BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO THE U.S. FISH AND WILDLIFE SERVICE TO LIST THE WHITE-MARGINED PENSTEMON (*Penstemon albomarginatus*) AS THREATENED OR ENDANGERED UNDER THE ENDANGERED SPECIES ACT AND TO CONCURRENTLY DESIGNATE CRITICAL HABITAT

Photo by Duncan Bell.

CENTER FOR BIOLOGICAL DIVERSITY

March 16, 2023

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 white-margined penstemon (*Penstemon albomarginatus*) as threatened or endangered 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 white-margined penstemon concurrently with the species being listed, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12.

References will be sent on a flash drive to the Las Vegas FWS office, and can be found here:

https://drive.google.com/drive/folders/1GWWApWEnlCcy5wMRufxJYQl_nmRzNaV8?usp=share_link

Petitioner 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 1.7 million members and online activists throughout the country. The Center works to secure a future for all species, great and 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 white-margined penstemon and its habitat.

Submitted this 16th day of March, 2023.

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EXECUTIVE SUMMARY

The Center for Biological Diversity submits this petition to list the white-margined penstemon (*Penstemon albomarginatus*) as a threatened or endangered species pursuant to the Endangered Species Act ("ESA"). This petition demonstrates that the white-margined penstemon is eligible for and warrants listing under the ESA based on the best scientific information, in the context of the five listing factors specified in the statute.

The white-margined penstemon is a distinctive member of the genus *Penstemon* found in certain sandy habitats of the Mojave Desert. The species is known from four geographically disjunct and genetically distinct population centers in northwestern Arizona (1), southeastern California (1), and southern Nevada (2), with a combined range of ca. 716 km^2.

The white margined penstemon is declining in abundance and extent across its global range, and all four population centers are experiencing significant threats including exurban sprawl, utility corridor maintenance and development, renewable energy development, public land privatization, off-highway vehicle (OHV) recreation, cattle grazing, herbivory, historic and persistent drought conditions, competition with invasive species, and pollinator limitation. While population numbers of this short-lived perennial generally fluctuate in response to precipitation trends, increasing aridification caused by prolonged drought due to climate change is likely to limit population growth, and recovery, effectively bringing the white-margined penstemon to the brink of extinction.

There are no existing regulatory mechanisms that are sufficient to protect this plant from extinction. Listing the white-margined penstemon as a threatened or endangered species and designating critical habitat under the ESA is necessary to provide critical legal protections to ensure the survival of this highly imperiled plant species.

INTRODUCTION

The white-margined penstemon (*Penstemon albomarginatus*) was formally described in 1908 and was noted to be a "most conspicuous and remarkable plant" (Jones 1908, p. 61). The species has four population centers across the Mojave Desert: Mohave County, AZ; San Bernardino County, CA; Clark County, NV; and Nye County, NV. Long taproots anchor these perennial plants in deep sandy soils, allowing them to endure brief periods of environmental stress. However, the rapidly accelerating effects of climate change including severe drought, combined with compounding pressures of habitat loss, proposed development, herbivory, off-highway vehicle use, and other threats have put the species on a declining trajectory with a high potential for quasi-extinction (Miller 2021, p. 32).

Due to these existential threats, the white-margined penstemon has long been recognized as a species of conservation concern and several studies have investigated its viability. A 2001 status review concluded that "active long-term management to reduce or eliminate further habitat destruction, and appropriate long-term monitoring" would avert the need for listing (Smith 2001, p. 22). Since then, full habitat protection has not been secured, population centers have not been effectively managed, and the severe impacts of drought intensified by climate change have become apparent. A recent population viability analysis projected the current climatic conditions into the future and found the probability of quasi-extinction (fewer than 10 individuals) for all population centers within 50 years was at least 50% (Miller 2021, p. 41).

Compounding the threats posed by drought and climate change are numerous factors contributing to habitat loss and degradation for this species. The Mohave County, AZ population center is being fragmented and impacted by exurban development; the San Bernardino, CA population center is being harmed by off-highway vehicles and utility corridor construction and maintenance; much of the Clark County, NV population center is proposed for sale to developers and/or is within the footprint of already planned development; and the Nye County, NV population center faces threats from energy development. Without the protections of the ESA, the white-margined penstemon is at severe risk of extinction.

NATURAL HISTORY

Description and Taxonomy

White-margined penstemon (*Penstemon albomarginatus* M.E. Jones) is a perennial hemicryptophyte that is typically 15 to 35 cm in height, with several to many glabrous stems arising from a root crown buried in sand, and anchored by a lengthy taproot (Scogin 1989; Baldwin et al. 2012, p. 1020). Its oblanceolate leaves are entire to weakly dentate with prominent white margins, a distinctive coloration uncharacteristic of other *Penstemon* species that it co-occurs with. Its morphology is also distinctive when compared to the eight other species that are placed in *Penstemon* sect. *Penstemon* (Smith 2001, p. 8; Freeman 2019, p. 191; Fig. 1). The corollas are 13 to 17 mm long, pink to purple with dark purple striations in the throat, and glabrous except for the hairy floor. The fruit is a capsule which splits lengthwise at maturity, and generally contains many seeds (Jones 1908, p. 61; Baldwin et al. 2012, p. 1020).

Figure 1. *Penstemon albomarginatus*. Photo by Patrick Donnelly

Under favorable conditions, white-margined penstemon emerges from dormancy in the winter-spring growing season, flowers from March to May, fruits from May to June, and dies back completely to its below ground structures during the hot summer months (Moore and Pavlik 2015, p. 91). Below average winter-spring precipitation can drastically inhibit or reduce seedling emergence, and is one of the driving factors affecting population dynamics of this rare species (Moore and Pavlik 2015, p. 91; Miller 2021, p. 6).

The first herbarium specimen of *Penstemon albomarginatus* was collected in 1884 by Marcus E. Jones, who described and published the species in 1908, and its validity has never been disputed (Jones 1908, p. 61; Smith 2001, p. 6). The type specimen was collected by Jones at Good Spring's Station, Clark County, Nevada, in 1905.

Range

The white-margined penstemon occupies four disjunct population centers in the southwestern US (Fig. 2): 1) Mohave County, AZ; 2) San Bernardino County, CA; 3) Clark County, NV; and 4) Nye County, NV. These four population centers are separated by over 100 km and appear to be genetically distinct with little genetic admixture (Wolfe et al. 2016, p. 1250). Evidence of relatively greater amounts of genetic diversity and admixture in the Arizona population center suggests recent dispersal to the north following the last glacial retreat (Wolfe et al. 2016, p. 1252-1253). Further details regarding the size, extent, and area of occupancy for each population center are provided below. The GeoCAT tool (Bachman et al. 2011) was used to calculate the range extent (convex hull) and area of occupancy for each of the population centers. The area of occupancy was estimated using 2 x 2 km grid cells for each occurrence according to International Union for Conservation of Nature (IUCN) guidelines (IUCN 2022, p. 54). While the

2 x 2 km grid cell size likely overestimates the occupied habitat for white-margined penstemon[1], it has been shown to be the optimal scale for risk assessments (Keith et al. 2018, pp. 327-330; IUCN 2022, p. 54).

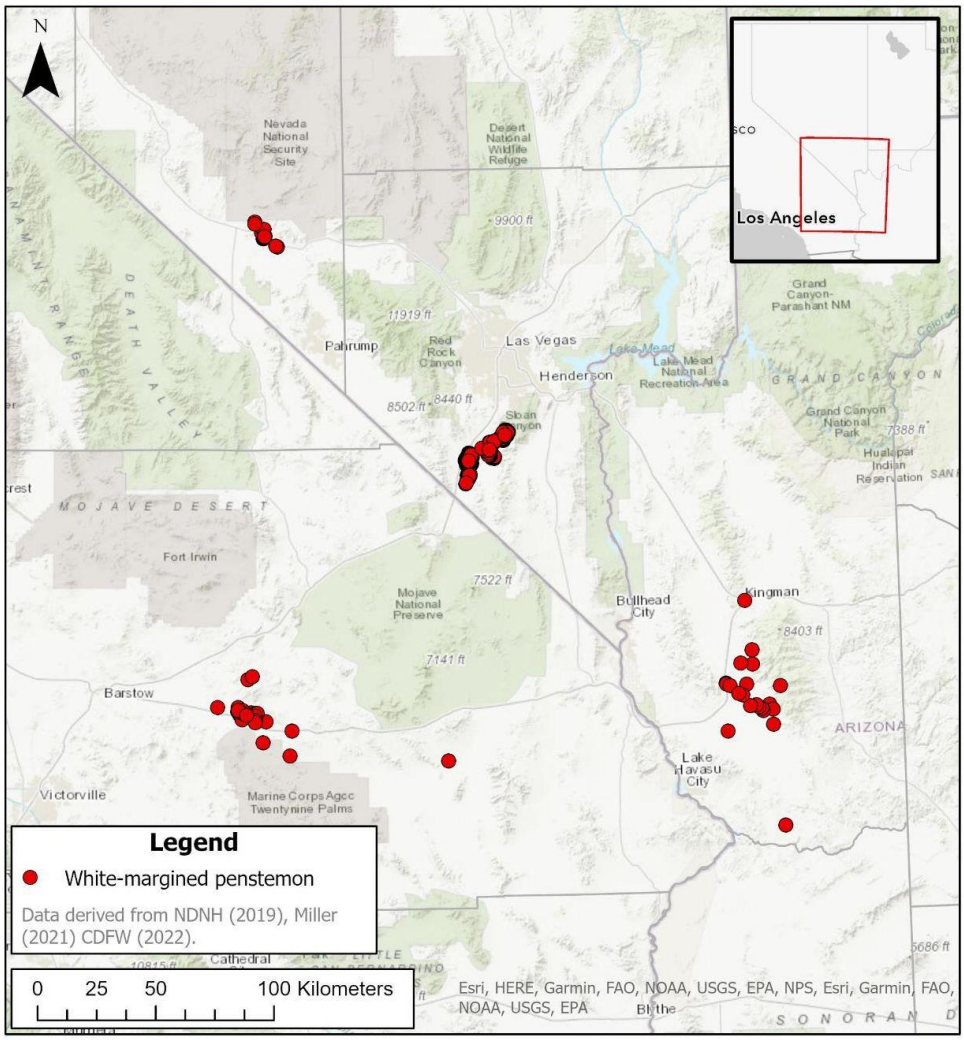

Figure 2. Map of all reported occurrences of white-margined penstemon.

Mohave County, AZ

The Mohave County, AZ population center is concentrated in Dutch Flat, AZ with two putative disjunct occurrences near Kingman, AZ and the Bill Williams Wildlife Refuge (Miller 2021, p. 19). This population center is not well-studied and it is likely that a portion of the reported occurrences are based on poor locality data (e.g., Miller 2021, pp. 23-24) or are otherwise erroneous. Currently, the two disjunct occurrences are not represented in the most recent range map produced by the Arizona Game and Fish Department (2019a) and thorough field surveys are needed to delineate the true range of the white-margined penstemon in Arizona. As such, estimates of the range extent for the Arizona population center vary considerably and range from 1315 km^2

[1] For instance, the sum of the area reported for each occurrence in California is just over 4 km^2 (CDFW 2022).

based on all reported occurrences (Miller 2021, p. 11) to 259 km^2 according to a BLM assessment conducted in 1990 (Button 1991, p. 5). In all cases, large areas within the range consist of unsuitable habitat (Anderson 2001, p. 33). The generalized area of occupancy using all reported occurrences is 72 km^2. A 1998 survey carried out in Dutch Flat estimated 100,000 individuals across the whole area (Smith 2001, Appendix 1; AZGFD 2019b, p. 5).

San Bernardino County, CA

The majority of occurrences in the California population center are located ca. 64 km east of Barstow, CA near Pisgah Crater and Lavik Lake (Fig. 2). Two small occurrences are located in Hidden Valley, ca. 11 km to the north and separated by the Cady Mountains. The three easternmost occurrences are based on vague and/or incorrect locality data from herbarium vouchers collected in the 1940s (CDFW 2022). Subsequent fieldwork has failed to locate these putative occurrences (Scogin 1989, pp. 3–4; Moore and Pavlik 2015, p. 92). The total range extent in California, based on all known California Natural Diversity Database (CNDDB) Element Occurrences (EOs), excluding the three easternmost occurrences (EOs 4–6) (CDFW 2022), is approximately 276 km^2 although much of this area consists of unsuitable habitat. Additionally, given the scale of recent extirpation (*see below "Population Status and Trend")*, it is possible the range extent has been reduced. The generalized area of occupancy is 68 km^2. The total abundance of the population center in San Bernardino County has ranged from an estimated 4,420 individuals in 1993 (Smith 2001, p. 16) to 35 plants in 2022 (Pyramid Botanical Consultants 2022, p. 18). Several occurrences appear to have been extirpated in recent decades (Moore and Pavlik 2015, pp. 91–93; D. Bell pers. comm.).

