Coachella Valley fringe-toed lizard
(*Uma inornata)*

5-Year Review:
Summary and Evaluation

Photo credit: U.S. Fish and Wildlife Service/2008

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This 5-year status review was prepared by Allison Menelli during her 2022 Directorate Fellows Program fellowship at the Carlsbad Fish and Wildlife Office. To complete this assessment, Allison conducted a literature review, updated occurrence data, and coordinated with the U.S. Fish and Wildlife Service staff and external partners. Allison assessed current threats to the species and identified priority research and conservation tasks.

5-YEAR REVIEW

Coachella Valley fringe-toed lizard
(*Uma inornata*)

GENERAL INFORMATION

Species: Coachella Valley fringe-toed lizard (*Uma inornata*), a reptile species
Date listed under the Endangered Species Act: September 25, 1980
Federal Register citation: Service 1980 (45 FR 63812)
Classification: Threatened
State classification: Endangered (1980)
Recovery Plan: Final, September 11, 1985. Coachella Valley fringe-toed lizard Recovery Plan.
Recovery Priority Number: 5C
Critical Habitat Designation: September 25, 1980 (Service 1980)

BACKGROUND

Under the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 et seq.), the U.S. Fish and Wildlife Service (Service), referred to as "we" in this document, maintains lists of endangered and threatened wildlife and plant species in the Code of Federal Regulations (CFR) at 50 CFR 17.11 (for wildlife) and 17.12 (for plants). Section 4(c)(2)(A) of the Act requires us to review each listed species' status at least once every 5 years.

Most recent status review: U.S. Fish and Wildlife Service. 2010. Coachella Valley fringe-toed lizard (*Uma inornata*) 5-year review. Prepared by the Carlsbad Fish and Wildlife Office, Carlsbad, California. 49 pp. + appendices.

We initiated the previous status review for the Coachella Valley fringe-toed lizard on February 14, 2007. The review was finalized on August 6, 2010 and recommended no change in listing status. This current review is based on the previous review.

Federal Register notice announcing this status review: On May 20, 2021, we published a *Federal Register* notice announcing initiation of the 5-year review of this species, and the opening of a 60-day period to receive information (Service 2021, pp. 27462–27464). We did not receive new information about this species in response to our notice.

Species overview and habitat: Coachella Valley fringe-toed lizard (CVFTL) (*Uma inornata*) is a medium-sized, endemic lizard that inhabits windblown desert ecosystems of the Coachella Valley in Riverside County, California. This species averages 15 to 23 centimeters (6 to 9 inches) in total length. Individuals have a white or sandy-colored belly and back and light, eye-like patterns that form shoulder stripes. Since listing, the species' potential habitat has decreased due to urban development, blowsand (finer sand particles) stagnation, and invasive species (Service 2010, pp. 14, 18).

CVFTL escape heat by burrowing or "swimming" beneath sand (Service 2010, p. 5). The species prefers fine-grained sand, areas of low sand compaction, and deep sand deposits. These characteristics make it easier for CVFTL to burrow in sand (Service 2010, p. 13).

There are four types of aeolian communities in the Coachella Valley that can provide habitat for CVFTL. As described in Barrows and Heacox (2021, p. 248; see also Service 2008, Appendix A p. 227; Service 2010, pp. 15–16; CVAG 2016, pp. 10-12, 10-15, 10-39), these habitats are:

1. Active dunes, characterized by dunes with high mobility, which have a deep layer of fine sand and little vegetation.

2. Stabilized sand fields, which have a compacted bottom layer of sand and a shallow layer of fine sand on top. Limited mobility allows for higher plant compositions.

3. Honey mesquite dunes. These dunes are similar to active dunes but have higher plant cover—including mesquite (*Prosopis* sp.)—which contributes to low sand mobility.

4. Ephemeral sand fields, which have significant heterogeneity in land cover, ranging from fine sand to rocks and boulders. These habitats have extremely high mobility and few plants, except for some perennials.

While CVFTL can be found in all four habitat types, active sand dunes are the best CVFTL habitat (Barrows and Heacox 2021, p. 254).

Four sand transport systems regenerate blowsand in CVFTL habitat: 1) Thousand Palms, 2) Whitewater Floodplain, 3) Willow Hole and Edom Hill, and 4) Snow Creek (Service 2010, p. 14). About 7,500 acres (ac) (3,035 hectares (ha)) of CVFTL designated critical habitat are important for maintaining ecosystem functions such as sand replenishment (Service 1980, p. 63818).

ASSESSMENT

Information acquired since the last status review

This 5-year review was conducted by the Service's Carlsbad Fish and Wildlife Office. Data for this review were solicited from the public and interested parties through a Federal Register notice announcing this review on May 20, 2021. We also contacted species experts to request any data or information we should consider in our review. Additionally, we conducted a literature search and reviewed information in our files. For this short-form review, we did not use information from the 289 CVFTL observations in iNaturalist (2023) due to their obscured geolocation.

SUMMARY OF NEW INFORMATION SINCE 2010

Abundance

There are no rangewide population abundance estimates for CVFTL (Service 2015, p. 17). We do have estimates and trends of population abundance within survey plots and estimates of effective population size based on genetic data. Long-term monitoring shows that CVFTL abundance fluctuates widely based on annual precipitation.

Precipitation is the primary driver of CVFTL population growth (Barrows and Heacox 2021, p. 245). Precipitation timing, amount, and intensity all affect CVFTL density (Barrows and Heacox 2021, p. 245). In particular, the cool season rains from November to April are important for CVFTL breeding success (Barrows and Heacox 2021, p. 249). CVFTL populations experience

large fluctuations, which are positively correlated with precipitation (Barrows and Heacox 2021, p. 252).

At the Whitewater Floodplain Reserve, Fisher et al. (2020, p. 4) found that drier years resulted in reduced CVFTL reproductive output, likely due to a decrease in available food resources. Like Barrows and Heacox (2021,), Fisher et al. (2020, p. 5) found large fluctuations in CVFTL populations between wet and dry periods. Both studies show that CVFTL experiences natural population fluctuations which do not inherently require a management response (Barrows and Heacox 2021, pp. 249, 252). However, if population density were to shift without a significant correlation with rainfall, then management actions may be warranted (Barrows and Heacox 2021, pp. 252, 254).

Occurrence status

This section summarizes changes to CVFTL occurrence status since 2010. We assessed new information from CVFTL studies and long-term monitoring efforts. We also assessed aerial imagery to determine whether CVFTL habitat may be present.

CNDDB occurrence status

We reviewed each CVFTL occurrence in the California Natural Diversity Database (CNDDB 2022) (Appendix I). The CNDDB contains 162 CVFTL occurrences: 135 are presumed extant, 17 are possibly extirpated, and 10 are extirpated. CNDDB is a positive sighting database and occurrences are generally considered presumed extant unless documentation supports a change to “extirpated” or “possibly extirpated” (CNDDB 2020, p. 11). Aerial imagery can also support a status change (CNDDB 2020, p. 11).

