**BEFORE THE SECRETARY OF THE INTERIOR**

# PETITION TO LIST THE MOJAVE POPPY BEE (*Perdita meconis*) UNDER THE ENDANGERED SPECIES ACT AND CONCURRENTLY DESIGNATE CRITICAL HABITAT

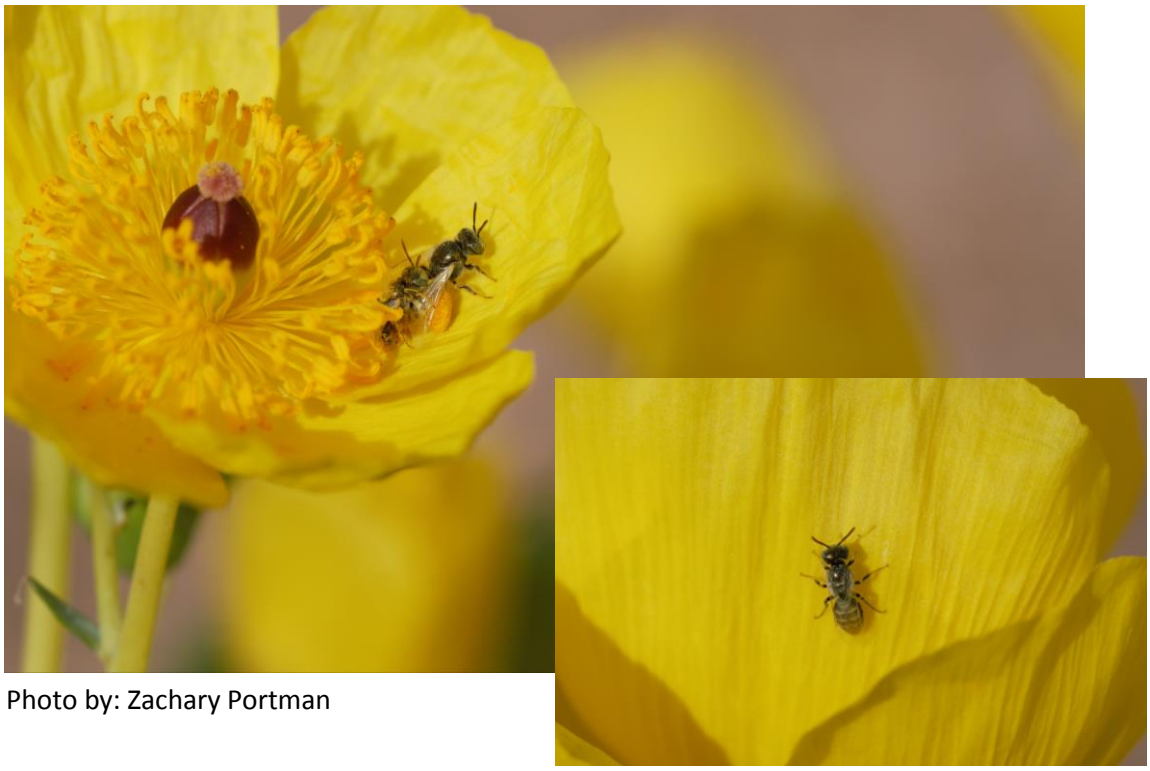

Photo by: Zachary Portman

**CENTER FOR BIOLOGICAL DIVERSITY**

**OCTOBER 17, 2018**

**NOTICE OF PETITION**

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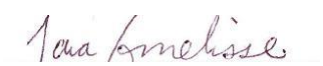
Pursuant to Section 4(b) of the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b); Section 553(e) of the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity hereby petitions the Secretary of the Interior, through the United States Fish and Wildlife Service ("FWS," "Service"), to protect the Mojave poppy bee (*Perdita meconis*) under the ESA.

FWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on the Service. Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). FWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." Id.

Petitioner also requests that critical habitat be designated for the Mojave poppy bee concurrently with the species being listed, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12.

Petitioner is The Center for Biological Diversity ("Center") is a nonprofit, public interest environmental organization dedicated to the protection of imperiled species and the habitat and climate they need to survive through science, policy, law, and creative media. The Center is supported by more than 1.6 million members and online activists throughout the country. The Center works to secure a future for all species, great or small, hovering on the brink of extinction. The Center submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the Mojave poppy bee and its habitat.

Submitted this 17th day of October, 2018



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## Executive Summary

*Perdita meconis*, or the Mojave poppy bee, is an extremely rare and declining bee that was described in 1993. The Mojave poppy bee has its current known range in Clark County, Nevada in the Lake Mead National Recreation Area and adjacent Bureau of Land Management land. Historically, it was found in Washington County, Utah but its extinction in Utah was documented in 2014 with confirmation in 2017. In addition, there are historic occurrences in California and one occurrence in Arizona. The Mojave poppy bee is not formally protected in any capacity.

The Mojave poppy bee is a rare oligolege (pollen specialist) that collects pollen from poppies that produce pollen but no nectar (Tepedino et al. 2014 pp. 317–318). Specifically, the bee is a pollinator of two rare plants, the Las Vegas bear-poppy (*Arctomecon californica*) and the Dwarf bear-poppy (*Arctomecon humilis*) and is vital to their survival in turn. The Las Vegas bear-poppy is a rare plant and critically endangered species in the state of Nevada and the Dwarf bear-poppy is a federally endangered species found only in Washington County, Utah. Both plants continue to be imperiled due to the loss of the Mojave poppy bee in Utah and throughout its range in Nevada. The relationship between the Mojave poppy bee and the bear-poppies has evolved over thousands if not millions of years in one of the most unique ecosystems in the world, the Mojave Desert. In spring, the Mojave Desert erupts in a gorgeous floral display that attracts thousands of people who want to witness this unparalleled ecosystem. The Mojave poppy bee is an integral part of this ecosystem, playing a vital role by effectively pollinating two characteristic bear-poppies. Without this tiny but charismatic bee, the Mojave Desert is at risk of losing three species that define the very essence of the Mojave.

Unfortunately, the Mojave poppy bee is imperiled by habitat fragmentation due to urbanization, grazing that degrades its habitat, non-native honey bees that compete with the bee and degrade the plant community, motorized recreational activities, gypsum mining, climate change, lack of genetic diversity, and lack of protective regulatory mechanisms. While remaining populations of the Mojave poppy bee are on public land, these areas are not managed to protect the bee and activities that threaten the bee are ongoing. In addition to ongoing threats, the Mojave poppy bee faces new and looming threats, including recently approved expansion of the disposal boundary around Las Vegas, approved expansion of gypsum mining adjacent to two of the known remaining Mojave poppy bee populations, and the impacts of the highest human population growth rates in the country occurring within the bee's range. These threats have caused the Mojave poppy bee to decline from across a large regional range of the Mojave Desert to seven known populations and a confirmed extinction in Utah. Continuation of threats and lack of protections are causing the demise of this native bee species.

Conservation actions needed to prevent the otherwise imminent extinction of Mojave poppy bee will require managing key threats such as mining and grazing, managing recreation in areas containing host plants, and controlling non-native honey bees. Critical habitat must provide connected, dense areas containing their host plants within open areas of gypsum soil that remain undisturbed. The Service must act to protect the Mojave poppy bee under the Endangered Species Act of 1973 (as amended) in order to prevent the extinction of the species and its important pollination mutualisms that shape the iconic Mojave Desert.

# Introduction

It is well established that the health of natural ecosystems and humanity are intricately linked to the health of pollinators (Pollinator Health Task Force 2015 p. 1,8; IPBES 2016). Animal pollination, the vast majority of which is done by bees, is required for successful reproduction of around 90% of wild plants and 75% of leading global food crops, with 35% of the global food supply depending on animal pollinators (Moissett & Buchanan 2010 p. 2; IPBES 2016 p. 16). Beyond food production, pollinators play an important role in ensuring the natural production of medicines, biofuels, fibers, construction materials, as well as recreational, cultural, and aesthetic values (IPBES 2016 p. 18).

There are over 4,000 species of native, wild, mostly solitary (non-social), bees in the United States that are needed to pollinate the full spectrum of plants in an ecosystem (Aslan et al. 2016 p. 483; Winfree et al. 2018 p. 359). Native bees often provide more effective pollination (i.e. resulting in higher seed set) of native plants than the introduced honey bee (*Apis mellifera*) (Moissett & Buchanan 2010 p. 1; Garibaldi et al. 2013 p. 2). These wild pollinators have declined in diversity, abundance, and occurrence in North America (IPBES 2016 pp. 21–22) and are imperiled by a multitude of confounding threats that include habitat loss, agricultural intensification, pesticide use, invasive non-native species, climate change, and pathogens (Pollinator Health Task Force 2015 p. 5; IPBES 2016 pp. 24–29).

The Mojave poppy bee (*Perdita meconis*) plays a vital role in maintaining the Mojave Desert ecosystem, as it pollinates two rare bear-poppies: the federally endangered Dwarf bear-poppy (*Arctomecon humilis*) and the Nevada state critically endangered Las Vegas bear-poppy (*Arctomecon californica*) (Senft 1990 p. 3). However, these pollination mutualisms are being simplified by the decline of the Mojave poppy bee throughout its range due to ongoing and imminent threats described in this petition. To conserve these important and imperiled pollination mutualisms, the Service should list the Mojave poppy bee as endangered and designate critical habitat for the species.

# Natural History

## Description

The Mojave poppy bee was described in 1993 during efforts to determine the pollinators of the endangered Dwarf bear-poppy (Griswold 1993 p. 183). *Perdita meconis* is named so for the Latin "mecon", or poppy, as it is oligolectic, or a pollen gathering specialist that is restricted to the genera *Arctomecon* and *Argemone* in the eastern Mojave Desert (Griswold 1993 p. 187). Females of the Mojave poppy bee have pale yellow head markings and are 6.5-7 mm in length with a forewing length of 4.5-5 mm, males have dark green heads with pale yellow mandibles and are 4.5-5.5 mm long with a forewing length of around 4 mm (Griswold 1993 pp. 184–185). While females are difficult to distinguish from close relatives in the *P. californica* group, males of the Mojave poppy bee have distinctive yellow facial marks, shagreened galea, and a dark metasoma with yellow markings, among other identifiers that distinguish the species (Griswold 1993 p. 183).

## Taxonomy

There is no confusion or dispute over the taxonomic validity of *Perdita meconis*; it is a member of the tribe Perditini in the family Andrenidae. The genus *Perdita* is restricted to North America and

consists of tiny (2mm) to moderate (10mm) sized bees with a defining wing characteristic of a short, truncate marginal cell; Perditini generally also have clear body color patterns with sparse hair (Michener 2007 p. 296). Nearly all species of *Perdita* are oligolectic (Michener 2007 p. 296). The highest diversity of Perdita is located in the desert southwest in the United States and northern Mexico (Michener 2007 p. 299).