Clark County, NV

The Clark County, NV population center is located south of Las Vegas, NV and consists of four main occurrences located near Hidden Valley, Jean Lake and to the north and south of Roach Lake (Fig. 3). An isolated occurrence near Potosi Mountain is most likely a misidentification (Miller 2021, p. 8) and a 1997 survey failed to locate any plants in this location (Smith 2001, Appendix 1). The total range extent of all known occurrences in Clark County (NDNH 2019), excluding the Potosi Mountain occurrence, is 158 km^2 and the generalized area of occupancy is approximately 120 km^2. Estimates of abundance of the Clark County population center have ranged from 25,964 in 1997–1998 (Smith 2001, Appendix 1) to 125,825 in 2007–2008 (Etyemezian et al. 2010, p. 52). The most recent estimate of abundance is 33,735 (Miller 2021, p. 45).

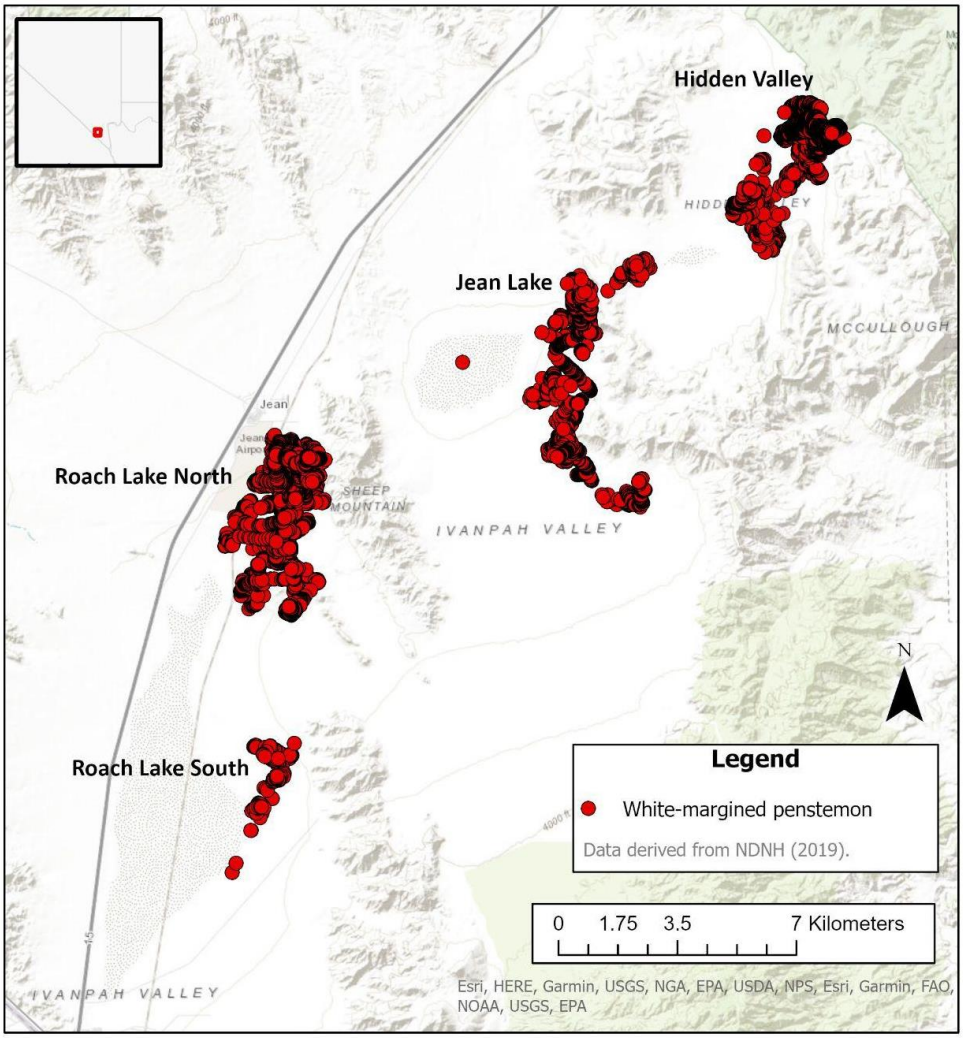

Figure 3. Range map of four main occurrences of white-margined penstemon in Clark County.

Nye County, NV

The Nye County, NV population center is located near U.S. Highway 95 between the Nevada National Security Site and the Ash Meadows National Wildlife Refuge (Fig. 2). The total range extent of all known occurrences in Nye County (NDNH 2019) is approximately 23 km^2 and the generalized area of occupancy is 28 km^2. Estimates for the total abundance of the Nye County population center have ranged from 42,200 in 1997–1998 (Smith 2001, Appendix 1) to 78,954 in 2007–2008 (Etyemezian et al. 2010, p. 52). The most recent survey estimated 34,606 individuals (Miller 2021, p. 45).

Habitat

The white-margined penstemon is limited to the Mojave Desert, a warm desert ecoregion characterized by high variability in temperature and precipitation (Smith 2001, p. 12). While total annual precipitation varies considerably by year, it tends to be greatest during the cool

season (October to April; Hereford et al. 2006 p. 17–18). On average, warm-season precipitation (July to October) accounts for 29% of total annual precipitation for locations east of the 117°W meridian (Hereford et al. 2006, p. 17). However, an analysis of 30-year climate modeling data indicates the California population center of white-margined penstemon received 30% less precipitation than the Arizona and Nevada population centers, likely due to lower levels of warm-season rain (Moore and Pavlik 2015, p. 111). PRISM climate data for 1994–2021 suggests the Arizona population center is the wettest overall and the Nye County population center is the coolest (Miller 2021, p. 29).

The white-margined penstemon typically occupies sandy desert washes, valley floors, mountain foot-slopes, and erosional terraces (Scogin 1989, p. 3; Anderson 2001, p. 28; Smith 2001, p. 12; Etyemezian et al. 2010) comprised of deep eolian sand deposits or sandy alluvium (Scogin 1989, p. 6; Smith 2001, p. 13, Etyemezian et al. 2010, p. 80; Baldwin et al. 2012, p. 1020), although specific soil characteristics vary by location. The California population center occurs on stabilized to semi-stabilized sand deposits (Scogin 1989; Anderson 2001, p. 28; Miller 2021, p. 17) while the Arizona population center occurs on more stabilized sand with a surface gravel component (Miller 2021, p. 17). Soil characteristics of the Clark and Nye County population centers are more variable in stability and texture (Etyemezian 2010 pp. 22-23, Miller 2021, p. 17), although many occupied sites share the common characteristic of having an accumulation of carbonates at the soil surface (Etyemezian 2010, p. 79). Elevations of reported occurrences range from 608–1354 meters (Smith 2001, p. 12; CDFW 2022) and plants appear to prefer gentle slopes averaging about three degrees. However, they are occasionally found on steeper slopes (TNC 2007, p. 111).

The white-margined penstemon tends to grow in areas of sparse vegetation cover dominated by *Ambrosia dumosa*, *Larrea tridentata*, and *Yucca brevifolia* (Anderson 2001, p. 28, Etyemezian et al. 2010, p. 45, CDFW 2022). Other co-occurring species include *Abronia villosa, Acamptopappus sphaerocephalus, Ambrosia salsola, Amsinckia tessellata, *Bromus rubens, Chaenactis stevioides, Croton californicus, Ephedra nevadensis, Eremalche exilis, Hilaria rigida, Krameria erecta, Krascheninnikovia lanata, Malacothrix glabrata, Menodora spinescens, Plantago ovata, Oenothera deltoides, *Schismus arabicus, *Schismus barbatus, Senegalia greggii, Sphaeralcea ambigua, Sporobolus cryptandrus, Stephanomeria pauciflora, Stipa hymenoides, Streptanthella longirostris, Tiquilia plicata,* and *Yucca brevifolia* (Anderson 2001, p. 28; Smith 2001, p. 15; Etyemezian et al. 2010, p. 48, CDFW 2022). Species marked by an asterisk (*) are non-native, and invasive species.

Reproduction

Seedling emergence rarely occurs in years with below-average precipitation and multiple studies indicate large recruitment events are episodic (e.g., Moore and Pavlik 2015, p. 91; Etyemezian 2010; Miller 2021), similar to many Mojave Desert plant species (Hereford et al. 2006, p. 25). Growing season precipitation is positively correlated with juvenile plant survival (Moore and Pavlik 2015, p. 105), although herbivory often precludes successful recruitment (Etyemezian 2010, p. 76; Moore and Pavlik 2015, p. 108; Miller 2021, p.16).

Plants that survive to reproductive age are most likely pollinated by insects, although self-fertilization is suspected to occur. While many *Penstemon* species are known to be self-compatible, fruit production is generally higher with pollinator visitation (e.g., Tepedino et al. 1999, p. 42; Lange et al. 2000, p. 258; Lewinsohn and Tepedino 2007, p. 232). A limited study of pollen to ovule ratios in the California population center suggests the white-margined

penstemon has a tendency towards outcrossing (Scogin 1989, p. 10). Wasps belonging to Vespidae (yellowjackets, hornets, and paper wasps) were observed visiting flowers with pollen deposited on their upper body surfaces (Scogin 1989, p. 13). Other floral visitors have been observed, including *Ashmeadiella holtii* and *A. xenomastax*, small bees in the Megachilidae family, but the presence of pollen on these visitors was not confirmed (Smith 2001, p. 18).

Fruit production appears to be quite variable between years and population centers (Scogin 1989, p. 7; Etyemezian 2010, p. 78) and an examination of herbarium specimens indicates that aborted fruits and flowers are a common occurrence (Moore and Pavlik 2015, p. 102). While the white-margined penstemon has been shown to produce adventitious roots in a greenhouse setting, propagation from cuttings was unsuccessful (Scogin 1989, p. 8), indicating the species most likely reproduces by seed. Little is known about the germination requirements for the white-margined penstemon and routine tests of ex-situ seed collections generally show low germination rates (mean value 9%) under a variety of pretreatments (California Botanic Garden 2023). Studies of mature fruits indicate the average number of seeds per fruit ranges from 8.1 (Moore and Pavlik 2015, p. 102) to 15.5 (Scogin 1989, p. 10). Seed dispersal is most likely facilitated by abiotic factors such as gravity, wind, rain, and run-off (Smith 2001, p. 18). Observations from the Hidden Valley, NV location indicate a short dispersal distance from 1 to 15 cm (Etyemezian et al. 2010, p. 76). Seeds may also be dispersed by ants or rodents (Mackay 2006), but no known instances of animal dispersal have been recorded.

The average age for individual plants in the California population center ranges from 3.3 years (Smith 2001, p. 6) to 5.2 years (Moore and Pavlik 2015, p.102), but individuals in the Clark County and Nye County NV population centers may be more long-lived given their relatively lower mortality rates (Miller 2021, p.35). Recent observations of plants marked with pin flags presumed to be left from a 2008–09 study (Etyemezian et al. 2010) indicate that some plants may live to at least 13 years old (Miller 2021, p. 26).

Population Status and Trend

While the global population of the white-margined penstemon has fluctuated considerably over time, recent surveys indicate that all four population centers are in decline and are severely threatened by drought, climate change, herbivory, invasive species, development, and OHV recreation (Miller 2021, pp. 19-20). Further details regarding each of the four population centers are described below.

Mohave County, AZ

The Arizona population center of white-margined penstemon has not been well studied despite being described as the largest occurrence of the global population (Anderson 2001, p. 28). A 1998 survey estimated 100,000 individuals across the whole area which includes public and private lands (Smith 2001, Appendix 1; AZGFD 2019b, p. 5). Eight occurrences on public lands were resurveyed by Miller (2021) and only 189 plants were found. It is notable that all of these plants were emergent during the initial survey period, in contrast to other locations in California and Nevada where dormant plants were dominant (Miller 2021, p. 15). However, as observed during a June 2021 revisit to the site, not a single plant successfully produced seed as individuals were senesced, partially grazed, or gone entirely (Miller 2021, p. 25).

Quasi-extinction (fewer than 10 individuals) probabilities were calculated based on matrix projection models derived from the Clark County, NV long-term dataset (Miller 2021, p. 13) in conjunction with the 2021 demographic data for Arizona. The 50-year quasi-extinction

probability under the 2021 climatic conditions was nearly 80%. Doubling the drought frequency slightly increased the quasi-extinction probability to over 80% (Miller 2021, p. 44).

In addition to the impacts of unfavorable climate conditions, plants continue to be impacted by exurban development, insect and mammalian herbivory, cattle grazing, OHV recreation, and development (Oliva et al. 2004, p. 7; AGFD 2019, p. 6; Miller 2021, p. 25).