For this review, we assessed each CNDDB occurrence using the following definitions of CVFTL occurrence status:

1. The occurrence is considered extant if the species was observed in the last 15 years.

2. The occurrence is presumed extant if the species was not observed in the last 15 years, but suitable habitat is present.

3. The occurrence is possibly extirpated if no observations have been reported for greater than 15 years and the habitat is degraded or partially developed.

4. The occurrence is considered extirpated if no observations have been reported for greater than 20 years and the habitat is destroyed or no longer suitable (such as being fully developed).

Using these definitions of occurrence status, we found that as of 2023, 17 CNDDB occurrences are extant and 38 are presumed extant (Table 1; Figure 1). Compared with our 2010 review, 33 more occurrences are possibly extirpated (Table 1). This increase in possibly extirpated occurrences is because we used updated definitions of occurrence status to better reflect on-the-ground conditions: in the absence of records for 15 years, if an area was partially or fully developed according to aerial imagery, we considered it possibly extirpated or extirpated (respectively) rather than presumed extant.

Table 1. Summary of Coachella Valley fringe-toed lizard occurrence status in 2010 and 2023.

Occurrence status	Number of occurrences in 2010[1]	Number of occurrences in 2023
Extant	–	17
Presumed extant	59	38
Possibly extirpated	–	33
Extirpated	76	76
Total number of occurrences	**135**	**164**

Conservation area status

Long-term monitoring of CVFTL occurs in research plots within four conservation areas[2] (Whitewater Floodplain, Willow Hole, Thousand Palms, and Windy Point) identified in the Coachella Valley Multiple Species Habitat Conservation Plan (CVMSHCP), as described in CVCC (2018, p. 7), Fisher et al. (2021, pp. 2–3), and Barrows and Heacox (2021, entire). No range-wide monitoring has occurred since our 2010 5-year review.

In 2010, CVFTL was presumed extant within six conservation areas (Table 2). CVFTL is now extant within five conservation areas and presumed extant in two conservation areas (Figure 2). The two conservation areas with changes between 2010 and 2023 are 1) East Indio Hills and 2) Santa Rosa and San Jacinto Mountains.

CVFTL within the East Indio Hills conservation area is presumed extant because the species was last observed around 2010 (Barrows 2022, pers. comm.). A patch of mesquite dune CVFTL habitat outside the conservation area was disturbed after 2010 (Barrows 2022, pers. comm.). Subsequently, 2013 monitoring reported CVFTL as extirpated from the East Indio Hills Conservation Area (CVCC 2014, p. 22 in Appendix 2A). Since the area is not developed, we consider CVFTL within East Indio Hills to be presumed extant for this review but recommend additional survey.

[1] Our 2010 5-year review described occurrences as either “presumed extant” or “extirpated” (Service 2010, p. 5, Appendix 1). This review includes “extant” and “possibly extirpated”.
[2] Conservation areas are a system of lands from which the Coachella Valley Multiple Species Habitat Conservation Plan is assembled.

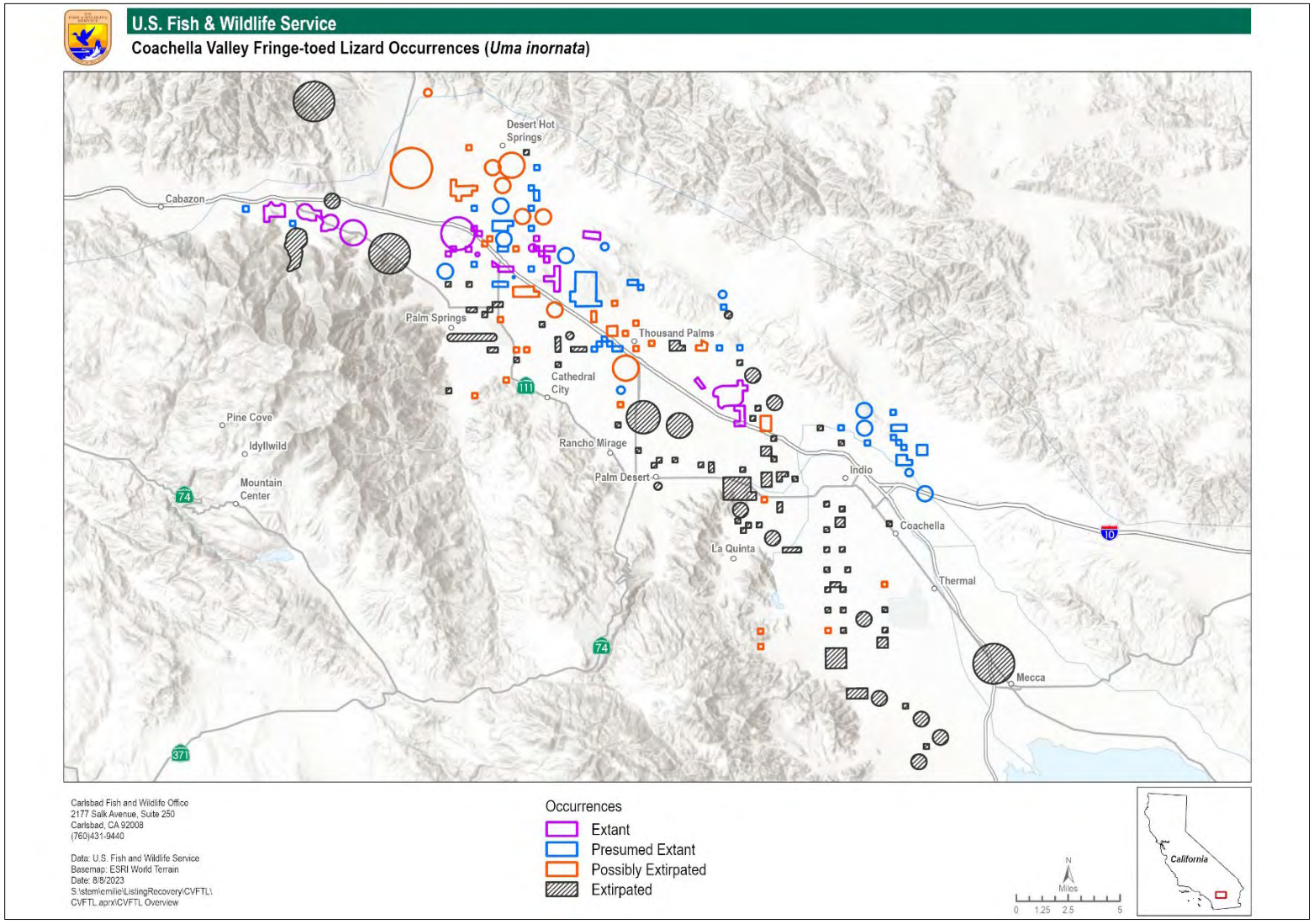

Figure 1. CVFTL CNDDB occurrences in the Coachella Valley in southern California, showing our 2023 assessment of occurrence status.

