Bell’s Vireo (Least and Arizona)  
(Vireo bellii – pusillus and arizonae)

Legal Status

**State:** Both the least Bell’s vireo and Arizona Bell’s vireo are listed as endangered under the California Endangered Species Act (CESA).

**Federal:** Least Bell’s vireo is listed as endangered under the federal Endangered Species Act (ESA).

**Critical Habitat:** Designated (59 FR 4845–4867) for least Bell’s vireo.

**Recovery Planning:** For least Bell’s vireo: U.S. Fish and Wildlife Service (USFWS) 1998.

**Notes:** The species Bell’s Vireo is also listed as a Bird of Conservation Concern by the USFWS within the Mojave Desert Bird Conservation Regions (BCR) (USFWS 2008).

Taxonomy

There are four recognized subspecies of Bell’s vireo (*Vireo bellii*) including *V. b. bellii*, *V. b. medius*, *V. b. arizonae*, Arizona Bell’s vireo, and *V. b. pusillus*, the least Bell’s vireo (AOU 1998). While all subspecies are similar in appearance, least Bell’s vireo is mostly gray above and pale below, while easternmost birds are greenish above and yellowish below. Southwestern subspecies are intermediate in plumage characteristics. Descriptions of the species’ physical characteristics, behavior, and distribution are provided in a variety of field guides (e.g., Peterson 1990; Sibley 2000; National Geographic 2002).

Distribution and Occurrences within the Plan Area

**General**

Bell’s vireo is a migratory species that breeds in North America and overwinters primarily along the Pacific Coast in southern Mexico (Figure S-27). The breeding range for Bell’s vireo is from north-central to southwestern United States and into central Mexico.
Breeding has been documented from southwestern California and northwestern Baja California, Mexico, to central South Dakota, east to Illinois and northwestern Indiana, south to the gulf coast and into southern Sonora, Mexico. Breeding in California usually takes place in southwestern California and northwestern Baja California, Mexico. However, recently (1997 and 2001) breeding individuals have been reported as far north as southern Santa Clara County along Llagas Creek (Santa Clara Valley Water District 2002; CDFG 2006).

Breeding habitat generally consists of dense, low, shrubby vegetation, (early successional stages) in riparian areas, brushy fields, young second-growth forest or woodland, scrub oak, coastal chaparral, and mesquite brushlands, often near water in arid regions (Brown 1993). The winter range of the Bell’s vireo extends from south Baja California along the west coast of Central America, through Mexico, El Salvador, Guatemala, Nicaragua, and Honduras (Brown 1993). This species winters in habitat that contains thornscrub vegetation adjacent to watercourses or in riparian gallery forests along the west coast of northern and central Mexico.

**Historical**

Historically, the breeding range of least Bell’s vireo was widespread throughout California, including the Sacramento and San Joaquin Valleys (Grinnell and Miller 1944). Over 99% of the least Bell’s vireo population was found south of Santa Barbara County at the time of listing in 1986. Populations occurred in foothill streams of the Sierra Nevada and Coast Ranges, in Owens and Death Valley, and in scattered locations in the Mojave Desert (Cooper 1861; Belding 1878; Fisher 1893; Anthony 1893, 1895; Grinnell and Swarth 1913; Grinnell and Storer 1924; Grinnell et al. 1930; Grinnell and Miller 1944).

Since 1900, populations of the Arizona Bell’s vireo have declined along the lower reaches of the Colorado River, where it is now a rare to locally uncommon summer resident from Needles south to Blythe (Rosenberg et al. 1991).

**Recent**

At the time of its listing, least Bell’s vireo had been extirpated from most of its historic range, and numbered just 300 pairs statewide (Kus
Bell's vireo (Vireo belli)

The least Bell's vireo is increasing throughout southern California, with a tenfold increase in the recorded population since its listing in 1986. However, least Bell’s vireo has not yet meaningfully recolonized its historical breeding range in the San Joaquin and Sacramento valleys (USFWS 2006).

Since the late 1960s, the Arizona Bell's vireo has been expanding its range eastward along the Colorado River into Grand Canyon National Park (Brown et al. 1983). Breeding pairs have been observed in the counties of Monterey, San Benito, Inyo, Santa Barbara, San Bernardino, Ventura, Los Angeles, Orange, Riverside, and San Diego, with the highest concentration in San Diego County along the Santa Margarita River (USFWS 2006). In San Diego County, however, significant population increases in the period from 1986 to 1996 are primarily due to management of local cowbird populations (USFWS 1998). See Figure S-27 for current and historical occurrences of Bell’s vireo in the Plan Area.

Natural History

Habitat Requirements

Bell's vireo is a neotropical migrant that breeds in the summer in riparian scrub (Table 1). Both subspecies are largely associated with early successional cottonwood-willow and are known to nest in riparian woodlands dominated by willow (Peterson et al. 2004) and Fremont cottonwood (Populus fremontii) (Kus 2002a). Suitable willow woodlands are typically dense with well-defined vegetative strata or layers. The most critical structural component of nesting habitat in California is a dense shrub layer 2 to 10 feet aboveground (Goldwasser 1981; Franzreb 1989; Brown 1993). The presence of water, including ponded surface water or moist soil conditions, may be an important component of nesting habitat (Rosenberg et al. 1991).

The Arizona Bell’s vireo relies heavily on cotton-willow forests at low elevations, possibly due to high midsummer temperatures that exist outside of the forests (Hunter et al. 1987). At higher elevations (above 1,400 feet), the Arizona Bell’s vireo uses tamarisk (Tamarix spp.) and honey mesquite (Prosopis glandulosa), as well as cottonwood-willow forest.
Table 1. Habitat Associations for Bell’s Vireo

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Land Cover Use</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riparian woodland</td>
<td>Breeding,</td>
<td>Primary</td>
<td>Typically riparian woodland dominated by willow shrubs and other thick understory</td>
<td>Goldwasser 1981; USFWS 1986</td>
</tr>
<tr>
<td></td>
<td>foraging</td>
<td></td>
<td>vegetation</td>
<td></td>
</tr>
<tr>
<td>Riparian scrub</td>
<td>Breeding,</td>
<td>Primary</td>
<td>Typically riparian scrub dominated by willow and other thick vegetation</td>
<td>Goldwasser 1981; USFWS 1986</td>
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<td></td>
<td>foraging</td>
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</table>

Foraging Requirements

Individuals may forage in scrub or chaparral habitat near nesting habitat (USFWS 1986). During the winter, Bell’s vireo utilizes scrub vegetation along watercourses or riparian gallery forests along the west coast of northern and central Mexico (Hutto 1980).

Reproduction

Breeding least Bell’s vireos begin arriving on their breeding grounds in late March and begin nesting in early April (Table 2; Kus 2002b). Individuals may remain on the breeding grounds into early October, but nesting is typically finished by the end of July (Kus 1999). Most pairs are monogamous during the breeding season (Brown 1993). Several factors may have an effect on breeding success, including development adjacent to riparian habitat, brown-headed cowbird (Molothrus ater) parasitism, and water management.

Table 2. Key Seasonal Periods for Bell’s vireo

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<tr>
<td>Migration</td>
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<td>✓</td>
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<td>Wintering</td>
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</table>

Spatial Behavior

Little is known about the migratory routes of this species (Table 3). Individuals leave the northernmost breeding grounds by August or September (Barlow 1962). Most have left the United States by early October, although some may remain in the Lower Colorado River Valley until late November (Brown 1993). During spring migration, adults return to their breeding grounds in early to mid-March and reach the northern limits of the breeding range in May (Brown 1993; Kus 1999). Home range and movement during the breeding season is limited to areas within dense riparian corridors. Territories are often linear in nature, following the stream course. Size of home range is dependent on the quality of breeding habitat available and the number of breeding individuals that the area will support.

Table 3. Movement Distances for Bell’s Vireo

<table>
<thead>
<tr>
<th>Type</th>
<th>Distance/Area</th>
<th>Location of Study</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Range</td>
<td>1.2 acres (0.5 ha)</td>
<td>Kansas</td>
<td>Barlow 1962</td>
</tr>
<tr>
<td></td>
<td>0.5 to 4 acres (0.2 to 1.6 ha)</td>
<td>California</td>
<td>Gray and Greaves 1984</td>
</tr>
<tr>
<td>Dispersal</td>
<td>0.7 ha</td>
<td>California</td>
<td>Collins et al. 1989</td>
</tr>
<tr>
<td></td>
<td>33 feet on day 1 to 330 feet on day 5</td>
<td>Indiana</td>
<td>Hensley 1950</td>
</tr>
<tr>
<td>Migration</td>
<td>100 to 200 feet on day 14</td>
<td>North America</td>
<td>Nolan 1960</td>
</tr>
<tr>
<td></td>
<td>From breeding grounds to Pacific Coast of southern Mexico</td>
<td>North America</td>
<td>Brown 1993</td>
</tr>
</tbody>
</table>

Ecological Relationships

For successful breeding, this species is dependent on dense riparian corridors, typically along watercourses. Scrub habitats adjacent to these watercourses are equally important to the success of the species because they provide foraging opportunities as well as protection for nesting habitat.

Brown-headed cowbirds have decimated Bell’s vireo populations throughout its breeding range, and this is true for both subspecies. Dense riparian breeding habitat that is surrounded by agricultural
lands or developed areas will facilitate brown-headed cowbird abundance and lower the breeding success of riparian nesting species such as the least Bell’s vireo.

### Population Status and Trends

**Global:** Declining (Kus 2002b; Peterson et al. 2004; NatureServe 2005)

**State:** Recent evidence of range extensions and population increase (USFWS 2006)

**Within Study Area:** Unknown, may be increasing

Least Bell’s vireo was described as common or abundant in the late 1800s and early 1900s. By 1986, the population had declined to an estimated 300 pairs, with the majority occurring in San Diego County (Kus 2002a). The current population of Bell’s vireo is estimated to be approximately 1,500,000. Bird Life International estimates that this species is declining at an average rate of 2.7% per year since 1966 (BirdLife International 2009). The North American Breeding Bird Survey data also indicate a significant survey-wide decline that averages 3.2% per year (Sauer et al. 2008). Recent Great Basin Bird Observatory data show Bell’s vireo population declines in most regions (Great Basin Bird Observatory 2009).

However, the USFWS records show a tenfold increase in the least Bell’s vireo population since its listing under the federal ESA in 1986, from 291 to 2,968 known territories, with “tremendous” growth of the vireo populations in specific areas in San Diego and Riverside counties and lower but still significant growth in Orange, Ventura, San Bernardino, and Los Angeles counties (USFWS 2006). With population declines in the northern portions of the state, the overall population status has increased significantly from Ventura County southward, with declines north of Santa Barbara County.

Due to extensive alteration of riparian corridors and adjacent habitats throughout its range, this subspecies has limited breeding habitat. Although populations have shown signs of increased range in California, numbers throughout North America are in decline. At its low point in the early 1980s, the California breeding population of the least Bell’s vireo was estimated at only 300 pairs. Since the species was listed as endangered under CESA in 1980, and under the federal
ESA in 1986, riparian habitat restoration and cowbird trapping have resulted in considerable increases in Bell’s vireo population in southern California, which now exceeds 1,300 pairs (USFWS 1998). The species may be expanding its range northward in California.

**Threats and Environmental Stressors**

Historic loss of riparian habitat due to agricultural practices, urbanization, and exotic plant invasion has contributed to decline of the species (USFWS 2006). Loss of breeding habitat due to water source alteration (e.g., channelization, urbanization, and firewood cutting) also threatens the species. In addition, nest parasitism by the brown-headed cowbird has greatly reduced nest success throughout most of its breeding range and has been suggested as a primary cause for decline throughout California. A recent study found that vireo productivity increased by one young for each 30% decrease in nest parasitism (Kus and Whitfield 2005). An increase in cowbird abundance is propagated by particular land-use practices (e.g., residential development, agriculture, grazing) on lands adjacent to breeding habitats (Kus 1999; NatureServe 2005). In urbanized areas, where habitat is fragmented and breeding habitat lacks buffers, nest predation may also increase due to mesopredator release and the addition of non-native predators such as domestic or feral cats (USFWS 2006). The Argentine ant (*Linepithema humile*) also has been noted as a potential nest predator (Peterson et al. 2004).

Other threats to this species’ habitat include urban and suburban development on floodplains, the presence of large areas of invasive plants such as tamarisk and giant reed (*Arundo donax*), and off-road vehicular activity (Wildlife Action Plan Team 2006). Also, flood control projects and grazing have destroyed much of the western nesting habitat (NatureServe 2010).

**Conservation and Management Activities**

Within the Plan Area, the Arizona Bell’s vireo is covered under the Lower Colorado River Multi-Species Conservation Program. The goal of this program is to conserve habitat of threatened and endangered species and reduce any additional species being listed; accommodate present water diversions and power production; and provide the
basis for incidental take authorizations (Lower Colorado River Multi-Species Conservation Program 2004).

Near the Plan Area, the least Bell’s vireo is covered by the Coachella Valley Multiple Species Habitat Conservation Plan (MSHCP), which also aims to conserve habitat of covered species. One of the goals of the Coachella Valley MSHCP is to ensure species persistence in the Plan Area by protecting and managing riparian habitat, controlling invasive plants such as tamarisk, and controlling brown-headed cowbird, when necessary. The MSHCP will protect and manage in perpetuity 1,282 acres of modeled breeding habitat and 19,301 acres of migratory habitat. The plan also will establish 44 acres of permanent Sonoran cottonwood-willow riparian forest.

Various integrated natural resource management plans (INRMPs), developed as part of compliance under the Sikes Act Improvement Act of 1977, have successfully contributed to vireo conservation, including the 2001 INRMP for Camp Pendleton, which includes management actions such as cowbird trapping that have met with short-term success at improving population numbers (USFWS 2006).

The species also is included in the Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004), where it is designated as a Watch List species that warrants immediate action. Additionally, the species is on the USFWS list of Birds of Conservation Concern 2008 (USFWS 2008).

**Data Characterization**

In general, there is a good deal of information regarding Bell’s vireo in the Plan Area. However, Bell’s vireo is highly mobile and can occur unexpectedly in new areas far from known breeding areas. Particularly, given that the species’ range is expanding and population numbers are growing, continued survey work that seeks to document species presence over time is necessary.

**Management and Monitoring Considerations**

Bell’s vireo is dependent on riparian vegetation, so management actions that improve riparian habitat will likely benefit the species. In particular, removal of tamarisk from existing riparian areas would
enhance habitat for least Bell’s vireo and other riparian birds. Additional management and monitoring considerations include browheaded cowbird nest parasitism, which should be controlled and/or monitored in areas targeted for bell’s vireo restoration.

**Predicted Species Distribution in Plan Area**

Species model summary and results will be provided following model development.

**Literature Cited**


Birds


Amargosa Vole
(*Microtus californicus scirpensis*)

**Legal Status**

**State:** Endangered  
**Federal:** Endangered  
**Critical Habitat:** Designated on November 15, 1984, when species was listed Endangered (49 FR 45160–15164)  
**Recovery Planning:** *Recovery Plan for the Amargosa Vole* (*Microtus californicus scirpensis*) (USFWS 1997)  
**Notes:** Most recent 5-year review on May 21, 2010, recommended no change in listing status (75 FR 28636–28642)

**Taxonomy**

The Amargosa vole (*Microtus californicus scirpensis*), is one of 17 recognized subspecies of the widespread California vole (*M. californicus*), which is found from the interior valleys of Oregon, near Eugene, to El Rosario, Baja California, Mexico (Cudworth and Koprowski 2010). The type locality for the Amargosa vole is the Amargosa River, near Shoshone and the California–Nevada border in Inyo County. Its range is small and disjunct from other populations of California vole. The Amargosa vole was once thought to be a distinct species (USFWS 1997), but is currently included as a subspecies of the California vole, and no taxonomic classification or nomenclature changes are currently proposed (USFWS 2009). However, based on an assessment of variation in mitochondrial DNA and nuclear DNA throughout the California vole’s range, Conroy and Neuwald (2008) found evidence of limited gene flow between clades (groups of a taxa sharing closer ancestry within the group than among the groups, indicating genetic distinctions between the clades). These clade differences may be correlated with ecological differences. From this evidence, Conroy and Neuwald (2008) suggest the possibility of two distinct species of California vole. If the California vole is split into two distinct species, it is unlikely to affect the listing status of the Amargosa.
vole because it would still be a small, isolated population at high risk of extinction regardless of species assignment. Descriptions of Amargosa vole physical characteristics can be found in Cudworth and Koprowski (2010) and U.S. Fish and Wildlife Service (USFWS 1997).

Distribution

General

The Amargosa vole has a small, disjunct range limited to areas along the Amargosa River in the eastern Mojave Desert near the California–Nevada state line, as shown in Figure S-15a. The entire range of the Amargosa vole is within the Desert Renewable Energy Conservation Plan (DRECP) Area.

Distribution and Occurrences within the Plan Area

Historical

The historic distribution of the Amargosa vole has been in disjunct “pockets” of marsh habitats along the Amargosa River from about Shoshone to Amargosa Canyon, Inyo County, although the full historic range of the subspecies has never been documented (USFWS 1997). The Amargosa River is largely subterranean, but supports marshy areas with perennial surface water in areas fed by tributary springs along an approximately 10-mile reach of the river (USFWS 1997).

At one time, the Amargosa vole was thought to be extinct, but was “rediscovered” in pockets of marsh habitat during trapping conducted between 1977 and 1988 (Bleich 1979; USFWS 1997). Occupied pockets ranged from about 0.5 mile north of Tecopa Hot Springs and south approximately 3.5 miles to the northern end of Amargosa Canyon.

The California Natural Diversity Database (CNDDB) includes seven “historic” occurrences for the species (i.e., pre-1990), with the most recent being 1984 (CDFG 2011a). This database includes the type of specimen collected by Bailey in 1891 near Shoshone (and extirpated for a hog farm) and trapping data from 1977, 1983, and 1984.
Recent

The most recent available data for the Amargosa vole are from surveys for the subspecies conducted by McClenaghan and Montgomery in 1997 under a contract with the California Department of Fish and Game (CDFG), and more focused surveys by Neuwald in 1999 and 2000 in conjunction with a study of California vole genetics (see discussion of genetics study in the Management and Monitoring Considerations section) (McClenaghan and Montgomery 1998; USFWS 2009). (Note to reader: an extensive study was completed from September 2010 to April 2011, with preliminary findings to be submitted to CDFG by late 2011). The McClenaghan and Montgomery (1998) survey included live trapping, diagnostic sign evidence of occupation, and a habitat assessment at 48 sites, including all sites previously surveyed in the 1980s (Figure S-15b). This study is the most detailed work to date on Amargosa vole (USFWS 2009). These more recent survey data overlap with the pre-1990 CNDDDB occurrences (CDFG 2011a) and should be considered the most current and complete dataset for the Amargosa vole (i.e., the older data representing extant sites are superseded by data collected in 1997 by McClenaghan and Montgomery (1998) and in 1999–2000 by Neuwald) (USFWS 2009).

McClenaghan and Montgomery (1998) found the Amargosa vole at 17 of the 48 sites surveyed. Of the 17 sites, 3 were sites where the vole had not been previously documented; 8 of the sites were known to be occupied in previous surveys in the mid- to late-1980s; and the remaining 6 occupied sites were sites where the Amargosa vole’s status was previously uncertain due to either a lack of surveys or insufficient level of surveys, as noted in the species’ 5-year review (USFWS 2009). McClenaghan and Montgomery (1998) also found that 23 of the 31 unoccupied sites had suitable vole habitat, but trapping may not have been sufficient to reliably conclude presence or absence at the site (USFWS 2009). One site that was previously occupied no longer contained suitable habitat. Field work by Neuwald in 1999 and 2000 confirmed presence at seven sites occupied in 1997; presence at a site occupied in 1988, but not confirmed in 1997 by McClenaghan and Montgomery; and at a new site not previously occupied (USFWS 2009).
Most of the habitat occupied by the Amargosa vole is currently administered by the Bureau of Land Management (BLM), California State Lands Commission (CSLC), and The Nature Conservancy (TNC).

Natural History

Habitat Requirements

The Amargosa vole inhabits discontinuous pockets of marshy habitats along the Amargosa River, which is mostly subterranean (USFWS 2009). The marshy areas, which range from about 1 to 5 acres in size, are fed by perennial tributary springs along the river that maintain perennial surface water. It is estimated that suitable habitat for the Amargosa vole totals about 247 acres (USFWS 2009).

Occupied marsh habitats are closely associated with surface water and are dominated by an overstory of bulrush (Scirpus olneyi) in densities rated as moderate to high (USFWS 2009) (see Table 1). Occupied sites also support other overstory species, such as arrow weed (Pluchea sericea), seep-weed (Suaeda torreyana), quailbush (Atriplex lentiformis), and southern reed (Phragmites australis). Understory vegetation includes yerba mansa (Anemopsis californica) and saltgrass (Distichilis spicata) (USFWS 2009). McClenaghan and Montgomery (1998) found the highest abundance of voles at the wet or lightly flooded ecotone between bulrush and saltgrass, but also noted that one occupied site was dominated by rush (Juncus sp.) and marsh plants other than bulrush. The recent study by CDFG, however, provides somewhat different findings for species constituents of occupied and unoccupied habitat. In this study, and consistent with previous descriptions, occupied sites included habitat mainly supporting bulrush, and on rare occasions, voles were trapped in rush, and/or a mix of yerba mansa and seep-weed (CDFG pers. comm. 2011b). However, in this study, voles were absent in arrow weed, quailbush, saltgrass, and southern reed.

As a sedentary species, the Amargosa vole likely spends its entire life in marsh-associated habitats, except possibly when dispersing between habitat patches.

Table 1. Habitat Associations for Amargosa Vole
Mammals

Amargosa Vole (*Microtus californicus scirpensis*)

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Land Cover Use</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland</td>
<td>All life history phases</td>
<td>Primary</td>
<td>Dominated by bulrush, Gentle terrain (&lt; 20%)</td>
<td>USFWS 2009</td>
</tr>
</tbody>
</table>

Occupied sites tend to be on level to gently sloping terrain; trapping in the 1970s found occupied sites were on slopes less than 20% (USFWS 2009).

Burrows may be excavated by voles themselves, or voles may use the entrance of gopher burrows or overcover such as boards for refuge and nest sites.

**Foraging Requirements**

There is relatively little ecological and behavioral information for the Amargosa vole subspecies, so much of the information presented in this section and the other natural history sections that follow are for the California vole, which is simply referred to as the “vole.” Where the information is specific to the Amargosa vole, this will be indicated.

Voles primarily feed on grasses, sedges, and forbs (Cudworth and Koprowski 2010). Food preference tests showed that grasses (e.g., *Hordeum*, *Bromus*, and *Lolium*) were the preferred food item in a captive population, which is consistent with field observations (Batzli and Pitelka 1971; Gill 1977). Seed and roots become more important in their diet during the dry summer (Cudworth and Koprowski 2010). Batzli and Pitelka (1971) found that seasonal condition is correlated with diet; as the diet changes from grass stems to grass seeds, individuals show lower growth rates, lower survival rates, and lower fat reserves. Green vegetation is necessary for reproduction (Cudworth and Koprowski 2010).