San Bernardino County, CA

The California population center of the white-margined penstemon has been the subject of several survey efforts and long-term population studies which point to an overall decline in population size and extent. The earliest known survey in this population center estimated greater than 450 individuals in 1988 (Scogin 1989, p. 6) and a subsequent survey in 1993 documented the largest estimate at 4,420 individuals (Smith 2001, p. 16). Demographic data collected from 1994–2003 and 2011–2012 indicate a net decrease in population size despite occasional short-term population growth correlated with periods of favorable climatic conditions (Moore and Pavlik 2015, p. 104) (Fig. 4). Surveys conducted in 2021 located only 14 emergent plants and one reproductive individual (Miller 2021, p. 16) and in 2022 only 5 emergent plants were found (Pyramid Botanical Consultants 2022, p. 18)

The demographic dataset from 1994–2003 and 2011–2012 provided the basis for a population viability analysis which indicates quasi-extinction (fewer than 10 individuals) is likely under a variety of climate scenarios (Moore and Pavlik 2015, p. 106) and that "there is a high risk of extirpation of the rare perennial PENALB [*Penstemon albomarginatus*] in California in the near future" (Moore and Pavlik 2015, p. 109). Bolstering this conclusion, a second population viability analysis, conducted with an updated dataset from 2021, indicates that quasi-extinction is 100% likely within 50 years under current climatic conditions (Miller 2021, p. 44). A third analysis, based on survey data from 2022, indicates an 80% likelihood of quasi-extinction in 17 years, but it is possible quasi-extinction will occur sooner since the analysis likely overestimates the survival rate for dormant individuals (Pyramid Botanical Consultants 2022, p. 33)

Of the four main population centers, the California occurrences of white-margined penstemon are at the highest risk of quasi-extinction, primarily due to lower population growth rates and smaller population size (Miller 2021, p. 46). Moore and Pavlik (2015) found a strong relationship between precipitation and population vital rates (p. 109) and individuals in California are less likely to survive drought via dormancy compared to other population centers (Miller 2021, p. 35). High levels of herbivory have further limited the ability of individuals to survive and reproduce (Moore and Pavlik 2015, p. 108). Mortality rates for the California population center have ranged from 5% in 1998 to 100% in 2003 (Miller 2021, p. 35). Little is known about the soil seed bank dynamics of the white-margined penstemon and it is unclear to what degree more favorable climatic conditions leading to possible germination of long-lived seeds might change quasi-extinction outlooks. However, despite recent periods of favorable precipitation, it appears few seedlings have been able to establish and endure the increase in drought frequency (Pyramid Botanical Consultants 2022, pp. 35-36). Furthermore, given the impacts of compounding threats such as herbivory, invasive species, OHV recreation, and development (Scogin 1989, p. 9; Miller 2021, p. 19), management intervention is urgently needed to improve the possibility that germinating individuals will survive and reproduce.

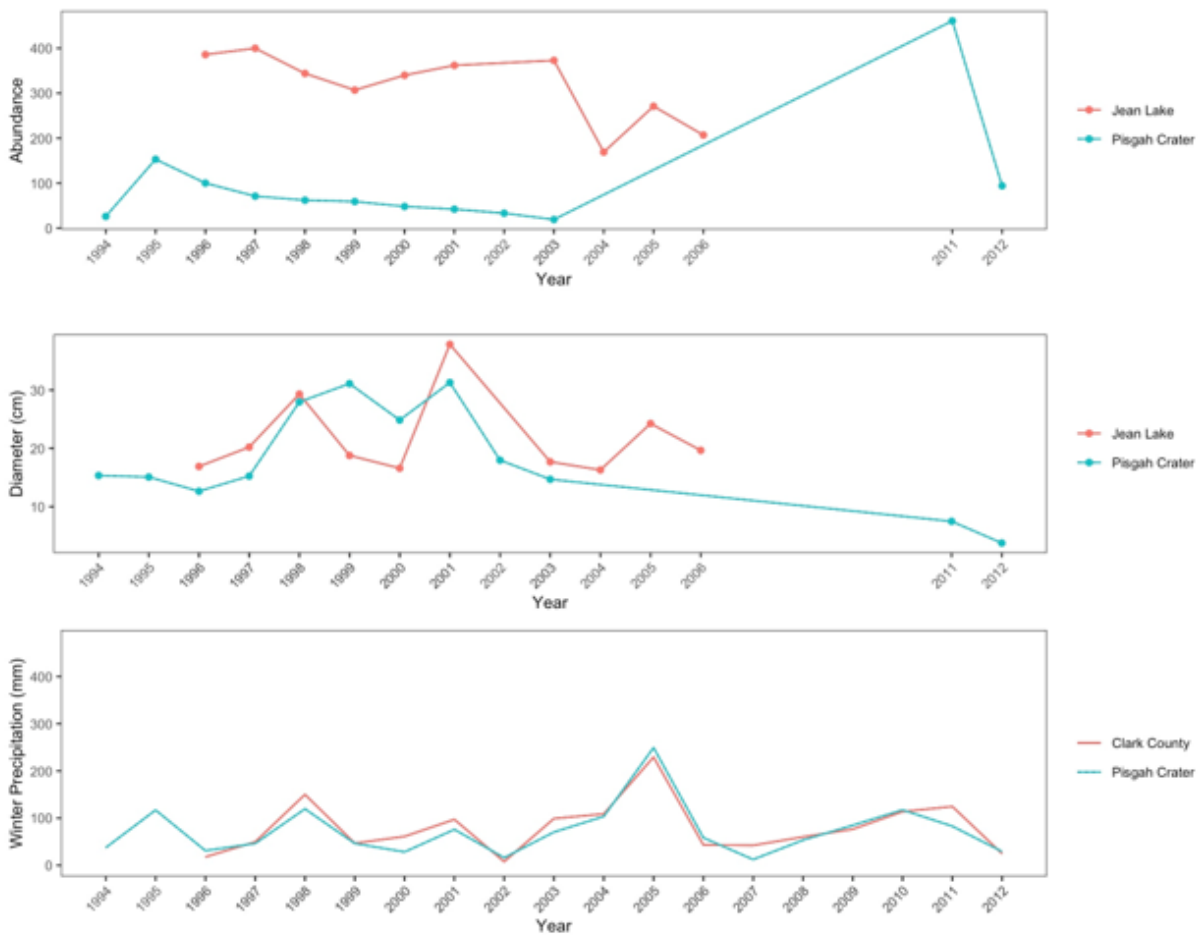

Figure 20. Population size and mean diameter (cm) for the 1994-2012 Pisgah Crater demographic monitoring and the 1996-2006 Clark County demographic monitoring, with total precipitation (mm) over the monitoring period.

Figure 4. (Source: Miller 2021, p. 33)

Clark County, NV

A series of surveys and demographic studies of the Clark County, NV population center have taken place from 1997 to 2021. Initial surveys conducted from 1997–1998 across the entire area estimated 25,964 individuals (Smith 2001, Appendix 1). This general area was resurveyed using a continuous series of transects and resulted in an estimate of 125,825 individuals (Etyemezian et al. 2010, p. 58). It is unclear to what extent the larger estimate is due to a true increase or differences in methodology between the two studies (Etyemezian et al. 2010, p. 52). The most recent estimate for the Clark County population center is 33,735 (Miller 2021, p. 45), considerably lower than previous years.

Long-term demographic data were collected by the BLM from the Jean Lake occurrence between 1996 and 2006; these data were used to inform a recent population viability analysis (Miller 2021, p. 13). While there was considerable variation in population size over the monitoring period, there was an overall net decline (Miller 2021, p. 32). Mortality rates for this occurrence

ranged from 1% to 13% from year to year and dormancy rates varied from 14% to 77% (Miller 2021, p. 35). While high dormancy rates provide some level of buffering from unfavorable conditions, the Jean Lake occurrence had a quasi-extinction rate of 50% within 50 years under the observed climatic conditions (Miller 2021, p. 40). Incorporating demographic data collected in 2021 increased the probability to 80% (Miller 2021, p. 44) and doubling drought frequency increased the probability for both datasets (Miller 2021, pp. 40-44).

In addition to the impacts of severe climatic conditions, the Clark County population center has also suffered impacts from OHV recreation, grazing, invasive species, and development (Smith 2001, p. 22; Miller 2021, p. 20). Finally, much of the Clark County population center lies within the footprint of two proposed developments: the Southern Nevada Supplemental Airport and ancillary facilities; and the increased disposal boundary proposed under the Clark County lands bill, wherein white-margined penstemon habitat would be sold to developers (see Factor A discussion below).

Nye County, NV

Surveys for plants in Nye County, NV were conducted in 1992 and 1994 as part of an effort to locate new occurrences of the white-margined penstemon in the vicinity of the Nevada Test Site (Blomqist et al. 1995, p. 53). These initial surveys estimated 6,200 individuals across 133 acres and subsequent surveys from 1997—1998 reported by Smith estimated 42,200 individuals across 441.5 acres (Smith 2001, Appendix 1). The same general area was resurveyed using a series of continuous transects resulting in an estimate of 78,954 individuals (Etyemezian et al. 2010, p. 52). As with estimates for the Clark County population center, it is unclear to what extent this increase is due to differences in methodologies as opposed to a true increase. The most recent survey estimated 34,606 individuals (Miller 2021, p. 45).

Demographic data for Nye County were collected by Miller (2021) to inform predictions of quasi-extinction based on demographic matrix projection models derived from the Clark County long-term dataset (Miller 2021, p. 13). Under the observed climatic conditions of 2021, the quasi-extinction probability for the Nye County population center in 50 years was 50%. Doubling the drought frequency increased the probability to 80% (Miller 2021, p. 42–43). Factors specific to the Nye County population center such as relatively cooler temperatures and reduced disturbance should be considered when interpreting these values (Miller 2021, p. 43). However, it should be noted that not a single plant was observed to have successfully reproduced under the extreme drought conditions of 2021 (Miller 2021, p. 28).

Although the 2021 data indicate that the Nye County population center is in decline, it was the center with the highest abundance (Miller 2021, p. 27). A 2007 qualitative assessment of landscape context, condition, and size, suggests the Nye County population center has the best viability among the global population (TNC 2007, p. 121). Nevertheless, occurrences in Nye County continue to be impacted by herbivory, invasive species, OHV recreation, and poorly sited berms (Miller 2021, p. 28) further eroding the sustainability of this population center. Further, these occurrences are now at significant risk due the multiple proposed renewable energy projects including the Greenlink West transmission line, and numerous proposed solar projects (see Factor A discussion below).

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). 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 white-margined penstemon has been recognized as imperiled and at risk of extinction at the national, state, and county level. According to NatureServe, it is globally imperiled (G2), meaning it is at high risk of extinction or elimination (NatureServe 2022). BLM lists the white-margined penstemon as a sensitive species in Arizona (BLM 2017a), California (BLM 2020; CNDDB 2022), and Nevada (BLM 2017b) under its mandate to "[implement] measures to conserve these species and their habitats...to promote their conservation.." (BLM 2008). In Arizona, it is ranked as critically imperiled to imperiled (S1S2) by NatureServe (2022) and is salvage restricted under the 2016 Arizona Native Plant Law (Ariz. Admin. Code §R3-3-1101 to 1110 and Appendix A). In California, it is ranked as critically imperiled (S1) by NatureServe and has a California Rare Plant Rank of 1B.1, meaning that this taxon is rare or endangered throughout its range and seriously threatened (CNDDB and CNPS 2020; CNDDB 2022). In Nevada, the white-margined penstemon is ranked as imperiled (S2) by NatureServe (2022), considered "at-risk" by the Nevada Department of Natural Heritage (NDNH 2022, p. 8), and is listed as a covered species under the Clark County MSHCP (Clark County Department of Comprehensive Planning 2000, p. B-272) and was recommended for continued coverage by the plan in 2018 (WRA Environmental Consultants). However, these designations do not provide sufficient protections or enforcement needed to prevent extinction due to ongoing threats.

Under the ESA, 16 U.S.C. § 1533(a)(1), FWS is required to list a species for protection if it is in danger of extinction or threatened by possible extinction in all or a significant portion of its range. In making such a determination, FWS must analyze the species' status in light of five statutory listing factors:

> (A) the present or threatened destruction, modification, or curtailment of its habitat or range;
> (B) overutilization for commercial, recreational, scientific, or educational purposes;
> (C) disease or predation;
> (D) the inadequacy of existing regulatory mechanisms;
> (E) other natural or manmade factors affecting its continued existence.
> 16 U.S.C. § 1533(a)(1)(A)-(E); 50 C.F.R. § 424.11(c)(1) - (5).