## Life Cycle and Behavior

Adult Mojave poppy bee activity occurs after winter rains when poppies begin to bloom around early April, lasting for a few weeks as adults mate and females build nests and lay eggs. Solitary bees are central place foragers, bringing food back to a central nest after long bouts of foraging (Cane 2001 p. 4). Females provision a brood cell with a ball of pollen upon which one egg is laid and left to hatch and develop. The larvae develop and then enter diapause as the final larval instar or pre-pupa, remaining in that stage overwinter before pupating and then emerging in early spring as adults (Danforth 1999 p. 1986). Members of the genus *Perdita* nest in the soil with an entrance burrow that leads to many branches ending in one brood cell (Michener 2007 p. 296). A single nest is used by only one female (Danforth 1989 pp. 59–60) and each nest is likely to have multiple brood cells (average 1-20 cells per nest), with one provisioned per day (Danforth 1989 pp. 64–65).

Desert *Perdita* exhibit bet hedging, or a reproductive strategy that reduces between year variance in reproductive success and increases overall survival in their desert habitat, an ecosystem with extremely unpredictable annual weather conditions (Danforth 1999 p. 1985). In response to their unpredictable habitat, they can enter extended diapause for two or three years due to their arid habitat, delaying emergence until blooms of their host plants (Portman et al. 2016 p. 6). Oligolectic bees do not switch pollen sources if they emerge when their host plant is not in bloom and they have evolved synchrony in emergence time with the blooming period of the plants, using rainfall or humidity as an emergence cue (Danforth 1999 p. 1986 and 1991–92).

### Pollination and Mating Behavior

Female Mojave poppy bees collect pollen for 30 seconds to several minutes and often visit more than one flower on a plant; they are often seen landing on a poppy flower with pollen from another congener and pollination occurs when they contact the stigma (Hickerson 1998 pp. 35–36). Females that have been tracked visited more than one plant while foraging (Tepedino et al. 2014 p. 318). Males wait and defend spots on flowers and copulate with females as they arrive to the flower (Tepedino et al. 2014 p. 319). Specifically, males move about the poppy flowers while waiting for females and will actively engage in aggressive behavior with other males, resulting in tumbling of the males throughout the flower with both of them collecting pollen and contacting the stigma (Portman et al. 2018a p. 10). The presence of a defending Mojave poppy bee male on a poppy flower causes other males as well as other bee species to move on to a different flower, promoting outcrossing and pollination efficiency (Portman et al. 2018a p. 10). Mojave poppy bee mating occurs in a flower, with the pair often contacting the stigma, before the female moves on to another flower (Hickerson 1998 p. 36). Thus, the Mojave Poppy bee is an effective pollinator of bear-poppies (Portman et al. 2018a p. 10). Its pollination behavior and oligolectic relationship with the bear-poppies strongly suggests that the Mojave poppy bee was

once abundant wherever poppies occurred, as it is most effective at pollinating when abundant (Hickerson 1998 p. 36).

### Foraging Range

The flight distance or dispersal radius of a bee species is dependent upon its size and physiological factors as well as external barriers (Zurbuchen et al. 2010b p. 669). In a test of six bee families, including Andrenidae, Greenleaf et al. (2007 p. 592) found that foraging distance increased with bee body size and that smaller bees, like the Mojave poppy bee, forage disproportionately shorter distances than larger bees (Greenleaf et al. 2007 p. 593). Maximum foraging ranges for Andrenid bees with lengths measured between 8 and 15 mm ranged from 130 m to 1150 m (Zurbuchen et al. 2010b p. 671). However, there is a significant decrease in the number of female bees foraging at increasing distance: for tested bees that had a maximum foraging distances of 1100 m and 1400 m, 75% of females discontinued foraging at 400 m and 700 m, respectively (Zurbuchen et al. 2010b pp. 673–674). At 10 mm in length *Andrena humilis* is larger than the Mojave poppy bee (Franzén & Nilsson 2013 p. 1406), yet was found to have an average foraging range of only 50 m and habitat patches more than 200 m apart were too isolated to reach based on the movement of marked bees (Franzén & Nilsson 2013 p. 1401).

Considering the small size, oligolectic foraging, and strict nesting requirements of the Mojave poppy bee, it is expected that this bee would have a maximum foraging distance of around 300 m. This is most likely an overestimate as it is based on foraging ranges of larger bees (Zurbuchen et al. 2010b p. 671) and Tepedino (2000 p. 8) found that the maximum distance traveled by a bee in desert landscapes was 400 m. Indeed, most individual solitary bees cannot reach foraging maximums and thus require nest and host plant habitat be overlapping to within 100 m of each other (Zurbuchen et al. 2010b p. 675). In a similar desert plant specialist, *Perdita coreopsidis*, marked bees foraged less than *five* meters from the nest, which is more likely the case for the tiny, oligolectic Mojave poppy bee (Danforth 1989 p. 69).

## Habitat

As the Mojave poppy bee is a strict specialist and does not switch host plants, its habitat must consist of both dense patches of bear-poppies and nesting substrate within flight range of those patches (Cane 2001 p. 2). For nesting, the Mojave poppy bee requires open patches of gypsum soil (Clark County Department of Comprehensive Planning 2000a p. 216). Gypsum substrates within which the bear-poppy host plants grow and the Mojave poppy bee nests are those that contain 18-69% gypsum, which tend to have lower bulk densities (a measure of soil particle concentration) and moisture availability during the dry summer months (Megill & Walker 2006 p. 4). Mojave gypsum soils are often covered with flat or low-growing lichen, moss, and cyanobacteria (or cryptogamic) crusts that, when left undisturbed, prevent erosion and increase nitrogen availability in the soil (Harper & Van Buren 2004 pp. 482–483). Nesting resources are key factors in solitary bee population viability; however, Mojave poppy bee nests are difficult to locate and proxy measurements of gypsum soil with bare ground or cryptogamic crusts and host plant proximity can be used to quantify nesting site availability and habitat quality (Sardinas & Kremen 2014 p. 162).

## Host Plants

### *Dwarf bear-poppy*

Federally listed in 1979 as endangered, the Dwarf bear-poppy is one of only three species in the poppy genus *Arctomecon* (family Papaveraceae). It is endemic to Utah, where it is the only resident member of this genus (U.S. Fish and Wildlife Service 2016 p. 4). The Dwarf bear-poppy is a perennial that lives for five years and flowers in its second year in early April, producing 20-30 flowers, on average, that last for 1-3 days (Harper & Van Buren 2004 p. 482; Tepedino et al. 2014 p. 315). The Dwarf bear-poppy is found on sparsely vegetated soils characterized by high levels of gypsum, calcium, and copper and low concentrations of magnesium, iron, and potassium; suitable habitat is predicted by annual precipitation, gypsum in soils, and maximum summer temperatures (U.S. Fish and Wildlife Service 2016 pp. 4–5). There are eight remaining Dwarf bear-poppy populations that are all fragmented by rapid human development (Tepedino et al. 2014 p. 312) as well as threatened by grazing and recreation (Portman & Tepedino 2018 p. 2).

Dwarf bear-poppies depend on pollinators for successful reproduction, as flowers that reproduced via a pollinator produced significantly more fruits and seeds than self-pollinated plants (Tepedino et al. 2014 p. 316). The flowers are visited by pollen collecting bees that included Mojave poppy bee in the past and, now, the introduced honey bee (Tepedino et al. 2014 p. 318). Honey bees lack floral fidelity as they visit many other plants in a foraging bout and so are less effective at pollinating the bear-poppy (Harper et al. 2001 p. 105; U.S. Fish and Wildlife Service 2016 pp. 34–35). Pollination rate is also influenced by plant density, thus when Dwarf bear-poppy is rare in the habitat, seed production declines (Harper et al. 2001 p. 107; U.S. Fish and Wildlife Service 2016 p. 5). Dwarf bear-poppy seeds can require years to germinate and captive germination has not been successful for this species (U.S. Fish and Wildlife Service 2016 p. 6).

The five-year review of the Dwarf bear-poppy by the FWS Utah Office in 2016 concluded the loss of the Mojave poppy bee in Utah is a high level threat that causes pollen limitation and synergistically exacerbates existing threats to the poppy (U.S. Fish and Wildlife Service 2016 pp. 34–36). The review also concluded that Dwarf bear-poppy recovery requires protection of unoccupied suitable habitat because the majority of any given population may be in the seedbank and thus not visible on the landscape (U.S. Fish and Wildlife Service 2016 p. 18). In addition, to properly conserve the poppy, measures must be taken on private lands, however FWS is limited in protecting ESA listed plants on such lands (U.S. Fish and Wildlife Service 2016 p. 27 and 37). Listing the Mojave poppy bee is the only way to mitigate these threats and prevent the extinction of the Dwarf bear-poppy.

### *Las Vegas bear-poppy*

The Las Vegas bear-poppy grows in gypsum soils and is listed as critically endangered in the state of Nevada, as it is declining in Clark County (Clark County Department of Comprehensive Planning 2000a p. 212). It has also been found in Mohave County, Arizona and is protected as a state listed species there as well (Arizona Game and Fish Department 2016 p. 15). The Las Vegas bear-poppy has been on the decline across its range since a population high in 1994 (Megill & Walker 2006 p. 3) and the Clark County populations are crucial for survival of the species (The Nature Conservancy 2007 pp. 48–49). In a survey done by The Nature Conservancy contracted by the Nevada Division of Forestry in 2005,

Las Vegas bear-poppy populations were found at only nine (24%) of the 37 previously occupied sites surveyed (Klein 2005 pp. 6–9). A population viability analysis of 30 years of Las Vegas bear-poppy demographic data revealed that while smaller, fragmented stand are threatened by lack of pollination and, even large, dense stands are vulnerable to extinction due to environmental stochasticity such an fluctuations in climate (The Nature Conservancy 2007 p. 60). More recent Las Vegas bear-poppy monitoring for the Clark County Multiple Species Habitat Conservation Plan (MSHCP) occurred in 2008-2009 in 28 sites randomly chosen from 104 historic sites documented in 1996 (Bangle et al. 2010 p. 12). During the surveys, the number of bear-poppies decreased at all sites except one and percent cover of the Las Vegas bear-poppy decreased and very few seedlings were documented (Bangle et al. 2010 p. 22). Further, compared to numbers in 1996, 25 out of 28 populations had a reduction in bear-poppy individuals, in some cases by an order of magnitude or more, such as from 50,000 to 1,000 at Rainbow Gardens on BLM land and 15,000 to 1,000 at sites in both Gold Butte on BLM land and Echo Wash in LMNRA (Bangle et al. 2010 p. 77).

The main driver of decline in Las Vegas bear-poppy abundance is habitat fragmentation and soil compaction caused by urbanization and associated development of Clark County (Hickerson 1998 p. 13). There is also a lack of gene flow and diversity in fragmented Las Vegas bear-poppy populations as each is becoming genetically distinct (Hickerson 1998 p. 46). This leads to erosion of genetic variation needed to withstand future threats, such as climate change. Thus, despite the intention in the MSHCP to prevent the need to list the Las Vegas bear-poppy as federally endangered, it is still declining.