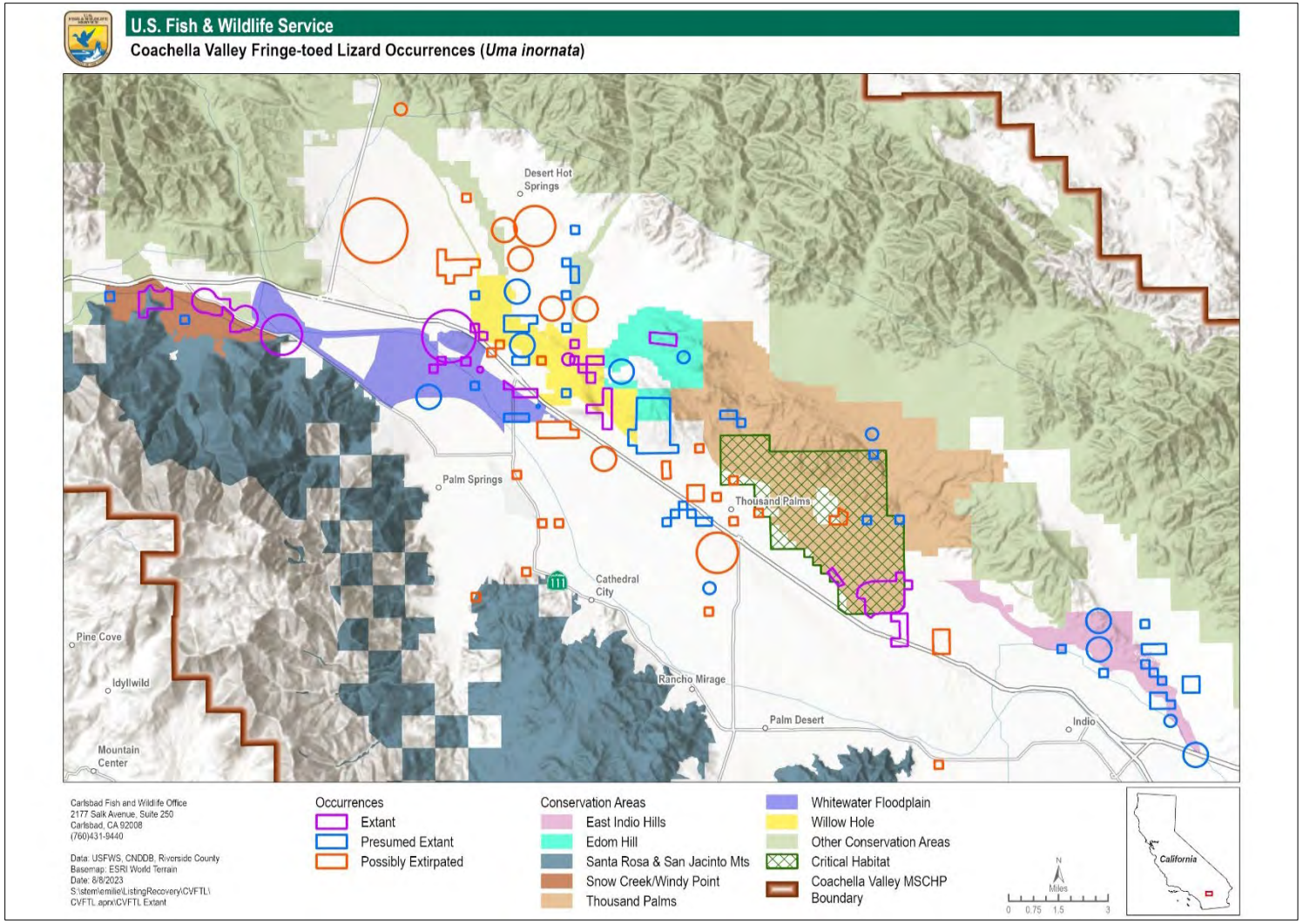

Figure 2. Extant, presumed extant, or possibly extirpated CVFTL CNDDB occurrences in the north portion of the Coachella Valley. The map also shows CVFTL conservations areas and designated Critical Habitat.

CVFTL status within the Santa Rosa and San Jacinto Mountains Conservation Area changed from extirpated in 2010, to presumed extant for this review. While there have been no focused surveys of this conservation area, CVFTL tissue samples were obtained just within this conservation area in 2008, and two extant CNDDB EOs (80 and 98) intersect the conservation area. Since the area is not developed and suitable habitat may exist—especially adjacent to other occupied conservation areas such as Snow Creek/Windy Point—we consider CVFTL to be presumed extant within this conservation area for this review.

Table 2. CVFTL status within each conservation area.

Conservation area	2010 CVFTL status	2023 CVFTL status
East Indio Hills	Presumed extant	Presumed extant
Edom Hill	Presumed extant	Extant
Santa Rosa and San Jacinto Mountains	Extirpated	Presumed extant
Snow Creek/Windy Point	Presumed extant	Extant
Thousand Palms	Presumed extant	Extant
Whitewater Floodplain	Presumed extant	Extant
Willow Hole	Presumed extant	Extant
Number of conservation areas where CVFTL is extant or presumed extant	**6**	**7**

Genetics

Our 2010 5-year review summarized research that found low genetic variability within CVFTL populations, potentially indicating a species-wide bottleneck (Service 2010, p. 18). These losses were attributed to the loss of sand dune habitat (Service 2010, p. 18). Since 2010, research by Vandergast (2016, 2019) has provided information about CVFTL genetic diversity and population structure.

Genetic diversity

Vandergast et al. (2016, p. 353; 2019, p. 15) found a significant loss of CVFTL genetic diversity in the Whitewater Floodplain Conservation Area between 1996 and 2008. By 2019, there were significant declines in genetic diversity at three additional areas: Windy Point, Willow Hole, and Central Indio Hills (Vandergast et al. 2019, p. 15). Assisted gene flow and increased habitat connectivity could slow the loss of CVFTL genetic diversity (Vandergast et al. 2019, p. 16).

Genetic structure

Genetic structure (genetic variation within and between populations) among CVFTL populations has significantly increased since 1996, likely due to the combined effects of habitat fragmentation and extended drought (Vandergast et al. 2016, pp. 350, 352; Vandergast et al. 2019, p. 4). Prior to habitat fragmentation, CVFTL were able to recolonize areas if local extirpation occurred due to drought conditions (Vandergast et al. 2016, p. 352).

Between 1996 and 2008 sampling, rapid genetic drift and genetic bottlenecks during droughts lead to the emergence of genetic structure (Vandergast 2016, p. 352). Despite years of above-average rainfall after the 2004 drought, genetic structure remained in the 2008 sampling, suggesting that habitat fragmentation had limited recolonization (Vandergast et al. 2016, p. 352). Genetic structure was more stable between 2008 and 2017 sampling, but differentiation continued to develop in that time frame (Vandergast 2019, p. 15).