**Reproduction**

The vole breeding season is not sharply defined, but rather is tied to environmental conditions and trigger events. Because green vegetation is necessary for reproduction, early precipitation can offset...
the inhibiting effect of a short photoperiod (e.g., shorter fall and winter daylight periods may suppress reproductive conditions, such as testes size or weight in males) (Cudworth and Koprowski 2010). Although voles are capable of reproducing year-round, the main breeding period extends from about mid-September, with peak pregnancy rates in March and April (Greenwald 1956; Cudworth and Koprowski 2010; CDFG pers. comm. 2011b) (see Table 2). The breeding season terminates with the lack of available green vegetation. McClenaghan and Montgomery (1998), however, found more males and females in reproductive condition in June than in November, when reduced reproductive activity may be expected, indicating potential regional seasonal variation in reproduction.

Table 2. Key Seasonal Periods for Amargosa Vole

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<td>Breeding</td>
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Notes: Reproduction is generally associated with production of green vegetation. Voles can reproduce year-round. Sources: Cudworth and Koprowski 2010; CDFG pers. comm. 2011b).

The gestation period for voles is about 21 days and young are weaned in about 14 days (Greenwald 1956). Voles can be highly prolific. They exhibit a postpartum estrus (sexual receptivity) that lasts for several days following birth, which allows for several successive litters in short periods of time. In a laboratory setting, over a 185-day period, seven pairs produced an average of six litters per pair, or a new litter every 31 days on average (Colvin and Colvin 1970). The average litter size is 4 or 5, with a range of 1 to 10 pups (Greenwald 1956; Colvin and Colvin 1970; Cudworth and Koprowski 2010). In the wild, litter sizes appear to be correlated with season, with peak litter sizes in the mid-breeding season (Cudworth and Koprowski 2010). Young can appear within about 6 weeks of the first major rainfall of the season (Cudworth and Koprowski 2010). Not only are adult females highly productive, juvenile females can be reproductive by 3 weeks of age and males can be reproductive by 6 weeks of age (Cudworth and Koprowski 2010). However, sexual maturation may be related to social factors and
mediated by pheromones produced by the family group (Batzli et al. 1977). Batzli et al. (1977) found that California vole littermates suppress growth and sexual maturation when kept in the same cage while isolated individuals were not suppressed.

With a long breeding season, postpartum estrus, large litter sizes, and reproduction by young of the year, vole populations can expand very rapidly. However, voles also exhibit high nestling and juvenile mortality. One study estimated 35% nestling mortality and early juvenile mortality of 0% to 82% (Cudworth and Koprowski 2010). Based on mark-recapture data, McClenaghan and Montgomery (1998) estimated an 83% month-to-month survival rate and a 32% 5-month survival rate for the Amargosa vole. Generally, the lifespan of the vole is fairly short (i.e., less than 1 year), but McClenaghan and Montgomery (1998) documented one individual Amargosa vole living at least 1 year.

Not all vole species exhibit cyclical population fluctuations, and too little information is available to determine whether the Amargosa vole exhibits population irruptions (an irregular, abrupt increase in a population related to environmental factors) and crashes seen in other vole populations (USFWS 2009).

Spatial Behavior

California voles are sedentary and have small home ranges, but the size of home ranges vary with season and population density (Cudworth and Koprowski 2010). One study estimated home ranges of 0.02 acre (732 feet²) for females and 0.03 acre (1,109 feet²) for males (Cudworth and Koprowski 2010). A male's home range may overlap the home ranges of several females, and voles live in family groups of one male, up to several females, and their offspring. Males tend to maintain ranges exclusive of other male ranges (Cudworth and Koprowski 2010).

The majority of a vole's daily activity occurs within 16–17 feet of the burrow (Cudworth and Koprowski 2010). Voles may be active throughout the day, with peaks of activity typically occurring at dusk and dawn, although they may become more nocturnal during the hot summer months (Cudworth and Koprowski 2010). Males exhibit shorter distance movements than females during the non-breeding
season, but longer distance movements during the breeding season, with a peak at the onset of the breeding season. Movements by females increase in July and peak in January (Cudworth and Koprowski 2010).

All age classes of voles disperse, but dispersal by the Amargosa vole may be limited by the spatial patchiness of suitable marsh habitat (USFWS 2009; Cudworth and Koprowski 2010).

**Ecological Relationships**

Where present, voles are often one of the most common members of the rodent community, and the species may negatively affect at least one other native rodent species, the western harvest mouse (*Reithrodontomys megalotis*), where they co-occur (Heske et al. 1984).

In a 6-year study in Contra Costa County, California, harvest mouse populations increased on study sites when voles occurred in low densities, but declined to very low numbers or extirpation when vole populations irrupted (Heske et al. 1984). Heske et al. (1984) concluded that severe behavioral interactions occurring at high vole densities was likely responsible for the decline in the harvest mouse rather than a decline in habitat quality or an increase in predators, but whether there was interference with harvest mouse reproduction by voles could not be determined.

Voles may have a substantial effect on their environment, which may affect population cycles. Batzli and Pitelka (1971) found that high vole population densities can severely reduce grass crop and seed production. A reduction in available food may delay the onset of reproduction, which is highly dependent on environmental cues, such as the availability of green vegetation in the fall, or result in early termination of reproduction. These periodic food shortages may affect population cycles.

As one of the most common rodents and because of their flexible daily activity patterns, voles are prey for a variety of nocturnal and diurnal predators. Avian predators include American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), white-tailed kite (*Elanus leucurus*), red-tailed hawk (*Buteo jamaicensis*), barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), clapper rail (*Rallus longirostris*), and herons and egrets (family Ardeidae) (Cudworth and Koprowski 2010). White-
tailed kites, in particular, appear to be attracted to areas with high vole densities (Warner and Rudd 1975). Voles are also prey for various snakes and mammals such as long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale gracilis*), common raccoon (*Procyon lotor*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), and feral and pet cats (*Felis catus*) (Pearson 1971; Cudworth and Koprowski 2010).

Because voles may be a preferred prey item, predators can exert a severe effect on vole populations (Pearson 1971). On a 35-acre study site in Tilden Park, California, Pearson (1971) determined that voles were the primary prey of feral cats, skunks, raccoons, and foxes, despite high densities of other potential prey, including rodents, rabbits, and lizards and snakes. From June 1961 until spring 1962, when reproduction began again, these carnivores preyed on 88% of the existing vole population (Pearson 1964). Pearson (1971) suggests that predation is a primary factor in controlling population cycles because as populations decline, the number of predators ultimately declines, until a new irruption of voles occurs.

**Population Status and Trends**

**Global:** Critically Imperiled (NatureServe 2010)

**State:** Same as above

**Within Plan Area:** Same as above

As summarized in the species’ 5-year review, the data on status and trends are inconclusive because of a lack of key baseline information (USFWS 2009). The McCloughan and Montgomery (1998) study provides the most complete set of currently available. (Note to reader: CDFG has completed a recent study in 2010–2011, the results of which will be incorporated into the profile when they become publicly available.) They found the Amargosa vole at the eight sites known to be occupied in the mid- to late-1980s, and also found three new occupied sites, suggesting that the population may at least be stable, if not expanding. However, trapping at 23 of 31 sites that had suitable habitat was insufficient to reliably assess presence or absence (USFWS 2009). With regard to population trends, because only eight sites have been trapped by more than one investigator since the 1970s, an assessment of trends (which would require repeated comparable surveys over
time) cannot be made (USFWS 2009). Therefore, the data collected to date are adequate only to assess presence.

**Threats and Environmental Stressors**

Historic threats to the Amargosa vole have included destruction of marsh habitat. The type locality at a spring near Shoshone was converted to a hog farm by 1918, as reported by Kellogg (CDFG 2011a). Other historic impacts included livestock grazing, burning of marsh for pasture, diversion and channelization of springs in the Shoshone area, and development of mineral baths and mobile home courts in the Tecopa Hot Springs area (USFWS 2009). Construction of the Tonopah and Tidewater Railroad line, Tecopa Hot Springs Road, and the Old Spanish Trail Highway also may have altered ponding patterns and degraded habitat for the Amargosa vole (USFWS 2009).

Historic threats that are no longer considered to be a substantial threat to the Amargosa vole are cattle grazing and purposeful burning, although localized burning on private property continues to be a local threat (USFWS 2009). Large-scale wildfires are also a continuing threat.

While most of the suitable habitat for the Amargosa vole is now administered by BLM, CSLC, and TNC, some threats to the species are still present. Unresolved threats include groundwater pumping and development, tamarisk (*Tamarix* spp.) invasion, and water diversions and man-made barriers to natural spring flows (USFWS 2009). Groundwater pumping and development is not an issue directly within the Amargosa vole’s range, but future development of groundwater in the carbonate aquifer in the Pahrump Valley could affect habitat quality because the valley lies between the springs and the source of recharge for the aquifer (USFWS 2009). Tamarisk, which has infested several areas in Amargosa Canyon, may reduce the available surface water and displace active vegetation that provides Amargosa vole habitat. However, there is no current information about whether, or the extent to which, tamarisk has directly affected vole habitat (USFWS 2009).

Two non-native species associated with urban and rural development—domestic cat and house mouse (*Mus musculus*)—are potential threats to the Amargosa vole. Domestic and feral cats are known predators of voles and are considered to be potential predators
of the Amargosa vole (Pearson 1964; USFWS 2009). The number of house mice at trapping sites was negatively correlated with the number of Amargosa voles, but whether there is direct or indirect interspecific competition (e.g., for resources) or direct behavioral exclusion is unknown (McClenaghan and Montgomery 1998; USFWS 2009).

A potential long-term threat to the Amargosa vole is habitat fragmentation and population isolation. Although the subspecies probably always existed in a naturally fragmented habitat, anthropogenic habitat loss and degradation has probably increased natural fragmentation and isolation. Based on an analysis of mitochondrial DNA and nuclear DNA, Neuwald (2010) determined that Amargosa vole exhibits significantly lower variation in both mitochondrial and nuclear DNA compared to a more broadly distributed subspecies (M. c. sanctidiegi). Heterozygosity was only 30% of that of the broadly distributed subspecies. Despite overall low genetic diversity, there were significant genetic differences among the Amargosa vole populations and no significant evidence of inbreeding.

The 5-Year Review: Summary and Evaluation also identified climate change as a potential future threat to the Amargosa vole because prolonged droughts could negatively affect marsh habitats (USFWS 2009). While broad-scale climate model predictions are for warmer temperatures in the northern hemisphere, more intense precipitation events, and increased summer continental drying, actual impacts at a smaller regional or sub-regional scale are too uncertain to make specific predictions on particular species (USFWS 2009).

(Note to reader: CDFG has completed a recent study in 2010–2011 for which a potential new threat is being analyzed. The profile will be updated when this new information becomes publicly available.)

**Conservation and Management Activities**

Prior to the listing of the Amargosa vole as federally endangered, BLM designated the Amargosa River and Grimshaw Lake Areas of Critical Environmental Concern (ACECs) (USFWS 2009). These ACECs encompass approximately 10,302 acres and include most of the suitable habitat for the Amargosa vole. In 2006, BLM published the Amargosa River Area of Critical Environmental Concern Implementation Plan (BLM 2006). The implementation plan sets forth
management goals for the ACEC, which generally include protection, restoration, and enhancement of natural riparian and wetland systems and endangered and threatened species habitat; inventory and monitoring; and accommodation of public recreation consistent with resource protection. Based on the goals, the implementation plan identifies management actions, several of which will likely directly benefit the Amargosa vole and its habitat, including, but not limited to:

- Control tamarisk within and upstream of the ACEC
- Actively restore areas of weed control and priority damaged areas
- Prohibit ground fires in the ACEC
- Evaluate current and proposed land use authorizations for potential adverse impacts to listed species
- Eliminate bathing at native hot springs located in suitable habitat for the Amargosa vole
- Reduce house mice and free-roaming domestic and feral cats
- Reduce and modify, as necessary, the fire management plan to provide protection for listed species
- Develop a formalized agreement between BLM, CDFG, the U.S. Geological Survey, and USFWS for the implementation of actions in the Amargosa Vole Recovery Plan and encourage the establishment of an interagency Amargosa vole recovery team
- Prohibit new non-administrative, discretionary stream diversions and groundwater-disturbing activities on public lands within the ACEC
- Monitor and evaluate habitat trends and conditions specific to listed species on public lands throughout the ACEC.

In addition to the goals and implementation actions identified by BLM for the Amargosa River ACEC, the 5-Year Review: Summary and Evaluation discusses conservation and management activities that have been planned and undertaken since the species was federally listed in 1984 (USFWS 2009). These activities are briefly summarized here.

Since the listing, TNC, in coordination with the Amargosa Conservancy, acquired approximately 2,700 acres of private land in Tecopa and the Tecopa Hot Springs area to help consolidate
management in the ACECs. CDFG, TNC, USFWS, and the Desert Managers Group obtained a Section 6 grant to acquire a 40-acre parcel near Tecopa Hot Springs that contains occupied Amargosa vole habitat. CDFG also funded the 1997 survey conducted by McClenaghan and Montgomery (1998) described previously.

The 5-Year Review: Summary and Evaluation also summarizes the status of the recovery actions from the 1997 recovery plan (USFWS 1997, 2009). BLM, CDFG, TNC, and USFWS have taken steps to acquire land supporting the Amargosa vole, and BLM has prepared the management plan for the Amargosa River ACEC. However, many spring sources to the river are still in private ownership and unprotected from diversions and channelization. Some local burning of bulrush vegetation continues to affect Amargosa vole habitat. Groundwater development in the Pahrump Valley that could affect spring outflows continues to be a concern.

Along with the listing of the Amargosa vole as federally endangered, USFWS has designated approximately 4,520 acres of critical habitat (49 FR 45160–15164) (Figure S-15a). Although the critical habitat designation does not specify specific conservation measures, it requires that evaluations of potential impacts to critical habitat be made on projects with a federal nexus (e.g., a federal permit action or funding) and may result in protection measures to avoid adverse modification or destruction of critical habitats associated with the project.

Data Characterization

As discussed previously, information for the Amargosa vole is inadequate to assess the overall population status and trends. Until the 1970s, the subspecies was thought to be extinct, and since that time there have been only six reports on trapping surveys (Bleich 1979; USFWS 2009). Only eight sites have been trapped by more than one investigator, and the level of trapping in 1997 on 23 sites with apparently suitable habitat was not sufficient to determine presence or absence (USFWS 2009). However, the geographic range limits of the Amargosa vole are well understood and it is unlikely that additional surveys would significantly extend the range of the subspecies. The main uncertainty is the distribution of the Amargosa vole within its current known range in suitable marsh habitat pockets.
Management and Monitoring Considerations

Most of the occupied and otherwise suitable marsh habitat for the Amargosa vole is now protected through the efforts of BLM, CDFG, TNC, and USFWS. The main concern for now and the future is the long-term management and monitoring of the Amargosa vole and its habitat to ensure that the subspecies persists or expands within its range. Ongoing threats that require management and monitoring include localized burning of marsh habitat, tamarisk invasion, diversion of spring outflows, groundwater pumping from the carbonate aquifer, house mice and domestic and feral cats, and potential genetic impacts from small fragmented populations (USFWS 2009). As discussed previously in the Conservation and Management Activities section, the Amargosa River Area of Critical Environmental Concern Implementation Plan (BLM 2006) includes a comprehensive set of implementation actions that includes management and monitoring considerations to address these ongoing threats. With respect to genetics, maintaining ephemeral tributaries for dispersal between population clusters is critical (Neuwald 2010).

Predicted Species Distribution in Plan Area

A species habitat model was not completed at this time for the Amargosa vole because existing information is considered to be complete for depicting the subspecies’ geographic range and potential habitat areas within its range. Figure S-15a shows the wetland habitat within the potential range of the Amargosa vole. Figure S-15b shows the specific locations where the Amargosa vole was trapped by McClenaghan and Montgomery (1998). Figure S-15b also shows sites that were trapped because habitat was determined to be suitable, but trapping results were negative. These sites may be considered to contain suitable habitat, but are currently not occupied. The exception is Site #40, which was previously occupied, but no longer supports suitable habitat.

In addition, based on the yet unpublished recent CDFG study, a suitable habitat model may be developed (CDFG pers. comm. 2011b). This habitat model will be used if and when it becomes publicly available.
Mammals

Amargosa Vole (Microtus californicus scirpensis)

Literature Cited


CDFG. 2011b. Unpublished data in personal communication from T. Branston (CDFG) to P. Behrends (Dudek) regarding results of CDFG study conducted from September 2010–April 2011 and received in comment on draft species profile.

Mammals

Amargosa Vole (*Microtus californicus scirpensis*)


Mammals

Amargosa Vole (*Microtus californicus scirpensis*)


Cushenbury Oxytheca  
*(Acanthoscyphus parishii var. goodmaniana)*

**Legal Status**

- **State:** S1.1
- **CNPS:** Rare Plant Rank 1B.1
- **Federal:** Endangered
- **Critical Habitat:** 67 FR 59239–59241
- **Recovery Planning:** *San Bernardino Mountains Carbonate Plants Draft Recovery Plan* (USFWS 1997)
- **Notes:** No changes in federal listing status recommended by the U.S. Fish and Wildlife Service (USFWS) as of 2009.

**Taxonomy**

Cushenbury oxytheca (*Acanthoscyphus parishii var. goodmaniana*) is a small annual plant approximately 0.5 to 3 decimeters (2 to 12 inches) in size. It was originally described by Parry (1882) as *Oxytheca watsonii* in his descriptions of the genus *Oxytheca* from earlier descriptions of plants collected by Nuttall (1848). The genus Oxytheca was further defined by Ertter in 1980 when she described *Oxytheca parishii* (Parry) var. *goodmaniana* (Ertter) as distinct from either *Oxytheca parishii* var. *parishii* or *Oxytheca watsonii*. Cushenbury oxytheca was known as *Oxytheca parishii* (Parry) var. *goodmaniana* (Ertter) in the *Jepson Manual* (Hickman 1996, p. 886), and was federally listed under that name. However, as originally suggested by Small (1898) and substantiated by Reveal (2004), the varieties of plants that fall under the rank of *Oxytheca parishii* should be treated as distinct from the genus Oxytheca and are properly grouped in the genus Acanthoscyphus. This taxonomic change is primarily the result of morphological studies that have identified the currently accepted name of Cushenbury oxytheca as *Acanthoscyphus parishii* var. *goodmaniana* (Costea and Reveal 2011).

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1 **S1:** Critically imperiled; **X.1:** Very threatened.
2 **1B:** Rare, threatened, or endangered in California and elsewhere; **X.1:** Seriously endangered in California.
Plants  
Cushenbury Oxytheca (*Acanthoscyphus parishii* var. *goodmaniana*)

There are two other varieties of *Acanthoscyphus parishii* in the San Bernardino Mountains, var. *parishii* and var. *cienegensis*. Cushenbury oxytheca can be differentiated by its possession of four (or rarely five) involucral awns, and these awns are shorter and more slender and inconspicuous than the other two varieties (Sanders 2007). A full physical description of the species can be found in Sanders (2007).

**Distribution**

**General**

Cushenbury oxytheca occurs along the north foot of the San Bernardino Mountains in San Bernardino County on limestone and other carbonate talus slopes (CDFG 2011; Sanders 2007). The California Natural Diversity Database (CNDDB) and the USFWS species database document 224 occurrences of Cushenbury oxytheca. The majority of these populations occur within the San Bernardino National Forest. As reported by the USFWS in 2009, Cushenbury oxytheca occupies approximately the same range as it did at listing, which is approximately 500 acres (USFWS 2009).

**Distribution and Occurrences within the Plan Area**

**Historical**

Cushenbury oxytheca is primarily associated with a region of carbonate soils that predominantly occur along the northern edge of the San Bernardino Mountains (USFWS 2009). It has been estimated by Gonella and Neel (1993) that the mining industry has impacted over 1,600 acres of potential habitat for a variety of carbonate-endemic plants; and because Cushenbury oxytheca was not described until 1980, the historical distribution of this species is unknown, except only by inference.

**Recent**

Twenty-eight known occurrences of Cushenbury oxytheca occur within the Plan Area (Figure S-28), of which 21 are considered recent occurrences (i.e., since 1990) and the status of 7 occurrences are unknown (CDFG 2011). However, each of the 28 occurrences is presumed to be extant.
Plants  
Cushenbury Oxytheca (*Acanthoscyphus parishii var. goodmaniana*)

**Natural History**

**Habitat Requirements**

Cushenbury oxytheca is an annual herb that generally grows on limestone or a mixture of limestone and dolomite soils. This species is most commonly found on talus slopes within pinyon and juniper woodland (see Table 1; Hickman 1996, p. 886; CNPS 2011; CDFG 2011; USFWS 2009). Slope where it occurs are usually steep and almost always on loose scree or talus (Sanders 2007). Habitat preferences include an open canopy structure with little or no accumulation of organic material at the soil surface.

Dominant species within pinyon and juniper woodland include singleleaf pinyon pine (*Pinus monophylla*), Utah juniper (*Juniperus osteosperma*), and more rarely California juniper (*Juniperus californica*) and western juniper (*Juniperus occidentalis*). Understory species within pinyon and juniper woodland are more variable, but may include mountain-mahogany (*Cercocarpus ledifolius*), Mormon tea (*Ephedra viridis*), Mojave yucca (*Yucca schidigera*), Joshua tree (*Yucca brevifolia*), and encelia (*Encelia* sp.). Cushenbury oxytheca co-occurs with another carbonate endemic, Parish’s daisy (*Erigeron parishii*). Its presence, however, appears to be negatively related to at least two other carbonate soils species that tend to occur on stable slopes. Gonella and Neel (1995) never found Cushenbury oxytheca on sample plots centered on Cushenbury milk-vetch (*Astragalus albens*), but it was fairly regularly found on plots without the milk-vetch. Cushenbury milk-vetch is a species typical of stable, often bedrock, slopes. Cushenbury oxytheca also appears to be negatively correlated with the presence of Cushenbury buckwheat (*Eriogonum ovalifolium var. vineum*). However, later surveys conducted by Rancho Santa Ana Botanic Garden for the U.S. Forest Service did find Cushenbury oxytheca growing with Cushenbury milk-vetch and Cushenbury buckwheat in some areas (V. Sosa, cited in Sanders 2007).