Loss the Mojave poppy bee from fragmented and urban areas in Clark County (Hickerson 1998 p. 33) is a major threat to the Las Vegas bear-poppy (The Nature Conservancy 2007 p. 52). Fragmented populations of the Las Vegas bear-poppy are severely pollen limited and have reduced seed set (Hickerson 1998 p. 24). The Las Vegas bear-poppy may well be heading towards extinction unless conservation actions ensure connectivity for pollinator viability, including and especially those that would stem from the listing of the Mojave poppy bee (The Nature Conservancy 2007 pp. 55–57).

## Current and Historic Distribution

The Mojave poppy bee is narrowly distributed and its current known range is in Clark County, Nevada in the Lake Mead National Recreation Area (LMRNA) and adjacent Bureau of Land Management (BLM) lands. Historically, it was found in Washington County, Utah but is now extirpated from the state. Historic occurrences at one site in Arizona and at one area within the Mojave National Preserve of California are uncertain (Portman et al. 2018b pp. 594–595). Below is a summary of the declining status of the Mojave poppy bee in the four states, with the best available science, which indicates that it is heading towards extinction.

When the Mojave poppy bee was originally described as a new species in 1993, bees found in 1980 and 1982 on an *Argemone sp.* in the Mojave National Preserve in San Bernardino County, California were labeled as *Perdita meconis* (Griswold 1993 p. 184). Outside of Utah and Nevada, the most recent record of the Mojave poppy bee in California area is 23 years ago in 1995 and 25 years ago in 1993 at one site in Arizona's White Hills (Griswold 2018). The Mojave poppy bee has not been documented in either location since and there are no records of the bee in the entomological collections at the University of California at Riverside (Yanega 2018).

In Utah, the Mojave poppy bee was found as the main pollinator of the endangered Dwarf bear-poppy in 1988-1993 in Washington County (Griswold 1993 p. 184). Mojave poppy bee males and females were common on Dwarf bear-poppy in 1988 and 1993, so much so that hundreds of sightings were made in 1993 (Tepedino et al. 2014 p. 318). Its extinction in Utah is now documented (see section on Utah extinction due to lack of adequate regulatory mechanisms) (Portman & Tepedino 2018 p. 43).

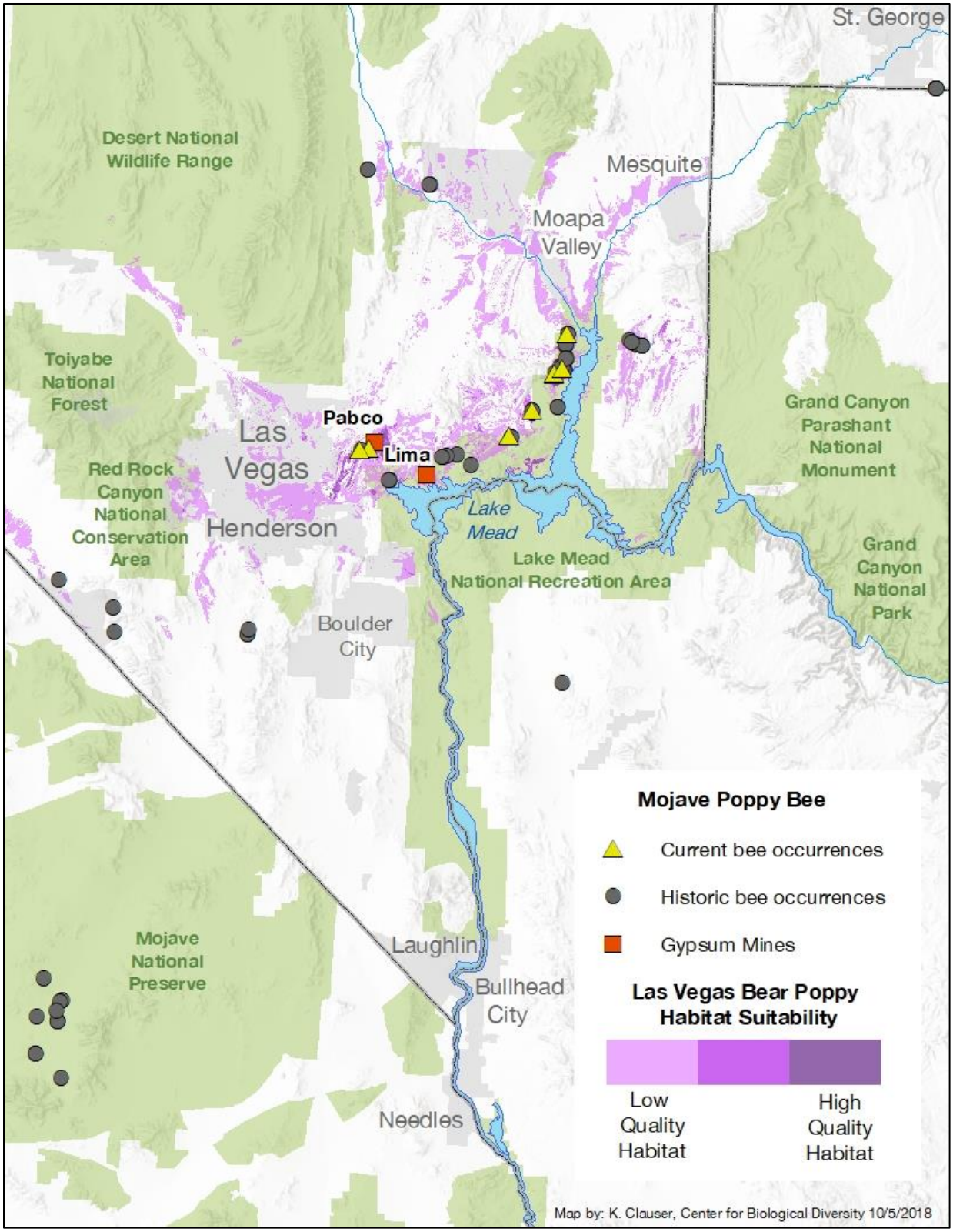
In Nevada, the distribution of the Mojave poppy bee was assumed to correspond to the range of the Las Vegas bear-poppy in and around Las Vegas. However, the bee was not detected when searched for in 1995 by Hickerson in fragmented patches in and around the city of Las Vegas (Hickerson 1998 p. 33). Hickerson (1998 p. 33) did find the Mojave poppy bee at nine unfragmented sites: one, Pabco Junction, managed by the BLM and eight within the LMNRA, managed by the National Parks Service: Calville Wash, Upper Echo Wash, Roger's Spring, St. Thomas, Stewart's Bay, Stewart's Bay Road Junction, Overton Beach Road Junction, and Echo Bay.

In 2017, Portman et al. (2018a p. 7) found the Mojave poppy bee at five of those nine sites in the LMNRA examined by Hickerson in 1998: Pinto Ridge (Calville Wash area), Upper Echo Wash, Roger's Spring, St. Thomas, and Stewart's Bay/Stewart's Bay Road Junction. They found that the animals at the Stewart's Bay Road Junction most likely had become part of the Stewart's Bay population, so they are not considered separate populations (Portman 2018b). At both the Overton Beach Road Junction and what was thought to be the original Calville Wash site, Portman et al. found little to no bear-poppies, suggesting the sites are no longer viable habitat for the Mojave Poppy bee (Portman 2018b). The Mojave poppy bee was found to be extirpated from Echo Bay (Portman et al. 2018a p. 7). The bee was still present on the BLM site Pabco Junction as well as found at a nearby site called Pabco Road (Portman et al. 2018a p. 7). These two Pabco sites are in close proximity (Portman et al. 2018a p. 26).

At both Pabco Junction and Pabco Road, the Mojave poppy bee was the only bee species observed visiting the Las Vegas bear-poppy and at all sites it was the dominant bear-poppy visitor (Portman et al. 2018a p. 7), attesting to its importance as a pollinator of this critically endangered plant. At Echo Bay, where the bee was not found, few bear-poppies were present: the Mojave poppy bee is generally associated with a high density of bear-poppies plants (Portman et al. 2018a p. 7).

The Mojave poppy bee is completely absent from urbanized areas and locations affected by human activity in both Utah and Nevada (Portman et al. 2018a pp. 4, 15). As the bee was recently described in 1993 and then searched for in 1995 and recent years, it is likely that it was present throughout the range of the Dwarf bear-poppy in Utah and was reduced to one site due to increasing habitat destruction and fragmentation caused by human settlements, highways, and industrial and recreation activities so that this one Utah site ultimately became extirpated (Portman et al. 2018a p. 15).

This same pattern can be seen in Nevada, with the absence of the Mojave poppy bee in urbanized, fragmented Las Vegas bear-poppy patches (Hickerson 1998 p. 33; Portman et al. 2018a pp. 14–15). Urban, fragmented areas not only have less host plants, they also lack suitable Mojave poppy bee nesting sites, due to the soil disturbance (Hickerson 1998 p. 41). Thus, the Mojave poppy bee has been extirpated from a significant portion of its range and its known current range has been reduced to merely seven known fragmented populations within the non-urbanized LMNRA and adjacent BLM lands. Worse, as this petition describes, it is greatly imperiled even still within those few sites and needs federal protection under the ESA to avoid extinction.




Mojave poppy bee current (yellow triangles) and historic (gray circles) occurrences; also showing the locations of two active gypsum mines and habitat suitability for the Las Vegas bear-poppy.

## Conservation Status and Warranted ESA Protection

The ESA is a "comprehensive scheme with the 'broad purpose' of protecting endangered and threatened species." Ctr. for Biological Diversity v. U.S. Bureau of Land Mgmt., 698 F.3d 1101, 1106 (9th Cir. 2012) (quoting Babbitt v. Sweet Home, 515 U.S. 687, 698 (1995)). Congress' plain intent in enacting the ESA was "to halt and reverse the trend toward species extinction." Tenn. Valley Auth. v. Hill, 437 U.S. 153, 184 (1978). In doing so, the ESA requires that "all Federal departments and agencies *shall* seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of [these] purposes." 16 U.S.C. § 1531(c)(1) (2012). Endangered and threatened species are "afforded the highest of priorities." Tenn. Valley Auth., 437 U.S. at 174. Endangered species are species that are "in danger of extinction throughout all or a significant portion of its range," and threatened species, species that are "likely to become endangered species within the foreseeable future" and are listed for protection pursuant to section 4 of the ESA. 16 U.S.C. § 1532(6), 1532(20), 1533.