Home Range

In a 31-year study of CVFTL home range, Fisher et al. (2020, p. 178) found that home range size is positively correlated with age. Males had a larger home range than females of the same age, which correlated with their faster growth and larger body size (Fisher et al. 2020, p. 179). Mean CVFTL home ranges were 0.125 acres (ac) (505 square meters) for females and 0.164 ac (662 square meters) for males (Fisher et al. 2020, p. 178). Fisher et al. (2020, p. 177) also found that CVFTL home range shifts in size and location over the years. CVFTL have high site fidelity, and can be frequently spotted in just a few, discrete locations within their home range (Fisher et al. 2020, p. 180). Rainfall inversely impacts home range size, presumably because in drier years, the lizards must travel farther to find enough food (Fisher et al. 2020, p. 180).

Translocation

In 2017, 46 CVFTL were salvaged from a site scheduled for development and relocated to Stebbins Dune, an area of unoccupied suitable habitat (CVCC 2018, p. 24; Vandergast et al. 2019, p. 2). Surveys conducted in 2018 detected two to three lizards from the translocation effort, and four lizards that had hatched onsite (CVCC 2018, p. 24).

Based on decadal genetic analysis, Vandergast (2019, pp. 15–16) suggested that:

1. Windy Point and Central Indio Hills populations may benefit from augmentation to restore genetic diversity.

2. Even low levels of gene flow (1 to 10 percent) can help populations maintain genetic diversity over time.

3. Assisted gene flow or other actions to restore connectivity could restore CVFTL genetic diversity and gene flow.

Coachella Valley Multiple Species Habitat Conservation Plan

Plan summary

The CVMSHCP permits take of covered species for certain covered activities, while conserving covered species and natural communities within the plan area. The overall goal of the CVMSHCP is to "enhance and maintain biological diversity and ecosystem processes while allowing future economic growth" (CVAG 2016, p. 1-2). The Coachella Valley Conservation Commission (CVCC) was established to oversee CVMSHCP implementation.

Our 2010 5-year review discussed the CVMSHCP in detail (Service 2010, pp. 29–32). Under the CVMSHCP, permittees are required to manage and protect 12,998 ac (5,260 ha) of CVFTL habitat in exchange for the maximum potential loss of 13,801 ac (5,585 ha) of CVFTL habitat that existed in 1996 (Service 2010, p. 31). Conserved habitat is being assembled from a reserve system of 21 conservation areas (CVAG 2016, p. 4-1). Conservation areas provide core and other conserved habitat for covered species and conserve natural communities, ecological processes, and biological corridors (CVAG 2016, p. 4-1).

In 2008 we consulted (intra-Service section 7) on the issuance of a 10(a)(1)(B) Incidental Take Permit for the CVMSHCP (Service 2008, entire). CVFTL on lands outside of the conservation areas are subject to incidental take and were assumed lost for our analysis purposes because those areas will likely be urbanized over the 75-year permit term (Service 2008, pp. 16, 85). Our intra-Service Biological Opinion concluded that the issuance of the CVMSHCP incidental take permit would not likely jeopardize the continued existence of the CVFTL and was not likely to destroy or adversely modify critical habitat (Service 2008, p. 177). (For complete discussion, refer to Service 2008, entire).

The CVMSHCP authorizes take for covered activities within and outside of conservation areas (CVAG 2016, p. 7-1). Outside of conservation areas, a number of activities are covered, including development, public facility construction, operation/maintenance, and transportation projects (CVAG 2016, pp. 7-1–7-15). Certain activities within conservation areas are also permitted but are subject to additional conservation measures (CVAG 2016, p. 6-15). Additionally, for projects within conservation areas that would result in disturbance to habitat, natural communities, biological corridors, or ecological processes, permittees participate in a Joint Project Review process to ensure compliance with the CVMSHCP and its Implementing Agreement (CVAG 2016, pp. 6-22–6-23, 6-25).

2016 major amendment

The CVMSHCP was amended in 2016 to include additional permittees and analyze additional take of covered species (Service 2015, p. 1). The amendment resulted in a 2 ac (0.8 ha) reduction to CVFTL conserved habitat within the Willow Hole Conservation Area, from 1,594 ac (645 ha) to 1,592 ac (644 ha) (Service 2015, p. 48). Our 2015 Biological Opinion on the amendment concluded that the CVMSHCP amendment would not likely jeopardize the continued existence of CVFTL (Service 2015, p. 48). The Major Amendment did not change the habitat conservation goals, management and monitoring requirements, or Permit Terms and Conditions for CVFTL (Service 2015, p. 48).

Conservation goals for CVFTL under the CVMSHCP

The CVMSHCP established the following conservation goals for CVFTL within the CVMSHCP Reserve System:

> "Goal 1: Protect at least four Core Habitat areas that include occupied habitat, and associated Essential Ecological Processes, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between patches of Core Habitat.
>
> Goal 2: Protect Other Conserved Habitat, to provide sufficient area and variety of Habitat types to accommodate population fluctuations, allow for genetic diversity, and to conserve the range of environmental conditions within which this lizard is known to occur.
>
> Goal 3: Protect Essential Ecological Processes, including sand source/transport systems, necessary to maintain Core Habitat and Other Conserved Habitat for this species.
>
> Goal 4: Maintain Biological Corridors and Linkages among all conserved populations.
>
> Goal 5: Ensure conservation of the Coachella Valley fringe-toed lizard by maintaining the long-term persistence of self-sustaining populations and conserving Habitat quality through biological monitoring and Adaptive Management actions in the Plan Area" (CVAG 2016, p. 9-102–9-103).

(For complete discussion and objectives for each goal, refer to CVAG 2016, pp. 9-102–9-103).

2010–2023 CVFTL habitat acquisition under the CVMSHCP

The CVMSHCP established a reserve system to conserve covered species, natural communities, and ecological processes in perpetuity (CVCC 2022, p. 2). Land is conserved: 1) by the CVCC on behalf of permittees, with funding from development mitigation fees, 2) by State and Federal agencies, or 3) through complementary conservation within conservation areas, which benefits plan implementation but is not a permittee obligation (CVAG 2016, p. 4-2; CVCC 2022, pp. 2, 4).

Since CVMSHCP plan inception, 4,517 ac (1,828 ha) additional acres of CVFTL habitat have been conserved within six conservation areas (Table 3).

Agua Caliente Tribal Habitat Conservation Plan

The Agua Caliente Tribal Habitat Conservation Plan (ACTHCP) was approved by the Agua Caliente Band of Cahuilla Indians (Tribe) in 2010. The ACTHCP encompasses approximately 88,258 ac (35,717 ha) within the Coachella Valley (Tribe 2010, p. ES.4).

For CVFTL, the ACTHCP includes measures for habitat conservation and management, and certain avoidance and minimization measures (Tribe 2010, p. ES.6). Habitat conservation will occur over time using fees from development (Tribe 2010, p. ES.7; Service 2017, p. 11). While

the Service has not yet approved a section 10(a)(1)(B) permit or implementing agreement for the ACTHCP, the Tribe began implementation and continues of focus on achieving plan goals and objectives (Service 2017, p. 11).