**Table 1.** Habitat Associations for Cushenbury Oxytheca

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
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<td>Pinyon and juniper</td>
<td>Primary</td>
<td>Carbonate soils</td>
<td>Sanders 2007;</td>
</tr>
</tbody>
</table>
DRAFT
October 26, 2011

Plants

Cushenbury Oxytheca (Acanthoscyphus parishii var. goodmaniana)

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
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<td>habitat</td>
<td>(limestone)</td>
<td>USFWS 2009</td>
</tr>
<tr>
<td>Joshua tree</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>woodland,</td>
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<td></td>
<td></td>
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<tr>
<td>Mojavean desert</td>
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<td>scrub,</td>
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<tr>
<td>Jeffrey pine-</td>
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<tr>
<td>western</td>
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Reproduction

Cushenbury oxytheca is a small annual that germinates in late fall, producing a relatively long taproot and basal rosette of leaves that remain until the inflorescence develops and flowers bloom from May to October. Observations suggest that it is pollinated by generalist insects, such as small flies and small beetles (S. Morita, cited in Sanders 2007). Little is known about seed bank, seedling establishment, or population structure (USFWS 2009).

Ecological Relationships

Other than Cushenbury oxytheca’s association with carbonate soils, little is known of the life history and ecological relationships of this species. What is known of its life history is based on personal observations and museum records; little information has been published on the species (Sanders 2007). Gonella and Neel (1995) noted its presence/absence on plots in relation to Cushenbury buckwheat and Cushenbury milk-vetch, as described under Habitat Requirements; generally is does not co-occur with these two species.

Population Status and Trends

Global: Critically Imperiled (CNPS 2011)
State: Same as above
Within Plan Area: Same as above

Cushenbury oxytheca is a small, annual species of xerophytic habitats that is subject to year-to-year fluctuations in population size as a
result of differential rainfall (USFWS 2009). Further, what is defined as an “occurrence” has been variable and subjective, making it difficult to detect changes in abundance (USFWS 2009). Due to these factors, population status and trends are difficult to measure. It should also be noted that as increased survey efforts have occurred since the species original listing, there has also been an increase in the number of detected occurrences (USFWS 2009).

Threats and Environmental Stressors

According to a variety of sources, the primary threat to Cushenbury oxytheca is limestone mining (CDFG 2011; Sanders 2007; Hickman 1996). Besides direct impacts, dust and artificial lighting can affect the species through dust impacts on soil chemistry and potential lighting impacts on seedbanks and pollinators and seed dispersers (USFWS 2009). The USFWS (2009) reports that 79% of known occupied habitat is currently subject to mining claims. Additional threats are non-native plant encroachment, power line maintenance, a hydroelectric project, and off-highway vehicles (CNPS 2011; USFWS 2009).

Conservation and Management Activities

The San Bernardino Mountains Carbonate Plants Draft Recovery Plan addressed Cushenbury oxytheca and four other federally listed species: Parish’s daisy, Cushenbury milk-vetch, San Bernardino Mountains bladderpod (Lesquerella kingii ssp. bernardina), and Cushenbury buckwheat (USFWS 1997). The recovery plan for these species included the following recovery criteria:

1. Sufficient habitat protected in a reserve system for persistence of existing populations in their ecological context, including the largest populations and best and manageable habitat
2. Identification of potential buffer zones, although not necessarily secured, with an estimate of 4,600 acres needed for habitat connectivity, buffers, and a natural community context
3. Population monitoring and habitat management to provide for early detection of population instability in the reserve system
4. Expansion of existing populations or reintroductions to reduce the chance of extinction due to randomly occurring events.
Based on these recovery criteria, the recovery plan identified the following actions:

1. Protect significant extant populations in a reserve system on federally owned land, which would include buffer zones and maintain selection habitat connections
2. Restore habitat and conduct reintroductions and/or population enhancements where appropriate and feasible
3. Identify and implement appropriate management measures
4. Monitor populations
5. Conduct limited surveys and taxonomic assessments to find new populations.

The recovery plan identified the U.S. Forest Service (USFS), Bureau of Land Management (BLM), California Department of Fish and Game (CDFG), and USFWS as the agencies primarily involved in the recovery effort (USFWS 1997).

In 2003, the Carbonate Habitat Management Strategy (CHMS) was developed by the USFS and BLM in collaboration with a working group consisting of mining interests, private landowners, and conservation groups to address impacts to the five federally listed plants associated with carbonate habitats (Olsen 2003). The CHMS, which covers about 160,000 acres (called the Carbonate Habitat Management Area), has three main objectives:

1. Economic: regulatory certainty for mining activities, protection of the viability of mining, and streamlining and cost reduction of the permitting process
2. Conservation: maintenance and management of geomorphic and ecological processes of the landscape and placement of habitat blocks to maintain the carbonate plants, to avoid jeopardy (per Section 7 of the federal Endangered Species Act) and adverse modification or destruction of critical habitat, to contribute to recovery, and to avoid future listings
3. Regulatory: streamlining of permitting, California Environmental Quality Act (CEQA) review, and County of San Bernardino implementation of the California Surface Mining...
Plants

Cushenbury Oxytheca (*Acanthoscyphus parishii* var. *goodmaniana*)

Reclamation Act, as well as allowing BLM and USFS to comply with certain court-ordered stipulations stemming from lawsuits (i.e., *Center for Biological Diversity v. BLM* and *Southwest Center for Biological Diversity v. Sprague*).

The CHMS includes delineation of an initial habitat reserve, designation of conservation units within the Carbonate Habitat Management Area whereby loss and conservation of habitat values can be objectively measured, and contribution by federal agencies and mining interests to reserve assembly through various mechanisms (e.g., dedication of existing unclaimed federal land, purchase of private lands or lands with mining claims, land exchanges, or conservation banking) (Olsen 2003). Upon successful completion, the CHMS would meet or exceed recovery criteria 1 and 2 listed above (USFWS 2009).

Implementation of the CHMS has been incorporated by the USFS into the Land Management Plans for the Angeles and San Bernardino National Forests (USFS 2005) and by the BLM into the West Mojave Plan (BLM 2005).

Data Characterization

The general distribution of Cushenbury oxytheca is fairly well known based on its close association with carbonate substrates and increased survey efforts since its federal listing as endangered in 1994. However, its population status in terms of population trends is not well understood due to subjective mapping of occurrences and the natural fluctuation of populations sizes related to variable precipitation (USFWS 2009).

Management and Monitoring Considerations

In order to achieve species recovery, the USFWS (2009) has identified several management and monitoring strategies that need to be implemented for Cushenbury oxytheca. These strategies include the following:

1) Work with the San Bernardino National forest to conduct systematic monitoring of Cushenbury oxytheca throughout known and potentially occupied sites
Plants  
Cushenbury Oxytheca (*Acanthoscyphus parishii* var. *goodmaniana*)

2) Within occupied Cushenbury oxytheca habitat, continue monitoring programs for the effectiveness of measures to protect the species from recreation activities.

3) Avoid new developments in or near Cushenbury oxytheca habitat.

**Predicted Species Distribution in Plan Area**

Species model summary and results will be provided following model development.

**Literature Cited**


http://www.cnps.org/inventory.
Plants

Cushenbury Oxytheca (*Acanthoscyphus parishii* var. *goodmaniana*)


Plants  

Cushenbury Oxytheca (*Acanthoscyphus parishii* var. *goodmaniana*)


Cushenbury Milk-Vetch (Astragalus albens)

Legal Status

State: S1.1
CNPS: Rare Plant Rank 1B.1
Federal: Endangered
Critical Habitat: Designated on December 24, 2002 (67 FR 78570–78610)
Recovery Planning: San Bernardino Mountains Carbonate Plants Draft Recovery Plan (USFWS 1997)

Taxonomy

Cushenbury milk-vetch (Astragalus albens) was first collected by Parish and Parish in 1882 (Greene 1885). Cushenbury milk-vetch is in the pea family (Fabaceae) (Jepson Flora Project 2011). There have been no changes in taxonomic classification or nomenclature since its listing as endangered in 1994 (USFWS 2009). Genetic work on the species by Neel (2008) found that it has a high level of genetic variation for an endemic species and shows no signs of a historic genetic bottleneck.

Cushenbury milk-vetch is a prostrate annual or perennial plant with stems approximately 2 to 30 centimeters (0.8 to 12 inches) in length. A full physical description of the species can be found in MacKay (2003).

Distribution and Occurrences within the Plan Area

General

Cushenbury milk-vetch is endemic to the San Bernardino Mountains in San Bernardino County (USFWS 2009). The species occurs along the northeastern end of the San Bernardino Mountains, north and east of Big

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1 S1: Critically imperiled; X.1: Very threatened.
2 1B: Rare, threatened, or endangered in California and elsewhere; X.1: Seriously endangered in California.
Bear Lake from a ridgetop just east of Dry Canyon, southeast through Lone Valley, east of Baldwin Lake, and to upper Burns Canyon (Figure S-36; MacKay 2003). As of 2002, there were an estimated 103 mapped localities for the species (67 FR 78570–78610). With a few exceptions, it is closely associated with carbonate and carbonate-related soils (limestone and dolomite) and outcrops at elevations between 4,000 and 6,600 feet above mean sea level (amsl) (MacKay 2003).

Natural History

Habitat Requirements

Cushenbury milk-vetch is closely associated with carbonate and carbonate-related soils (limestone and dolomite) and outcrops at elevations between 4,000 and 6,600 feet amsl (MacKay 2003). General vegetation communities associated with the species are pinyon-juniper woodland, Joshua tree woodland, and Mojave desert scrub (see Table 1; CNPS 2011). Most occurrences are between 5,000 and 6,600 feet amsl for soils deriving from decomposed limestone (USFWS 2009). In some cases, the species has been found in carbonate alluvium that was deposited over granitic rocks or has fallen into other soils as a result of a debris slide (MacKay 2003).

Gonella and Neel (1995) compared habitat conditions of carbonate sites both occupied and unoccupied by Cushenbury milk-vetch. Carbonate sites occupied by Cushenbury milk-vetch, compared with unoccupied carbonate sites, typically had more open canopy, lower litter accumulation (2.3%), higher percentage calcium (21.3%), and lower slope angles (average of 12.1 degrees) (Gonella and Neel 1995). Generally, species constituents of plant communities on carbonate sites do not distinguish Cushenbury milk-vetch occupied and unoccupied sites, although plant constituents on carbonate sites are distinguishable from non-carbonate sites in terms of species richness and diversity (Gonella and Neel 1995). Cushenbury milk-vetch occupied plots did not support any indicator plant species, but did support four characteristic shrub species: blackbush (Coleogyne ramosissima), hedgehog cactus (Echinocereus mojavensis), desert almond (Prunus fasciculata), and Mojave yucca (Yucca schidigera) (Gonella and Neel 1995). Occupied sites also supported one characteristic bunchgrass (sand dropseed [Sporobolus cryptandrus])
and three characteristic herb species (Allium sp., Eriastrum sapphirinum ssp. sapphirinum, and Phacelia douglasii). Carbonate sites (both occupied and unoccupied) generally support three overstory plant species: Utah juniper (Juniperus osteosperma), singleleaf pinyon pine (Pinus monophylla), and Joshua tree (Yucca brevifolia). Shrub species characteristic of carbonate sites included Great Basin sagebrush (Artemisia tridentata), rabbitbrush (Chrysothamnus viscidiflorus), Mormon tea (Ephedra viridis), sticky snakeweed (Gutierrezia microcephala), beavertail cactus (Opuntia basilaris), and antelope bitterbrush (Parshia tridentata var. glandulosa). Three bunchgrass species were characteristic of carbonate sites: Fendler’s bluegrass (Poa fendleriana), Parish’s needlegrass (Achnatherum parishii), and desert needlegrass (Achnatherum speciosum). Six herb species were also characteristic of carbonate sites: beautiful rock-cress (Arabis pulchra), Shockley’s rock-cress (Arabis shockleyi), desert paintbrush (Castilleja angustifolia), tansy mustard (Descurainia pinnata), southwestern gilia (Gilia austro-occidentalis), and Fremont’s phacelia (Phacelia fremontii). MacKay (2003) reports that Cushenbury milk-vetch has also been observed with other dominant species, including bladdersage (Salazaria mexicana), bigberry manzanita (Arctostaphylos glauca), and flannel bush (Fremontodendron californicum).

Information about these habitat features provided the basis for identification of primary constituent elements for designated critical habitat (67 FR 78570–78610):

1. Soils derived primarily from the upper and middle members of the Bird Spring Formation and Undivided Cambrian parent materials that occur on dry flats and slopes or along rocky washes with limestone outwash/deposits at elevations between 3,864 and 6,604 feet amsl

2. Soils with intact, natural surfaces that have not been substantially altered by land use activities (e.g., graded, excavated, re-contoured, or otherwise altered by ground-disturbing equipment)
Plants

Cushenbury Milk-Vetch (*Astragalus albens*)

3. Associated plant communities that have areas with an open canopy cover and little accumulation of organic material (e.g., leaf litter) on the surface of the soil.

Notably, plant community constituents are not included in the primary constituent elements.

**Table 1. Habitat Associations for Cushenbury Milk-Vetch**

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinyon-juniper</td>
<td>Primary habitat</td>
<td>Carbonate soils (limestone,</td>
<td>Gonella and Neel 1995; MacKay 2003; USFWS 1997</td>
</tr>
<tr>
<td>woodland,</td>
<td></td>
<td>dolomite)</td>
<td></td>
</tr>
<tr>
<td>Joshua tree</td>
<td></td>
<td>4,000–6,600 feet,</td>
<td></td>
</tr>
<tr>
<td>woodland,</td>
<td></td>
<td>5%–30% slopes</td>
<td></td>
</tr>
<tr>
<td>Rabbitbrush,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackbush,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Basin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sagebrush,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mojavean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desert scrub</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Reproduction**

Cushenbury milk-vetch is a member of the pea family. Individual plants may be annual or perennial (MacKay 2003; Hickman 1996), but otherwise little is known of its natural history, including reproduction (MacKay 2003). Flowering occurs from late March to mid-June and pods ripen as early as May (MacKay 2003). It is probably pollinated by small bees given flower shape and color (MacKay 2003; USFWS 2009). It is unknown whether plants flower and fruit in their first year, how long they live, or what conditions cause them to be annuals or perennials (MacKay 2003). They reproduce by seed and seeds have been shown to have high viability (MacKay 2003). Seeds require scarification (cutting of the outer seed coat) to germinate and may remain dormant in the soil during drought years (MacKay 2003). The length of time seeds can remain viable, the characteristics of seed banks (e.g., size, kinds of seeds), and the type and extent of seed predation and/or dispersal are unknown (MacKay 2003). However, populations increase in response to rainy seasons after droughts,
indicating that seed banks persist and seeds remain viable for at least several years (MacKay 2003).

**Ecological Relationships**

Other than their association with carbonate soils and some other habitat features such as canopy, litter, and slope described in Habitat Requirements, little is known of the life history and ecological relationships of Cushenbury milk-vetch. Pollinators are probably small bees and seeds appear to have high viability and resistance to drought (MacKay 2003). Dispersal mechanisms are unknown. Of particular interest is the factor(s) related to whether individuals are annual or perennial. A factor potentially related to conservation and management of the species is its apparent ability to colonize slightly disturbed sites such as little used roads and long abandoned quarries, but it does not appear to tolerate high or continuing levels of disturbance (MacKay 2003).

**Population Status and Trends**

**Global:** Critically Imperiled (CNPS 2011)

**State:** Same as above

**Within Plan Area:** Same as above

The most recent data for population status and trends of Cushenbury milk-vetch is from the federal 5-year review for the species (USFWS 2009).

The estimated population of Cushenbury milk-vetch when it was listed in 1994 was 5,000 to 10,000 individuals in fewer than 20 locations (USFWS 2009). At the time the Recovery Plan was prepared in 1997, there were 33 known occurrences of Cushenbury milk-vetch (USFWS 1997). At the time critical habitat was designated in 2002, there were 239 site-specific occurrences of Cushenbury milk-vetch (67 FR 78570–78610). However, in the 5-year review in 2009, the U.S. Fish and Wildlife Service (USFWS) indicated that determining population trends was difficult because what constitutes site-specific occurrences has been subjectively defined and survey efforts have likely increased since its listing in 1992.
**Cushenbury Milk-Vetch (Astragalus albens)**

**Threats and Environmental Stressors**

The main threat to Cushenbury milk-vetch when it was federally listed in 1994 was mining (USFWS 2009). Other threats at the time included off-highway vehicle (OHV) use, a hydroelectric project, and a 115-kilovolt power line proposed for construction through Cushenbury Canyon (USFWS 2009). About 97% of occupied habitat was under threat as a result of being under claim for mining, in private ownership and subject to mining, or as a result of other disturbances (USFWS 2009). Mining continues to be the primary threat to the species, but other threats include energy development and OHV use, which can result in direct ground disturbance and dust generation (USFWS 2009). Further, dispersed target shooting, dispersed camping areas, and fuel wood collection can result in trampling of Cushenbury milk-vetch and impact its habitat through ground disturbance or dust creation (USFWS 2009). Dust can reduce plant viability by altering soil chemistry and light penetration into the seed banks (USFWS 2009). Fire suppression activities can result in ground disturbance through fire line construction, retardant and water drops, and establishment of fire camps (USFWS 2009). Artificial lighting is also cited as a potential threat due to potential impacts on the behavior of pollinators or seed dispersers, or by altering photoperiod responses (USFWS 2009).

The specific potential effects of climate change on Cushenbury milk-vetch are unknown, but if climate change caused a shift to higher elevations due to warmer and drier conditions, as has occurred with other plant species on the Santa Rosa Mountains of Southern California (Kelley and Goulden 2008), this endemic species could be concentrated in a smaller area and more vulnerable to extinction (USFWS 2009).

**Conservation and Management Activities**

The San Bernardino Mountains Carbonate Plants Draft Recovery Plan was prepared by the USFWS in 1997, which addressed Cushenbury milk-vetch and four other federally listed species: Parish's daisy (*Erigeron parishii*), Cushenbury buckwheat (*Eriogonum ovalifolium* var. *vineum*), San Bernardino Mountains bladderpod (*Lesquerella kingii* ssp. *bernardina*), and Cushenbury oxytheca (*Oxytheca parishii*)
Plants

Cushenbury Milk-Vetch (*Astragalus albens* var. *goodmaniana*) (USFWS 1997). The Recovery Plan for these species included the following recovery criteria:

1. Sufficient habitat protected in a reserve system for persistence of existing populations in their ecological context, including the largest populations and best and manageable habitat

2. Identification of potential buffer zones, although not necessarily secured, with an estimate of 4,600 acres needed for habitat connectivity, buffers, and a natural community context

3. Population monitoring and habitat management to provide for early detection of population instability in the reserve system

4. Expansion of existing populations or reintroductions to reduce the chance of extinction due to randomly occurring events.

Based on these recovery criteria, the Recovery Plan identified the following actions:

1. Protect significant extant populations in a reserve system on federally-owned land, which would include buffer zones and maintain selection habitat connections

2. Restore habitat and conduct reintroductions and/or population enhancements where appropriate and feasible

3. Identify and implement appropriate management measures

4. Monitor populations

5. Conduct limited surveys and taxonomic assessments to find new populations.

The Recovery Plan identified the U.S. Forestry Service (USFS), Bureau of Land Management) BLM, California Department of Fish and Game (CDFG), and USFWS as the agencies primarily involved in the recovery effort (USFWS 1997).

In 2003, the *Carbonate Habitat Management Strategy* (CHMS) was developed by the USFS and BLM in collaboration with a Working Group consisting of mining interests, private landowners, and conservation groups to address impacts to the five federally listed plants associated with carbonate habitats (Olsen 2003). The CHMS,
which covers about 160,000 acres (called the Carbonate Habitat Management Area, or CHMA), has three main objectives:

1. Economic: regulatory certainty for mining activities, protection of the viability of mining, and streamlining and cost reduction of the permitting process.

2. Conservation: maintenance and management of geomorphic and ecological processes of the landscape and placement of habitat blocks to maintain the carbonate plants, to avoid jeopardy (per federal Endangered Species Act (ESA) section 7) and adverse modification or destruction of critical habitat, to contribute to recovery, and to avoid future listings.

3. Regulatory: streamlining of permitting, California Environmental Quality Act (CEQA) review, streamlining of county implementation of the California Surface Mining Reclamation Act, and to allow BLM and USFS to comply with certain court-ordered stipulations stemming from lawsuits (i.e., Center for Biological Diversity vs. BLM; Southwest Center for Biological Diversity vs. Sprague).

The CHMS includes delineation of an Initial Habitat Reserve, designation of Conservation Units within the CHMA whereby loss and conservation of habitat values can be objectively measured, and contribution by federal agencies and mining interests to reserve assembly through various mechanisms (e.g., dedication of existing unclaimed federal land, purchase of private lands or lands with mining claims, land exchanges, conservation banking) (Olsen 2003).

Upon successful completion, the CHMS would meet or exceed recovery criteria 1 and 2 listed previously (USFWS 2009). Based on an evaluation in 2008 that some occurrences of Cushenbury milk-vetch in the CHMA may not be protected, that genetic diversity and some local adaptations could be affected (Neel 2008), and mining could occur on private lands that could affect the species, the USFWS (2009) concluded in its 5-year review that while the CHMS has the potential to reduce threats from mining, its effectiveness in doing so was not yet clear.

Implementation of the CHMS has been incorporated by the USFS into the Land Management Plans for the Angeles and San Bernardino...
Plants

Cushenbury Milk-Vetch (*Astragalus albens*)

National Forests (USFS 2005) and by the BLM into the West Mojave Plan (BLM 2005).

The USFWS 5-year review (USFWS 2009) also listed some other activities conducted by the USFS to reduce threats to Cushenbury milk-vetch such as OHV use and other activities by the public. The USFS has closed roads and erected barriers and signage to help limit OHV use. The USFS also has prohibited fuel wood collection and target shooting in carbonate plant habitat and has provided fire-fighting personnel with maps and guidance to reduce impacts to the extent practicable during fire suppression activities. The Land Management Plans for the Angeles and San Bernardino National Forests (USFS 2005) also address impacts to the carbonate plants, including land use zoning and standards such that new planned activities are neutral or beneficial to Cushenbury milk-vetch.

**Data Characterization**

The general distribution of Cushenbury milk-vetch is fairly well known based on its close association with carbonate substrates and increased survey efforts since its federal listing as endangered in 1994. However, its population status in terms of population trends is not well understood due to subjective mapping of occurrences between the different survey efforts (USFWS 2009). In addition, the lack of detailed information about the species’ life history (e.g., reproduction, seed bank characteristics, dispersal) (MacKay 2003) and its likely high responsiveness to wet/drought cycles make it difficult to assess population trends and to implement appropriate conservation and management measures.

**Management and Monitoring Considerations**

MacKay (2003) identified several research needs for informing management of Cushenbury milk-vetch. Foremost, there needs to be research on life history traits and habitat requirements. An understanding of reproductive traits (e.g., responses to environmental conditions, flowering and fruiting, longevity, seed viability) is necessary to monitor population trends and to identify triggers for management. An understanding of mycorrhizal associations and soil nutrients and textures is important for the purpose of managing, enhancing,
reintroducing populations (MacKay 2003). Understanding these factors will also allow for distinguishing population fluctuations and trends related to natural stochastic factors (e.g., rainfall) from anthropogenic factors. An understanding of these factors will also help inform establishment of buffers and habitat linkages needed to protect the integrity of disjunctive populations.