The white-margined penstemon is threatened by at least three of these factors and thus qualifies for federal protection. As further discussed infra, the species is threatened by present or threatened destruction, modification, or curtailment of its habitat or range; lack of existing

regulatory mechanisms to protect it from these threats; and other natural or manmade factors affecting its continued existence. While the plant itself is not overutilized for commercial, recreational, scientific, or educational purposes, its habitat is significantly overutilized for commercial and recreation use. Given the white-margined penstemon's restricted range and known threats, that listing as a threatened or endangered species may be warranted cannot be subject to reasonable dispute. The best available science shows that the white-margined penstemon is in danger of extinction in a significant portion of its range and a prompt decision to list the species based on this petition is necessary to ensure it does not go extinct.

THREATS

A. Present or Threatened Destruction, Curtailment, or Modification of Habitat or Range

Population-Specific Threats

Mohave County, AZ

The land ownership pattern for the Arizona population center of white-margined penstemon is different from those of the other population centers in that it is a mixture of private and public land. In particular, there are areas of checkerboard ownership in addition to contiguous blocks of private land. The development of these private lands has been ongoing for decades, and has resulted in negative outcomes for the white-margined penstemon.

Ostensibly in an effort to address this, BLM completed a large-scale land exchange with a private land holding company in 1999, in an effort called the Hualapai Mountains Land Exchange (Anderson 2001, p. 27). However, the vast majority of the land exchange occurred outside of white-margined penstemon habitat, and the results of the land exchange on the conservation of the rare plant were "mixed," (*Id*., p. 34). BLM gave up 3,575 acres of suitable white-margined penstemon habitat, and gained only 1,040 acres (*Id.*). While this fact is mitigated by the quality of the habitat transferred – BLM gained significant high quality habitat while giving up primarily low quality habitat (*Id.*) – the fact remains that the land exchange had little net effect on the conservation of the white-margined penstemon. Anderson (2001, p. 35) states that "...the comparative habitat unit values are similar between the preferred alternative… and the no-action alternative…" This means there was little if any net conservation gain resulting from the exchange.

As a result, the chief threat of habitat loss for the Arizona population center of white-margined penstemon is development of the private lands which make up a significant portion of its habitat. Exurban sprawl – larger parcels being developed with low-density – impacts the penstemon by constructing new roads, grading parcels, developing infrastructure, altering hydrology, increasing dust and emissions, and introducing new disturbance into previously undisturbed areas. "Urban development in the Dutch Flat population was significant, and increased roads, development, and overall use of the area is reducing the habitat available for the [white-margined penstemon], and reducing population abundance," (Miller 2021, p. 49).

The private land in the Dutch Flat area was parcelized and some amount of roads were constructed many decades ago. However, it's only in recent decades that large-scale development of these parcels occurred. Rudimentary analysis of satellite imagery bears this out. Below in Figure 5 are two satellite photographs pulled from Google Earth, one from 1997 and the second from 2021. White-margined penstemon locations from Miller 2021 are indicated with red icons. The conversion of a landscape which was previously undisturbed to one which is increasingly dense with human development is plain to see.

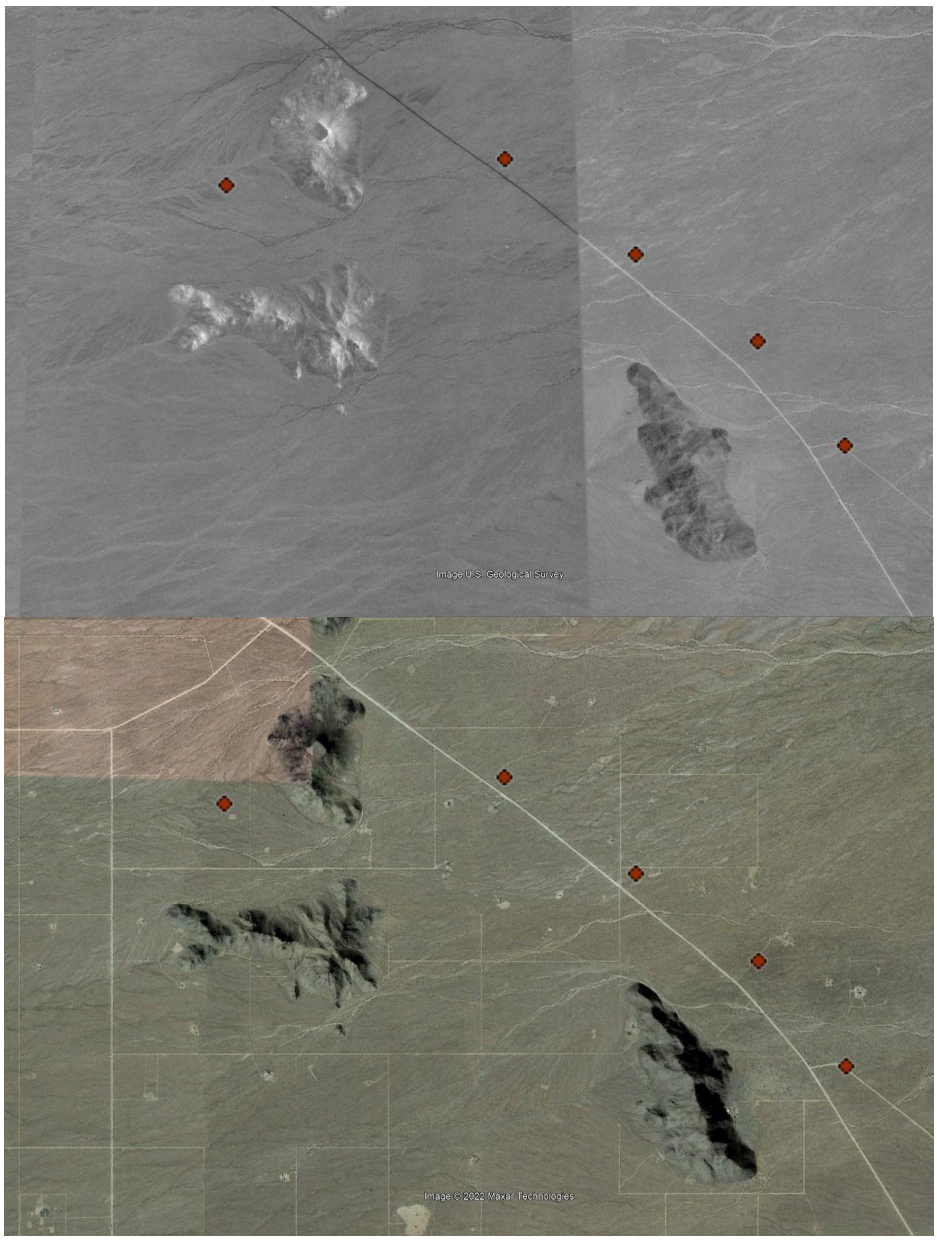

Figure 5: Dutch Flat in July 1997 and March 2021. Photos from Google Earth. Alamo Road can be seen crossing the photograph and Flattop is the northernmost mountain. White-margined penstemon points from Miller 2021 are indicated with red icons. The conversion of the landscape from one free of disturbance to one primarily influenced by exurban sprawl is plain to see.

Exurban sprawl can have "substantial" negative impacts on biodiversity, "both in the immediate vicinity of homes and even on adjacent or even distant public lands," (Hansen, *et al.* 2005, p. 1903). Impacts include: reduced survival and reproduction of native species; introduction and proliferation of exotic species; introduction of herbicides, pesticides, and other contaminants, alteration of ecological processes, including fire, flood, and nutrient cycles; alteration of biotic interactions, which could affect pollinator abundance and behavior; and introduction of direct human disturbance through recreation, pets, vehicle miles traveled, and other factors (*Id.*, pp. 1901-1903).

Exurban development "introduces new factors that shape plant communities," (Huntsinger 2009, p. 134). Such development can "...create[] widespread change by introducing new species or changing habitat, adding barriers to movement or dispersal, introducing new herbivores, and changing competitive dynamics among species," (*Id.*, p. 139). Areas with highly fragmented land management and discontinuous exurban development can see increased impacts to biodiversity as development causes fragmentation of habitat patches and increased edge effects (*Id.*, p. 151).

There is in general "an increase in human-adapted wildlife and non-native plant species with exurban development," (Maestas, *et al.* 2010, p. 518). Exurban developments may function as "ecological traps": areas where species are functionally stuck, and suffer reduced survival and reproduction due to the aforementioned factors (*Id.*, p. 519).

There are two further factors to consider with regards to exurban sprawl in Dutch Flat. First, this is an ongoing process that is occurring in real time. There are still thousands of acres of private land within white-margined penstemon habitat – 14,679 in the ACEC alone – and there is no plan for BLM to acquire these lands (Olivia, *et al.* 2004, p. 54). Road construction and home construction are ongoing, and such construction has been observed causing direct habitat loss of occupied white-margined penstemon habitat and direct mortality of individual plants (Donnelly, personal observation). Further, the effects of exurban sprawl may not yet be fully understood. The effects of exurban sprawl on biodiversity "...are cumulative and often nonlinear and continue to emerge for decades after development occurs," (Huntsinger 2009, p. 139).

Clark County, NV

On March 3, 2021 Senator Catherine Cortez Masto introduced the Southern Nevada Economic Development and Conservation Act, S.567, abbreviated as SNEDCA and commonly known as the Clark County lands bill. Section 204(a)(1) of the legislation proposed to expand the public land disposal boundary, established in 1998 in the Southern Nevada Public Land Management Act (SNEDCA, p. 9). This expansion would include lands south of the Las Vegas Valley, including in Hidden Valley, Jean Valley, and along I-15 south to the town of Jean (SNEDCA map, p. 1). The expansion of this disposal boundary means that public lands within the boundary would be subject to sale to private interests for development.

The sale of public lands proposed by the Clark County lands bill would result in a significant loss of white-margined penstemon in the Clark County population center. In addition to direct habitat loss, development on these parcels would entail indirect impacts to Jean Valley plants and Hidden Valley plants. In both cases, the disposal boundary surrounds these plants on two or more sides, and presumably development would occur right up to the edge of the disposal boundary. This would mean these plants would exist within the wildland-urban interface, and

would be subject to impacts from trampling, off-highway vehicles, trash dumping, alterations to drainage and hydrology, and other impacts associated with urban development. In addition, development and paving in these areas would alter aeolian processes which create and sustain the white-margined penstemon's sandy habitats. In short, the Clark County lands bill poses a threat of habitat loss and habitat degradation to large portions of the Clark County population of white-margined penstemon.

Further to the south is the proposed Ivanpah Airport, also known as the Southern Nevada Supplemental Airport (SNSA). In 2000, the federal government conveyed 6,000 acres of land to Clark County for development of a supplemental airport in the Ivanpah Valley Airport Public Lands Transfer Act (p. 1). Subsequently, the County was given congressional authorization to acquire an additional 17,000 acres for the airport in 2002 in Section 501(c) of the Clark County Conservation of Public Land and Natural Resources Act (p. 15). Additionally, the 2015 National Defense Authorization Act allowed for the County to acquire land for retention basins and flood control infrastructure (Clark County Department of Aviation 2021, p. 4). In total, these allocations would result in the loss of at least 23,000 acres of public land and possibly more with the flood control acquisitions. These areas also overlap with the Roach Lake North and Roach Lake South occurrences of the white-margined penstemon.

In particular, if all of these areas were sold or conveyed to Clark County and fully built-out for the SNSA, it would result in the near-complete extirpation of the Roach Lake North occurrence of white-margined penstemon, and the loss of a portion of the Roach Lake South occurrence, resulting in significant losses of the white-margined penstemon in the Clark County population center (Fig. 6). In addition to direct habitat loss and loss of individual plants, there would be significant indirect impacts to the remaining plants in the Roach Lake North and South occurrences. Similar to issues described above with indirect impacts from development resulting from the Clark County lands bill, all of the remnant plants at Roach Lake North and South would live in the wildland-urban interface, and would be subject to numerous impacts including trampling, trash dumping, alterations to drainage and hydrology, and increased nitrogen deposition. Additionally, such development could cause disruption to the aeolian processes which create and sustain white-margined penstemon habitat (Smith 2001, p. 19).

There are other developments which have caused habitat loss to occurrence of white-margined penstemon in Clark County. For instance, the Roach Lake North occurrence has been impacted, as "...habitat losses have likely occurred… where the Southern Nevada Correctional Center, sewage disposal ponds, a railroad corridor, and several dirt roads have been developed" in the area of the town of Jean (Smith 2001, p. 19). Multiple power lines cross both the Roach Lake South occurrence and the Jean Lake occurrence, and their ongoing operations and maintenance may cause impacts to white-margined penstemon. In addition, "Two historic locations of [white-margined penstemon] in the Roach Lake South area appear to have been extirpated due to pylon construction," (Miller 2021, p. 49). Mining is also a potential cause of habitat loss, in particular for sand and gravel operations (Smith 2001, p. 19). Such activities have already impacted the Jean Lake occurrence (*Id.*).