Summary

New research since 2010 has provided more information about CVFTL biology and genetics. CVFTL are dependent on aeolian communities and prefer mobile, fine-grained active sand dunes. CVFTL population abundance naturally fluctuates in response to precipitation (Fisher et al. 2021, p. 4; Barrows and Heacox 2021, p. 252). Decadal genetic monitoring found increased genetic structure, decreased diversity, and evidence of genetic bottleneck after drought events (Vandergast et al. 2016, entire; Vandergast et al. 2019, entire).

Our assessment of CVFTL occurrence status found that 56 occurrences are extant or presumed extant, compared to 59 presumed extant in 2010. In addition, 33 more CNDDB occurrences are possibly extirpated compared with our 2010 5-year review. This change is due to our review of aerial imagery and our assessment that CVFTL is possibly extirpated from heavily fragmented or developed areas. Since 2010, CVFTL has not been detected in the East Indio Hills Conservation Area, the eastern extent of the species' range (CVCC 2014, p. 22 in Appendix 2A; Service 2015, p. 17), although we considered these occurrences "presumed extant" for this review.

The CVMSHCP was amended in 2016. The amended plan outlined conservation goals for CVFTL to protect core habitat, conserved habitat, essential ecological processes, and biological corridors, and to adaptively manage CVFTL populations (CVAG 2016, entire). The CVCC continues to assemble the reserve system to support CVMSHCP implementation.

Table 3. Summary of conservation and authorized disturbance within CVFTL conservation areas as of 2022. Data from (CVAG 2016, p. 9-104; CVCC 2023, Appendix IV).

Conservation area	CVFTL habitat designation	Total acres of habitat in conservation area	Required conservation (ac)[3]	Conservation as of 2022 (ac)	Disturbance authorized (ac)	Disturbance as of 2022 (ac)
East Indio Hills	Other conserved habitat	824	631	0	70	0
Edom Hill	Other conserved habitat	120	56	144	6	0
Santa Rosa and San Jacinto Mountains	Other conserved habitat	122	90	0	10	0
Snow Creek/Windy Point	Core habitat	1,374	1,174	650	130	0
Thousand Palms	Core habitat	3,962	834	684	93	0
Thousand Palms	Other conserved habitat	3	1	NA	0	NA
Whitewater Floodplain	Core habitat	5,617	2,777	880	309	53
Willow Hole	Core habitat	897	666	2,159	74	0
Willow Hole	Other conserved habitat	857	771	NA	86	NA
Total acres	**NA**	**13,776**	**6,999**	**4,517**	**778**	**53**

[3] From “Remaining acres to be conserved” column, Table 9-16 in CVAG 2016, p. 9-104

Threats

The final listing rule (Service 1980, p. 63818) identified the following Factor A threats for CVFTL: urbanization, agricultural growth, nonnative invasive plants, and off-highway vehicle (OHV) activity. The rule also identified Factor B threats (overcollection, specifically in the spring of 1978). Factor C (disease or predation) and Factor E (other natural or manmade factors) threats were not identified at the time of listing.

In the previous 5-year review (Service 2010, pp. 18–25), we discussed threats to CVFTL under the five factors. Factor A threats for CVFTL were (1) urbanization, (2) agricultural growth, (3) nonnative invasive plants, (4) obstruction of sand transport systems, (5) changes in hydrology, and (6) OHV activity. These threats had contributed to the extirpation of at least 72 CVFTL occurrences since listing, with 52 of those extirpations attributed to urbanization (Service 2010, pp. 18–19). Urbanization and agriculture had reduced or fragmented habitat for CVFTL rangewide, and nonnative plant species, changes in hydrology, and OHV activity had all negatively impacted dune habitats.

Over-collection (Factor B) was noted at the time of listing, but no information about its extent was included in the listing rule, and over-collection was not considered a threat to the species in the previous 5-year review (Service 2010, p. 26). OHV activity was poorly regulated at listing, but as of 2010, State and Federal mechanisms protect CVFTL populations (Service 2010, pp. 26–27). Factor E threats, small population size and climate change (Factor E) were added to the 2010 5-year review with new information about CVFTL population fluctuations, genetic bottlenecks, and population isolation (Service 2010, pp. 33, 36).

Since the previous 5-year review, new information regarding invasive species, urbanization, loss of ecosystem process, and climate change has become available and is discussed below.

Invasive species

In the 2010 5-year review, we discussed Saharan mustard (*Brasssica tournefortii*) as an emerging threat to CVFTL (Service 2010, pp. 20–21). Saharan mustard has continued to spread throughout the Coachella Valley, particularly on stabilized sand fields and active dune habitats (Barrows and Heacox 2021, p. 254), and are present at 29 extant or presumed extant CVFTL occurrences. Saharan mustard density increases with increased early precipitation and with increased sand compaction (Barrows and Heacox 2021, pp. 254–255). Sahara mustard outcompetes native plants and is associated with decreased insect abundance and diversity (Barrows and Heacox 2021, pp. 249, 255). Due to decreased food resources, increasing Saharan mustard density reduces CVFTL population density (Barrows and Heacox 2021, p. 254). Hand-pulling is the most effective method of removing Saharan mustard, while herbicide has been shown to be widely ineffective and can harm native species (Barrows and Heacox 2021, p. 255).

Urbanization

Urbanization continues to impact CVFTL rangewide. Impacts from urbanization include direct habitat loss, habitat fragmentation, and altered ecological processes (Service 2010, p. 19; CVCC 2014, p. 14 in Appendix 2A). Habitat fragmentation coupled with periodic drought have increased CVFTL genetic structure across the species' range (Vandergast et al. 2019, p. 15 refer

to discussion under *Genetic structure*). Habitat fragmentation is associated with edge effects, which may increase CVFTL road mortality and predation by urban-associated predators (Vandergast et al. 2019, p. 14).

The CVCC tracks development and disturbance within and outside of conservation areas. As of 2023, CVCC reports 8,397 ac (3398 ha) disturbed for CVFTL outside of conservation areas (CVCC 2023, Appendix IV). Since plan inception, the CVCC has reported 53 ac (21 ha) of authorized disturbance within conservation areas (Table 3).

In 2017, we issued a Biological Opinion on permit issuance for a development project on Tribal allottee lands (Service 2017, p. 2). About 357 ac (144 ha) of the 577-ac (233-ha) Section 24 parcel are planned for development, and CVFTL likely occurs throughout the parcel (Service 2017, pp. 2, 12, 14). Development will be offset by ATHCP fee payment, which will acquire land for CVFTL habitat conservation (Service 2017, pp. 2–3, 14). We concluded that the Section 24 development would not likely jeopardize the continued existence of CVFTL due to habitat conservation under the ATHCP (Service 2017, p. 15).