**Predicted Species Distribution in Plan Area**

Species model summary and results will be provided following model development.

**Literature Cited**


Plants

Cushenbury Milk-Vetch (Astragalus albens)


Lane Mountain Milk-Vetch

(Astragalus jaegerianus)

Legal Status

State: S1.1
CNPS: Rare Plant
Rank 1B.1
Federal: Endangered

Critical Habitat: Originally, zero acres were designated on April 8, 2005 (70 FR 18220–18241); proposed revision on April 1, 2010 (75 FR 16404–16421); final rule published May 19, 2011 (76 FR 29108–29129)

Recovery Planning: N/A

Notes: The federal 5-year review for the species recommended downlisting the species to threatened because most of its habitat has been placed under various conservation designations and because the number of populations and individuals was greater than what was known at the time of listing (USFWS 2008).

Taxonomy

Lane Mountain milk-vetch (Astragalus jaegerianus) was first named Astragalus jaegerianus by biologist Edmund Jaeger in 1941 (Charis 2002). There is no available information to suggest that taxonomy of Lane Mountain milk-vetch is uncertain or in question (e.g., Jepson Flora Project 2011). Recent DNA studies of Lane Mountain milk-vetch indicate that it is genetically depauperate compared with two other widespread Astragalus species (Walker and Metcalf 2008). However, range-wide, the species exhibits substantial population genetic diversity and significant population structure that are comparable to wide-ranging species. Within local populations, population density

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1 S1: Critically imperiled; X.1: Very threatened.
2 1B: Rare, threatened, or endangered in California and elsewhere; X.1: Seriously endangered in California.
Plants

Lane Mountain Milk-Vetch (Astragalus jaegerianus)

was significantly correlated with population size, and population structure was accounted for by the geographic distances and gene flow between different populations (Walker and Metcalf 2008).

Lane Mountain milk-vetch is perennial herb approximately 3 to 7 decimeters (11.8 to 27.6 inches) in size. A full physical description of the species can be found in Charis (2002).

**Distribution and Occurrences within the Plan Area**

All known locations of Lane Mountain milk-vetch are within the Desert Renewable Energy Conservation Plan (DRECP) Area and are composed of four discrete population locales north of Barstow, covering about 21,000 acres: NASA Goldstone, Brinkman Wash/Montana Mine, Paradise Valley, and Coolgardie Mesa (Charis 2002) (see Figure S-37). Populations at these four sites are separated from each other by at least 0.6 mile (Charis 2002). The extensive transect and sampling surveys by Charis (2002) in 2001 documented what is accepted as the current range and distribution of the species (USFWS 2008; 76 FR 29108–29129). Because the survey work by Charis (2002) is the most comprehensive to date and the only distribution information cited by the U.S. Fish and Wildlife Service (USFWS 2008) in their 5-year review of the species, the remainder of this description of the distribution and occurrences is taken from the Charis study. It should be noted that based on the level of genetic differentiation among populations, Walker and Metcalf (2008) recommended that the Coolgardie Mesa population be considered two distinct populations. However, for this species profile, the Coolgardie Mesa is treated as one of the four known populations.

**Historical**

Historically (prior to 1990), Lane Mountain milk-vetch was known from the Brinkman Wash, Coolgardie Mesa, and Paradise Valley areas; and as late as 1999, these were the only documented populations (Charis 2002).

**Recent**

The 2001 survey work by Charis (2002) confirmed the populations at the three previously known locations and found a new population—
NASA Goldstone—which extended the species’ range by about 1.4 miles north and 2.6 miles east (Figure S-37). The Coolgardie Mesa population comprises approximately 9,775 acres in the Mud Hills and Lane Mountain U.S. Geological Survey (USGS) quadrangles (see previous note about the genetic distinction within the Coolgardie Mesa population). The Paradise Valley population comprises approximately 4,794 acres in the Williams Well quadrangle. Both the Brinkman Wash and NASA Goldstone populations are in the Paradise Range quadrangle, with Brinkman Wash comprising approximately 5,497 acres and NASA Goldstone comprising about 1,283 acres (Charis 2002).

**Natural History**

**Habitat Requirements**

Lane Mountain milk-vetch occurs in Mojave creosote scrub and Mojave mixed woody scrub with widely scattered Joshua trees (*Yucca brevifolia*), and intergrades of the two communities that have relatively high shrub diversity (Charis 2002). The California Native Plant Society (CNPS 2011) also lists Joshua tree woodland as habitat occupied by the species, but the Charis (2002) study indicates that Joshua trees are widely scattered in occupied habitat. The species does not occur in areas dominated by creosote bush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*) (Charis 2002). Occupied habitat is characterized by gentle slopes and low ridges 6.5 to 8.8 feet high, with shallow and lighter granitoid soils (Charis 2002). The species’ distribution suggests that it may be responding to water supply (Charis 2002). It occurs at elevations of 3,100 to 4,200 feet above mean sea level (Charis 2002).

Lane Mountain milk-vetch typically occurs in patchy (i.e., clustered) distributions, but also occurs less commonly in distributions of a few scattered individuals over a broader area. It almost always is associated with a host*3* shrub, which the Lane Mountain milk-vetch uses as a trellis. Of 4,888 mature plants recorded by Charis (2002), less than 0.5% were found growing alone. The six most frequent host plants accounted for approximately 75% of the records, with turpentinebroom (*Thamnosma*

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*3 In this case, host indicates a shrub that physically supports the milk-vetch and is not intended to imply a parasitic relationship.*
Plants

Lane Mountain Milk-Vetch (Astragalus jaegerianus)

...montana) accounting for about 20% of the host records, and white bursage, Eastern Mojave buckwheat (Eriogonum fasciculatum ssp. poliolium), Cooper's goldenbush (Ericameria cooperi), Nevada jointfir (Ephedra nevadensis), and "dead shrub" accounting for about 10% each (Charis 2002). Host-specific selection was apparent because some relatively frequent shrubs had extremely low frequencies as hosts, including creosote bush, littleleaf rhatany (Krameria erecta), Johnson's indigobush (Psorothamnus arborescens var. minutifolius), desert peppergrass (Lepidium fremontii), and peach thorn (Lycium cooperi) (see the discussion in the Ecological Relationships section below regarding interspecific relationships).

Information about these habitat features documented by Charis (2002) is the main basis for identification of primary constituent elements for designated critical habitat for Lane Mountain milk-vetch (70 FR 18220–18241):

1. Shallow soils between 3,100 and 4,200 feet derived primarily from Jurassic or Cretaceous granitic bedrock, and less frequently on soils derived from diorite or gabbroid bedrock, or on granitic soils overlain by scattered rhyolitic cobble, gravel, and sand

2. Host shrubs, primarily turpentinebroom, white bursage, Eastern Mojave buckwheat, Cooper's goldenbush, Nevada jointfir, and Mexican bladdersage (Salazaria mexicana) that are usually found in mixed desert shrub communities.

Table 1. Habitat Associations for Lane Mountain Milk-Vetch

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojave mixed woody scrub,</td>
<td>Primary habitat</td>
<td>Jurassic or Cretaceous granitic bedrock</td>
<td>Charis (2002); 75 FR 16404–16421</td>
</tr>
<tr>
<td>Mojave creosote scrub</td>
<td></td>
<td>3,100 to 4,200 feet</td>
<td></td>
</tr>
</tbody>
</table>
Reproduction

Lane Mountain milk-vetch is a member of the pea family. It is a perennial herb that flowers in April and May (Charis 2002). Fruits ripen from the end of April to the end of May (Charis 2002). A pollination study by Charis (2003) observed four insect species visiting Lane Mountain milk-vetch flowers. A megachilid bee (also called “leafcutter bees” or “mason bees”), *Anthidium dammersi*, was the main visitor. Occasional visitors included the hover fly (*Eupeodes volucris*), a large anthophorid bee (*Anthophora* sp.), and the white-lined sphinx moth (*Hyles lineata*) (Charis 2003). Charis (2003) noted that pollen carried in the female megachilid bee’s scopae (a group of stiff hairs on the first tarsal segment of the first and second pair of legs, also called the “pollen brush”) consisted primarily of milk-vetch or common phacelia (*Phacelia distans*). Subsequent work on pollinators indicates the species most likely to be effective pollinators include the megachilid bees *Anthidium dammersi*, *A. emarginatum*, and *Osmia latisculata* (Hopkins 2005; USFWS 2008).

Greenhouse studies have shown higher rates of seed production in individuals that are self- and cross-pollinated compared with unpollinated individuals, so pollination appears to be important for reproduction by this species (Rundel et al. 2005, cited in USFWS 2008). Genetic studies indicate that Lane Mountain milk-vetch is a facultative outcrosser (i.e., cross-pollinator) that relies more on outcrossing within dense populations than within low-density populations (Walker and Metcalf 2008). Dispersal mechanisms in Lane Mountain milk-vetch are unknown, although Charis (2002) suggests that dispersal may be by gravity, but notes that seeds and pods of other *Astragalus* species are fed upon by various birds, rabbits, and rodents.

Lane Mountain milk-vetch exhibits a relatively low recruitment rate; less than 2% of the 4,888 individuals detected by Charis (2002) were seedlings. Field and greenhouse studies by Rundel et al. (2007) found that key factors for seedling growth and survival include the amount, frequency, and timing of precipitation. Generally, seed germination may be high under controlled greenhouse conditions, but much lower in the wild (Rundel et al. 2007). Germination and seedling growth and
survival in relation to environmental conditions are discussed in more detail in Ecological Relationships, as follows.

Ecological Relationships

Community structure and the availability of suitable host plants for Lane Mountain milk-vetch appear to be important ecological factors. Charis (2002) found that Lane Mountain milk-vetch occurs in Mojave creosote scrub and Mojave mixed woody scrub with widely scattered Joshua trees. It does not occur in creosote scrub habitat dominated by creosote and white bursage. More than 99% of mature individuals were found on host plants, and the association with host plants appears to be non-random, with turpentinebroom accounting for about 20% of the host records, and white bursage, Mojave Desert California buckwheat, Cooper's goldenbush, Nevada jointfir, and “dead shrub” accounting for about 10% each (Charis 2002). Some common shrubs such as creosote bush and white bursage are used less frequently as host plants in relation to their abundance.

The growth patterns and distribution of Lane Mountain milk-vetch also appear to be related to the availability of moisture. Individuals annually go dormant during the hot, dry summer season and respond with vegetative growth to winter rains, or possibly also in response to temperature and photoperiod (Charis 2002). In very dry years, the species may have little vegetative growth, flowering, or fruiting (Bagley 1989, cited in Charis 2002). The greater presence of Lane Mountain milk-vetch on shallow ridges where soils are thinner and bedrock much closer to the surface, as opposed to deeper alluvial soils, suggests that occupied sites have a better moisture supply (Charis 2002).

Precipitation amounts, timing, and frequency are key factors in seedling growth and survival of Lane Mountain milk-vetch. In the wild, wet years are critical for seedling growth and survival, but invasive species may also proliferate in wet years, and may compete with and promote herbivory of milk-vetch (Rundel et al. 2007). Even in a wet year (2004–2005), on a study plot, seedling survival to the following year was only 16% (8 of 49 individuals) (Rundel et al. 2007). Rundel et al. (2007) suggest that summer rains may be critical for seedling establishment and survival. More recent information indicates that drought over the
last decade has had severe adverse effects on Lane Mountain milk-vetch populations, because of low seedling survival and depleted seed banks. Huggins et al. (2010) report that the numbers of individuals on study plots monitored since 1999 are less than 13% of their previous size, although, as discussed in the Population Status and Trends section below, the number of individuals on study plots has steadily increased since 2007 (76 FR 29108–29129). Drought has affected the species indirectly by killing or degrading host shrub plants, which decreased in volume and cover by about 10% since the onset of drought conditions (Huggins et al. 2010).

As discussed in the Reproduction section above, pollination appears to be important to this species, with studies showing that self- and cross-pollinated individuals show higher rates of seed production (USFWS 2008). The mechanisms and/or importance of dispersal are unknown, but seeds and pods of other Astragalus species are fed upon by various birds, rabbits, and rodents (Charis 2002).

**Population Status and Trends**

**Global:** Critically Imperiled (NatureServe 2010)

**State:** Same as above

**Within Plan Area:** Same as above

The most recent data for population status and trends of Lane Mountain milk-vetch are from the federal 5-year review for the species (USFWS 2008), and some site-specific population trend data have been collected since 1999 by Huggins et al. (2010) and are updated in the May 2011 critical habitat final rule (76 FR 29108–29129). The rangewide population status information cited by USFWS (2008) in the 5-year review is based on the Charis (2002) surveys conducted in 2001, as summarized in Table 1 of the 5-year review. The number of documented plants in 2001 was 5,723 individuals over approximately 21,350 acres of occupied habitat among the four mapped populations. Charis (2002) also provided estimates for the population because transect survey coverage of potential was not 100% (see discussion in Data Characterization section below). The population estimate incorporated a “percentage observability” factor assumption, ranging from 10% to 100%, and an assumption of average plant density for unsurveyed areas based on transect count data. Charis (2002) estimated a population of
Plants

Lane Mountain Milk-Vetch (*Astragalus jaegerianus*)

approximately 14,120 individuals based on 100% observability to 141,200 individuals based on 10% observability; clearly, the population estimate is highly sensitive to the assumed observability.

Recent data indicate a declining population of Lane Mountain milk-vetch related to the prolonged drought from 1999 to 2009. As discussed in Ecological Relationships, there has been about an 88% reduction in population size, as measured by aboveground individuals, on plots continuously monitored since 1999, mainly as a result of degradation and mortality of host plants (Huggins et al. 2010). However, the most recent data reported in the May 2011 critical habitat final rule indicate that while the current number of individual plant is smaller than in 2005, the number of individual plants on the study plots has increased from four plants in 2007 to 154 plants in 2010 (76 FR 29108–29129). Further, the mortality rate of individuals has decreased over the last 2 years (76 FR 29108–29129).

The relationship between population and drought and wet cycles is still not well understood. Plants can be dormant for several years, resulting in observations of fewer plants, but then reappear in a year with more favorable conditions, so the “population” has not really declined.

USFWS (2008) reported that the U.S. Army has also been monitoring the four populations, but these data were not available for the 5-year review. However, because drought has had such a dramatic effect on this narrow endemic species on the monitored plots and it has fairly restricted habitat associations (i.e., it probably does not occur in heterogeneous microhabitats), it is reasonable to assume that other populations of Lane Mountain milk-vetch have suffered similar drought-related declines and that the current range-wide population is much smaller than documented in 2001 by Charis (2002).

**Threats and Environmental Stressors**

The main anthropogenic threats to Lane Mountain milk-vetch are surface mining, off-highway vehicle (OHV) recreation, and military training activities (USFWS 2008). The Coolgardie Mesa area has high mineral potential, with several small recreational mining operations that may have cumulative effects (USFWS 2008). Unauthorized OHV use increased in one portion of the Coolgardie Mesa site in the 2000s, creating a barren area of approximately 20 acres where the species...
Plants

Lane Mountain Milk-Vetch (*Astragalus jaegerianus*)

formerly occurred (USFWS 2008). In the critical habitat rule, the USFWS also acknowledged the potential effects of climate change on Lane Mountain milk-vetch, but there is no information specific to this species indicating what areas may become important in the future in response to climate change (76 FR 29108–29129).

The large majority of the four documented populations are located on federal lands managed by the Department of Defense (DOD) at Fort Irwin and the Bureau of Land Management (BLM). The Goldstone, Montana-Brinkman, and Paradise populations, which comprise 54% of the documented populations, are either entirely or mostly on Fort Irwin and the Coolgardie population, which is the largest single location at 9,757 acres (46%), is almost entirely on BLM land (USFWS 2008, Table 2). About 78% (16,690 acres) are under conservation or limited use management (USFWS 2008).

As of 2008, training activities were planned to commence in 2009 on about 20% of the known distribution of Lane Mountain milk-vetch (USFWS 2008). Military activities involving the use of wheeled and tracked vehicles have the potential to directly impact individual plants and degrade occupied habitat, particularly at the Brinkman Wash/Montana Mine and Paradise Valley population sites. Loss and degradation of habitat may increase habitat fragmentation and population isolation, thus potentially reducing population viability (USFWS 2008).

Dust generated by military training activities was hypothesized to have a potentially adverse impact on the growth and physiology of the species. Wijayratne et al. (2009) conducted field experiments simulating the amount of dust particulates Lane Mountain milk-vetch would be exposed to during military activities. They found that while average shoot growth declined with increased dust accumulation, net seasonal photosynthesis increased, possibly due to increased leaf temperatures (Wijayratne et al. 2009). Wijayratne et al. (2009) also found that the ambient dust deposition near experimentally dusted field plants was less than the experimental exposure, suggesting that the plants were not greatly affected by the ambient dust exposure levels.

The monitoring study by Huggins et al. (2010) discussed in the Ecological Relationships section indicated that Lane Mountain milk-
Plants

Lane Mountain Milk-Vetch (Astragalus jaegerianus)

Vetch is highly vulnerable to prolonged drought. Populations on study plots are less than 13% of their previous size prior to the drought (Huggins et al. 2010), although the number of individuals on the plots has been steadily increasing since 2007 (76 FR 29108–29129). Drought has indirectly affected the species through loss and degradation of host shrubs. Such drought conditions may continue under projected climate changes for the southwestern United States.

The USFWS (2008) also identifies two other threats to Lane Mountain milk-vetch: wildfires and non-native species. Wildfires may occur more frequently near the Coolgardie Mesa area due to higher levels of human activities. Fire can kill both individual milk-vetch plants and host plants and degrade habitat by facilitating the spread of non-native invasive annual grasses such as schimus (Schismus spp.) and bromes (Bromus spp.), which in turn, increase future fuel loads and exacerbate fire conditions (Brooks 1999). These non-native grasses may also outcompete Lane Mountain milk-vetch seedlings for resources, including water, space, light, and nutrients (USFWS 2008). The 5-Year Report includes personal communications from field researchers that brome grasses under the host shrub canopies were dense enough to overtake milk-vetch seedlings (R. Sharifi, pers. obs. 2006; B. Prigge, pers. obs. 2006; and C. Rutherford, pers. obs. 2006, cited in USFWS 2008).

Conservation and Management Activities

Conservation and management activities primarily have occurred on Fort Irwin where about 54% of Lane Mountain milk-vetch population acreage occurs in the Goldstone, Montana-Brinkman, and Paradise populations. The U.S. Army has established two conservation areas for the species in areas that will not be subject to training use, including 2,470 acres at the NASA Goldstone site and 4,302 acres at the Paradise Valley Conservation Area (USFWS 2008). Military activities take place in a third conservation area, the Brinkman Wash site, which encompasses about 2,000 acres and is called a “no dig” zone, where only “non-ground-disturbing activities” will be allowed (USFWS 2008). A few roads may be built and troops can traverse area on foot, but vehicles would be limited to the roads (USFWS, pers. comm. 2011).
The DOD and/or USFWS has also commissioned various monitoring and research studies for the species, including the surveys and pollination studies by Charis (2002, 2003), pollination studies by Hopkins (2005), population trends on study plots (e.g., Huggins et al. 2010), ecological studies of seedling production and survival in relation to precipitation (e.g., Rundel et al. 2007), and the genetic studies conducted by Walker and Metcalf (2008).

The BLM’s West Mojave Plan (BLM 2005) includes about 50% of the distribution of Lane Mountain milk-vetch in the southern portion of its range. The West Mojave Plan establishes two conservation areas for the species. The 13,354-acre Coolgardie Mesa Conservation Area and the 1,243-acre West Paradise Conservation Area have been designated Areas of Critical Environmental Concern (ACECs) and are being managed for the species through withdrawal from mineral development (subject to valid existing rights), minimization of vehicle routes of travel, and fencing, as deemed necessary. The BLM has initiated fencing and signage within the ACECs. Private lands that may be acquired would also be withdrawn from mineral development. There would be a 1% limitation on allowable disturbance in the Conservation Areas (BLM 2005). In addition, botanical surveys would be required for use permits and no permits will be issued to allow take of individuals (projects would have to be relocated), and grazing is prohibited in the Conservation Areas (BLM 2005). About half of the privately owned portion of the Coolgardie population has been acquired by DOD since 2005 (BLM 2005; USFWS 2008). The USFWS (2008) notes that even with the BLM’s withdrawal of the ACECs from further mineral development, the rights to existing mining claims remain valid until they are rendered invalid by the BLM. Therefore, Lane Mountain milk-vetch may still be threatened by mining activities at specific locations (USFWS 2008).

**Data Characterization**

The general geographic range and distribution of Lane Mountain milk-vetch probably are well known based on the extensive surveys conducted in 2001 by Charis (2002) (see also 76 FR 29108–29129). The purpose of the surveys was to identify new populations of Lane Mountain milk-vetch, to determine population boundaries, and to collect an adequate sample for estimating population numbers. The surveys included initial screening habitat assessments for potential population occurrences, followed by contiguous (i.e., large blocks of
adjacent smaller transects), parallel, or meandering transects (Charis 2002). The surveys also included enumeration and global positioning system (GPS) locations for documented individuals, including mature plants and seedlings. Because transect surveys did not cover 100% of the potential habitat for the species, population estimates were also made by factoring in the number of plants directly observed on a transect, a percentage observability factor (to account for false negatives, or plants not seen), the total population (area of occurrence), and the area surveyed in the transects.

Charis (2002) also reported on other surveys with negative results that were conducted in areas with at least some potential to support Lane Mountain milk-vetch, including surveys by USGS within the general area covered by Charis in 2001; surveys on the China Lake Naval Air Weapons Station; other surveys in the Charis 2001 study area, but on rocky and boulder-covered ridges; and surveys on a large sandy area just north and east of Superior Lake. These negative surveys near the documented populations provide strong evidence that the species is limited to the areas delineated in 2001 by Charis (2002).

**Management and Monitoring Considerations**

Management and monitoring considerations for Lane Mountain milk-vetch include adequately protecting the population viability on DOD lands from military activities that directly destroy and degrade habitat given that some habitat and plant losses are likely to occur. As described in the Conservation and Management Activities section, the DOD has addressed these issues by establishing three conservation areas. The DOD and/or USFWS have also sponsored field research on the ecology of the species to help gain an understanding of natural population fluctuations in relation to precipitation, genetics, host plant relationships, pollination, and dust. These studies will be invaluable for long-term management of the species.

Populations on BLM lands are addressed by the West Mojave Plan (BLM 2005). Protection and management of populations include the designation of the Coolgardie Mesa and West Paradise Conservation Areas and designations as ACECs. Recreational mining is still a concern since withdrawal of occupied areas from mining activities is subject to an invalidation process for existing mining claims even
though the BLM recommended withdrawing the ACECs from mineral entry in the West Mojave Plan (USFWS 2008). Fencing and limitations on vehicle routes in the ACECs will facilitate management of the conservation areas. The West Mojave Plan also requires botanical surveys for use permits and will not issue permits for take of individuals. In addition, grazing is prohibited in the Conservation Areas and ground disturbances are limited to 1% of these areas.