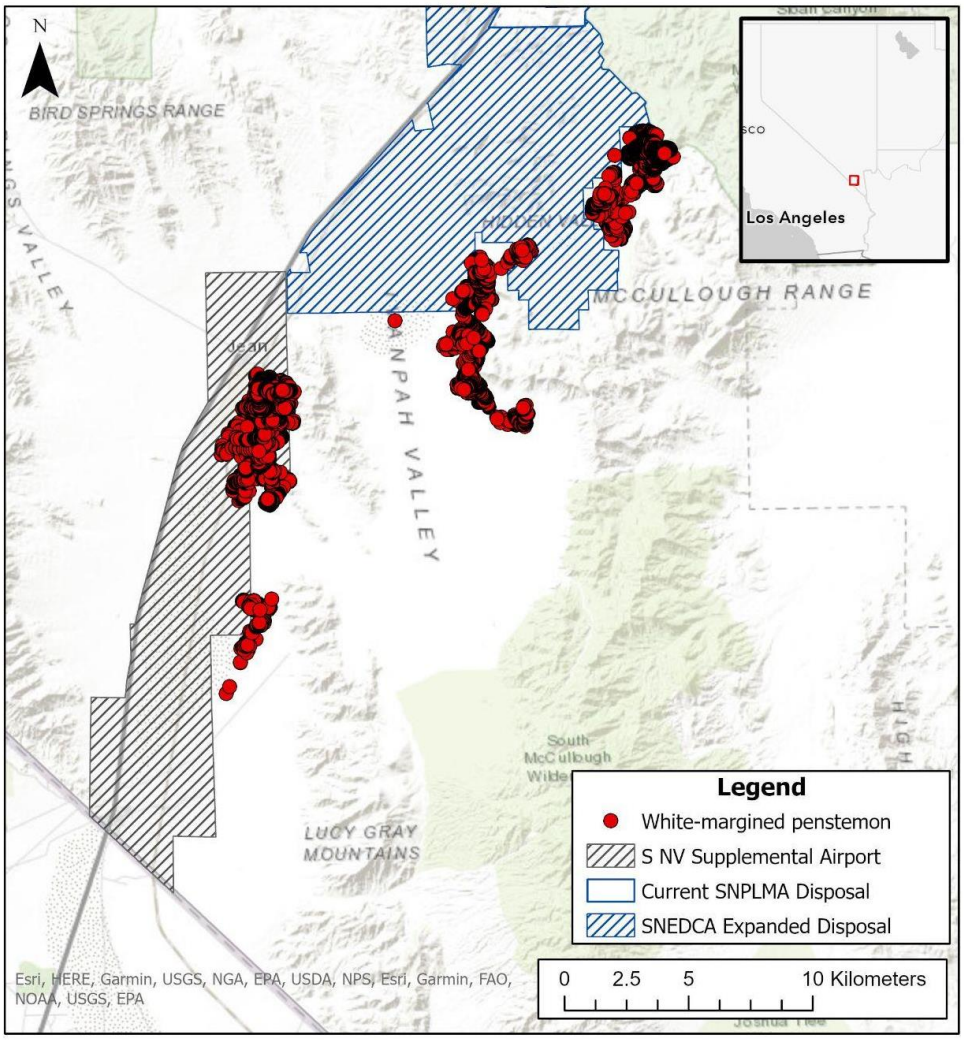

Figure 6. Proposed Southern Nevada Supplemental Airport and proposed lands disposal near Clark County population of white-margined penstemon.

Nye County, NV

Occurrences of white-margined penstemon in Nye County have already been impacted by habitat loss. The U.S. Highway 95 corridor bisects an occurrence and has directly eliminated a small portion of the habitat (Smith 2001, p. 18), in addition to providing a vector for invasive species, trash dumping, increased pollution, and other impacts.

More recently, BLM and NV Energy have proposed the Greenlink West transmission line, which would run generally down the U.S. 95 corridor, and would similarly impact the same occurrence already bisected by U.S. 95. Greenlink West entails the construction of new access roads, improving of existing roads, a 600 foot wide construction corridor and a 200 foot wide permanent operation corridor, and staging areas and other miscellaneous impacts (87 Fed. Reg. 25659). Greenlink West, in addition to causing direct habitat loss, would cause significant alteration of the white-margined penstemon's habitat. Increased erosion and alterations to the

hydrology and drainage of the habitat could be expected from the impacts of construction and operation within white-margined penstemon habitat. Increased perches for ravens could alter the behavior of small mammals and other species that interact with the white-margined penstemon, potentially changing the plant's ecology in unexpected ways. Construction and ongoing maintenance would be a major vector for invasive species. And increased road density would lead to more off-highway vehicle use, potentially impacting the plant's habitat.

In addition to the direct impacts of Greenlink West's construction and operation, the white-margined penstemon would be impacted by the new energy production sources that Greenlink West would enable. In particular, there are numerous utility-scale solar projects proposed for the area of Amargosa Valley in and among the Nye County occurrences of white-margined penstemon (BLM 2022, p. 4). Some of these solar projects would come very close to occupied white-margined penstemon habitat (*Fig. 7*). Whether or not these projects result in direct habitat loss, they will certainly cause indirect impacts to the white-margined penstemon. These include alteration of hydrology, alteration of aeolian processes which create and sustain white-margined penstemon habitat, introduction of invasive species, alteration of behavior patterns of white-margined penstemon pollinators and herbivores, destruction of pollinator habitat, increased dust, and other indirect impacts.

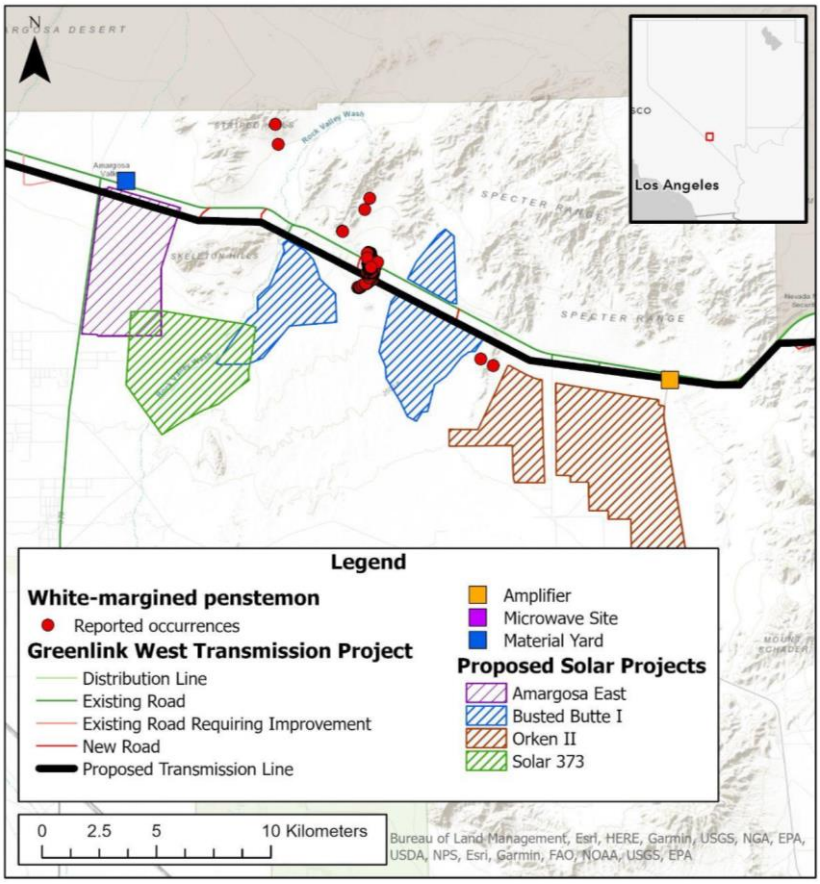

Figure 7: Energy development proposals near Nye County population center of white-margined penstemon.

Threats Under Factor A Common to All Populations

Off-Road Vehicle Use

Off-highway vehicle (OHV) use threatens the white-margined penstemon by impacting individual plants and destroying suitable habitat. The California population center is especially vulnerable to these threats as many occurrences are adjacent to roads and illegal OHV corridors (Scogin 1989, p. 8; Miller 2021, p. 21). Vehicle tracks were noted at many white-margined penstemon occurrences in the California population center by Miller (2021, p. 21) (Fig. 8) and several other observations note the presence of OHV threats there (Smith 2021; CDFW 2022).

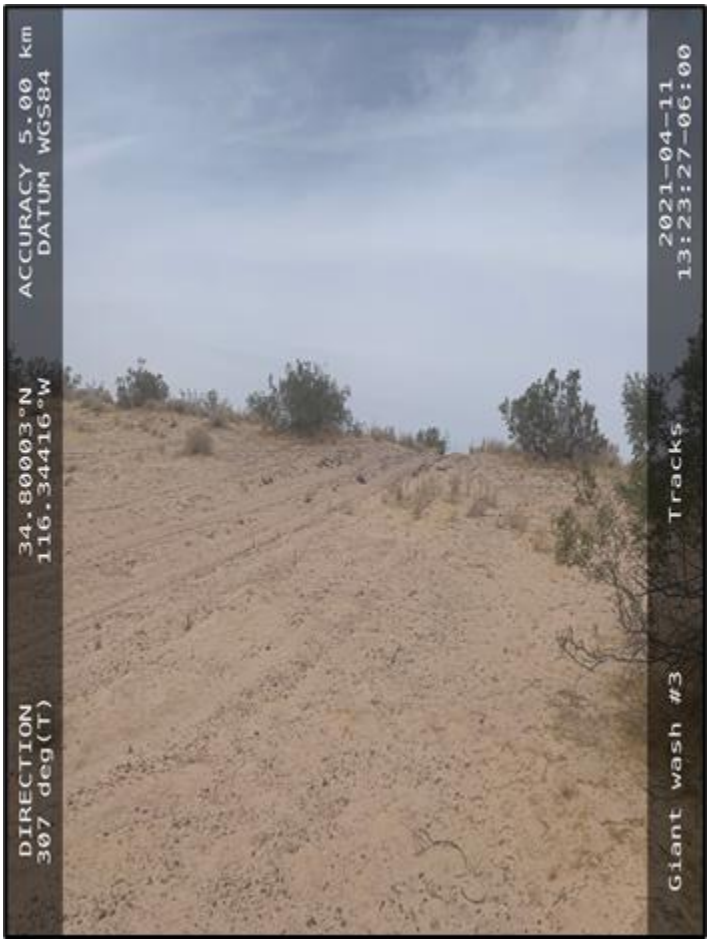

Figure 8: OHV tracks within white-margined penstemon habitat in Giant Wash, California. (Miller 2021, p. 23)

The Clark County population center is experiencing significant impacts from OHV use, especially racing and other organized events. Miller noted that apart from climate change, OHV use was the primary threat to Clark County occurrences observed in 2021 (Miller 2021, pp. 26-27) and the area is known to be a popular site for OHV and motorcycle races (Smith 2001). Indeed, one of the most famous OHV races in the world, the Mint 400, occurs right within the habitat of the white-margined penstemon (BLM 2021, p. 5). The most recent environmental review document for the Mint 400, a determination of NEPA adequacy tiered off a 9 year old

environmental assessment, does not mention the white-margined pentstemon at all (*Id.*, entire), despite the fact that the race tracks go directly through penstemon habitat. In the Fish and Wildlife Service's 2020 biological opinion on activities in the Southern Nevada District, the Service depicts hundreds of miles of OHV race course tracks in the Jean/Roach Dry Lakes area *(Fig. 9)*, many going right through white-margined penstemon habitat occurrences in both valleys (FWS 2020, p. 324) (*Fig. 10*). Based on a monitoring study conducted in association with an OHV race, researchers found that even one OHV racing event "dramatically affected population size and condition viability criteria," (TNC 2007, p. 116).