The Mojave poppy bee has been recognized as imperiled or needing protection by international, state and local entities. It has a NatureServe ranking of G2/imperiled from 2005, which was prior to the confirmation of its extirpation from Utah and increased threats (NatureServe 2018 p. 1). According to NatureServe, as of 2005, 86 sites that contained host plants were sampled and the bee was absent from "most sites" (NatureServe 2018 p. 2). It is also a BLM Nevada sensitive species, and is listed as a high priority evaluation species under the Clark County MSHCP for certain ecosystems (Clark County Department of Comprehensive Planning 2000a p. 185).

The ESA defines an endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range" and a threatened species as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." As demonstrated by the best available science, the Mojave poppy bee meets the definition of endangered and must be listed as endangered.

The ESA states that a species shall be determined to be endangered or threatened based on any one of five factors (16 U.S.C. § 1533 (a)(1)): 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting its continued existence. The Mojave poppy bee's most significant known imperilment is caused by factors one, four, and five. The third factor, the threat of "disease or predation," specifically disease from non-native honey bees, is a likely threat. Also, while the bee itself is not overutilized for commercial, recreational, scientific, or educational purposes, its habitat is significantly overutilized for commercial and recreational purposes. Thus, the Mojave poppy bee warrants protection under the Act. The best available science shows that the Mojave poppy bee is in danger of extinction in a significant portion of its range, which has already declined significantly from its historical range. A prompt decision to move forward with listing the Mojave poppy bee based on this petition is required to ensure that the Mojave poppy bee does not go extinct.

# Threats

## The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

### Urbanization, Habitat Fragmentation, and Reduced Gene Flow

#### *Urbanization*

Urbanization has led to the current severely fragmented habitat and has resulted in the loss of vital population connectivity and habitat throughout Washington County, Utah and Clark County, Nevada. This can be seen by the current declining range of its obligate host plants, the Dwarf bear-poppy and the Las Vegas bear-poppy. The Mojave poppy bee is further restricted than the Las Vegas bear-poppy, found only in a subset of the bear-poppy's range (see map) as a consequence of urbanization, fragmentation, and other threats outlined below.

Urbanization has resulted in removal of host plants and nesting sites, direct mortality of the bee, population declines and losses caused by habitat fragmentation, degradation, and disturbance. In general, urbanization results in a reduction of both abundance and species diversity of native bees (Cardoso & Gonçalves 2018 p. 2) as well as loss of species richness (Hung et al. 2017 p. 8). Urbanization generally results in a shift in the species community from solitary to social bees (Banaszak-Cibicka & Żmihorski 2012 p. 335; Cardoso & Gonçalves 2018 pp. 3–4) and to more generalist bees (Banaszak-Cibicka & Żmihorski 2012 p. 334; Hung et al. 2017 p. 8).

Urbanization is a current and imminent threat to the Mojave poppy bee because its remaining populations are in the two fastest growing areas of the United States. Urbanization and human population growth in and around St. George, Utah was a contributing factor to fragmentation of the bee's habitat, and ultimate extirpation, in Washington County. St. George is the fastest growing area in the country, with a population increase of 4% from 2016 to 2017 (adding nearly 6500 people) causing rapid and sprawling construction (Davidson 2018a pp. 1–2). Continued growth in St. George is resulting in the destruction of protected areas, such as the recent approval of a new highway in the Red Cliffs Desert Reserve (Yachnin 2018 p. 2).

The majority of the Mojave poppy bee's remaining habitat is located near Las Vegas, one of the most populous regions in the country, and in Clark County, which had the second largest county population growth in the nation in 2017, adding 47,355 residents to its population of over 2.2 million (Brean 2018a p. 1). Much of Clark County's new growth is outside of Las Vegas at the urban-wildland interface in unincorporated areas of the County, which recently surpassed a combined population of 1,000,000 that continues to consume much of the remaining desert habitat (Davidson 2018b p. 1). The sprawl and development have been facilitated by Congressional land acts and the Southern Nevada Public Land Management Act which provide for the disposal of BLM lands for private development. With growth projections of 2.8 million by 2050 (Center for Business and Economic Research 2017 p. 8), the Clark County Commission recently approved the development of 44,000 acres of public land with a plan to further convert thousands of acres from conservation to development (Brean 2018b p. 1).

Road construction from the increasing growth in Clark and Washington Counties reduces connectivity for the Mojave poppy bee between undeveloped habitat, reducing gene flow and

population viability. Roads act as dispersal barriers to small bees, such as the Mojave poppy bee (Andersson et al. 2017 p. 53). Also, as discussed in greater detail under threats caused by recreation, dust from motorized vehicles can cause direct mortality to bees via desiccation as well as loss of pollen resources due to dust covered host plants. Thus, habitat destruction and fragmentation due to urbanization is a major ongoing and escalating threat to the Mojave poppy bee and its habitat.

### *Habitat Fragmentation*

Smaller insects with limited dispersal abilities, like the Mojave poppy bee, tend to exist in patchy populations or metapopulations (Franzén & Nilsson 2009 p. 79). Within patchy populations, dispersal between patches, known as patch dynamics, is crucial to the survival of the species (Pulliam 1988 pp. 652–654). Even small habitat patches of lower quality, often known as sinks, and the ability of an individual to disperse to sinks, is of vital importance to the survival of the species as a whole; sinks can act as spill over areas for less competitive bees to establish mating territory and nests (Pulliam 1988 p. 659; Howe et al. 1991 p. 251). Nests in sinks can be as successful as those found in better quality habitat, they are just fewer in number (Franzén & Nilsson 2009 p. 83). The Mojave poppy bee is threated with loss of habitat at the landscape scale because the remaining patches are too far apart for adequate dispersal, which disrupts patch dynamics, and leaves populations isolated and subject to small population extinction (Brook et al. 2008 pp. 454–456; Kuussaari et al. 2009 p. 565).

The distribution of Mojave poppy bee populations suggests that there are potentially two remaining and fragmented metapopulations of a once larger more widely distributed and connected metapopulation. The original distribution of the Mojave poppy bee occurred diagonally from southeastern California, up through both the Arizona and Nevada sides of Lake Mead, and into southwestern Utah. As mentioned above, the Mojave poppy bee likely has a typical foraging range of <10 m but a maximum of 300-400 m, which can be seen as a dispersal distance proxy. The distance between present sites within the LMNRA are 13.6 km apart, on average, with the BLM sites a further 33-56 km away. As such, only a few patches in a subset of those remaining are connected enough for dispersal. The nearest population to the Mojave poppy bee in Utah before it went extinct was 130 km away in LMNRA, indicating lack of dispersal between Nevada and Utah, most likely contributing to the extinction of the bee in Utah (Portman et al. 2018b p. 602).

The Mojave poppy bee is also threatened by habitat fragmentation at a local scale as anthropogenic land use changes in areas between floral hosts have been found to negatively affect nesting site availability (Cane 2001 p. 4). Female bees must complete several foraging bouts between host plants and nests to provision brood cells with sufficient pollen, creating high energetic demands. Solitary bees have reduced fecundity via a reduction in the portion of provisioned brood cells when nesting sites and host plants are too far apart in space, even distances of 300 and 500 m (Zurbuchen et al. 2010a p. 677) and 150 m (Peterson & Roitberg 2006 p. 592). Increased foraging time can decrease the already small number of solitary bee progeny by 50% (i.e. from 32 and 15 down to 22 and 7, respectively) (Zurbuchen et al. 2010a p. 679) as well as dramatically decrease the total number of nests provisioned (i.e. from 199 to 51) (Peterson & Roitberg 2006 p. 592). In addition, the threat of large distances between host plants is compounded by increased exposure of adults to predators and, while adults are away foraging, increased exposure of nests to parasitism (Franzén & Nilsson 2013 p. 1404). Additional costs include poor quality of or less pollen provisioned and lower overwinter survival of

offspring and an overproduction of male offspring, as they require smaller pollen provisions (Peterson & Roitberg 2006 p. 593; Zurbuchen et al. 2010a pp. 679-680 and references therein).

The Mojave poppy bee is significantly harmed by even small increases in foraging distances. Pollination and seed set of the Dwarf bear-poppy decreased by over 40% if the poppies were locally fragmented (Harper et al. 2001 pp. 107–108). Specifically, when the density of poppies decreases in the landscape such that the plant or clusters of plants are >10 m apart (compared to less than 3 m), pollination rate declines from 90% to 57% and seed set from 67% to 19%, clearly showing decreases in pollination efficacy (Harper et al. 2001 pp. 107–108, Table 2). The small foraging distance of the Mojave poppy bee could lead to failed reproduction in small or isolated populations of their host plants (Greenleaf et al. 2007 p. 589), this is especially a threat to oligolectic bees like the Mojave poppy bee that cannot switch host plants when the poppies are scarce or absent (Franzén & Nilsson 2013 p. 1404). As a result, loss of connectivity on both a local and landscape scale is a key threat to the continued survival of the Mojave poppy bee.

### *Loss Genetic Diversity and Production of Diploid Males*

The lack of connectivity between Mojave poppy bee populations results in lower gene flow, or genetic mixing, between metapopulations (Packer et al. 2005 p. 199). This population isolation leads to inbreeding depression (the increased incidence of mating among relatives leading to an increase in homozygosity of deleterious alleles), lower effective population size, diploid male production (results from and exacerbates inbreeding), loss of genetic diversity, and subsequent extinction (Zayed 2009 p. 238; Portman et al. 2018b p. 602). As an example, *Colletes floralis* is a rare, solitary, and ground-nesting bee found on dunes in 12 fragmented patches and is one of the few solitary bees for which population genetics have been tested (Davis et al. 2010 pp. 4923–4924). Genic differentiation between all *C. floralis* populations, save for the two closest, was found to be highly significant, even across short distances, indicating lack of gene flow (Davis et al. 2010 pp. 4927–4928). Areas between habitat patches without preferred sandy nesting substrate, such as urban areas, acted as barriers to gene flow (Davis et al. 2010 p. 4929); despite a foraging and dispersal distance assumed to be 0.4-10 km (Davis et al. 2010 p. 4926).

Inbreeding depression occurs in small populations with no gene flow and is a major threat to population viability (Zayed 2009 p. 244). The mating and sex determination system in bees makes them particularly susceptible to the negative effects of inbreeding depression. Bees are haplodiploid organisms in that haploid males develop from unfertilized eggs while diploid females develop from fertilized eggs (Zayed 2009 p. 239). Diploid males form when females fertilize eggs with sperm that has the same allele at the sex-determination locus; an increase in the same allele is a result of a small and inbred population (Zayed 2009 p. 239). Diploid males are sterile or produce inviable offspring, such as sterile triploid daughters, reducing the already low fecundity in solitary Andrenid bees (Zayed & Packer 2005 p. 10745; Zayed 2009 p. 242). In addition, females fertilize eggs to produce females and thus waste reproductive effort when males are inadvertently produced, leading to increased male biased sex ratio and further reduced population sizes, creating a positive feedback loop that ultimately leads to extinction (Zayed & Packer 2005 pp. 10744–10745; Zayed 2009 pp. 239, 241).