**Predicted Species Distribution in Plan Area**

Species model summary and results will be provided following model development.

**Literature Cited**


Plants

Lane Mountain Milk-Vetch (Astragalus jaegerianus)

National Training Center. Fort Irwin, California. Contract Number GS09K99BHD0007.


USFWS. 2011. Personal communication from R. Bransfield (USFWS) to Dudek on military uses in no dig zone on Fort Irwin, received as comment on species profile.


Coachella Valley Milk-Vetch
(*Astragalus lentiginosus* var. *coachellae*)

Legal Status

**State:** S2

**CNPS:** Rare Plant Rank 1B.2

**Federal:** Endangered

**Critical Habitat:** None

**Recovery Planning:** None

**Notes:** In the *5-Year Review: Summary and Evaluation for Astragalus lentiginosus var. coachellae (Coachella Valley milk-vetch)*, the U.S. Fish and Wildlife Service (USFWS) recommended no changes to the current classification due to the existing threats including habitat loss and degradation, such as the loss or degradation of sand sources and sand transport corridors, disturbance, and fragmentation (USFWS 2009). Additionally, in 2005 the USFWS designated zero acres of critical habitat for Coachella Valley milk-vetch (70 FR 74112–74136).

Taxonomy

Coachella Valley milk-vetch (*Astragalus lentiginosus* var. *coachellae*) was originally described by Rupert Charles Barneby in the *Vegetation and Flora of the Sonoran Desert* prepared by Forest Shreve and Ira Loren Wiggins in 1964 (IPNI 2005). There are 19 varieties of *A. lentiginosus* in California, none of which occur in the same region or habitat types (Jepson Flora Project 2011). Coachella Valley milk-vetch is in the legume family (Fabaceae) (Jepson Flora Project 2011). It is a winter annual or short-lived perennial that stand approximately 1 to 3 decimeters (3.9 to 11.8 inches) in height. A full physical description of the species can be found in the Jepson Flora Project (2011).

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1 S2: Imperiled.

2 1B: Rare, threatened, or endangered in California and elsewhere; X.2: Fairly endangered in California.

3 As a federally listed species, the Coachella Valley milk-vetch could have critical habitat and/or recovery planning status.
Distribution and Occurrences within the Plan Area

General

This species is considered to be endemic to the Coachella Valley from Cabazon to the Salton Sea in the western Sonoran Desert of Riverside County, California (NatureServe 2010; Jepson Flora Project 2011; 63 FR 53596–53615; USFWS 2009). Formerly there were thought to be six outlying occurrences in the Chuckwalla Valley approximately 50 miles east of Coachella Valley, near Desert Center (BLM 2007; 63 FR 53596–53615), but it has been determined that these outlying occurrences are *Astragalus lentiginosus* var. *variabilis* (Knaus 2008; Meinke et al. 2009). Currently, there are only known occurrences from the Coachella Valley between Cabazon and Indio (63 FR 53596–53615; USFWS 2009) (Figure S-47). The cited elevation range for this species varies by source. The Jepson Flora Project (2011) states the species’ elevation range extends from 0 to 650 meters (0 to 2,133 feet) and the California Native Plant Society (CNPS) Online Inventory (2011) states the species’ elevation range extends from 40 to 655 meters (131 to 2,149 feet).

Historical

There are no California Natural Diversity Database (CNDDB) occurrences for Coachella Valley milk-vetch in the Plan Area. There are six occurrences in the Chuckwalla Valley near Desert Center (BLM 2007; 63 FR 53596–53615; Dudek 2011). Three of these occurrences are historical and were last observed in 1949, 1958, and 1973. These three historical occurrences (i.e., the Desert Center occurrences) are considered extant. However, in the 5-Year Review: Summary and Evaluation for *Astragalus lentiginosus* var. *coachellae* (*Coachella Valley milk-vetch*), the USFWS (2009) stated that these outlying occurrences are most likely *Astragalus lentiginosus* var. *variabilis*.

Recent

As mentioned, there are six occurrences of Coachella Valley milk-vetch in the Chuckwalla Valley near Desert Center (BLM 2007; 63 FR 53596–53615; Dudek 2011). Three of these occurrences are considered recent and are from 1998 records (Dudek 2011). All three of these recent occurrences are considered extant. However, in the 5-
Plants 

Coachella Valley Milk-Vetch (Astragalus lentiginosus var. coachellae)

Year Review: Summary and Evaluation for Astragalus lentiginosus var. coachellae (Coachella Valley milk-vetch), the USFWS (2009) stated that these outlying occurrences (i.e., the Desert Center occurrences) are most likely Astragalus lentiginosus var. variabilis. The USFWS (2009) states that current populations of Coachella Valley milk-vetch are known only from the Coachella Valley between Cabazon and Indio.

Natural History

Habitat Requirements

Coachella Valley milk-vetch is strongly associated with active, stabilized, and shielded sandy substrates and is primarily found on loose eolian sand dunes or flats, or alluvial sands along disturbed margins of sandy washes (see Table 1). An important habitat type for this taxon is active sand dunes, which is supported by the fact that the highest densities of Coachella Valley milk-vetch have been found in locations containing large areas of eolian sand. The active sand dunes where Coachella Valley milk-vetch has been observed are typified by nearly barren expanses of shifting sand with few perennial shrub species. Coachella Valley milk-vetch also occurs in localized areas of eolian sand or along active washes and is intermittently found on alluvial soils on floodplain terraces of alluvial fans (USFWS 2009).

Vegetation communities in which this species are typically found include desert dunes and Sonoran desert scrub (CNPS 2011). According to the USFWS (2009), species found in association with Coachella Valley milk-vetch include creosote bush (Larrea tridentata), burrobush (Ambrosia dumosa), dyebush (Psorothamnus emoryi), fourwing saltbush (Atriplex canescens), desert sand verbena (Abronia villosa), desert twinbugs (Dicoria canescens), Indian ricegrass (Achnatherum hymenoides), California croton (Croton californicus), smallseed sandmat (Chamaesyce polycarpa), Thurber’s sandpaper plant (Petalonyx thurberi), annual desert milkvetch (Astragalus aridus), Salton milk-vetch (Astragalus crotalariae), and birdcage evening-primrose (Oenothera deltoides).
### Table 1. Habitat Associations for Coachella Valley Milk-Vetch

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desert dunes, Sonoran desert scrub</td>
<td>Primary habitat</td>
<td>Sandy substrates, 0–1,148 feet (CNPS 2011), 0–2,149 feet (Jepson Flora Project 2011)</td>
<td>CNPS (2011); Jepson Flora Project (2011); USFWS (2009)</td>
</tr>
</tbody>
</table>

Notes: While the vegetation communities that Coachella Valley milk-vetch is typically found on include desert dunes and Sonoran desert scrub (CNPS 2011), sandy substrate is the key factor, not vegetation type, that defines suitable habitat for the species (USFWS 2009). Therefore, substrate will be used as a habitat parameter for suitable habitat modeling.

### Reproduction

Coachella Valley milk-vetch is a winter annual or short-lived perennial (NatureServe 2010). In fall to early winter, Coachella Valley milk-vetch seeds germinate; and starting in December, seasonally dormant root crowns develop new shoots (USFWS 2009). This taxon’s blooming time has been generally characterized as February to May (CNPS 2011; Jepson Flora Project 2011). However, the first flower on perennial plants can appear as early as December (USFWS 2009).

Because of the inflated fruits, it is assumed that seeds are dispersed by wind and that wind dispersal enables gene flow and population growth between occurrences. Coachella Valley milk-vetch is genetically self-compatible but is only minimally self-pollinating (Meinke et al. 2009). According to Meinke et al. (2009), seed production in Coachella Valley milk-vetch is highly dependent on pollinators and in some cases the primary pollinator of Coachella Valley milk-vetch may be non-native honeybees. Native bees in the family Megachilidae are known to visit flowers of other varieties of *Astragalus lentiginosus* (Hurd 1979).

### Ecological Relationships

It has been observed that the life form of Coachella Valley milk-vetch is dependent upon rainfall. Where the rainfall is higher (i.e., the northwestern portion of the range) individuals are primarily short-lived...
perennials and may survive into their second year or longer, whereas individuals occurring where there is less rainfall (i.e., the southeastern portion of the range) are primarily annuals (USFWS 2009).

Because the sands that provide suitable habitat for Coachella Valley milk-vetch are fluctuating, suitable habitat may shift over time. Therefore, currently unoccupied areas may become occupied following fluvial and/or eolian activities and currently occupied habitat may become unsuitable habitat. Additionally, the sandy substrates that support Coachella Valley milk-vetch depend upon adequate sand sources, as well as an unobstructed eolian sand transport system and natural flood flows for fluvial sand deposition (USFWS 2009).

**Population Status and Trends**

**Global:** Imperiled (NatureServe 2010)
**State:** Same as above
**Within Plan Area:** Same as above

The 2011 CNDDB includes 49 extant occurrences for this Coachella Valley milk-vetch, although this estimate includes 13 occurrences that are historical (prior to 1990), the majority of which are located between Indio and Cabazon within 5 kilometers (3.1 miles) of Interstate 10 (CDFG 2011).

The historical abundance of Coachella Valley milk-vetch is unknown (63 FR 53596–53615). The number of individuals present fluctuates from year to year depending on the environmental conditions, making the assessment of population status challenging. In years with favorable environmental conditions, Coachella valley milk-vetch may occur in large numbers; however, most accounts report 20 plants or less per occurrence (USFWS 2009). According to the USFWS (63 FR 53596–53615), a 1995 monitoring study noted that densities varied from 1.25 plants per hectare (0.67 plant per acre) to 60 plants per hectare (24 plants per acre). At the Snow Creek Road occurrence, one of the largest known sites for the milk-vetch, densities were about 60 plants per hectare (24 plants per acre) (63 FR 53596–53615).
Threats and Environmental Stressors

The primary threat to Coachella Valley milk-vetch is urbanization in the Coachella Valley, which directly impacts individuals but also modifies or reduces the source and transport of blow sands that maintain the primary suitable habitat for the species (63 FR 53596–53615). Other threats that can result in the loss of individuals and/or the loss, fragmentation, or degradation of habitat include the development of wind energy parks; off-road vehicle use; road widening; flood control projects; groundwater pumping; trampling by humans; consumption of leaves, fruits, and seeds from predators or herbivores; unidentified fungal or viral diseases; and the introduction of non-native plant species including Asian mustard (*Brassica tournefortii*) and common Mediterranean grass (*Schismus barbatus*) (63 FR 53596–53615; BLM 2007; Nature Serve 2010; CNPS 2010; USFWS 2009). Because of the small population size, Coachella Valley milk-vetch is susceptible to extinction from stochastic events (NatureServe 2010).

Conservation and Management Activities

As of 1998, the Coachella Valley Preserve System, jointly owned and managed by the USFWS, Bureau of Land Management (BLM), California Department of Fish and Game (CDFG), the Nature Conservancy, and the California Department of Parks and Recreation, preserved approximately 20% to 25% of the Coachella Valley milk-vetch occurrences in the southeastern and central portion of its range (63 FR 53596–53615). In 2007, the Coachella Valley Association of Governments (CVAG) finalized the Coachella Valley Multiple Species Habitat Conservation Plan/Natural Community Conservation Plan (Coachella Valley MSHCP), which covered Coachella Valley milk-vetch (CVAG 2007). The Coachella Valley MSHCP Plan Area includes 48 of the 49 CNDDB occurrences for this taxon (CDFG 2011). Approximately 36,398 acres of potential habitat for Coachella Valley milk-vetch occurs in the Coachella Valley MSHCP Plan Area, and a total of 19,357 acres will be conserved as part of the Coachella Valley MSHCP Reserve System (CVAG 2007).

Private lands within the City of Desert Hot Springs are not subject to requirements of the Coachella Valley MSHCP or the requirements of the Section 10(a)(1)(B) permit (USFWS 2009). There are 7 current (post-
Coachella Valley Milk-Vetch (Astragalus lentiginosus var. coachellae)

1990) CNNDB records in the City of Desert Hot Springs (CDFG 2011). The USFWS (2009) describes the occurrences in the City of Desert Hot Springs as being densely occupied and providing two essential alluvial sand sources (i.e., Mission Creek and Morongo Wash).

CVAG (2007) has identified the following monitoring and management actions that may be needed to provide long-term protection for Coachella Valley milk-vetch:

1. Control and manage activities that degrade Coachella Valley milkvetch Habitat. In particular, control and manage those activities that result in sand compaction and vegetation destruction, which may include OHV travel within Core or Other Conserved Habitat except on designated routes of travel, if any; vegetation manipulation or clearing; and other human disturbance.

2. Control invasive species if it is determined from monitoring results that there are impacts to the milkvetch or milkvetch Habitat.

3. Maintain the aeolian sand transport system through the Monitoring and Management Programs.

4. Develop and test models through the Management and Monitoring Programs to address the distribution.

Data Characterization

The general distribution and population status of Coachella Valley milk-vetch is probably fairly well known based upon the data provided in the 5-Year Review: Summary and Evaluation for Astragalus lentiginosus var. coachellae (Coachella Valley milk-vetch) (USFWS 2009). As a result, the USFWS (2009) did not recommend that additional distribution or population status data be collected over the next 5 years. However, the recommended actions for the next 5 years did include gathering more information on the threat of non-native plants and the identity, ecology, and management needs for its native pollinators.
Management and Monitoring Considerations

The 5-Year Review: Summary and Evaluation for Astragalus lentiginosus var. coachellae (Coachella Valley milk-vetch) recommended the following action over the next 5 years: pursue habitat management, restoration, and enhancement opportunities; determine the level of threat posed by non-native plants and effective management options to reduce the threat; determine the identity of native pollinators, their ecology, and their management needs; implement a tracking system to record habitat losses or degradation and habitat gains from conservation; and develop a recovery plan for the species (USFWS 2009).

Annual monitoring efforts on existing conservation lands in the Coachella Valley MSHCP for Coachella Valley milk-vetch have been ongoing since 1986. The monitoring program developed for the Coachella Valley MSHCP includes baseline monitoring, and the data collected will be used to evaluate conceptual monitoring strategies followed by implementation of long-term species and natural communities monitoring. Thereafter, the monitoring program will be adaptive (CVAG 2007).

Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

Literature Cited


Coachella Valley Milk-Vetch (Astragalus lentiginosus var. coachellae)


http://www.cnps.org/inventory.


http://www.biodiversitylibrary.org/item/26295.


Plants  Coachella Valley Milk-Vetch (Astragalus lentiginosus var. coachellae)

http://ucjeps.berkeley.edu/interchange.html.

http://ir.library.oregonstate.edu/xmlui/handle/1957/9510.


Plants  
Sodaville Milk-Vetch (*Astragalus lentiginosus var. sesquimetralis*)

**Sodaville Milk-Vetch**  

described by Per Axel Rydberg as *Cystium sesquimetrale* (63 FR 53631–53635). Other botanists did not recognize the genus *Cystium*, however, and Rupert Charles Barneby reclassified the plant as *Astragalus lentiginosus var. sesquimetralis* in 1945 (63 FR 53631–53635; IPNI 2005). Sodaville milk-vetch is in the pea family (Fabaceae) (Jepson Flora Project 2011). It is a prostrate perennial herb with stems approximately 6-8 decimeters (24 to 32 inches) in length. A full physical description of the species can be found in the Jepson Flora Project (2011).

**Taxonomy**

Sodaville milk-vetch (*Astragalus lentiginosus var. sesquimetralis*) was described by Per Axel Rydberg as *Cystium sesquimetrale* (63 FR 53631–53635). Other botanists did not recognize the genus *Cystium*, however, and Rupert Charles Barneby reclassified the plant as *Astragalus lentiginosus var. sesquimetralis* in 1945 (63 FR 53631–53635; IPNI 2005). Sodaville milk-vetch is in the pea family (Fabaceae) (Jepson Flora Project 2011). It is a prostrate perennial herb with stems approximately 6-8 decimeters (24 to 32 inches) in length. A full physical description of the species can be found in the Jepson Flora Project (2011).

**Distribution and Occurrences within the Plan Area**

**General**

Sodaville milk-vetch occurs from three locations that are arranged along the north–south corridor of the western Great Basin, referred to as the Lahontan Trough (63 FR 53631–53635). There is only one

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1 *S1*: Critically imperiled; *X.1*: Very threatened (CNPS 2011).
2 *1B*: Rare, threatened, or endangered in California and elsewhere; *X.1*: Seriously threatened in California.
Plants  Sodaville Milk-Vetch (Astragalus lentiginosus var. sesquimetralis)

occurrence of Sodaville milk-vetch in the California Natural Diversity Database (CNDDB) (CDFG 2011), which also occurs in the Plan Area (CDFG 2011). There are also two occurrences of Sodaville milk-vetch in Nevada where it is on the State of Nevada’s list of critically endangered species and may not be removed or destroyed unless authorized by a permit issued by the state forester fire warden (CDFG 2005). The single record in California occurs at the north end of Death Valley National Park at Big Sand Spring at 950 meters (3,117 feet) (CDFG 2011).

**Historical**

Although originally documented as early as 1985, the single CNDDB record was last observed in April 2007 and therefore remains current (Figure S-38; CDFG 2011).

**Recent**

The only CNDDB occurrence occurs within the Plan Area (CDFG 2011) and was last observed April 2007, noted above. This occurrence is located at the north end of Death Valley National Park at Big Sand Spring (Figure S-38). Therefore, this occurrence is within public land owned by the National Park Service (CDFG 2011).

**Natural History**

**Habitat Requirements**

Sodaville milk-vetch grows in meadows and seeps and moist, open hummocks, flats, and drainages near cool springs (see Table 1; CNPS 2011; Jepson Flora Interchange 2011; CDFG 2005). This species occurs on powdery clay alkaline soils (CDFG 2011; 63 FR 53631–53635). It occurs in open areas or under shrubs. Associated species include rubber rabbitbrush (Ericameria nauseosa), shadscale saltbush (Atriplex confertifolia), saltgrass (Distichlis spicata), Death Valley blue-eyed grass (Sisyrinchium funereum), alkali sacaton (Sporobolus airoides), and greasewood (Sarcobatus sp.) (CDFG 2005; CDFG 2011).
Plants

Sodaville Milk-Vetch (Astragalus lentiginosus var. sesquimetalis)

Table 1. Habitat Associations for Sodaville Milk-Vetch

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadows and Seeps</td>
<td>Primary habitat</td>
<td>Powdery saline/alkaline clay soils, near cool springs, 950–975 meters (3,117–3,199 feet)</td>
<td>CNPS 2011; CDFG 2011; CDFG 2005; 63 FR 53631–53635</td>
</tr>
</tbody>
</table>

Reproduction

Sodaville milk-vetch is a prostrate perennial (63 FR 53631–53635) that can bloom between April and July, but typically blooms between May and June (CNPS 2011; Jepson Flora Interchange 2011). Fruits of Sodaville milk-vetch seed pods are moderately inflated, elongated, and have an upwardly curved beak (63 FR 53631–53635; CNPS 2005). There is little information regarding the reproductive biology of Sodaville milk-vetch, including establishment and dispersal mechanisms.

Ecological Relationships

Population abundance and distribution likely varies with rainfall and other environmental factors. Also, as discussed in the Threats and Environmental Stressors section, it is likely that Sodaville milk-vetch is vulnerable to extinction from stochastic events, such as prolonged drought or disease, because its distribution and abundance are very limited. Like most Astragalus species, Sodaville milk-vetch contains compounds that may cause toxic and/or narcotic reactions when consumed by animals (63 FR 53631–53635).

Population Status and Trends

**Global:** Critically Imperiled (CNPS 2011)

**State:** Same as above

**Within Plan Area:** Same as above

Reduced to several hundred individuals in the early 1980s, the population at Big Sand Spring generally has increased after an enclosure was constructed to eliminate grazing in 1985 (NatureServe 2010). Approximately 180 plants were observed in 1985; 345 in 1987; over 100 in 1988; 10 in 1995; 1,526 in 1997; 3,003 in 1998; 794 in...
Plants

Sodaville Milk-Vetch (*Astragalus lentiginosus var. sesquimetralis*)

2003; and 222 in 2007 (CDFG 2011). Therefore, the census data indicates the population has made a substantial comeback, from only 10 individuals in 1995 to approximately 1,500 individuals in 1997, and over 3,000 in 1998 (CDFG 2005), but has declined in more recent years, possibly in response to drought conditions.

**Threats and Environmental Stressors**

The California occurrence of Sodaville milk-vetch is susceptible to trampling by feral burros and livestock if the fence is not functioning properly and the animals are able to access the protected site. However, the U.S. Fish and Wildlife Service (USFWS) has determined that due to the current management conducted by the National Park Service to eliminate or mitigate the threat of trampling, such as monitoring and patrolling the area, impacts from livestock and feral burrows are no longer a threat to the taxon (63 FR 53631–53635). Other identified threats to Sodaville milk-vetch include surface developments, water diversions, and vehicular traffic (63 FR 53631–53635; CNPS 2011).

Because the distribution and abundance of Sodaville milk-vetch is very limited, this milk-vetch is vulnerable to extinction from stochastic events, such as prolonged drought or disease; as noted above the population peaked 1998, but more recent censuses have observe fewer individuals.

**Conservation and Management Activities**

Prior to 1994, Big Sand Spring within Death Valley National Park was owned and managed by the Bureau of Land Management (BLM) as a Critical Environmental Concern and a Wild Horse and Burro Herd Management Area (CDFG 2005; 63 FR 53631–53635). Currently, the site is managed by the National Park Service to mitigate or avoid the threat of trampling by feral burros and livestock through management activities that include installing new fencing, monitoring the site, and increasing the patrolling activities (63 FR 53631–53635). Specifically, in 1997, an electric fence was installed to exclude cattle and burros, and in 1996 cattle grazing was not permitted. The grazing lease was terminated in 2002. Feral cattle and burros were removed from the area in 2001 and 2002 (CDFG 2005).
Data Characterization

In general, data availability for Sodaville milk-vetch is poor. Range-wide population trend data are not available and population status as of 1998 was unknown (63 FR 53631–53635), although the Big Sand Spring population increased in the 1990s, followed by a decrease in the 2000s. Little is known regarding the variety’s reproduction, seed germination and dispersal, recruitment, establishment, and pollination. No studies have examined seed viability, longevity in the soil, and predation.

Management and Monitoring Considerations

As mentioned, the only California occurrence of a Sodaville milk-vetch site is managed by the National Park Service to mitigate or avoid the threat of trampling by feral burros and livestock, including installing new electric fencing, monitoring the site, increasing the patrolling activities, and eliminating grazing altogether (63 FR 53631–53635).

Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

Literature Cited

63 FR 53631–53635. Proposed rule; withdrawal: “Endangered and Threatened Wildlife and Plants; Withdrawal of Proposed Rule to List the Plants Astragalus lentiginosus var. micans (shining milkvetch) and Astragalus lentiginosus var. sesquimetalis (Sodaville milk-vetch) as Threatened.” October 6, 1998.