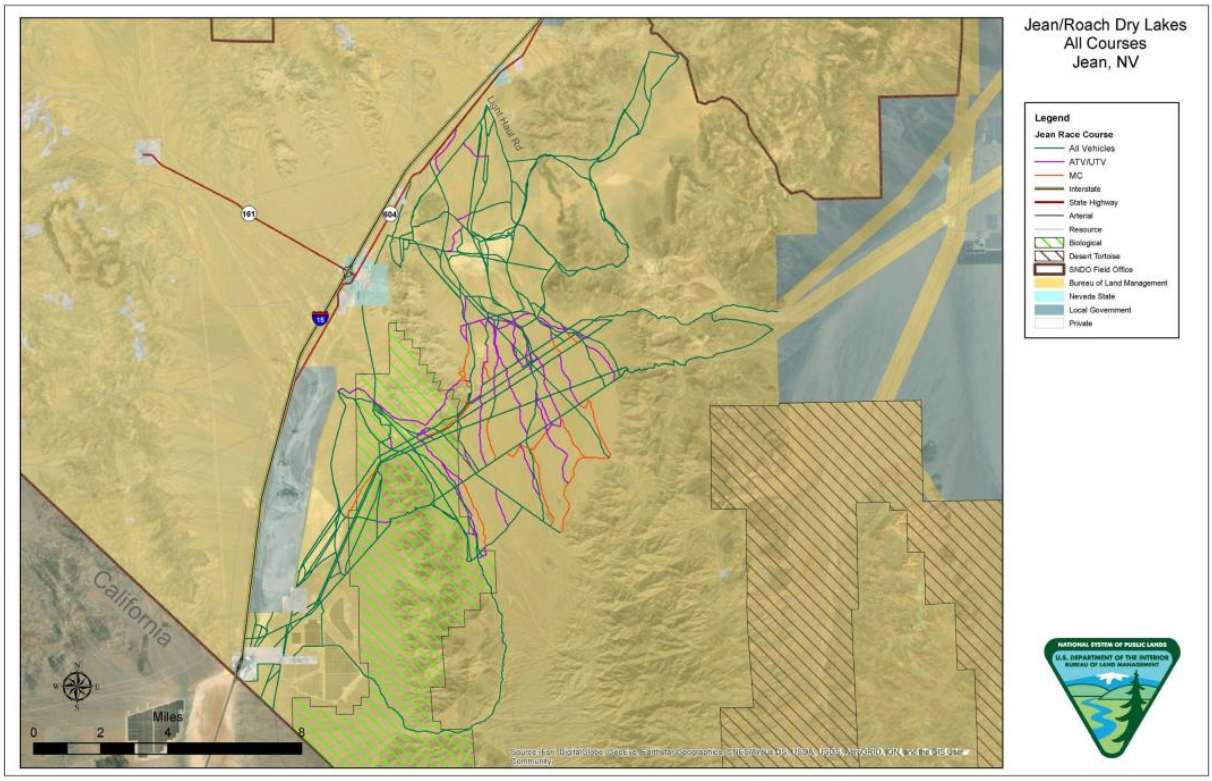

Figure 9: OHV race course routes in the Jean and Roach Dry Lake area. Numerous routes are within white-margined penstemon habitat. (FWS 2020, p. 324).

Figure 10: Off-road vehicle tracks and damage seen within white-margined penstemon habitat in Jean Valley. Photo: Patrick Donnelly, January 12, 2020.

OHV tracks have been noted at two occurrences in Nye County (Miller 2021, p. 28) but illegal use may increase as off-road enthusiasts travel further afield (AZGFD 2019b) and transmission corridors create new routes as described above. Similar to the Clark County population center, there are OHV races through Amargosa Valley which go through white-margined penstemon habitat (*Fig. 11*, FWS 2020, p. 335).

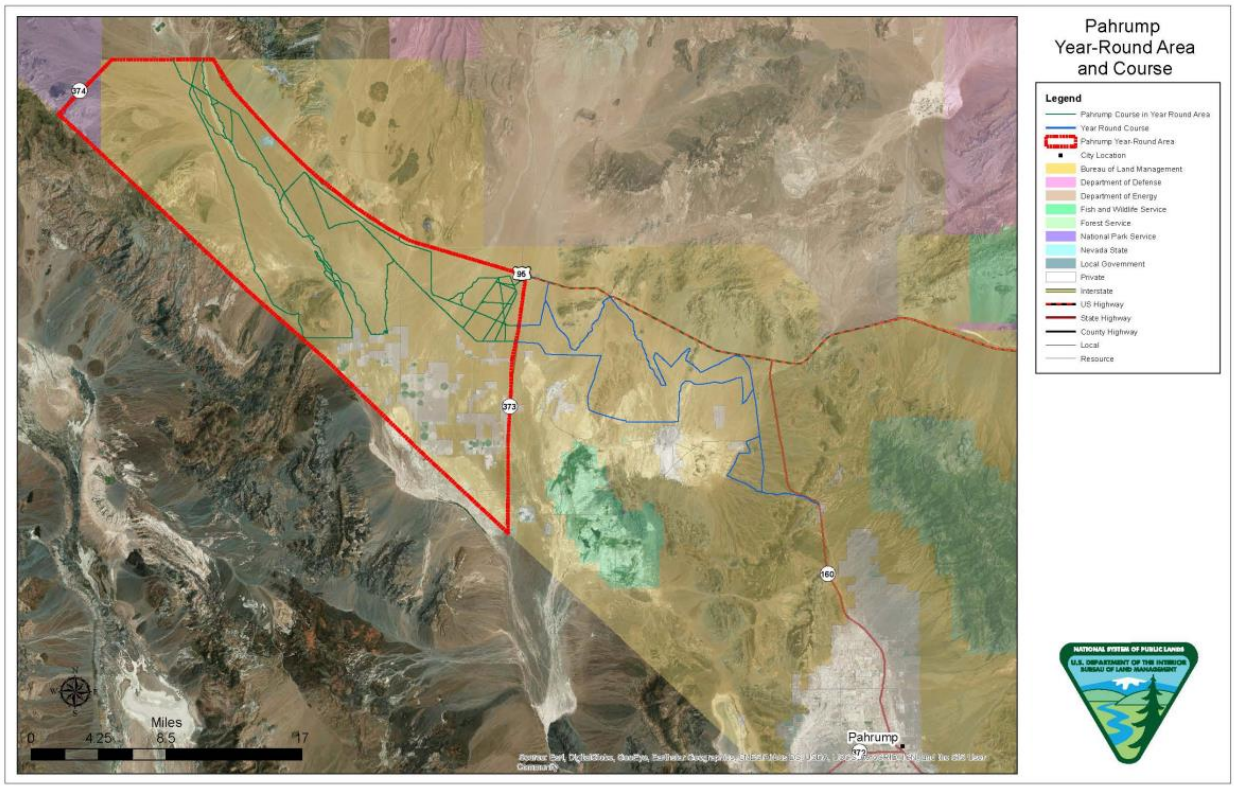

Figure 11: OHV race courses in Amargosa Valley, Nye County, depicting the "Year Round Course" through white-margined penstemon habitat (FWS 2020, p. 335).

OHV use can harm plant species in arid environments by disturbing the soil, and crushing or uprooting individual plants, and increasing soil loss (Switalski 2019, p.89). OHV recreation is also a vector for exotic and invasive species (*Id.*). OHV use can cause soil compaction, potentially inhibiting recruitment (Ouren *et al.* 2007, p. 11). By altering the hydrologic regime, soil compaction can also promote invasive species and discourage establishment of deep rooted annuals (*Id.*, p. 12). Even a single pass from an OHV in wet loamy sand, or twenty passes in dry loamy sand, can cause a reduction in desert annual plant cover due to a reduction in plant size (*Id.*, p. 11 citing Adams *et al.* 1982). In particular, annuals with large taproots like the white-margined penstemon decrease with increased OHV use (*Id.*). Fugitive dust created by OHV traffic can also impact plants, potentially affecting processes such as photosynthesis, respiration, and transpiration because the dust may block stomata (Ouren *et al.* 2007, p. 13; Spellerberg and Morrison 1998, p. 16). This may in turn result in reduced plant growth, size, productivity, or survivorship (Ouren *et al.* 2007, p. 13).

While the effects of OHV use on the white-margined penstemon have not been specifically studied, there are several studies on a different psammophyte plant, Pierson's milkvetch (*Astragalus magdalenae* var. *piersonii*), which grows in the Algodones Dunes, a popular OHV area in Imperial County, CA. One study found that areas with OHV use had 4-5 times fewer Pierson's milkvetch plants than areas legally closed to OHVs (Groom *et al*. 2007, p. 130). High levels of vegetation destruction have been found in areas of the Algodones Dunes open to OHVs, both through direct destruction of above-ground vegetative matter, but also through damage to the root systems of psammophytes (Luckenbach and Bury 1983, p. 275). Groom *et al.* suggest that seed pod production by Pierson's milkvetch is likely one fifth as much in areas used by OHVs as opposed to those closed (Groom *et al.* 2007, p. 130). One mechanism through which OHVs may harm the overall population of Pierson's milkvetch is by reducing small plant survival, which was found to be reduced by 33% in areas open to OHVs (*Id.*, p. 132). A different study found that OHV use at the Algodones Dunes is also likely impacting invertebrate populations, possibly due to a reduction in plant density, in particular causing declines in *Coleoptera* (beetle) abundance and diversity (Van Dam and Van Dam, p. 415-416). While findings from the Algodones Dunes are not a direct comparison to the white-margined penstemon, given its sandy habitat and intensive OHV use in some parts of its range, they are likely informative of some of the potential impacts of OHVs on the plant.

In short, given the severity of OHV impacts at three of the four population centers, and the grave implications for the long-term viability of the species due to the numerous negative impacts from OHV use on rare plants, OHV use must be considered a leading threat to the white-margined penstemon.

Cattle Grazing

Trampling associated with cattle grazing can impact individual plants and negatively alter habitat. Two of the four population centers of white-margined penstemon are grazed by cattle: Arizona and Clark County.

The Arizona population center is grazed across the entirety of the plant's local range (Miller 2021, p. 19). Sixty-three percent of all occurrences demonstrated negative impacts from cattle grazing (*Fig. 12, Id.*). Trampling from cattle tracks and trailing "could damage and compress soils, making them less suitable for new plant establishment"(*Id.*, p. 49). While not a comprehensive list, three primary grazing allotments containing white-margined penstemon

habitat in Arizona include Happy Jack Wash (#AZ00043), Chicken Springs (#AZ00021), and La Cienega (#AZ00051) (PEER 2020).

c

Figure 12: "Small [white-margined penstemon] plant near cowpie and cattle trail" in Dutch Flat population center. (Miller 2021, p. 25).

Habitat in Clark County has been particularly impacted by an allotment in Hidden Valley that has been active since at least 1975 and has led to the establishment of invasive species (TNC 2007, p. 119). The Hidden Valley dunes have been "very disturbed by long term cattle grazing" which had also caused an increase in invasive annuals (*Id.*, citing Sheldon 1994). BLM documented that 85% of plant occurrences documented in Hidden Valley were "heavily disturbed," (*Id.*, p. 114). Given that cattle grazing is the primary use of public lands in Hidden Valley, one can ascertain that significant disturbance is resulting from the presence of cows within white-margined penstemon habitat. The Hidden Valley occurrences of white-margined penstemon occur in the Hidden Valley allotment (#NV15412).

Grazing in arid desert lands has been shown to have "dramatic effects on species composition of plant communities," (Fleischner 1994, p. 631). Grazing also "destabilizes plant communities" by spreading invasive species including through dispersing seeds in fur and dung, creating disturbance which allows invasive species to thrive, and reducing competition by native

plants through herbivory (*Id.*, p. 633). Cattle grazing can also cause deterioration of soil stability, increasing erosion and compaction (*Id.*, p. 634). This could have significant impacts on the white-margined penstemon by preventing germination and eliminating habitat.

Grazing has been shown to negatively correlate with perennial forb cover, and positively correlate with an increase in exotic annual plants, including *Bromus tectorum* (Loeser, *et al*. 2007, p. 91). The effects of grazing on plant communities and individual species can be greatly magnified during drought conditions (*Id.*, p. 93-94; Souther, *et al.* 2020, p. 12). This has important ramifications for the white-margined penstemon, as the Mojave Desert has been under long-term drought conditions for many years.

There is relatively little literature on the effects of cattle grazing on rare plants in deserts. A recent study examined dormant season grazing in the habitat of *Astragalus holmgrenorium* and found that mortality during dormancy dramatically increased following grazing (Searle and Meyer 2020, p. 6). Reduction in survival in this study was "directly linked to trampling disturbance" from cattle (*Id.*). Most if not all grazing in the white-margined penstemon's habitat occurs during the dormant season, though some allotments are open year round (BLM 2023a, BLM 2023b, BLM 2023c, BLM 2023d). This increases the chances of cattle grazing negatively impacting white-margined penstemon.

B. Overutilization

Overutilization is not known to be a threat at this time.

C. Disease and Predation

Multiple studies have found that insect and mammalian predation of white-margined penstemon is a major contributor to mortality and lack of reproductive success (Scogin 1989; Etyemezian et al. 2010; Moore and Pavlik 2015; Miller 2021). All documented instances of herbivory involve the destruction of aboveground plant material and it is unknown whether seed predation is also a limiting factor.