The production of diploid males in haplodiploid bees can increase extinction risk by 50-63%, an order of magnitude higher than extinction risk caused by inbreeding alone, making diploid male production a unique and serious threat to already endangered haplodiploid solitary bees like the Mojave

poppy bee (Zayed & Packer 2005 pp. 10744–10745). Small and genetically depauperate populations are also less able to adapt to changing environmental conditions (Zayed 2009 p. 246); for instance, with less genetic diversity due to reduced gene flow and inbreeding, the Mojave poppy bee will be less likely to adapt to reduction in rainfall due to climate change.

### Grazing

Cattle grazing greatly contributed to the extinction of the Mojave poppy bee in Utah (Portman et al. 2018a pp. 15–16) and continues to threaten its little remaining habitat, as cows directly consume, kill, and reduce reproduction of the bear-poppies ("Bureau of Land Management Emails" 2018 pp. 1, 12–13, 24). Grazing occurs on the former site of the Mojave poppy bee in Utah despite being part of the BLM's Desert Reserve System (U.S. Fish and Wildlife Service 2016 p. 24; Portman et al. 2018b pp. 602–603), verifying lack of regulatory mechanisms to conserve the species in this area. Livestock grazing is also allowed in the Mojave National Preserve (Abella et al. 2016 p. 75). Although domestic animal grazing is legally prohibited in LMNRA, wild burro grazing in the Mojave Desert is concentrated in the Lake Mead area (Abella 2008 p. 810) and currently there is illegal cattle grazing on the National Park Service land (Bureau of Land Management 2014; Ellis & Martinez 2014 p. 1; Yachnin 2017 p. 1), threatening the bee's habitat and host plant.

In addition to direct habitat destruction, grazing causes soil disturbance and leads to use of pesticides. Grazing areas on federal public rangeland are sprayed with insecticides toxic to bees, such as carbaryl and malathion, to control grasshoppers (Tepedino 2000 p. 3). Of critical importance to the ground nesting bee, soil surface stability is decreased and soil compaction increased by grazing (Kimoto et al. 2012 p. 7). Further, grazing disturbs and eliminates the important cryptogamic crusts that maintain soil stability and hold in essential moisture and nutrients (Mattoni et al. 1997 p. 112). These soil alterations degrade quality and availability of Mojave poppy bee nesting sites.

Grazing further alters the bee's habitat by facilitating invasive plants that change the soil microhabitat and compete with bear-poppy host plants (Brooks 2009 pp. 105–106). Wild burros are generalist grazers and can spread nonnative seeds, such as Sahara mustard and *Bromus sp*. in LMNRA (Abella 2008 p. 813 and 817). Cattle feces and hay-feed increase organic matter and moisture in the soil, creating microhabitats that favor nonnative plants and allow them to outcompete native plants (Brooks 2009 p. 113). Watering sites for current or past livestock grazing found throughout the Mojave Desert serve as a source of and refuge for nonnative grasses that then spread during rainy periods (Brooks 2009 p. 113) This effect is further exacerbated by rapid urbanization in these areas leading to increased human water use, such as irrigated lawns (Portman et al. 2018b p. 603).

Treatment of invasive plants on public lands, including LMNRA, often involves herbicides (National Park Service 2010 p. 52). To control invasive plants, LMNRA uses many herbicides, including aerial spraying of glyphosate (National Park Service 2010 pp. 53, 115, 116). Aside from harming Las Vegas bear-poppies (National Park Service 2010 p. 38), use of herbicide could harm the bee directly. Specifically, exposure to glyphosate was recently found to alter bee gut microbiota and resulted in increased susceptibility to pathogens and subsequent increased mortality (Motta et al. 2018 p. 3).

Cattle graze less on bear-poppies when other plant species are available, but this leads to a decrease in the overall abundance of co-blooming floral resources. This reduction in nectar and pollen sources causes honey bees to exploit bear-poppies more frequently, reducing resources for and

increasing competition with the Mojave poppy bee (Portman et al. 2018b p. 603, 2018a pp. 15–16). This negative effect of grazing is exacerbated by the increase in Africanized honey bees, as it favors pollen more than its European ancestor (Portman et al. 2018b p. 603). The high abundance of Africanized honey bees on the remaining Mojave poppy bee habitat patches is thus a significant threat. For these reasons, grazing is a key threat to the continued existence of the Mojave poppy bee.

### Recreation

Nearly 7.9 million people visited LMNRA in 2017, up 10% from 2016, making it the sixth most visited National Park in the system (National Park Service 2018c pp. 1–2). The National Park Service attributes this partly to their "find your park" campaign and advertising of the "diverse recreational opportunities" at LMNRA (National Park Service 2018c p. 2). Many recreational activities, from horseback riding, driving, and biking can be detrimental to ground nesting bees but off-road vehicles use, which encompass all-terrain vehicles (ATVs), such as quads and motorcycles, is the most common, far-reaching, and detrimental recreational activity in Mojave poppy bee habitat. The Mojave poppy bee and its bear-poppy hosts are restricted to gypsum soils, a substrate that weathers to form smooth, rock-free mounds that attract off-road vehicles due to the open terrain (Harper & Van Buren 2004 p. 482).

Many sites where the bear-poppies are still present but the Mojave poppy bee is extirpated or not found are those with high off-road vehicle use (Nevada Off-Highway Vehicle Commission 2018 p. 1), such as the Rainbow Gardens Area of Critical Environmental Concern (ACEC) (Trails Off Road 2018 p. 5). The Las Vegas bear-poppy populations utilized by the remaining Mojave poppy bee populations are highly threatened by off-road vehicle use (The Nature Conservancy 2007 p. 62). Off-road vehicles operators travel both on designated or established routes and also frequently create new routes, including in areas that are supposed to be closed to such uses. Specific threats from off-road vehicles including direct mortality of the bee and its host plants, alteration of soil physical and chemical properties, reduction in nutritional quality and availability of pollen, and alteration of the plant community via facilitation of invasive plants are explained below.

The Mojave poppy bee nests underground, likely around 10 cm below the surface (Danforth 1989 pp. 63–64). Off-road vehicles reduce the abundance of ground nesting native bees by compacting the soil and disturbing nests (Sardinas & Kremen 2014 p. 164). Desert soil compaction and damage can occur with as few as 1-10 passes by an off-road vehicle, leading to water runoff and alteration of the soil biotic community (Lei 2009 p. 159). As discussed above, gypsum soils have low bulk densities that allow for more air availability for the bear-poppies and Mojave poppy bee larvae and pupae. As such, the increase in soil bulk density caused by compaction negatively alters the properties of gypsum soil that make it suitable for the Mojave poppy bee and its host plants. Off-road vehicles can disturb the critically important seed bank that regenerates bear-poppy populations in favorable years; without which they could completely disappear (Harper & Van Buren 2004 p. 488).

Off-road vehicles also disturb and kill cryptogamic crusts on the soil surface. Cryptogamic crusts prevent erosion and increase nitrogen availability in gypsum soils (Harper & Van Buren 2004 pp. 482–483). As a result, off-road vehicles reduce the amount of nitrogen available in the soil and thus to the bee in the form of pollen. Nitrogen is a key nutrient for bee progeny development and population growth (Wiesenborn 2010 p. 5). Loss of cryptogamic crusts also reduces water retention, additional nutrient retention, and seedling germination (The Nature Conservancy 2007 p. 52 and 58).

The combination of loss of cryptogamic crusts, altered nitrogen and carbon dioxide, and disturbances by recreation and grazing alters the biotic community and favors invasive grasses, such as *Bromus sp.* (Smith et al. 2009 pp. 36–37). Tracks created by off-road vehicles, even single passes, can facilitate the spread of invasive plants by creating areas that trap and shelter seeds (Brooks 2009 pp. 112–113). Large increases in nonnative plant biomass and nonnative species richness has been found within off-road vehicle tracks and areas with increased off-road vehicle track density, respectively, in the Mojave Desert (Brooks 2009 p. 116). Invasive plants displace the bee's host poppies and reduce nesting site availability by covering bare soil.

Off-road vehicles also create environmental pollution through expelling significant amounts of fine and coarse dust particles (Goossens & Buck 2009 pp. 118, 134). Dust particles can cause direct bee mortality in many ways: by increasing desiccation due to cuticle abrasion, desiccation due to excessive salivary grooming, respiratory stress by blocking or impairing a bee's spiracles, and disruption of digestion if ingested (Edwards & Schwartz 1981 p. 715). Indirectly, the dust could cover the stigma and pollen of bear-poppies, reducing food available to the Mojave poppy bee as well as reducing pollination and seed set (Harper & Van Buren 2004 p. 489). While there are no studies that look at off-road vehicle dust on plant-pollinator interactions, studies have shown that deposition of particles from volcanic ash decreased bee species richness and pollination (Morales et al. 2014 pp. 46–47) as well as visitation by pollinators (Martínez et al. 2013 p. 271). Off-road vehicles are thus a major threat to the continued existence of the Mojave poppy bee.

### Gypsum mining

Gypsum mining is a threat to the Mojave poppy bee in many ways: mining outright destroys bee and bear-poppy habitat by digging up the gypsum base of the habitat, soil not dug up is compacted and disturbed by vibrations from machinery, and the action of mining suspends dust particles that desiccate bees and reduce pollen availability, leading to increased mortality, as described above.

The Las Vegas bear-poppy host plant populations within current and former Mojave poppy bee habitat are highly threatened by gypsum mining (The Nature Conservancy 2007 p. 62). There are three active gypsum mines in Clark County, Nevada that mined over 2.7 million tons of gypsum in 2017 (Perry & Visher 2017 p. 21). The Blue Diamond Hill Mine is west of Las Vegas in the historic range of the Mojave poppy bee and current range of the Las Vegas bear-poppy; as such it negatively impacts any future growth or reintroduction of the Mojave poppy bee to western Clark County.

The two mines that appear to directly affect current or recent Mojave poppy bee populations are the Lima Nevada Gypsum Mine and the Pabco Gypsum Mine that are located near the Pabco Road and Pabco Junction populations (see map). These mines are a threat to the Mojave poppy bee via destruction of gypsum nesting substrate and removal of Las Vegas bear-poppy host plants- despite both being in the Rainbow Gardens ACEC (Bureau of Land Management 2018 p. 17). The Pabco Road and Pabco Junction Mojave poppy bee populations are the western-most of known Mojave poppy bee populations and thus are isolated from the remaining populations. They are also on land managed by the BLM and due their proximity to the Las Vegas metro area, most negatively impacted by urbanization and recreation in addition to the gypsum mining.