Plants  
Sodaville Milk-Vetch (*Astragalus lentiginosus* var. *sesquimetralis*)


Peirson's Milk-Vetch (Astragalus magdalenae var. peirsonii)

**Legal Status**

- **State:** Endangered; S2.2
- **CNPS:** Rare Plant Rank 1B.2
- **Federal:** Threatened
- **Critical Habitat:** Originally designated on August 4, 2004 (69 FR 47330–47351); revised February 14, 2008 (73 FR 8748–8785).
- **Recovery Planning:** None
- **Notes:** A 5-year review of Peirson’s milk-vetch was completed by the U.S. Fish and Wildlife Service (USFWS) in 2008, and no status change was recommended because the plant continues to be at risk (74 FR 12878–12883; 73 FR 41007–41022; USFWS 2008).

**Taxonomy**

Peirson’s milk-vetch (Astragalus magdalenae var. peirsonii) was originally described by Philip Alexander Munz and Jean McBurney in 1932 under the synonym Astragalus peirsonii before its affiliation with Astragalus magdalenae was clarified by Rupert Charles Barneby in 1958 (IPNI 2005). There is only one variety of A. magdalenae in California (Jepson Flora Project 2011). There are two other recognized varieties that occur in Mexico (73 FR 41007–41022). Peirson’s milk-vetch is in the legume family (Fabaceae) (Jepson Flora Project 2011). It is an herbaceous, short-lived perennial with ascending or erect stems approximately 2 to 9 decimeters (11 to 35 inches) in height. A full physical description of the species can be found in the Jepson Flora Project (2011).

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1 S2: Imperiled; X.2: Threatened.
2 1B: Rare, threatened, or endangered in California and elsewhere; X.2: Fairly endangered in California.
Distribution and Occurrences within the Plan Area

General

In the United States, Peirson's milk-vetch is restricted to a narrow 40-mile belt, extending northwest to southeast along the western portion of the Algodones Dunes, also referred to as the Imperial Sand Dunes, of eastern Imperial County, California, in the Sonoran Desert (NatureServe 2010; 73 FR 41007–41022). Additionally, Peirson's milk-vetch was noted in Borrego Valley, California, but no verified reproducing population exists (73 FR 41007–41022) (Figure S-39). The Bureau of Land Management (BLM) (2010) describes the distribution along the dunes as scattered with the higher abundance occurring on the central and western aspect of the dune. It has also been noted that the distribution and abundance of Peirson's milk-vetch is tied to precipitation (i.e., more abundant with higher rainfall and less abundant with less rainfall) (73 FR 41007–41022).

The cited elevation range for this species varies by source. The Jepson Flora Project (2011) states the species' elevation range extends from 50 to 250 meters (164 to 820 feet), and the California Native Plant Society (CNPS) online inventory states the species' elevation range extends from -55 to 250 meters (-180 to 2,149 feet)(CNPS 2011).

Historical

The historical range of Peirson's milk-vetch is likely the same as its current range. The Borrego Valley occurrence has not been observed for several decades, and a portion of the dune habitat in Borrego Valley is currently used as a county landfill (63 FR 53596–53615). There are three California Natural Diversity Database (CNDDB) occurrences for Peirson's milk-vetch in the Plan Area, all of which are presumed extant (CDFG 2011a, 2011b). Of these three CNDDB occurrences, one is considered historical (Occurrence No. 40). This historical occurrence, located in the Borrego Valley, was reported by Barneby in 1964. A 1978 survey by Sproul at this occurrence was negative (CDFG 2011a, 2011b).
As mentioned previously, there are two recent CNDDB occurrences of Peirson's milk-vetch presumed extant. The 2005 occurrence is from Borrego Valley, and the 2009 occurrence is from the Algodones Dunes (CDFG 2011a, 2011b). As mentioned, the Borrego Valley occurrence has not been observed for several decades, and a portion of the dune habitat in Borrego Valley is currently used as a county landfill (63 FR 53596–53615).

**Natural History**

**Habitat Requirements**

Peirson's milk-vetch occurs on intact, active sand dunes with slopes less than 30 degrees, but it is more often found on slopes less than 20 degrees (see Table 1; 69 FR 47330–47351; 73 FR 8748–8785). Peirson's milk-vetch occurs in vegetation communities described as psammophytic scrub and is often found in association with psammophytes. The white-faced digger bee (*Habropoda pallida*), the species' primary pollinator, is also associated with psammophytic scrub (69 FR 47330–47351; 73 FR 8748–8785; 73 FR 41007–41022).

**Table 1. Habitat Associations for Peirson's Milk-Vetch**

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Description</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact, active sand dunes</td>
<td>Primary habitat</td>
<td>Occurs on psammophytic scrub in association with psammophytic species, 180–2,149 feet (CNPS 2011), 164–820 feet (Jepson Flora Project 2011)</td>
<td>CNPS 2011; Jepson Flora Project 2011; USFWS 2008</td>
</tr>
</tbody>
</table>

**Reproduction**

The Jepson Flora Project (2011) describes Peirson's milk-vetch as an annual or perennial herb. However, the USFWS, based on reports conducted by BLM (2001) and Philips and Kennedy (2004), describes this species as an herbaceous, short-lived perennial. This taxon's
blooming time has been generally characterized as occurring from December to April (CNPS 2011; Jepson Flora Project 2011).

Preliminary experiments and studies indicate that Peirson’s milk-vetch is not capable of self-pollination and thus requires pollinators for outcrossing. The white-faced digger bee has been identified as the only effective pollinator of Peirson’s milk-vetch (73 FR 41007–41022).

This species is able to reproduce in a single season and usually completes seed production by June (BLM 2010). Peirson's milk-vetch seeds are either dispersed locally by dropping from partially opened fruits remaining on the parent plant, or they are dispersed farther distances by fruits, which are inflated, dropping from the parent plant and then blowing across its habitat (73 FR 41007–41022; Thomas Olsen Associates 2001).

Adequate rain in combination with cool temperatures and wetter-than-average fall weather seem to cause germinating events. It is likely that this species depends on seed production in wetter years and the seed bank from previous years to survive until proper conditions for germination occur again (73 FR 8748–8785; 73 FR 41007–41022; Thomas Olsen Associates 2001).

**Ecological Relationships**

Peirson’s milk-vetch is considered a narrow endemic because it is an obligate psammophyte (BLM 2010) and, in the United States, is assumed to occur only in the Algodones Dunes (73 FR 8748–8785).

It is thought that Peirson’s milk-vetch is not capable of self-pollination and requires pollinators for outcrossing; specifically, the white-faced digger bee is considered its only effective pollinator. Because this species exhibits traits consistent with sporophytic self-incompatibility (73 FR 41007–41022; NatureServe 2010), large populations of Peirson's milk-vetch with high self-incompatibility (SI) allele diversity are probably required to reproduce. Although additional studies are required, the large SI allele diversity may be essential across the species range and temporally through episodes of drought (73 FR 41007–41022).
Peirson's milk-vetch probably depends on the seed production in the wetter years and the continuation of the seed bank from the preceding year to survive until appropriate conditions for germination occur (73 FR 8748–8785; 73 FR 41007–41022). This species likely relies on “rescue” events from the seed bank, where a substantial amount of plants germinate when the conditions are favorable (73 FR 41007–41022). Peirson's milk-vetch population size and density, climate, distribution, and area occupied are highly variable (73 FR 41007–41022; NatureServe 2010). In years when the production rate is low, the species is vulnerable to stochastic events, such as prolonged drought (73 FR 41007–41022).

Population Status and Trends

Global: Imperiled (CNPS 2011)
State: Same as above
Within Plan Area: Same as above

The 12-month finding on the petition to Peirson’s milk-vetch cites four primary studies related to the abundance of Peirson’s milk-vetch, including a 1977 survey conducted by WESTEC, surveys conducted in 1998–2002 by BLM, surveys conducted in 2001–2006 by Phillips, and surveys conducted in 2004–2007 by BLM (73 FR 41007–41022). However, the differences among the survey methods and data collected make it difficult to assess the population using these datasets (73 FR 41007–41022). The USFWS considers that the data gathered in 2005 provide the best estimate of the potential Peirson's milk-vetch population and extent of habitat for the species due to the large amount of data collected, and the exceptionally good rainfall year and cool temperatures from October 2004 through March 2005). In 2005, it was estimated that 1,831,076 Peirson’s milk-vetch plants were present in the Algodones Dunes with an estimated density of 35 plants per acre (BLM 2010; 73 FR 41007–41022).

Peirson's milk-vetch, when compared to other dune species, has a lower density. The species’ population size and density, climate, distribution, and area occupied are highly variable. The USFWS asserts that for a species whose numbers fluctuate so widely annually, an assessment of abundance may not be an appropriate measure of the likelihood of persistence and that assessment of its population
trend, resilience, and long-term viability is more pertinent in assessing likelihood of persistence (73 FR 41007–41022).

**Threats and Environmental Stressors**

Off-highway vehicle (OHV) activity and the development associated with OHV activity are the primary threats to Peirson’s milk-vetch (73 FR 41007–41022; USFWS 2008). The USFWS has also identified the following as secondary threats to Peirson's milk-vetch: “rodent and insect herbivory, seed predation, and effects of fragmentation and environmental stochasticity/catastrophes, all of which may be exacerbated by the low reproduction of A. magdalenae var. peirsonii (73 FR 41007–41022; USFWS 2008).” In addition to the threat of OHVs, CNPS (2011) identifies grazing and trampling, foot traffic, non-native plants, development, and hydrological alterations as threats as well.

**Conservation and Management Activities**

Based on the 2005 population estimates, less than 9% of Peirson’s milk-vetch in the United States occurs within the North Algodones Dunes Wilderness, which remains closed to OHV use due to its designation as a Wilderness Area. BLM was required to temporarily close five areas in the Imperial Sand Dunes Recreation Area, totaling 49,300 acres, to OHV use through a court order (73 FR 41007–41022; USFWS 2008). As of May 2009, these vehicle closures have been in place (BLM 2009). Absent this court order, all areas in the Algodones Dunes with Peirson’s milk-vetch, except the North Algodones Dunes Wilderness, would be available for OHV use (73 FR 41007–41022; USFWS 2008). The BLM has prepared an Imperial Sand Dunes Draft Recreation Area Management Plan that, when approved, will be implemented for the protection and management of Algodones Dunes species, including Peirson’s milk-vetch (BLM 2010).

**Data Characterization**

The general distribution of Peirson's milk-vetch probably is fairly well known based upon the data provided in the Endangered and Threatened Wildlife and Plants; 12-Month Finding on the Petition to Delist Astragalus magdalenae var. peirsonii (Peirson’s milk-vetch) (73 FR 41007–41022). There are multiple years of studies on the
Plants

Peirson's Milk-Vetch (Astragalus magdalenae var. peirsonii)

abundance of this species, but as previously noted, population size varies widely annually, and an assessment of abundance may not be an appropriate measure of the likelihood of persistence (73 FR 8748–8785). The USFWS-recommended actions for the next 5 years include collecting monitoring data to assess impacts from OHVs and the effects on the species from changes in the seasonal rainfall (USFWS 2008). This 5-year review also recommended that the following should be investigated: fruit and seed predation, dispersal, pollinator identification and interactions, self-incompatibility, seedling establishment, and phylogenetic relationship between United States and Mexico occurrences (USFWS 2008). Additionally, other research needs for the Peirson’s milk-vetch identified by the USFWS include gaining more information about the following: the dynamics of the species’ breeding system; the species response to disturbances; information to determine the viability and productivity of its seed bank, including seed mortality and aging rates, seed loss to predators, and germination variability; population trends, resilience, and long-term viability; and the effects of cyclic reduction and reestablishment of the seed bank (73 FR 41007–41022).

Management and Monitoring Considerations

The 5-Year Review: Short Form Summary for Astragalus magdalenae var. peirsonii (Peirson’s milk-vetch) (USFWS 2008) recommended the following action over the next 5 years: assess and prioritize areas for OHV restrictions and designate travel corridors between campgrounds and other access points to frequently used recreation areas to reduce impacts associated with travel corridors (USFWS 2008).

Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

Literature Cited

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Peirson's Milk-Vetch (Astragalus magdalenae var. peirsonii)


CDFG (California Department of Fish and Game). 2011a. California Natural Diversity Database (CNDDB). GIS Data for the Plan
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Peirson’s Milk-Vetch (Astragalus magdalenae var. peirsonii)

Area. Sacramento, California: California Department of Fish and Game. May 2011.


Thomas Olsen Associates Inc. 2001. Biology, Distribution, and Abundance of Peirson’s Milkvetch and Other Special Status

Triple-Ribbed Milk-Vetch (Astragalus tricarinatus)

Legal Status

State: S1.2
CNPS: Rare Plant Rank 1B.2
Federal: Endangered
Critical Habitat: N/A
Recovery Planning: N/A
Notes: The federal 5-year review of the species recommended no change needed for the endangered status of the species (USFWS 2009).

Taxonomy

Triple-ribbed milk-vetch (Astragalus tricarinatus) was first described by American botanist Asa Gray in 1876, based on a collection from Whitewater Canyon (63 FR 53596–53615). Although it was transferred to another genus—Hamosa—in 1927, this species is currently accepted as Astragalus tricarinatus (63 FR 53596–53615; Spellenberg 1993, p. 604). There is no available information to suggest that the taxonomy of triple-ribbed milk-vetch is uncertain or in question (Jepson Flora Project 2011).

Triple-ribbed milk-vetch is short-lived, perennial herb with stems approximately 5 to 25 centimeters (2 to 10 inches) in length. A full physical description of the species can be found in Spellenberg (1993).

Distribution and Occurrences within the Plan Area

General

The general range of triple-ribbed milk-vetch includes the eastern San Bernardino Mountains/Whitewater Canyon area, Morongo Canyon, and the western part of the Little San Bernardino Mountains, with disjunctive occurrences in the Orocopia and Santa Rosa mountain ranges.

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1 S1: Critically imperiled; X.2: Threatened.
2 1B: Rare, threatened, or endangered in California and elsewhere; X.2: Fairly endangered in California.
ranges, although the Orocopia occurrence is unvouchedered (USFWS 2009; Figure S-40). Throughout the species’ range, there are approximately 20 occurrences, of which, about 18 are still considered extant (CNPS 2011). Within the Plan Area, triple-ribbed milk-vetch occurs in the Morongo Canyon area and in the Little San Bernardino Mountains at Coyote Hole Spring, Long Canyon, and possibly at Key’s Ranch (this latter occurrence is unvouchedered, and a follow-up survey failed to detect the species [USFWS 2009]).

**Historical**

Historically (prior to 1990), triple-ribbed milk-vetch was known from Whitewater and Morongo canyons in Riverside and San Bernardino counties and southeast to the Orocopia Mountains in Riverside County (63 FR 53596–53615). The California Natural Diversity Database (CNDDB) includes one historical occurrence in the Plan Area in Big Morongo Canyon (CDFG 2011). Two individuals of triple-ribbed milk-vetch were observed in 1983, but the species was not detected in several later surveys up to 2005, and this small population has possibly been extirpated as a result of road grading (CDFG 2011). A 1926 collection representing a small population is also noted from Coyote Hole Spring along the northern edge of the Little San Bernardino Mountains and south of the town of Joshua Tree (USFWS 2009), but no recent information is available for this site, and the occurrence is not in the CNDDB (CDFG 2011). The Key’s Ranch site in Joshua Tree National Park is also from 1926 but is unvouchedered, and it was not detected in a 1999 survey (USFWS 2009).

**Recent**

This description of recent occurrences is primarily taken from the 2009 5-year review of triple-ribbed milk-vetch (USFWS 2009) because it includes all of the CNDDB occurrences in the Plan Area as well as some occurrences that are not in the CNDDB. As shown in Figure S-40, there are about nine recent occurrence locations for triple-ribbed milk-vetch in the Plan Area: Wathier Landing, Catclaw Flat, upper Mission Creek, Dry Morongo Creek, Big Morongo Canyon (two occurrence locations), Long Canyon, and Key’s Ranch (note that this site is unvouchedered). The characterization of the species distribution is complicated by the fact that the observed populations appear to represent different types of
populations, including source populations, waifs, and deme populations (USFWS 2009). Source populations are larger, permanent populations (i.e., up to several hundred individuals) typically located in the upper watershed areas. Waifs are scattered individuals in washes downstream of source populations that are not permanent populations. Deme populations are discrete or isolated groups of waifs that may exhibit intra-population breeding but do not persist. Habitats associated with these population types are discussed in more detail in Habitat Requirements.

There are two recognized source populations in the Plan Area: Wathier Landing and Catclaw Flat. The Wathier Landing population, which is in the Mission Creek drainage just east of Wathier Landing, supported at least 300 aboveground individuals in 2004 (White 2004) and more than 300 adult individuals in 2005 and many seedlings (Amsberry and Meinke 2007). The Catclaw Flat occurrence was first discovered in 2005 about 2.5 miles from the Wathier Landing site and consisted of about 100 individuals, including seedlings (Amsberry and Meinke 2007). Both sites are conserved in the privately owned Wildlands Conservancy lands.

The other occurrences in the Plan Area are considered waifs (i.e., an isolated plant) and deme (i.e., a group of isolated plants) populations that are not self-sustaining (USFWS 2009). Besides the Wathier Landing and Catclaw Flat source populations, the largest documented population was in Big Morongo Canyon; this population numbered less than 50 individuals in 1993, but a survey of the site in 2005 failed to detect the species (CDFG 2011). One large reproductive individual (but no seedlings) was found in 2005 on a slide of exposed, decomposed granite on the canyon wall in Big Morongo Canyon (Amsberry and Meinke 2007); this site is within the Bureau of Land Management (BLM) Big Morongo Canyon Reserve (CDFG 2011). Two waif individuals were detected in Long Canyon in Joshua Tree National Park in 2006 (CDFG 2011).

It should be noted that botanists suspect that more populations of triple-ridged milk-vetch exist on upland slopes in suitable habitat (e.g., rocky, exposed slopes and ridges), but accessibility in the rugged terrain occupied by this species is an issue, and small plants tend to
blend in with light-colored granitic substrates, making them hard to detect (Amsberry and Meinke 2007).

Natural History

Habitat Requirements

Triple-ribbed milk-vetch is characterized as generally occurring in Joshua tree woodland and Sonoran desert scrub (see Table 1; CDFG 2011; CNPS 2011). Throughout its range, it occurs at elevations of 1,300 to 4,000 feet above mean sea level (amsl) (USFWS 2009). Occurrences within the Plan Area occur at 2,300 to 3,700 feet amsl. However, as discussed in Recent Occurrences, populations are characterized as source populations, deme populations, and waifs. The focus of this description is habitat for source populations because they are considered the most important element for the species for conservation purposes. The deme populations and especially the waif populations that likely occur from seedlings washed downstream and downslope from source population are small and not self-sustaining and, therefore, are not as important for conservation and management. These sites are not the primary habitat for the species (Amsberry and Meinke 2007), and these small ephemeral populations likely do not contribute to long-term viability of the species.

The Wathier Landing source population occurs on an outcrop of “unproductive-looking” gravelly soil at about 3,700 feet amsl (White 2004). Triple-ribbed milk-vetch was not detected in surrounding granitic slopes or alluvial fans and washes (White 2004). The substrate where the plants were actually detected was largely bare of other species, but associated plants included giant needlegrass (Achnatherum coronatum), California buckwheat (Eriogonum fasciculatum), ceanothus (Ceanothus greggii), bush poppy (Dendromecon rigida), bigberry manzanita (Arctostaphylos glauca), bitter snakewood (Condalia globosa), yerba santa (Eriodictyon trichocalyx), and Spanish bayonet (Yucca schidigera) (Amsberry and Meinke 2007; White 2004). The Catclaw Flat population was located on decomposed granite substrate on an exposed ridge at about 3,400 feet amsl in association with the same plant species as the Wathier Landing site (Amsberry and Meinke 2007).

Generally, primary habitat for source populations in the Plan Area consists of rocky slopes and ridges that are mostly barren. Notably the two source
populations are at the two highest elevations of all of the occurrences in the Plan Area, supporting the notion that the large source populations occur in upslope areas in the upper watersheds and the smaller deme populations and waifs occur at lower elevations in downstream washes and downslope (White 2004; USFWS 2009).

**Table 1.** Habitat Associations for Triple-Ribbed Milk-Vetch

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojave mixed woody</td>
<td>Primary habitat for source</td>
<td>Granitic substrates</td>
<td>White 2004</td>
</tr>
<tr>
<td>desert scrub</td>
<td>population</td>
<td>Elevation 2,300 to</td>
<td>Amsberry and Meinke 2007</td>
</tr>
<tr>
<td>Sonoran desert scrub</td>
<td></td>
<td>4,000 feet amsl</td>
<td>CDFG 2011</td>
</tr>
</tbody>
</table>

**Reproduction**

Triple-ribbed milk-vetch is a short-lived, perennial member of the pea family (USFWS 2009). Very little species-specific life history information is available about this species. The information cited in this section and the following natural history section largely comes from a single study of the species conducted in 2005 and 2006 by Amsberry and Meinke (2007) at the two source populations in Wathier Landing and Catclaw Flat.

The blooming season for triple-ribbed milk-vetch is February through May (CNPS 2011). Amsberry and Meinke (2007) found that 62% of sample individuals at Wathier Landing were in flower in March 2005, and 38% were beginning to produce fruit. At Catclaw Flat, all sampled plants were in fruit in May 2005. Sampled plants at Catclaw Flat reproduced an estimated mean of 2,759 seeds per plant, which is higher than reported rates for other members of this genus. Hundreds of seedlings were observed at both sites in 2005, which was a high rainfall year (a “good” rainfall year), and seedlings were also observed in 2006, which was a dry year. White (2004) also observed seedlings at the Wathier site in 2004, suggesting that reproduction and seedling germination may occur in most years at these source populations (Amsberry and Meinke 2007).

In a pilot greenhouse study of germination requirements of triple-ribbed milk-vetch, Amsberry and Meinke (2007) found that 80% of
“viable-appearing” seeds germinated within 72 hours after scarification and wetting; scarification probably occurs naturally through exposure and/or the action of tumbling gravel during flooding. Amsberry and Meinke (2007) also found that growth was more robust in pots inoculated with soil from vigorous, cultivated plants of the obligately mycorrhizal species *Astragalus applegatei* that were previously inoculated with native soil containing mycorrhizae and *Rhizobium*.

Despite the apparent high productivity of this species, the 5-year review for the species states that “the abundance of this species fluctuates from year to year and may not be present above ground in drought years” (USFWS 2009, p. 1). Long-term studies of this species have not been conducted to determine its response to wet and dry cycles.

Amsberry and Meinke (2007) noted that all mature reproductive individuals appeared to be perennial and had obvious woody bases. The longevity of individuals is suspected to be 3 to 5 years, but long-term studies are needed (Amsberry and Meinke 2007).

Pollinators of triple-ribbed milk-vetch are unknown. Amsberry and Meinke (2007) noted that field conditions were too windy to observe pollinators but indicate that the species’ showy flowers are typical of legumes pollinated by native bees and honeybees.