Invertebrate predation of the white-margined penstemon is often severe and contributes to reproductive failure in the species (Etyemezian et al. 2010, p. 76; Miller 2021, p. 19, p. 45-46). Large blister beetles (*Epicauta puncticaulis*) were observed "voraciously devouring leaves," and are thought to be a significant herbivore of the California population center (Scogin 1989, p. 13). A survey of five occurrencess in Nevada demonstrated that pallid-winged grasshoppers (*Trimerotropis pallidipennis*) caused significant damage ranging from 14% of shoots at the "Roach Lake South" site to 98% at the "Hidden Valley" site (*Fig. 13*, Etyemezian et al. 2010, pp. 55-64). Surveys of the same occurrencess in 2009 indicated that most herbivory was caused by a leaf mining caterpillar species that caused damage ranging from 29% of shoots at the Roach Lake South occurrence to 79% of shoots at the Jean Lake occurrence (Etyemezian et al. 2010, p. 55-56). At the Arizona population center, desert leafcutter ants *(Acromyrmex versicolor*) were seen completely destroying individual plants in a matter of minutes, but it is unknown whether this was an isolated occurrence or a recurring issue (Miller 2021, p. 25).

Figure 13: Insect herbivory on *P. albomarginatus* at Roach Lake South (RLN) site (April 26, 2009). (Etyemezian et al. 2010, p. 57)

Mammalian herbivory of the white-margined penstemon prevents reproductive success and contributes to increased rates of mortality. An herbivore exclusion study found that caged plants had greater survivorship and fruit production than uncaged plants (Moore and Pavlik 2015, p. 108). Seedlings that were excluded from herbivores had 21.1% survival compared to only 6.0% for the uncaged plants. A lower proportion of uncaged adult plants produced fruit compared to caged plants (56.7% and 78.4%, respectively), although the average number of fruits per inflorescence was only 0.4. Overall, plants that were protected from herbivores for all or part of the survey period lost only 23% of canopy compared to uncaged plants that lost 62%. These occurrences were revisited in 2021 and over half of the plants that survived from the Moore and Pavlik (2015) study were located in or near cages, indicating herbivore exclusion greatly contributes to long-term survival in the species (Miller 2021, p. 20).

Cattle grazing threatens several occurrences and is discussed in more detail above. Disease is not known to be a significant threat at this time.

D. Inadequacy of Existing Regulatory Mechanisms

Existing regulatory mechanisms are inadequate to ameliorate the significant threats to the white-margined penstemon described in this section of this petition. The global threats of climate change and drought to the species can only be addressed through a reduction in greenhouse gas emissions; and there are no regulatory mechanisms in place to prevent the large-scale habitat

destruction, degradation, and loss which is ongoing and would be further expanded through development proposals.

According to NatureServe, the white-margined penstemon is globally imperiled (G2), meaning it is at high risk of extinction or elimination (NatureServe 2022). Arizona ranks the species as imperiled to critically imperiled (S1S2) (*Id.*). California ranks it as critically imperiled (S1) and has a California Rare Plant Rank of 1B.1, meaning that this taxon is rare or endangered throughout its range and seriously threatened (CNDDB and CNPS 2020; CNDDB 2022). In Nevada, the white-margined penstemon is ranked as imperiled (S2) (NatureServe 2022) and is considered "at-risk" by the Nevada Department of Natural Heritage (NDNH 2022, p. 8). However, NatureServe, Natural Heritage, and native plant society rankings are non-regulatory in nature and do not provide any protection for the species.

BLM lists the white-margined penstemon as a sensitive species in Arizona (BLM 2017a), California (BLM 2020; CNDDB 2022), and Nevada (BLM 2017b) under its mandate to "[implement] measures to conserve these species and their habitats… to promote their conservation…" (BLM 2008). Although the BLM must consider sensitive species in National Environmental Policy Act documents when evaluating proposed actions (BLM 2008 p. 37), the responsible official may still authorize impacts to occur, as they are not obligated to conserve the species as would be required under Section 7 of the ESA. BLM sensitive species regulations also do nothing to protect against environmental or climate impacts, impacts on private land, invasive species, or many of the other threats faced by the white-margined penstemon. A BLM sensitive species designation alone is not enough to prevent impacts to the species or even sufficient to preclude Endangered Species Act listing - for instance, Tiehm's buckwheat (*Eriogonum tiehmii*) was recently listed under the Endangered Species Act, despite being designated a BLM sensitive species (87 Fed. Reg. 77368).

A portion of the white-margined penstemon's habitat in Arizona has been designated as the White-Margined Penstemon Reserve Area of Critical Environmental Concern (ACEC). An ACEC is intended to provide special management provisions to promote the conservation of vulnerable resources. However, there is a pattern of checkerboard land ownership within the ACEC. In an attempt to address this, BLM executed the Hualapai Mountains Land Exchange in 1999. As discussed above under Factor A, this had only a modest effect in reducing the issues of checkerboard land ownership within white-margined penstemon habitat. "Within the ACEC, there are still private lands that continue to be converted to residential areas," (AZGFD 2019b, p. 6). The ACEC designation does not prevent impacts or development to white-margined penstemon habitat on private lands, and has not been sufficient to prevent the overall degradation and fragmentation of habitat in the Arizona population center.

A portion of the white-margined penstemon's habitat in California is protected under National Conservation Land status as established under the California Desert Renewable Energy and Conservation Plan (DRECP). Another portion of the white-margined penstemon's habitat in California is protected as a part of Mojave Trails National Monument. Yet another portion of the habitat is part of the Pisgah Research Natural Area of Critical Environmental Concern (ACEC). However, numerous occurrences of the plant occur in a gap of unprotected land which is not part of the national monument and is not DRECP National Conservation Lands (*Fig. 14*). This includes those determined to be occupied by plants in Miller (2021, pp. 61-63) including CA EO 18, CA EO 13, CA EO 19. Additionally, several other occurrences which were unoccupied

during Miller's surveys are also in this gap, including CA EO 24, CA EO 17, CA EO 23, CA EO 22, CA EO 21, and CA SN_5021. While national monument or DRECP National Conservation Land status provides protective mechanisms for some portions of the white-margined penstemon's habitat in California, these mechanisms will not address the primary threats facing the plant in California, namely climate change, drought, and unauthorized OHV use. And for the occurrences outside of those areas, they have no protections at all.

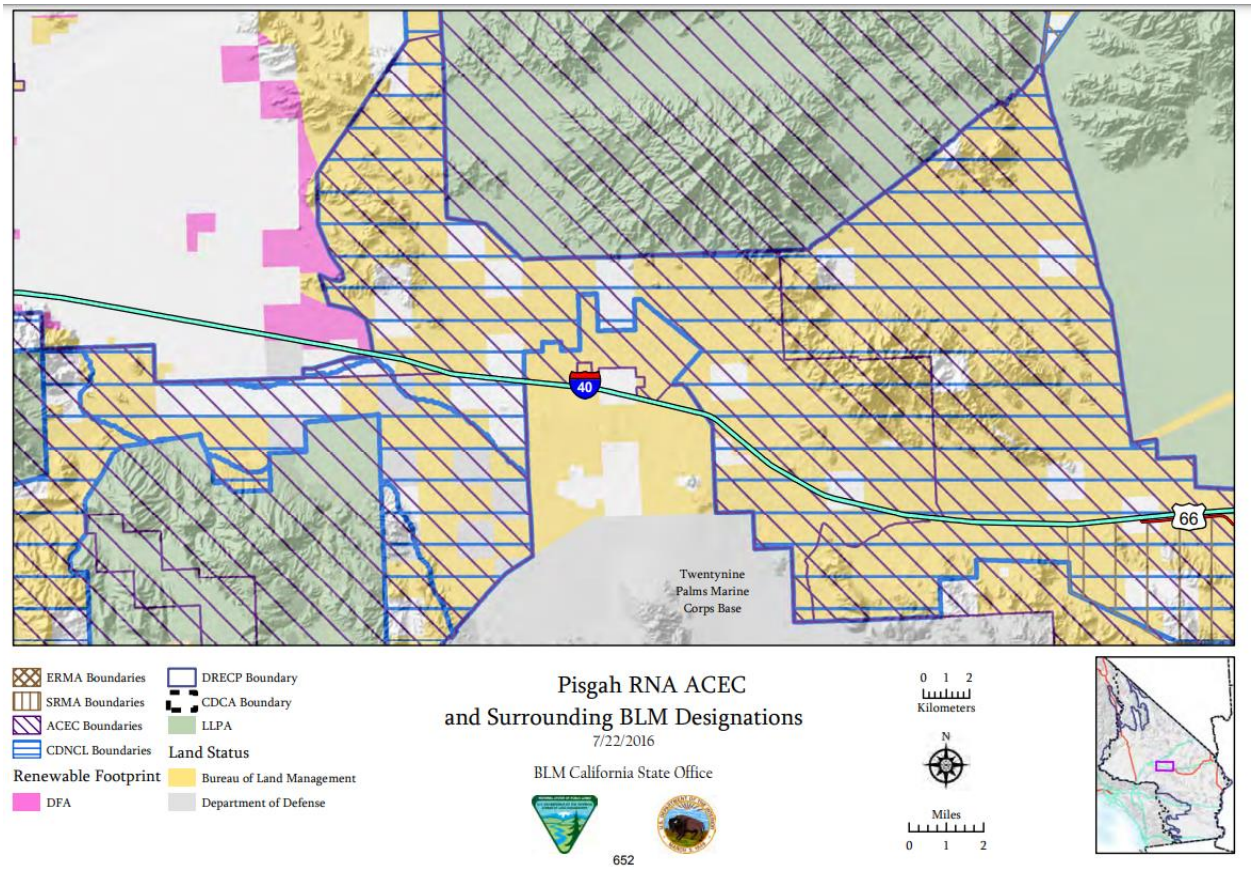

Figure 14: Pisgah Research Natural Area ACEC and surrounding designations. The large unprotected area west of Pisgah Crater is the site of several occupied white-margined penstemon occurrences. Mojave Trails National Monument is not pictured but does not affect this unprotected area. (BLM 2016 p. 652)

The white-margined penstemon is salvage restricted under the 2016 Arizona Native Plant Law (Ariz. Admin. Code §R3-3-1101 to 1110 and Appendix A). However, this simply means one needs to obtain a permit before removing one of the plants from the wild. It does not protect against habitat loss, destruction, or degradation, nor does it impose any restrictions on private or public landowners who have white-margined penstemon on their lands. This is a very low level of protection.

The white-margined penstemon is unprotected under Nevada state law or regulations.

The white-margined penstemon has only modest protections under California state law. As a CNPS ranked 1B.1 plant, agencies are obliged to analyze impacts to the white-margined penstemon when environmental analyses are conducted under the California Environmental Quality Act (CEQA), per CEQA guidelines 15125(c) and 15380. However, the threats faced by the white-margined penstemon in California, such as climate change, drought, and unauthorized OHV use, are not subject to analysis under CEQA. Thus, this regulatory mechanism is inadequate to provide protections for the species against existing or emerging threats.

The white-margined penstemon is listed as a covered species under the Clark County MSHCP (Clark County Department of Comprehensive Planning 2000, p. B-272) and was recommended for continued coverage by the plan in 2018 (WRA Environmental Consultants). However, these designations do not provide sufficient protections or enforcement needed to prevent extinction due to ongoing threats. "The biologic goals for managing *Penstemon albomarginatus* are to 1) allow no net unmitigated loss or fragmentation of habitat in the areas where it occurs; 2) maintain stable or increasing population numbers; 3) and implement modifications to grazing practices as indicated by exclosure studies at the Jean Lake and Hidden Valley sites" (Anderson 2001, p. 20). However, these goals are non-binding, and based on the proliferation of threats faced by the white-margined penstemon and documented here, whatever actions the agencies have been taking to meet these goals have been insufficient and ineffective.

One activity Clark County was supposed to undertake as a part of the MSHCP was to prepare a Low Elevation Plant Management Plan, which was intended to detail specific conservation actions to provide for the long-term viability of the species. This document was prepared by The Nature Conservancy (TNC 2007, *entire*) and made nine recommendations for conservation actions, including: proactive protection and management; removal of significant OHV impacts; controlling weeds; limit rural development and sprawl; ensure that disposal of federal lands will not impact the plants; address altered fire regimes; manage within utility corridors and highways; and ensure Ivanpah airport does not significantly impact the species. Essentially none of these conservation objectives have been met, and at any rate they are all voluntary actions so they do not provide adequate protection for the species.

