and forces the host workers to feed her and her young. All resulting Suckley cuckoo bumble bee offspring are reproductive – not workers – and leave the colony to mate. Male Suckley cuckoo bumble bees patrol circuits in search of mates. Mated females seek a place to overwinter, and the cycle repeats. Little is known about the hibernacula, or overwintering sites, of the Suckley cuckoo bumble bee, although bumble bees of other species are known to overwinter in soft, disturbed soil (Goulson 2010) or under leaf litter or other debris (Williams et al. 2014).

2. Other Relevant Scientific Information

Male bumble bees visit flowers for energy while they look for females (Thorp et al. 1983).

3. Conclusion

The Petition provides sufficient scientific information regarding the Suckley cuckoo bumble bee's life history.

F. Kind of Habitat Necessary for Survival

1. Scientific Information in the Petition

The Petition addresses the Suckley cuckoo bumble bee's habitat requirements on pages 35 to 36. The Petition notes that Suckley cuckoo bumble bees require floral resources during the free-flying portions of their life. They have been observed primarily visiting composite flowers (e.g., *Aster*, *Centaurea*, *Cirsium*, *Solidago*) and also *Penstemon* and *Salix* (Thorp et al. 1983). Overwintering requirements of Suckley cuckoo bumble bees are not specifically known. Other species generally bury themselves in soft soil or under leaf litter or other debris.

The Petition notes that Suckley cuckoo bumble bees use Western bumble bee colonies as hosts and have only been observed reproducing in Western bumble bee nests. As a result, their essential habitat not only must include their own floral and overwintering requirements, but also those of their host species (see section III.3.F for discussion of the Western bumble bee's habitat requirements).

2. Conclusion

The Petition presents sufficient information regarding the kind of habitat necessary to the Suckley cuckoo bumble bee for survival. It indicates the species requires habitat with resources that support its own needs and also those of its host, the Western bumble bee.

G. Factors Affecting the Ability to Survive and Reproduce

1. Scientific Information in the Petition

The Petition discusses factors affecting the Suckley cuckoo bumble bee's ability to survive and reproduce on pages 37 to 62. As outlined in section II.D., the Petition highlights several threats to all bumble bees, including the Suckley cuckoo bumble bee. These include habitat modification, herbicides, pesticides, competition, disease, and population dynamics. Additionally, factors affecting the Western bumble bee (see section III.3.G.) indirectly impact the Suckley cuckoo bumble bee due to their host-parasite relationship. The Petition highlights that the pathogen *N. bombi* may threaten the continued existence of the species directly, as well as indirectly by reducing the population of its host, the Western bumble bee.

2. Conclusion

The Petition adequately describes factors affecting the Suckley cuckoo bumble bee's ability to survive and reproduce, including the factors affecting its host, the Western bumble bee.

H. Degree and Immediacy of Threat

1. Scientific Information in the Petition

The Petition discusses the degree and immediacy of the threat to the Suckley cuckoo bumble bee on pages 62 to 63. The Petition highlights that bumble bees as a whole are threatened by a number of factors including agricultural intensification, habitat loss and degradation, pesticide use, pathogens from managed pollinators, competition with non-native bees, climate change, and genetic factors (reviewed in Goulson 2010; Williams et al. 2009; Williams and Osborne 2009; Cameron et al. 2011b; Hatfield et al. 2012; Fürst et al. 2014). It notes the magnitude of loss and rate of decline the Suckley cuckoo bumble bee has experienced and states that current regulations and regulatory mechanisms are inadequate to protect Suckley cuckoo bumble bees against the threats they face within California. The Petition states that, without protective measures, the Suckley cuckoo bumble bee is likely to go extinct in California. Potential loss of its host, the Western bumble bee, is noted as a particular threat to this cuckoo bumble bee.

2. Conclusion

The Petition presents sufficient information to indicate that the Suckley cuckoo bumble bee may be subject to substantial and present threats within California, due to the decline of its host, the Western bumble bee, and from disease and other factors.