Dispersal mechanisms are unknown, but observations of many seedlings around mature reproductive plants suggest that dispersal occurs over short distances within the source populations (Amsberry and Meinke 2007; White 2004). The deme populations and waifs probably stem from seeds washed downstream or downslope from the source populations (USFWS 2009; White 2004).

**Ecological Relationships**

Little is known about the ecological relationships of triple-ribbed milk-vetch. The 5-year review for the species indicates that the individuals may not be aboveground during drought years (USFWS 2009), but Amsberry and Meinke (2007) suggest that reproduction and seedling germination may occur in most years at the source populations. Long-term studies are needed to understand the species’ response to wet and dry cycles.
The pilot greenhouse study by Amsberry and Meinke (2007) found a positive growth response in soils from the obligately mycorrhizal congener *Astragalus applegatei*, raising the potential role of relationships with fungal or bacterial associates.

Pollination and dispersal studies have not been conducted, although the species' showy flowers may attract native bees and honeybees, and seedlings are readily observed around source populations (Amsberry and Meinke 2007; White 2004).

Associated plant taxa at the two source populations in the Plan Area—Wathier Landing and Catclaw Flat—are similar, but this similarity is not unexpected because of the close proximity of the two sites. The plant communities at most other occurrences have not been described, but the vegetation community at the East Deception Creek site, which is a deme population of about 50 individuals on a scree slope, includes creosote bush (*Larrea tridentata*), Schott’s indigo bush (*Psorothamnus schottii*), rush milkweed (*Asclepias subulata*), white burrobush (*Ambrosia salsola var. pentalepis* (burrobush), and deerweed (*Lotus scoparius*) (USFWS 2009). Given that most occurrences of triple-ribbed milk-vetch are in barren areas, local plant associations do not appear to be an important factor for presence or absence.

**Population Status and Trends**

**Global:** Critically Imperiled (CNPS 2011)

**State:** Same as above

**Within Plan Area:** Same as above

Other than the site-specific counts and population estimates for the approximately 18 extant occurrences for triple-ribbed milk-vetch, there are little data for population status and trends. For the 5-year review of the species, the U.S. Fish and Wildlife Service (USFWS) estimated the known rangewide population to be less than 500 individuals, including source and deme populations and waifs (USFWS 2009). The two observed source populations in the Plan Area—Wathier Landing and Catclaw Flat—were known to support approximately 300 and 500 individuals, respectively, in the mid-2000s (Amsberry and Meinke 2007), but their current status is unknown. The other sites in the Plan Area are small, unsustainable deme populations and waifs (see Recent
Plants

**Triple-Ribbed Milk-Vetch (Astragalus tricarinatus)**

Occurrences). However, the actual population is likely to be substantially larger because not all suitable habitat areas have been surveyed. The observed deme populations and waifs in downstream and downslope areas indicate the likely presence of larger, but as yet unknown, upslope source populations (USFWS 2009).

**Threats and Environmental Stressors**

The main anthropogenic threats to triple-ribbed milk-vetch identified in the federal listing of the species in 1998 included bulldozing for maintenance of a gas pipeline and earth-moving activities along a stretch of Big Morongo Canyon to realign segments of a crude oil pipeline that had been exposed during winter storms in 1992–1993 (63 FR 53596–53615). It is considered to be under continuing threat due to maintenance activities for this crude oil pipeline and to off-highway vehicle use in the canyons. Its small population numbers make it vulnerable to stochastic events and anthropogenic events such as pipeline leaks (USFWS 2009). New threats identified since the species’ federal listing include wildland fire suppression activities, flooding, and climate change (USFWS 2009). Amsberry and Meinke (2007) also identify exotic weed infestations resulting from increased vehicle and foot traffic as a potential threat to the species.

Rangewise, but outside the Plan Area, other potential threats include residential development of population location in East Deception Canyon and Lower Mission Creek, which may affect downstream habitat and facilitate off-highway vehicle use (USFWS 2009).

**Conservation and Management Activities**

Conservation and management activities within the Plan Area include preservation of the two known source populations—Wathier Landing and Catclaw Flat—on private lands owned by The Wildlands Conservancy (TWC). These lands are operated and managed with the same goals as the BLM San Gorgonio Wilderness Area (USFWS 2009). TWC also leased a nearby 40,032-acre BLM grazing allotment that has since been relinquished, and grazing is no longer permitted (USFWS 2009).

Small populations of triple-ribbed milk-vetch occur in Big Morongo Canyon in the Plan Area within the BLM Big Morongo Canyon
Plants

Triple-Ribbed Milk-Vetch (Astragalus tricarinatus)

Preserve, which is also designated an Area of Critical Environmental Concern (ACEC), encompassing about 31,000 acres. Further, the San Gorgonio Additions Wilderness Area comprises approximately 39,215 acres between San Bernardino National Forest and the Morongo Valley; it includes significant portions of the Mission Creek and Whitewater drainages, and preserves significant contiguous occurrences and contiguous habitat (USFWS 2009). It is highly possible that additional source populations within the Plan Area occur in the San Gorgonio Additions Wilderness Area, given the nearby locations of the Wathier Landing and Catclaw Flat source populations (see Figure S-40).

The Long Canyon and Key’s Ranch (unvoucherered) occurrences are within Joshua Tree National Park, and as of 2009 a management plan was being prepared for the species (USFWS 2009).

Conservation of the species outside the Plan Area is provided by the Coachella Valley Multiple Species Habitat Conservation Plan (MSHCP), which conserves 2,838 of the 3,007 acres of modeled habitat distributed across Whitewater Canyon (1,295 acres), Mission Creek and Big Morongo Canyon (819 acres), Whitewater floodplain (866 acres), and Santa Rosa and San Jacinto Mountains (1 acre) (CVMSHCP 2007).

Data Characterization

The broad geographic range of triple-ribbed milk-vetch probably is fairly well known since no new outlier populations have been discovered since 1985 (the Agua Alta site in the Santa Rosa Mountains). The Orocopia Mountains occurrence is unvoucherered. However, within the species’ geographic range boundaries, its distribution probably is still not well understood. Only two source populations for the species that are in close proximity to each other have been documented—the Wathier Landing and Catclaw Flat occurrences on TWC land. The other documented occurs are deme populations and waifs that indicate a larger upslope source population that has not been documented but that provides seedlings for the downstream and downslope populations (USFWS 2009). Due to the rugged and potentially inaccessible primary habitat for the species (i.e., rocky slopes, canyon walls, and ridges in remote upper watershed areas), much suitable habitat probably has not been
adequate surveyed. In addition, if the species’ abundance and detectability varies in relation to wet and drought cycles, it may not be observable on occupied sites without follow-up surveys (USFWS 2009). Also, smaller individuals may be difficult to detect from a distance because they blend in with the light-colored granitic substrates on which they occur (Amsberry and Meinke 2007). For these reasons, it is likely that the current distribution information about the species significantly underestimates its actual distribution.

Management and Monitoring Considerations

The 5-year review for triple-ribbed milk-vetch (USFWS 2009) recommended several actions related to management and monitoring of the species, including:

- Demographic and survival studies at known sites
- Predictive habitat modeling involving source soils to locate new source populations
- Site-specific fire suppression plans, including avoidance areas, bulldozer lines, and aerial retardant drops, as well as post-fire surveys
- Development of protocols to ensure low impacts during facilities maintenance (e.g., pipelines).

Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

Literature Cited


Plants

Triple-Ribbed Milk-Vetch (*Astragalus tricarinatus*)

PO485100. Sacramento, California: California Department of Fish and Game.


Wiggins’ Croton (Croton wigginsii)

Legal Status

**State:** Rare; S1.2

**CNPS:** Rare Plant Rank 1B.2

**Federal:** Bureau of Land Management (BLM) Sensitive

**Critical Habitat:** N/A

**Recovery Planning:** Imperial Sand Dunes Draft Recreation Area Management Plan (BLM 2010)

Taxonomy

Wiggins’ croton (Croton wigginsii) was described in 1939 by Wheeler in Contributions from the Gray Herbarium of Harvard University (IPNI 2011). Wiggins’ croton has had no taxonomic revision since initial naming.

Wiggins’ croton is a shrub or sub-shrub less than 1 meter (3.3 feet) in height. A full physical description of the species can be found in the Jepson Flora Project (2011). It can be differentiated from the more common California croton (Croton californicus) by larger seeds (6.5–7 millimeters [0.26–0.28 inch] compared to 3.5–5.5 millimeters [0.14–0.22 inch]), longer pedicel in fruit (4–7 millimeters [0.16–0.28 inch] compared to less than 2 millimeters [0.08 inch]), and staminate sepals being slightly larger (2.5–3 millimeters [0.10–0.12 inch] compared to 2–2.5 millimeters [0.08–0.10 inch]). Vegetatively, the two species are very similar and can often be difficult to distinguish where they co-occurs (Mayfield 2011). In fact, some herbarium specimens that were originally identified as Croton californicus have recently been corrected and are now identified as Croton wigginsii (CDFG 2011).

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1. **S1:** Critically imperiled; **X.2:** Threatened.
2. **1B:** Rare, threatened, or endangered in California and elsewhere. **X.2:** Fairly endangered in California.
Distribution

General

Wiggins’ croton occurs primarily in the southeastern Sonoran Desert in southeast Imperial County, California (Hickman 1996, p. 572; Mayfield 2011). In addition, there are populations in southwest Arizona, northeast Baja California, and northwest Sonora in Mexico. The California Natural Diversity Database (CNDDB) reports eight known occurrences from California and the Desert Renewable Energy Conservation Plan (DRECP) Area. Of these occurrences, six are considered historical and two have been recently verified (see Figure S-29). However, all eight occurrences are presumed to be extant.

Distribution and Occurrences within the Plan Area

Historical

The historical distribution of Wiggins’ croton within the Plan Area roughly corresponds to the current distribution, with the exception of a 1986 collection from “East Mesa, E end of Montgomery Rd at the Coachella Canel, ca. 1.25 mi NW of Mammoth Wash crossing of the canal” (Consortium of California Herbaria 2011). This locality is not recorded in the CNDDB and has not been noted since the collection in 1986. However, this location would have represented the northwestern-most extent of the species range. As discussed in the General distribution section, six of the eight occurrences within the CNDDB are considered historical and have not been verified since the 1980s. The ownership status of two these populations is unknown, and the remaining four occurrences occur on BLM lands (CDFG 2011).

Recent

Two recent observation of Wiggins’ croton are included in the CNDDB. These populations occur on the west side and the extreme southeastern portion of the Algodones Dunes system in the southeast corner of Imperial County, California, in a range roughly 40 miles long. Each of these occurrences occurs on lands owned by the BLM.
Natural History

Habitat Requirements

Wiggins’ croton is a shrub that grows in psammophytic scrub (or dune vegetation) habitat and prefers stabilized or partially stabilized sand dunes (see Table 1; CDFG 2011). This species is reported as occurring on south or southeast slopes of basins and sometimes grows within the floor of basins (BLM 2010). Associated shrub species found in transects on the Algodones Dunes system included burrobush (*Ambrosia dumosa*), desert twinbugs (*Dicoria canescens*), longleaf jointfir (*Ephedra trifurca*), Colorado Desert buckwheat (*Eriogonum deserticola*), Peirson’s milk-vetch (*Astragalus magdalena var. peirsonii*), Algodones Dunes sunflower (*Helianthus niveus ssp. tephrodes*), creosote bush (*Larrea tridentata*), giant Spanish needle (*Palafoxia arida var. gigantean*), Thurber’s sandpaper plant (*Petalonyx thurberi ssp. thurberi*), sand food (*Pholisma sonorae*), dyebush (*Psorothamnus emoryi*), and fanleaf crinklemat (*Tiquilia plicata*) (Willoughby 2004).

Table 1. Habitat Associations for Wiggins’ Croton

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desert sand dunes</td>
<td>Primary</td>
<td>Sand dunes</td>
<td>CNPS 2011; CDFG 2011</td>
</tr>
</tbody>
</table>

Reproduction

Wiggins’ croton is a dioecious, long-lived shrub or sub-shrub that has a blooming period from March to May (CNPS 2011). Pollinators for Wiggins’ croton are unknown, but it has been reported that this species is an important source of nectar for a variety of endemic insect species that occur in the Algodones Dunes. Large seed such as is produced by Wiggins’ croton is a common adaptation for plants that establish on shifting sands (Mayfield 2011; Hickman 1996, p. 572). Research on seedling emergence on Sonoran Desert dunes found that Wiggins’ croton seedlings germinated in response to moderate rain storms, typically less than the amount of rain required to trigger other
Sonoran desert shrubs such as creosote bush, brittlebush (*Encelia* spp.), and burrobush (Bowers 1996).

**Ecological Relationships**

Other than its association with sand dunes and psammophytic scrub (CDFG 2011; CNPS 2011) described under the Habitat Requirements and Reproduction sections above, little is known about the life history and ecological relationships of Wiggins’ croton.

**Population Status and Trends**

**Global:** Uncertain between Imperiled and Vulnerable (CNPS 2011)

**State:** Critically Imperiled (CNPS 2011)

**Within Plan Area:** Same as State

Wiggins’ croton populations were monitored by the BLM in the years 1977, 1998, 1999, and 2000 along transects at the Algodones Dunes (BLM 2001). The population along transects appeared to double between 1977 and 1998, and populations in 1999 and 2000 were about the same as 1998 (BLM 2001). However, the abundance class index used in this monitoring was not appropriate for estimating population densities and sizes (Willoughby 2004). As a relatively long-lived species, the population size Wiggins’ croton does not appear to fluctuate much from year to year in response to annual rainfall and is able to maintain its population over multiple years of drought or low rainfall (BLM 2001). Monitoring at the Algodones Dunes suggested that this species had expanded its cover within the dune system since the original monitoring effort in 1977. Although it is unclear why the population expanded over this time period, the expansion could be attributed to multiple factors including differential rainfall patterns or an increase in moderate disturbance levels (BLM 2001). Monitoring for this species was not conducted in 2001 and 2002 due to the increased workload associated with monitoring Peirson’s milk-vetch and Algodones Dunes sunflower (BLM 2004).

**Threats and Environmental Stressors**

Vehicular disturbance is considered to be a threat to Wiggins’ croton, and about 75% of the Algodones Dunes system is open to off-highway
vehicle (OHV) use (CNPS 2011 and CDFG 2004). Although Wiggins’ croton appears to respond well to moderate levels of disturbance (BLM 2001), frequent, ongoing OHV use could result in long-term impacts to this species (CDFG 2004).

**Conservation and Management Activities**

The two known occurrences located within the Plan Area occur in the Algodones Dunes, public lands owned and managed by BLM (CDFG 2011). Pursuant to Manual 6840, the Special Status Species Management Manual, it is BLM policy to manage for special-status plants, including Rare Plant Rank 1B species (http://www.blm.gov/ca/st/en/prog/ssp.htm). Actions for BLM-designated special-status plants per BLM Manual Supplement 6840.06 – Special Status Plant Management - include:

- Determining the distribution, abundance, reasons for current status, and habitat needs for special-status species occurring on lands administered by the BLM and evaluate the significance of BLM lands or actions in maintaining those species;

- Managing habitat for special-status species where BLM lands or actions have a significant effect on the species to conserve the species;

- Developing and implementing rangewide and/or site-specific management plans for special-status plant species that include specific habitat and population management objectives designed for recovery, as well as the management strategies necessary to meet those objectives;

- Ensuring that BLM activities affecting the habitat of special-status plant species are carried out in a manner consistent with the objectives for managing those species; and

- Monitoring populations and habitats of special-status plant species to determine whether management objectives are being met.
BLM guidance for special-status plant management is also provided in BLM Manual Handbook 6840-1, *Special Status Plant Management* (BLM 1996).

As described under Population Status and Trends, BLM has conducted periodic monitoring of the Wiggins’ croton and other special-status species. The BLM has prepared the Imperial Sand Dunes Draft Recreation Area Management Plan, which when approved, will be implemented for the protection and management of Algodones Dunes species, including the Wiggins’ croton (BLM 2010).

**Data Characterization**

The general distribution of Wiggins’ croton is well known based on its primary association with the Algodones Dunes. Within the Plan Area, this species is known only from the Algodones Dunes. Little is known regarding the species’ pollination, seed dispersal, and recruitment, but based on monitoring conducted in 1977, 1998, 1999, and 2000 by BLM, the population appeared to be stable or increasing (BLM 2001). No systematic monitoring of the species has been conducted since 2001.

**Management and Monitoring Considerations**

The goal and objective for Wiggins’ croton within the Imperial Sand Dunes Recreation Area is to maintain suitable habitat of sufficient quality and quantity with adequate patch sizes to support the species (BLM 2010). It should be noted that this species also appears to withstand moderate levels of disturbance and can be found thriving within areas of the Algodones Dunes that are currently open to OHV activity.

**Predicted Species Distribution in Plan Area**

Species model summary and results will be provided following model development.

**Literature Cited**

BLM (Bureau of Land Management). 2001. *Monitoring of Special Status Plants in the Algodones Dunes, Imperial County,*
**Wiggins’ Croton (Croton wigginsii)**


Wiggins’ Croton (Croton wigginsii)

http://www.ipni.org/ipni/idPlantNameSearch.do;jsessionid=253B747636F1F8BD6BCF92ED702E4A2B?id=343758-1&back_page=%2Fipni%2FeditSimplePlantNameSearch.do%3Bjsessionid%3D253B747636F1F8BD6BCF92ED702E4A2B%3Ffind_wholeName%3DCroton%2Bwigginsii%26output_format%3Dnormal.


Red Rock Tarplant
(*Deinandra arida*)

**Legal Status**

- **State:** Rare; S1.2\(^1\)
- **CNPS:** Rare Plant Rank 1B.2\(^2\)
- **Federal:** Species of Concern, Bureau of Land Management (BLM) Sensitive
- **Critical Habitat:** N/A
- **Recovery Planning:** N/A
- **Notes:** Red Rock tarplant was previously a candidate for federal listing (58 FR 64828–64845), but was removed from candidacy on February 28, 1996, in a notice of review (61 FR 7597–7613).

**Taxonomy**

Red Rock tarplant (*Deinandra arida*) was originally described by D.D. Keck in 1958 (Keck 1958) as *Hemizonia arida* and was reclassified as *Deinandra arida* by B.G. Baldwin in 1999 (Baldwin 1999; IPNI 2005). The taxonomic revision was intended to more accurately reflect phylogenetic relationships within Madiinae (a subtribe within Asteraceae) (Baldwin 1999). Red Rock tarplant is in the sunflower family (Asteraceae) (Jepson Flora Project 2011). It is an annual herb approximately 2 to 8 decimeters (7.9 to 32 inches) in height. A full physical description of the species can be found in the Jepson Flora Project (2011).

**Distribution and Occurrences within the Plan Area**

**General**

There are a total of six occurrences in the California Natural Diversity Database (CNNDDB) for the Desert Renewable Energy Conservation Plan (DRECP) Area (CDFG 2011). Red Rock tarplant is known from

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\(^1\) S1: Critically imperiled; X.2: Threatened.
\(^2\) 1B: Rare, threatened, or endangered in California and elsewhere; X.2: Fairly endangered in California.
Plants  

Red Rock Tarplant (*Deinandra arida*)

Red Rock Canyon and Last Chance Canyon, primarily in Red Rock Canyon State Park in Kern County, California (Faull 1987; Tanowitz 1982; CDFG 2011; Figure S-42). This species occurs at elevations from 300 to 950 meters (900 to 2,850 feet) (CNPS 2011).

**Historical**

There are no CNDDB occurrences from before 1990 (Figure S-42; CDFG 2011).

**Recent**

There is a total of six CNDDB occurrences in the Plan Area, all of which are recent (status updated since 1990 [CDFG 2011]). Each of these occurrences is from Red Rock Canyon and Last Chance Canyon, and five of the six occurrences are within the Red Rock Canyon State Park (one is located just south of the state park) (CDFG 2011; Figure S-42). The sixth occurrence is on BLM property (Faull 1987).

**Natural History**

**Habitat Requirements**

Red Rock tarplant grows in Mojavean desert scrub communities on clay soils and volcanic tuff (see Table 1; CNPS 2011). In general, this species is associated with seeps and seasonally moist substrates along ephemeral streams (sandy and gravelly washes), low ridges, and road shoulders (CDFG 2011). Faull (1987) found that Red Rock tarplant habitat consists of the following:

1. Sandy to gravelly ephemeral alluvial washes, sometimes exhibiting surface platey structure;

2. Moist alkaline fringes of seeps and springs along alluvial flats and washes;

3. Relatively shallow, dry, sandy alluvial and colluvial slopes at the base of ridges and cliffs and associated erosional ravines; and

4. Ledges of dry colluvium suspended on steep cliff slopes up to 160 feet above the valley floor by ribs of resistant bedrock.
The preferred habitat appears to be adjacent to seeps and along washes (Sanders 2006).

From a geologic substrate perspective, Red Rock tarplant appears to prefer erosional remnants of the Ricardo Group, but also occurs on Quaternary alluvium (Faull 1987).

Associated species in moister locations include the seep-spring monkeyflower (*Mimulus guttatus*) and Palmer's monkeyflower (*Mimulus palmeri*) (Faull 1987).

**Table 1.** Habitat Associations for Red Rock Tarplant

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojavean desert scrub</td>
<td>Primary habitat</td>
<td>Clay soils and volcanic tuff, adjacent to seeps and along washes, 900–2,850 feet</td>
<td>CDFG 2011; CNPS 2011</td>
</tr>
</tbody>
</table>

**Reproduction**

As an annual herb, Red Rock tarplant does not appear to reproduce vegetatively, but rather reproduces via seeds. Seedling establishment has not been reported for this species. Red Rock tarplant and Mojave tarplant (*Deinandra mohavensis*) are the only two self-compatible species of *Hemizonia* (now *Deinandra*) (Tanowitz 1982; Sanders 2006). This may be the result of genetic drift and/or the relative isolation of these two species, which occur on the edge of the desert as local populations (Sanders 2006).

Red Rock tarplant blooms from April through November (CNPS 2011). Pollination studies have not been conducted for this species; however, Faull (1987) has observed small beetles and honey bees visiting Red Rock tarplant flowers. Seed germination has not been reported for this species. Bruce Baldwin reports that *Hemizonia* (now *Deinandra*) ray achenes maintain some degree of dormancy while the disk achenes freely germinate (Sanders 2006). Red Rock tarplant consistently produces fertile ray achenes (but few to zero fertile disk achenes). Sanders (2006) suggests that the ray achenes could...
Plants

Red Rock Tarplant (*Deinandra arida*)

contribute to the persistence of a Red Rock tarplant seed bank through difficult climatic cycles.