Loss of ecosystem processes

About 95 percent of sand dunes and aeolian sand fields in the Coachella Valley have been lost in the past century (CVCC 2018, p. 4; CVCC 2022, p. 3 in Appendix V). Urban development and transportation have blocked key sand transport systems, altering habitat sand patterns downwind (CVCC 2018, pp. 3, 24). Sand transport systems for all CVFTL habitat areas have been negatively affected at some level (CVCC 2018, pp. 4, 24). Some sites previously identified as active dune sites—preferred habitat for CVFTL—now have sand compaction levels of stabilized sand fields, which consistently have the lowest CVFTL densities out of the four suitable habitat types (CVCC 2022, p. 11 in Appendix V). To manage increased sand stabilization, Barrows and Heacox (2021, p. 248) recommended recycling fugitive sand (i.e., sand in unwanted areas such as roadways) back to sand corridors.

Sand dune restoration efforts

In 2019, the CVCC began a pilot project to experimentally restore sand dune habitat in areas where sand input has declined due to development (UCR CCB 2018, p. 24; CVCC 2021 Appendix XI, p. 2). Stebbins Dune was chosen as a study site because sand transport to this dune has declined and parts of the dune have become armored (CVCC 2021 Appendix XI, pp. 2–3).

For the pilot restoration project, sand was collected from CVAG's regional street sweeping program and transported to Stebbins Dune, then deposited upwind of dune habitat (CVCC 2021 appendix XI, pp. 2–4). Monitoring will assess whether the new sand improves habitat for CVFTL (CVCC 2021 Appendix XI, p. 10).

Climate change

Projected changes

Climate change refers to a shift in the mean or variability in measures of climate (e.g., precipitation or temperature) that persists for an extended period (typically a decade or more) due

to natural variability, human activity, or both (IPCC 2013, p. 1450). In our 2010 5-year review, we considered climate change a threat to CVFTL and discussed documented increases in average temperature since 1950 (Service 2010, pp. 35–36).

Since 2010, scientists have used downscaled climate models to project changes in temperature and precipitation in California under a range of future climate scenarios (Pierce et al. 2018, entire). Temperature has increased throughout Southern California over the past century, and warming is expected to continue (Hopkins et al. 2018, pp. 12, 14) (Table 4).

Wet and dry precipitation extremes are projected to increase in the future, although models project small mean changes compared to historical precipitation variability (Hall et al. 2018, p. 13; Hopkins et al. 2018, p. 18). Models also project increases in the frequency of atmospheric-river storms, which deliver intense precipitation and can cause severe flooding (Dettinger 2011, p. 519). However, droughts are also projected to become more frequent and intense and will be exacerbated by higher temperatures (Kalansky et al. 2018, p. 25).

Effects on CVFTL

In our 2010 5-year review, we discussed potential climate change effects from 1) altered fluvial sand deposits and 2) food abundance (Service 2010, pp. 35–36).

Barrows et al. (2010, entire) used niche modeling to project the effects of climate change on suitable CVFTL niche space. Niche modeling showed that CVFTL populations may avoid extinction as climate change reduces niche space; at the highest levels of projected temperature increase, 45 percent of current CVFTL niche space would remain (Barrows et al. 2010, p. 734). However, if annual precipitation is less than 50 millimeters (2.0 inches) for greater than 5 years, Barrows et al. (2010, p. 734) projected CVFTL population declines of over 97 percent.

Since 1985, the Coachella Valley has experienced multiple droughts and the region's driest years on record (Fisher et al. 2021, p. 5). CVFTL genetic structure has developed over time, due in part to genetic drift and genetic bottlenecks during droughts (Vandergast 2016, p. 352). Climate change is a range wide threat to CVFTL, and effects are expected to be more severe in the hotter, drier areas of the eastern Coachella Valley (Barrows et al. 2010, p. 734; Barrows and Heacox 2021, p. 249). Effects include reduced CVFTL surface activity, reduced vegetation cover, higher mortality, and lower recruitment rates (Barrows and Heacox 2021, p. 249). Due to population isolation and fragmentation, CVFTL may have less ability to withstand extended droughts (Barrows et al. 2010, p. 734). As suggested by Vandergast (2019, pp. 15–16), assisted gene flow and restored habitat connectivity could increase CVFTL resiliency to stochastic environmental conditions.

Table 4. Projected annual average minimum and maximum temperatures across the range of CVFTL.[1]

Year range	RCP 4.5 projected annual average minimum temperature (°F)	RCP 4.5 projected annual average maximum temperature (°F)	RCP 8.5 projected annual average minimum temperature (°F)	RCP 8.5 projected annual average maximum temperature (°F)
Historical (1961–1990)	48.5 (range 46.5–50.9)	79.7 (range 76.7–82.7)	Same as RCP 4.5	Same as RCP 4.5
Mid-century (2035–2064)	52.9 (range 50.6–56.6)	84.1 (range 81.2–87.2)	53.9 (range 51.1–58.3)	85.2 (range 81.9–89.6)
End of century (2070–2099)	54.1 (range 51.6–56.6)	85.6 (range 82.7–88.7)	57.8 (range 54.1–62.8)	88.4 (range 84.2–92.7)

[1]The values are the average of projections from four priority models (MIROC5, CanESM2, HadGEM2-ES, and ENRM-CM5) during a mid-century (2035–2064) and end-of-century period (2070–2099). Data from Cal-Adapt (CEC 2022, entire). All columns display the modeled 30-year annual average and range in degrees Fahrenheit (°F).

Summary of threats

Since the last 5-year review, no new threats to CVFTL have been identified, but new information has increased our understanding of ongoing threats.

Sahara mustard continues to spread in the Coachella Valley, catalyzed by sand compaction and poor blow sand transport. Sahara mustard outcompetes native plant species and reduces food resources for CVFTL. Habitat fragmentation has reduced CVFTL genetic diversity, increased genetic structure, and compromised sand transport systems. Climate change also remains a range wide threat to CVFTL: while populations naturally fluctuate with rainfall, prolonged drought conditions cause large population declines. After such declines, CVFTL may not be able to recolonize areas due to fragmented habitat if there are no nearby occupied areas.

CONCLUSION

We listed CVFTL as a threatened species in 1980. In our 2010 review, we recommended no change in listing status (Service 2010, pp. 40–41). For this 5-year review, we assessed new information since 2010.

New research has provided more information about CVFTL biology, genetics, and occurrence status. CVFTL populations naturally fluctuate in response to precipitation, but decadal monitoring has found increased genetic structure, decreased diversity, and evidence of genetic bottleneck after drought events. CVFTL has not been detected in the East Indio Hills Conservation Area during 2013 surveys; while we considered these occurrences "presumed extant" for this review, additional surveys are needed to confirm presence or absence.

The CVMSHCP was amended in 2016. The document outlined conservation goals for CVFTL to protect habitat, ecological processes, and biological corridors, and to adaptively manage CVFTL populations. Reserve System assembly continues as the CVCC, and other entities acquire land within conservation areas. Local non-governmental organizations are also partnering with State and Federal agencies to acquire land outside of the conservation areas to complement the CVMSHCP.