I. Impact of Existing Management Efforts

1. Scientific Information in the Petition

The Petition discusses the impact of existing management efforts on page 63. The Petition notes that the Suckley cuckoo bumble bee is on the Department's Special Animals List (CDFW 2018) and is listed as Critically Endangered by the IUCN Red List (Hatfield et al. 2015c). Range wide, the species has a NatureServe Global Status rank of G1G3 (Critically Imperiled to Vulnerable) and a state rank of S1 (Critically Imperiled) in California (NatureServe 2018).

2. Other Relevant Scientific Information

Some factors that may result in threats to the petitioned species, including herbicides and pesticides, competition, and disease, are subject to various forms of federal and State regulatory oversight. However, these regulatory mechanisms are not specifically designed to conserve or recover Suckley cuckoo bumble bee populations.

3. Conclusion

The Petition provides sufficient information to raise concerns about whether existing management adequately offsets possible threats to the species. Although the species is on the Department's Special Animals list and designated on other organizations' lists, these designations do not afford the species specific protections, and the Petition does not indicate there are any other management actions specifically designed and implemented to conserve or recover the Suckley cuckoo bumble bee.

J. Suggestions for Future Management

1. Scientific Information in the Petition

The Petition provides suggestions for future management on pages 65 to 73. The Petition first outlines management actions that would benefit all bumble bees, including the petitioned species. Management actions to protect or enhance flower, nesting, and overwintering resources are expected to benefit the species. These include: practices that ameliorate or reduce the frequency of ground disturbance of nesting habitat or overwintering habitat (Black et al. 2011, Osborne et al. 2008); restoring appropriate native flower resources throughout the flight period (Aldridge et al. 2011, Mäder et al. 2011); reducing exposure to harmful pesticides, diseases, and competitors such as nonnative bees (Cane and Tepedino 2016, Geldmann & González-Varo 2018, Mallinger et al. 2017); and managing land use in a way that is compatible with burrowing animal populations that provide nesting sites for native bumble bees (McFrederick and LeBuhn 2006).

Addressing the Suckley cuckoo bumble bee specifically, the Petition asserts that more research is needed to determine if the species can use species other than the Western bumble bee to reproduce and notes additional life history information could improve understanding of the species' biological needs. The Petition also notes this species would benefit from management

actions to protect known and potential sites from practices, such as livestock grazing, and other threats, such as conifer encroachment, that may interfere with the habitat requirements of this species or its host.