Ecological Relationships

As described in Habitat Requirements, Red Rock tarplant is associated with seeps and along washes within Mojavean desert scrub communities on clay soils and volcanic tuff (CNPS 2011). This species has a very limited geographic distribution, and little is known of its life history and ecological relationships. While pollination studies have not been conducted for Red Rock tarplant, Faull (1987) has observed small beetles and honey bees visiting Red Rock tarplant flowers, and the species is considered to be self-compatible (Tanowitz 1982; Sanders 2006). Information regarding seed germination and dispersal have not been reported for this species. Red Rock tarplant is considered susceptible to anthropogenic disturbances such as off-road vehicle use (Faull 1987).

Population Status and Trends

**Global:** Critically Imperiled (CNPS 2011).
**State:** Same as above
**Within Plan Area:** Same as above

As of 1987, according to the California Department of Parks and Recreation, the Red Rock tarplant was well protected and its abundance was stable or increasing (Faull 1987). For the five occurrences within the Red Rock Canyon State Park, abundance estimates for the four 1998 CNDDB records were 3,060 plants (1,250 plants in 1986), 2 plants, 1 plant, and 2,300 plants. The 2004 CNDDB record abundance estimate was 3,400 plants (11,000+ in 1986). The 1993 CNDDB record outside the Red Rock Canyon State Park does not include an estimate of plants (CDFG 2011). No additional data are available to determine its current status and population trend.

Threats and Environmental Stressors

The primary threat appears to be off-highway vehicle (OHV) use and colonization by invasive non-natives such as shrub tamarisk (*Tamarisk ramosissima*) (Faull 1987). Camping and vehicle parking at Red Cliffs in Red Rock Canyon may also be threats. Measures to control these
Red Rock Tarplant (*Deinandra arida*)

Threats have been implemented by the California Department of Parks and Recreation in the past (Faull 1987), but current management is uncertain, especially in light of the existing State budget issues. Faull (1987) observed that Red Rock tarplant experiences herbivory by rabbits (and possibly ground squirrels): the main stems and branches of up to 75% of plants at one location were observed to have been removed by herbivores.

**Conservation and Management Activities**

Five of the six known occurrences are within Red Rock Canyon State Park (CDFG 2011). These occurrences have been managed in the past by the California Department of Parks and Recreation to limit effects of vehicle traffic and colonization by invasive non-natives such as shrub tamarisk (*Tamarisk ramosissima*). OHV use and camping are restricted to designated areas and barriers, and signage is maintained to guide visitor use (Faull 1987). The status of current management activities is unknown.

**Data Characterization**

The general distribution of Red Rock tarplant is well known based on its very limited geographic distribution (Red Rock Canyon and Last Chance Canyon). In addition, five of the six occurrences lie within the Red Rock Canyon State Park. The species is known to be self-compatible (Tanowitz 1982) and insect pollinated (Faull 1987). Little is known regarding the species’ seed dispersal and recruitment, but as of 1987, the population appeared to be stable or increasing (Faull 1987). Current population status and trends are unknown.

**Management and Monitoring Considerations**

Protection should focus on the six currently known occurrences in Red Rock Canyon and Last Chance Canyon, five of which occur within the Red Rock Canyon State Park (CDFG 2011). The primary threat appears to be OHV use and colonization by invasive non-natives such as shrub tamarisk (Faull 1987). Measures to control these threats have been implemented by the California Department of Parks and Recreation (Faull 1987), but considering current budget limitations, future management and monitoring activities are uncertain.
Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

Literature Cited


Red Rock Tarplant (*Deinandra arida*)

Fipni%2FeditSimplePlantNameSearch.do%3Ffind_wholeName%3DDeinandra%2Barida%26output_format%3Dnormal.


Mojave Tarplant
(*Deinandra mohavensis*)

**Legal Status**

- **State:** Endangered; S2S3
- **CNPS:** Rare Plant Rank 1B.3
- **Federal:** BLM Sensitive; Sensitive
- **Plant Species for Forest Service Region 5**
- **Critical Habitat:** N/A
- **Recovery Planning:** N/A

**Taxonomy**

Mojave tarplant was originally described by D.D. Keck (1935) as *Hemizonia mohavensis* and was reclassified as *Deinandra mohavensis* in 1999 (Baldwin 1999; IPNI 2005). The taxonomic revision was intended to more accurately reflect phylogenetic relationships within Madiinae (a subtribe within Asteraceae) (Baldwin 1999). Mojave tarplant is in the sunflower family (Asteraceae) (Jepson Flora Project 2011). The plant was thought to be extinct at one time but was rediscovered in 1994 by A. Sanders in the San Jacinto Mountains, in Riverside County (Sanders et al. 1997).

Mojave tarplant is an annual plant approximately 1 to 10 decimeters (3.9 to 39 inches) in height. A full physical description of the species can be found in the Jepson Flora Project (2011).

**Distribution and Occurrences within the Plan Area**

**General**

There are a total of 66 occurrences in the California Natural Diversity Database (CNDDB) (CDFG 2011). Mojave tarplant is known in Kern, Riverside, and San Diego counties (believed extirpated from San Bernardino County) (CDFG 2011; Figure S-41). This species occurs at...

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1. **S2:** Imperiled. **S3:** Vulnerable. S2S3 means the rank is somewhere between S2 and S3.
2. **1B:** Rare, threatened, or endangered in California and elsewhere; **X.3:** Not very endangered in California.
Plants

Mojave Tarplant (*Deinandra mohavensis*)

elevations of 640–1,600 meters (1,900–4,800 feet) (CNPS 2011). The distribution is discontinuous and possibly relictual.

**Historical**

Of the six occurrences in the Plan Area, none date from 1990 or earlier (CDFG 2011). This species was not known to occur in the Plan Area prior to 1990.

**Recent**

Within the Plan Area, Mojave tarplant is known from the desert slope of the southern Sierra Nevada Mountains in Kern County (Sanders 2006a). There are six occurrences in the Plan Area, all within Kern County: two were last observed in 1998, three were last observed in 2003, and one was last observed in 2004. Three of the occurrences are known from lands managed by the Bureau of Land Management (BLM); one is on private land, and ownership is unknown for two of the occurrences. The six occurrences are located west of Highway 14 and east of the Sequoia National Forest, north of Interstate 40: near Cutterbank Spring, in Jawbone Canyon, near Short Canyon, in lower Esperanza Canyon, and in lower Water Canyon (CDFG 2011; Figure S-41). Mojave tarplant may also occur at Red Rock Canyon in Red Rock Canyon State Park in Kern County (Faull, pers. comm. 1998, cited in Sanders 2006a).

**Natural History**

**Habitat Requirements**

The Mojave tarplant occurs in open moist sites in arid regions near the margins of the desert, within chaparral, coastal scrub, and riparian scrub (CNPS 2011; Sanders 2006a). Plants are typically observed at seeps and along grassy swales and intermittent creeks. The most suitable habitat occurs in mountainous areas within microhabitats of low gradient streams and on gentle slopes with few shrubs and trees. This species is associated with clay or silty soils that are saturated with water early in the year. Mojave tarplant prefers areas that are dry at the surface but which have a substantial water source at depth through summer. Dwarfed plants occasionally are found in drier sites near occupied moist areas (Sanders et al. 1997). This cycle of early
saturation with later desiccation may reduce competition from other plant species; dryness during drought years may further reduce competition (Sanders 2006a).

At the type locality, Mojave tarplant was known to occur along a sandy intermittent creek; however, this habitat is now believed to be atypical and not sufficient to maintain a permanent population. Sanders et al. (1997) does note that there are some occurrences of Mojave tarplant associated with sand, where the sand is adjacent to more typical habitat.

Table 1. Habitat Associations for Mojave Tarplant

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesic chaparral, coastal scrub, and riparian scrub</td>
<td>Primary</td>
<td>Clay or silty soils; seasonally (winter and spring) saturated with water; 640–1,600 meters (1,900–4,800 feet)</td>
<td>CNPS 2011; Sanders et al. 1997; Sanders 2006a</td>
</tr>
</tbody>
</table>

Reproduction

Mojave tarplant and Red Rock tarplant (*Deinandra arida*) are the only two self-compatible species of *Hemizonia* (now *Deinandra*) (Tanowitz 1982; Baldwin pers. comm. 1997, cited in Sanders 2006b). This may be the result of genetic drift and/or the relative isolation of these two species, which occur on the edge of the desert as local populations (Sanders 2006b). Pollination studies have not been conducted for this Mojave tarplant; however, Faull (1987) has observed small beetles and honey bees visiting Red Rock tarplant flowers, a closely related species.

Mojave tarplant is known to reproduce easily in cultivation (B. Baldwin, pers. comm. 1998, cited in Sanders 2006a) and at a botanical garden has been known to escape into disturbed places (S. Boyd, pers. comm. 1998, cited in Sanders 2006a).
Mojave tarplant blooms from June through January (CNPS 2011). Flowering peaks between August and October. Once flowering has begun, it continues until the plants begin to senesce. Fruit maturity and dispersal are continuous as well. Seed dispersal vectors have not been reported for this species; however, the seeds are relatively heavy and may just fall to the ground around the source plant. The seeds are not armed with any obvious mechanisms, such as hooks or wings, for long-distance dispersal (Sanders 2006a). Bruce Baldwin (in personal communication to Andy Sanders, cited in Sanders 2006b) reports that *Hemizonia* (now *Deinandra*) ray achenes maintain some degree of dormancy while the disk achenes freely germinate.

**Ecological Relationships**

As described in Habitat Requirements, Mojave tarplant is associated with seasonally saturated clay or silty soils on gentle slopes or low gradient streams, with few shrubs and trees. These saturated areas are typically dry at the surface but provide a substantial water source at depth through summer (Sanders et al. 1997). This species has a discontinuous and possibly relictual distribution (Sanders 2006a), and little is known of its life history and ecological relationships. Although pollination studies have not been conducted for Mojave tarplant, Faull (1987) has observed small beetles and honey bees visiting Red Rock tarplant flowers, a closely related species. Information on seed germination has not been reported for this species, although Mojave tarplant is known to be self-compatible (B. Baldwin, pers. comm. 1998, cited in Sanders 2006a). Seed dispersal vectors have not been reported for this species; however, the seeds are relatively heavy and may just fall to the ground around the source plant. The seeds are not armed with any obvious mechanisms, such as hooks or wings, for long-distance dispersal (Sanders 2006a). Mojave tarplant is threatened by grazing, recreational activities, development, hydrological alterations, road maintenance, and vehicles (CNPS 2011). Within the Plan Area, intense cattle grazing and trampling may be the most significant threats.
Population Status and Trends

**Global:** Imperiled (NatureServe 2010)
**State:** Same as above
**Within Plan Area:** Same as above

Because this species was only recently rediscovered (in 1994) there is little information available on population trends. Of the six occurrences in the Plan Area, three are known from BLM land, one is on private land, and ownership is unknown for two of the occurrences. The occurrence on private land numbered 14 individuals in 2003. Of the two occurrences for which ownership is unknown, one numbered in the thousands in 1998 and the other numbered 109 individuals in 2003. Of the three occurrences on BLM land, one numbered 50,000 in 2003 (with 30 rosettes observed very early in the year in 2004), one numbered in the several hundreds in 2008, and one numbered 5,000 in 1998 (and was locally common in 2001 and numbered 3,000 in 2003). Overall, there are 66 occurrences in Kern, Riverside, and San Diego counties (CDFG 2011) and most of these appear to have number of individuals estimated once, making it difficult to discern a population trend.

Threats and Environmental Stressors

Mojave tarplant is threatened by grazing, recreational activities, development, hydrological alterations, road maintenance, and vehicles (CNPS 2011). The type locality was modified by construction of the Mojave River Forks Dam. Within the Plan Area, cattle grazing occurs at some of the Mojave tarplant occupied areas, and in some areas is locally intense and may pose a threat. However, plants of the genus *Hemizonia* (now *Deinandra*) may not be palatable to cattle, so grazing may not be a major threat. Trampling by cattle may be a threat around limited watering sources in dry areas (Sanders 2006a).

Conservation and Management Activities

Three of the occurrences are known from BLM land, one is on private land, and ownership is unknown for two of the occurrences (CDFG 2011). No conservation or management activities have been identified currently for Mojave tarplant.
Data Characterization

The general distribution of Mojave tarplant is discontinuous and patchy. Sanders (2006a) recommends that additional surveys be conducted in the southern Sierra Nevadas and along the north foot of the Transverse Range, particularly the San Gabriel Mountains. Within the Plan Area, three of the occurrences are known from BLM land, one is on private land, and ownership is unknown for two of the occurrences. Many of the known occurrences outside the Plan Area occur within the San Bernardino and Cleveland National Forests and therefore receive some protection (Sanders 2006a). The species is known to be self-compatible (B. Baldwin, pers. comm. 1998, cited in Sanders 2006a) and a related species (Red Rock tarplant) is known to be insect-pollinated (Faull 1987). Little is known regarding the species’ seed dispersal and recruitment.

Management and Monitoring Considerations

Because the general distribution of Mojave tarplant is discontinuous and patchy, Sanders (2006a) recommends that additional surveys be conducted in the southern Sierra Nevadas and along the north foot of the Transverse Range, particularly the San Gabriel Mountains. Additional surveys may identify new occurrences.

Mojave tarplant is threatened by grazing, recreational activities, development, hydrological alterations, road maintenance, and vehicles (CNPS 2011). Measures to control these threats should be considered.

Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

Literature Cited

Plants

Mojave Tarplant (*Deinandra mohavensis*)


Plants

Mojave Tarplant (*Deinandra mohavensis*)

http://www.blm.gov/pgdata/etc/medialib//blm/ca/pdf/pdfs/cdd_pdfs.Par.79a96f52.File.pdf/mohavetar1.PDF.

http://www.blm.gov/pgdata/etc/medialib//blm/ca/pdf/pdfs/cdd_pdfs.Par.79a96f52.File.pdf/mohavetar1.PDF.

Tracy’s Eriastrum
(Eriastrum tracyi)

Legal Status

State: Rare; S1.1
CNPS: Rare Plant Rank 1B.2
Federal: Bureau of Land Management (BLM) Sensitive, U.S. Forest Service (USFS) Sensitive
Critical Habitat: N/A
Recovery Planning: N/A

Taxonomy

Tracy’s eriastrum (Eriastrum tracyi) was originally described by Mason (1945; IPNI 2005). Tracy’s eriastrum is in the phlox family (Polemoniaceae; Jepson Flora Project 2011). Mason (1945) notes that Eriastrum tracyi superficially resembles E. brandegeae, but that Tracy’s eriastrum can be distinguished by its very small anthers, corolla proportions, and its racemose branching. Although The Jepson Manual (Jepson Flora Project 2011) considers E. tracyi a synonym of E. brandegeae, E. tracyi is a recognized taxon with the California Native Plant Society (CNPS 2011) and California Natural Diversity Database (CNDDB) (CDFG 2011).

Tracy’s eriastrum is an annual herb with stems 5 to 30 centimeters (0.4 to 11.8 inches) in length. A full physical description of the species can be found in the Jepson Flora Project (2011).

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1 S1: Critically imperiled; X.1: Very threatened.
2 1B: Rare, threatened, or endangered in California and elsewhere; X.2: Fairly endangered in California.
Tracy’s Eriastrum (*Eriastrum tracyi*)

**Distribution**

**General**

There are a total of 44 occurrences in the CNDDB (CDFG 2011). Tracy’s eriastrum is associated with the foothills on the east and west sides of the Central Valley and is known from the following counties: Colusa, Fresno, Glenn, Kern, Santa Clara, Shasta, Stanislaus, Tehama, Trinity, and Tulare (CNPS 2011; CDFG 2011). This species occurs at elevations from 315–1,125 meters (950–3,400 feet) (CNPS 2011). Within the Desert Renewable Energy Conservation Plan (DRECP) Area, Tracy’s eriastrum is known from 14 occurrences on the desert slope of the southern Sierra Nevada Mountains in Kern County; 13 of the occurrences date from 2010 and occur north of State Route 58 and west of Highway 14 (Figure S-43).

**Distribution and Occurrences within the Plan Area**

**Historical**

There is one occurrence from before 1990 (Figure S-43; CDFG 2011). This occurrence dates from 1910 and the precise location is unknown; the occurrence is noted to be in the vicinity of Tehachapi (CDFG 2011).

**Recent**

Thirteen of the fourteen CNDDB occurrences of Tracy’s eriastrum in the Plan Area date from 2010 and are all within Kern County. Two of these occurrences were recorded near Schoolhouse Well, on private lands. Three of these occurrences were recorded near Tom’s Hill on private lands. Five of these occurrences were recorded near Miller Springs; one of these records is on private land, one is on BLM land, and three are on land indicated as BLM/private. Three of the occurrences were recorded near Pine Spring; two of these records are on BLM land and one is on private land. In summary, 7 of the 13 records are on private lands, 3 are on BLM land, and 3 are on land indicated as BLM/private (CDFG 2011; Figure S-43).
Natural History

Habitat Requirements

Tracy's eriastrum grows in chaparral and cismontane woodland (see Table 1; CNPS 2011). Within the Plan Area, the CNDDB 2010 occurrence records indicate that the species is typically associated with cheatgrass (*Bromus tectorum*) and red brome (*B. madritensis*), and occurs in openings within a variety of communities, including pinyon/juniper woodland, Tucker oak chaparral, and blackbrush scrub. Of the 13 recent records within the Plan Area, 9 were observed along a road or trail, 2 were observed on a ridge/hilltop, 1 along a creek, and 1 in a valley. All of the 2010 records indicate that some portion of the occurrences show some signs of previous disturbance by grazing or road blading (CDFG 2011).

Table 1. Habitat Associations for Tracy’s Eriastrum

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaparral, cismontane woodland</td>
<td>Primary</td>
<td>Openings in vegetation communities; typically associated with cheatgrass and red brome; 315–1,125 meters (950–3,400 feet)</td>
<td>CNPS 2011; CDFG 2011</td>
</tr>
</tbody>
</table>

Reproduction

Tracy’s eriastrum is an annual herb that blooms from June to July (CNPS 2011). There is no species-specific information available regarding pollinators, seed germination, seed dispersal, or seedling establishment.

Ecological Relationships

As described in Habitat Requirements, Tracy’s eriastrum is associated with chaparral and cismontane woodland communities (CNPS 2011). Within the Plan Area, the CNDDB 2010 occurrence records indicate that the species is typically associated with cheatgrass and red brome, and occurs in openings within a variety of communities, including
pinyon/juniper woodland, Tucker oak chaparral, and blackbrush scrub. Of the 13 recent records within the Plan Area, 9 were observed along a road or trail, 2 were observed on a ridge/hilltop, 1 along a creek, and 1 in a valley. All of the 2010 records indicate that some portion of the occurrences show some signs of previous disturbance by grazing or road blading (CDFG 2011), so this species may be tolerant of disturbance to some extent. Little else is known of the life history and ecological relationships of Tracy’s eriastrum. Information regarding pollination, seed germination, dispersal, or seedling establishment has not been reported for this species.

**Population Status and Trends**

**Global:** Critically Imperiled (CNPS 2011)  
**State:** Same as above  
**Within Plan Area:** Same as above

There is no abundance information for the one historic CNDDB occurrence from 1910 (CDFG 2011). The 13 recent CNDDB occurrences of Tracy’s eriastrum in the Plan Area date from 2010 and do include abundance data, but with only 1 year of data, a trend cannot be established. The abundance of Tracy’s eriastrum varies from 50 to 5,380 plants at the 13 locations, with 9 of the 13 occurrences having more than 1,000 plants, and 4 of the occurrences having more than 3,000 plants (CDFG 2011). Additional monitoring of these populations over time would be necessary to assess population trends.

**Threats and Environmental Stressors**

Threats to this species have been identified as competition with other plant species, vehicles, road maintenance, development, and grazing (CNPS 2011). All of the CNDDB 2010 records indicate that some portion of the occurrences in the Plan Area show some signs of previous disturbance by grazing or road blading (CDFG 2011), so this species may be tolerant of disturbance to some extent. Moreover, Tracy’s eriastrum is reported as typically occurring with cheatgrass and red brome in openings in scrub, chaparral, and woodland (CDFG 2011), so this species may be tolerant of competition with grasses but may not tolerate shading. Without monitoring and trend data, the
relationship of this species to potential environmental stressors cannot be determined.

**Conservation and Management Activities**

Seven of the recent thirteen CNDDB records are on private lands, three are on BLM land, and three are on land indicated as BLM/private (CDFG 2011; Figure S-43). The recent occurrences are within the BLM West Mojave Plan (BLM 2005), but there is no species-specific information on the management of Tracy’s eriastrum in the West Mojave Plan; the species was only documented in 2010 within the plan area after the plan was prepared. However, pursuant to Manual 6840, the Special Status Species Management Manual, it is BLM policy to manage for special-status plants, including Rare Plant Rank 1B species (http://www.blm.gov/ca/st/en/prog/ssp.htm). Actions for BLM-designated special-status plants per BLM Manual Supplement 6840.06 – Special Status Plant Management - include:

- Determining the distribution, abundance, reasons for current status, and habitat needs for special-status species occurring on lands administered by the BLM and evaluate the significance of BLM lands or actions in maintaining those species;

- Managing habitat for special-status species where BLM lands or actions have a significant effect on the species to conserve the species;

- Developing and implementing rangewide and/or site-specific management plans for special-status plant species that include specific habitat and population management objectives designed for recovery, as well as the management strategies necessary to meet those objectives;

- Ensuring that BLM activities affecting the habitat of special-status plant species are carried out in a manner consistent with the objectives for managing those species; and

- Monitoring populations and habitats of special-status plant species to determine whether management objectives are being met.
BLM guidance for special-status plant management is also provided in BLM Manual Handbook 6840-1, *Special Status Plant Management* (BLM 1996).

**Data Characterization**

The known current distribution of Tracy’s eriastrum in the Plan Area is limited to the foothills north of State Highway 58 and west of State Highway 14 (CDFG 2011; Figure S-43). Because all current locations were observed in a single year (2010) in the same general location, future surveys in the southern Sierra Nevada and east Tehachapi mountain ranges may reveal additional occurrences. Within the Plan Area, 7 of the 13 CNDDB records are on private lands, 3 are on BLM land, and 3 are on land indicated as BLM/private (CDFG 2011). Little is known regarding the species’ pollination, seed germination, seed dispersal, recruitment, or population trends.

**Management and Monitoring Considerations**

Based on existing distribution information in the Plan Area, protection of the areas where Tracy’s eriastrum are known to occur probably will be important to maintain viable populations of the species in the Plan Area. Tracy’s eriastrum may benefit from the elimination of excessive off-road vehicle use and overgrazing in occupied areas, but its relationship to these potential stressors is unknown and needs further study in order to manage the species. The fact that it occurs in areas showing some disturbance from grading and road blading (CDFG 2011) indicates that it may be tolerant (or even benefitted by) some level of disturbance, especially if that disturbance controls the proliferation of and competition with non-native brome grasses. In addition, focused surveys for this species should be conducted in suitable habitat where it is likely to occur.

**Predicted Species Distribution in Plan Area**

Species model summary and results will be provided following model development.
Plants

Tracy’s Eriastrum (*Eriastrum tracyi*)

**Literature Cited**