The threat of gypsum mining on BLM land is a growing and imminent threat as the BLM approved an expansion of the Lima Nevada Gypsum Mine in May of 2018 (Bureau of Land Management

2018 p. Finding of No Significant Impact and Decision Record) that is 15 miles east of Las Vegas and entirely within BLM land that houses the Pabco Road and Pabco Junction Mojave poppy bee populations (Johnson 2017 pp. 1–2). The newly approved mine expansion will impact 228.5 acres of gypsum habitat by creating open pit mines south of Pabco Road (Bureau of Land Management 2018 p. 4). The gypsum mining will destroy the rare gypsiferous soils and crusts that are endemic to the region and provide habitat for the Mojave poppy bee and the Las Vegas bear-poppy (Bureau of Land Management 2018 p. 17 and 22). The mitigation measure, allowing researchers to study how to restore crusts (Bureau of Land Management 2018 p. 18), is not real mitigation in that it does nothing to avoid, offset, minimize loss, or conserve these rare crusts that take many years to form, including upwards of 250 years to form or regenerate moss cover (Belnap 2016 p. 2).

Critical for the Mojave poppy bee, this mine expansion would impact one of the largest and densest remaining populations of the Las Vegas bear-poppy (Bureau of Land Management 2018 p. 22). As indicated above, the Mojave poppy bee needs dense stands of its bear-poppy host plants in order to have viable populations. With the approved mine expansion, 150 acres of prime habitat- a unique gypsum plateau- will be permanently destroyed; this is added to the 44% of bear-poppy habitat already lost (Bureau of Land Management 2018 p. 23). The BLM manages about half of the remaining 66% of bear-poppy habitat but despite the plant's endangered status, the BLM's management strategy continues to imperil the species with other mining authorizations, recreational and organized off-road vehicle races, and dumping, amongst other threats (Bureau of Land Management 2018 p. 23); the remaining habitat is found in LMNRA that is not without threats from recreation or grazing (see above).

The primary mitigation proposed by the Lima Nevada Gypsum Mine expansion is to remove soil and propagate bear-poppy seeds (Johnson 2017 p. Appendix F). However, attempts to grow the Las Vegas bear-poppy from seed or restore their habitat after disturbance to reestablish the plants have not been successful, by BLM's own admission (Bureau of Land Management 2018 p. 22). There is no reason to assume the mitigation would be any more successful than past failed attempts (Bureau of Land Management 2018 pp. 23–25). Further, the mitigation allows for collection and storage of Las Vegas bear-poppy seeds "to use when better methodologies for germinating and growing these species becomes available in the future" (Bureau of Land Management 2018 p. 24); this in no way protects the declining Mojave poppy bee that exhibits a boom and bust bet-hedging life cycle wherein the larvae pupate and emerge as adults after rainfall cues in order to synchronize with the blooming of the host poppies (Smith et al. 2009 p. 34). Although most bees will likely be killed directly by the mining expansion, any surviving bees that emerge due to environmental cues will not survive and produce offspring due to the absence of bear-poppies. As a result, populations of the Mojave poppy bee at Pabco Road and Pabco Junction will be unable to utilize the most proximate bear-poppies because of their limited foraging ranges and become extirpated. On the BLM's own admission, "there would be long-term loss of 228.5 acres in the Rainbow Gardens ACEC" (Bureau of Land Management 2018 p. 25).

## Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization pushes imperiled species towards extinction, especially in conjunction with other threats. It is not known whether overutilization threatens the Mojave poppy bee, but given its limited

geographic range and low population numbers, any utilization for commercial, recreational, scientific or educational purposes could pose a serious threat.

## Other Natural or Manmade Factors Affecting its Continued Existence

### Loss of Pollination Mutualism

Pollination mutualisms create and maintain ecosystem structure and function, as biotic pollination is responsible for >90% of flowering plant reproduction (Traveset & Richardson 2014 p. 91). Loss of plant-pollination mutualisms due to human activity is an increasing threat to ecosystem integrity across the globe (Traveset & Richardson 2014 p. 91; Portman et al. 2018b p. 594). Plant-pollinator mutualisms can become endangered as a result of biological invasions that alter seed set, genetic structure, and population growth of mutualists, such as reduction in the Mojave poppy bee caused by non-native honey bees; climate change that causes phenological mismatch, such as bear-poppy bloom happening before emergence of the Mojave poppy bee; and habitat loss and fragmentation that decreases the abundance of the native bee via loss of breeding sites and/or decreased gene flow leading to inbreeding depression that leads to a change in seed set of the plant (Toby Kiers et al. 2010 p. 1460; Traveset & Richardson 2014 p. 101 Figure 3).

Oligolectic pollinators are duly affected by habitat fragmentation both directly via reduction in their own population connectivity and gene flow, but also indirectly through the decrease in host plant density within remnant habitats patches (Hickerson 1998 p. 11). The reduced host plant density and subsequent pollinator abundance results in runaway ecosystem degradation in which self-pollinating plants outcompete host plants and generalist pollinators outcompete specialists, further reducing the populations of both specialist plants and their pollinators (Hickerson 1998 p. 11). The more tightly linked an oligolectic bee is to its pollen hosts, the more susceptible it is to negative population trends in the plant (and vice versa), making the bees particularly vulnerable due to a failed mutualism (Packer et al. 2005 p. 196), as was demonstrated in Utah with the Mojave poppy bee and the Dwarf bear-poppy.

In the case of the bear-poppies and Mojave poppy bee mutualism, invasive honey bees cause invasion meltdown because honey bees facilitate the spread of non-native plants while competitively displacing the Mojave poppy bee (Traveset & Richardson 2014 pp. 99–101). Further, generalist pollinators like honey bees prefer plants with nectar rewards, reducing the quality of visits and seed set in native non-nectar producing plants (Traveset & Richardson 2014 p. 100) such as the rare bear-poppies (Portman et al. 2018b p. 603). This breakdown of mutualisms and pollination networks has been increasingly documented with the introduction of non-native pollinators as they visit common, weedy plants and increase the seed set of invasive, non-native plants (Barthell et al. 2001 p. 1874; Aizen et al. 2014 pp. 324–325).

The ESA protects individual species, not species relationships, such as mutualisms, however, in order to prevent the extinction of both the Mojave poppy bee and the bear-poppies, it is necessary to have both plant and pollinator listed as endangered and properly protected in order to keep such mutualisms intact. Protection of both key players in this pollinator mutualism is needed because each species has its own specific requirements that must be met in order for overall survival.

## Non-native Honey Bees and Exploitative Competition

Honey bees displace native bees from preferred high quality forage plants through exploitative competition, higher number of individuals, and the longer activity period during which honey bees forage; because they recruit nest mates to floral resources, honey bees overwhelm other species (Goulson 2003 p. 8; Dupont et al. 2004 p. 307; Thomson 2004 pp. 463–465, 2016 p. 5). Proximity to honey bee hives and/or presence of hive-dense apiaries forces native bees to forage greater distances on less pollen with a resultant reduction in fitness and, in turn, population (Henry & Rodet 2018 p. 2). A typical honey bee colony pastured for three months collects the equivalent of 110,000 (92,000-300,000 depending on number of bees per hive) native bee pollen provisions (Cane & Tepedino 2017 p. 207). As managed honey bees are not native to North America, neither the Mojave poppy bee or its desert habitat has evolved to coexist with honey bees. As such, no surplus pollen remains in the ecosystem, resulting in exploitative competition with the Mojave poppy bee (Cane & Tepedino 2017 p. 208). This is especially a concern for the Mojave poppy bee which is unable to forage at greater distances or switch host plants. In addition, honey bees often arrive to gather pollen from bear-poppies in the morning, before female Mojave poppy bees, reducing the quantity of pollen available for provisions and increasing foraging time (Portman et al. 2018a pp. 9, 12).

### *Africanized honey bees*

Africanized honey bees are a hybrid of European (*Apis mellifera ligustica*) and African (*Apis mellifera scutellata*) honey bee subspecies that spread into the Americas after accidental release in Brazil in the 1950s, making their way up to Texas in 1990, then to New Mexico, Arizona, Nevada, and California (Rabe et al. 2005 p. 307; Harrison et al. 2006 p. 1111; Kono & Kohn 2015 pp. 1–2). Africanized honey bees are now documented within the entire historical range of the Mojave poppy bee after being detected in Utah in 2008 (Hodgson et al. 2010 p. 1). The percent African honey bee mtDNA in Arizona feral honey bee colonies has steadily increased since their introduction (Harrison et al. 2006 p. 1113); of over 500 honey bees among 54 sites collected in Southwestern Arizona, an average of 88% contained African mtDNA (Rabe et al. 2005 p. 310). Portman et al. found that 73% of honey bees caught in patches of Las Vegas bear-poppy in the remaining Mojave poppy bee habitat exhibited the African mitotype (Portman et al. 2018a p. 12).

Feral Africanized honey bee colonies nest in rock cavities in the desert ecosystems (Harrison et al. 2006 p. 1112) and it is hypothesized that they are restricted to areas with warmer winter temperatures due to physiological and life history characteristics (Harrison et al. 2006 pp. 1114–1115; Kono & Kohn 2015 p. 10). While few managed European honey bee hives become feral, Africanized honey bees are more likely to swarm and start feral colonies in small cavity locations, underground, or in the open (Hodgson et al. 2010 p. 3), making them more prone to invade natural systems. The expansion of the Africanized honey bees throughout the southwest mostly likely negatively impacted historical and current Mojave poppy bee populations (Portman et al. 2018b p. 604).

A clearly documented trait of Africanized honey bees that differs from European honey bees is their preference for pollen collection, presumably due to the greater nutrition benefit of pollen for brood production (Harrison et al. 2006 p. 1117). The pollen-collecting behavior of Africanized honey bees negatively impacts the reproductive output of the oligolectic Mojave poppy bee (Portman et al. 2018b pp. 601–602). As described above, exploitative competition from honey bees forces the Mojave

poppy bee to seek other patches of its host plants, which due to habitat fragmentation are no longer within foraging distance of the small and weak flying bee. As such, the Mojave poppy bee can no longer survive where Africanized honey bees dominate and bear-poppies are sparse.

### Climate Change and Temporal Mismatch

Human activities have increased global average temperatures 0.8-1.2°C above pre-industrial levels with a trend of about 0.2°C per decade due to past and current emissions (Intergovernmental Panel on Climate Change 2018 p. 4). At current emissions rates, global temperatures will increase by 1.5°C between 2030-2052, resulting in further sea level rise, increased incidence of severe weather events, and loss of ecosystems (Intergovernmental Panel on Climate Change 2018 p. 4,8). At a warming of 1.5°C, temperature and precipitation extremes will be exacerbated; for example, extreme hot days, common in desert ecosystems, are expected to increase further to 3°C with cold nights warming up (Intergovernmental Panel on Climate Change 2018 pp. 8–9).

The bear-poppies have a life cycle wherein they produce a seed bank that remains dormant until periods of sufficient rainfall (The Nature Conservancy 2007 p. 52). The Mojave poppy bee exhibits a boom and bust bet-hedging life cycle wherein the larvae emerge as adults after rainfall cues in order to synchronize with the blooming of the host poppies, in a pulse-reserve paradigm typical of the Mojave Desert (Smith et al. 2009 p. 34), its plants, and specialized pollinators (Portman et al. 2018a p. 14).