The new information and updated occurrence status does not substantially alter the species' status or the results of our five-factor analysis in the 2010 5-year review. Threats from invasive species, urbanization, loss of ecosystem processes, and climate change continue to affect CVFTL. Therefore, we conclude that CVFTL remains a federally threatened species and recommend no change in listing status.

RECOMMENDATIONS FOR FUTURE ACTIONS

The recovery plan outlined recovery objectives for CVFTL. This includes having two or more large-scale protected areas that maintain viable self-sustaining populations (Service 1984, p. 7). The recovery plan focuses on protecting remaining habitat and avoiding future habitat loss, which has always been the primary threat to CVFTL. Based on our synthesis of new information in this 5-year review, recommendations for future actions are listed below.

1. Conduct surveys in CVFTL habitat to determine presence.

    a. Survey the East Indio Hills Conservation Area to determine whether CVFTL are extant or extirpated.

    b. Survey suitable habitat within the Santa Rosa and San Jacinto Mountains Conservation Area.

2. Continue to acquire land to conserve CVFTL habitat and sand transport systems.

    a. Support Reserve System assembly to meet CVMSHCP goals and objectives. Conserve additional areas to directly protect occupied habitat, minimize fragmentation and edge effects, create or maintain linkages, and protect ecological processes.

b. Identify opportunities for land acquisition outside of conservation areas to conserve habitat and ecological processes.

c. Work with local, State, and Federal partners to identify and leverage funding (i.e., section 6) to acquire occupied and potential habitat, and other habitat necessary ecological processes to maintain CVFTL habitat.

3. Maintain or restore CVFTL genetic diversity and connectivity across the species' range.

   a. Assess and implement options for assisted gene flow. Implement translocation efforts to maintain or restore diversity.

   b. Identify opportunities to salvage CVFTL where development is planned. Coordinate with partners to plan and implement translocations.

   c. Continue to monitor genetic metrics (genetic diversity, structure, and effective population size)

4. Adaptively manage CVFTL habitat to maintain or restore habitat quality.

   a. Treat Sahara mustard within and adjacent to CVFTL habitat. Manage other nonnative species as needed.

   b. Continue to monitor the pilot restoration at Stebbins Dune.

   c. Plan and implement further dune restoration as needed to maintain habitat and sand source/transport systems.

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APPENDIX A

Table A1. Occurrence table for CVFTL, showing the CNDDB occurrence number, occurrence status, land ownership, conservation area, and threats.

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
1	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
11	N/A	Extirpated	Private	N/A	N/A	N/A
13	N/A	Extirpated	Private	Santa Rosa and San Jacinto Mountains	N/A	Extirpated by development, no habitat left
14	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
19	N/A	Presumed Extant	Private, BIA	N/A	N/A	N/A
20	N/A	Extant	Private, CVWD	Whitewater Floodplain	N/A	N/A
21	N/A	Extirpated	Private	N/A	N/A	N/A
24	N/A	Extirpated	USFS, Private, DWA	Santa Rosa and San Jacinto Mountains	N/A	N/A
25	Presumed Extant	Extant	Center for Natural Lands Management, Private	Thousand Palms	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence. development planned south of 38th Avenue (pers comm).
29	Presumed Extant	Possibly Extirpated	BLM, Private	North of Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
30	N/A	Extirpated	BLM, Non-Profit	Whitewater	N/A	Invasive species: *B. tournefortii* found within the occurrence
33	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
38	N/A	Extant	Private, BLM, CVWD	Whitewater Floodplain	N/A	Invasive species: *B. tournefortii* found within the occurrence
43	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
44	N/A	Possibly Extirpated	Private	Willow Hole	N/A	N/A
48	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
51	N/A	Extirpated	Private	N/A	N/A	N/A
52	N/A	Extirpated	Private, Local Government	N/A	N/A	N/A
53	N/A	Extirpated	Private, CA Dept of FWS	Thousand Palms	N/A	N/A
55	Presumed Extant	Presumed Extant	Private	East Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
58	N/A	Extirpated	Private, BIA	N/A	N/A	Invasive species: *B. tournefortii* found within the occurrence
61	N/A	Extirpated	USFWS	Thousand Palms	N/A	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
68	Presumed Extant	Presumed Extant	Private	Big Dune Area	Factor A: development; Hydrology. Factor E: population size; climate change	N/A
72	Presumed Extant	Extant	Private-Union Pacific RR, BLM, BIA, Non-Profit	Snow Creek/Windy Point	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence
80	Presumed Extant	Extant	Private-SPRR, BLM	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence
82	N/A	Extirpated	Private, Local Government	N/A	N/A	Extirpated by development, no habitat left
83	N/A	Extirpated	Center for Natural Lands Management	Thousand Palms	N/A	N/A
84	N/A	Extirpated	Private, BLM	Santa Rosa and San Jacinto Mountains, Whitewater Floodplain	N/A	N/A
86	N/A	Extirpated	Private, BIA	N/A	N/A	N/A
88	N/A	Possibly Extirpated	Private	Upper Mission Creek/Big Morongo Canyon	N/A	N/A
94	Presumed Extant	Extant	CVWD	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
96	Presumed Extant	Presumed Extant	BLM, Center for Natural Lands Management, Private	Thousand Palms	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
97	Presumed Extant	Presumed Extant	Private, BLM	Edom Hill	Factor A: development; Hydrology. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence
98	Presumed Extant	Extant	Private-Union Pacific RR, BLM	Santa Rosa and San Jacinto Mountains, Snow Creek/Windy Point	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A
100	Presumed Extant	Presumed Extant	Private, BIA-Agua Caliente Reservation	Edom Hill	Factor A: development; Hydrology. Factor E: population size; climate change	N/A
102	N/A	Extant	Private	Willow Hole	N/A	Invasive species: *B. tournefortii* found within the occurrence
103	Presumed Extant	Presumed Extant	Private	East Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence
106	Presumed Extant	Extant	BLM, Private	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
107	Presumed Extant	Presumed Extant	Center for Natural Land Management, Coachella Valley Mountains Conservancy, Private	Thousand Palms	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
110	Presumed Extant	Presumed Extant	BLM	Snow Creek/Windy Point	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
111	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
113	Presumed Extant	Presumed Extant	Private, BLM	Snow Creek/Windy Point	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
116	Presumed Extant	Presumed Extant	Coachella Valley Water District	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A
117	Presumed Extant	Possibly Extirpated	Private	Upper Mission Creek/Big Morongo Canyon	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
118	Presumed Extant	Presumed Extant	Private, Friend of the Desert Mountains	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
119	Presumed Extant	Presumed Extant	Private, BLM	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A
120	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
121	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
122	Presumed Extant	Extant	Private	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
123	Presumed Extant	Extant	Coachella Valley Water District, Private	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A
124	N/A	Possibly Extirpated	Private	Willow Hole	N/A	N/A
125	Presumed Extant	Presumed Extant	Private	Long Canyon	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
126	N/A	Possibly Extirpated	Private	N/A	N/A	Invasive species: *B. tournefortii* found within the occurrence
127	Presumed Extant	Presumed Extant	Private	N/A	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
128	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
129	Presumed Extant	Presumed Extant	Private	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
130	Presumed Extant	Presumed Extant	Private	N/A	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
131	Presumed Extant	Presumed Extant	Private	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence
132	Presumed Extant	Possibly Extirpated	Private	N/A	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
133	N/A	Presumed Extant	Private	N/A	N/A	N/A
134	Presumed Extant	Presumed Extant	Private, Center for Natural Lands Management	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
135	Presumed Extant	Extant	Private, Center for Natural Lands Management	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
136	Presumed Extant	Presumed Extant	Private	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
137	Presumed Extant	Presumed Extant	Private, Friends of the Desert Mountains	Edom Hill	Factor A: development; Hydrology. Factor E: population size; climate change	N/A
138	Presumed Extant	Presumed Extant	Private	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
139	Presumed Extant	Extant	Private-SCE, BLM, Friends of the Desert Mountains	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence
140	Presumed Extant	Possibly Extirpated	Private	N/A	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
141	Presumed Extant	Possibly Extirpated	Private, BIA	N/A	Factor A: development; Hydrology. Factor E: population size; climate change	N/A
142	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
143	N/A	Possibly extirpated	Private	Santa Rosa and San Jacinto Mountains	N/A	N/A
144	Presumed Extant	Possibly Extirpated	Private	N/A	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
145	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
146	Presumed Extant	Possibly Extirpated	Private, BIA	N/A	Factor A: development; Hydrology. Factor E: population size; climate change	N/A
147	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
148	Presumed Extant	Possibly Extirpated	Private	N/A	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
149	N/A	Extirpated	Private	N/A	N/A	N/A
150	N/A	Extirpated	Private, BIA	N/A	N/A	Extirpated by development, no habitat left
151	N/A	Possibly Extirpated	BIA	N/A	N/A	N/A
152	N/A	Possibly Extirpated	BIA, Private	N/A	N/A	N/A
153	N/A	Extirpated	Private	N/A	N/A	N/A
154	N/A	Extirpated	Private, Local Government	N/A	N/A	Extirpated by development, no habitat left
155	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
156	N/A	Possibly Extirpated	Private, BIA	N/A	N/A	Invasive species: *B. tournefortii* found within the occurrence
157	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
158	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
159	Presumed Extant	Possibly Extirpated	Private	N/A	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
160	Presumed Extant	Possibly Extirpated	Private	N/A	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
161	Presumed Extant	Possibly Extirpated	Private, BIA	Big Dune Area	Factor A: development; Hydrology. Factor E: population size; climate change	Invasive species: *B. tournefortii* found within the occurrence
162	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
163	Presumed Extant	Presumed Extant	Center for Natural Lands Management, BLM	Thousand Palms	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
164	Presumed Extant	Presumed Extant	CA Department of Parks and Recreation, Private, BLM	Thousand Palms	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
165	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
166	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
167	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
168	N/A	Extirpated	Private, Local Government	N/A	N/A	Extirpated by development, no habitat left
169	N/A	Extirpated	Private, Local Government	N/A	N/A	Extirpated by development, no habitat left
170	N/A	Extant	Private	N/A	N/A	Threatened by development
171	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
172	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
173	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
174	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
175	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
176	Presumed Extant	Presumed Extant	Private	East Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
177	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
178	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
179	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
180	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
181	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
182	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
183	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
184	N/A	Extirpated	Private	Santa Rosa and San Jacinto Mountains	N/A	Extirpated by development, no habitat left
185	N/A	Extirpated	Private, Local Government	N/A	N/A	Extirpated by development, no habitat left