E. Other Natural or Anthropogenic Factors

Climate Change

Climate change impacts to the southwestern U.S. are expected to include warming temperatures (Adlam et al. 2017, pp. 12-13; Vose et al. 2017; Bradford et al. 2020), increased aridity (Seager et al. 2007, pp. 1181-118; Seager and Vechi 2010, p. 21281; Wahl et al. 2021, p. 8), shifts in precipitation patterns (Cook and Seager 2013, pp. 1694-1697), more intense heat waves (Hicke et al. 2022, p. 1937) and severe drought (Cook et al. 2015, pp. 2-5; Mankin et al. 2021, p. Cook et al. 2021, p. 15). Indeed, the annual average temperature for the southwestern U.S. has already risen at least 1.61°F since 1901 (Vose et al. 2017) with steeper increases occurring after 1980 (Mankin et al. 2021, p. 6). Since 1979, droughts in this region have become longer and more frequent (Zhang et al. 2021, p. 8). Furthermore, the region has been experiencing an unprecedented megadrought that began in the year 2000 (Cook et al. 2022, p. 10) and is largely attributed to the influence of anthropogenic climate change on soil moisture deficit (Williams et al. 2021, pp. 233-234). These changes threaten to push the white-margined

penstemon beyond its climatic tolerance limits, a process that appears to be already underway (Moore and Pavlik 2015, p. 109; Miller 2021, p. 47).

Drought.–In particular, severe drought is known to affect the white-margined penstemon at many stages of its life history, thus impacting the overall viability of the species (Etyemezian et al. 2010; Moore and Pavlik 2015; Miller 2021). As with many Mojave Desert species, there appears to be little to no recruitment during drought years as was the case in 2008, 2009 (Etyemezian et al. 2010, p. 76), 2012 (Moore and Pavlik 2015, p. 102), and 2021 (Miller 2021, p. 6). Established plants generally put on little growth during drought years and many plants remain dormant altogether (Miller 2021, p. 35). The few plants that do emerge are less likely to survive and/or reproduce (Etyemezian 2010; Moore and Pavlik 2015; Miller 2021). For instance, of the 1,567 plants that had emerged during the extreme drought conditions of 2021, there was no successful reproduction observed as all had either senesced or were destroyed by herbivores (Miller 2021, p. 47). Other demographic studies of the white-margined penstemon have found similar correlations between drought and reduced reproductive success (Etyemezian et al. 2010, p. 78; Moore and Pavlik 2015, p. 102).

Population viability analyses conducted with demographic data collected during drought years provide a basis for understanding population dynamics under a variety of climate scenarios. Using demographic data from the California population center collected from 1994-2003 and 2011-2012, Moore and Pavlik (2015) found that increasing the frequency of drought had a strong negative effect on the modeled long-term stochastic growth rate, more than long-term average precipitation levels (Moore and Pavlik 2015, p. 106). While the probability of quasi-extinction for the California population center is likely under all climate scenarios, increasing drought years reduced the time of an 80% probability of quasi-extinction to 19 years (Moore and Pavlik 2015, p. 106). Using demographic data collected from 1996-2006 in Clark County, Miller (2021) found that the quasi-extinction probability for the Clark County population center increased to roughly 80% within 50 years when the frequency of drought was doubled (Miller 2021, pp. 40-41). Quasi-extinction probabilities using population data from 2021, a year with exceptionally low precipitation (Mankin 2021, p. 6), found that quasi-extinction probabilities in the next 50 years were significant for all population centers (Miller 2021, pp. 42-44).

Southwestern North America, including the Mojave Desert, is in the midst of the worst multi-decadal drought experienced in over a millenia (Williams et al. 2021). Currently, the National Weather Service predicts that drought conditions are expected to continue into 2023 largely due to persistent La Niña conditions (NWS 2022). Notably, human caused climate change has contributed to the severity, length, and spatial scale of this megadrought due to the effect of rising temperatures on atmospheric evaporative demand and soil moisture deficit (Williams et al. 2021). According to modeling by Cook et al. (2021, p. 15) there is at least a 50% likelihood of another multi-decadal drought at least as severe as the current one. Drought-intensifying atmospheric evaporative demand is certain to increase in the coming decades (Ficklin and Novick 2017; Gamelin et al. 2022, p. 5) and will become the regional norm by 2030-2050 (Mankin et al. 2021, p. 16).

Seasonal Precipitation Changes.–While it is clear from the studies described above that increased drought frequency will negatively impact the white-margined penstemon, it is possible

that changes in the temporal distribution of precipitation will further impact the species. Future climate models for the southwestern U.S. indicate that seasonal dry periods will extend in duration and begin in the spring instead of the summer (Ting et al. 2018, p. 4272). Such a change could negatively impact the reproduction of the white-margined penstemon which typically flowers in March, April, and May in all population centers (Moore and Pavlik 2015, p. 91; Miller 2021, p. 6). Historically, the Clark County and Mohave County population centers have experienced less summer drying and are thought to be buffered by relatively high levels of summer precipitation (Moore and Pavlik 2015, p. 109; Miller 2021, pp. 11, 30). However, there is a wealth of research indicating that global warming will change the behavior of the North American monsoon which drives summer precipitation in these areas (Pascale et al. 2019, pp. 136-137). Possible changes include a delayed wet season (Cook and Seager 2013, p. 1697), reduced precipitation levels (Bukovsky et al. 2015, pp. 6726) and an increase in extreme summer precipitation events (Pascale et al. 2019, p. 137), all of which could diminish the buffering capacities of summer precipitation.

Heat.–Increasing temperatures could lead to declines in plant growth and reproduction, as well as increases in mortality of the white-margined penstemon. A recent study of widespread declines in desert vegetation cover indicates that rising temperatures are an important contributor to this trend (Hantson et al. 2021, pp. 9-10). Prolonged exposure to 2°C warming significantly reduced photosynthesis in desert vegetation (Werten et al. 2016, p. 302) and evidence suggests extreme heat events can greatly exacerbate the negative effects of drought on plant growth (De Boeck et al. 2010, p. 813).

Soil Seed Bank Dynamics.–Currently, little is known about the germination requirements and seed longevity for the white-margined penstemon, but it is assumed that a persistent soil seed bank plays an important role in the viability of the species (Moore and Pavlik 2015, p. 95). As described above, worsening drought and seasonal shifts could alter reproduction and decrease the rate at which the seed bank is replenished. In addition, rising temperatures have been shown to increase the proportion of seeds that germinate after a single precipitation event which can devastate the seedbank if favorable conditions do not persist long enough for seedlings to survive and reproduce (Ooi et al. 2009, p. 2382). The white-margined penstemon is especially vulnerable to such effects since it is thought to require consecutive wet years for successful reproduction (Etyemezian et al. 2010, p. 78). Increased germination rates in a single year could compromise the bet-hedging strategy that reduces long-term risk (Venable 2007, p. 1089). A study of soil seed bank dynamics in another rare hemicroptophyte from the Mojave Desert found that reducing seed bank persistence by just two years greatly reduced the stochastic population growth rate and increased extinction risk (Van Buren et al. 2021, p. 16201).

Biotic Interactions.–Climate change will likely alter herbivore and pollinator behavior in ways that could be detrimental to the white-marined penstemon. Herbivory has been shown to increase during periods of low water availability (McCluney et al. 2012, p. 572) and drought has been associated with increased mammalian herbivory of perennial plants due to the lack of alternative forage (DeFalco et al. 2010, pp. 247; Esque et al. 2015, pp. 89). Aridification and an increase in drought frequency could intensify this phenomenon. The white-margined penstemon may face novel herbivores as insects are expected to shift their range in response to climate change (Hamann et al. 2020, p. 1895, 1899). For instance, the desert leafcutter ants that were observed decimating white-margined penstemon plants in the Mohave County population center could

migrate to more tolerable temperatures (Gamboa 1976, p. 490) and become more common in the Mojave Desert.

However, shifts in suitable climate for insect species may also impact beneficial pollinators. Models of future climate change scenarios indicate 49% of insects will lose at least 50% of their ranges under 3.2°C warming (Warren et al. 2018, p. 1). Warmer winter temperatures have been shown to decrease body weight and alter emergence times for certain insect pollinators (Schenk et al. 2018; Slominski and Burkle 2019, p. 9) which could result in reduced pollinator effectiveness and phenological mismatch with the white-margined penstemon. Furthermore, climate change has been shown to exacerbate the effects of habitat loss in declines of insect populations (Halsch et al. 2020, p. 2; Outhwaite et al., pp. 99-100). This is of particular concern for pollinators of the white-margined penstemon due to their proximity to ongoing and proposed development projects, including industrial-scale solar installations which negatively impact local communities of floral insect visitors (Grodsky et al. 2021, pp. 5-7).

Vulnerability to Exposure.–Plant taxa that have specific edaphic requirements and poor dispersal capacity are particularly vulnerable to climate change since they are less likely to successfully migrate to tolerable habitat (Hawkins et al. 2008, p. 42). Restricted range size and low topographic heterogeneity have been identified as additional factors that contribute to climate change exposure (Rose et al. 2023, p. 11). The white-margined penstemon possess all these characteristics and it is highly unlikely the species would be able to migrate to locations with less exposure to climate change impacts.

Invasive Plant Species

The white-margined penstemon is threatened by invasions of non-native plant species which are known to alter habitat and compete for resources. *Brassica tournefortii* (Saharan mustard) is a rapidly spreading invasive species (Winkler et al. 2019, p. 7929) that can form thick stands and compete with germinating native species, particularly in above average precipitation years (Barrows et al. 2009, p. 683). Likewise, *Schismus arabicus* and *S. barbatus* (Mediterranean grass) and *Bromus rubens* (red brome) can outcompete native species (Brooks 2000, p. 103) and has been implicated in altering fire regimes in the Mojave Desert (Brooks 1999, p. 13; Brooks and Matchett 2006, p. 160). Worsening drought conditions associated with climate change are likely to facilitate non-native plant invasions (Ravi et al. 2021, p. 291) as are increased levels of nitrate deposition (Rao and Allen 2010) which have been noted in the Clark County population center (Etyemezian 2010, p. 81).

Invasive species have been documented at occurrences in California and Nevada since at least the early 2000's (Smith 2001, p. 22; TNC 2007, p. 119) and recent survey data indicates these species are becoming more widespread (Miller 2021). In 2021, Mediterranean grass (*Schismus arabicus*) was observed at the majority of white-margined penstemon occurrences in California and Nevada; Saharan mustard (*Brassica tournefortii*) was locally abundant at occurrences in California and Nye County; and Russian thistle (*Salsola tragus*) was occasionally present at occurrences in Nevada. Mediterranean grass and red brome were observed at occurrences in Arizona in 2019 (*Fig. 15;* P. Donnelly pers. obs.) and it is likely they were not detected by Miller in 2021 due to the dry conditions.

Figure 15: Mediterranean grass and red brome with the white-margined penstemon at Dutch Flat in 2019. Photo by Patrick Donnelly.

Pollinator Limitation

Moore and Pavlik (2015, p. 109) have suggested pollinator limitation may be a contributing factor to low seed set in the white-margined penstemon. Studies of other *Penstemon* species, including a rare species pollinated by vespid wasps, have found pollinator activity greatly increases with plant density which can affect seed output (Zorn-Arnold and Howe 2007, p. 1599; Barlow and Pavlik 2020, p. 32). Impacts such as off-highway vehicles, cattle grazing, habitat loss and conversion, and climate change may limit both the density of plants and the abundance of pollinators, potentially impacting reproductive activity for the white-margined penstemon. Ongoing climate change could be a contributing factor to pollinator limitation. In a study of southern California plant-pollinator interactions, warmer temperatures reduced corolla size and nectar production which in turn altered pollinator behavior resulting in reduced seedset (De Manicor et al. 2023, pp. 8).

REQUEST FOR CRITICAL HABITAT DESIGNATION

We urge the Service to designate critical habitat for the white-margined penstemon 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 white-margined penstemon's chance for survival significantly diminishes. Petitioners thus request that the Service designate critical habitat for the plant concurrently with its listing. Given the narrow range of the species and the plethora of threats it faces, we recommend designating all occupied habitat as critical habitat.

CONCLUSION

The white-margined penstemon is a rare perennial plant species that is restricted to deep sandy soils in the Mojave Desert. There are four genetically distinct population centers in southeastern California, southern Nevada, and northwestern Arizona. The global population abundance generally fluctuates in response to precipitation trends, but prolonged and intensifying drought indicates management intervention is needed in order for the species to survive future climate change. Additionally, there are numerous development pressures facing the white-margined penstemon, including existing exurban development, proposed urban and industrial development, and proposed transportation and energy infrastructure. There are no existing regulatory mechanisms that would otherwise protect this plant from extinction. Without ESA protection, this endemic plant is at risk of extinction in the foreseeable future. The white-margined penstemon needs ESA protection, including critical habitat designation, to ensure its continued existence in the face of numerous escalating threats.

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