With climate change, rainfall is becoming less predictable and less frequent in the Mojave Desert (Smith et al. 2009 p. 34; Iknayan & Beissinger 2018 p. 3). Drought years coincide with reduced blooms, reduced pollen, and hence more competition between adult bees for limited resources. As a result, some larvae prolong their diapause and emerge the second or third year after pupation (Portman 2018, email communication). This life cycle pattern may create a temporal fragmentation if different habitats experience different rainfall patterns, leading to different timing in emergence between Mojave poppy bee populations. Temporal fragmentation reduces gene flow and increases habitat isolation (Danforth 1999 p. 1992), exacerbating inbreeding depression caused by habitat loss and fragmentation.

As the bear-poppies have a short flowering period, any delay or acceleration in emergence due to climate change can cause the Mojave poppy bee to miss the peak blooming and consequently vital pollen resources needed to provision their offspring. Plant and bee phenological cues are often a combination of temperature and precipitation but very likely to respond at different rates to climate change (CaraDonna et al. 2018 p. 9), with solitary bees also responding to body size as an emergence cue (Schenk et al. 2018 p. 6). Climate change also alters the Mojave poppy bee's habitat and reduces poppy pollen resources as nonnative plants come to dominate the plant community due to decreased precipitation predictability (Brooks 2009 pp. 118–119) and reduction of frost due to nocturnal warming (Smith et al. 2009 pp. 33–34).

Finally, with increasing temperatures, climate change is likely to directly negatively impact the Mojave poppy bee via reduction in mating, reproductive success, and survival. In one of the few experiments on climate change impacts on a desert solitary bee, males and female bees emerged later but at different rates as a result of a warming of 1.8-2.6°C compared to controls (CaraDonna et al. 2018 pp. 5–6), most likely due to insufficient winter cooling time needed for development (CaraDonna et al. 2018 pp. 7–8). Further, experimental warming led to a 39-55% reduction in body fat in the solitary bee and mortality 25-70% increase above bees reared in control temperatures (CaraDonna et al. 2018 p. 7).

Thus with a small increase in temperature, such as 1.5°C reached by 2030-2052 based on current climate projections (Intergovernmental Panel on Climate Change 2018 p. 4), the Mojave poppy bee is likely to experience high mortality, phenological mismatch, and reduced population viability. Climate change is an imminent threat to the Mojave poppy bee survival and due to its already narrow range, it is unlikely able to adapt to climate warming.

## Disease or Predation

Disease from honey bees is a threat to the Mojave poppy bee. Several studies have shown that Deformed Wing Virus and Black Queen Cell Virus is transferred from honey bees to bees in several other families, including Andrenid bees, and also that the viruses replicate in those native bee genera (Tehel et al. 2016 pp. 18–19). As honey bees continue to proliferate throughout the Mojave Desert, the threat of diseases increases for the Mojave poppy bee.

## The Inadequacy of Existing Regulatory Mechanisms

The existing regulatory mechanisms are inadequate for preventing the Mojave poppy bee from extinction. In order to determine any existing regulatory mechanisms for the protection of the Mojave poppy bee, in the past year, the petitioner sought, received, cataloged, and evaluated both publicly available information and 1,991 pages of documents obtained from federal and state agencies pursuant to Freedom of Information Act and similar state public records requests. The Mojave poppy bee is listed as a high priority evaluation species under the Clark County MSHCP for certain ecosystems (Clark County Department of Comprehensive Planning 2000a p. 185), is a BLM Nevada sensitive species and got a NatureServe ranking of G2/imperiled in 2005, when it was still thought to be in Utah (NatureServe 2018 p. 1), but these designations are voluntary and/or do not provide adequate regulatory mechanisms.

Global NatureServe rankings are based only on data gathering and have no regulatory authority. Thus while the Mojave poppy bee's status of G2 in 2005 reflects the lack of regulatory mechanisms to protect the bee it in no way provides protection or regulatory mechanisms in and of itself.

Under BLM directives for sensitive species it states that "in compliance with existing laws, including the BLM multiple use mission as specified in the FLPMA [Federal Land Policy and Management Act], the BLM shall designate Bureau sensitive species and implement measures to conserve these species and their habitats" (Bureau of Land Management 2008 p. 36). Although the BLM must consider sensitive species in National Environmental Policy Act documents (Bureau of Land Management 2008 p. 37), the responsible official may still authorize impacts to occur as they are not obligated to conserve the species under Section 7 of the ESA. Some recent examples of this affecting the Mojave poppy bee include the approved expansion of the Lima Nevada Gypsum Mine and the sprawl and development facilitated by Congressional land acts and the Southern Nevada Public Land Management Act that provided for disposal of BLM lands for private development. As such, the designation of the Mojave poppy bee as a BLM Nevada sensitive species has not provided it or its habitat with adequate protections that will prevent its extinction.

Within National Park Service lands, the Mojave poppy bee is not specifically protected. While there are constraints on livestock grazing and off-road vehicles in the LMNRA (sees below), there is no enforceable regulatory mechanism to prohibit illegal livestock grazing or to restrict recreation that specifically harms the Mojave poppy bee and its habitat requirements in occupied and suitable habitat.

Currently, the Mojave poppy bee is not a protected species under Nevada Revised Statutes or Nevada Administrative Code, nor is there any management plan developed by the Nevada or any other state, Utah, Arizona, or California, for the bee.

At the local government level, the Clark County Multiple Species Habitat Conservation Plan (MSHCP) and associated Incidental Take Permit were developed for 78 species of plants and animals in Clark County in 2001. The Mojave poppy bee is not a Covered Species under the MSHCP or Take Permit, so has no regulatory or other protections under local government purview. It is an Evaluation Species under the MSHCP, meaning that insufficient information existed at the time to support an application for a Take Permit and that status has not changed.

To the extent that any voluntary, i.e. non-regulatory, mechanisms exist to protect the Mojave poppy bee, FWS cannot rely on voluntary measures to deny listing of species. Voluntary and unenforceable conservation efforts are simply *per se* insufficient as "regulatory mechanisms" under 16 U.S.C. 1533(a)(1)(d):

> [T]he Secretary may not rely on plans for future actions to reduce threats and protect a species as a basis for deciding that listing is not currently warranted . . . . For the same reason that the Secretary may not rely on future actions, he should not be able to rely on unenforceable efforts. Absent some method of enforcing compliance, protection of a species can never be assured. Voluntary actions, like those planned in the future, are necessarily speculative . . . . Therefore, voluntary or future conservation efforts by a state should be given no weight in the listing decision (*Oregon Natural Resources Council v. Daley,* 6 F. Supp.2d 1139, 1154-155 (D. Or. 1998).

As demonstrated in the following sections, the threats faced by the Mojave poppy bee throughout its range such as grazing, recreation, mining, honey bees, climate change, fragmentation, and inbreeding due to isolation, are not adequately addressed by any of the bee's current designations. These threats to the Mojave poppy bee's continued existence cannot be ameliorated via voluntary action. The only adequate regulatory mechanism available to save the Mojave poppy bee starts with listing it under ESA.

### Lack of Threat Amelioration

The Mojave poppy bee is not currently protected from grazing, recreation, gypsum mining, honey bees, or climate change. Grazing greatly contributed to the extinction of the Mojave poppy bee in Utah (Portman et al. 2018a pp. 15–16), underscoring the adverse effect it has on the species, especially in multi-use areas. Although domestic animal grazing is legally prohibited in LMNRA, wild burro grazing in the Mojave Desert is concentrated in the Lake Mead area (Abella 2008 p. 810) and currently there is illegal cattle grazing on the National Park Service lands around Lake Mead (Bureau of Land Management 2014; Ellis & Martinez 2014 p. 1; Yachnin 2017 p. 1). Further, recent email correspondence between BLM and Service staff discusses how despite the ban on grazing to conserve the endangered desert tortoise, there is widespread unauthorized grazing in Nevada, particularly in the LMNRA, including "extremely high" numbers of cattle and wild burros (Lambeth 2018 p. 4).

Recreation impacts to the Mojave poppy bee and its habitat are not managed within occupied and suitable habitat, nor is there adequate law enforcement to address unauthorized and illegal uses

(U.S. Fish and Wildlife Service 2016 p. 40). When reviewing existing regulatory mechanisms for the petitioned Las Vegas Buckwheat, the Service stated "Nation-wide enforcement of off-highway vehicle restrictions on federal land is limited by the low number of law enforcement officers on staff (Gregory 2008, pp. 1-12). In southern Nevada on BLM-managed lands outside of the Red Rock Canyon National Conservation Area, there is roughly 1 officer for every 370,200 acres of the District, and several portions of the District (Moapa, Gold Butte, and Nye County) are currently limited to 1 duty officer (Marrs-Smith 2007, p. 1). The ability to regulate off-highway vehicle activity in southern Nevada is not expected to improve in the near future." (Blair 2009 p. 14).

There is no regulatory mechanism that ameliorates the negative effect of honey bees on native bees or the hybridization of African with European honey bees. Placement of apiaries is allowed on public land as a categorical exclusion under 36 CFR 220.6 and in some cases encouraged (Pollinator Health Task Force 2015 p. 44 and 48; Dickie 2015 p. 2) and with honey bee farmers looking to federal lands for pesticide free areas (Dickie 2015 p. 3), this is an imminent threat not addressed by existing regulations. At minimum, any honey bee hives must be regulated by maintain a large (>10 km) distance from any Mojave poppy bee or bear-poppy population for conservation effectiveness, ensuring no exploitative competition from managed honey bees (Henry & Rodet 2018 p. 3). However, as apiaries are a substantial threat to the whole ecosystem, hives placement on federal public lands must be substantially restricted (Geldmann & González-Varo 2018 pp. 1–2).

The two mines that directly affect current Mojave poppy bee populations and destroy prime Las Vegas bear-poppy habitat are the Lima Nevada Gypsum Mine and the Pabco Gypsum Mine that are located near the Pabco Road and Pabco Junction populations. These mines are a threat to the Mojave poppy bee via destruction of gypsum nesting substrate and removal of Las Vegas bear-poppy host plants- despite both being in the Rainbow Gardens ACEC (Bureau of Land Management 2018 p. 17). The inadequate mitigation measures outlined for the mine expansion does nothing to protect the Mojave poppy bee and instead hastens its extinction.

### Lack of Connected Quality Habitat

The Mojave poppy bee is lacking crucial connectivity between its isolated populations, breaking down its population dynamics. At the landscape, or range-wide, scale, the Mojave poppy bee requires connectivity between patches. At the local, habitat level, the Mojave poppy bee requires dense stands of host poppies on undisturbed gypsum soil with cryptogamic crusts. As there is clear evidence for pollen limitation at the local scale and that bees colonize patches with more host plants at the landscape scale, areas of high density bear-poppy pollen resources need to be created and maintained to buffer against extinction (Harper & Van Buren 2004 p. 490; Franzén & Nilsson 2009 p. 82, 2013 p. 1406).