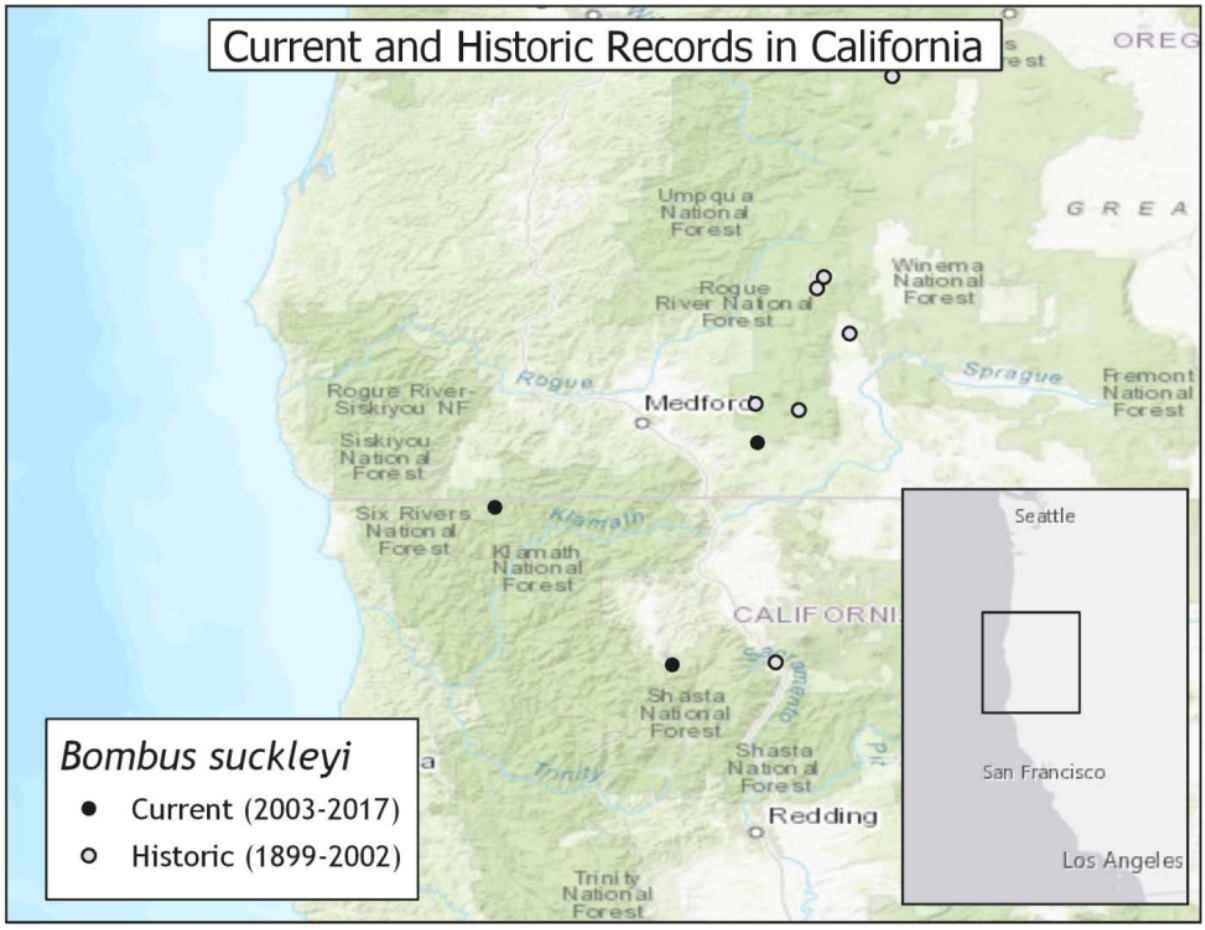
2. Conclusion

The Petition indicates additional, known management actions may aid in conserving the Suckley cuckoo bumble bee in California. The Petition also notes that further research into the species' life history and reproductive habits would improve understanding of the species, and this would contribute to the development of beneficial management practices.

K. Detailed Distribution Map

1. Scientific Information in the Petition

Suckley Cuckoo Bumble Bee (*Bombus suckleyi*) California Distribution



2. Other Relevant Scientific Information

One record of undetermined provenance may have been omitted from the map (see section III.4.B above).

3. Conclusion

The distribution map illustrates the Suckley cuckoo bumble bee's historic and contemporary distribution in California.

III.5. Sources and Availability of Information

A. Scientific Information in the Petition

The Petition cited over 300 sources of scientific information related to bumble bees, most of which are publicly available. Approximately 20 of these were cited specifically in relation to the Crotch bumble bee, 37 in relation to the Franklin bumble bee, 53 in relation to the Western bumble bee, and 22 in relation to the Suckley cuckoo bumble bee, in addition to references about related species or relevant to bumble bee biology generally. A small fraction of the cited sources are not readily available. The Petitioners provided electronic copies of most sources they cited in the Petition, including some unpublished sources, to the Department.

B. Other Relevant Scientific Information

The Department used additional sources of scientific information which are cited in this Petition Evaluation document.

C. Conclusion

The Petition contains sufficient available sources of information to inform whether the petitioned action may be warranted.

IV. Recommendation to the Commission

In completing its Petition Evaluation, the Department has determined the Petition provides sufficient scientific information to indicate the petitioned action may be warranted for the Crotch bumble bee, the Franklin bumble bee, the Western bumble bee, and the Suckley cuckoo bumble bee. Therefore, the Department recommends the Commission accept the Petition for further consideration under CESA.

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