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
186	N/A	Extirpated	Private, Local Government	N/A	N/A	Extirpated by development, no habitat left
187	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
188	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
189	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
190	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
191	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
192	Presumed Extant	Presumed Extant	Private, BLM	East Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
193	Presumed Extant	Presumed Extant	Coachella Valley Water District	East of E. Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
194	Presumed Extant	Presumed Extant	Private, BLM	East Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
195	Presumed Extant	Presumed Extant	Private	N/A	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
196	Presumed Extant	Presumed Extant	Private	N/A	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
197	Presumed Extant	Presumed Extant	Private	East of E. Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
198	Presumed Extant	Presumed Extant	Private	East Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
199	Presumed Extant	Presumed Extant	Private, BLM	East Indio Hills	Factor A: development; Nonnative Invasive Plant Species; Hydrology. Factor E: population size; climate change	N/A
200	Presumed Extant	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
201	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
202	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
203	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
204	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
205	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
206	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
207	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
208	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
209	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
210	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
211	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
212	N/A	Possibly Extirpated	Private	N/A	N/A	development, habitat fragmentation and isolation
213	N/A	Possibly Extirpated	CA Department of FWS	Santa Rosa and San Jacinto Mountains	N/A	N/A
214	N/A	Possibly Extirpated	CA Department of FWS	Santa Rosa and San Jacinto Mountains Conservation Area	N/A	N/A
215	N/A	Possibly Extirpated	Private	N/A	N/A	development and habitat fragmentation
216	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
217	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
218	N/A	Extirpated	Private, BIA	N/A	N/A	Extirpated by development, no habitat left
219	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
220	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
221	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
222	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
223	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
224	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
225	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
226	N/A	Extirpated	Private, BIA	N/A	N/A	Extirpated by development, no habitat left
228	N/A	Possibly Extirpated	Private	N/A	N/A	N/A
229	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
230	N/A	Extant	Private, BLM	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A
231	Presumed Extant	Presumed Extant	BLM	Willow Hole	Factor A: development; OHV activity; Hydrology. Factor E: population size; climate change	N/A
232	Presumed Extant	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left
234	N/A	Extirpated	Private	N/A	N/A	Extirpated by development, no habitat left

CNDDB Occurrence Number	2010 status	2023 status	Ownership	Conservation Area	Threats in 2010	Change in threats 2010–2023
235	N/A	Possibly Extirpated	USFWS, Private	Thousand Palms	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
236	Presumed Extant	Presumed Extant	Private	Thousand Palms	Factor A: development; OHV activity; nonnative invasive plant species. Factor E: population size; climate change	N/A
237	Presumed Extant	Presumed Extant	Private	Whitewater Floodplain	Factor A: development; nonnative invasive plant species. Factor E: population size; climate change	N/A
N/A	N/A	Extant	USFWS	Thousand Palms	N/A	N/A
N/A	Presumed Extant	Extant	Private, BLM	Edom Hill	N/A	N/A

FIELD OFFICE APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

☒ Approved

SCOTT SOBIECH

Digitally signed by SCOTT SOBIECH
Date: 2023.08.29 08:46:35 -07'00'

Scott A. Sobiech
Field Supervisor