In concurrence with site-specific management, region-wide management is needed to increase overall connectivity and reduce the negative effects of habitat fragmentation. Given the bee's small foraging range and distances between patches, effective management should assume that there is at least some inbreeding and diploid male production in the remaining populations. Stepping stone habitats or pockets of poppy host plants on gypsum soils within foraging distances of the Mojave poppy bee are required to increase gene flow. Translocating individuals between populations if connectivity cannot be achieved is also necessary (Zayed 2009 p. 242 and 244). The Service will need to protect

occupied and potential habitat from urban development, degradation, and additional fragmentation across its range. These protections can only arise once the Mojave poppy bee is listed under the ESA.

### Inadequate Protection Due To Host Plants

While the Dwarf and Las Vegas bear-poppies are federally and state protected, respectively, all agencies involved recognize that their conservation and recovery is unlikely unless there is a healthy presence of their specialist pollinator, the Mojave Poppy bee. ESA listing of the Mojave poppy bee is needed to conserve all three species. Listing the Mojave Poppy bee as a federally endangered species will not only ensure that this native, solitary bee receives the protection it requires to prevent its extinction, but the listing is also the only way that two rare and unique desert poppies will receive adequate pollination upon which their viability depends.

Due to loss of the Mojave poppy bee and habitat fragmentation in Utah, the status of the Dwarf bear-poppy has declined since it was listed as an endangered species (Tepedino et al. 2014 p. 321). The continued human population growth in Washington County, Utah is a major threat to Dwarf bear-poppy and the area must be actively managed for habitat connectivity, and the Mojave poppy bee must be introduced to reverse its decline (Tepedino et al. 2014 p. 322). The Service recognized the irreplaceable value of pollination provided by the Mojave poppy bee in several of their recommendations to conserve the Dwarf bear-poppy in their recent five-year review including: maintain adequate floral resources to support specialist pollinators, facilitate pollinator augmentation and translocation, reduce grazing within and near populations (U.S. Fish and Wildlife Service 2016 p. 39), evaluate and implement a pollinator rearing or transplant pilot study, and coordinate with State, County, City officials and developers for mitigation that includes permanent habitat protections with pollinator buffers to offset impacts (U.S. Fish and Wildlife Service 2016 p. 41)

The Las Vegas bear-poppy is listed as critically endangered in Clark County, Nevada and covered in the Clark County MSHCP in the Mojave Desert scrub ecosystem. The protection and management plan has been ineffective in protecting the species: “From 1988 through half of 2005, NDF [Nevada Department of Forestry] issued 26 out of 27 applications for take of plants and/or habitat... Most (41%) permits were for pipelines (gas, power, water), housing development (22%), and mining (19%), with just a few for airport development, a communications site, highway alignment, and military activity. Mitigation in early years involved transplant studies, none of which were successful” (The Nature Conservancy 2007 p. 60).

The Mojave poppy bee is not covered nor is listed as a priority evaluation species for Mojave Desert scrub ecosystem under the MSHCP, despite its being found there (Clark County Department of Comprehensive Planning 2000b p. 120). Of the remaining Mojave desert scrub habitat, ~57% falls within a Intensively Managed Area that includes National and State Parks that allow intensive recreation, 34% in a Multi-use Management Area on BLM land used for a variety of purposes such as intensive recreational uses including motorized vehicles and mining, and the remaining 9% in an Unmanaged Area that is privately owned and used for intensive uses (Clark County Department of Comprehensive Planning 2000b pp. 123–124).

Recognizing the essential mutualism, proposed conservation actions for the Las Vegas bear-poppy includes management of the Mojave poppy bee: “the relationship between pollinators and species should be monitored; the populations may be mutually dependent and both necessary for

successful conservation management" (Clark County Department of Comprehensive Planning 2000a p. 216). However, this monitoring has not provided any actual protection. Viability of the Las Vegas bear-poppy is poor when only generalist pollinators, such as the honey bee, are present but good to very good if specialist pollinators are in healthy numbers or dominate the pollinator community, respectively (The Nature Conservancy 2007 p. 54). Hickerson 1998 (p. 47) suggested translocation of specialist pollinators, particularly the Mojave Poppy bee, to the Las Vegas Valley; preceded by creation of floral-resource corridors with undisturbed soil, to enhance populations of the bear-poppy. However, none of these recommendations have been implemented.

### Utah Extinction of the Mojave poppy bee

The mutualism between the federally endangered Dwarf bear-poppy and its pollinator the Mojave poppy bee is now believed to be extinct (Portman et al. 2018b p. 594). Despite the documentation that the Mojave poppy bee is indeed extinct from Utah (Tepedino et al. 2014 p. 319), Portman et al. sought to confirm its absence due to their small size, potential for diapause during periods of unfavorable conditions, and the variable nature of bee populations (2018b p. 594). As Portman et al. stated "a confirmed loss of a population of this uncommon bee would further threaten its status" (2018b p. 595); unfortunately, its extinction was confirmed (Portman et al. 2018b p. 597).

After habitat loss and fragmentation due to urbanization reduced populations, the complete loss of the Mojave poppy bee and decline in Dwarf bear-poppy seed set is most likely due to the increase in Africanized honey bees in conjunction with grazing (Portman et al. 2018b p. 600). In 2017, two feral honey bee colonies were found at the Beehive Dome site, the site previously known to be inhabited by the Mojave poppy bee (Portman et al. 2018b p. 597). In addition, cattle have been eating, killing, and reducing reproduction of Dwarf bear-poppies at Beehive Dome since at least 2014 to the knowledge of the BLM and the Service ("U.S. Fish and Wildlife Service Emails" 2014 p. 1; "Bureau of Land Management Emails" 2018 pp. 1, 12–13, 24; Lewinsohn 2018 p. 1).

In recent years, Africanized honey bees are the main visitor to the Dwarf bear-poppy along with several species of sweat bees (*Lasioglossum*) (Portman et al. 2018b pp. 597–598). Sweat bees rarely contact the stigma and prefer co-blooming, nectar-producing plants adjacent to the poppy, resulting in low pollination efficiency (Portman et al. 2018b p. 599). In 2016 the Dwarf bear-poppy had reduced seed set compared to 2012 which was, in turn, lower than seed set in 1997, when the Mojave poppy bee was present (Portman et al. 2018b p. 600).

Portman et al. dismiss alternative explanations for loss of the Mojave poppy bee, such as lack of detection because the small males are obvious when they conspicuously wait and fight on flowers in the open or are in copulo with foraging females (Portman et al. 2018b p. 601). Poor weather conditions leading to extended diapause was also dismissed due to the fact that each survey year had sufficient rainfall for poppy blooms (Portman et al. 2018b p. 601). As a result, European and Africanized honey bees have taken over pollination and, in conjunction with grazing, are main causes of Mojave poppy bee extinction in Utah. Designating critical habitat and implementing a recovery plan pursuant to ESA listing are the only ways that these threats could be adequately managed to facilitate the return and recovery of the Mojave poppy bee in Utah.

### Likely Extinction in Arizona and California

Considering the threat of Africanized honey bees and recreation within the Mojave National Preserve, any remaining populations of the Mojave poppy bee in California represent an extinction debt due to isolation (Kuussaari et al. 2009 p. 565) and the inbreeding, synergies, and stochastic factors that accompany such a distribution (Brook et al. 2008 pp. 454–456). Most of the California populations are in designated wilderness areas (National Park Service 2018a p. 1), where they could at least have some measure of protection, and are near roads where camping is allowed (National Park Service 2018b p. 1), meaning that trampling of floral resources or nest sites is a real possibility.

If there are still a few populations hanging on in California, they are only connected to themselves, as the closest currently known site is 140-145 km (80-85 km to nearest historic site) away in Nevada and the Mojave poppy bee cannot disperse such a large distance. The nearest population to the Mojave poppy bee in Utah before it went extinct was one 130 km away in the LMNRA. There was one isolated population documented in Arizona in 1993 and, like the single remaining population in Utah, almost certainly has gone extinct due to the myriad threats listed above- namely Africanized honey bees, inbreeding depression, recreation, and grazing. Designating critical habitat and implementing a recovery plan pursuant to ESA listing are the only ways that these threats could be adequately managed to facilitate the return and recovery of the Mojave poppy bee in Arizona and California.

In sum, no existing regulatory mechanisms exist to adequately protect the Mojave poppy bee. The only non-voluntary regulatory mechanism in place is the designation of the Mojave poppy bee as a BLM Nevada sensitive species. However, as described throughout this petition, the BLM has failed to protect the Mojave poppy bee and its habitat. In addition, this designation is only in Nevada and so does not protect the Mojave poppy bee throughout its range. The continuing trend of decline plainly demonstrates that these existing measures are wholly insufficient to overcome the myriad threats to the species. Mojave poppy bees face threats that can only be adequately addressed through the comprehensive protections provided by the ESA.

## Request for Critical Habitat Designation

We urge the Service to designate critical habitat for the Mojave poppy bee concurrent with its listing. Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 U.S.C. § 1532(5)).

Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that: “classifying a species as endangered or threatened is only the first step in ensuring its survival. Of equal or more importance is the determination of the habitat necessary for that species’ continued existence… If the protection of endangered and threatened species depends in large measure on the preservation of the species’ habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat.” H. Rep. No. 94-887 at 3 (1976).

Critical habitat is an effective and important component of the ESA, without which the Mojave poppy bee's chance for survival significantly diminishes. Petitioners thus request that the Service propose critical habitat for the bee concurrently with its listing.

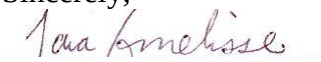
## Conclusion

In this petition, we have carefully assessed the best scientific and commercial information available regarding the Mojave poppy bee and its host plants, the endangered Dwarf bear-poppy and Las Vegas bear-poppy. We have reviewed the best scientific and commercial information available regarding the historic, present, and future threats faced by the Mojave poppy bee and have determined that the species is in imminent danger of extinction throughout its range. The ESA requires that the Service promptly issue an initial finding as to whether this petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A).

There is no question that protecting the Mojave poppy bee is warranted under the act as it is imperiled by 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting its continued existence that includes loss of habitat or range, rampant urbanization, recreation, grazing, climate change, loss of mutualisms, and honey bee competition. There are no existing regulatory mechanisms which are adequate to protect the Mojave poppy bee and its conservation is essential to the recovery of the critically endangered Dwarf and Las Vegas bear-poppies. The Service must act promptly to protect this species and to designate critical habitat in order to prevent its extinction and reverse its precipitous decline in range and habitat. Listing of the Mojave Poppy bee as an endangered species provides continued existence for three species that define the Mojave Desert of the American Southwest.

Please contact me at 503-283-5474 and/or tcornelisse@biologicaldiversity.org if you have any questions or need any clarification on the above information.

Sincerely,



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